RCS 14-363

EGLIN AIR FORCE BASE
FLORIDA

EGLIN GULF TEST AND TRAINING RANGE (EGTTR)

FINAL
RANGE ENVIRONMENTAL ASSESSMENT

OCTOBER 2015

EGLIN GULF TEST AND TRAINING RANGE (EGTTR)

FINAL RANGE ENVIRONMENTAL ASSESSMENT

Submitted to:

96 CEG/CEIE

Eglin Air Force Base, Florida

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ACRONYMS, SYMBOLS, AND ABBREVIATIONS

µ/L	micrograms per liter
413 FLTS	413th Flight Test Squadron
780 TS	780th Test Squadron
86 FWS	86th Fighter Weapons Squadron
96 CEG/CEIEC	96th Civil Engineer Group/Compliance
96 RANSS	96th Range Support Squadron
96 TW	96th Test Wing
96 TW/SEU	96th Test Wing\Test and Range Safety Office
AC	Aircraft
ACMI	Aircraft Combat Maneuvering Instrumentation
AFB	Air Force Base
AFI	U.S. Air Force Instruction (AFI)
AFOTEC	Air Force Operational Test and Evaluation Center (AFOTEC)
AFSOC	U.S. Air Force Special Operations Command
AFSOC	Air Force Special Operations Command (AFSOC)
AGL	above ground level
AGM	air-to-ground missile
AIM	Air Intercept Missile
APE	Area of Potential Effects
ASEP	Advanced Systems Employment Project (ASEP)
BMP	best management practices (BMPs)
cal	caliber
CATEX	categorical exclusion
CBU	Cluster Bomb Unit
CCF	Central Control Facility
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
cm	centimeters
CO	carbon monoxide
CO^2	and carbon dioxide
CONEX	Container Express
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB re 1 µPa	decibels referenced to 1 micropascal
dB re 1 $\mu Pa\text{-}s^2$	decibels referenced to 1 micropascal squared second
DoD	Department of Defense
DOI	Department of the Interior
DPS	Distinct Population Segment
EA	Environmental Assessment
ECM	electronic countermeasures
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EGTTR	Eglin Gulf Test and Training Range
EIS	environmental impact statement
EO	Executive Order
EO	Executive Order (EO)
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
ESTCP	Environmental Security Technology Certification Program
FAA	Federal Aviation Administration
FDEP	Florida Department of Environmental Protection
FWS	Fighter Weapons Squadron

ACRONYMS, SYMBOLS, AND ABBREVIATIONS, CONT'D

GBU	Guided Bomb Unit
GI	gastrointestinal
GIWW	Gulf Intracoastal Waterway (GIWW)
GOM	Gulf of Mexico
GPS	global positioning system
GRATV	Gulf Range Armament Test Vessel
GSMFC	Gulf States Marine Fisheries Commission
HAPC	habitat area of particular concern
HE	high explosive
HEI	high explosive incendiary
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HOB	height of burst
HSMST	High Speed Maneuverable Surface Target
ILAST	Integrated Laser Targeting camera
IMV	Instrumented Measurement Vehicle
IR	infrared
JASSM	Joint Air-to-Surface Stand-Off Missile
JDAM	joint direct attack munition
JUON	Joint Urgent Operational Need
kg	kilograms
km	kilometers
km^2	square kilometers
LAARS	large area artificial reef sites
lbs	pounds
LJDAM	laser joint direct attack munition
LOA	Letter of Authorization
LOAL	Lock On After Launch
LOBL	Lock On Before Launch
LSDB	Laser Small Diameter Bombs
mg/L	milligrams per liter
MK	Mark
mm	millimeters
MMPA	*Marine Mammal Protection Act of 1972*
MPA	marine protected area
ms	millisecond
MTS	Maritime Transportation System
NAAQS	National Ambient Air Quality Standards
Navy	U.S. Navy
NEODS	Naval Explosive Ordnance Disposal School
NEPA	*National Environmental Policy Act*
NEW	net explosive weight
NHPA	National Historic Preservation Act
NM	nautical miles
NM^2	square nautical miles
NMFS	National Marine Fisheries Service
NOTMAR	Notice to Mariners
NRHP	National Register of Historic Places
NSWC PCD	Naval Surface Warfare Center, Panama City Division
NWA	Northwest Atlantic
OG	Operations Group
PBX	plastic bonded explosive
PEA	Programmatic EA
PGU	Projectile Gun Unit
psi	pounds per square inch
PSW	precision strike weapon

ACRONYMS, SYMBOLS, AND ABBREVIATIONS, CONT'D

PTS	permanent threshold shift
RBFF	Recreational Boating and Fishing Foundation
RCRA	Resource Conservation and Recovery Act (RCRA)
RDX	research department explosive
REA	Range Environmental Assessment
ROI	region of influence
SDB	small diameter bomb
SEL	sound exposure level
SERDP	Strategic Environmental Research and Development Program
SHPO	State Historic Preservation Officer
SOCOM	U.S. Special Operations Command (SOCOM)
SOPGM	stand-off precision guided munition
SPL	sound pressure level
TM	telemetry
TNT	trinitrotoluene
TP	Target Practice
TR	training round
TTP	tactics, techniques and procedures
TTS	temporary threshold shift
U.S.	United States
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
W-	Warning Area
W-151	Warning Area 151
WCMD	Wind-Corrected Munitions Dispenser
WSEP	Weapon Systems Evaluation Program
ZOI	zone of influence

1. PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Major conflicts, terrorism, lawlessness, and natural disasters all have the potential to threaten the national security of the United States. National security, prosperity, and vital interests of the United States are increasingly tied to other nations because of the close relationships between the United States and other national economies. In order to protect and defend the rights of the United States against its enemies, the Department of Defense (DoD), through various military departments, including the Department of the Air Force, provides for military readiness activities. These activities include testing and training events that prepare a military unit to accomplish its assigned mission. Testing and training missions may trigger legal requirements identified in many federal environmental laws, regulations, and executive orders. Accordingly, the Air Force has prepared this Range Environmental Assessment (REA) to comply with the National Environmental Policy Act (NEPA) and Executive Order (EO) 12114, *Environmental Impacts Abroad of Major Federal Actions*.

1.2 LOCATION OF THE PROPOSED ACTION

All test and training activities included in this EA would take place within the Eglin Gulf Test and Training Range (EGTTR), which is defined as the airspace over the Gulf of Mexico (GOM) controlled by Eglin Air Force Base (AFB), beginning at a point three nautical miles (NM) from shore. This airspace is controlled by the Federal Aviation Administration (FAA), but is scheduled by Eglin. The EGTTR is subdivided into blocks consisting of Warning Areas W-155, W-151, W-470, W-168, and W-174, as well as Eglin Water Test Areas 1 through 6 (Figure 1-1). Warning Area W-155 is controlled by the U.S. Navy (Navy) but is used occasionally to support missions scheduled through Eglin. Over 102,000 square nautical miles (NM^2) of GOM surface waters occur under the EGTTR air space. Testing and training activities in the EGTTR include air-to-air actions, air-to-surface actions, surface-to-air actions, vessel operations, and other/subsurface operations. Many air-to-surface activities would require using instrumentation and communication links (typically housed on an on-site instrumentation barge), which would limit the distance from shore at which activities could occur. Therefore, although test and training missions could occur anywhere within EGTTR, many would occur in W-151 and specifically in sub-area W-151A (see Figure 2-3 in Chapter 2 for a depiction of W-151A). Most activities would occur approximately 15 to 20 miles offshore, which is beyond the territorial sea but within the contiguous zone. The territorial sea is the maritime zone over which the United States exercises sovereignty, extending from the seafloor into the air space and from the shore to 12 NM offshore. The contiguous zone extends from the territorial sea to 24 NM offshore; within this zone, the United States may respond to infringement of its customs or laws. Descriptive information for all of W-151 and for W-151A is provided below.

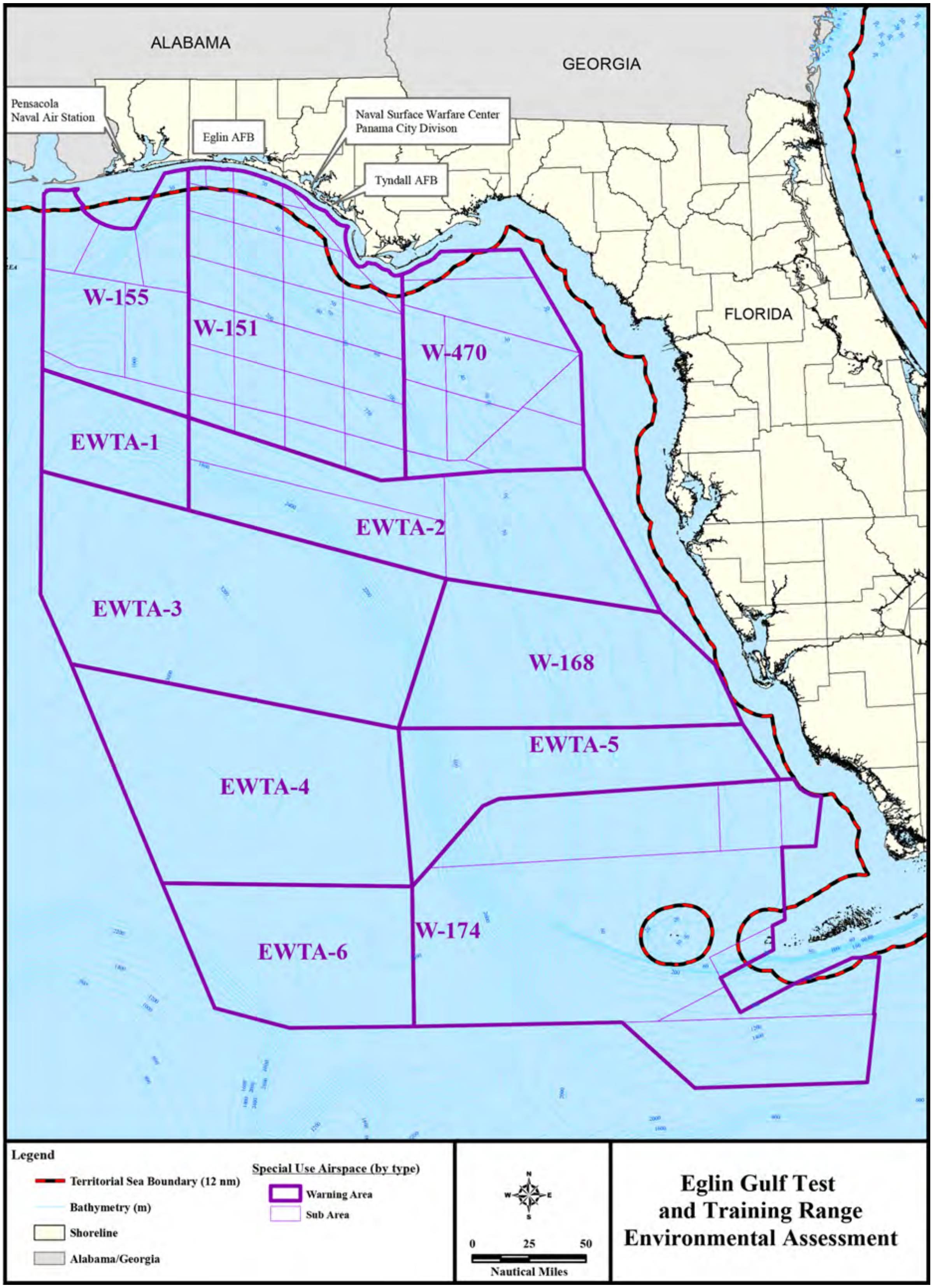

Figure 1-1. Eglin Gulf Test and Training Range

W-151

The inshore and offshore boundaries of W-151 are roughly parallel to the shoreline contour. The shoreward boundary is 3 NM from shore, while the seaward boundary extends approximately 85 to 100 NM offshore, depending on the specific location. W-151 covers a surface area of approximately 10,247 NM^2 (35,145 square kilometers [km^2]), and includes water depths ranging from about 20 to 700 meters (66 to 2,297 feet). This range of depth includes continental shelf and slope waters. Approximately half of W-151 lies over the shelf.

W-151A

W-151 is divided into subsections for scheduling purposes. The subsection directly south of Eglin AFB is W-151A. W-151A extends approximately 60 NM offshore and has a surface area of 2,565 NM^2 (8,797 km^2). Water depths range from about 30 to 350 meters (98 to 1,148 feet) and include continental shelf and slope zones. However, most of W-151A occurs over the continental shelf, in water depths less than 250 meters (820 feet). Many of the air-to-surface missions described later in Chapter 2 would occur in the shallower, northern inshore portion of the sub-area, in a water depth of about 35 meters (115 feet).

1.3 PURPOSE AND NEED FOR THE ACTION

The purpose of the Proposed Action is to conduct testing and training activities to ensure that Eglin AFB meets its mission, which is to support research, development, test, and evaluation of conventional weapons and electronic systems, and to support the individual and joint training of operational units. This mission is achieved in part by conducting testing and training within the Study Area. Activities conducted in the airspace of, or on the water surface below the EGTTR nearly always involve aircraft sorties (drones or other unmanned vehicles may be used at times instead of piloted aircraft). Many activities also include the release of expendables. A sortie is defined as an individual flight of an aircraft from takeoff to landing; one or more sorties comprise a mission. “Expendables” refer to items that are deployed, released, or consumed (or potentially consumed) while performing a mission. Expendables include items such as bombs, missiles, projectiles, drones, chaff, flares, and boats. Testing and training are the two major categories of missions performed in the EGTTR. Test missions are designed to test, verify, validate, demonstrate, or prove that a new or improved hardware, system, software, or tactic will work safely and accomplish the desired effect. Training missions are designed to teach, maintain, or increase an operator’s proficiency in performing certain activities.

The need for the Proposed Action is to update previous NEPA analysis by reevaluating the mission activities and performing a cumulative environmental analysis of all mission activities. In 2002, Eglin AFB completed a Programmatic EA (PEA) that analyzed potential impacts from air-to-air testing and training, air-to-surface testing and training, vessel operations, and subsurface operations conducted in the EGTTR (U.S. Air Force, 2002). This EA addresses the changes in the mission set, specifically newly proposed actions that will occur in the EGTTR over the next five years. Major updates included in this analysis involve increases in the level and types of air-to-surface testing and training that are being proposed. Air-to-air testing and

training, vessel operations, and subsurface operations will mostly remain the same as what was analyzed in the 2002 PEA.

1.4 SCOPE OF THE ENVIRONMENTAL REVIEW

In this REA, Eglin AFB assesses testing and training activities that could potentially affect human and natural resources, especially marine mammals, sea turtles, and other marine resources. The range of alternatives includes No Action and other reasonable courses of action. Analyses included direct, indirect, cumulative, short-term, long-term, irreversible, and irretrievable impacts. Eglin AFB is the lead agency for the Proposed Action; the National Marine Fisheries Service (NMFS) is a cooperating agency because of its expertise and regulatory authority over marine resources. This document will serve as NMFS' NEPA documentation for the rule-making process under the *Marine Mammal Protection Act of 1972* (MMPA).

1.5 ISSUES

An *issue*, as discussed in this document, is an effect of a mission activity that may directly or indirectly impact physical, biological, and/or cultural environment resources. A *direct* impact is a distinguishable, evident link between an action and the potential impact, whereas an *indirect* impact may occur later in time and/or may result from a direct impact.

Potential environmental impacts of alternative actions on resource areas were identified through preliminary investigation. Resource areas eliminated from further analysis are discussed in Section 1.5.1. Resource areas identified for detailed analysis are described in Section 1.5.2, with narratives providing a summary of the preliminary screening for potential impacts.

1.5.1 Issues Not Carried Forward for Detailed Analysis

Air Quality

Air quality, with respect to those pollutants for which the U.S. Environmental Protection Agency (USEPA) has promulgated National Ambient Air Quality Standards (NAAQS) and/or the Florida Department of Environmental Protection (FDEP) has promulgated an ambient standard, was eliminated as a potential issue. Under existing conditions, the ambient air quality in Okaloosa and surrounding counties is classified as in attainment for all NAAQS as promulgated by USEPA. Testing and training activities would release emissions from munitions use, surface craft, and aircraft over a large area, mostly beyond state waters and within the territorial sea. EGTTR emissions have been previously analyzed and found not to be significant (U.S. Air Force, 2002). As the nature of testing and training has not changed, a quantified analysis is not warranted.

Airspace

Airspace was eliminated as a potential issue because the EGTTR test and training missions would occur in airspace designated as warning areas of the EGTTR that are established for the purpose of military testing and training. Missions would be conducted in accordance with

established Air Force procedures for testing and training in the EGTTR, and through coordination with the FAA.

Noise Impacts to the Public

Noise impacts to the public were eliminated as a potential issue because the Air Force will establish safety footprints around target areas when there is a potential for harmful in-air noise from detonations. Members of the public will not be allowed to enter the safety footprint. Additionally, mission support personnel will likewise maintain a safe distance from the target area. Because of the distance of the target area from shore, the detonation noise perceptible to people on shore can be compared to very faint or distant thunder. Potential noise impacts to protected marine species are discussed under Biological Resources.

Hazardous Waste

Generally, conventional explosive ordnance testing does not constitute hazardous waste as regulated by the *Resource Conservation and Recovery Act* (RCRA) (UXOINFO, 2013). Similarly, the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) does not apply directly to unexploded ordnance (UXO) sites, because under most conditions, UXO is considered a solid waste and not a hazardous waste. However, the number and type of munitions expended on Eglin AFB ranges, including munitions associated with EGTTR testing and training, must be recorded and reported each year pursuant to the Emergency Planning and Right-to-Know Act. In addition, the proponent is responsible for reporting and funding all costs associated with chemical and fuel spills during test events. All spills, regardless of quantity, are to be reported immediately to 96th Civil Engineer Group/Compliance (96 CEG/CEIEC) at (850) 240-1828. The potential for fuel contamination from aircraft was addressed in the 2002 EGTTR PEA and found not to be significant (U.S. Air Force, 2002). That analysis is incorporated here by reference. Byproducts and chemical emissions of test and training are discussed in the context of the potential impacts they may have on physical resources in Section 3.2, *Physical Resources*, and biological resources in Section 3.4, *Biological Resources*. UXO and other debris are addressed in Section 3.1, *Safety and Restricted Access*, and in Section 3.4, *Biological Resources*.

1.5.2 Issues Carried Forward for Detailed Analysis

Safety

The issue of safety pertains to hazards from the Proposed Action or alternatives to military personnel and the public. Such hazards include expending live and inert ordnance, live detonations and the possibility of creating UXO from munitions that fail to detonate. The analysis assumes a dud rate of 3% (U.S. Air Force, 2015). In addition, floating debris could present a hazard to boat traffic. The analysis also identifies measures implemented by the Air Force to ensure public safety.

Physical Resources

Physical resources, which include water and sediments, would potentially be exposed to explosive byproducts, target materials and residues, and petroleum products. Liquid, solid, and

gaseous substances released into the environment from EGTTR test and training missions would consist of organic and inorganic materials that may produce a chemical change or toxicological effect to the environment. Although some mission-related debris would float on the water surface, some percentage, such as destroyed targets, munitions fragments, and unexploded bombs, would be a source of debris in water or on the seafloor.

Socioeconomic Resources

Potential socioeconomic impacts are closely related to the restricted access and environmental justice. Periodically closing portions of EGTTR could potentially impact the availability of these areas for commercial fishing or other economic activity.

Environmental justice addresses the potential for a proposed federal action to cause disproportionately high and adverse health effects on minority populations or low-income populations, including children. The analysis examines the demographics of potentially affected commercial and recreational users and whether they constitute minority or low-income groups.

Biological Resources

Noise from detonations is the primary issue with regard to potential effects to biological resources. Noise may produce stress reactions or behavioral changes (avoidance of the area) in wildlife species and may cause hearing loss or damage. Analysis of potential noise impacts includes discussing two noise components: pressure waves and acoustic sound. Direct impact to a biological resource from an inert munition, non-high explosive munition, munition fragment, or moving target boat, while theoretically possible, is either so unlikely as to be discountable, or the associated risk is surpassed by the risk of mortality or injury from blast noise given the larger area of impact. Anchoring may directly impact sea life or habitats on the ocean floor. Target debris may pose an ingestion risk, or may settle on the bottom to become habitat. Spills and other emissions may have the potential to create localized areas of contamination, affecting animals in the water column. Debris and other materials may also be carried from the immediate test area by water currents.

Cultural Resources

Test and training would occur within and over offshore waters of the GOM and some activities would have potential to disturb the seafloor. It is not expected that detonation overpressure great enough to disturb sediments or structures on the seafloor would be generated. However, intact or fragmented ordnance or target boats could sink and impact sediments or any structures present. In 2013, the Eglin AFB Cultural Resources Office conducted a remote sensing survey of a 1-mile square region around the existing live air-to-surface target area using side-scan sonar, a magnetometer, and a subbottom profiler to confirm the presence or absence of potential historic shipwrecks. A detailed analysis and remote sensing surveys would be required for any proposed new live air-to-surface target areas.

1.6 ORGANIZATION OF THE DOCUMENT

The REA was developed per the requirements established by Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations [CFR] 1500–1508). This document consists of the following chapters:

- Chapter 1. Purpose and Need for Action
- Chapter 2. Description of Proposed Action and Alternatives
- Chapter 3. Affected Environment and Environmental Consequences
- Chapter 4. Cumulative Impacts
- Chapter 5. Management Practices
- Chapter 6. Persons/Agencies Contacted
- Chapter 7. List of Preparers
- Chapter 8. References
- Appendix A. Coastal Zone Management Act (CZMA) Consistency Determination
- Appendix B. Public and Agency Review
- Appendix C. Consultations (Endangered Species Act [ESA] and MMPA Letter of Authorization)
- Appendix D. MMPA and ESA Acoustic Impact Modeling

1.7 ENVIRONMENTAL PLANNING PROCESS

1.7.1 National Environmental Policy Act

NEPA requires federal agencies to consider the environmental consequences of proposed actions in the decision-making process (42 U.S. Code [USC] 4321, et seq.). CEQ was established under NEPA, 42 USC 4342, et seq., to implement and oversee federal policy in this process. In 1978, CEQ issued regulations implementing the NEPA process under Title 40, CFR, Parts 1500–1508. CEQ regulations require that the federal agency considering an action must evaluate or assess the potential consequences of the action or alternatives to the action, which may result in the need for an EA or environmental impact statement (EIS). Under 40 CFR:

- An EA must briefly provide sufficient evidence and analysis to determine whether a finding of no significant impact or EIS should be prepared.
- An EA must facilitate the preparation of an EIS if required.

The proposed activities addressed in this document constitute a federal action and, therefore, must be assessed in accordance with NEPA. To comply with NEPA, as well as other pertinent environmental requirements, the decision-making process for the Proposed Action must include the development of an EA to address environmental issues related to the proposed activities. The

Air Force Environmental Impact Analysis Process is accomplished via procedures set forth in CEQ regulations and 32 CFR Part 989.

1.7.2 Executive Order 12114

EO 12114, *Environmental Impacts Abroad of Major Federal Actions*, directs federal agencies to provide for informed environmental decision making for major federal actions outside the United States and its territories. Presidential Proclamation 5928, issued December 27, 1988, extended the exercise of U.S. sovereignty and jurisdiction under international law to 12 NM; however, the proclamation expressly provides that it does not extend or otherwise alter existing federal law or any associated jurisdiction, rights, legal interests, or obligations. Thus, as a matter of policy, the Air Force analyzes environmental effects and actions within 12 NM under NEPA (an EA) and those effects occurring beyond 12 NM under the provisions of EO 12114.

1.7.3 Other Environmental Requirements

The Air Force must comply with all applicable federal environmental laws, regulations, and EOs, including, but not limited to, NEPA, EO 12114, and those listed below. Analysis of the proposed actions, as they relate to applicable environmental requirements, can be found in Chapter 3, *Affected Environment and Environmental Consequences*.

- *Abandoned Shipwreck Act*
- *Antiquities Act*
- *Clean Air Act*
- *Clean Water Act* (CWA)
- *Coastal Zone Management Act* (CZMA)
- *Endangered Species Act*
- *Magnuson-Stevens Fishery Conservation and Management Act*
- *Marine Mammal Protection Act*
- *Migratory Bird Treaty Act*
- *National Historic Preservation Act*
- *National Marine Sanctuaries Act*
- *Rivers and Harbors Act*
- EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*
- EO 12962, *Recreational Fisheries*
- EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*
- EO 13089, *Coral Reef Protection*
- EO 13158, *Marine Protected Areas*

- EO 13175, *Consultation and Coordination with Indian Tribal Governments*

1.8 RELATED ENVIRONMENTAL DOCUMENTS

Several related environmental documents preceded the preparation of this REA. The documents, prepared by or in response to Eglin AFB, have evaluated the environmental impacts of some of the same missions and/or same resources included in this REA, on an individual basis. The documents include the following:

- *Biological Assessment of Impacts to Federally Listed Endangered Species Resulting from Air-to-Surface Gunnery Test Operations*, April 1998
- *Eglin Gulf Test and Training Range Final Programmatic Environmental Assessment*, November 2002
- Eglin Gulf Test and Training Range Final Programmatic Biological Opinion, November 2002
- Request for a Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from the Programmatic Mission Activities within the Eglin Gulf Test and Training Range (EGTTR), February 2003
- Eglin Gulf Test and Training Range Air-to-Surface Gunnery, Biological Opinion, October 2004
- Request for a Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from Eglin Gulf Test and Training Range (EGTTR) Precision Strike Weapons (PSW) Test (5-Year Plan), January 2004
- Request for a Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from Naval Explosive Ordnance Disposal School (NEODS) Training Operations, February 2004
- *Naval Explosive Ordnance Disposal School (NEODS) Training Operations at Eglin AFB, Florida, Biological Assessment*, March 2004
- Incidental Harassment Authorization Issued by the National Marine Fisheries Service to Eglin Air Force Base for Air-to-Surface Gunnery Exercises in the Eglin Gulf Test and Training Range, May 2006
- Incidental Harassment Authorization Issued by the National Marine Fisheries Service to Eglin Air Force Base for Air-to-Surface Gunnery Exercises in the Eglin Gulf Test and Training Range, January 2010
- Request for a One-Year Incidental Harassment Authorization and a Five-Year Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from the Programmatic Mission Activities Within the Eglin Gulf Test and Training Range (EGTTR), May 2011
- Request for a Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from Eglin Gulf Test and Training Range (EGTTR) Precision Strike Weapons

(PSW) and Air-to-Surface Gunnery Testing and Training Activities (5-Year Plan), December 2011

- Request for a Letter of Authorization the Incidental Harassment of Marine Mammals Resulting from Naval Explosive Ordnance Disposal School (NEODS) Training Operations, November 2011
- *Endangered Species Act Informal Section 7 Consultation, Naval Explosive Ordnance Disposal School (NEODS) Training Operations*, December 2011
- *Maritime Strike Operations Tactics Development and Evaluation, Eglin Air Force Base, Florida, Environmental Assessment*, 2012
- *U.S. Fish and Wildlife Service Formal Endangered Species Act Section 7 Consultation for Maritime Strike Operations Tactics Development and Evaluation, Eglin Air Force Base, Florida*, September 2012
- Revised Request for an Incidental Harassment Authorization of Marine Mammals Resulting from Maritime Strike Operations Tactics Development and Evaluation, Eglin Air Force Base, Florida, January 2013
- Request for an Incidental Harassment Authorization of Marine Mammals Resulting from Maritime Weapons System Evaluation Program Operational Testing, October 2014
- *Maritime Weapons System Evaluation Program Operational Testing, Final Biological Assessment and Essential Fish Habitat Assessment*, July 2014
- *Maritime Weapons System Evaluation Program Operational Testing, Final Environmental Assessment* and Final Finding of No Significant Impact, December 2014

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter describes the alternatives evaluated for potential environmental impacts in this REA. Alternatives are possible activities or combinations of activities designed to maximize mission capabilities while also maintaining compliance with environmental requirements. The alternatives analyzed in this REA include:

- Proposed Action, which represents the activities and expendables authorized in the 2002 PEA plus known or planned additional air-to-surface test and training activities that have since become necessary for Eglin AFB to fulfill its mission. Consultations with the NMFS are required for this action, and mitigations and monitoring would be conducted as part of this action. Known and planned missions described for this action that require protected species take authorizations would be considered the primary stakeholders and owners of permitted takes.
- Alternative 1, which is the Preferred Alternative, includes all activities of the Proposed Action, and addresses expanding the existing live air-to-surface target area to a point within a 5-mile radius of the existing location.
- No Action Alternative, which represents only a continuation of the activities and expendables evaluated and approved in the 2002 PEA. New missions would be analyzed under separate NEPA, and where required individual consultations would be performed.

A description of each alternative is provided in the following sections. The potential environmental impacts associated with each alternative are summarized at the end of this chapter.

2.2 PROPOSED ACTION

The Proposed Action represents a continuation of all activities described in the 2002 PEA, plus additional activities that have become necessary or are expected to become necessary for Eglin AFB to fulfill its mission since completion of the 2002 PEA. The actions previously analyzed in 2002 include air-to-air, air-to-surface, surface-to-surface, and other miscellaneous types of missions. A detailed description of each of these missions is provided in Section 2.5, No Action Alternative.

The additional test and training activities that would be conducted in the EGTTR consist primarily of air-to-surface missions, although a few other types of missions would be included. Many of the missions would include using live munitions. Each type of test, training, and support activity is described below. Specific organizations conducting each type of mission are discussed below as program owners or stakeholders. These organizations would likewise be the owners or stakeholders of any associated consultation permits, take authorizations, and will also be responsible for observing and abiding by any permit conditions or mitigations.

2.2.1 86th Fighter Weapons Squadron Maritime Weapons System Evaluation Program

Live and Inert Munitions Testing

Figure 2-1. Intact Small Boat Targets in EGTTR

The 86th Fighter Weapons Squadron (86 FWS) proposes to authorize using multiple types of live and inert munitions in EGTTR against small boat targets for the Maritime Weapons System Evaluation Program (WSEP). The purpose of this testing is to continue the development of tactics, techniques, and procedures (TTP) for Air Force strike aircraft to counter small maneuvering surface vessels (Figure 2-1) in order to better protect United States' and other vessels or assets from small boat threats. Damage effects of these conditions must be known to generate TTPs to engage small moving boats. The test objectives would be to (1) develop TTPs to engage small boats in all weather, and (2) determine the impact of TTPs on Combat Air Force training. The test results would be used to develop publishable TTPs for inclusion in Air Force TTP 3-1 series manuals. Maritime WSEP testing is a high national defense priority.

The initial phases of the Maritime WSEP program focused on detecting and tracking boats using various sensors, simulated weapons engagements, and testing with inert (containing no explosives) munitions. These actions were reviewed under the Eglin Environmental Impact Analysis Process and a categorical exclusion (CATEX) was applied based on analyses in the 2002 PEA (Air to Ground and Maritime WSEP CATEX RCS 14-019). The proposed actions represent the final phase of testing the effectiveness of live (containing explosive charges) munitions on small boat threats.

Maritime WSEP activities involve using multiple types of aircraft and live munitions in EGTTR, including bombs, missiles, and gunnery rounds (Table 2-1). Because the focus of the tests would be weapon/target interaction, no particular aircraft would be specified for a given test as long as it met the delivery requirements. Various Air Force active duty units, National Guard, Navy, and Air Force reserve units would participate as interceptors and weapons release aircrews, with multiple types of aircraft typically operating within the same air space.

Table 2-1. Proposed Maritime WSEP Munitions and Aircraft

Munitions	Aircraft
AGM-114 (Hellfire)	F-15 fighter aircraft
AGM-176 (Griffin)	F-16 fighter aircraft
AGM-65 (Maverick)	F-18 fighter aircraft
AIM-9X	F-22 fighter aircraft
BDU-56	F-35 fighter aircraft
CBU-105 (WCMD)	AC-130 gunship
GBU-12/GBU-54	A-10 fighter aircraft
GBU-10/GBU-24	B-1 bomber aircraft

Table 2-1. Proposed Maritime WSEP Munitions and Aircraft, Cont'd

Munitions	Aircraft
GBU-31 GBU-38 PGU-13/B PGU-27 2.75 inch rockets 7.62 mm/.50 cal GBU-39 (Laser SDB) GBU-53 (SDB II)	B-52 bomber aircraft B-2 bomber aircraft MQ-1 MQ-9

AGM = air-to-ground missile; AIM = air intercept missile; BDU = Bomb, Dummy Unit; cal = caliber; CBU = Cluster Bomb Unit; GBU = Guided Bomb Unit; mm = millimeter; PGU = Projectile Gun Unit; SDB = Small Diameter Bomb; WCMD = Wind-Corrected Munitions Dispenser

The proposed test location is centered at a point in W-151A approximately 17 miles offshore from Santa Rosa Island, in nearshore waters of the continental shelf (Figure 2-3). Water depth at the proposed site is about 35 meters (115 feet). Test events would be conducted in various sea states and weather conditions, up to a wave height of four feet. Live munitions would be deployed against static (anchored), towed, and remotely controlled boat targets. Static and controlled targets would consist of stripped boat hulls with plywood simulated crews and systems and, in some cases, heat sources. Moving targets would be towed by remotely controlled High Speed Maneuverable Surface Target (HSMST) boats. Damaged boats would be recovered for data collection. Test data collection would be conducted from an instrumentation barge known as the Gulf Range Armament Test Vessel (GRATV) anchored on-site, which would also provide a platform for cameras and weapon-tracking equipment (Figure 2-2). HSMST boats would be remotely controlled from a facility on Eglin main base and would follow set track lines with specific waypoints at least 2 to 3 NM away from the GRATV. Additional air assets such as chase aircraft or unmanned aerial vehicles would transit to the target area and set up flight orbits to provide aerial video of the mission site including weapon impacts on boat targets and assisting with range-clearing activities. Missions would be controlled from the Eglin Central Control Facility (CCF) on the main base.

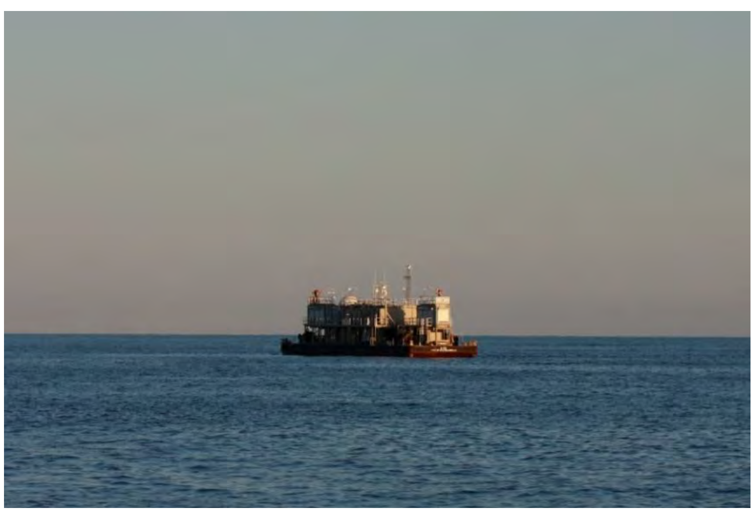

Figure 2-2. Gulf Range Armament Test Vessel (Instrumentation Barge)

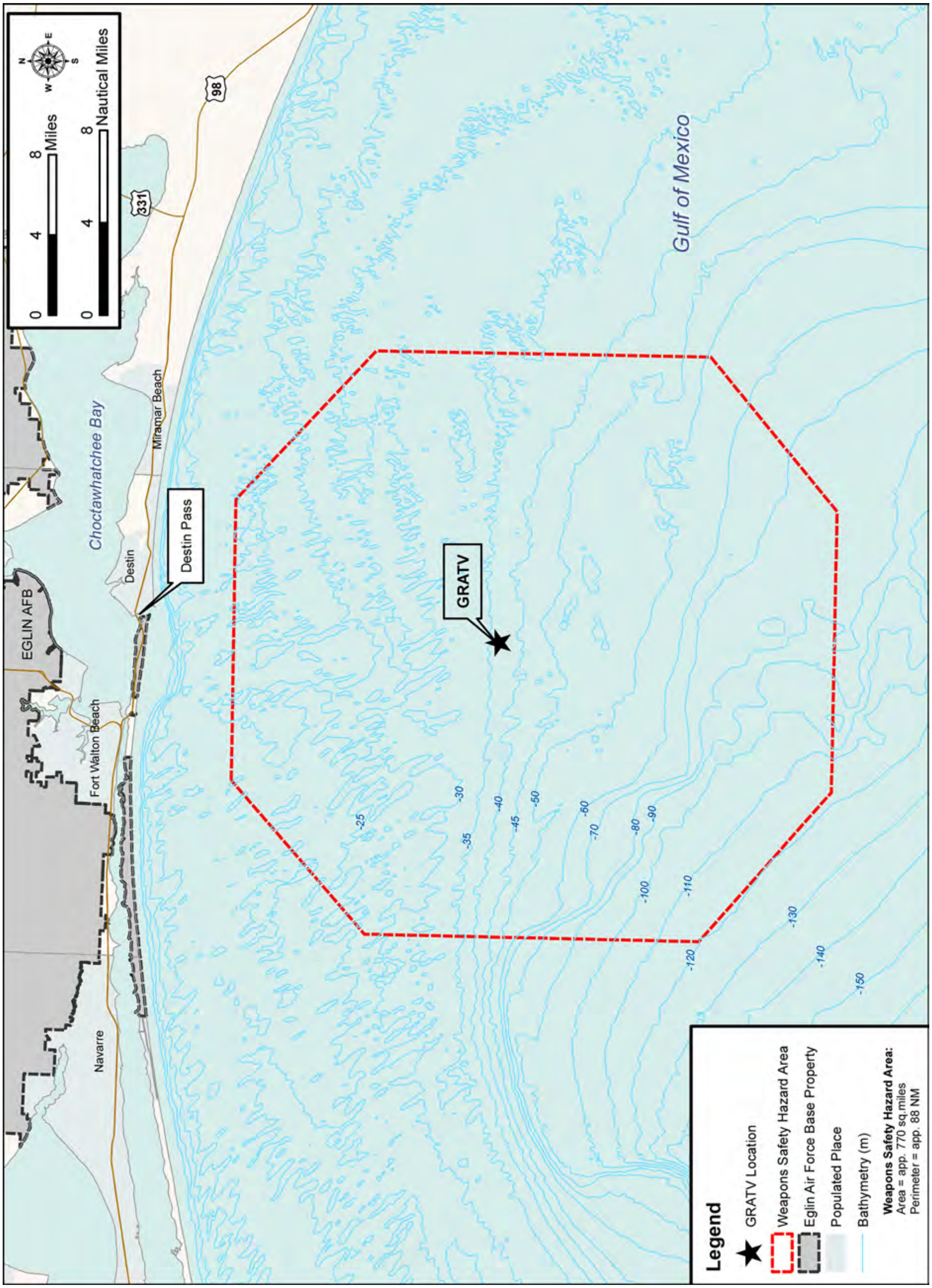

Figure 2-3. Location for Maritime WSEP Tests

Live munitions would be set to detonate either in the air, instantaneously upon contact with a target boat, or after a slight delay (5 to 10 milliseconds) after impact (approximately 5 to 10 feet water depth). The annual number, height or depth of detonation, explosive material, and net explosive weight (NEW) of each munition associated with Maritime WSEP is provided in Table 2-2. The quantity of live munitions tested is considered necessary to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable confidence level regarding munitions capabilities.

Table 2-2. Proposed Maritime WSEP 2017-2021 Annual Live Fire in the EGTTR

Type of Munition	# Live Munitions	Detonations Scenario	Warhead – Explosive Material	Net Explosive Weight
GBU-10 or GBU-24	2	Surface or Subsurface	MK-84 - Tritonal	945 lbs
GBU-12 or GBU-54 (LJDAM)	6	Surface or Subsurface	MK-82 - Tritonal	192 lbs
AGM-65 (Maverick)	6	Surface	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
CBU-105	4	Airburst	10 BLU-108 submunitions with 4 projectiles, parachute, rocket motor & altimeter. 10.69 lbs NEW/submunition (includes 2.15 lbs/projectile)	107.63 lbs
GBU-39 (LSDB)	4	Airburst, Surface or Subsurface	AFX-757 (Insensitive munition)	37 lbs
AGM-114 (Hellfire)	30	Airburst or Surface, Subsurface	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge. For subsurface (10 ms delay, maximum)	20 lbs
GBU-53 (SDB II)	4	Airburst, Surface or Subsurface	PBX-N-109 Aluminized Enhanced Blast, Scored Frag Case, Copper Shape Charge	22.84 lbs
AGM-176 (Griffin)	10	Airburst or Surface	Blast fragmentation	4.58 lbs
Rockets (including APKWS)	100	Surface	Comp B-4 HEI	10 lbs
PGU-13 HEI 30 mm	1,000	Surface	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1 lbs
AIM-9X	4	Surface	PBXN-3	68 lbs
GBU-10	21	Inert	N/A	N/A
GBU-12	27	Inert	N/A	N/A
GBU-24	17	Inert	N/A	N/A
GBU-31	6	Inert	N/A	N/A
GBU-38	3	Inert	N/A	N/A
GBU-54	16	Inert	N/A	N/A
BDU-56	13	Inert	N/A	N/A
AIM-9X	3	Inert	N/A	N/A
PGU-27	46,000	Inert	N/A	N/A

AGM = air-to-ground missile; AIM = air intercept missile; BDU = Bomb, Dummy Unit; CBU = Cluster Bomb Unit; GBU = Guided Bomb Unit; HEI = high explosive incendiary; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bombs; MK = mark; mm = millimeters; N/A = not applicable; PGU = Projectile Gun Unit; RDX = research department explosive; SDB = Small Diameter Bomb

In addition to the live munitions described above, 86 FWS also proposes to expend inert munitions in W-151. The expected number of each munition type expended during a typical year is included in Table 2-2. Use of inert munitions was analyzed in the 2002 PEA and found to have no significant environmental impact. Therefore, there is no particular limit on the number of inert items that may be expended, and actual numbers may vary somewhat from those listed in Table 2-2. However, the items are included in this EA in order to document the programmatic use of the EGTTR.

Pre-Test Target Area Clearance Procedures for Public Safety and Protected Marine Species

A human safety zone would be established around the test area prior to each mission, and would be enforced by up to 20 to 25 safety boats. The size of this zone may vary, depending upon the particular munition and delivery method used in a given test. A composite safety footprint has been developed for previous tests using live munitions and incorporated the average of all munitions deployed. This composite safety footprint consisted of a circle with a 29-mile-wide diameter (14.5-mile-wide radius), which was converted to an octagon shape for ease of support vessel placement and range clearance. The GRATV is located approximately 2 miles north of the center of the octagon (Figure 2-3). Other than the types of vessels identified in 33 CFR 334.720, all non-participating vessels (such as recreational fishing vessels) would be excluded from entering the safety footprint while it is active, which is expected to be up to four hours per mission on test days (multiple munitions may be deployed within the four-hour time period). The Eglin Test and Range Safety Office (96 TW/SEU) would position the safety support vessels around the safety footprint to ensure commercial and recreational boats did not accidentally enter the area. Before delivering the ordnance, mission aircraft could make a dry run (no munitions deployed) over the target area to ensure that it is clear of non-participating vessels, although this action would not necessarily be performed before all releases. 96 TW/SEU would monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. To inform the public, the Eglin Safety Office would request that the Coast Guard release a Notice to Mariners (NOTMAR) prior to closing the safety footprint around the target location. In addition, 96th Range Support Squadron (96 RANSS) personnel would also distribute flyers with maps at public docks and to vessels in Destin Pass explaining why the area would be closed.

In addition to actions carried out to ensure human safety during live missions, measures designed to avoid or minimize impacts to protected marine species have been developed in cooperation with the NMFS. A separate zone around the target would be established for marine species protection, based on the distance to which energy- and pressure-related impact zones could extend for the various types of live ordnance. The dimensions of this zone would be different than those of the human safety zone, and would depend on the specific munitions being released that day. Trained marine species observers would survey the protection zone before each mission.

Up to four video cameras would also be positioned on the GRATV anchored on-site. The camera(s) would primarily be used to document the weapons' performance against targets, but could also be used to monitor for the presence of unauthorized vessels and protected species. An Eglin Natural Resources representative would be located in Eglin's CCF on the main base, along

with mission personnel, to view the live video feed before and during test activities. All cameras have a zoom capability of up to at least a 300-millimeter (-mm) equivalent. At this setting, when targets are at a distance of 2 NM from the GRATV, the field of view would be 195 feet by 146 feet. Video observers can detect an item with a minimum size of one square foot up to 4,000 meters away. The Air Force is in the process of acquiring cameras with even greater zoom capability (up to a 1,200-mm zoom lens). Missions would not proceed until the target area is confirmed to be clear of protected species (when live munitions are used) and unauthorized vessels. In addition, the test would not be conducted if all video cameras are not operational.

Post-Test Activities

Post-test activities would consist of Air Force Explosive Ordnance Disposal (EOD) personnel detonating in place any munitions components or items remaining on the target boats that would be considered UXO, debris retrieval, and post-mission protected species surveys. Unexploded bombs, missiles, or other similarly large items would sink to the seafloor and would not be recovered or detonated. However, smaller unexploded items such as cluster bomb submunitions could remain intact on target boats. Each Cluster Bomb Unit (CBU)-105 contains 10 submunition cylinders, and each cylinder contains 4 sub-submunitions (skeets), which fire inert projectiles. Therefore, there are a total of 40 skeets per bomb. On test days involving the release of CBU-105s, the Eglin EOD team would be on hand to inspect floating targets and identify and render safe any UXO, including fuses, classified components, or intact munitions (Figure 2-4). In the rare instance that UXO cannot be removed, proper disposal methods would be employed (typically accomplished by using C-4 explosive); however, these types of scenarios are not considered likely. Once the area has been cleared by the Eglin EOD team (typically one hour after the release of CBU-105s), the range will be re-opened for the debris clean-up team and the protected species survey vessels (when live munitions are used). Depending on the specific weapon system used and the location or position of the UXO, the test area could be closed for an extended period of time.

Figure 2-4. Target Boat after UXO Disposal with C-4 Explosive

Following completion of the live mission (and declaration of the target area by EOD as safe, when applicable), several Air Force vessels would engage in retrieving target debris. Large, mostly intact damaged target vessels may be towed, while smaller pieces of debris would be netted or lifted aboard Air Force vessels and taken to shore for disposal. Figure 2-5 shows debris and damaged target vessels from a similar exercise conducted in 2013. The Air Force would also conduct post-mission monitoring for protected species once the range is confirmed to be safe to enter.

Figure 2-5. Debris and Target Vessels from Previous Similar Mission

Pre-test and post-test management actions, including human safety zone enforcement and protected species protection measures, are described in detail in Chapter 5, *Management Practices*.

Swarm Missions

To counter the small boat threat, aircrews would test and train in performing electronically simulated targeting and attack techniques (no ordnance is used, either live or inert) against groups of fast moving, human-piloted boats simulating a coordinated attack on an objective. These missions are called "swarm" missions due to the number of boats involved. The target fleet typically consists of up to 30 boats (the actual number may vary) divided into multiple squadrons of 4 or 5 boats that travel along predetermined transects and possibly perform predetermined maneuvers as directed by Air Force personnel. The boats would range in size from 20 to 45 feet and would travel at speeds of 20 to 40 knots, depending on sea state. Additional numbers of vessels, formations and maneuvers are possible depending on real-world threats and situations.

Aircraft would be directed in the CCF by the 86 FWS mission director. Aircraft would perform tactical maneuvers, including dives, dive recoveries, and pull-up procedures in accordance with aircraft 3-1 manuals and Air Force Instruction (AFI) 11-214 publications. Aircraft would fly no lower than altitudes specified in AFI 11-214 and 3-1 manuals commensurate with the simulated weapon delivery. Aircraft would not carry bombs, and aircraft guns would be mechanically "safed" and unable to fire. Due to the lack of munitions (live or inert), the pre- and post-mission activities described for live testing in the EGTTR would not be required. Specifically, there

would be no need for safety zone establishment, EOD clearance, debris retrieval, or protected species surveys.

2.2.2 Advanced Systems Employment Project

The proposed Advanced Systems Employment Project (ASEP) action includes evaluating upgrades to numerous research and development, as well as Air Force hardware and software, initiatives. F16, F15E, and BAC1-11 aircraft would be used to deploy a variety of pods, air-to-air missiles, bombs, and other munitions. Many of the missions are conducted over Eglin land ranges. However, inert instrumented Mk-84 joint direct attack munition (JDAM) bombs would be expended in W-151 under the Proposed Action. Bombs would be dropped on target boats located 20 to 25 miles offshore. A maximum of 12 over-water missions could be conducted annually, although the number could be as low as 4. There would be no live ordnance associated with ASEP actions in EGTTR.

2.2.3 Air Force Special Operations Command Training

The Air Force Special Operations Command (AFSOC) conducts various training activities with multiple types of munitions in nearshore waters of EGTTR (W-151). Training activities include air-to-surface gunnery and small diameter bomb/Griffin missile proficiency training. The following subsections describe the proposed actions included in this REA.

AC-130 Air-to-Surface Gunnery

AC-130 air-to-surface gunnery missions have been conducted in the EGTTR for over two decades, and were analyzed previously in the 2002 PEA as well as in multiple protected species incidental take permits requested and granted by the NMFS and U.S. Fish and Wildlife Service (USFWS). The number and types of munitions evaluated in the 2002 PEA are included as part of the No Action Alternative of this document (Section 2.5). A description of current mission requirements, including updated information on the number and location of missions, gunnery rounds used, and number of expenditures, is provided in the following paragraphs.

Air-to-surface gunnery missions involve firing live gunnery rounds at targets on the water surface in the EGTTR. Ordnance used in this training includes 25-mm high explosive incendiary (HEI), 30-mm HEI, 40-mm HEI, and 105-mm HEI rounds. The NEW ranges from about 0.07 to 4.7 pounds. The Air Force has developed a 105-mm training round that contains less than 10 percent of the amount of explosive material contained in the 105-mm full up round. The training round was developed as a method to mitigate effects on marine mammals and is used only during nighttime missions when visual surveys would be ineffective. All HEI gunnery rounds are fired from AC-130 gunship aircraft.

Water ranges within EGTTR that are typically used for gunnery operations include W-151A, W-151B, W-151C, and W-151D. However, W-151A is the most frequently used water range due to its proximity to Hurlburt Field (where gunnery flights originate). AC-130s normally transit from Hurlburt Field to the water ranges at a minimum of 4,000 feet above surface level. Potential target sites are typically established at a distance from the coast of at least 15 miles (beyond the 12 NM territorial sea boundary). Targets consist of either an MK-25 floating flare

or an inflatable target. For missions where flares are used, the aircrew scans a 5 NM radius around the potential target area to ensure it is clear of surface craft and other objects that would make the site unsuitable. Scanning is accomplished using radar, Electro Optical, infrared (IR) sensors, and visual means. An alternative area would be selected if any non-mission vessels were detected within the 5 NM search area, or if protected marine species were sighted within the marine mammal behavioral impact zone (see Chapter 5, *Management Practices*, for a full description of survey methods and impact zones). Once the scan is completed, the marking flare is dropped onto the water surface. The flare's burn time is typically 10 to 20 minutes, but could be less if it is actually hit by one of the rounds. However, flares may burn as long as 40 minutes.

Missions using an inflatable target would proceed under the same general protocol. A tow boat would transit to a potential target site located at least 15 miles from the coast. An AC-130 would then arrive at the site and, as with missions using flares, the aircrew would scan an appropriate area around the potential target area (5 NM radius for non-mission vessels and a protected species zone as specified in Chapter 5) using visual observation and the aircraft's sensors. An alternative area would be selected if any protected marine species or non-mission vessels were detected within the applicable search areas. Once the scan is complete, the 20-foot target is inflated and deployed into the water. The tow boat then proceeds to pull the target, which is attached to a 2,200-foot cable. The target continues to float even when struck by ordnance and deflated. After the mission, the tow boat recovers any debris produced by rounds striking the target, although little debris would be expected.

After target deployment, the firing sequence is initiated. A typical gunship mission lasts approximately five hours without air-to-air refueling, and six hours when refueling is accomplished. A typical mission includes:

- 30 minutes to take off and perform airborne sensor alignment; align visual sensor and Electro Optical to heads-up display.
- 1½ to 2 hours of dry fire (no ordnance expended); this time includes transition time.
- 1½ to 2 hours of live fire; this time includes clearing the area and transiting to and from the range; actual firing activities typically do not exceed 30 minutes.
- 1 hour air-to-air refueling, if included in the mission.
- 30 minutes transition work (takeoffs, approaches, landings, and pattern work).

The guns are fired during the live fire phase of the mission. Actual firing can last from 30 minutes to 1½ hours but is typically completed in 30 minutes. The number and type of munitions deployed during a mission varies with each type of mission flown. Training rounds for the 105-mm ammunition are used during nighttime training.

Live fire events are continuous, with pauses during the firing usually well under a minute and rarely from two to five minutes. Firing pauses would only exceed 10 minutes in one of the following situations: 1) surface boat traffic caused the mission to relocate; 2) aircraft, gun, or targeting system problems existed; or 3) more flares needed to be deployed. 96 TW/SEU has

described the gunnery missions as having 95 percent containment within a 5-meter radius around the target (i.e., 95 percent of the rounds strike the water within 5 meters of the target.

Gunnery missions may occur any season of year, during daytime or nighttime hours. As a conservation measure to avoid impacts to the federally listed sperm whale and other deep water marine mammal species, AFSOC has agreed to conduct all gunnery missions within the 200-meter water depth contour, which transects portions of W-151A, W-151D, and W-151F. All of W-151B lies shoreward of the shelf break. As a further conservation measure, only the 105 mm training round is used during nighttime missions due to the very limited effectiveness of visual surveys.

Under the Proposed Action, the quantity of live rounds expended would be based on estimates provided by AFSOC regarding the annual number of missions and number of rounds per mission. Full up 105 mm rounds may be used during daytime missions, while 105 mm training rounds would always be used at night. The total anticipated number of missions and rounds that would be expended for daytime and nighttime activities annually is shown in Table 2-3.

Table 2-3. Summary of Annual AFSOC AC-130 Gunnery Operations

Category	Expendable	Number of Missions	Rounds per Mission	Quantity
Daytime Missions	105 mm HE (FU)	25	30	750
	40 mm HE		64	1,600
	30 mm HE		500	12,500
	25 mm HE		560	14,000
Nighttime Missions	105 mm HE (TR)	45	30	1,350
	40 mm HE		64	2,880
	30 mm HE		500	22,500
	25 mm HE		560	25,200
TOTAL		**70**		80,780

HE = High Explosive; FU = full up; mm = millimeter; TR = Training Round

Measures designed to avoid or minimize potential impacts to protected marine species (primarily marine mammals and sea turtles) are summarized here and described in detail in Chapter 5, *Management Practices*. The primary management measure consists of pre- and post-mission visual monitoring, which may also be supplemented with IR and Electro Optical monitoring as applicable. After arriving at the target site, aircrews would commence visual scans and continue observing during ascending orbits until reaching operational altitude. Monitoring would continue throughout the mission and during a post-mission descent to an altitude of approximately 6,000 feet. If protected species are detected at any time, the mission will halt immediately and relocate as necessary or be suspended until the animals have left the area. Additional management measures include adhering to sea state restrictions, using the 105 mm training round at night, using ramp-up procedures (beginning with the smallest round during calibration and proceeding to increasingly larger rounds), and complying with the requirement to conduct all missions shoreward of the 200-meter isobath. No mortality or injury to protected marine species has been documented as a result of previous AFSOC gunnery missions.

On March 5, 2014, NMFS issued a five-year Letter of Authorization (LOA) in accordance with the Marine Mammal Protection Act for AFSOC's air-to-surface gunnery activities. Since then,

new acoustic thresholds and criteria have been adopted by NMFS to analyze impacts to marine mammals and sea turtles from exposure to explosive sources. The analysis in Chapter 3 will incorporate the latest acoustic modeling that is based on these new requirements.

Small Diameter Bomb and Griffin/Hellfire Missile Training

AFSOC has been tasked to develop TTPs and training for strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. Training would involve using live AGM-114P/R Hellfire Missiles, AGM-176 Griffin Missiles, and GBU-39 small diameter bomb (SDB) munitions in the EGTTR against small towed boats within the GRATV target location (W-151A). AFSOC would expend 100 AGM-114P/R missiles, 200 AGM-176 missiles, and 30 GBU-39 laser or global positioning system (GPS)-guided SDBs annually. All these weapons are capable of airburst, point, or delayed fuzing detonations. However, only airburst detonations would occur under the Proposed Action.

The capability to counter small vessels is categorized as a Joint Urgent Operational Need (JUON). A JUON is defined as an urgent operation need identified by a combatant commander that, if not addressed immediately, will seriously endanger personnel or pose a major threat to ongoing operations. Currently, the majority of AFSOC crews deploy into combat with no actual AGM-176, AGM-114P/R, or GBU-39 weapons delivery experience, significantly increasing the potential to miss their intended targets during combat missions.

Due to the fact that only airburst detonations would occur, management practices would differ from those required for use of the same munitions during Maritime WSEP missions. Details are provided in Chapter 5, *Management Practices*.

CV-22 Training

Rotary-wing air-to-surface gunnery missions have been conducted in EGTTR for over two decades, and were analyzed previously in the 2002 PEA. The 8th SOS proposes to conduct CV-22 training in W-151 (primarily W-151A and W-151F), which would involve firing of .50-caliber (-cal)/7.62-mm ammunition at flares floating on the water surface. There would be approximately 50 training sorties annually. For two-ship formations, 600 rounds are expended per mission (300 .50-cal and 300 7.62-mm rounds), for a total of 30,000 rounds per year. Flight procedures for CV-22 training would be similar to those described for AC-130 gunnery missions above, except that CV-22 aircraft typically operate at much lower altitudes (100 to 1,000 feet above surface level) than AC-130 gunships. Aircrews would maintain Visual Flight Rules cloud clearances and a minimum altitude of 100 feet above water height at all times. Weather must be sufficient to maintain a 3-NM clearance around the target area. Live fire would be conducted only when sea surface conditions do not exceed Beaufort sea state 4 (wind speed 16 knots, wave height 3 feet, fairly frequent white caps). Similar to AC-130 missions, crews would conduct a visual survey of the target area (3-NM radius for non-mission vessels and a protected species zone based on requirements described in Section 11) at a maximum altitude of 1,000 feet to ensure the area is clear of protected species and indicators before live-fire begins. Pre- and post-live fire clearing searches are anticipated to take about five minutes to accomplish. After live

fire operations, the crew would scan the target area utilizing all available visual scanners and operable sensors for any injured or dead marine species. Missions would only be conducted shoreward of the 200-meter depth contour, as described for AC-130 gunnery training above.

Summary of AFSOC Activities in the EGTTR

Table 2-4 summarizes all AFSOC live air-to-surface training operations in the EGTTR associated with the Proposed Action.

Table 2-4. Total Annual AFSOC Air-to-Surface Training Operations

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario
7.62 mm/.50 cal	N/A	30,000	N/A
25 mm	0.067 lbs	39,200	Surface
30 mm	0.1 lbs	35,000	Surface
40 mm	0.87 lbs	4,480	Surface
105 mm FU	4.7 lbs	750	Surface
105 mm TR	0.35 lbs	1,350	Surface
AGM-176 (Griffin missile)	4.58 lbs	200	Airburst
AGM-114P/R (Hellfire missile)	20 lbs	100	Airburst
GBU-39 (SDB I)	37 lbs	30	Airburst

AGM = air-to-ground missile; mm = millimeters; cal = caliber; N/A = Not applicable; lbs = pounds; FU = full up; TR = training round; GBU = Guided Bomb Unit; SDB = Small Diameter Bomb

2.2.4 413th Flight Test Squadron

The United States Special Operations Command (SOCOM) has requested the 413th Flight Test Squadron (413 FLTS) to demonstrate the feasibility and capability of the Precision Strike Package and the Stand-Off Precision Guided Munitions (SOPGM) missile system on the AC-130 aircraft. SOCOM, in conjunction with A3 Operations at Wright-Patterson AFB, is fielding the new AC-130J for flight characterization, as well as testing and evaluation. AFSOC is integrating some of the same weapons on the AC-130W. Therefore, the activities described below for the 413 FLTS may involve either of these aircraft variants.

AC-130J Precision Strike Package Testing

The proposed AC-130J gunnery testing associated with the 413 FLTS's Precision Strike Package would be similar to that described above for AFSOC AC-130 gunnery training in terms of location and general procedures. Testing would occur in W-151A and would involve firing either 1) PGU-44/B (105 mm high explosive [HE] with FMU-153/B point detonation/delay fuse) or PGU-43B Target Practice (TP) rounds (105 mm training round [TR]) from a 105 mm M102 (U.S. Air Force designation M137A1) light-weight Howitzer cannon, or 2) PGU-13 HEI, PGU-46 HEI rounds, or PGU-15 TP rounds (inert) from a 30 mm GAU-23/A gun system. A MK-25 flare would be dropped prior to firing and used as a target. Management measures would be the same as those described for AFSOC's AC-130 gunnery missions. Table 2-5 shows types of

rounds fired, as well as total number of missions and rounds proposed to be expended each year. All missions are conducted shoreward of the continental shelf break.

Table 2-5. Summary of 413 FLTS Precision Strike Package Gunnery Testing

Expendable	Net Explosive Weight	Number of Missions Per Year	Rounds per Mission	Total Number of Rounds Per Year
PGU-13/46 (30 mm)	0.1 lbs	3	33	99
PGU-44 (105 mm FU)	4.7 lbs	4	15	60
PGU-43B TP (105 mm TR)	0.35 lbs	4	15	60

FU = full up; lbs = pounds; mm = millimeters; PGU = Projectile Gun Unit; TP = target practice; TR = training round

AC-130J and AC-130W Stand-Off Precision Guided Munitions Testing

The SOPGMs proposed for use in this testing would include AGM-176 Griffin missiles, AGM-114 Hellfire missiles, GBU-39/B SDBs, and GBU-39B/B Laser Small Diameter Bombs (LSDBs). The purpose of this testing would be to demonstrate the feasibility and capability of the SOPGMs on AC-130 aircraft. Initial actions would consist of various ground tests (not included as part of this REA), including systems testing and static drops. After ground testing is completed, captive carry, store separation, and weapon employment tests would be conducted. Captive-carry missions would be conducted with an Instrumented Measurement Vehicle (IMV) to collect environmental data or an inert telemetry (TM) missile in order to evaluate the integration of the SOPGM with the AC-130J. Store separation missions would require a TM missile with an inert warhead and a live motor, if applicable, to verify that the weapon can be employed without significant risk to the aircraft.

Weapon employment missions would be flown using any combination of inert and/or live weapons for a final end-to-end check of the system. Missions may be conducted over land or water ranges, with water ranges used for SDB/LSDB and Griffin missile tests. It is expected that over-water testing would be conducted at the GRATV target location. The target would be laser designated with a standard range instrumentation designator. Plywood targets, as well as stationary and moving vehicles, would be used for the end-to-end functionality tests. They would be set up so that the Integrated Laser Targeting camera (ILAST) could capture the laser spot on the target, and so that the high speed digital video could record the impact. The ILAST cameras and digital cameras would be mounted in such a way as to have a clear view of the target while being a safe distance from any debris from the impact.

Similar to preceding mission descriptions, pre- and post-test surveys would be conducted within the applicable human and marine species safety zones. Surveys would be conducted from vessels, aircraft, and possibly live video feed. Survey requirements are described in detail in Chapter 5, *Management Practices*. Table 2-6 shows the annual number of munitions expended annually for SOPGM testing. It is noted that the 413 FLTS provided the number of munitions required per fiscal year over a span of four years. The numbers in Table 2-6 represent the average per year (total number divided by four).

Table 2-6. Summary of 413 FLTS SOPGM Annual Testing

Expendable	Net Explosive Weight	Approximate Number Released/Year*	Detonation Scenario
AGM-176 (Griffin)	4.58 lbs	10	Surface
AGM-114 (Hellfire)	20 lbs	10	Surface
GBU-39 (SDB I)	37 lbs	6	Surface
GBU-39 (LSDB)	37 lbs	10	Surface

AGM = air-to-ground missile; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb

*Total number of munitions over a four-year period divided by four

Total expendables proposed to be released annually in the EGTTR for all combined 413 FLTS air-to-surface testing operations are shown in Table 2-7.

Table 2-7. Total Annual 413 FLTS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario
30 mm	0.1 lbs	99	Surface
105 mm FU	4.7 lbs	60	Surface
105 mm TR	0.35 lbs	60	Surface
AGM-176 (Griffin)	4.58 lbs	10	Surface
AGM-114 (Hellfire)	20 lbs	10	Surface
GBU-39 (SDB I)	37 lbs	6	Surface
GBU-39 (LSDB)	37 lbs	10	Surface

AGM = air-to-ground missile; FU = full up; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb; TR = training round

2.2.5 780th Test Squadron

Testing activities proposed by the 780th Test Squadron (780 TS) include Precision Strike Weapon, Longbow missile littoral testing, and several other various future actions. Each activity category is described below.

Precision Strike Weapon

The Air Force Life Cycle Management Center and the Navy, in cooperation with the 780 TS, proposes to conduct Precision Strike Weapon (PSW) test missions utilizing resources within the Eglin Military Complex, including sites in EGTTR. The weapons proposed to be used in testing are the AGM-158 A and B (Joint Air-to-Surface Standoff Missile [JASSM]), and the GBU-39/B (SDB I).

The JASSM (Figure 2-6) is a precision cruise missile designed for launch from outside area defenses against hardened, medium-hardened, soft, and area type targets. The JASSM has a range of more than 200 NM and carries a 1,000-pound warhead. The JASSM has approximately 300 pounds of 2,4,6-trinitrotoluene (TNT) equivalent NEW. The specific explosive used is AFX-757, a type of plastic bonded explosive (PBX). The JASSM would be launched more than 200 NM from the target location. Platforms for the launch include B-1, B-2, B-52, F-16, F-18, and F-15E aircraft. Launch from the aircraft would occur at altitudes greater than 25,000 feet. The JASSM would cruise at altitudes greater than 12,000 feet for the majority of the flight profile until making the terminal maneuver toward the target.

Figure 2-6. Joint Air-to-Surface Standoff Missile (JASSM) in Flight

The SDB (Figure 2-7) is a guided bomb and is an important element of the Air Force's Global Strike Task Force. The SDB I carries a 217-pound warhead with approximately 37 lbs NEW. The explosive used is AFX-757. The SDB I may be launched from over 50 NM away from the target location. Platforms for the launch include F-15E, F-16, and AC-130W aircraft. Launch from the aircraft would occur at altitudes greater than 5,000 feet above ground level (AGL). The SDB I would then commence a non-powered glide to the intended target.

Up to two live and four inert JASSM missiles per year could be launched to impact a target at the GRATV target location. The JASSM missile would detonate upon impact with the target. Although impact would typically occur about 5 feet (1.5 meters) above the water surface, detonations are assumed to occur at the water surface for purposes of impacts analysis.

Figure 2-7. Small-Diameter Bomb (SDB) in Flight

Additionally, up to 6 live and 12 inert SDBs could also be deployed against targets in the same target area. Two SDB-Is may be launched simultaneously during two of the live missions and four of the inert missions. Detonation of the SDBs would occur under one of two scenarios:

- Detonation upon impact with the target.
- Height of burst (HOB) test, which involves detonation 7 to 14 feet (2.21 to 4.54 meters) in the air above the surface target.

There would generally be only one detonation per test event, and thus no more than one detonation in any 24-hour period. In instances of a simultaneous SDB launch scenario, two bombs are deployed from the same aircraft at nearly the same time to strike the same target. It is expected that the bombs would strike the target within five seconds or less of each another. Under this scenario, the detonations are considered a single event (NEW is doubled) for the purpose of acoustic modeling and marine species impacts analysis (Chapter 3). Modeling both detonations as a single event results in a conservative impact estimate. Refer to Appendix D for a complete description of the acoustic modeling conducted in support of this document. PSW munitions under the Proposed Action are shown in Table 2-8.

Table 2-8. Summary of Annual Precision Strike Weapon Tests

Weapon	# of Live Tests/Year	# of Live Munitions Released	# of Inert Tests/Year	# of Inert Munitions Released
AGM-158 (JASSM)	2	2	4	4
GBU-39 (SDB I) Single Launch	2	2	4	4
GBU-39 (SDB I) Simultaneous Launch	2	4	4	8

AGM = air-to-ground missile; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; SDB = Small Diameter Bomb

Chase aircraft, consisting of F-15, F-16, and/or T-38, would accompany each launch. These aircraft would follow the test items during captive carry and free flight but would not follow either item below a predetermined altitude as directed by Flight Safety. Other assets on site may include an E-9 turboprop aircraft circling around the target location. Tanker aircraft including KC-10s and KC-135s would also be used. The GRATV may also be on location to hold instrumentation, and would be anchored up to 1,000 feet away from the target location.

Figure 2-8. Example of a CONEX Target

Based on availability, one of two potential target types would be used during PSW tests. The first is a Container Express (CONEX) target (Figure 2-8) that consists of up to five containers strapped, braced, and welded together to form a single structure. The dimensions of each container are approximately 8 by 8 by 40 feet. Each container would contain 200 55-gallon steel drums (filled with air and sealed) to provide buoyancy. The second type of target is a hopper barge, which is a non-self-propelled vessel typically used for transporting bulk cargo (Figure 2-9). A typical hopper barge is approximately 30 by 12 by 125 feet. The targets would be held in place by a four-point anchoring system using cables.

Figure 2-9. Typical Hopper Barge

The CONEX target would be constructed on land and shipped to the target location two to three days prior to the test. The barge target would also be stationed at the target location two to three days prior to the test. During an inert mission, the JASSM would pass through the target and the warhead would sink to the bottom of the Gulf. Immediately following impact, the JASSM recovery team would pick up surface debris originating from the missile and target. Depending on the test schedule, the target may remain in the GOM for up to one month at a time. If the target is significantly damaged, and it is deemed impractical and unsafe to retrieve it, the target remains may be sunk through coordination with the U.S. Coast Guard or

Tyndall AFB. Coordination with the U.S. Army Corps of Engineers would be required prior to sinking a target.

PSW test activities would occur in W-151 at the GRATV target location. Targets would be located in approximately 115-120 feet of water, 17 miles offshore of Test Area A-3 on Santa Rosa Island. This area is the same as the Maritime WSEP test site. Test missions may occur during any time of the year, but during daylight hours only.

PSW missions are currently authorized to be conducted in the EGTTR. An EA was prepared and completed in November 2005. In association with that EA, a Biological Opinion was issued by USFWS on March 14, 2005 (Consultation No. F/SER/2004/00223) in accordance with the Endangered Species Act. More recently, on March 5, 2014, NMFS issued a five-year LOA in accordance with the Marine Mammal Protection Act for the 780 TS's PSW testing activities, as described above. Since then, new acoustic thresholds and criteria have been adopted by NMFS to analyze acoustic impacts to marine mammals and sea turtles from exposure to explosive sources. The analysis in Chapter 3 will therefore incorporate the latest acoustic modeling requirements. The LOA includes specific measures, including pre- and post-test surveys, marine species observer training, and reporting requirements. All of these requirements are described in detail in Chapter 5, *Management Practices*.

In addition to the above description, future (Phase 2) testing of the JASSM and SDB is planned by the Air Force Operational Test and Evaluation Center (AFOTEC) (Table 2-9). AFOTEC proposes to expend two live and one inert GBU-53 (SDB II) weapons in the EGTTR. The live weapons would be deployed against moving boats with a length of 30 to 40 feet, while the inert weapon would be used against a smaller fiberglass boat. Details of Phase 2 JASSM testing are currently unknown; this testing is, therefore, not included as part of the Proposed Action.

Table 2-9. Summary of Phase 1 and Phase 2 Precision Strike Weapon Live Tests

Weapon	Net Explosive Weight	# of Live Munitions Released	# of Inert Munitions Released
AGM-158 (JASSM)	300 lbs	2	4
GBU-39 (SDB I)	37 lbs	2	4
GBU-39 (SDB I) Simultaneous Launch*	74 lbs	2	4
GBU-53 (SDB II)	22.84 lbs	2	1

AGM = air-to-ground missile; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; lbs = pounds; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

Longbow Littoral Testing

The 780 TS/OGMT proposes to collect data on the ability of the Longbow missile (AGM-114L) to track and impact moving boat targets in the Lock On Before Launch (LOBL) and Lock On After Launch (LOAL) modes, and at varying launch elevation angles. A secondary objective of the tests would be to acquire telemetry data in order to evaluate tracking quality. Missiles would typically be launched from an Avenger system (a mobile missile launch system) mounted to a High Mobility Multipurpose Wheeled Vehicle (HMMWV). The HMMWV would be located either at the shoreline of Eglin's Santa Rosa Island property or on a barge or boat in W-151A.

Missiles could also be launched from an AH-64D Apache helicopter. Missiles launched from Santa Rosa Island are outside the EGTTR boundary and are not included in this REA. The targets would consist of small (approximately 25 feet in length), remotely controlled fiberglass boats. The distance of the targets from the missile launch site would be either 1.5 or 4 kilometers (km) (0.9 or 2.5 miles).

Up to 16 live Longbow missiles could be launched annually in the EGTTR (Table 2-10). The NEW of each missile is 35.95 pounds. All missiles would contain a proximity fuse, with detonations occurring at a minimum height of 1 to 3 meters (3.3 to 9.8 feet) above the water. There would be no detonations below the surface. Management actions would include human safety zone clearance and pre- and post-mission protected marine species surveys, as described in Chapter 5.

Table 2-10. Annual Longbow Munitions

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – Explosive Material	Net Explosive Weight
AGM-114 L (Longbow)	16	1 to 3 meter height (airburst)	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge	35.95 lbs

AGM = air-to-ground missile; lbs = pounds

Future Proposed Actions

The 780 TS proposes to conduct other various testing activities that involve targets on the water surface in the EGTTR. Many of the missions would target small boats or barges. Weapons would primarily be delivered by aircraft, although a rail gun would be used for one test. Live warheads would be used for some missions, while others would involve inert warheads with a live fuse (typically contains a very small NEW). Total munitions for the five-year period of 2017 to 2021 are listed in Table 2-11. As with the preceding missions using live weapons, safety zone enforcement and pre- and post-mission marine species monitoring would be required.

Table 2-11. 780 TS Annual Munitions, Other Future Actions

Munition	NEW (pounds)	Number of Releases	Proposed Location	Target Type	Detonation Type
Joint Air-Ground Missile	27.41	2	W-151 (subareas A, S5, and S6)	HSMST or Boston Whaler type boat	1 – Point Detonation 1 - Airburst
Navy Rail Gun	Inert	19	W-151	Barge	Penetrating Rod
	1	5	W-151	Barge	Airburst
JDAM – Extended Range	Inert	3	W-151	Water surface (2) Barge (1)	Inert
Navy HAAWC	Inert	2	W-151	Water surface	Inert
Laser SDB	0.4 (fuse)	4 maximum	W-151A	Small boats	Airburst or Surface
SDB II Guided Test Vehicle	0.4 (fuse)	4	W-151A	Small boats	Surface

HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; HSMST = High Speed Maneuverable Surface Target; JDAM = joint direct attack munition; NEW = net explosive weight; SDB = Small Diameter Bomb

Summary of Combined 780th Test Squadron Activities

Total expendables proposed to be released annually in the EGTTR under 780 TS air-to-surface testing operations, including PSW, Longbow, and other various missions, are shown in Table 2-12.

Table 2-12. Total Annual 780 TS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario
Live AGM-158 (JASSM)	300 lbs	2	Surface
Inert AGM-158 (JASSM)	N/A	4	N/A
Live GBU-39 (SDB I)	37 lbs	2	Surface
Inert GBU-39 (SDB I)	N/A	4	N/A
Live GBU-39 (SDB I) Simultaneous Launch*	74 lbs	2	Surface
Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	4	N/A
Live GBU-53 (SDB II)	22.84 lbs	2	Surface
Inert GBU-53 (SDB II)	N/A	1	N/A
AGM-114 L (Longbow)	35.95 lbs	16	Airburst
Joint Air-to-Ground Missile	27.41 lbs	1	Surface
		1	Airburst
Live Navy Rail Gun	1	1	Airburst
Inert Navy Rail Gun	N/A	19	N/A
JDAM Extended Range	N/A	3	N/A
Navy HAAWC	N/A	2	N/A
Inert GBU-39 (LSDB) with live fuse	0.4 lbs	4	Airburst or surface
Inert GBU-53 (SDB II with live fuse)	0.4 lbs	4	Surface

AGM = air-to-ground missile; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; JDAM = joint direct attack munition; lbs = pounds; LSDB = Laser Small Diameter Bomb; N/A = not applicable; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

2.2.6 96th Test Wing Inert Munitions

The 96th Test Wing (96 TW), Eglin's host wing, provides developmental test and evaluation for a wide variety of air-delivered weapons and other systems. The 96 TW proposes to expend approximately nine inert bombs yearly in the EGTTR. The weight of each bomb would be 2,000 pounds, but there would be no warhead. Use of inert munitions was analyzed in the 2002 PEA and found to have no significant environmental impact. Therefore, there is no limit on the number of inert items that may be expended, and actual numbers used by the 96 TW may vary. However, the bombs are included in this EA in order to document the programmatic use of the EGTTR.

2.2.7 96 Operations Group (OG)

The 96 Operations Group, which conducts the 96 TW's primary missions of developmental testing and evaluation of conventional munitions and command and control systems, anticipates support of air-to-surface missions for several user groups on an infrequent basis. Sub-surface

detonations would be at 5 to 10 feet below the surface. Projected typical annual munitions expenditures and detonation scenarios are listed in Table 2-13.

Table 2-13. Annual Munitions for 96 Operations Group Support

Munition	NEW (lbs)	Detonation Scenario	# Annual Releases
GBU-10 or GBU-24	945	Subsurface	1
GBU-12 or GBU-54	192	Subsurface	1
AGM-65 (Maverick)	86	Surface	2
GBU-39 (SDB I or LSDB)	37	Subsurface	4
AGM-114 (Hellfire)	20	Subsurface	20
105 mm full-up	4.7	Surface	125
40 mm	0.9	Surface	600
Live fuse	0.4	Surface	200
30 mm	0.1	Surface	5,000

AGM = air-to-ground missile; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; mm = millimeter; SDB = Small Diameter Bomb

2.2.8 Summary of Munitions Expendables for All Known Missions Under the Proposed Action

Table 2-14 shows an inclusive list of munitions expendables associated with all new test and training missions included in the Proposed Action. The list incorporates all new missions (since completion of the 2002 PEA) proposed by the 86 FWS, ASEP, AFSOC, 413 FTLS, 780 TS, 96 TW, and 96 OG.

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR

Organization/Activity	Munition	NEW	Detonation Scenario	# of Annual Releases
86 FWS/ Maritime WSEP Live Munitions	GBU-10 or GBU-24	945 lbs	Surface or subsurface	2
	GBU-12 or GBU-54 (LJDAM)	192 lbs	Surface or subsurface	6
	AGM-65 (Maverick)	86 lbs	Surface	6
	CBU-105	107.63 lbs	Airburst	4
	GBU-39 (LSDB)	37 lbs	Airburst, Surface, or Subsurface	4
	AGM-114 (Hellfire)	20 lbs	Airburst, Surface, or Subsurface	30
	GBU-53 (SDB II)	22.84 lbs	Airburst, Surface, or Subsurface	4
	AGM-176 (Griffin)	4.58 lbs	Airburst or Surface	10
	2.75-in Rockets (including APKWS)	10 lbs	Surface	100
	PGU-13 HEI (30 mm)	0.1 lbs	Surface	1,000
	AIM-9X	68 lbs	Surface	4
86 FWS/ Maritime WSEP Inert Munitions	GBU-10	N/A	N/A	21
	GBU-12	N/A	N/A	27
	GBU-24	N/A	N/A	17
	GBU-31	N/A	N/A	6
	GBU-38	N/A	N/A	3
	GBU-54	N/A	N/A	16

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR, Cont'd

Organization/Activity	Munition	NEW	Detonation Scenario	# of Annual Releases
	BDU-56	N/A	N/A	13
	AIM-9X	N/A	N/A	3
	PGU-27	N/A	N/A	46,000
ASEP	Mk-84 bomb (inert)	N/A	N/A	12
AFSOC/Air-to-Surface Training Operations	7.62 mm/.50 cal	N/A	N/A	30,000
	25 mm	0.067 lbs	Surface	39,200
	30 mm	0.1 lbs	Surface	35,000
	40 mm	0.87 lbs	Surface	4,480
	105 mm FU	4.7 lbs	Surface	750
	105 mm TR	0.35 lbs	Surface	1,350
	AGM-176 (Griffin)	4.58 lbs	Airburst	200
	AGM-114P/R (Hellfire)	20 lbs	Airburst	100
	GBU-39 (SDB I)	37 lbs	Airburst	30
413 FLTS/Air-to-Surface Testing Activities	30 mm	0.1 lbs	Surface	99
	105 mm FU	4.7 lbs	Surface	60
	105 mm TR	0.35 lbs	Surface	60
	AGM-176 (Griffin)	4.58 lbs	Surface	10
	AGM-114 (Hellfire)	20 lbs	Surface	10
	GBU-39 (SDB I or LSDB)	37 lbs	Surface	16
780 TS/Air-to-Surface Testing Activities	Live AGM-158 (JASSM)	300 lbs	Surface	2
	Inert AGM-158 (JASSM)	N/A	N/A	4
	Live GBU-39 (SDB I)	37 lbs	Airburst or Surface	2
	Inert GBU-39 (SDB I)	N/A	N/A	4
	Live GBU-39 (SDB I) Simultaneous Launch*	74 lbs	Airburst or Surface	2
	Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	N/A	4
	Live GBU-53 (SDB II)	22.84 lbs	Surface	2
	Inert GBU-53 (SDB II)	N/A	N/A	1
	AGM-114 L (Longbow)	35.95 lbs	Airburst	16
	Joint Air-to-Ground Missile	27.41 lbs	Surface	1
			Airburst	1
	Live Navy Rail Gun	1	Airburst	1
	Inert Navy Rail Gun	N/A	N/A	19
	JDAM Extended Range	N/A	N/A	3
	Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	N/A	N/A	2
	Inert GBU-39 (LSDB) with live fuse	0.4 lbs	Airburst or surface	4
	Inert GBU-53 (SDB II with live fuse)	0.4 lbs	Surface	4
96 TW Inert Munitions	Bomb (2,000 pounds)	N/A	N/A	9
96 Operations Group	GBU-10 or GBU-24	945	Subsurface	1
	GBU-12 or GBU-54	192	Subsurface	1
	AGM-65 (Maverick)	86	Surface	2
	GBU-39 (SDB I or LSDB)	37	Subsurface	4
	AGM-114 (Hellfire)	20	Subsurface	20
	105 mm full-up	4.7	Surface	125

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR, Cont'd

Organization/Activity	Munition	NEW	Detonation Scenario	# of Annual Releases
	40 mm	0.9	Surface	600
	Live fuse	0.4	Surface	200
	30 mm	0.1	Surface	5,000

AIM = air intercept missile; AFSOC = Air Force Special Operations Command; AGM = air-to-ground missile; ASEP = Advanced Systems Employment Project; BDU = Bomb Dummy Unit; CBU = Cluster Bomb Unit; FLTS = Flight Test Squadron; FU = Full up; FWS = Fighter Weapons Squadron; GBU = Guided Bomb Unit; HEI = high explosive incendiary; JASSM = Joint Air-to-Surface Standoff Missile; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bombs; MK = mark; mm = millimeters; ms = millisecond; N/A = Not Applicable; PGU = Projectile Gun Unit; SDB = Small Diameter Bomb; TR = training round; TW = Test Wing; WSEP = Weapons System Evaluation Program
*NEW is doubled for each simultaneous launch

2.2.9 Surface Vessel Operations and Subsurface Support

Under the Proposed Action, surface vessels would be operated in the EGTTR in support of a variety of missions. As summarized in preceding subsections, small boats would be used during many air-to-surface missions as targets, Air Force mission support vessels, safety boats, and marine species survey boats. Missions for which a particularly large number of boats would be used include Maritime WSEP and test missions associated with the 780 TS, although small boats would be used for several other missions as well. For Maritime WSEP missions, up to 25 boats per mission could participate as part of the safety team. Up to 30 vessels could participate as targets during each swarm mission. Most vessel operations would be conducted in W-151A. Moving target boats would for the most part be towed or remotely controlled and would be fired on with various types of munitions. Some percentage of these vessels would sink to the ocean floor after being struck, although the specific number is unknown.

Other miscellaneous operations would include surface vessels used to launch Navy missiles (cruise missiles, AEGIS Cruiser testing, etc.), Landing Craft Air Cushion and Ship to Shore Connector hovercraft operation, and small boats routinely used for Water Survival and parachute water entry training. Missile Retrieval Vessels may be used to remove downed target drones from the water. The Navy may occasionally bring an aircraft carrier and other vessels into the EGTTR to conduct Naval Air Operations.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED

Locating live air-to-surface testing and training in deeper water was eliminated from further consideration because the deeper continental slope regions of EGTTR are home to several more protected species. The risk of take of endangered species would increase for areas that support numerous large whales and other cetaceans. Further, mitigation and monitoring measures would be more costly and more difficult to carry out based on additional travel time and perhaps the need for larger vessels or aerial assets. In addition, difficulties in communications links would increase with increasing distance offshore.

2.4 ALTERNATIVE 1 (PREFERRED ALTERNATIVE)

Alternative 1 proposes to conduct the same level of missions as those of the Proposed Action but to expand the live air-to-surface target location to include any point within a 5-mile radius of the existing live air-to-surface target location described for Maritime WSEP missions above. An alternative target location could be chosen anywhere within the 5-mile radius zone. Similar to the Proposed Action, a remote sensing survey of the 1-square mile area around the new target site would be required using side-scan sonar, a magnetometer, and a subbottom profiler to confirm the presence or absence of potential historic shipwrecks. The entire 5-mile radius area would not be surveyed. This information would also be used to avoid artificial reefs.

2.5 NO ACTION ALTERNATIVE

The No Action Alternative represents all mission activities included and analyzed in the 2002 PEA, but does not include new test and training requirements that have been identified since publication of the 2002 document. The actions would include air-to-air, air-to-surface, surface-to-surface, and other miscellaneous types of test and training missions. Most munitions used in EGTTR would be inert, although missiles would have live motors and live weapons would be used in a few cases. Under the No Action Alternative, new missions involving live detonations or requiring protected species permits would undergo separate NEPA analysis and consultation. A description of each type of testing and training mission is provided below.

2.5.1 Air-to-Air Testing and Training

Air-to-air testing and training generally refers to aircraft missions that do not purposely target the water surface, but that are designed to address aircraft or weapons performance in the air. However, expended items incidentally fall to the water during many of these activities. Sorties may originate at either Eglin or Tyndall AFB near Panama City, Florida. These missions have remained largely unchanged since publication of the 2002 PEA, with minor updates such as drone types (the QF-16 full-scale drone has replaced the QF-4). Air-to-air activities are summarized below. More detailed descriptions may be found in the 2002 PEA.

Air-to-Air Testing

Air-to-air testing involves launching live missiles against full or subscale drone targets. The most common targets include the QF-16 full-scale drone, as well as BQM-34 and MQM-107 subscale drones. Air-to-air testing missions usually require four aircraft, including the target. Testing commonly occurs in W-151 and W-470, but not within the Aircraft Combat Maneuvering Instrumentation (ACMI) Range. Activities involved with recovering drones, banners, or other expendables are discussed in the Subsurface Operations section below.

Air-to-Air Aircraft Gunnery Testing

Under this type of testing, aircraft guns (typically F-15 or F-16 aircraft) are fired at a banner that is towed by a second aircraft. The purpose is to verify software upgrades to fire-control system, ballistics, or to qualify new ammunition. After shooting, the tow banner is recovered after being

dropped in the water (boat recovery), on B-70 (Eglin Reservation), or along the drone runway at Tyndall AFB. Testing usually occurs in W-151, at a tempo of approximately six events per year.

Air-to-Air Combat Training

Air-to-air combat training refers to pilot training for engaging enemy aircraft. The training is completed in three levels. Level one involves simulated dogfights using only the systems onboard participating aircraft, with no weapons expended. During level two, aircraft interaction is tracked through instrumentation pods on each aircraft and ground-based computer and communication systems. Level three training involves using live ordnance (missiles and guns) fired at drone targets or towed banners. Multiple aircraft and targets may be engaged in complex scenarios during level three training. Activities occur in W-151 and W-470 (occasionally including the ACMI Range).

2.5.2 Air-to-Surface Testing and Training

Air-to-surface testing and training refers to missions that purposely target objects on the water surface as part of weapons or tactics evaluations. Sorties may originate at either Eglin or Tyndall AFB. The 2002 PEA analyzed impacts from mostly inert ordnance being released from aircraft, with some exceptions such as AFSOC's live air-to-surface gunnery training which involved 25-, 40-, and 105-mm HEI rounds.

Air-to-Surface Testing (Bombs and Missiles)

This category of testing occurs over the water and is intended to verify aircraft/weapons characteristics after weapons leave the aircraft. Missions typically involve a new weapon or a new mix of weapons, where the ballistics are not known or verified. Various types of bombs and missiles may be used. Weapons almost always have an inert warhead; however, missiles usually have a live motor.

Air-to-Surface Training

Special Operations personnel from Hurlburt Field or Duke Field may fire .50 cal and 7.62 mm rounds from CV-22 aircraft into the water. Any water range can be used, but activities usually occur in W-151.

Air Force Special Operations Command (AFSOC) Air-to-Surface Gunnery Training

AFSOC air-to-surface gunnery missions are described in detail for the Proposed Action (Section 2.2.3). Missions associated with the No Action Alternative would generally be the same, with some exceptions. The primary differences would be in the type and number of gunnery rounds used. The 30 mm rounds were not included in previous analyses and would therefore not be part of the No Action Alternative. The annual number of missions and quantity of expenditures would also be different, as shown in Table 2-15. In addition, the only targets associated with the No Action Alternative are flares; towed targets would not be used. All other aspects of the mission would be identical to those described in Section 2.2.3.

Table 2-15. Summary of Annual AFSOC AC-130 Gunnery Operations, No Action Alternative

Expendable	Total Number of Rounds
105 mm FU	242
105 mm TR	1,500
40 mm	17,830
25 mm	15,062

FU = full up; mm = millimeters; TR = training round

2.5.3 Surface-to-Surface and Surface-to-Air Testing

Surface-to-surface testing typically consists of missile launches (cruise missiles or other types) from a surface ship or submarine. The missile flies a pre-programmed course and is followed at all times by at least two aircraft so that it can be redirected or destroyed if necessary. The missile transitions to land and is usually recovered on Test Area B-70. Surface-to-air tests involve missiles launched from a variety of land-based platforms or surface vessels. These missiles are usually targeted at aircraft in the EGTTR.

2.5.4 Other Testing and Training

Electronic Countermeasures and Electronic Systems Testing

Electronic Countermeasures (ECM) generally refer to actions intended to interfere with an enemy's use of electromagnetic radiation (radar, etc.). ECM systems are tested against land- and air-based threats. Electronic Systems Testing includes radar software testing, radios, radar cross-section, and any electronic system except ECM. These missions are usually flown at a low speed and altitude (usually 500 to 15,000 feet), and no munitions are involved.

ECM and Other Training

This category includes training on combatting electronic signals designed to degrade onboard equipment, confuse the equipment operator, or degrade any other use of the airspace. ECM Training is routinely done against aircraft or ground/surface ship systems. Any part of the EGTTR can be used for this type of training.

Air Operations Testing

Air Operations Testing includes any use of the EGTTR airspace not previously described. The most common activity is "speed soaking," where ordnance is carried on an aircraft through its entire speed range. A typical mission is three hours long and includes aerial refueling.

Personnel and Equipment Drops

Special Operations (Joint Services) routinely drops personnel and equipment into the water either at low-altitude (no parachutes used) or high-altitude (parachutes used). Drops typically occur in W-151S (Shoreline), which designates the northern portions of W-151 closest to shore. However, drops are occasionally conducted "over the horizon" in other sections of W-151. The typical drop involves three to five personnel at a height of 5 to 2,000 feet above the surface.

Air-to-Air Refueling

This training involves a refueling aircraft (KC-46, KC-135, KC-10, or C-130) passing fuel to one or more receiver aircraft. Altitudes at which refueling occurs varies by aircraft type (16,000 to 26,000 feet for fighter aircraft, 4,000 to 8,000 feet for helicopters, and 10,000 to 14,000 feet for C-130s).

2.5.5 Summary of Activities Under the No Action Alternative

A summary of the activities, user groups, aircraft, and types of expendables under the No Action Alternative is provided in Table 2-16. The total number of expendables associated with combined activities is shown in Table 2-17 (25-mm rounds have been added to the expendables list to account for F-35 training). The environmental effects potentially resulting from these combined activities were analyzed in the 2002 PEA. Impact categories included noise (sonic booms, etc.), air emissions, fuel and other chemical releases, restricted airspace and water surface access, and ordnance testing and training (bombs, missiles, gunnery rounds, intact and fragmented drones, chaff, flares, and other items entering the water with the potential to strike marine species and impact habitats). Analyses concluded that there would be no significant impacts to physical, biological, or human environments or resources. Because the activities included in the No Action Alternative of this REA are the same or similar to those in the 2002 PEA, potential impacts would also be similar and would not be considered significant.

Table 2-16. Summary of Testing and Training Activities, No Action Alternative

Activity	Organization(s)	Typical Aircraft	Expendables
Air-to-Air Testing	96 TW, 53 WEG	F-15, F-16, E-9, MU-2, Drones	Missiles (various types), Chaff, Flares
Air-to-Air Aircraft Gunnery Testing	96 TW, 53 WEG	F-15, F-16, C-130	20 mm rounds, 25 mm rounds
Air-to-Surface Testing	96 TW, 53 WEG	F-15, F-16	Bombs and missiles (various types)
Electronic Countermeasures and Electronic Systems Testing	96 TW, 53 WEG	F-15, F-16, E-3, B-1, C-130	Calibration spheres, Chaff, Flares
Air Operations Testing	96 TW, 53 WEG	F-15, F-16	None
Surface-to-Surface or Surface-to-Air Testing	96 TW, 53 WEG	F-15, F-16, MU-2, Drones	Missiles (various types)
Air-to-Air Combat Training	96 TW, 33 FW, 325 FW, 53 WEG	F-15, F-16, F-22, F-35, E-9, MU-2, Drones	Missiles (various types), 20 mm rounds, 25 mm rounds, Chaff, Flares
Air-to-Surface Training	Special Ops (Hurlburt Field and Duke Field)	C-130	105 mm, 40 mm, 20 mm
Personnel and Equipment Drops	Special Ops (Joint Services)	C-130	Paratroops, Smoke, Boats, Fuel Bladders, Debris (chemical light sticks, drop gear, etc.)
Air-to-Air Refueling	96 TW, 33 FW, AWC, 325 FW, Special Ops	Almost all types of aircraft	None
Electronic Countermeasures Training and Other	33 FW, 325 FW, Special Ops	Almost all types of aircraft	Chaff, Flares

AWC = Air Warfare Center; FW = Fighter Wing; mm = millimeters; TW = Test Wing; WEG = Weapon Evaluation Group

Table 2-17. Summary of Annual Testing and Training Expendables, No Action Alternative

Expendable	Quantity
Bombs – Inert	551
Missiles – Live	21
Missiles – Inert	560
Drones	99
Chaff	434,275
Flares	202,747
Rockets – Inert	602
Gun, 105 mm Full Up – HE	242
Gun, 105 mm Training Round – HE	1,500
Gun, 40 mm – HE	17,830
Gun, 25 mm – HE	15,062
Gun, 20 mm Training Round - HE	75,580
Small Arms (.50 cal, 7.62 mm, 5.56 mm)	1,108,695
Small Arms (.50 cal, 7.62 mm, 5.56 mm) – Blanks	1,844
Smoke	476
Other – Live (impulse cartridges)	417
Other - Inert	4,282

Cal. = caliber; HE = High Explosive; mm = millimeters

Summaries of the analyses and conclusions found in the 2002 PEA are provided in Chapter 3, *Affected Environment and Environmental Consequences*, of this REA.

2.6 IMPACT SUMMARY

A summary of potential impacts from the Proposed Action, Alternative 1, and No Action Alternative is provided in Table 2-18.

Table 2-18. Impact Summary Comparison by Resource and Alternative

Resource	Proposed Action	Alternative 1	No Action Alternative
Safety/ Restricted Access	Nonparticipating vessels and persons would be kept from the mission area by use of safety boats and Notice to Mariners. The Eglin Air Force Base EOD team would resolve any UXO issues on surface targets. As the study area is characterized by stable bathymetry and low energy, migration of UXO shoreward is not expected to occur. Floating target debris would be retrieved. With regard to restricted access, closures of the mission area would be temporary and intermittent and would not significantly impact recreational or commercial fishing.	The potential safety/restricted access impacts would be similar for Alternative 1 as for the Proposed Action, though geographically shifted to within five miles of the Proposed Action live impact area. The Air Force would minimize potential safety impacts by implementing the same safety measures as for the Proposed Action.	There would be no significant impacts due to safety or restricted access issues. EGTTR training and testing would remain at currently analyzed levels; new programs would be individually addressed.
Physical Resources	There would be no significant impacts to physical resources. Impacts to water column and substrate quality due to chemical materials and metals from expendables would be minor. Detonations would not be of sufficient strength to cause seafloor cratering. Scouring of the seafloor by debris pieces would be minor.	Impacts to the waters and substrate would not be significant under Alternative 1. The potential physical resources impacts would be the similar to those under the Proposed Action, however, impacts would occur over a slightly larger geographic area. Chemicals, metals, and debris would potentially impact a greater area but to a lesser degree, since the same quantity of materials would be expended over a larger region.	There would be no significant impacts to physical resources, as EGTTR training and testing would remain at currently analyzed levels; new programs would be individually addressed.
Socioeconomic s	There would be potential for impacts to revenue and income generating activities such as recreational and commercial fishing and boating from delays, rerouting, and restricted access under the Proposed Action; however implementation of BMPs, temporary employment of local fishermen, and continued use of communication services would minimize adverse impacts. Therefore, no significant impacts to socioeconomic resources would be anticipated under the Proposed Action. Additionally, no disproportionate impacts to low-income communities, minorities, or children have been identified under the Proposed Action.	The potential socioeconomic impacts would be the same for Alternative 1 as for the Proposed Action.	There would be no potential impacts to socioeconomic and environmental justice resources from additional access restrictions under this alternative. EGTTR training and testing would remain at currently analyzed levels; new programs would be individually addressed.
Biological Resources	Marine fish may be injured or killed by detonations, but the number would be negligible relative to overall populations. A small number of fish could be affected by debris ingestion or water quality effects. Activities would occur outside the principle distribution range of ESA-protected fish species, and Gulf sturgeon critical habitat would not be affected. Detonations would not significantly affect benthic	Potential impacts to biological resources would be the same as those identified for the Proposed Action, with the exception that artificial reefs or hard bottom areas could be impacted by alternate mission site selection. Any alternate site would be investigated by using side-scan sonar, a magnetometer, and	Potential effects to biological resources would be the same as those identified in the 2002 EGTTR Programmatic Environmental Assessment, which concluded that impacts would not be significant.

Table 2-18. Impact Summary Comparison by Resource and Alternative, Cont'd

Resource	Proposed Action	Alternative 1	No Action Alternative
	communities. Known hard bottom habitats and artificial reefs would be avoided. Essential fish habitat and other protected marine habits would not be significantly impacted. Significant impacts to marine birds, including ESA-listed and migratory species, are not expected. Marine mammals and sea turtles could be exposed to noise or blast pressure resulting in mortality, injury, or harassment. Mitigation measures developed in cooperation with the NMFS would be implemented. A 5-year Letter of Authorization and Biological Opinion from NMFS are required. Effects to marine mammals and sea turtles resulting from debris and boat strikes/physical disturbance would not be significant.	subbottom profiler, so that bottom structures could be avoided. With these measures, there would be no significant impacts.	Analysis in the 2002 document is incorporated by reference.
Cultural Resources	In 2013, Eglin AFB Cultural Resources Office conducted a remote sensing survey around the existing live air-to-surface target area using side-scan sonar, a magnetometer, and a subbottom profiler. The results of this survey suggested that neither avoidance nor further investigation was necessary. No adverse effects to cultural resources are anticipated under the Proposed Action.	Effects to cultural resources would be identical to those discussed under the Proposed Action with the exception of the expansion of the live air-to-surface target location to include any point within a 5-mile radius of the existing live air-to-surface target location. Should the Air Force expand or move the current air-to-surface target area from its current location to a new location as proposed, a detailed analysis and remote sensing survey would be required for any new live air-to-surface target areas. Consultation with SHPO and completion of the Section 106 process would be required. Should historic properties be identified within this survey area, avoidance of the resource or other additional mitigation measures would be necessary. Until the Section 106 process is complete, there is a danger of direct adverse effects to any cultural resources present in the new target area.	No adverse effects to cultural resources are anticipated under the No Action Alternative. Under the No Action Alternative only those missions authorized as part of the 2002 PEA would be authorized. Any current or future planned test and training activities would require additional NEPA and NHPA consideration if continued or proposed.

AFB = Air Force Base; BMP = best management practice; EOD = Explosive Ordnance Disposal; ESA = Endangered Species Act; NEPA = National Environmental Policy Act; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Officer; PEA = Programmatic Environmental Assessment; UXO = unexploded ordnance

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 SAFETY

3.1.1 Definition of the Resource

Safety as discussed in this section refers to aspects of EGTTR missions that are hazardous due to the potential for interaction between mission areas and areas used by the public. *Safety* includes evaluating risks to public health (military and civilian personnel) due to direct strikes by weapons, blast effects, UXO, and debris. Injury or death is possible without proper safety precautions.

Analysis Methodology

Analysis considers the inherent hazardous aspects of missions and the potential pathways of interaction between missions and the public and military personnel. As the air and water resources of GOM are shared by military users and the public, there is often overlap between areas used for missions and those used by the public for commercial or recreational purposes such as fishing, diving, dredging, and maritime navigation. Hazards generally include delivering live or inert ordnance, live detonations, and the possibility of creating UXO from munitions that fail to detonate. In addition, floating debris could present a hazard to boat traffic. The analysis identifies the potential safety hazards and any measure implemented by the Air Force to ensure public safety.

Significance Determination

This section evaluates the potential for the Proposed Action to increase safety risks as well as the Air Force's capability to manage these risks. Potentially significant safety impacts would occur if the proposed missions or items resulting from the missions place the public at a high risk for injury or mortality, or if they pose an unusual risk to military personnel.

3.1.2 Affected Environment

The affected environment consists of open waters of GOM approximately 15 to 20 miles offshore where fishing, diving, dredging, and other uses occur, and beach areas where debris could wash ashore. All mission types have been an integral part of the existing condition for decades. Recent years have seen an increase in the number of nearshore air-to-surface live testing missions at the GRATV location.

For actions occurring in EGTTR with inherent safety risks, the Air Force implements measures to control the risk to the public. Such measures include restrictions on airspace and water surface use by recreational or commercial aircraft and vessels. EGTTR is composed of several Warning Areas, plus the Eglin Water Test Areas 1 through 6. Warning Areas are a subset of Special Use Airspace, which is defined as airspace in which certain activities must be confined or where limitations may be imposed on aircraft operations that are not part of those activities. Warning Areas are delineated where operations are hazardous and where operating non-

participating aircraft is subject to restrictions. The hazards are typically considered unusual and may be difficult to see from the aircraft (e.g., military gunnery training). When munitions are planned to be expended during missions in EGTTR, the affected airspace is closed to private and commercial aircraft.

There are generally no restrictions on public or commercial use of the surface water under the Warning Areas unless DoD activities are planned, including activities that require airspace use. If there is an activity that could be hazardous to public or commercial use of the water surface, the Air Force designates certain areas as "restricted" or "closed" to the public. These closures are driven by the dimensions of the "safety footprint" of a particular action that may have potential harmful noise, blast, or other effects. Safety footprints vary based on several factors, including weapon type, flight profile, altitude of delivery, speed, or flight system of the specified activity. When applying the individual weapon safety footprint to a test or training area in EGTTR, it is generally the policy of the Eglin Range Safety Office to apply a safety buffer called the "impact limit line." This line is the outermost impact boundary of items generated by the test. The safety buffer not only protects public users from areas potentially impacted by the test activity, but it also buffers the activity from adjacent GOM uses (e.g., shipping, recreational boating, commercial activities), thereby ensuring public safety and compatible use of GOM. The buffer can also encompass attenuating noise from test area activities, mitigating the impact to adjacent/surrounding user groups.

During missions that require area closures, a local NOTMAR may be issued through the U.S. Coast Guard Service stating the activity and potential hazards, although a NOTMAR is not necessarily requested for all hazardous tests. In addition, the Air Force may inform the public through printed fliers placed in Destin harbor marinas and shops and by personal and radio contact by guard vessels with public vessels. Even with these notices, it is the responsibility of Air Force personnel to ensure that there is no civilian surface traffic in the area. If there is, aircrews must wait until the area is clear or find another location in EGTTR that is clear of traffic. Due to the level of cooperation historically provided by local commercial and public users of the surface and the offshore nature of EGTTR waters, rescheduling of tests has rarely occurred. Potential socioeconomic impacts to the public from closures are discussed in Section 3.3, *Socioeconomic Resources*.

3.1.3 Environmental Consequences

Proposed Action

Potential safety issues resulting from test and training missions described under the Proposed Action include physical strikes or detonations close to non-mission aircraft and surface vessels, noise, debris, and UXO. Each potential impact category and the associated safety measures are discussed below. In addition to on-site safety measures, the Eglin Safety Office Risk Management Board would review the specific mission plan approximately one month in advance in order to discuss issues and identify risks. Missions considered "high risk" would be elevated to the base commander for further review.

Direct Strikes and Detonations

It is unlikely that private and commercial aircraft or boats would be impacted directly by gunnery missions (expenditure of gunnery rounds ranging from 20 to 105 mm) because aircrews visually scan the water surface before beginning fire, remain close to the target area, and are able to see the surface and airspace around targets. Gunnery missions have been conducted in EGTTR for many years with no safety incidents. Increased bomb and missile use would be of more concern due to the greater distance between the delivery aircraft and surface targets. Direct strikes or detonations of live bombs or missiles near non-participating aircraft or vessels could result in human injury or death, as well damage to or loss of the craft. However, Eglin would implement appropriate safety measures. The Air Force schedules the airspace to ensure that non-participating aircraft would not be within the hazard zone.

For missions involving using bombs or missiles, the affected area of sea surface would be cleared of all commercial and recreational boats on the morning of the mission by using several methods. A NOTMAR would be issued in advance of each mission and would describe the hazard, mission area location, and time frame of closure. The NOTMAR would be broadcast on channel 16 through the U.S. Coast Guard. In addition, 96 RANSS personnel would distribute flyers at local public docks explaining the closure and diagram the area to be closed.

The cleared area would include a safety footprint around the target, the size of which would depend on the particular weapon being tested. The area would be cleared with the assistance of the Air Force and contracted safety boats. The number of safety boats involved would depend on the specific mission, but could include up to about 25 vessels. Safety boats would be positioned in a pattern such that unauthorized vessels would be seen if entering the cleared area. Some of the safety boats would be equipped with radar to detect nonparticipating vessels. Safety boat crews would attempt to contact any nonparticipating vessel and direct it to maneuver away from the hazard area. In the case of live missions, the Eglin Safety Office would monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. Test area clearance would begin at daylight and continue throughout the mission. The safety footprint is expected to be closed for approximately four hours for each test (no more than two tests per day).

In addition to clearance by safety boats, the mission area would be surveyed from aircraft prior to some missions. In these instances, aircraft would make surveillance passes before ordnance delivery to ensure recreational and commercial vessels were clear of the danger area. The surveillance may consist of mission aircraft (weapon delivery or chase aircraft) making a dry run over the target area, although this action would not necessarily be performed for all tests. In addition, video cameras would also be positioned on the GRATV during some missions. The camera(s) would primarily be used to document the weapons' performance against targets, but can also be used to monitor for the presence of unauthorized vessels. Mission personnel would be located in Eglin's CCF on main base to view the live video feed before and during test activities. Missions would not proceed until the target area is confirmed to be clear of unauthorized vessels. In addition, the test would not be conducted if all video cameras were not operational.

With the protection measures described above, the potential for direct strikes or detonations occurring close to non-participating aircraft and boats in considered low, and impacts would therefore not be significant. In addition, there is no potential for civilian personnel to be subjected to hazardous noise due to the safety hazard zone that prevents public access.

Debris

Debris would be produced when munitions (particularly live munitions) strike boat targets. Some debris would sink to the seafloor, while other types would remain at the surface for some time. Floating debris would potentially consist of large pieces of target boats, in addition to smaller items such as foam, fiberglass, plastic, and plywood particles. Debris would be dispersed from the immediate mission site due to water currents and wind. There is potential for floating debris to impact recreational and commercial surface vessels by causing damage to the hull, engine, or propeller. Post-mission debris cleanup would be conducted for some, but not all, activities. Multiple vessels would search the target area, focusing on down-current areas, and retrieve smaller debris by hand or by using dip nets. The debris would be hauled aboard vessels and then transported inland for proper disposal. Large target boat pieces would be mechanically lifted from the water or towed for disposal. Due to the fact that debris would become distributed over a large area of GOM, and that debris cleanup would remove large items in many cases, the potential to impact recreational and commercial boats is considered low.

There is a potential for debris to wash ashore and become litter on the beach. The edges of some target pieces may be jagged and could pose a safety hazard to the public. Much of the floating debris consists of materials that are light, buoyant, and easily wind-driven, such as boat hull foam core material. Denser materials may sink but some wood and fiberglass components will also float. Combusted materials disperse and would not reach shore. The amount of combusted materials would not pose a public health concern.

Unexploded Ordnance

There is potential for some live munitions to fail to detonate, resulting in UXO within test or training areas. UXO would generally consist of munitions heavy enough to sink to the seafloor, such as bombs and missiles. The only missions considered to have the possibility of UXO remaining within or on surface targets would be those involving the release of CBU-105s. Cluster bomb submunitions that do not detonate are small enough to potentially remain intact on target boats. Therefore, on test days involving the release of CBU-105s, the Eglin EOD team would be on hand to inspect floating targets and identify and render safe any UXO, including fuses, classified components, or intact munitions. In the rare instance that UXO cannot be removed, proper disposal methods would be employed (typically accomplished by use of C-4 explosive). Submunitions that fail to detonate but strike the water surface would sink to the seafloor.

UXO items that sink to the seafloor would not be retrieved or detonated in place, but would remain in the marine environment. Submerged UXO would potentially pose a safety hazard because of the potential for contact with members of the public. Once in the marine

environment, UXO may be subject to a number of processes, including transport, burial, exhumation, encasement, and corrosion/degradation. UXO may be buried upon impact with the seafloor (depending on munition velocity and sediment characteristics) or may become buried over time due to current-induced sediment movement. Shifting sediments may also cause exposure of previously buried ordnance, and a cycle of repeated burial/exhumation events can occur in some cases. Water currents may transport unburied UXO either landward, seaward, or laterally along the shoreline contour. Shoreward migration could increase the potential for interaction with the public. Migration of UXO is more likely for smaller items.

The quantity of UXO items potentially deposited in EGTTR may be estimated by combining the number of munitions expended and the estimated dud rate of the various types of munitions. The dud rate of various munitions determined during quality control tests conducted by the U.S. Army is provided in Rand Corporation (2005). The dud rate for guns, rockets, and submunitions was found to be 4.68, 3.84, and 8.23 percent, respectively. A dud rate for other high-explosive munitions is provided by USACE (2007), and is considered to be 3.37 percent. The applicability of these specific rates to missions in the EGTTR is uncertain. For example, the Rand Corporation (2005) authors state that actual rates in the field may be much higher, but no quantitative adjustment is provided. Also, the applicability of tests conducted in laboratory environments to maritime conditions is unknown. Eglin generally considers the overall dud rate to be three percent, but the rate may be much higher or lower for certain munitions. The dud rates provided by Rand Corporation (2005) and USACE (2007) are considered reasonable estimates for the air-to-surface munitions included in this document.

The total number of unexploded items produced annually is calculated by applying the dud rates discussed above to the number of live munitions under the Proposed Action. The NEW varies substantially between the various types of munitions. Therefore, the potential number of UXO items is calculated separately for several munition types and ranges of NEW, as shown in Table 3-1.

Table 3-1. Potential Number of Unexploded Ordnance Items Produced Annually

Munition	Net Explosive Weight or Range (pounds)	Number of Items Expended Annually	Dud Rate (percent)	Potential Number of Unexploded Items Produced Annually
Bombs	945	3	3.37	0.101
Bombs	192	7	3.37	0.236
Bombs	22.84 – 37	64	3.37	2.157
CBU-105	2.69[a]	160	8.23	13.168
Missiles	300	2	3.37	0.067
Missiles	86	8	3.37	0.270
Missiles	20 – 68	180	3.37	6.066
Missiles	4.58	220	3.37	7.414
Rockets	10	100	3.84	3.840
Other[b]	0.4 – 1	209	3.37	7.043
Gunnery Rounds	0.067 – 4.7	87,724	4.68	4,105.483

CBU = cluster bomb unit
a. Net explosive weight of one skeet.
b. Includes miscellaneous items such as inert bombs with small live fuses.

The table above illustrates the different rate at which unexploded munitions of various sizes (and therefore, of variable magnitude of potential impact) could be produced. Over 4,000 unexploded gunnery rounds could be produced annually. However, these items are small, have a small NEW, and are not likely to be encountered by the public. Gunnery training has occurred for many years in EGTTR, and there are no known instances of the public encountering an unexploded round. The largest items include bombs and missiles with NEWs of 945, 300, and 192 pounds. Other munitions fall between these extremes (e.g., seven or less missiles in each of various NEW range categories).

UXO may fall within the mission area or may land in or migrate to other areas used by the public. Most munitions are expected to be deposited at the intended target site, as many have guidance packages and are very accurate. If UXO were to migrate out of the mission area, it could be encountered by scuba divers or during fishing operations (for example, bottom trawling during shrimp fishing), or could be impacted by dredging operations. Dredging periodically occurs south of the Destin Pass and Eglin's Santa Rosa Island property. The borrow site for dredging operations is approximately 16 miles from the GRATV target area (Figure 3-1). In extreme cases, ordnance could eventually reach the shoreline where it could be accessible to a larger number of people, although this would not be likely for the larger munitions.

Water depths average 115 feet in the artificial reef areas closest to the GRATV target location. The Professional Association of Diving Instructors (one of several scuba diving instruction organizations) suggests that open-water divers with basic certification limit their dives to 60 feet (18 meters). More experienced divers are generally limited to 100 feet (30.5 meters); in general, no recreational diver should exceed 130 feet (40 meters) (PADI, 2015). The closest recreational areas (i.e., reefs) are located over 2 miles from the GRATV and approximately 1.5 miles from target locations. Popular dive spots include the Liberty Ship, Destin Bridge Rubble, Mohawk Chief/Sand Dollar Artificial Reef, and the Tanks. Of these, the Mohawk Chief/Sand Dollar Artificial Reef shares similar water depths as missions at the GRATV location. The others are close to shore but may still occur within safety hazard footprints of some missions. There is also the possibility that divers would purposely access the primary GRATV site as debris accumulates on the seafloor over time, potentially attracting fish and other marine life. Water depth at the site is relatively deep for recreational divers but is within the range occasionally used.

Public interaction with UXO by any of the scenarios described above (scuba divers, commercial fishing, or dredging operations) would be considered a human safety hazard. Several incidents have occurred as a result of the public encountering UXO on current and historic military training sites (other than Eglin). In some cases, UXO was identifiable and the proper authorities were contacted. However, other cases involved UXO being removed or handled by members of the public that did not understand the potential dangers. In some of those instances, injuries and deaths occurred when the UXO was mishandled.

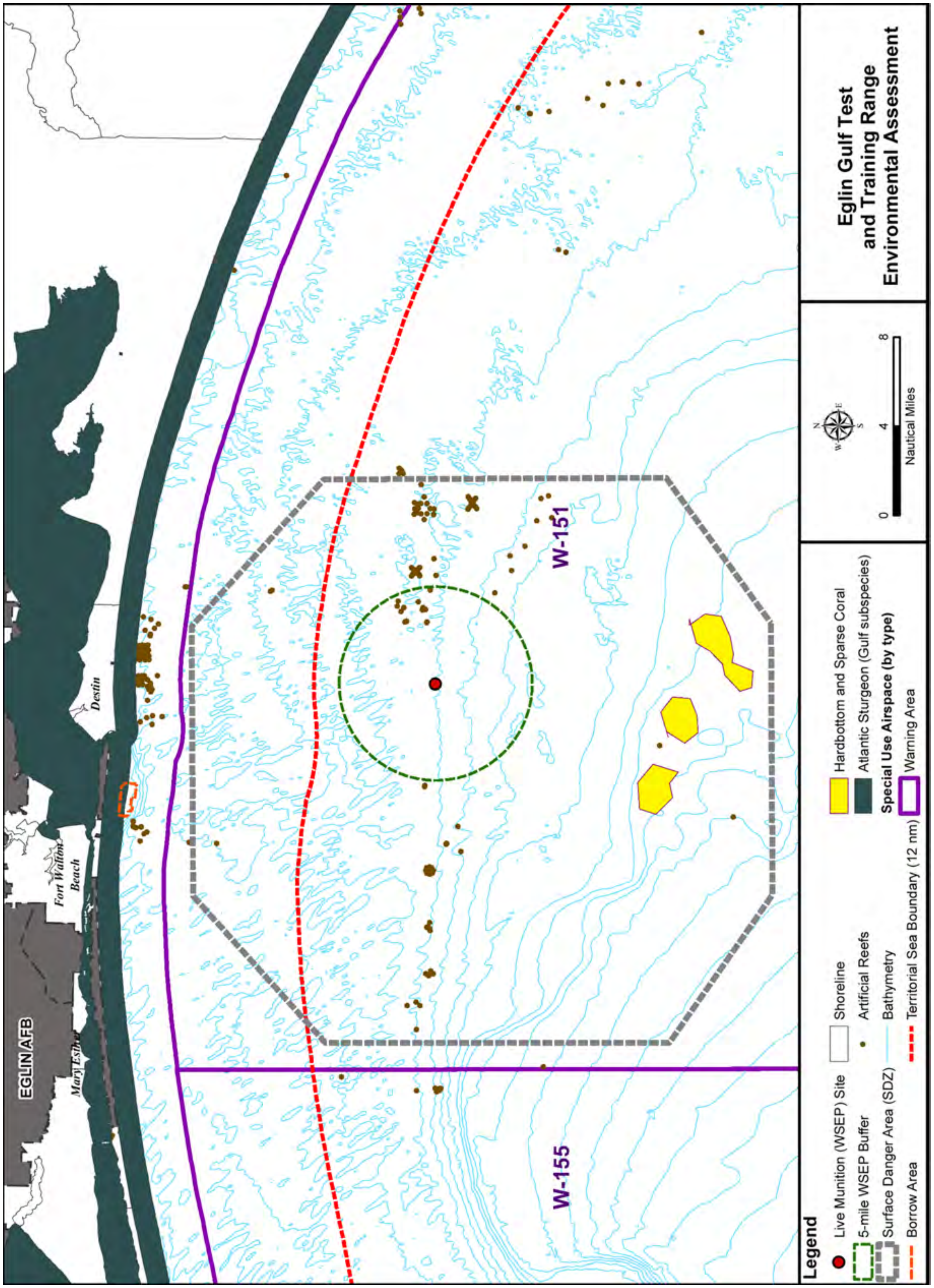

Figure 3-1. Artificial Reefs, Hard Bottom, and Borrow Areas in the Vicinity of EGTTR Target Area

The potential for UXO burial and/or migration is dependent upon factors such as bottom topography, substrate characteristics, and local water currents, which may vary in intensity and direction over time. Some of these factors are unknown in the northern EGTTR, and the fate of UXO items therefore cannot be predicted. However, several factors could decrease the likelihood of impacts. Submerged UXO would corrode and degrade over time in the saltwater environment. In some cases, unexploded munitions can become entombed long term within the seabed. In addition, UXO may be subject to concretion, whereby the munition becomes encased by minerals, metals, or biogenic accretion. Concretion may stabilize the munition to some degree, possibly resulting in decreased likelihood of detonation from physical disturbance, although it may also result in preservation of the detonation mechanisms for some time.

A number of investigations into to the fate of underwater UXO (mobility versus burial) have recently been sponsored by Naval Facilities Engineering Command Service Center, Strategic Environmental Research and Development Program (SERDP), and Environmental Security Technology Certification Program (ESTCP) (Wilson et al., 2009; Wilson et al., 2008; Wilson et al., 2006; Calantoni, 2014; Jenkins et al., 2015; SERDP and ESTCP, 2010; SERDP and ESTCP, 2015). SERDP and ESTCP are DoD environmental research programs. Although the investigations do not provide conclusive predictions on UXO fate near the GRATV target location in the EGTTR, the results are described below in order to provide the most current information available.

As described in several of the documents cited above, UXO movement is influenced by the surrounding underwater topographic structure due to the associated effects on waves and water movement. For example, UXO behavior would be different between areas with nearby extensive reef structure, areas with steep underwater topography and shoreline cliffs, and areas with a broad, flat seafloor. UXO migrates when it is exposed above the seafloor and the drag and lift forces of water movement are greater than gravitational pull. However, other physical processes tend to result in UXO burial. As water flows around an object on the seafloor, a vortex or eddy is typically formed at each edge, resulting in sediment scouring on the down-current side of the object. Sustained scouring eventually produces a hole in the sediment into which the object rolls or slides, depending on its shape. The object then becomes fully or partially buried. A series of re-exposure and re-burial events may occur shortly after deposition, but the object typically reaches a point of long-term burial called "lockdown." After this, subsequent movement is only possible if the bottom profile changes enough to cause re-exposure and release from lockdown conditions. In addition, objects such as UXO that are located in water depths beyond which there is no net sediment movement (known as "closure depth") are assumed to be either permanently entombed (buried items) or permanently immobile (exposed items).

Migration and burial processes consist of two different types called "nearfield" and "farfield," which operate on significantly different distance and time scales. Nearfield processes occur over short distances (a few inches to a few feet) and time (a few seconds to hours) and are primarily governed by the scour mechanics described above. Farfield processes involve changes in the seabed elevation over cross-shore distances of hundreds of meters and may extend along the coast for thousands of meters. Time scales are typically on the order of seasons or years and are

influenced by variations in climate and longshore sediment movements associated with accretion/erosion waves.

Model simulations and field testing of UXO fate have been conducted in different geographic areas with varying underwater topography, including offshore areas of Hawaii, Washington State, and North Carolina. In all tests, initial computer modeling was conducted based on the assumption of a planar (flat) bed of coarse-grained sediments similar to sand. These conditions are most similar to the North Carolina field site. Modeling resulted in the prediction of scour holes, a series of re-exposure and burial, and ultimately long-term burial. Simulation also indicated that UXO mobility would increase with 1) increased wave velocity/height, 2) decreasing caliber of the UXO, and 3) decreasing density of the UXO.

Field tests showed generally similar results at the different sites, although there were differences in some details. Surrogate 5-inch naval gun rounds (about 5 inches in diameter and 21 inches in length) were tested off Hawaii and North Carolina. At Hawaii, items were placed in offshore (depth of about 55 feet) and inshore (depth of about 30 feet) areas. Migration started slowly at a wave height of 1.3 meters and increased rapidly with rising wave height. Similarly, burial rates began slowly but quickly increased to entombment at wave height of about 1.6 meters. All test items became buried. Items in the deeper portion were buried sooner and, therefore, had less time to migrate.

At the North Carolina site, 20-mm rounds were used as well the naval gun rounds. Items were placed in various orientations in two depth zones about 3 and 6 meters deep. Compared to the GRATV target location in the EGTTR, these locations were very close to shore (100 and 500 meters from the shoreline, respectively). All items were found to be buried within the first five days after deposition. A series of migration and burial was then found during the next several months, after which migration stopped and the items became buried long term. It was assumed that shifting of sandbars and possibly other physical processes caused the episodes of re-exposure and burial, with short periods of migration while exposed. Migration proceeded in various directions over time, but the average net migration distance for all items was only about 4 four meters. Modeling of the North Carolina site suggests there is little burial or migration for wave heights less than 0.4 meter but that these processes proceed rapidly when wave height exceeds 1.2 meters. The closure depth of the site was initially assumed to be 40 feet but proved to be only about 20 feet. Only a small number of 20-mm rounds were recovered, and analysis was not provided for this UXO type.

Extreme weather events are considered to have the potential to cause substantially more movement. For example, computer simulations of a 10-year event at the Washington State site showed that 20-foot waves occurring over for a few days would cause the UXO to move onto the shore (664 feet). However, no hurricanes or unusually strong storms occurred at any of the test areas during the studies, and actual field investigation of UXO items during such events was, therefore, not available.

Although no UXO studies or modeling efforts have been conducted for areas offshore of Eglin AFB, some general considerations may be discussed based the studies mentioned above. Water depth at the GRATV target area (35 meters/115 feet) is considerably greater than that of the Hawaii (17 meters/55 feet) or North Carolina (6 meters/20 feet) test sites. Therefore, the possibility that water depth is great enough that shoreward UXO migration would not occur may be considered. The closure depth at the North Carolina site (the test area most similar to areas off Eglin) is presumed to be no more than 40 feet. If water currents or waves are able to move UXO items at the GRATV site, it is assumed that a pattern similar to that described above would occur. UXO might be buried quickly and then undergo a series of re-exposure and re-burial phases before reaching lockdown stage. Once at that stage, re-exposure could be unlikely, except possibly during extreme weather events. It is hypothesized that buried UXO remains buried under conditions of stable large-scale bathymetry (farfield conditions remain steady). Although shifting sandbars occur in shallow water near the shore off Eglin, long-term bathymetry is stable at the GRATV target area. These conditions would likely result in little or no movement of buried UXO. Also, wave energy is lower at the GRATV site than that of the other study areas referenced above, including the North Carolina area (wave energy at Panama City is reportedly less than that of the North Carolina site [SERDP and ESTCP, 2015]). This situation may result in both lowered migration and burial rates. The effects of hurricanes or strong tropical storms on UXO movement off Eglin are unknown. As noted above, computer simulations of the Washington State area suggested substantial shoreward movement. However, rapid burial during storm events was noted in another study. Considering all the above information, it may be speculated that significant shoreward UXO migration would not be expected from the GRATV target location, with the possible exception of extreme weather events. In this case, potential exposure of the public to UXO would generally be limited to encounters in the GRATV area during activities such as scuba diving, commercial fishing, or dredging. However, in the absence of site-specific information (field studies or modeling), conclusory statements are difficult.

Alternative 1

Under Alternative 1 the Air Force would select an alternate area within 5 NM of the existing GRATV location to conduct live munitions testing and training. Use of this area would have similar types of safety risks, and likewise public safety measures implemented as that described in the Proposed Action. There would potentially be a slightly higher risk of UXO interacting with areas used by the public depending on the precise location of the new impact area. To the east and west of the current GRATV location are clusters of artificial reefs. Moving closer towards those areas could potentially mean less distance for UXO to migrate. Moving north toward shore would likewise decrease the distance between potential UXO and beaches, or sand borrow areas. The likelihood of this occurrence is low given the distance to shore from a new target location would still be approximately 15 miles.

No Action Alternative

Safety concerns would be the same for the No Action Alternative. The number of missions would be fewer, thus the potential for UXO would be lower. The same protective measures would continue to be used to inform and protect the public.

3.2 PHYSICAL RESOURCES

3.2.1 Definition of the Resource

Physical resources evaluated in this document include GOM water column and underlying sediments. Sediment is the solid fragments of organic and inorganic matter created from weathering rock transported by water, wind, and ice (glaciers) and deposited at the bottom of bodies of water. Components of sediment range in size from boulders, cobble, and gravel to sand, silt, and clay. Most sediment in nearshore areas and on the continental shelf is aluminum silicate derived from rocks on land that is deposited by rivers. Sediment may also be produced locally as nonliving particulate organic material ("detritus").

Water quality is based on the physicochemical characteristics of marine waters, including pH, temperature, oxygen, nutrients, salinity, and other dissolved elements. These characteristics are influenced by marine physical, chemical, and biological processes. Physical processes include currents and tidal flows, seasonal weather patterns and temperature, sediment characteristics, and local conditions, such as the volume of freshwater delivered rivers. Chemical processes involve salinity, pH, dissolved minerals and oxygen, particulates, nutrients, trace minerals, dissolved ions, and pollutants. Biological processes involve the influence of living things on the physical and chemical environment. The two dominant biological processes in the ocean are photosynthesis in upper waters, and respiration, particularly by microorganisms.

Analysis Methodology

Impacts to sediments and water quality were evaluated in terms of intensity and duration. Potential impacts could be associated with the release of materials into the water that then disperse, react, or dissolve; the deposition of materials on the ocean bottom and any subsequent interactions with sediment or the accumulation of such materials over time; the deposition of materials or substances on the ocean bottom and any subsequent interaction with the water column; and the deposition of materials on the ocean bottom and any subsequent disturbance of that sediment or the creation of turbidity. Of particular concern is the explosive byproduct, cyanide. Florida has set standards in state waters and sediments of ≤ 0.2 milligrams per liter (mg/L) (FDEP, 2014). Federal water standards are set at a maximum concentration of 1.0 micrograms per liter (µ/L) (USEPA, 2014).

The potential impacts could be generated by explosives and byproducts, metals, or other chemical materials. Using explosives may also disturb sediment, increasing turbidity. However, these turbidity impacts are not considered substantial because, depending on specific site

conditions of wind and tidal currents, the turbidity plume eventually dissipates as particles return to the bottom or are dispersed. Therefore, this issue is not considered further. Explosions that occur above or at the surface are assumed to distribute nearly all explosion byproducts into the air, rather than into the water.

Most studies of UXO in marine environments have not detected explosives or have detected them in the range of parts per billion. Studies examining the impact of ordnance on marine organisms have produced mixed results (DON, 2013).

Many metals occur naturally in seawater, and several are necessary for marine organisms and ecosystems to function properly, such as iron, zinc, copper, and manganese. Zinc, copper, and manganese may also be harmful to plants and animals at high concentrations. Other metals have negative impacts on sediment and water quality (e.g., cadmium, chromium, lead, and mercury). The USEPA National Recommended Water Criteria for saltwater are shown in Table 3-2. Section 304(a) provides guidance to states and tribes in adopting water quality standards. Criteria are developed for the protection of **marine life** as well as for **human health**. Florida has set state standards for metals in sediment, provided below in Table 3-3.

Table 3-2. Federal Thresholds for Metals in Saltwater

Metal	Acute Toxicity (µg/L)	Chronic Toxicity (µg/L)
Cadmium	40	8.8
Chromium	1,100	50
Copper	4.8	3.1
Lead	210	8.1
Mercury	1.8	0.94
Nickel	74	8.2
Silver	1.9	N/A
Zinc	90	81

Source: USEPA, 2014
µg/L = microgram per liter

Table 3-3. Sediment Screening Guidelines for Metals

Metal	Threshold Effects Level (µg/L)	Probable Effects Level (µg/L)
Chromium	52.3	160
Lead	30.2	112
Mercury	0.13	0.696

Source: Navy, 2013
µg/L = micrograms per liter

State jurisdiction for sediments and waters extends form the low tide line out to 9 NM from shore in Florida. Federal jurisdiction takes over at 9 NM and extends out to 200 NM. These standards and guidelines are mainly the responsibility of the USEPA, specifically ocean discharge provisions of the CWA (33 USC § 1343).

In general, three things happen to military expended materials that come to rest on the ocean floor: (1) they lodge in sediment where there is little or no oxygen, usually below 4 inches (10 centimeters [cm]); (2) they remain on the ocean floor and begin to react with seawater; or (3) they remain on the ocean floor and become encrusted by marine organisms (Navy, 2013).

Significance Determination

Impacts were evaluated with respect to context and intensity of the impact. The context includes the geographic, biophysical, and social context in which the impact would occur. Intensity refers to the severity of the impact. This means that an impact could be small or large in scale or severity and may also occur over a short or long duration. All of these factors must be considered when determining significance of an impact. An impact would be determined to be significant if it would directly or indirectly lead to permanent alteration or irreparable damage to sediments or water resources such that the physical or chemical composition was severely impacted. A change leading to the habitat becoming unusable for biological species, the waters being unsafe for current uses (recreation and recreational and commercial fishing and seafood harvest) due to risks to human health, would be considered a significant impact.

Any impact to water quality which would cause water quality standards to fall below levels required by Section 304(a) of the CWA would be considered significant. Ocean discharges may not result in "unreasonable degradation of the marine environment." Specifically, disposal may not result in: (1) unacceptable negative effects on human health; (2) unacceptable negative effects on the marine ecosystem; (3) unacceptable negative persistent or permanent effects due to the particular volumes or concentrations of the dumped materials; and (4) unacceptable negative effects on the ocean for other uses as a result of direct environmental impact (40 CFR § 125.122) (Navy, 2013).

3.2.2 Affected Environment

The physical marine environment potentially affected by the Proposed Action includes waters and sediments from nearshore out to the deep ocean (approximately 115 miles offshore). However, most test and training would occur in W-151, approximately 15 NM southeast of the Destin Pass. This location is therefore outside of the 12-NM state water boundary. The affected environment includes the water column and sediments, as described below.

Ocean water in the vicinity of the EGTTR typically has a salinity equal to or greater than 35 parts per thousand. Dissolved inorganic ions in GOM waters over the continental shelf include sodium, chlorine, magnesium, potassium, calcium, and phosphate (SAIC, 1997). Tidal action in the GOM is less developed than that of the Atlantic Coast and may be diurnal (one high and one low), semidiurnal (two high and two low tides daily), or mixed (ESE, 1987 as cited in U.S. Air Force, 2002). Water depth in the EGTTR ranges from 20 to 700 meters, and the depth at the test site is about 35 meters. Turbidity, a measure of water clarity in the GOM, generally decreases from nearshore to offshore, and bottom turbidity measurements tend to be higher than turbidity levels at the surface. High turbidity measurements are caused by suspended solids or impurities in the water column.

The substrate (sediments) underlying the EGTTR is comparable to that found throughout the eastern half of the Gulf and consists primarily of quartz sand high in sulfur and phosphate content. There are locations of hard-bottom substrate and artificial reefs, these are rare (<1 percent) and not beneath the primary target area. However, a number of artificial reefs could occur inside safety footprints and would be inaccessible for the duration of certain tests. The number of such structures affected would depend on the type of munition used, delivery parameters, etc. The geology of this area of GOM is characterized as a shallow, broad continental shelf, with steep slopes leading to two large deep water plains several miles from the target area and scattered regions where the bottom is somewhat higher.

Water quality within EGTTR could be impacted by a number of effectors, including chemical materials, waste disposal, tides, and impacts from commercial activities, artificial reefs, and military activities (USEPA, 2012). Chemical pollutants from oil spills, leaks, discharges, and organotins (boat de-fouling reagents) may enter the nearshore coastal environment and flow outward to the open ocean by tidal action and eventually impact water quality. Chemical pollutants can have an effect through ingestion and long-term accumulation in the bodies of marine species. Pollutants have a tendency to bioaccumulate based on where the animal is situated within the food chain. Waters of the GOM region have been rated by USEPA as being fair, with 10 percent of the area rated poor. However, most of the coastal locations sampled on Florida's GOM were rated good to fair. Only waters near the more metropolitan areas around Pensacola, Tampa, and Fort Meyers received poor ratings (USEPA, 2012).

Vessels passing through the affected area may discharge food waste, oil and grease, cleaning products, detergents, oil, lubricants, fuel, and sewage. Untreated sewage in unregulated open ocean waters can cause eutrophication leading to excessive algal growth and depleted oxygen in the water column, resulting in harm to other organisms in the marine habitat. Certain algal species can produce biotoxins that can kill fish and marine mammal species.

In the GOM, the sediment quality index is rated poor because 19 percent of the coastal area was rated poor for at least one of the component indicators. However, the results were variable and may have been indicators of natural circumstances at the time of sampling. Further, the sediment contaminants component indicator for the GOM region is rated good, with only 3 percent of the coastal area rated poor for this component indicator (USEPA, 2012). Elements such as nitrogen, iron, zinc, aluminum, manganese, and organic compounds are found naturally in GOM waters, but some are also common byproducts of underwater explosives and ammunition firing.

EGTTR testing and training would result in deposition of target and munitions fragments, and potentially UXO, on the seafloor. Other types of past missions occurring in EGTTR have resulted in deposition of similar items in the northeastern GOM. The Military Munitions Rule, which addresses military munitions deposited on military ranges, is the result of a requirement for the USEPA, DoD, and the states to issue a rule identifying when such munitions become hazardous waste under RCRA. A "military munition" is defined as all ammunition produced or used for national defense, and includes a number of items such as bombs, missiles, and small arms ammunition (40 CFR, Parts 260 – 270). A military munition is not considered solid waste under RCRA when it is used for its intended purpose on a military range, which includes testing and evaluation, among other uses. However, a munition is considered solid waste if it lands off-

range and is not promptly rendered safe and/or retrieved. Generally, conventional explosive ordnance testing does not constitute hazardous waste under RCRA (UXOINFO, 2013). The rule's discussion of hazardous waste management includes reference to an "explosives or munitions emergency" involving UXO.

3.2.3 Environmental Consequences

Proposed Action

Physical resources (substrate and the water column) could be affected by metals and chemical materials introduced through spent munitions and explosive byproducts and by direct impacts.
Metals typically used to construct bombs, missiles, and gunnery rounds include copper, aluminum, steel, and lead. Aluminum is also present in some explosive materials such as tritonal and PBXN-109. Lead is present in batteries typically used in vessels such as the remotely controlled target vessels. Metals would settle to the seafloor after munitions are detonated. Metal ions would slowly leach into the substrate and the water column, causing elevated concentrations in a small area around munitions fragments. Some of the metals, such as aluminum, occur naturally in the ocean at varying concentrations and would not necessarily impact the substrate or water column. Other metals, such as lead, could cause toxicity in microbial communities in the substrate. However, such effects would be localized and would not significantly affect the overall habitat quality of sediments in the northeastern GOM. In addition, metal fragments would corrode, degrade, and become encrusted over time.

Chemical materials include explosive byproducts and fuel, oil, and other fluids (including battery acid) associated with vessel operations and using remotely controlled target boats. Explosive byproducts would be introduced into the water column through detonating live munitions. Explosive materials associated with EGTTR operations include tritonal and research department explosive (RDX), among others. Tritonal is primarily composed of TNT. RDX is sometimes referred to as cyclotrimethylenetrinitramine. Various byproducts are produced during and immediately after detonating TNT and RDX. During their detonation, energetic compounds may undergo high-order detonation, low-order detonation, or may fail to detonate. High-order (complete) detonations consume 98 to 99 percent of the explosive, with the remainder released into the environment as discrete particles. The majority of high-order explosions occur at or above the surface of the ocean and would have minimal impacts on sediment and water quality. Low-order (incomplete) detonations consume a lower percentage of the explosive and release larger amounts of explosives into the environment. If the ordnance fails to detonate, the energetic compound may be released to the environment over time if corrosion of the shell occurs (Navy, 2013). For the purposes of this analysis, only ordnance that does not undergo high order detonation is of concern from the perspective of chemical release to waters or sediments.

Chemicals introduced to the water column would be quickly dispersed by waves, currents, and tidal action and eventually become uniformly distributed throughout the northern GOM. A portion of the carbon compounds, such as carbon monoxide (CO) and carbon dioxide (CO_2), would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds, including petroleum products, would be metabolized or assimilated during protein synthesis by phytoplankton and bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be

released to the atmosphere. Due to dilution, mixing, and transformation, none of these chemicals are expected to have significant impacts on the marine environment.

Explosive material that is not consumed in a detonation could sink to the substrate and bind to sediments. However, the quantity of such materials is expected to be inconsequential. Research has shown that if munitions function properly, nearly full combustion of the explosive materials will occur, and only extremely small amounts of raw material will remain. In addition, TNT decomposes when exposed to sunlight/ultraviolet radiation and is also degraded by microbial activity (Becker, 1995). Several types of microorganisms have been shown to metabolize TNT. Similarly, RDX is decomposed by hydrolysis, ultraviolet radiation exposure, and biodegradation. Direct physical impacts to the seafloor could occur due to debris and detonation shock waves.

Chemical, physical, or biological changes to sediment or water quality would not be detectable and would be below or within existing conditions or designated uses. The number of explosives proposed is relatively small when compared to the very large EGTTR across which they could be distributed. The majority of explosive chemicals are found naturally in the environment and the ecosystem is equipped to handle them in the relatively small levels associated with the Proposed Action. Lastly, chemicals associated with explosives would be expected to rapidly degrade and/or dissipate due to the natural currents, sunlight, and other environmental factors. Neither state nor federal standards or guidelines would be exceeded.

Detonations in the water column of sufficient strength to produce pressure waves reaching the seafloor would displace sediments and possibly cause cratering. Equations for determining the radius of a crater due to underwater explosions on the seafloor are provided by O'Keefe and Young (1984). However, the equations for seafloor detonations cannot be directly applied to detonations in the water column. In this case (and when the detonation occurs in relatively deep water), the radius of the explosive gas bubble may be considered a reasonable approximation of the radius of a crater if the detonation were to occur on the seafloor. Based on this association, the bubble radius of detonations in the water column is used to determine impacts to bottom sediments. If the radius extends to the seafloor, then impacts to the sediment would likely occur. If, however, the radius does not reach the bottom, then no impacts to sediment would be considered.

Swisdak (1978) provides the equation for the maximum radius of a gas bubble as:
$Amax = (J)\ (W^{.33}/[H+Ho]^{.33})$, where

Amax = maximum bubble radius (m)
J = bubble coefficient, which for TNT is 3.5 $m^{4/3}/kg^{1/3}$
W = charge weight (kilograms [kg])
H = depth of explosion (m)
Ho = atmospheric head, which equals 10 m

The largest NEW among EGTTR missions would be associated with Maritime Strike operations and is 954 pounds (428.6 kg). The depth of underwater detonations is 5 or 10 feet (1.5 or 3 m) beneath the surface. Because water pressure increases as the depth increases, the gas bubble caused by an explosion would be largest at shallower depths. For the purposes of analysis, a worst-case scenario is assumed of 945 pounds of NEW detonated 5 feet beneath the surface.

Using these values in the equation above, the maximum bubble radius would be 11.5 m (38 feet). Given the water depth at the target location to be approximately 35 m, the explosive bubble radius would not extend to the seafloor. In addition, the bubble radius is larger than the detonation depth, which would result in a venting of explosive gas at the surface. Thus, sediment displacement from underwater detonations is not expected.

Debris deposited on the seafloor would include spent munitions fragments and possibly pieces of targets (fiberglass, plywood, etc.). Debris would not appreciably affect the sandy seafloor. Debris moved by water currents could scour the bottom, but sediments would quickly refill any affected areas, and overall effects to benthic communities would be minor. Large pieces of debris would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Target boats have foam-filled hulls and most of the pieces are designed to float in order to facilitate collection for a damage assessment. Overall, the quantity of material deposited on the seafloor would be small compared with other sources of debris in the GOM. Hard-bottom habitats and artificial reefs would be avoided when possible through locating target sites and training missions and would not be likely to be affected by debris. There is a potential for some debris to be carried by currents and interact with the substrate, but damage to natural or artificial reefs is not expected and the impacts would not be significant.

The impacts of unconsumed explosives associated with training and testing activities would be long-term but would be expected to remain localized. The frequency of low-order detonations or dudded munitions is low. The constituents of unconsumed explosives are subject to several physical, chemical, and biological processes that render the materials harmless or would otherwise dissipate them to undetectable levels (Navy, 2013). Neither state nor federal standards or guidelines would be exceeded.

Under the Proposed Action, potential impacts on sediment and water quality from training and testing activities involving materials with metal components would occur over a long period, but the impact would be primarily contained to the area immediately surrounding the metal object on the seafloor. The majority of these components would become quickly buried in sediment. If not, they would likely become encrusted with sea life or covered in a corrosive layer. This would cause metals to corrode very slowly over many years, releasing only small quantities of metal compounds into the water or surrounding sediment. Harmful metals (such as lead, chromium, or cadmium) make up only a very small portion of the total constitution of the munitions. Similar to chemicals discussed above, metals released through corrosion would be quickly diluted by currents or bound up and sequestered in adjacent sediment. Neither state nor federal standards or guidelines would be exceeded.

Chaff is generally resistant to chemical weathering and likely remains in the environment for long periods. However, all components of chaff's aluminum coating are already present in seawater (Nozaki, 1997). Chaff is generally composed of elements that are common in ocean sediments. Study results indicate that adverse impacts are not anticipated even at concentrations much higher than would ever be encountered due to Air Force testing and training in the EGTTR.

Flares are generally consumed entirely during use. Small amounts of metals are used to give flares and other pyrotechnic materials bright and distinctive colors. Combustion products from flares include magnesium oxide, sodium carbonate, carbon dioxide, and water. Combustion products of flares are mostly phosphates, which are harmless. Flares that function properly are consumed during use and expended in the air, and therefore would not have any impact on sediments or waters. The failure rate is low (5 percent), and the remaining amounts are small and subject to additional chemical reactions and subsequent dilution in the ocean (Navy, 2013).

In summary, there would be no significant impacts to physical resources from the Proposed Action.

Alternative 1

Impacts to waters and sediments under Alternative 1 would be similar to those discussed for the Proposed Action, though potentially slightly greater. Using munitions over an increased area would increase the potential to physically disturb sediments or other seafloor substrate. However, the depth of the water in which these operations would continue to occur would guard against concussive impacts. Metals and chemical materials from live ordnance would similarly increase in the geographic area they may impact, but still would not have a significant adverse effect on physical resources. Further, increased quantities of dudded munitions would likely accumulate on the seafloor, but over a larger area, potentially decreasing the impact of debris accumulation in the current target area. However, as previously discussed, these materials are most likely to become quickly buried, covered in sea life, or rapidly degraded, such that no physical or chemical impacts are likely outside of the small area where the munition is contacting the substrate. Any new target area to be utilized should be surveyed similar to what was conducted at the current site. Through sidescan, magnetometer and other efforts, the Air Force can be reasonably sure to avoid any habitat of concern such as natural or artificial reefs. No significant impacts to sediments or GOM waters would occur as a result of implementing Alternative 1.

No Action

Under the No Action Alternative test and training activities in the EGTTR would remain at levels analyzed and approved in the 2002 EGTTR PEA (U.S. Air Force, 2002). Any new missions involving live detonations or requiring protected species permits would undergo separate NEPA analysis and consultation. Therefore, there would be no significant adverse impacts to physical resources resulting from No Action Alternative implementation.

3.3 SOCIOECONOMIC RESOURCES

3.3.1 Definition of the Resource

Socioeconomics

Socioeconomics refers to features or characteristics of the human environment related to economic and social conditions and trends in the region of influence (ROI). Socioeconomic activities associated with the alternatives are concentrated in GOM, which is the ROI for this

analysis. The major socioeconomic concerns are the potential impacts associated with restricted access to the marine environment during testing and training operations. Many recreational and commercial activities take place in the GOM and are an important economic contributor to the coastal communities adjacent to the GOM. Potential impacts to certain socioeconomic resources, such as the oil and gas industry and commercial air traffic and have been previously analyzed and found not to be significant (U.S. Air Force, 2002) and would not change under the Proposed Action; therefore, these activities are not further analyzed. Dredge operations collecting sand from nearshore borrow areas would not be affected.

Environmental Justice and Special Risks to Children

In 1994, EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations (Environmental Justice)*, was issued to focus the attention of federal agencies on how their actions affect the human health and environmental conditions to which minority and low-income populations are exposed. This EO was also established to ensure that, if there were disproportionately high and adverse human health or environmental effects of federal actions on these populations, these effects would be identified and addressed. The environmental justice analysis addresses the characteristics of race, ethnicity, and poverty status for populations residing in areas potentially affected by implementation of the proposed action.
In 1997, EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks (Protection of Children)*, was issued to identify and address anticipated health or safety issues that affect children. The protection-of-children analysis addresses the distribution of population by age in areas potentially affected by implementation of the proposed action.

For the purpose of the environmental justice analysis, these populations are defined as follows:

- **Minority Populations**: All persons identified by the U.S. Census Bureau to be of Hispanic or Latino origin, regardless of race, plus non-Hispanic persons who are Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, or members of some other (i.e., nonwhite) race or two or more races.
- **Low-Income Populations**: All persons who fall within the statistical poverty thresholds established by the U.S. Census Bureau. For the purposes of this analysis, low-income populations are defined as persons living below the poverty level. Starting with the 2010 decennial census, poverty data will be provided through the annual American Community Survey rather than as part of the decennial census.
- **Children**: All persons identified by the census to be under the age of 18 years.

The affected area is EGTTR in the northern GOM. As such, a characterization of population groups living in the GOM is not applicable. However, impacts on human populations (i.e., effects on commercial or recreational fishing) were considered in the analysis of environmental consequences to determine effects on users.

Analysis Methodology

To assess the potential socioeconomics impacts of the Proposed Action and Alternatives, commercial and recreational activities that occur in EGTTR that would be potentially impacted were considered. Access restrictions associated with the Proposed Action and alternatives that

would limit these activities and result in changes to employment, income, or economic stability of the region would result in socioeconomics impacts.

Human activity in EGTTR consists primarily of military training exercises and commercial endeavors such as fishing and shipping. A characterization of population groups living in the GOM is not applicable; however, based on demographic information of recreational fishing and boating participants reported by the Recreational Boating and Fishing Foundation [RBFF], (2013), the majority of saltwater fisherman participants were 44 years of age or older (44.4 percent), were male (68.1 percent), had 1 to 3 years of college education (27.8 percent) or higher, had an annual income of over $100,000 (28.8 percent), and classified themselves as Caucasian/White (71.8 percent) (RBFF, 2013). Therefore, no disproportionate impacts to minority, low-income individuals, or children under the Proposed Action would be anticipated under the Proposed Action and environmental justice concerns are not discussed further.

Significance Determination

In general, any adverse, long-term or permanent change in socioeconomics conditions (i.e., employment, income, recreational opportunities, etc.) that could not be minimized through the use of best management practices (BMPs) and would adversely affect the economic stability in the region would be considered a significant impact to socioeconomics resources.

3.3.2 Affected Environment

Recreational Fishing

Recreational fishing effort in GOM is a popular activity for residents in adjacent GOM communities and visitors. Recreational fishing participation in GOM has fluctuated over the past decade but is anticipated to increase over the next several years. In 2013, more than 25 million angler trips were made to the GOM (NMFS, 2014a) (Table 3-4).

Table 3-4. Annual Estimate of the Number of Angler Trips to the Gulf of Mexico

Year	Angler Trips	Percent Change over Previous Year
2004	26,429,207	15.13%
2005	23,289,807	-11.88%
2006	23,292,921	0.01%
2007	24,289,264	4.28%
2008	24,789,852	2.06%
2009	22,597,249	-8.84%
2010	21,047,433	-6.86%
2011	22,575,779	7.26%
2012	23,172,483	2.64%
2013	25,233,371	8.89%

Source: NMFS. 2014a

Each state agency regulates the type and number of fish that can be caught and kept, which fish can be caught and released, and the maximum size of each type of fish caught. The species of fish caught also depend on the fishing location and the time of the year. In 2013, the majority of total catch in the GOM were fished primarily from inland waters, (inshore saltwater and brackish water bodies), (61 percent), followed by state territorial seas, (approximately 10 statute miles

from shore) (29 percent), and the federal economic exclusive zone, (State Territorial Seas to 200 nautical miles) (10 percent) (NMFS, 2012a). Certain types of species of fish are available year round.

There are typically two types of recreational fishing participants in the GOM that would have access to the area of influence: private/rental and charter participants. Private recreational participants include those who own a boat or have access to a private or rental boat. Table 3-5 shows the number of angler trips made to specific fishing areas in the GOM during 2013.

Table 3-5. Angler Trips by Area, 2013

Fishing Mode	Fishing Area	Angler Trips
Shore	Ocean (<=3 miles)	1,498,313
Shore	Ocean (<=10 miles)	3,745,909
Shore	Inland	5,572,622
Charter Boat	Ocean (<=3 miles)	27,862
Charter Boat	Ocean (> 3 miles)	71,672
Charter Boat	Ocean (<=10 miles)	199,908
Charter Boat	Ocean (> 10 miles)	322,185
Charter Boat	Inland	285,301
Private/Rental	Ocean (<=3 miles)	207,437
Private/Rental	Ocean (> 3 miles)	398,438
Private/Rental	Ocean (<=10 miles)	2,572,325
Private/Rental	Ocean (> 10 miles)	1,136,161
Private/Rental	Inland	9,195,239

Source: NMFS, 2014b

The second type of recreational fishing participant in the GOM include those individuals who do not have access to a private boat or choose to hire a charter boat for access to the fisheries. In 2013, the majority of angler trips by charter boat to the GOM were in the federal economic exclusive zone (greater than 10 miles from shore) followed by inland trips (NMFS, 2012b). Charter boats typically operate during the months of May through October, each day beginning at 6:00 AM in the morning. Late morning and early afternoon trips are typically available for 8-, 10-, 12-hour and overnight trips. Rates vary depending on several factors, including the length of the trip and the number of persons participating. Charter boat captain salaries are highly dependent on experience, employer, and geographic location. Based on the 2013 Occupational Employment Statistics Survey by the U.S. Bureau of Labor Statistics, "water vessel captains, mates, and pilots" had an annual mean wage of $69,450 in the state of Florida, which was lower than the national average of $75,580 (BLS, 2014).

Commercial Fishing

Commercial fishing refers to harvesting and selling fish to markets, seafood wholesalers, processors, and retailers for a profit. Commercial fisheries are operated under strict guidelines established by the NMFS. In 2012, a total of approximately 1.3 billion pounds of fish were caught commercially within the five Gulf States (i.e., Alabama, Florida West Coast, Louisiana, Mississippi, and Texas), with the majority from Louisiana, for a total worth of $309.96 million (NMFS, 2014c). In 2010, the most commonly caught species in Louisiana between 3 and 200 miles from U.S. shore were menhaden followed by shrimp (NMFS, 2012a); off the Florida

west coast, the most commonly caught species between 3 to 200 miles was shrimp, followed by grouper (NMFS, 2012b).

Tournaments and Events

A number of fishing tournaments, festivals, concerts, and other events are held annually in the GOM. The most popular events are center around boating and fishing and take place between March and October. Popular species sought during tournaments in the GOM includes cobia, kingfish, red snapper, blue marlin, sailfish, and king mackerel.

Maritime Transportation

The Maritime Transportation System (MTS) refers to the system of waterways, ports, and intermodal connections in which vessels traverse and transport people and goods on the water (DOT, 2012a). There are over 300 ports in the U.S. (DOT, 2012a). The closest ports to the W151A are the Port of Pensacola and the Panama City Marina Wharf. The majority of maritime cargo in the area takes place in the Gulf Intracoastal Waterway (GIWW), the 1,300 miles inland waterway that links deep-water ports, tributaries, rivers, and bayous from Brownsville, Texas, along the entire coast of the GOM to Apalachicola, Florida (USACE, 2012).

The Office of Security issues maritime administration advisories to vessel masters, ship operators, and other U.S. maritime interests. Advisories are communicated through several mediums, including telex or message formats, Maritime Administration's web site, and the National Imaging and Mapping Agency's weekly NOTMARs (DOT, 2012b).

Artificial Reefs

Artificial reefs provide many opportunities for recreational anglers, divers, and other user groups which result in economic benefits to the coastal communities adjacent to the GOM. There are approximately 2,700 artificial reef deployments located off 34 coastal counties in Florida, making it the state with the most permitted artificial reefs in the nation. The economic benefits, or expenditures, associated with artificial reefs in northwest Florida, which is comprised of 5 counties, have been estimated at $414 million and support 8,136 jobs and contribute $84 million in wages and salaries. Of the total expenditures, $359 million were attributed to visitors and $56 million to residents. The annual recreational use value of artificial reefs was estimated to be $19.7 million. The majority of expenditures were distributed in Bay (36 percent), followed by Okaloosa (30 percent), Escambia (22 percent), Santa Rosa (7 percent), and Walton (5 percent) (Adams et al., 2012).

3.3.3 Environmental Consequences

Proposed Action

Under the Proposed Action, the Air Force would occasionally close areas of the EGTTR to the public for discrete time periods during some live and inert missions. The size of the closed area, or safety hazard area, would vary depending on the specific mission (size of the munition, delivery method, etc.). The maximum area typically closed is represented by the safety hazard zone for the Maritime Weapons System Evaluation Tests conducted in 2014 (Figure 3-2). The Air Force would advise non-participating vessels (such as recreational and commercial fishing vessels) to not enter the safety footprint while it is active.

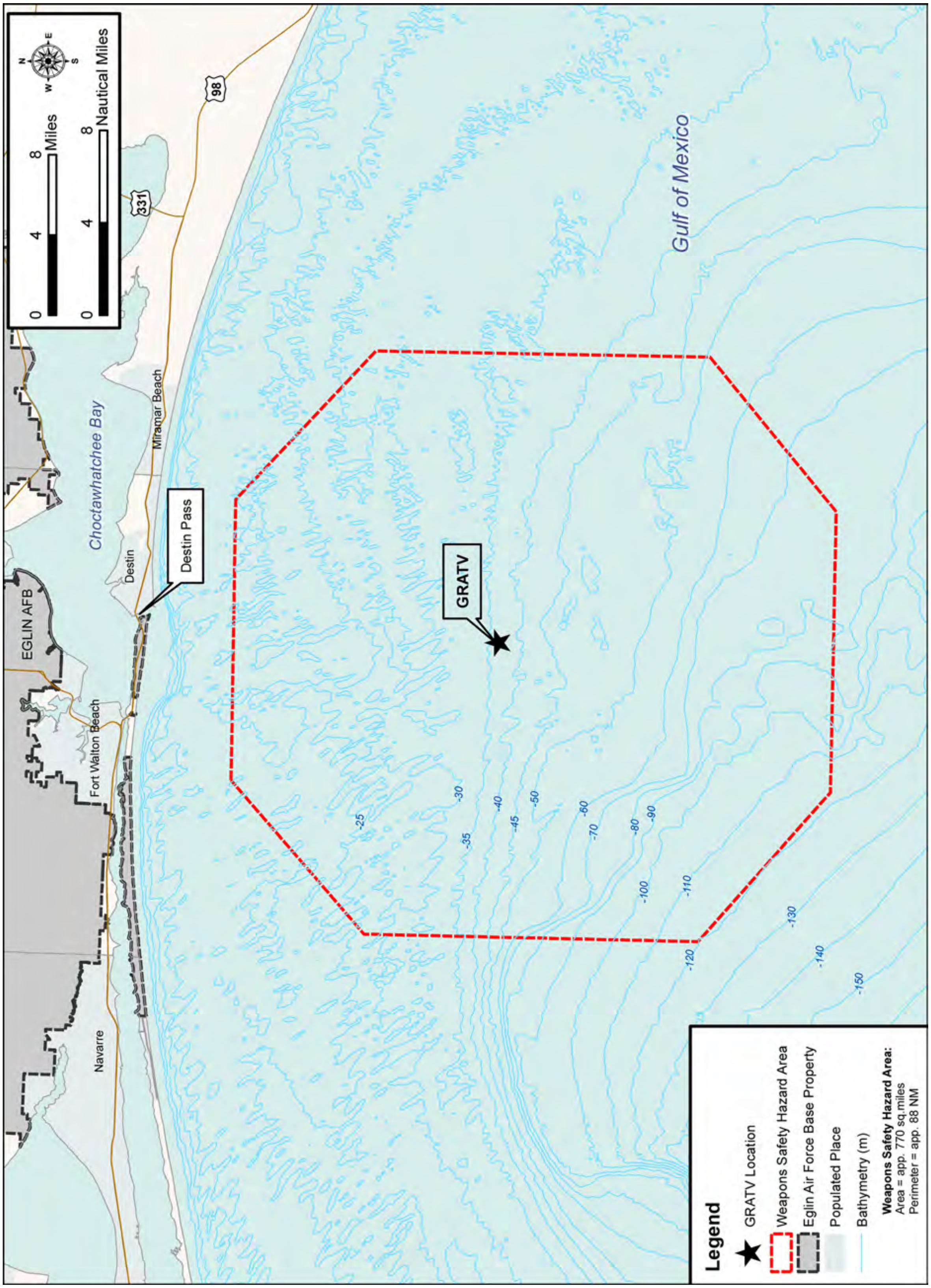

Figure 3-2. Maritime WSEP Safety Danger Zone

The number of munitions expended per mission day for the various test and training groups is uncertain and could be influenced by a variety of factors. Due to this uncertainty, the total number of days that mission areas could be closed varies from year to year. Based on assumptions regarding a range of mission variables, it is estimated that areas of GOM could be closed for portions of 30 to 60 days per year. During the approximately five to six hours of closure each mission day, the affected area would be inaccessible to commercial and recreational fishing vessels, recreational boaters, scuba divers, and other civilian operations. A number of known artificial reefs and hard bottom areas occur within the closed area (Figure 3-3), and it is likely that additional unknown or undisclosed reefs are present as well. These areas would temporarily be unavailable to the public.

The Air Force practice of advance notice and communication with the public helps to minimize hardship and allow for alternate planning. For closure of an area of the EGTTR and activation of the safety hazard area the Air Force may issue a local Notice to Mariners (NOTMAR) through the U.S. Coast Guard Service stating the activity and potential hazards. In addition, the Air Force may inform the public through printed fliers placed in Destin harbor marinas and shops and by personal and radio contact by guard vessels with public vessels. Air Force vessels make initial contact with public vessels in Destin Pass and advise them how to avoid the safety hazard area. The Air Force establishes a perimeter of vessels around the safety hazard area that may make additional subsequent contacts with non-participating vessels. Depending on their intended destination, members of the public may expend additional fuel or require extra time to reach an alternate fishing location. Short trips, such as the four-hour excursions offered by some charter fishing boats based at Destin, could be affected more than longer trips. Although it is unlikely that closure would require a vessel to return to port due to limited fishing capability or require a charter fishing company to provide a refund to passengers, there is potential for public annoyance and some economic impact. Compared with the overall area of nearshore Gulf waters available in the region, the closed area would be small and established on an intermittent, short-term basis. Commercial and recreational users of the Gulf would generally not be excluded from access to similar nearby resources. Recreational and commercial fishermen operating in Choctawhatchee Bay or the GOM swarm mission area would not be affected, as the Air Force would not restrict access to these waters.

While the Air Force makes efforts to avoid closures during the busiest times of the tourist season, some mission activities could potentially occur during the same months as fishing tournaments. Closures and may affect some tournament participants planning to utilize the area within the safety footprint.

Several charter boats and local boat owners would be temporary employed by Eglin Range Safety and compensated by the Air Force in exchange for providing assistance as part of the safety perimeter team. Compensation received from the Air Force could offset the potential loss in income associated with the loss in business activities or other recreational excursions during the closures.

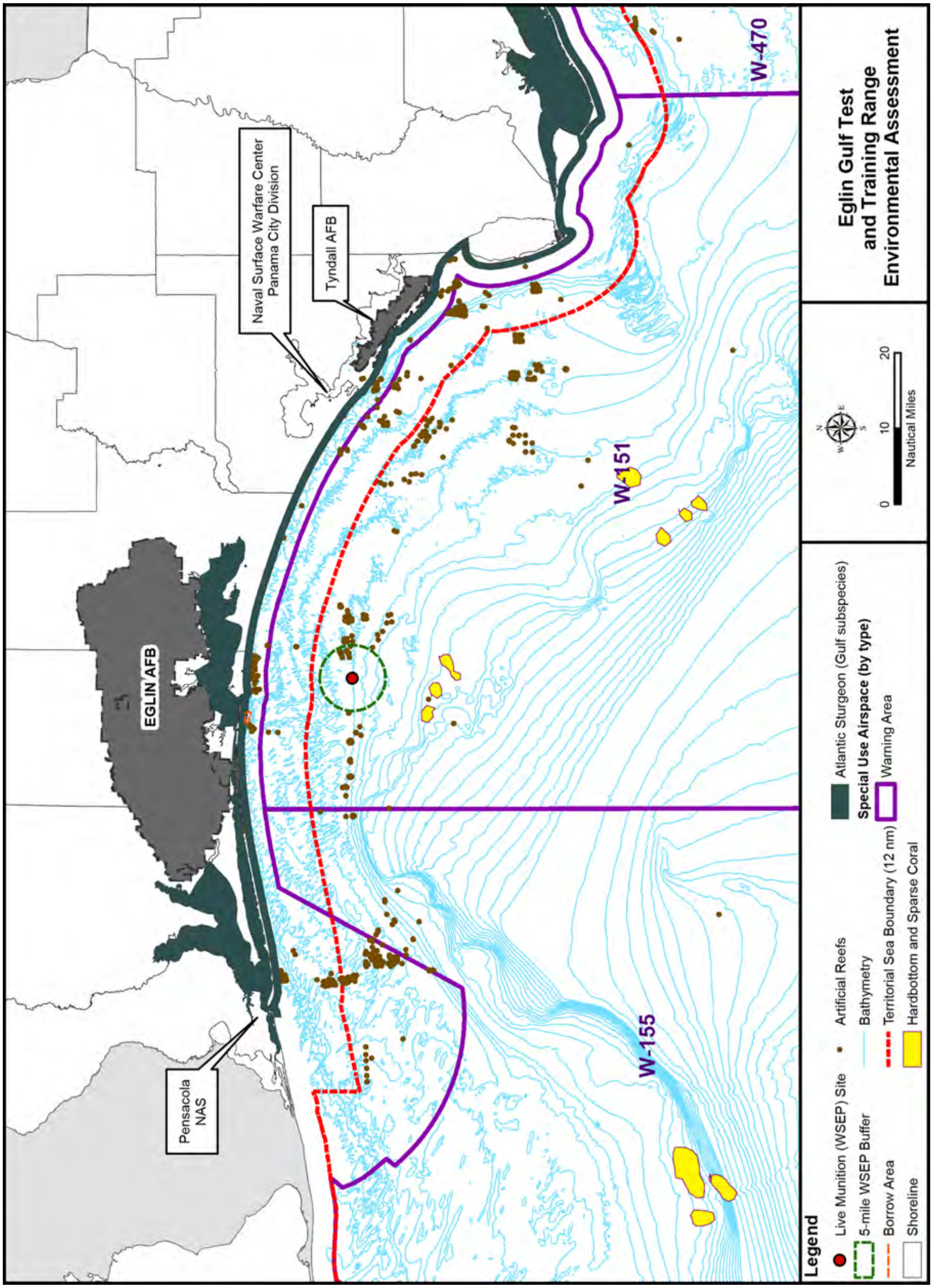

Figure 3-3. Artificial Reefs, Hard Bottom, and Borrow Areas in the Vicinity of EGTTR Target Area

As described above, there would be potential for adverse impacts to socioeconomic activities, including fishing and boating from restricted access but also beneficial impacts to several local boat owners and charter boats that would be compensated by the Air Force in exchange for their service as part of the safety perimeter team. Implementing BMPs and continued use of communication services would minimize adverse impacts; therefore, no significant impacts to socioeconomic resources would be anticipated under the Proposed Action.

Alternative 1

Alternative 1 proposes to conduct the same level of missions as those of the Proposed Action but to expand the live air-to-surface target location to include any point within a 5-mile radius of the existing live air-to-surface target location. An alternative target location could be chosen anywhere within the 5-mile radius zone. Under this alternative, the number and length of access restrictions would be the same as those under the Proposed Action; therefore, potential impacts to socioeconomic resources from access restrictions under this alternative would be similar to those described under the Proposed Action.

No Action

Under the No Action Alternative, only those activities and expendables evaluated and approved in the 2002 PEA would continue in EGTTR. Testing and training activities under the No Action Alternative have been previously analyzed and found that due to the level of cooperation provided by local commercial and public users of the surface and the offshore nature of EGTTR waters, restricted access should not impact socioeconomics resources. Any activity that could be hazardous to public or commercial use of the surface would require a local NOTMAR notification made through the U.S. Coast Guard Service stating the activity and potential hazards. However, it is the responsibility of the DoD agency conducting the testing/training activity to ensure that there is no surface traffic in the area. If there is, aircrews must wait until the area is clear or find another location in the EGTTR that is clear of traffic to pursue the activity.

3.4 BIOLOGICAL RESOURCES

3.4.1 Definition of the Resource

This subsection summarizes the biological environment of the EGTTR, emphasizing the portion of the EGTTR that would be affected by the Proposed Action. The biological environment includes living resources that use the water column and substrates underlying the EGTTR, as well as the habitats in which they occur. This section includes information on special biological resource areas and special status species, which are protected by federal laws such as the ESA and MMPA. The ESA and MMPA are applicable to numerous species included in this EA and are described in the following paragraphs. Other relevant laws are described for specific resources.

The ESA provides for the protection of endangered and threatened species and the habitats upon which they depend. An "endangered species" is defined as any species that is in danger of extinction throughout all or a significant portion of its range, whereas a "threatened species" is defined as any species likely to become an endangered species within the foreseeable future. In

addition to endangered and threatened designations, the U.S. Fish and Wildlife Service (USFWS) and/or National Marine Fisheries Service (NMFS) further categorize species, including "candidate species" and "species of concern." Candidate species are those identified by either agency as facing immediate, identifiable risks but that have not yet been listed as threatened or endangered. A species of concern is a species about which NMFS has concerns regarding status and threats but for which insufficient information is available to indicate a need to list under the ESA.

The ESA prohibits, with certain exceptions, the "taking" of listed species. The act defines "take" as harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting listed species or attempting to engage in any such conduct. The ESA also requires critical habitat to be identified for listed species. Critical habitat is defined as the physical and biological features essential for a species' conservation, such as food, water, and shelter, and other features. The ESA requires all federal agencies to ensure that their actions do not jeopardize the continued existence of a listed species or their designated critical habitat.

Similar to the ESA, the MMPA prohibits, with certain exceptions, the "taking" of marine mammals. The term "take" is defined as harassing, hunting, capturing, or killing any marine mammal or the attempt to do so. The term "harassment" is further categorized by level of severity as Level A or Level B. For military readiness activities specifically, "harassment" is defined as any act of pursuit, torment, or annoyance that:

1) Has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment).
2) Has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered (Level B harassment).

To facilitate management of marine mammals under the MMPA, the NMFS has identified various stocks, which are defined as groups of mammals of the same species occurring in the same area that interbreed when mature. A stock may be categorized as a *strategic stock*, which is defined as a stock that is 1) subject to elevated levels of human-caused mortality, 2) is declining and likely to become listed under the ESA, or 3) is currently listed under the ESA or designated as depleted under the MMPA.

Analysis Methodology

Analysis considers potential impacts to biological resources, including special habitats and special status species. The analyses primarily include an assessment of potential impacts resulting from munitions detonations (noise and pressure effects), other disturbance, and alteration of the water column and seafloor. Where appropriate, projected conditions are compared with baseline conditions.

Significance Determination

The potential impacts of the Proposed Action on biological resources were evaluated to determine whether or not they would be adverse. An adverse impact would degrade habitat

quality or diminish the health or distribution of marine species. Adverse impacts were further evaluated as to their significance. A significant adverse impact is defined as an impact that would be likely to jeopardize the continued existence of a species or to result in an overall decrease in population diversity, abundance, or fitness.

3.4.2 Affected Environment

Biological resources in the overall EGTTR were described and analyzed in detail in the 2002 PEA. Potential impacts to some of these resources would change under the Proposed Action of this REA, while there would be little to no change in the anticipated effects to others. Compared with the 2002 document, the primary difference in the type of proposed activities would be increased numbers of air-to-surface missions involving live munitions. Therefore, the biological resources affected by these new missions are analyzed in detail in this document. Resources analyzed include marine fish and essential fish habitat (EFH), marine mammals, sea turtles, and special habitat types. Impacts could result from noise and overpressure caused by detonations underwater and at the water surface; munitions and target fragments that would impact the water surface, water column, and sediments; and the introduction of explosive materials and explosion byproducts into sediments and the water column. Potential impacts to other biological resources would not differ substantially from those described in the 2002 PEA. Analyses provided in the 2002 document, which are incorporated here by reference, are included as part of the No Action Alternative.

3.4.2.1 Marine Fish

The eastern GOM contains a variety of habitats that support a wide diversity of fish species. Fish are an important component of the marine food web because they feed on other marine species such as plants, plankton, and smaller fish, while at the same time they are prey to other organisms including larger fish, birds, and marine mammals. Many species, such as snapper, grouper, mackerel, amberjack, and cobia, are economically important. Fish abundance and distribution is affected by factors such as physical water characteristics, habitat availability, species life cycles, and position in the water column. Physical characteristics include water salinity, temperature, depth, bottom type, oxygen content, turbidity, and currents. The primary habitat features in the vicinity of the air-to-surface test and training site include sandy substrate and areas of hard bottom (reefs, shipwrecks, etc.). The life cycles of fish species may result in occurrence in varying environments at different times. Some species may move between estuarine and offshore areas or between fresh and marine waters.

Fish of the eastern GOM may be characterized by where they typically reside in the water column. Benthic and reef fish are found at or near the bottom. Benthic habitats may include sediments and artificial or natural reef systems. Typical benthic species include snapper, grouper, grunt, and triggerfish. Pelagic fish, which may be categorized as coastal or pelagic, occur mostly in the open waters of the GOM and may undergo seasonal migrations. Coastal pelagic families include jack, herring, mullet, bluefish, cobia, tuna, and mackerel. Oceanic pelagic species include dolphinfish, marlin, tuna, and swordfish.

Threatened and Endangered Fish Species

Two fish species listed under the ESA, the Gulf sturgeon (*Acipenser oxyrinchus desotoi*) and smalltooth sawfish (*Prestis pectinata*), occur in the eastern GOM. The Gulf sturgeon is listed as

threatened, while the sawfish is listed as endangered. In addition, five species of concern have some potential for occurrence in the EGTTR. Table 3-6 includes all species with a federal listing status that could potentially occur in the study area.

Table 3-6. Fish Species with Federal Listing Status Potentially in the Study Area

Species Common Name	Species Scientific Name	Federal Status
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Smalltooth sawfish	*Pristis pectinata*	Endangered
Alabama shad	*Alosa alabamae*	Species of concern
Dusky shark	*Carcharhinus obscurus*	Species of concern
Sand tiger shark	*Carcharius taurus*	Species of concern
Speckled hind	*Epinephelus drummondhayi*	Species of concern
Warsaw grouper	*Epinephelus nigritus*	Species of concern

The **Gulf sturgeon** is an anadromous fish (spawns in fresh water but occurs at other times in saltwater) found in riverine, estuarine, and nearshore marine environments of coastal states along the GOM. The species' freshwater range includes seven river systems from Lake Pontchartrain in Louisiana to the Suwannee River in Florida. Adult sturgeons occupy fresh water during the warm months, when spawning occurs, and migrate into estuarine and marine waters in the fall to forage and overwinter. While juveniles may remain in the rivers for the first few years, adults are often found in the nearshore marine waters of the northern GOM from fall to spring. Some individuals have been documented in estuarine waters, such as bays and sounds, for at least a portion of the fall and winter. When in the open GOM, sturgeons are generally thought to remain near the shoreline, although factors such as water depth or prey distribution may be more important factors than distance from land. For example, Gulf sturgeons have been observed off the Suwannee River area as far as 9 NM (16.7 km) from shore (USFWS and NMFS, 2003).

Eglin AFB has studied Gulf sturgeon occurrence and distribution near the northern boundary of the EGTTR for several years. Results show that the fish generally begin migration out of the rivers in October or November and move back toward the rivers in March. After moving into the GOM, some sturgeons remain in the vicinity of Eglin's Santa Rosa Island property, while others move out of the area. Initial study results showed that sturgeons in the GOM remained very close to shore off Santa Rosa Island (within 1,000 meters, or 0.6 miles). However, a more offshore distribution was noted during the last year of study, when most sturgeon detections were recorded approximately 1 mile from shore. The maximum offshore distance could not be determined due to a lack of receivers farther out in the GOM. The reason for the offshore shift is unknown.

The USFWS has designated critical habitat for the Gulf sturgeon in several habitat types, including the nearshore GOM. Critical habitat includes spawning rivers, estuarine habitat, and coastal waters from the mean high water line and out to 1 NM (1.9 km) offshore. Coastal water critical habitat is delineated from approximately Pensacola Pass to the Cape San Blas region (Figure 3-4).

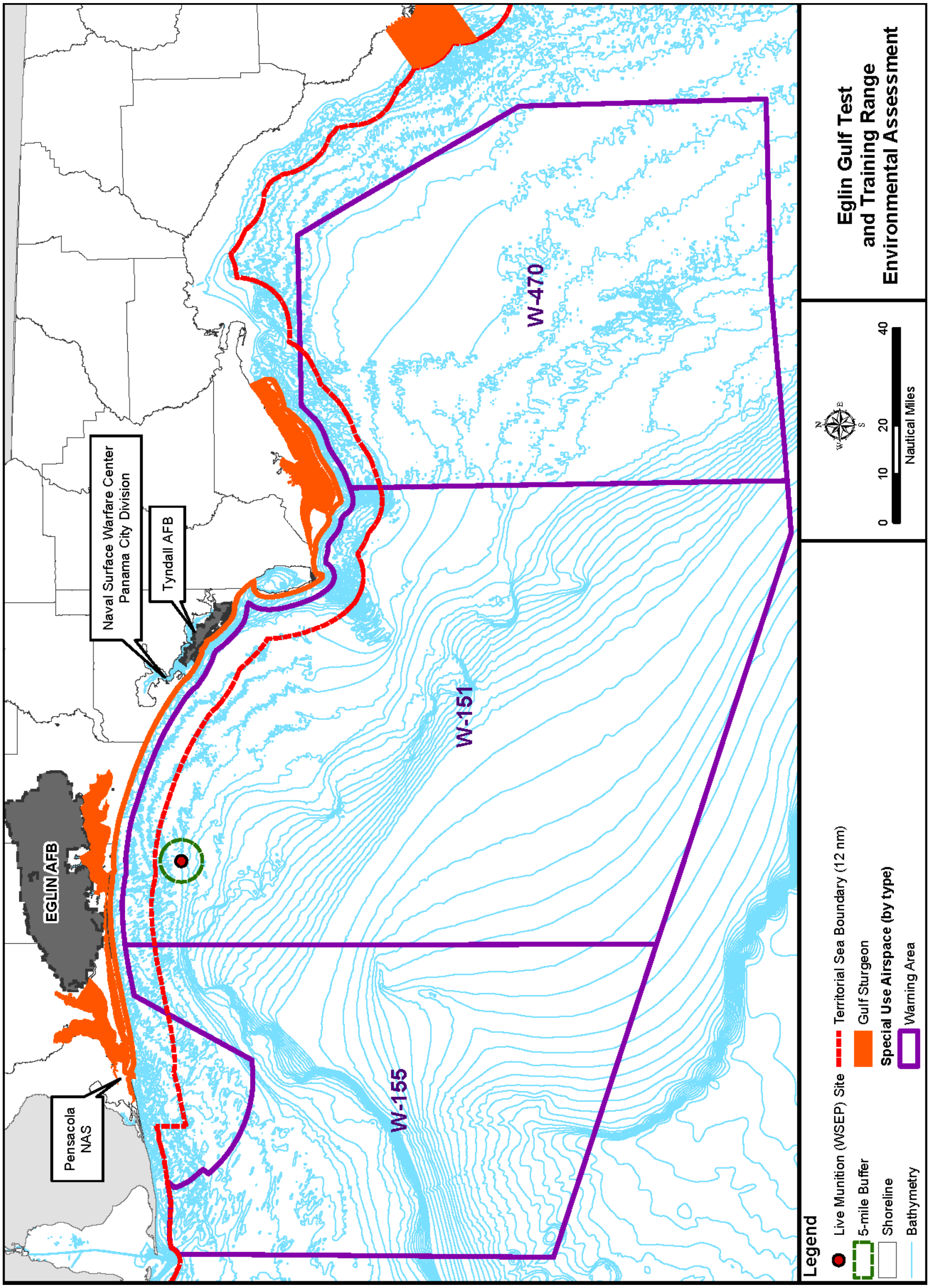

Figure 3-4. Gulf Sturgeon Critical Habitat

The **smalltooth sawfish** is an elasmobranch (the group of fish that includes sharks and rays) that may reach lengths of up to 20 feet. Once common throughout the GOM from Texas to Florida, the current distribution is limited primarily to peninsular Florida. The species is considered common only in areas of southern Florida. However, occurrence has been documented in northern Florida, including areas near Panama City and Pensacola, Florida (Simpendorfer, 2006). Sawfish are typically found within 1 NM (1.9 km) of the shore in estuaries, bays, and river mouths with sandy and muddy bottoms, although larger adults may occur in water depths of over 200 feet (Poulakis and Seitz, 2004; Simpendorfer, 2006). Occasionally, they are found offshore on reefs or wrecks and over hard or mud bottoms. Critical habitat has been designated for this species but occurs only in southern peninsular Florida.

The **Alabama shad** is an anadromous species that occurs between the Mississippi River and Suwannee River (Florida). Fish enter fresh water during January to April to spawn. Adults leave the spawning area soon after spawning is complete. Distribution in the GOM is presently unknown. The current primary threats to Alabama shad include locks and dams blocking spawning migration, commercial and navigational dredging, and alteration of hydrology and river substrates (NMFS, 2008).

The **dusky shark** has a wide-ranging but patchy distribution in warm-temperate and tropical waters. It occurs in both coastal and pelagic areas, occurring from the surf zone to well offshore and from the surface to depths of over 1,000 feet (NMFS, 2011). The dusky shark undertakes long migrations, moving northward in summer as the waters warm and southward in fall as water temperatures drop.

The **sand tiger shark** is distributed in most warm and temperate seas (NMFS, 2010). Sand tiger sharks range from the surf zone to depths to 190 meters (626 feet). They are often found near the seafloor but may occur at any point in the water column. This species is migratory, moving north during the summer and south during fall and winter.

The **speckled hind** inhabits warm, moderately deep waters from North Carolina to Cuba, including the GOM. The preferred habitat is hard-bottom reefs in depths from 80 to 1,300 feet, although they generally prefer depths of 200 to 400 feet (NMFS, 2009a).

The **Warsaw grouper** occurs on reefs in water depths of 55 to 525 meters (180 to 1,700 feet) (NMFS, 2009b). The species ranges from North Carolina to the Florida Keys, including the GOM. On September 28, 2010, the NMFS issued a finding that the petition to list the Warsaw grouper under the ESA did not present substantial information, indicating listing was warranted. However, as of March 2015, this species remains listed as a species of concern on the NMFS website.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) governs commercial fishing within the U.S. Exclusive Economic Zone (EEZ) (from state waters to 200 NM offshore). The MSA required the formation of eight regional fishery management councils (FMCs), which function to conserve and manage fisheries within their geographic jurisdiction. The Gulf of Mexico Fishery Management Council (GMFMC) manages fisheries in the area of the EGTTR.

The FMCs are required to identify EFH for each fishery under their management. EFH is defined as the waters and substrate necessary for spawning, breeding, or growth to maturity (16 USC 1802[10]). Federal agencies must consult with the Secretary of Commerce on any action that may adversely affect EFH.

The Gulf States Marine Fisheries Commission (GSMFC) and NMFS also have management responsibilities for certain fisheries. The GSMFC manages fishery resources in state waters of all states bordering the GOM. NMFS has jurisdiction over "highly migratory" species in federal waters of the GOM.

Managed fisheries occurring in the GOM and their designated EFH are shown in Table 3-7.

Table 3-7. Fish Species, Management Units, and Essential Fish Habitat in the Gulf of Mexico

Species or Management Unit	Essential Fish Habitat
Coastal migratory pelagics (7 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council, from estuarine waters out to depths of 100 fathoms.
Coral and coral reefs (over 300 species)	The total distribution of coral species and life stages throughout the Gulf of Mexico, including the East and West Flower Garden Banks, Florida Middle Grounds, southwest tip of the Florida reef tract, and predominant patchy hard bottom offshore of Florida from approximately Crystal River south to the Keys and scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge.
Red drum	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from Vermilion Bay, Louisiana, to the eastern edge of Mobile Bay, Alabama, out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms.
Reef fish (31 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S.-Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.
Shrimp (4 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S.-Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.
Spiny lobster	Gulf of Mexico waters and substrates extending from Tarpon Springs, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 15 fathoms.

Table 3-7. Fish Species, Management Units, and Essential Fish Habitat in the Gulf of Mexico, Cont'd

Species or Management Unit	Essential Fish Habitat
Stone crab	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; waters and substrates extending from Sanibel, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 15 fathoms.
Highly migratory species (49 species)	Coastal to offshore water column throughout the Gulf of Mexico, out to the U.S. Exclusive Economic Zone boundary.

Source: GMFMC, 2004; NMFS, 2009c

In addition to EFH, the MSA also requires the identification of habitat areas of particular concern (HAPCs). HAPCs are subsets of EFH that are rare, especially ecologically important, particularly susceptible to human-induced degradation, or located in environmentally stressed areas. HAPCs located off Florida include bluefin tuna spawning habitat (NMFS, 2014d), Madison and Swanson closed areas, Florida Middle Ground, Pulley Ridge, and Tortugas North and South Ecological Reserves. Most air-to-surface missions using live ordnance do not occur over these areas. Bluefin tuna spawning, egg, and larvae habitat is delineated in the study area beyond the 100-meter (328-foot) depth contour. Therefore, some AC-130 and CV-22 gunnery training missions (conducted by AFSOC and 413 FLTS) could occur in the tuna spawning habitat as these missions are allowed out to the 200-meter (656-foot) depth contour. AFSOC gunnery missions could also occur over the Madison and Swanson closed areas when W-151B or W-151D is used. However, use of these areas would be infrequent, as most AFSOC missions occur in W-151A. Such missions would not occur over any other HAPC. Additional HAPCs located in the GOM (but not off Florida) include East and West Flower Garden Banks and the following reefs and banks: Stetson, Sonnier, MacNeil, 29 Fathom, Rankin Bright, Geyer, McGrail, Bouma, Rezak Sidner, Alderdice, and Jakkula (GMFMC, 2010).

3.4.2.2 Marine Mammals

Marine mammals are species that rely on ocean environments for all or a significant portion of their life cycles. All marine mammals are protected by the MMPA. Marine mammals that occur in the northeastern GOM include numerous species of cetaceans (whales and dolphins) and one sirenian, the Florida manatee (*Trichechus manatus latirostrus*). Manatees primarily inhabit coastal and inshore waters and are rarely sighted offshore. The EGTTR boundary is 3 miles offshore, and most missions occur at least 15 miles from the coast. Therefore, manatee occurrence in affected areas is considered unlikely and the species is not discussed further.

General Occurrence

Up to 28 whale and dolphin species occur in the northern GOM, from deep offshore waters to shallow estuarine environments. Distribution is influenced by factors such as prey availability and environmental conditions, among many others. Distribution in the northern GOM may be broadly categorized as those species occurring over the continental shelf (typically considered to be water depths of about 100 to 200 meters or less) and those occurring at and beyond the continental shelf break (water depths greater than about 200 meters). Only two species, the

bottlenose dolphin (*Tursiops truncatus*) and Atlantic spotted dolphin (*Stenella frontalis*), are frequently sighted in shelf waters. Dwarf sperm whales (*Kogia sima*), pygmy sperm whales (*Kogia breviceps*), and rough-toothed dolphins (*Steno bredanensis*) are occasionally sighted over the shelf but are not considered regular inhabitants (Fulling et al., 2003; Davis et al., 2000). Under the Proposed Action, all test and training activities involving live detonations at or underneath the water surface, and therefore having the potential to impact cetaceans by noise and pressure, would occur in continental shelf waters less than 150 feet deep. Therefore, only the bottlenose dolphin and Atlantic spotted dolphin are included in this REA.

Species Descriptions

Bottlenose Dolphin

The bottlenose dolphin has a worldwide range that includes tropical and temperate waters and may be found from the shoreline (including estuarine waters and river mouths) to deep offshore waters. Scientists currently recognize nearshore (coastal) and offshore forms. The bottlenose dolphin is the most widespread and common cetacean in coastal waters of the GOM. Bottlenose dolphins are opportunistic feeders that prey upon a variety of fish, cephalopods (octopus, squid), and crustaceans (crabs, shrimp, etc.).

In the area of the northern GOM affected by the Proposed Action, NMFS has identified multiple bay, sound, and estuarine stocks; a coastal stock; a continental shelf stock; and an oceanic stock (NOAA Fisheries, 2012). Table 3-8 summarizes information on these stocks, and additional information follows. Information was obtained from stock assessment reports available on the NMFS website.

Table 3-8. Bottlenose Dolphin Stocks in the North-Central and Northeastern Gulf of Mexico

Stock		Distribution	Strategic Stock	Estimated Abundance
Bay, sound, and estuarine stocks:	Choctawhatchee Bay	Areas of contiguous, enclosed, or semi-enclosed water bodies	Yes	179 resident, 53 transient
	Pensacola/East Bay		Yes	33
	St. Andrew Bay		Yes	124
Gulf of Mexico northern coastal		Waters from shore to the 20-meter (66-foot) isobath, from the Mississippi River delta to 84°W (Florida Big Bend region)	Yes	2,473
Northern Gulf of Mexico continental shelf		Waters between the 20- and 200-meter (66- and 656-foot) isobaths, from Texas to Key West	No	17,777
Northern Gulf of Mexico oceanic		Waters from the 200-meter (656-foot) isobath to the seaward extent of the U.S. Exclusive Economic Zone	No	5,806

The NMFS has identified 32 bay, sound, and estuarine stocks which inhabit contiguous, enclosed, or semi-enclosed water bodies adjacent to the northern GOM. The stocks generally consist of dolphin communities, which are defined as resident dolphins that share a large portion of their range, have similar genetic information, and interact with each other to a much greater extent than with dolphins in other areas. The NMFS considers each of these stocks to be strategic.

Three coastal bottlenose dolphin stocks have been identified in the northern GOM (eastern, northern, and western), occupying waters from the shore to the 20-meter (66-foot) depth contour. Of these, the northern coastal stock coincides with the portion of the EGTTR typically used for live air-to-surface missions. The northern coastal stock's range extends from the Mississippi River Delta to the Big Bend region of Florida. This stock is considered strategic.

The northern GOM continental shelf stock is defined as bottlenose dolphins inhabiting waters from the Texas-Mexico border to Key West, Florida, in water depths between 20 and 200 meters (66 and 656 feet). The continental shelf stock probably consists of a mixture of coastal and offshore types. The stock is not considered strategic.

The oceanic stock is defined as dolphins inhabiting waters from the 200-meter (656-foot) depth contour to the seaward extent of the U.S. EEZ. The continental shelf stock may overlap with the oceanic stock in some areas. The stock is not considered strategic.

Atlantic Spotted Dolphin

The Atlantic spotted dolphin is similar in appearance to the bottlenose dolphin, with the exception of spots that develop on mature individuals. Also similar to bottlenose dolphins, there appears to be a coastal and offshore form. Atlantic spotted dolphins feed on small cephalopods, fish, and benthic invertebrates. The species occurs in temperate and tropical waters of the Atlantic Ocean and GOM and is expected in the EGTTR from water depths of 10 meters (33 feet) to beyond the continental shelf break. The Atlantic spotted dolphin is the second most common cetacean in coastal waters of the GOM. Only one stock, the northern GOM stock, is associated with the study area. Current abundance is unknown, but the previous best estimate was 37,611 dolphins.

Sound Production and Hearing Ability

Because cetaceans use sound for a variety of life functions, including communication, prey detection, predator avoidance, and navigation, noise produced by underwater detonations is a primary consideration in evaluating potential impacts. Sound production and hearing sensitivity differ among various species. However, the NMFS currently evaluates noise impacts based on functional hearing groups, which are groups of mammals having similar sound production and hearing ability. Bottlenose and Atlantic spotted dolphins are both categorized within the mid-frequency functional hearing group. A summary of the characteristics, as described in DON (2013), is provided in Table 3-9.

Table 3-9. Mid-Frequency Cetacean Functional Hearing Groups

Functional Hearing Group	Species with Occurrence in the Study Area	Sound Production		Hearing Ability Frequency Range
		Frequency Range	Source Level (dB re 1 µPa at 1 m)	
Mid-frequency cetaceans	Bottlenose dolphin and Atlantic spotted dolphin, among numerous others	100 Hz to >100 kHz	118 – 236	150 Hz – 160 kHz

dB re 1 µPa = decibels referenced to 1 micropascal, Hz = hertz; kHz = kilohertz; m = meter

Marine Mammal Density

Under currently accepted analysis methods, animal density is necessary to estimate the number of each marine mammal species affected. Bottlenose dolphin density estimates were obtained from a habitat modeling project conducted for portions of the EGTTR (Garrison, 2008). As part of the modeling effort, NOAA Fisheries personnel conducted line transect aerial surveys over the eastern GOM during winter and summer of 2007, including areas adjacent to Eglin AFB property. The number of animals recorded was corrected for sighting probability and the probability that animals were not available on the surface to be seen. The survey data were combined with environmental and habitat information to develop a habitat model that can be used to predict densities in different areas and at different times of year.

Garrison (2008) calculated monthly bottlenose dolphin density estimates at various scales within the EGTTR, including large aggregate areas and small blocks (sub-areas) corresponding to airspace units. Density estimates corresponding to sub-area 137 (Figure 3-5) are used in this document because most of the air-to-surface testing and training missions that use live munitions would be conducted within this block. Other types of missions (e.g., target drone training, supersonic flights) may occur in different areas of the EGTTR, including areas farther offshore, and were analyzed in the 2002 PEA. However, the live weapon use under the Proposed Action has the greatest potential for impacts due to underwater shock waves and noise. Missions involving live weapons may occur at any time of the year, and water temperature affects noise propagation and the results of acoustic modeling. Therefore, separate density estimates are calculated for summer (May to October) and winter (November to April). In the absence of specific information on mission timing, it is assumed that half of the missions would occur in summer and half would occur in winter.

The Atlantic spotted dolphin density estimate is derived from Fulling et al. (2003), which describes the results of mammal surveys conducted in the GOM from the U.S.-Mexico border to southern Florida in water depths of 20 to 200 meters. Density estimates were generated for east and west regions, with Mobile Bay as the dividing point. Thus, for purposes of this document, the east region is used. Densities were provided for unidentified *T. truncatus*/*S. frontalis*, which is treated as a separate species group. Density estimates from Fulling et al. (2003) were not adjusted for sighting probability or surface availability in the original report, likely resulting in underestimation of true density. Therefore, Eglin AFB has adjusted density estimates based on calculations provided by Barlow (2003). The surveys were conducted in fall (August to October), and results were not extrapolated for other months or seasons. Therefore, separate summer and winter density estimates are not available; the fall estimate is used for all impact calculations. The bottlenose dolphin and Atlantic spotted dolphin density estimates used to model take estimates are listed in Table 3-10.

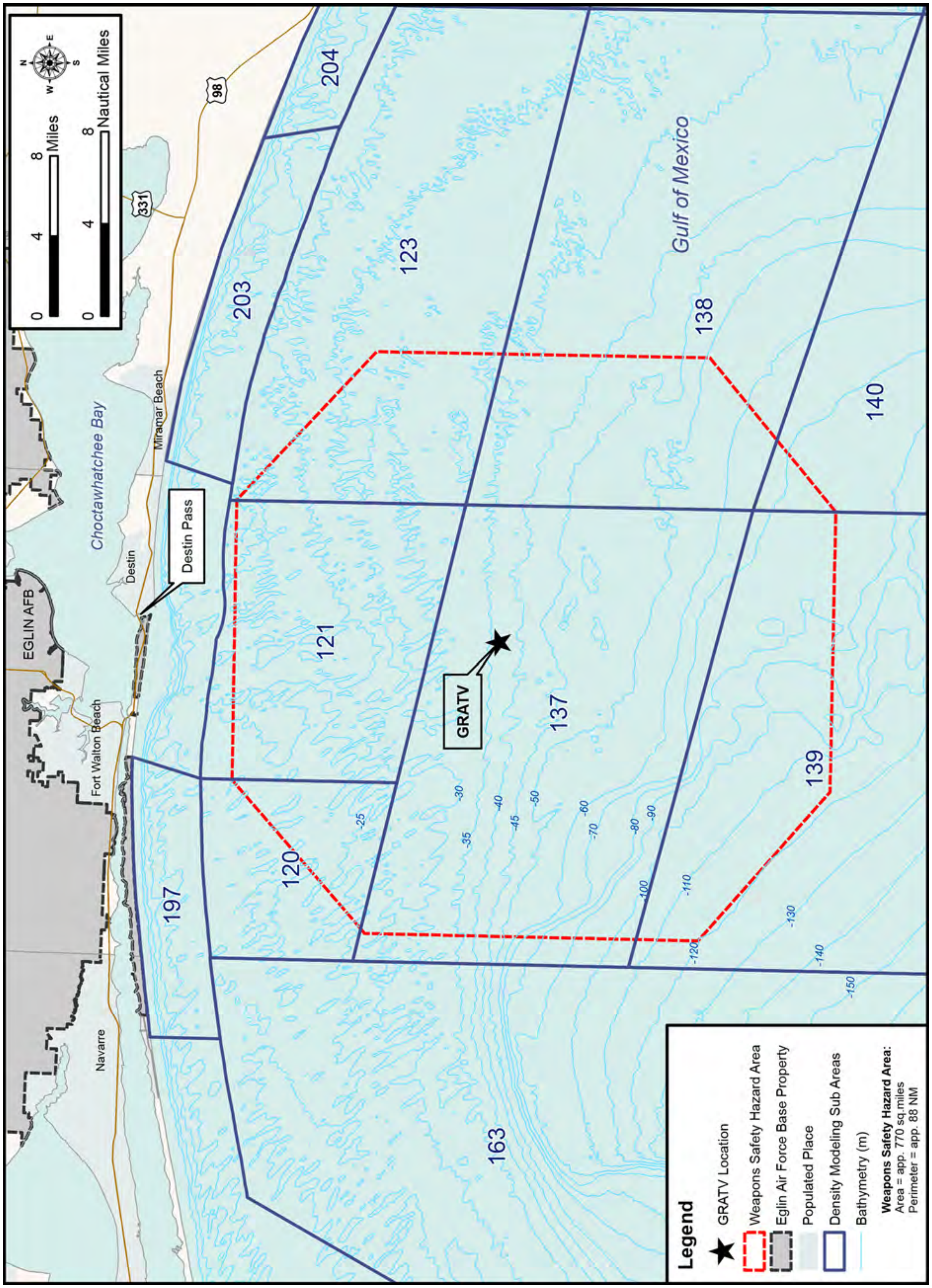

Figure 3-5. Sub-Areas Included in Garrison (2008)

Table 3-10. Marine Mammal Density Estimates

Species	Density Estimate (animals per km^2)[a]	
	Summer	Winter
Bottlenose dolphin	0.404	2.560
Atlantic spotted dolphin	0.265	0.265
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.009	0.009

km^2 = square kilometer

a. Adjusted for sighting probability and surface availability where applicable.

3.4.2.3 Sea Turtles

General Occurrence

Five sea turtle species occur in the EGTTR, including the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), Atlantic green (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*) (Table 3-11). Hawksbill turtles are only occasionally sighted in the northern GOM, including areas off the Florida panhandle, and are not considered regular inhabitants near the air-to-surface mission site. Therefore, the hawksbill is not considered further in this REA. All species but the loggerhead are classified under the ESA as endangered. The loggerhead turtle Northwest Atlantic (NWA) Distinct Population Segment (DPS), which includes turtles in the GOM, is classified as threatened. Sea turtles spend their lives at sea and rarely come ashore except to nest. The number of sea turtles has decreased significantly worldwide during the past several decades. Factors contributing to the decline include the negative influence of beach lighting on nesting and hatching behavior, erosion control practices, off-road vehicle use, predator activities, and illegal egg harvesting.

Table 3-11. Sea Turtle Species Potentially Occurring in the Study Area

Species	Federal Status
Loggerhead sea turtle *(Caretta caretta)* (NWA DPS)	Threatened
Kemp's ridley sea turtle *(Lepidochelys kempii)*	Endangered
Leatherback sea turtle *(Dermochelys coriacea)*	Endangered
Atlantic green sea turtle *(Chelonia mydas)*	Endangered

DPS = Distinct Population Segment; NWA = Northwest Atlantic

Nesting activity in Florida is documented by the Florida Fish and Wildlife Conservation Commission for the loggerhead, green, and leatherback sea turtles. Of these species, the loggerhead is the most prolific, with Florida accounting for over 90 percent of nesting in the U.S. (FWRI, 2012). The majority of sea turtle nesting occurs along the southeastern Florida peninsula. Although the FWC website does not list nesting for leatherback or Kemp's ridley sea turtles in the northern GOM, nesting does occur to some extent, as Eglin AFB reports that these two species occasionally nest on military-controlled areas of Santa Rosa Island.

Species Descriptions

Loggerhead Sea Turtle – Northwest Atlantic Ocean Distinct Population Segment

The loggerhead sea turtle occurs worldwide in habitats ranging from coastal estuaries to waters far beyond the continental shelf (Dodd, 1998). Loggerheads are primarily oceanic as post-hatchlings and early juveniles, often occurring in *Sargassum* drift lines (Bolten and Balazs,

1995). As juveniles and adults, loggerheads most often occur on the continental shelf and shelf edge of the Atlantic and GOM coasts; they are also known to inhabit coastal estuaries and bays (CETAP, 1982; Shoop and Kenney, 1992). Loggerheads are the most commonly seen sea turtles in the southeastern U.S. and may be found near underwater structures and reefs (USFWS NFESO, 2010). Diet consists of gastropods, mollusks, coelenterates, and cephalopods. Adult loggerheads congregate in the nearshore and offshore waters of the GOM from March to June to mate. Nesting sites include beaches and barrier islands. The Florida panhandle, including beaches on Eglin AFB property, supports one of three demographically independent loggerhead nesting groups in the continental U.S. (TEWG, 2000; Epperly et al., 2001).

On July 10, 2014, the USFWS and NMFS issued final rules to designate critical habitat for the NWA DPS of the loggerhead sea turtle. Under the USFWS rule, approximately 1,102 km (685 miles) of loggerhead sea turtle nesting beaches from North Carolina to Mississippi are included in the terrestrial component of critical habitat. The nesting beaches on Eglin AFB are exempt because Eglin AFB's *Integrated Natural Resources Management Plan* (INRMP) already incorporates measures that provide a benefit for the species.

Under the NMFS rule, 38 occupied marine areas are included in the marine component of critical habitat and contain one or a combination of the following habitat types: nearshore reproductive habitat, winter area, breeding area, constricted migratory corridor, and *Sargassum*. Of these, only nearshore reproductive habitat and *Sargassum* habitat areas were designated in the northern GOM (Figure 3-6).

Nearshore reproductive habitat includes nearshore waters adjacent to nesting beaches that are used by hatchlings and nesting females to access the open water. Nearshore habitat includes waters out to 1.6 km (1 mile) from shore. A total of 36 units of nearshore reproductive critical habitat have been identified. Nearshore habitat occurs in the Cape San Blas region and in an area from approximately Pensacola Bay to Mobile Bay but does not occur off Eglin AFB property or in the area affected by increased surface-to-air missions.

The *Sargassum* habitat portion of the marine designation consists of the western GOM from the 10-meter bathymetry line starting at the mouth of the Mississippi River and proceeding west and south to the outer boundary of the EEZ. The southern boundary is the U.S. EEZ from the 10-meter bathymetry line off Texas to the GOM-Atlantic Ocean border. The eastern edge follows the 10-meter bathymetry line from the mouth of the Mississippi River then goes in a straight line to the northernmost boundary of the Loop Current and follows along its eastern edge to the GOM-Atlantic Ocean border.

Since neither the nearshore reproductive habitat nor the *Sargassum* habitat units occur within the air-to-surface mission area, loggerhead sea turtle critical habitat would not be affected by the Proposed Action.

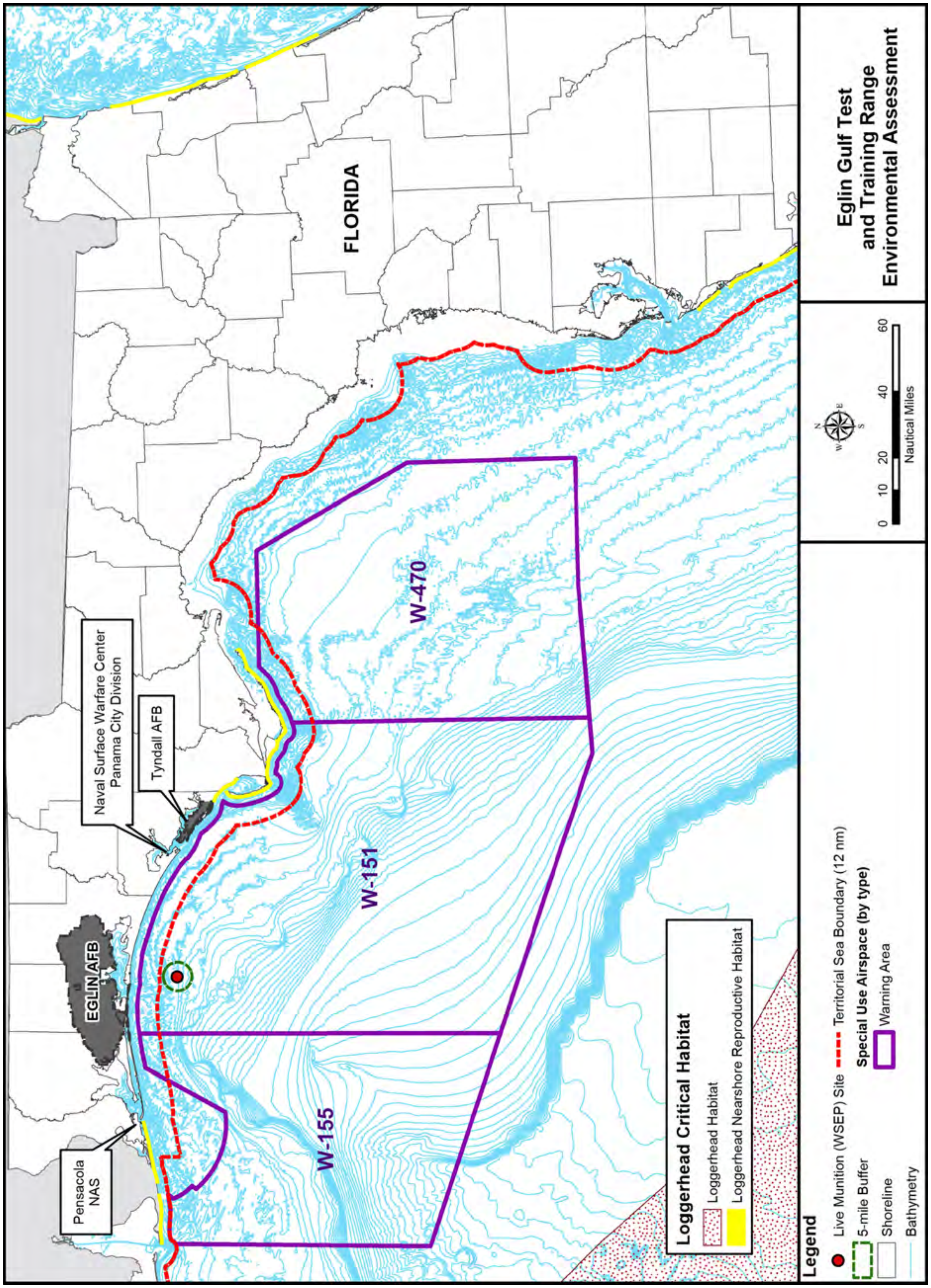

Figure 3-6. Loggerhead Sea Turtle Critical Habitat, Marine Component

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle is the smallest living sea turtle, with a shell length of about 65 cm (26 inches) (USFWS and NMFS, 1992). Adults have the most restricted distribution of any sea turtle and are largely confined to the GOM. Like other species, juveniles may be found in *Sargassum* mats or drift lines. This species commonly nests from April to June along the Gulf coast (USFWS NFFO, 2009a). The Kemp's ridley is a rare nester on Eglin AFB beaches and was documented for the first time in 2008, when three nests were deposited on Santa Rosa Island. Nesting has subsequently been documented in 2010, 2011, and 2012.

Green Sea Turtle

The green sea turtle is the largest hard-shelled sea turtle, commonly reaching 100 cm (39.4 inches) in shell length (NMFS and USFWS, 1991). Green turtles are distributed worldwide in tropical and subtropical waters. In the GOM, the species occurs from Texas to southern Florida. Post-hatchlings are believed to reside in oceanic waters for a period of three to seven years. After this time, green turtles migrate to shallow nearshore areas (less than 50 meters [164 feet] in depth) where they spend the majority of their lives as late juveniles and adults (NMFS and USFWS, 1991; Bjorndal and Bolten, 1988). Adults are predominantly tropical. Juveniles are frequently found in the GOM in areas where there is an abundance of seagrass (USFWS NFFO, 2009b).

In the U.S, green turtles nest from North Carolina to Florida. Florida has the most nesting activity, and the Florida nesting aggregation is recognized as a regionally significant colony (USFWS NFFO, 2009b). The officially recognized nesting and hatching season for the green sea turtle extends from May 1 through October 31 in Florida's panhandle. Eglin AFB property supports the highest number of green sea turtle nests in northwest Florida.

Leatherback Sea Turtle

The leatherback turtle is the largest living sea turtle. Adult shell length may reach over 8 feet. The leatherback turtle is distributed worldwide in tropical, subtropical, and warm-temperate waters throughout the year and in cooler temperate waters during warmer months (NMFS and USFWS, 1992; James et al., 2005). The leatherback is the most oceanic and wide-ranging of sea turtles. Unlike other species, post-hatchlings are probably not associated with *Sargassum* (NMFS and USFWS, 1992; Eckert, 2002). Late juvenile and adult leatherbacks range from mid-ocean to the continental shelf and nearshore waters (Schroeder and Thompson, 1987; Shoop and Kenney, 1992). The leatherback feeds primarily on jellyfish but occasionally will eat sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed.

Only infrequent nesting activity has been documented for the leatherback turtle in northwest Florida. The officially recognized nesting and hatching season extends from March 1 through September 30. Until the spring of 2000, the only confirmed leatherback nesting in northwest Florida was in Franklin and Gulf Counties. In May and June 2000, leatherback nesting was

documented on Eglin's Santa Rosa Island property. Since then, one leatherback nest has been found (2012).

Juveniles/Hatchlings

Due to nesting activity on and near Eglin AFB beaches, sea turtle hatchlings are present at certain times of the year. Loggerhead and green turtles nest most frequently, with some nesting of leatherback and Kemp's ridley turtles as well. In general, nesting occurs between May and August, and the incubation period is approximately 60 days. Once hatchlings reach the GOM, at least some will be associated with floating mats of *Sargassum*, which provide food and cover.

Sea Turtle Density

Similar to marine mammals, sea turtle density is used to assess potential impacts resulting from underwater detonations. Density estimates were obtained from two sources. Estimates for the loggerhead, Kemp's ridley, and leatherback were obtained from the habitat modeling project described in the marine mammal section above (Garrison, 2008). The habitat model, based on species occurrence and habitat characteristics, was used to provide density predictions in different areas of the EGTTR at various times of the year. Similar to the marine mammal discussion, because missions may occur at any time of the year and because water temperature affects acoustic modeling results, separate density estimates are provided for summer (May to October) and winter (November to April). It is assumed that half of the missions would occur in summer and half would occur in winter.

In addition to the species mentioned above, acoustic modeling also predicted relatively high densities of green turtles in the northern GOM. However, Garrison (2008) cautions that this prediction is highly suspect and that the results should only be applied off southern Florida. Therefore, the green turtle density estimate is instead derived from Epperly et al. (2002), which describes aerial surveys conducted in conjunction with turtle bycatch studies in the GOM. Results were categorized by inshore (0 to 10 fathoms) and offshore (10 to 40 fathoms) areas, as well as western and eastern geographic zones. Results were also presented for upper and lower 95 percent confidence intervals. The density corresponding to the upper confidence interval of the 10- to 40-fathom stratum in the eastern area is used in this document. Density estimates were not adjusted for sighting or availability bias, therefore, Eglin AFB has provided an adjustment based on a 90 percent dive profile (sea turtles are assumed to spend an average of 90 percent of their time underwater and 10 percent of their time at the surface). Epperly et al. (2002) did not provide seasonal data. Therefore, separate summer and winter density estimates are not available.

Based upon the discussion above, density estimates listed in Table 3-12 for loggerhead, Kemp's ridley, and leatherback sea turtles correspond to the sub-area 137 block provided by Garrison (2008) (Figure 3-5 in Marine Mammal section). The green sea turtle density estimate represents the corrected upper 95 percent minimum estimate provided by Epperly et al. (2002), with a 90 percent dive profile incorporated.

Table 3-12. Sea Turtle Density Estimates

Species	Density Estimate (animals per km^2)*	
	Summer	Winter
Loggerhead sea turtle[1]	0.708	2.565
Kemp's ridley sea turtle[1]	0.052	1.107
Leatherback sea turtle[1]	0.321	0.276
Green sea turtle[2]	0.165	0.165

km^2 = square kilometer
[1] Source: Garrison, 2008; adjusted for observer and availability bias by author
[2] Source: Epperly et al., 2002; not adjusted for sighting or availability bias by the authors, but adjusted by Eglin AFB

3.4.2.4 Special Habitat Types

Marine Protected Areas and Closed Areas

Marine protected areas (MPAs) are broadly defined as areas of the ocean that are established for the protection of natural or cultural resources (NOS, 2014). There are currently over 1,600 total MPAs designated in U.S. waters in habitats ranging from open ocean environments to estuaries. Examples include national marine sanctuaries, national seashores, and national wildlife refuges, among many others. While some activities are restricted within MPAs, most allow certain types of use. MPAs may be managed by federal, state, local, or tribal agencies. There are currently 27 national system MPAs designated in the northern GOM. However, most of these sites are wildlife refuges located along the coast. There are currently no national system MPAs located within the EGTTR boundary.

Several areas in the GOM are closed permanently or temporarily to all or certain types of fishing methods in order to protect and conserve fishery resources. These areas are called closed areas. Closed areas in the northern GOM include the Reef Fish Stressed Area, shallow-water grouper recreational fishing area, DeSoto Canyon, Madison and Swanson sites, the Edges, and Steamboat Lumps (Figure 3-7). Closed areas related to longline fishing also occur in large portions of the GOM. Many of these features occur within the EGTTR boundary, and part of the Reef Fish Stressed Area and shallow-water grouper area coincide with the air-to-surface test and training area.

***Sargassum* Habitat**

A detailed description of *Sargassum* habitat in the GOM is provided in DON (2007) and is summarized here. *Sargassum* is a floating brown alga that grows in clumps or mats and that is transported by water currents or wind. The term "*Sargassum*" generally refers to two pelagic algae species: *Sargassum natans* and *S. fluitans*. Both species have leafy blades and air bladders that help the plants float at the surface. Pelagic *Sargassum* is found in most tropical and temperate oceans, including the GOM. Occurrence is unpredictable and depends primarily upon prevailing surface currents. *Sargassum* can potentially be found throughout the EGTTR at any time.

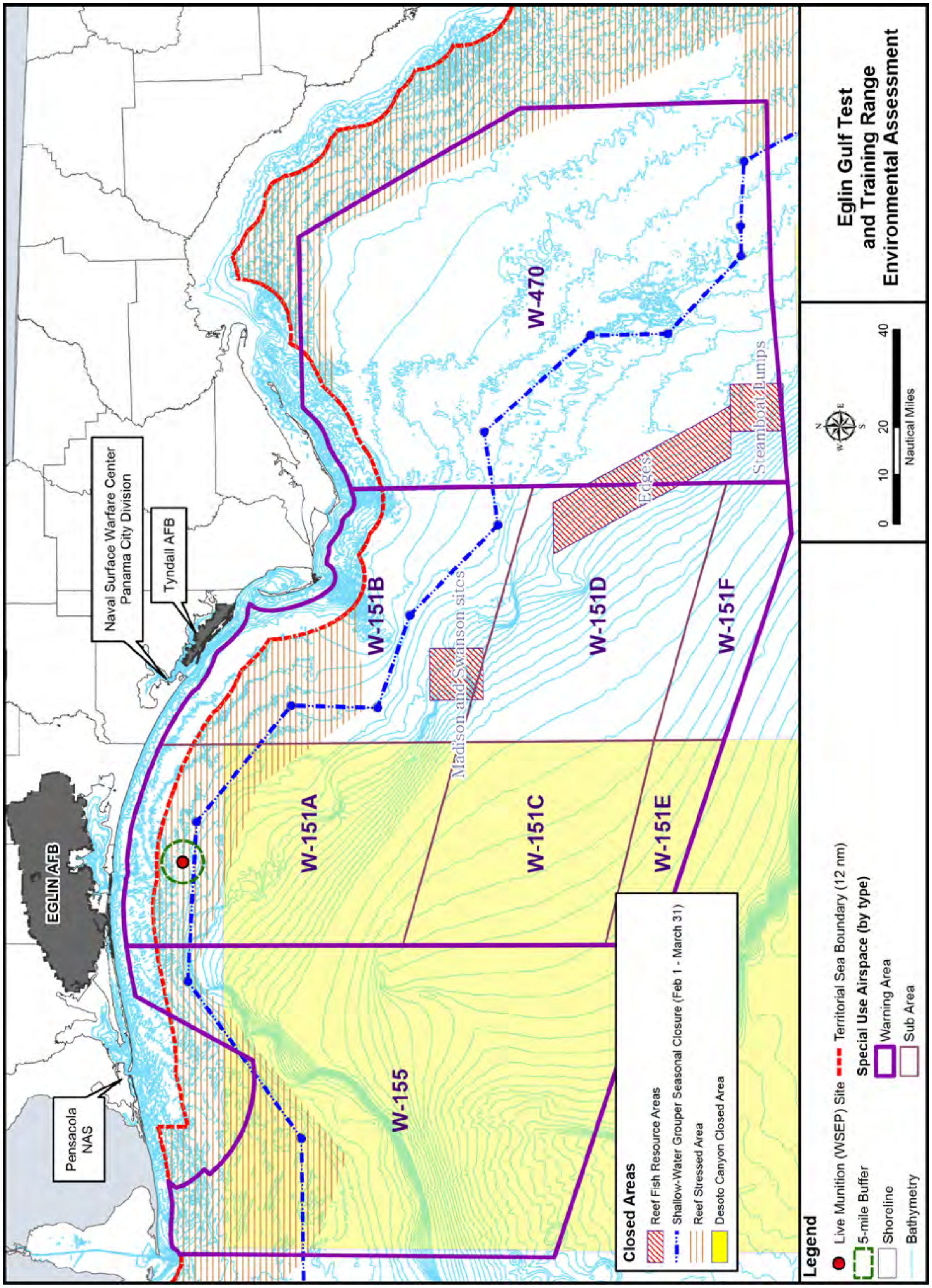

Figure 3-7. Closed Areas in the Northern Gulf of Mexico

Sargassum often aggregates into mats or rows on the ocean surface. These aggregations provide important foraging, protection, and spawning habitat for numerous marine organisms. Over 100 fish species are associated with *Sargassum* habitat during some life stage. The South Atlantic Fishery Management Council has developed a habitat plan and fishery management plan for *Sargassum*, although the GMFMC has not done so. Hatchlings of four sea turtle species are known to associate with *Sargassum* in the GOM. There is potential for young sea turtles to be present at any *Sargassum* aggregations encountered at sea. *Sargassum* aggregations also support many other types of organisms such as fungi, micro- and macro-epiphytes, hydroids, and crustaceans.

Live-Bottom, Hard-Bottom, and Coral Communities

Information on live-bottom, hard-bottom, and coral habitats is summarized from information provided in DON (2007). Live-bottom and hard-bottom habitats generally refer to small, isolated rock and reef formations on the GOM seafloor (although some areas are large), along with the biological communities that may be associated with them. Not all hard-bottom areas support a live-bottom community. However, in areas where live bottom occurs, diverse biological assemblages may occur, with species potentially present including sea fans, sea whips, ascidians, bryozoans, hard or soft corals, hydroids, sea anemones, sponges, sea turtles, commercial and recreational fishes, and other fauna. Primary areas of hard-/live-bottom habitat in the northeastern GOM include the Texas-Louisiana shelf, Mississippi-Alabama shelf, west Florida shelf, and Florida Keys/southeast Florida. The Texas-Louisiana shelf area lies outside the EGTTR region. However, the other areas contain bottom features that lie within or near the EGTTR boundary.

Biologically important hard-/live-bottom areas within the EGTTR include (generally from north to south) portions of the DeSoto Canyon, Madison and Swanson sites, Steamboat Lumps, the Edges, Florida Middle Ground, Pulley Ridge, Dry Tortugas, and the Florida Reef Tract. These features support a rich diversity of biological communities. However, none of these prominent sites occur within the area that would be affected by increased air-to-surface activities. Other known hard-bottom areas occur in the northern and central portions of W-151 but are not present at the Maritime WSEP air-to-surface site or within the 5-mile alternate location zone (Figure 3-8).

Artificial Reefs and Shipwrecks

Artificial reefs consist of items intentionally placed on the ocean floor to provide habitat for fish, invertebrates, and other marine species. A wide variety of materials may be used to construct artificial reefs. The placement of fish attractants in marine waters is regulated by the USEPA, USACE, U.S. Coast Guard, and state and local government agencies. The National Fishing Enhancement Act resulted in development of a national artificial reef plan (Lukens and Selberg, 2004), with NMFS having responsibility for the plan's development. NMFS encourages implementation of the national plan by individual state agencies and, therefore, many coastal states, including Florida, have adopted their own plans (NOAA, 2007).

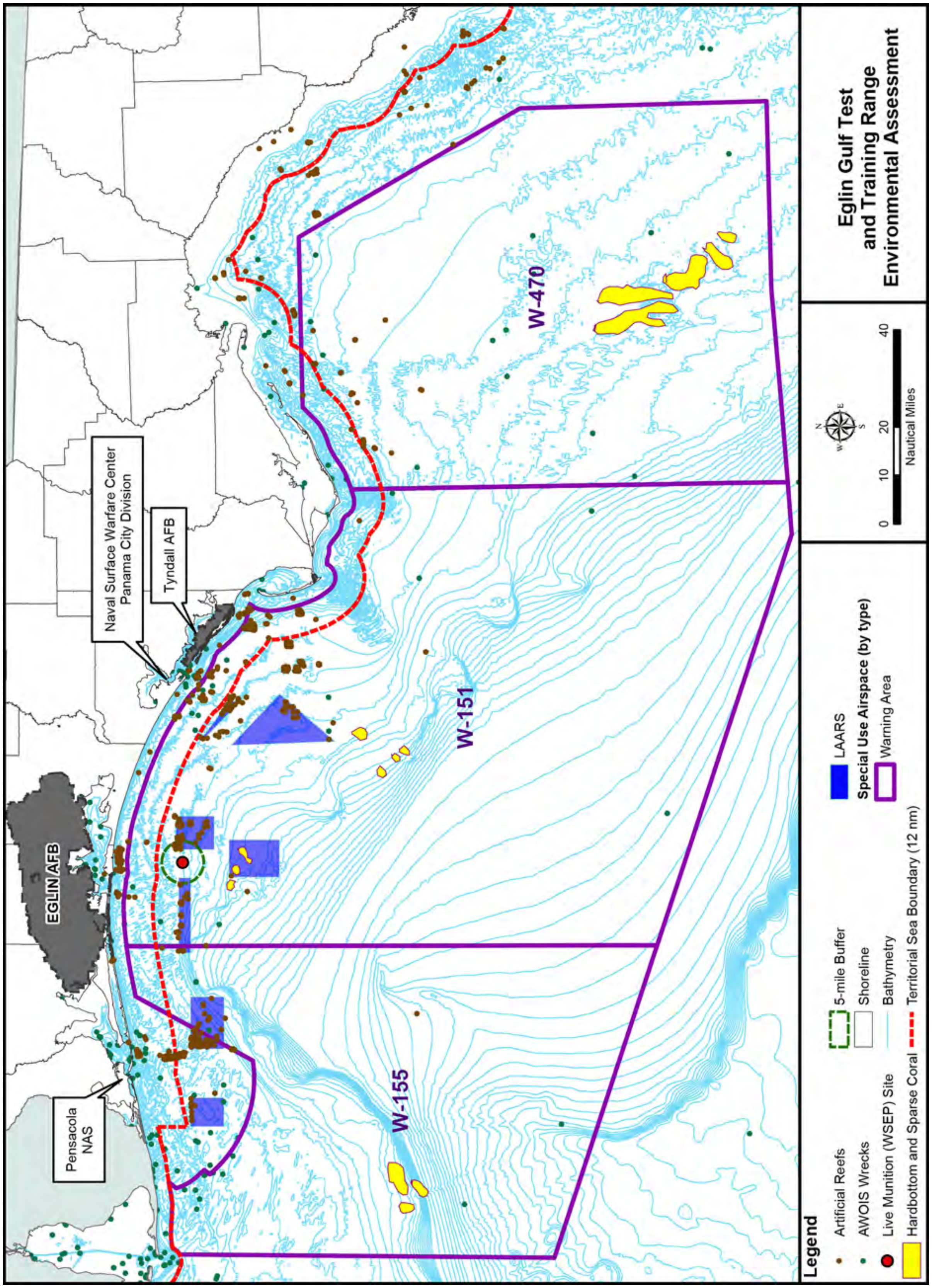

Figure 3-8. Hard-Bottom Habitat, Artificial Reefs, and Shipwrecks near the Study Area

The Florida Fish and Wildlife Conservation Commission (FWC) adopted a reef strategic plan for the state of Florida in 2003. Because of the extent of Florida's coastline and the magnitude of reef activities, the FWC program also involves county governments, cities, universities, and nonprofit corporations (FWC, 2014). In Florida, reef materials may be deposited in one of the numerous established large area artificial reef sites (LAARS), or in other areas as allowed by permit. As of 2006, there were 448 unique Florida permitted reef sites (300 were considered active), ranging in size from 48 square feet to 98 square miles. LAARS associated with the Florida panhandle include Escambia West, Escambia East, Okaloosa, Florida Area A, Florida Area B, Site C, and Site B.

As described in DON (2007), many shipwrecks exist in the GOM as a result of navigational hazards, human errors, and intentional sinking. Over 400 wrecks lie on the GOM's outer continental shelf, and thousands more lie closer to shore in state waters. There are 297 known shipwrecks off the Florida panhandle. Similar to artificial reefs, shipwrecks provide substrate for numerous encrusting marine organisms and, in many cases, function as habitat for fish, sea turtles, and other marine species. The locations of LAARS, known individual artificial reefs, and shipwrecks near the area proposed for increased air-to-surface missions are shown on Figure 3-8). No artificial reefs or shipwrecks occur at the Maritime WSEP test site, but a small number of artificial reefs occur within the 5-mile alternate location zone. It is possible that there are additional unknown or unreported hard-bottom areas, reef sites, and wrecks in the vicinity.

3.4.3 Environmental Consequences

Proposed Action

Marine Fish

Marine fish could potentially be impacted by noise or pressure resulting from detonations, ingestion of debris, and alteration of water and sediment quality. Detonation effects would be possible for fish relatively close to a test or training event, while debris and water quality alteration could affect fish farther from the mission site. Each type of potential effect is discussed below.

Detonation Effects

Detonations below, at, or near the water surface may generate overpressure (shock waves) and noise that move through the water column for some distance. The resulting effects to marine species such as fish could include blast injury, barotrauma, hearing effects, and stress or behavioral reactions. Blast injury refers to injuries resulting from compression of a fish's body when exposed to a shock wave, while barotrauma refers to injuries caused when gas-filled structures such as the swim bladder vibrate in response to a blast. A shock wave produces a sudden, intense change in pressure that can tear body tissues and cause rupture or hemorrhage in various internal organs (Wright, 1982; Lewis, 1996). Therefore, shock waves are often lethal to fish near the detonation (CSA, 2004). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors such as fish size, body shape, and orientation in the water column (e.g., Keevin and Hempen, 1997; Lewis, 1996; O'Keeffe and

Young, 1984; Wright, 1982). Underwater topography and water depth may also affect the potential for impact.

Military researchers have previously developed models to predict safe ranges for fish of various sizes (e.g., Young, 1991; O'Keeffe and Young, 1984). Young (1991) provides an equation that allows estimation of the potential effects of underwater detonations to fish with swim bladders (some fish species such as sharks and rays do not possess swim bladders). Table 3-13 shows the mortality ranges, based on the equation, for representative munitions that could be detonated underwater as part of the Proposed Action. The 10 percent mortality range is the distance beyond which 90 percent of fish would be expected to survive.

Table 3-13. Estimated Mortality Ranges for Fish with Swim Bladders

Representative Munition	Net Explosive Weight (pounds)	Depth of Explosion (feet)[1]	10 Percent Mortality Range (feet)	
			1-Pound Fish	30-Pound Fish
GBU-24 bomb	945	10	1,074	691
AGM-65 missile	192	10	687	442
GBU-39 bomb	36	10	430	277
AGM-176 missile	13	10	323	208
105-mm projectile	4.7	10	243	156

AGM = air-to-ground missile; GBU = Guided Bomb Unit; mm = millimeter
1. Subsurface detonations are assumed to occur at a depth of 10 feet.

Although the extent to which Young's equation applies to actual conditions in the EGTTR is unknown, the table illustrates the potential for fish located within a few hundred feet of an underwater detonation to be killed. The number of fish affected would depend on the local population density at the time of detonation, in addition to other factors such as fish size and position in the water. Variations in fish abundance, distribution, and distance from the detonation point make it very difficult to predict the number of fish affected at any specific site. Fish populations could increase over time in areas where target boats are frequently struck due to large target pieces settling on the seafloor and becoming artificial reef habitat. Multiple debris pieces in close proximity could increase the potential for fish occurrence. Populations of some fish species could also increase temporarily if individuals were to congregate under the GRATV or anchored target boats. Conversely, detonations in the target area could also cause fish populations to decrease over time. Populations of pelagic/near-surface species would probably be affected less because these species are not closely associated with bottom structure.

Most fish species experience large numbers of natural mortalities, and a relatively small level of additional mortality caused by test and training missions would not likely affect populations as a whole. As shown in Table 2-, many missions involve inert munitions or detonation of live munitions in the air or at the water surface. These scenarios would result in substantially less potential for mortality. Missions involving underwater detonations would be spread over time. Generally, it is not expected that large numbers of fish would be killed as a result of underwater detonations under the Proposed Action or that any population would be significantly affected. As a reference point, monitoring during the shock trial of the Navy destroyer *USS John Paul Jones*, in which a 10,000-pound charge was detonated underwater, revealed about 100 dead fish (presumably at the surface; underwater surveys were not reported) (Department of the Navy, 1998).

Potential injuries to fish may be considered separately from mortality. There are currently no generally accepted injury criteria specifically for detonations, but Stadler and Woodbury (2009) discuss criteria for injuries potentially resulting from pile driving (another source of impulsive underwater sound somewhat similar to detonations). The criteria were developed by state and federal agencies and used by NMFS to estimate impacts in marine environments. The onset of physical injury is assumed when either the peak sound pressure level exceeds 206 decibels referenced to 1 micropascal (dB re 1 μPa), or the cumulative sound exposure level (accumulated over a day) exceeds 187 decibels referenced to 1 micropascal squared second (dB re 1 $\mu Pa\text{-}s^2$). More recent investigation (NCHRP, 2011) has resulted in different criteria to estimate injury (barotrauma) caused by pile driving. The authors suggest an exposure threshold of 179 to 181 dB re 1 μPa^2-s (depending on the number of strikes), combined with a cumulative sound exposure level of 211 dB re 1 μPa^2-s over the duration of the pile driving event. It is anticipated that these levels would cause no more than mild, non-life-threatening injuries. Underwater noise levels have been modeled in order to estimate potential impacts to marine mammals in this document (refer to the *Marine Mammals* section below). The results suggest the potential for noise-related injury to fish. However, as described in the discussion of mortality potential, relatively few mission scenarios involve underwater detonation of live munitions, and such events would be spread out over time. The number of fish potentially injured would depend on local fish density at the time of the detonation, in addition to various other factors, and would be difficult to estimate. Similar to the preceding discussion, injury caused by test and training missions would not likely affect overall fish populations.

Exposure to high-intensity sound can cause hearing threshold shifts in fish. A threshold shift occurs when intense sound causes damage to the auditory system, resulting in a shift in the sound level that can be heard at a given frequency. That is, at the affected frequency, sound must be louder to be heard compared with the hearing ability before the shift. Such a shift may be temporary (called temporary threshold shift, or TTS) or permanent (permanent threshold shift, or PTS). Popper and Hastings (2009) provide a review of studies relevant to hearing shifts in fish due to impulsive noise (primarily from use of airguns). One study examined the effects of an airgun array on a fish species with hearing specializations and two species that lack specializations. The results showed temporary hearing loss for two of the species. Another study described loss of a small percentage of sensory hair cells in pink snapper (*Pagrus auratus*) exposed to a moving airgun array for 1.5 hours. In a third study involving airguns, investigators exposed various fish species to an airgun array at various distances from the noise source. The authors found no resulting hearing loss in any fish. Popper and Hastings (2009) caution that extrapolating the results of these or other studies to different environments, noise events, or fish species may not be valid. However, it may be reasonably considered that some number of fish occurring close to an underwater detonation could experience temporary hearing threshold shifts. It is not expected that the number of fish potentially affected would result in adverse effects to overall fish populations.

At distances beyond which mortality, injury, or hearing effects would be expected, underwater noise could result in stress reactions or behavioral responses in fish. A limited number of studies have shown or suggested noise-induced stress response in some fish species (e.g., Smith et al., 2004; Wysocki et al., 2006; Popper and Hastings, 2009). Noise exposure may cause altered behavior and a change in hormone levels in some species. Behavioral effects could include

disruption of activities such as swimming, schooling, feeding, breeding, or migrating. Sudden noise could also cause fish to dive, rise, or change swimming direction. Although some fish in the vicinity of test and training events could react negatively to the sound of underwater detonations, the sounds would be relatively short term and localized. Behavioral changes are not expected to have lasting effects on the survival, growth, or reproduction of fish populations.

Debris Effects

Projectiles such as gunnery rounds, small fragments of exploded ordnance, and small pieces of target debris could sink to the seafloor and be ingested by fish that forage for food items on or within the sediment. Similarly, floating pieces of debris resulting from target boat strikes, such as small fiberglass or plywood particles, could be ingested by fish that feed at the water surface. Overall, the potential for ingesting mission-related debris would be limited to individual fish that might consume an item and experience a negative (injurious) effect. While ingestion of debris could result in lethal or sub-lethal effects to a small number of individuals, the likelihood of a fish encountering an expended item is low based on the dispersed nature of the materials, particularly debris that floats on the water surface. Furthermore, an encounter may not lead to ingestion, and ingestion would not necessarily cause injury. The number of fish potentially impacted would be low compared with overall population numbers, and population-level effects would not be expected.

Water Quality Effects

Fish could potentially be impacted due to degradation of water and sediment quality resulting from deposition of chemical materials and metals. Chemical materials and metals would enter the water column in the form of explosive material, detonation byproducts, metals from munitions casings and fragments, and petroleum products. However, as detailed in Section 3.2, *Physical Resources*, these materials would have an overall negligible effect on water and sediment quality and would not result in degradation of the physical marine environment. No effects to the health or viability of fish populations or individuals would be expected.

Federally Protected Fish Species

Two fish species listed under the ESA, the Gulf sturgeon (threatened) and smalltooth sawfish (endangered), have a low potential for occurrence in the EGTTR. Individuals present in a test or training area could be subject to behavioral responses, hearing loss, physical injury, or death. However, although larger adult sawfish may occur in water depths of over 200 feet (Poulakis and Seitz, 2004; Simpendorfer, 2006) and Gulf sturgeon have been observed about 10 miles offshore, these species are generally considered to occur in nearshore coastal habitats. Occurrence in areas typically used for air-to-surface test and training (about 17 miles offshore), is expected to be infrequent. In addition, because these species often occur near the bottom, individuals would only be affected by missions involving underwater detonations or the use of munitions or targets that would impact the seafloor. The typical species distribution, combined with relative infrequency of missions that could affect species at depth, make impact to any individual unlikely.

Gulf sturgeon critical habitat occurs in the study area from the shoreline out to 1.9 km (1 NM) from shore. All test and training missions included as part of the Proposed Action would occur well beyond this boundary. Most missions would occur at least 17 miles offshore. Therefore, there would be no impact to Gulf sturgeon critical habitat resulting from the Proposed Action.

Five other fish species designated as species of concern have potential for occurrence in the northeastern GOM (refer to Section 3.4.2.1, Marine Fish). It is not expected that the Alabama shad would be found as far offshore as the EGTTR during any season. The dusky shark and sand tiger shark may occur throughout the water column. These species move long distances during migrations and thus have a sporadic occurrence. The likelihood of one or more individuals being present at the time of an underwater detonation is unquantified but is considered low. In addition, due to lack of a swim bladder, the potential for some types of injury would be less than for other fish species. The speckled hind and Warsaw grouper are associated with bottom structures such as reefs. Artificial reefs would be avoided during target site location for many of the missions involving underwater detonations. Some fish could become attracted to large pieces of target boats that come to rest on the seafloor, but it is not expected that this would lead to a large, concentrated population of these species in the area. In addition, these species generally prefer water depths of 200 to 400 feet (speckled hind) and 180 to 1,700 feet (Warsaw grouper). Therefore, occurrence is not considered likely in areas that would be frequently used for live underwater detonations. Therefore, there would be no significant impacts to protected fish species under the Proposed Action.

Essential Fish Habitat and Managed Fisheries

The MSA requires federal agencies to assess potential impacts to EFH for managed commercial fisheries. Adverse impacts to EFH are defined as those that reduce quality and/or quantity of EFH. The EFH constituents identified in Table 3-7 include estuaries, coral/hard bottom, all other substrates, and the water column. Missions included in the Proposed Action would not occur in estuaries. Coral reefs, hard-bottom areas, and artificial reefs occur in the EGTTR (Figure 3-8), but known sites would be avoided. Although missions will be planned to avoid these habitats, there is some potential for debris to be carried by water currents and cause some minimal damage. However, the potential for such a scenario to cause significant damage is considered low, and effects to natural or artificial reefs are not expected.

Impacts to other substrate and the water column could occur due to metals and chemical materials (explosives and explosion byproducts), debris (including sunken targets), and anchoring of the GRATV and target boats. Chemical materials and metals would have the potential to degrade water and sediment quality. However, as detailed in Section 3.2, *Physical Resources*, these materials would have an overall negligible effect on water and sediment quality and would not result in degradation of the physical marine environment. No effects to EFH would be expected.

Direct physical impacts to the seafloor could occur due to debris and anchoring of the GRATV and target boats. Debris deposited on the seafloor would include spent munitions fragments, UXO (in the case of dud munitions), and pieces of the target boats (fiberglass, plywood, plastics, etc.). Debris would not appreciably affect the sandy seafloor. Debris moved by water currents could scour the bottom, but sediments would quickly refill any affected areas, and overall effects

to benthic communities would be minor. Large pieces of debris would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Target boats have foam-filled hulls and most of the pieces are designed to float in order to facilitate collection for damage assessment. Overall, the quantity of material deposited on the seafloor would be small compared with other sources of debris in the GOM.

The GRATV would be anchored to the seafloor with four anchors, one on each corner of the barge. The anchors would cover a small area of sandy seafloor habitat immediately surrounding the GRATV. In addition, water currents flowing around the anchors would likely cause some scouring of the substrate. These actions could result in mortality, injury, or displacement of benthic organisms. However, the area of affected seafloor would be insignificant compared to the amount of available similar habitat in the vicinity of the mission area, and in the nearshore waters of the northeastern GOM generally. In addition, the GRATV would leave the area after test missions are completed (about one to two weeks), and water currents would redistribute sediments. Effects due to anchoring of target boats would be similar and would not result in significant impacts to the substrate.

As discussed in the preceding subsections, marine fish in general could potentially be impacted by noise or pressure resulting from detonations, ingestion of debris, and alteration of water and sediment quality. Some portion of the affected fish could include species managed by the GMFMC and/or NMFS. Detonations below, at, or near the water surface may generate overpressure (shock waves) and noise that move through the water column for some distance. The resulting effects to fish could include blast injury, barotrauma, hearing effects, and stress or behavioral reactions. Shock waves may be lethal to fish near a detonation. At greater distance from the detonation, the extent of mortality or injury depends on a number of factors, such as fish size, body shape, and orientation in the water column. Modeling used to predict safe ranges for fish (e.g., Young, 1991; O'Keeffe and Young, 1984) suggest the potential for fish located within a few hundred feet of an underwater detonation to be killed. Injury, hearing effects, and behavioral effects may occur at greater distances. The number of fish affected would depend on the local population density at the time of detonation, in addition to other factors such as fish size and position in the water. Variations in fish abundance, distribution, species composition, and distance from the detonation point make it very difficult to predict the number of fish affected at any specific site. Fish populations could increase over time in areas where target boats are frequently struck due to large target pieces settling on the seafloor and becoming artificial reef habitat. Populations of some fish species could also increase temporarily if individuals were to congregate under the GRATV or anchored target boats.

Most fish species experience large numbers of natural mortalities, and a relatively small level of additional mortality caused by test and training missions would not likely affect populations as a whole. Many missions involve inert munitions or detonation of live munitions in the air or at the water surface. These scenarios would result in substantially less potential for mortality. Missions involving underwater detonations would be spread over time. Generally, it is not expected that large numbers of fish would be killed, injured, or harassed as a result of underwater detonations or that any population would be significantly affected. As a reference point, monitoring during the shock trial of the Navy destroyer *USS John Paul Jones*, in which a 10,000-

pound charge was detonated underwater, revealed about 100 dead fish (presumably at the surface; underwater surveys were not reported) (DON, 1998). Behavioral changes are not expected to have lasting effects on the survival, growth, or reproduction of fish populations.

Projectiles such as gunnery rounds, small fragments of exploded ordnance, and small pieces of target debris could sink to the seafloor and be ingested by fish that forage for food items on or within the sediment. Similarly, floating pieces of debris resulting from target boat strikes, such as small fiberglass or plywood particles, could be ingested by fish that feed at the water surface. Overall, the potential for ingesting mission-related debris would be limited to individual fish that might consume an item and experience a negative (injurious) effect. While ingestion of debris could result in lethal or sub-lethal effects to a small number of individuals, the likelihood of a fish encountering an expended item is low, based on the dispersed nature of the materials, particularly debris that floats on the water surface. Furthermore, an encounter may not lead to ingestion, and ingestion would not necessarily cause injury. The number of fish potentially impacted would be low compared with overall population numbers, and population-level effects would not be expected.

Managed fish species could potentially be impacted due to degradation of water and sediment quality resulting from deposition of chemical materials and metals. Chemical materials and metals would enter the water column in the form of explosive material, detonation byproducts, metals from munitions casings and fragments, and petroleum products. However, as discussed previously, these materials would have an overall negligible effect on water and sediment quality and would not result in degradation of the physical marine environment. No effects to the health or viability of fish populations or individuals would be expected.

In summary, Eglin AFB believes there would be no reduction in EFH quality and/or quantity and no significant effects to managed fish species due to the Proposed Action. Eglin Natural Resources is consulting with the NMFS Habitat Conservation Division concerning impacts to EFH and with the Sustainable Fisheries Division concerning impacts to federally managed fisheries. Eglin would adhere to any required management actions identified by NMFS.

In summary, Eglin AFB's EFH assessment has resulted in the conclusions listed below. The Biological Assessment and EFH assessment will be included in the Final REA in Appendix C.

- The Proposed Action would not adversely affect essential fish habitat.
- The Proposed Action would not adversely affect habitat areas of particular concern.
- The Proposed Action would result in no significant adverse effects to federally managed fish species.

Marine Mammals

Potential causes of marine mammal impacts analyzed in this REA include debris and effects from noise and shock waves produced by underwater detonations. Due to the high mobility and hearing ability of dolphins, vessel strikes are not considered to be an issue. Bottlenose and Atlantic spotted dolphins have the ability to move quickly through the water column and are sometimes seen riding the bow wave of boats similar to the targets used during air-to-surface

missions. The potential for ordnance to physically strike marine mammals was evaluated in the 2002 PEA. Gunnery rounds were considered the worst-case scenario and were the only munitions evaluated, although inert bombs and falling debris were mentioned. The analysis concluded that, given the surface area impacted by gunnery rounds and marine mammal densities, approximately five years of activity would be required on average to physically strike one animal. Impacts were, therefore, considered negligible. While the quantity of expended gunnery rounds and inert bombs and missiles would increase somewhat under currently proposed actions, the probability of a direct strike is considered remote due to the dispersed distribution of dolphins and the frequency of test and training missions. In addition, the direct strike calculations provided in the 2002 PEA included all cetacean species potentially present in the northern GOM, whereas only two species are addressed in this REA. Potential impacts resulting from direct strikes are not considered further.

Debris

Fragments of exploded bombs, missiles, and gunnery rounds, as well as pieces of damaged targets, could be suspended in the water column or sink to the bottom. Debris can negatively impact marine species. Plastics and other debris introduced into the marine environment may cause potential injury or death through ingestion or entanglement. However, most of the small debris produced during live air-to-surface missions would be wood, fiberglass, or foam hull material that would float on the surface. After the conclusion of some test events, the mission team would recover surface debris to the extent practicable, potentially employing several vessels for up to two to three hours. Large debris that is not buoyant, as well as heavier small items, would sink to the bottom and would probably eventually become encrusted and/or covered by sediments, although cycles of covering/exposure could occur due to water currents. There would be no significant impacts to marine mammals due to direct effects from debris.

As discussed earlier, large debris pieces would likely settle on the seafloor near the air-to-surface site and would eventually attract fish and other marine organisms that are prey items for bottlenose and Atlantic spotted dolphins. Therefore, dolphins could be attracted to the area due to the presence of food sources and could, therefore, be more likely to occur during live missions. Although dolphins could intermittently hunt at debris around the boat target sites, they typically forage in a large area. Prey populations would not likely become great enough to result in sustained dolphin presence in the air-to-surface test area. The likelihood of increased dolphin presence and density resulting from debris accumulation is unknown. However, in this REA it is assumed that the densities calculated in Section 3.4.2.2 and used in detonation impacts analysis would not change substantially due to the presence of underwater debris.

Detonations

Dolphins spend their entire lives in the water and are submerged below the surface for much of the time. As a result, dolphins located near an underwater or surface detonation would be exposed to the resulting shock wave and underwater noise effects. Animals located near a detonation may experience tissue damage, eardrum rupture, or other physical impacts that can result in death or injury. As the pressure and sound waves spread away from the detonation point, they lose energy. Therefore, at increasing distances from a detonation, effects may include temporary or permanent hearing threshold shifts or behavioral reactions such as startle effects or

disruption of normal activities. Three sources of information are necessary for estimating the potential effects of detonations on marine mammals: 1) the zone of influence, which is the distance from the explosion to which particular levels of impact would extend; 2) the density of animals within the zone of influence; and 3) the number of detonations (events). Summary descriptions of these factors are provided below. For a full description of underwater acoustic principles, methods of deriving impact thresholds, mathematical formulas, and acoustic modeling methods, refer to Appendix D.

Zone of Influence

The zone of influence (ZOI) is defined as the area or volume of ocean in which marine mammals could be exposed to various pressure or noise energy levels caused by exploding ordnance. The pressure and energy levels that NMFS considers to be of concern are defined in terms of metrics, criteria, and thresholds. A metric is a technical standard of measurement that describes the noise and pressure at a given location. Criteria refer to the types of possible impact and include mortality and harassment, with several sub-categories of harassment included. A threshold is the level of pressure or noise above which the impact criteria are reached.

Metrics

Currently accepted energy and pressure metrics are used for impacts analysis in this document, including the following:

- *SPL* (sound pressure level): A ratio of the sound pressure and a reference level. Units are in dB re 1µPa.
- *SEL* (sound exposure level): A measure of sound intensity and duration. When analyzing effects on marine animals from multiple sounds, it is necessary to have a metric that incorporates cumulative exposures. SEL can be thought of as a composite metric that represents both the intensity of a sound and its duration. Units are dB re 1 μPa^2-s for sounds in water.
- *Positive impulse:* The time integral of the pressure over the initial phase of arrival. This metric represents a time-averaged pressure disturbance from an explosive source. Units are typically pascal seconds or pounds per square inch per millisecond.

Criteria and Thresholds

The criteria and associated thresholds currently endorsed by NMFS for use in marine mammal impacts analysis include mortality, injurious harassment (Level A), and non-injurious harassment (Level B). Mortality thresholds are based on the level of blast pressure that would cause extensive lung injury from which 1 percent of exposed animals would not recover. The equation used to calculate mortality thresholds incorporates sound propagation in the water, detonation/animal depths, and the mass of a newborn calf for the affected species.

Three categories of Level A harassment are currently recognized by NMFS: gastrointestinal (GI) tract injuries, slight lung injury, and irrecoverable auditory damage (PTS). GI tract injury (typically bruising) is correlated with the peak pressure of an underwater detonation and is not dependent on an animal's mass. In contrast to extensive lung injury that may cause death, all

animals experiencing slight lung injury are expected to survive. Similar to the mortality determination, the threshold equation for slight lung injury incorporates the mass of a newborn calf. PTS is auditory damage that does not recover and results in a permanent decrease in hearing sensitivity. PTS thresholds are defined for three cetacean groups based on their hearing sensitivity: low-frequency, mid-frequency, and high-frequency. Bottlenose and Atlantic spotted dolphins both fall within the mid-frequency hearing category. The PTS thresholds use a dual criterion, one based on SEL and one based on SPL of an underwater blast. The more conservative of the two is typically applied in impact analysis.

Two categories of Level B harassment are currently recognized: TTS and behavioral impacts. Marine mammals are expected to recover from TTS after some period of time. TTS thresholds use a dual criterion, one based on SEL and one based on SPL, and the more conservative of the two is applied. Behavioral impacts refer to disturbances that may occur at noise levels below those considered to cause TTS, particularly in cases of multiple detonations. Behavioral impacts may include decreased ability to feed, communicate, migrate, or reproduce, among others. Such effects are known as sub-TTS Level B harassment.

Table 3-14 summarizes the criteria and thresholds discussed above and used to estimate impacts to marine mammals resulting from detonations.

Table 3-14. Criteria and Thresholds Used for Marine Mammal Impact Analyses

	Level A Harassment			Level B Harassment	
Mortality[1]	**Slight Lung Injury***	**GI Tract Injury**	**PTS**	**TTS**	**Behavioral**
$91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	$39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	Unweighted SPL: 237 dB re 1 μPa	Weighted SEL: 187 dB re 1 $\mu Pa^2\cdot s$	Weighted SEL: 172 dB re 1 $\mu Pa^2\cdot s$	Weighted SEL: 167 dB re 1 $\mu Pa^2\cdot s$
			Unweighted SPL: 230 dB re 1 μPa	Unweighted SPL: 224 dB re 1 μPa (23 psi peak pressure)	

D = water depth (meters); dB re 1 μPa = decibels referenced to 1 micropascal; dB re 1 μPa^2-s = decibels referenced to 1 micropascal squared second; GI = gastrointestinal; *M* = animal mass based on species (kilograms); psi = pounds per square inch; PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift
1. Expressed in terms of acoustic impulse (pascal seconds).

Density

Marine mammal density estimates are provided in Table 3-10. As discussed previously, densities were derived from the results of published documents authored by NMFS personnel. Density is nearly always reported for an area of ocean surface (e.g., animals per square kilometer). Although the study area appears to represent only the surface, density actually includes animals anywhere within the water column under that surface area. Therefore, a three-dimensional depth distribution adjustment is applied to animal densities.

Number of Events

The number of events generally corresponds to the number of live weapons used, which is provided in Table 2-2. Exceptions include 25-, 30-, and 40-mm gunnery rounds, which are fired

in bursts, and simultaneous small diameter bomb (SDB) launches. In cases of multiple detonations in close proximity occurring over a very short time (a few seconds), pressure and energy impacts may be modeled differently. To summarize, pressure waves would be very unlikely to intersect and add to each other, so the pressure of multiple detonations is not combined. However, because energy accumulates over the duration of the impulse, energy from all arrivals is added. Appendix D provides additional details of underwater acoustic issues and an explanation of modeling used for impacts analysis. The 7.62-mm/.50-cal rounds do not contain high explosives and do not detonate and introduce energy or pressure into the water column; therefore, these rounds are not included in impacts analysis.

Exposure Estimates

An acoustic model incorporating the most current scientific methods and regulatory requirements was used to calculate the maximum estimated range, or radius, from the detonation point to which the various thresholds would extend (see Appendix D, MMPA and ESA Acoustic Impact Modeling). These ranges were used to calculate the total area of the ZOI, which was combined with density estimates and the total number of live munitions to provide an annual estimate of the number of marine mammals potentially exposed to the various impact thresholds (Table 3-15). For Level A harassment, which has multiple criteria, the criterion that resulted in the higher exposure estimate was used. The table indicates the potential for lethality, injury, and non-injurious harassment (including behavioral harassment) to marine mammals. However, the estimates do not take into account mitigation and monitoring measures that would be required, as described below.

Table 3-15. Number of Marine Mammals Potentially Affected Annually by Air-to-Surface Testing and Training Missions in the EGTTR

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	1.39	156	8,174	15,332
Atlantic spotted dolphin	0.48	56.3	1,810	2,600
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.08	0.31	1.15	60.2
TOTAL	1.95	213	9,986	17,992

EGTTR = Eglin Gulf Test and Training Range: TTS = temporary threshold shift

Mitigation and Monitoring

The potential takes shown above represent the maximum estimated number of animals that could be exposed to particular noise and pressure thresholds. The estimates do not take into account measures that would be employed to minimize impacts. Four levels of mitigation measures have been developed in cooperation with the NMFS to account for different types of activities. The categories represent different procedures and layers of mitigation effort based on the expected magnitude of potential effects, the mission location, and the types of assets available (aircraft, surface vessels, etc.). Requirements for each mitigation level are summarized below.

All air-to-surface testing and training missions in the EGTTR involving live ordnance would require some level of monitoring and mitigation requirements. Generally, these measures would

include trained observers, pre- and post-mission monitoring from various platforms, and sea state restrictions. All observers would be required to complete Eglin's Marine Species Observer Training Course, which was developed in cooperation with the NMFS. Pre-mission monitoring would be required to ensure that the ZOI is clear of marine mammals and marine mammal indicators before the missions begin, while post-mission monitoring would be used to detect any animals that were injured or killed. Live air-to-surface missions will be delayed or rescheduled if the sea state is such that marine mammal monitoring cannot be conducted.

Specific mitigation categories (A through D) would be employed during the various missions, as agreed upon by the NMFS. Mitigation Category A represents the most robust set of measures and includes pre- and post-mission visual monitoring from surface vessels, video cameras, and (in some cases) aircraft, in addition to evaluation of environmental conditions. Mitigation Category B would involve use of surface vessels and aircraft for surveys. Mitigation Category C would involve aerial surveys only and would be used for missions too far offshore for survey vessels to reach. Mitigation Category D would involve use of surface vessels only. This mitigation category would be employed for missions involving only airburst (no detonations at or under the water surface).

Eglin AFB is consulting with the NMFS regarding the takes described above through preparation of a LOA request under the MMPA. In addition, NMFS is a cooperating agency for the Proposed Action and therefore has had ongoing input into the evaluation of impacts and required mitigation and monitoring measures. NMFS may authorize the incidental (not intentional) taking of marine mammals if the taking will have only a negligible impact on any species or stock and if mitigation, monitoring, and reporting requirements are met. With implementation of the measures summarized above the Air Force concludes there would be no significant impact to marine mammals under the Proposed Action.

Sea Turtles

Potential causes of sea turtle impacts analyzed in this REA include physical disturbance, boat strikes, debris, and effects from noise and shock waves produced by underwater detonations. Due to sea turtles' generally dispersed distribution and relatively short surface intervals, the possibility of direct strikes by munitions is considered low and is not considered further.

Physical Disturbance and Boat Strikes

Depending on the specific mission, a relatively large number of boats could be present in a test or training area, including target boats, safety boats, swarm mission boats, and other mission-related vessels. Boats could be stationary or moving at various speeds at any given time. Physical disturbance refers to the reaction of a turtle in response to operation or approach of such vessels (excluding physical strikes). The effects would depend on several factors such as speed and direction of the boat, location of the turtle in the water column, and distance between boat and turtle. The distance, noise level, or change in water pressure required to alert a turtle to an approaching vessel is unknown. However, it is assumed that, at some point, an animal would become aware of the threat and attempt to respond by diving or swimming away. These reactions could interrupt important activities (feeding, resting, etc.) and would require energy expenditure. Although an avoidance response would cause a behavioral change and reduce the

amount of energy available for other biological functions, physical threats would be infrequent and brief in duration, and the energy expense is likely within the normal range experienced by a sea turtle over a short time period.

In addition to disturbance, there is also potential for direct boat strikes of turtles swimming or feeding at or just beneath the surface. The effects of a direct strike could range from slight injury to death. Propeller wounds have been increasingly noted among the loggerheads found dead or debilitated in Florida. The number and speed of vessels operated in the area may be considered in assessing collision risk. The activity with the greatest potential for impact would be swarm missions, where 25 to 30 boats would be operated in a small area at relatively high speeds (up to 30 knots). There would be two to three swarm missions per year, with up to four days per mission and three to four hours of boat operation per day. Other missions would involve lower numbers of boats and/or boats operated at lower speeds. Although the number of boats associated with air-to-surface testing and training would not appreciably change the typical overall background level of boat traffic in the area, where a large number of recreational and commercial fishing boats regularly operate, there is an increased chance for turtles present during swarm missions to be struck. However, because of the intermittent schedule of swarm missions and other missions involving surface vessels, the scattered distribution of turtles at sea, and the fact that turtles are submerged about 90 percent of the time, the probability of boat strikes during any particular mission is considered low, and no population-level impacts would be expected. Air Force vessels would be required to avoid large *Sargassum* mats to minimize impacts and as a practical matter to also avoid entangling vessel propellers in *Sargassum*. This requirement would further decrease the potential for hatchling, juvenile, and adult turtles to be struck.

<u>Debris</u>

Gunnery rounds and fragments of exploded bombs and missiles are expected to pass through boats and other targets and settle on the GOM floor. In addition, pieces of damaged targets could be suspended in the water column or sink to the bottom. Other debris includes plastic, plywood, and parachutes (associated with CBU-105 submunitions) that may float in the water column or settle to the seafloor. Sea turtle ingestion of plastics and other discarded items is well documented and may cause injury or death. Impacts may be direct or indirect. For example, debris may become lodged in the digestive tract and affect turtles by decreasing the ability to feed and absorb nutrients. Turtles may also become entangled in items such as parachutes or parachute cords.

The potential for ingestion of debris is a function of the amount of debris generated, location of the debris, and sea turtle feeding methods. Floating materials such as target debris could be eaten by turtles that feed at or near the surface, such as the leatherback, while items such as munitions on the seafloor could be ingested by other species. After missions involving boat targets are completed, boat crews would clean up the area by removing floating debris by hand or with a dip net. While these efforts would remove some portion of floating debris (particularly larger debris), it is likely that numerous pieces small enough to be ingested by a turtle would remain on the water. If ingested, effects to an individual turtle would depend on the size and shape of the debris item as well as the size of the animal. Debris pieces could either pass through the digestive tract without incident, cause temporary disruption of feeding and digestion processes, or become permanently encapsulated by the stomach lining. The probability of a

turtle encountering and eating floating debris would be decreased due to items on the surface being dispersed by currents and wind and the patchy distribution of turtles in the northern GOM.

Gunnery rounds and some other types of small debris would sink to the seafloor where they could be ingested by bottom-feeding turtles including the loggerhead, Kemp's ridley, and green. Potential effects to an animal's health would be the same as those described for floating debris above. In general, the seafloor in the area where most air-to-surface activities would occur is sandy with little relief and few bottom features. Therefore, food items for the various turtle species (submerged vegetation, benthic invertebrates, etc.) occur sporadically and are probably of low density. These factors would decrease the likelihood of turtles foraging in the area and ingesting mission debris. AFSOC gunnery missions would result in the greatest number of gunnery rounds deposited on the seafloor. These missions could occur throughout much of W-151A and, therefore, the likelihood of rounds being present in any given area is low. Many of the other missions would occur in the Maritime WSEP area. Eventually, debris would accumulate in the area and could function as habitat for the benthic species on which turtles feed, thereby possibly increasing turtle occurrence and the potential to ingest smaller debris items. Over time, debris pieces may become covered by sediment or colonized by attaching and encrusting organisms, which would reduce the potential for ingestion. Overall, significant impacts to any sea turtle species from debris are not anticipated.

Based on the projected expenditure of 4 CBU-105 munitions annually, with 10 submunitions and parachute systems per munition, there could be 40 parachute systems deposited in the GOM per year (a parachute system consists of a drogue and main parachute). Turtles could become entangled in the parachute or attached cords/lines while feeding at the surface, water column, or seafloor or could swim into the parachute as it sinks. An entangled individual might be able to free itself. It is also possible that material could remain wrapped around an animal, resulting in behavioral impacts, injury, decreased feeding ability, or death. The rate at which parachutes would sink, and therefore the proportion of time they would be at the surface/water column/seafloor, is unknown. However, it is assumed that many of the parachutes would move some distance due to wind and water currents and that all would eventually sink to the bottom. After sinking, parachutes would become encrusted and/or covered by sediments, although cycles of covering/exposure could occur due to currents. It is possible that individuals of any sea turtle species occurring in the northern GOM could become entangled in parachute debris. However, due to the relatively low number of parachutes used, patchy distribution of turtles, and eventual covering on the seafloor, it is not expected that there would be population-level effects to any species.

<u>*Detonations*</u>

Sea turtles spend most of their lives at sea, coming ashore only to nest and, in rare circumstances and locations, to bask. When at the water surface, sea turtles are mostly submerged. This makes turtles difficult to locate visually and also exposes them to effects of underwater explosions. Similar to other marine species, the susceptibility of sea turtles to mortality, injury, or harassment resulting from underwater detonations is influenced by factors such as animal size, animal and detonation depth, and distance between the animal and detonation. Near the detonation point, animals may be affected primarily by the shock wave, with typical effects including compression of gas-containing structures (e.g., lungs, GI tract), large pressure changes

across tissue interfaces, and concussive effects (e.g., bone fractures). Pressure may also result in effects to the auditory system such as ear drum rupture. Noise produced by an underwater explosion may cause other hearing effects including permanent or temporary hearing threshold shifts. At greater distances from the detonation, noise may also cause stress or disruption of natural behaviors. Compared to marine mammals, little is known about the role of sound and hearing in sea turtle survival or the effects of human-caused noise. However, the results of various investigations indicate that sea turtles are most sensitive to low-frequency sounds.

Similar to the analysis of marine mammals, three sources of information are necessary for estimating potential effects of underwater detonations on sea turtles: the ZOI, animal density within the ZOI, and the number of detonations (events). Until recently, there were no acoustic energy or pressure impact threshold ranges specifically for sea turtles, and in the absence of such information the thresholds used for marine mammal analysis were typically applied to turtles. However, the NMFS has recently undertaken a more detailed investigation of the effects of underwater detonations on turtles and provides the following summary of potential behavioral responses at various decibel levels (Table 3-16).

Table 3-16. Range of Sea Turtle Behavioral Responses at Multiple Underwater Noise Levels

Decibel Level (Peak) Range	Response Category	Number of Animals Potentially Affected
110 – 160	Discountable effects; minor response possible, but within the range of normal behaviors.	Very few
>160 – 200	Some swimming and diving response, becoming stronger and more frequent at higher decibel levels.	Few at 160 dB; most at 200 dB
>200 – 220	Strong avoidance response.	Some to all at 220 dB
>220	Intolerable.	All individuals

dB = decibel

NMFS has also developed five criteria and threshold levels for underwater detonations. The criteria are defined as follows:

- *Mortality*: mortal injury, cracked shell, or lung/intestinal/organ damage
- *Injury*: potentially lethal physical injuries, prolonged immobilization by stunning, or auditory trauma
- *Impairment*: temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization)
- *Disturbance*: habitat displacement, increased swimming speed, or increased heart rate
- *Onset of Behavioral Response*: brief response to a single explosion, startle responses including diving and swimming

Based on this information and other research examining the effects of underwater detonations and airgun operation on turtles and other vertebrates (e.g., Richmond et al., 1973; DeRuiter and Doukara, 2012; Finneran and Jenkins, 2012), NMFS has defined the impact threshold levels shown in Table 3-17. Thresholds are defined in terms of the peak noise level (in dB) or pressure in pounds per square inch (psi). Although there has been a recent effort to address turtle-specific

thresholds, there are currently no experimental or modeling data sufficient to support development of physiological thresholds. Therefore, mortality, primary blast injury, and auditory effects continue to be based on marine mammal thresholds. Mortality and blast injury thresholds are based on the GI tract injury threshold used for marine mammals; TTS and PTS thresholds are based on those used for low-frequency functional hearing group cetaceans. However, turtle-specific behavioral responses to impulsive sounds (airguns) have been documented in the literature (e.g., McCauley et al., 2000) and have been incorporated by NMFS into behavioral categories. The disturbance threshold listed in Table 3-17 is considered to approximate a sub-TTS, high-level behavioral response. However, NMFS considers the disturbance category to apply only to explosions occurring near *Sargassum* mats that may be occupied by juvenile turtles. As described in the marine mammal discussion above, Eglin's marine species observer training course requires missions involving surface or underwater detonations to be delayed or moved if potential sea turtle indicators (including large *Sargassum* mats) are present. Therefore, the disturbance category is not considered applicable to the actions evaluated in this document and is not included in the exposure estimates provided below.

Table 3-17. Sea Turtle Exposure Thresholds for Single Underwater Detonation Events

Mortality	Injury	Impairment	Disturbance	Onset of Behavioral Response
>237 dB (peak)	>229 dB (peak)	>224 dB (peak)	>218 dB (peak)	>180 dB (peak)
102 psi	40 psi	23 psi	12 psi	0.14 psi

dB = decibel; psi = pounds per square inch

An acoustic model incorporating the above information was used to calculate the maximum estimated range, or radius, from the detonation point to which the various thresholds would extend (see Appendix D for a more detailed description of the methods). Thresholds are defined in terms of peak dB level and psi for all criteria. Therefore, the threshold that resulted in the higher exposure estimate was used in this document. These ranges were used to calculate the total area of the ZOI, which was combined with the density estimates discussed in Section 3.4.2.3 and the total number of live munitions to provide an annual estimate of the number of sea turtles potentially exposed to the various impact thresholds (Table 3-18).

Table 3-18. Number of Sea Turtles Potentially Affected by Air-to-Surface Testing and Training Missions in the EGTTR

Species	Mortality	Injury	Impairment	Behavioral
Loggerhead turtle	13	46	84	24,005
Kemp's ridley turtle	7	22	41	11,618
Leatherback turtle	3	11	22	6,056
Atlantic green turtle	6	22	40	11,287
TOTAL	**29**	**101**	**187**	**52,966**

EGTTR = Eglin Gulf Test and Training Range

The table indicates the potential for mortality and a range of other physical and behavioral effects in the absence of mitigation measures. The mitigation and monitoring requirements described previously for marine mammals would also afford some protection for sea turtles. Observers would look for turtles as well as marine mammals during pre- and post-mission surveys. In addition, Eglin AFB's marine species observer training course requires missions involving surface or underwater detonations to be delayed or moved if potential sea turtle indicators are present (large *Sargassum* mats or large jellyfish schools). However, visual surveys

conducted from boats are likely to be of limited effectiveness due to difficulties in sighting turtles and, in most cases, it would not be possible to track a turtle that is sighted and then submerges. Therefore, noise and pressure effects due to detonations at or under the water surface are likely to adversely affect sea turtles. Eglin AFB is consulting with the NMFS under Section 7 of the ESA regarding the Proposed Action. In response to consultation under the ESA, NMFS will prepare a Biological Opinion that identifies terms and conditions that Eglin AFB would be required to implement and will result in NMFS issuing sea turtle "takes" to Eglin through an Incidental Take Statement. Activities involving live air-to-surface missions would not occur within loggerhead sea turtle nearshore reproductive critical habitat or *Sargassum* marine critical habitat. In addition, critical habitat would not be significantly affected by debris or water quality alteration. Therefore, loggerhead turtle critical habitat would not be adversely affected.

Similar discussion of potential impacts to sea turtles and critical habitat resulting from the Proposed Action is provided in the associated Biological Assessment, which will be used to initiate the Section 7 Consultation. The summary of potential impacts to sea turtles is as follows:

- The Proposed Action may affect, and is likely to adversely affect, sea turtles.
- The Proposed Action would not adversely affect loggerhead sea turtle critical habitat.

Special Habitat Types

Potential impacts to special habitat types would consist of deposition of munitions and target debris onto the seafloor and associated features, target debris at the water surface, and alteration of water and sediment quality. MPAs and closed areas could be indirectly affected by negative changes to water and sediment quality, as well as physical alteration of benthic habitats resulting from large debris pieces that could sink within these protected areas or be moved into the areas by water currents. *Sargassum* habitats could be affected if floating target debris were to be transported by currents and wind into existing mats or windrows. Live bottom, hard bottom, coral, artificial reefs, and shipwrecks could be impacted by debris pieces that could settle onto these features or be moved onto them by water currents.

As discussed in Section 3.2.3, *Physical Resources–Environmental Consequences*, impacts to sediment and water quality resulting from deposition of explosive materials, explosion byproducts, and metal items would be minor, localized, and insignificant. Therefore, there would be no adverse impacts to MPAs or fishery closed areas due to the Proposed Action. Floating debris pieces would, in some cases, be picked up to the extent practical. The number of floating debris pieces that would remain on the water surface and become entrained in floating *Sargassum* mats is difficult to estimate. However, it is not anticipated that such debris would significantly affect the algae or associated species.

Coral reefs, hard-bottom areas, and artificial reefs occur in the EGTTR (Figure 3-8), but there are no known resources at the proposed site of increased air-to-surface activity (Maritime WSEP test area). Although missions would be planned to avoid these habitats, there is some potential for debris to be carried to hard-bottom areas by currents and cause some minimal damage. In addition, some AFSOC missions could occur in other areas located farther offshore, potentially in water depths greater than 200 meters (656 feet). These missions could occur in any area clear

of surface vessels, and specific sites would not be designated. There is, therefore, some potential for gunnery rounds or ordnance debris pieces to settle onto hard structures. However, due to the distribution of such features throughout the northern GOM and the low probability of missions randomly occurring over any given structure, the potential for such scenarios to cause significant damage is considered low, and effects to bottom structures would not be significant.

Alternative 1

Potential impacts to marine fish, EFH, marine mammals, sea turtles, MPAs, fishery closed areas, and *Sargassum* habitat under Alternative 1 would be the same as those discussed for the Proposed Action. Any proposed alternate target site would be investigated using side-scan sonar, a magnetometer, and subbottom profiler. Areas with artificial reefs or detectable hard bottom would be avoided. With implementation of this practice, there would be no significant impacts to bottom habitats under Alternative 1. The number of marine mammals and sea turtles potentially exposed annually to the various pressure and noise impact thresholds is shown in Table 3-19 and Table 3-20. These estimates do not take into account mitigation and monitoring measures that would be required, as described for the Proposed Action and in Chapter 5, *Management Practices*. In addition, Eglin AFB is consulting with the NMFS regarding the takes through preparation of a LOA request under the MMPA and Section 7 consultation under the ESA. Eglin would adhere to any management requirements identified by NMFS. With implementation of the measures, the Air Force concludes there would be no significant impact to marine mammals or sea turtles under Alternative 1.

Table 3-19. Number of Marine Mammals Potentially Affected Annually by Air-to-Surface Testing and Training Missions in the EGTTR, Alternative 1

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	1.09	153	8,551	24,668
Atlantic spotted dolphin	0.40	56	1,923	4,654
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.05	0.36	1	63
TOTAL	**1.54**	**209**	**10,475**	**29,385**

EGTTR = Eglin Gulf Test and Training Range: TTS = temporary threshold shift

Table 3-20. Number of Sea Turtles Potentially Affected Annually by Air-to-Surface Testing and Training Missions in the EGTTR, Alternative 1

Species	Mortality	Injury	Impairment	Behavioral
Loggerhead turtle	13	56	137	22,938
Kemp's ridley turtle	6	28	65	11,099
Leatherback turtle	2	13	35	5,818
Atlantic green turtle	6	26	64	10,799
TOTAL	**27**	**123**	**302**	**50,564**

EGTTR = Eglin Gulf Test and Training Range

No Action Alternative

Potential impacts to biological resources resulting from the No Action Alternative were analyzed in the 2002 PEA. The analysis, which is incorporated here by reference, concluded that there would be no significant impacts to any resources, including plankton, invertebrates, fish and EFH, birds, marine mammals, sea turtles, and special biological resource areas (hard bottom and *Sargassum* habitat). Refer to the 2002 PEA for a detailed description of potential impacts, mitigation measures, and conclusions.

3.5 CULTURAL RESOURCES

3.5.1 Definition of the Resource

Cultural resources consist of prehistoric and historic sites, structures, artifacts, and any other physical or traditional evidence of human activity considered relevant to a particular culture or community for scientific, traditional, religious, or other reasons.

As defined under 32 CFR 800 (l)(1), "Historic Property means any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria."

The protection of GOM submerged traditional cultural properties falls within federal and state jurisdiction. Federal waters extend 12 nautical miles into the GOM, while state territorial waters extend 9 nautical miles into the GOM. The shoreline and offshore area is under the jurisdiction of the U.S. Department of the Interior (DOI). In the past, the Eglin Cultural Resources Office has coordinated the requirements of Section 106 of the National Historic Preservation Act (NHPA) with the Florida State Historic Preservation Officer (SHPO) and Minerals Management Service of the Outer Continental Shelf Region, DOI (U.S. Air Force, 2006).

There are three primary laws that address submerged cultural resources: the NHPA, the Abandoned Shipwreck Act, and the Florida Historical Resources Act. Section 106 of the NHPA, as amended, applies to submerged as well as terrestrial cultural resources. Section 106 requires all federal agencies to identify any historic properties that any undertaking has the potential to affect and seek ways to avoid or minimize any adverse effects on these historic properties. Furthermore, eligibility for listing on the NRHP must be determined. The EEZ is under the jurisdiction of the DOI. The Abandoned Shipwreck Act of 1987 gives the jurisdiction over historic shipwrecks to the federal government extending to the EEZ. This applies even if the shipwreck is within state waters. Before engaging in an activity that may negatively affect a shipwreck, this act requires consideration of the effect that the activity may have, often mandating preservation. The *Florida Historical Resources Act* protects sites on state-owned submerged land within the GOM (U.S. Air Force, 2006).

Analysis Methodology

The cultural resources section describes known historic properties within the affected areas that are potentially eligible for the NRHP and evaluates whether elements of the Proposed Action and alternatives would potentially affect these resources. They include any archaeological or shipwreck resources considered eligible, potentially eligible, or currently listed on the NRHP.

The Air Force currently requires activity restrictions and limitations, as well as avoidance and mitigation measures, to protect cultural resources on Eglin AFB. These measures are designed to avoid impacts to these resources. Eglin AFB Range users also observe procedures in Eglin AFB Instruction 13-212, where applicable, regarding cultural resources.

Cultural resources were analyzed by assessing each resource's state of investigation and condition, then evaluating the resource as it intersects with the Area of Potential Effects (APE) created by the Proposed Action. As defined under 36 CFR 800.16(d), "the Area of Potential Effects is the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist." The APE for this project is assumed not to extend beyond the footprint of the activity boundaries as defined within Chapters 1 and 2.

Significance Determination

Properties identified in the APE by the Air Force are evaluated according to the NRHP criteria, in consultation with the SHPO and other parties. Typically, if the SHPO and other parties and the Air Force agree in writing that a historic property is eligible or not eligible for listing on the NRHP, that judgment is sufficient for purposes of Section 106 (36 CFR 800.4[c][2]). Relevant procedures and criteria can be found in 36 CFR 63, Determinations of Eligibility for Inclusion in the National Register of Historic Places.

3.5.2 Affected Environment

Historic naval activity in the Gulf of Mexico began as early as 1513 when Ponce de Leon sailed around the Florida Keys into the area of present-day Tampa. In 1528 Panfilo de Narvaez also landed near present-day Tampa Bay and proceeded north to the vicinity of Apalachee. In 1559, Spaniard Tristan de Luna y Arellano lost all except three of his supply ships to a hurricane near Pensacola, Florida (NPS, 2015).

Historic naval activity continued in the Gulf from the seventeenth through nineteenth century with alternating incursions of French, Spanish and English colonists and conquerors. In the early 1800s as the Americans took control of Spanish Florida and Louisiana, the region saw a steady rise in American merchant shipping traffic traversing the Gulf. Strategic ports and fortresses around the Gulf of Mexico also accounted for the presence of American military vessels throughout the nineteenth and twentieth centuries (NPS, 2015).

Ships have been lost since the period of Spanish exploration until the modern age of shipping and commerce (U.S. Air Force, 2006). Shipwrecks within the Gulf of Mexico were often due to the severe summer weather that is common to the area. It has been postulated that less than 2 percent of pre-twentieth century ships and less than 10 percent of all ships reported lost in the Gulf between 1500 and 1945 have known locations (U.S. Air Force, 2006). There are 304 known shipwrecks identified within the EGTTR area of influence (NOAA, 2015) (Table 3-21). Due to the sensitive condition of these shipwrecks and the need to keep them protected from looting and salvage activities, the locations of known wrecks will not be included in this document.

Table 3-21. Identified Wrecks under EGTTR Airspace

Airspace	# Wrecks	Airspace	# Wrecks	Airspace	# Wrecks
EWC	2	W-151B	12	W-174A	2
EWC-C	1	W-151B-2	2	W-174B	15
EWTA-1*	1	W-151B-5	1	W-174C	1
EWTA-2	4	W-151BD	13	W-174D	2
EWTA-2A	1	W-151CD	1	W-174E	6
EWTA-2B	3	W-151D	1	W-174F	1
EWTA-3	4	W-151D-2	1	W-174G	1
EWTA-4	2	W-151E	1	W-470	13
EWTA-5	8	W-151E-2	1	W-470A	5
NSC	7	W-151S-3*	3	W-470A-1	4
R-2914A	4	W-151S-4**	1	W-470A-2	1
R-2915B	1	W-151S-5*	2	W-470AB	9
R-2915C	1	W-151S-6*	1	W-470B	4
R-2919A	3	W-151TTA	6	W-470B-2	5
Tyndall MOA E	3	W-155	13	W-470BC	7
Tyndall MOA F	3	W-155 AREA 1	8	W-470BC-1	2
Tyndall MOA G	4	W-155 AREA 3	11	W-470BC-2	5
W-151	18	W-155 AREA 5	2	W-470C	2
W-151A	4	W-155A	3	W-470C-1	2
W-151A-1	1	W-155B	2	W-470E	2
W-151AB	16	W-168	7		
W-151AC	4	W-174	28		

NOAA, 2015; *High Probability for Shipwrecks in this area, **High Probability for Prehistoric Resources and Shipwrecks in this area (U.S. Air Force, 2002)

Eglin has documented the location of known shipwrecks within their over-water ranges (U.S. Air Force, 2006; U.S. Air Force, 2013). The ICRMP and Historic Preservation Plan for Eglin AFB do not have any specific information regarding the management of submerged resources. Eglin AFB is currently developing a Programmatic Agreement that will deal with the identification, treatment and management of submerged as well as terrestrial resources on Eglin AFB and its ranges.

Other resources in the Gulf include underwater archaeological and shipwreck preserves. Only one of these preserves is located within the EGTTR, the SS Tarpon. The Tarpon was a freight and passenger steamer constructed in 1887. Beginning in 1903, the Tarpon started weekly trips from Mobile to Panama City, making stops in Pensacola. Early in the morning of September 1,

1937, the SS Tarpon sank 7.8 nautical miles from shore with a loss of 18 lives. The wreck of the SS Tarpon became a Florida Underwater Archaeological Preserve in 1997, and subsequently listed on the National Register of Historic Places in 2001 (DHR, 2015).

Because of the gradual rise in sea level over time, submerged prehistoric sites may also be present in the Gulf along historic river channels and relict shorelines in particular. Prehistoric peoples had a tendency to settle near coastlines and riverine areas because of the abundance of easily exploitable resources (U.S. Air Force, 2002; U.S. Air Force, 2006).

Criteria used to determine potential for submerged prehistoric sites include submerged geologic formations that suggest a high probability of associated prehistoric sites and the known conditions that would preserve a site, such as sedimentation and tidal movement. Due to the relatively high wave action in the central Gulf region, prehistoric site preservation in this area is considered low. Sites that may exist in coastal environments based upon historic seal level include Paleo-Indian, Archaic, and Early Gulf formational periods (U.S. Air Force, 2002; U.S. Air Force, 2006).

3.5.3 Environmental Consequences

Eglin Cultural Resources is responsible for identifying resources and impacts within the 12-NM offshore area. Consultation procedures cited in *The Management Plan for Florida's Submerged Resources* (1994) follow the standard Section 106 compliance process and promote avoidance as the primary method of avoiding adverse effects to cultural resources. For the over water ranges in the EGTTR located outside of state waters, the *Handbook for Archaeological Resource Protection*, presents guidelines for the identification of submerged cultural resources (U.S. Air Force, 2002; U.S. Air Force, 2006).

Proposed Action

The activity that has the greatest potential to impact cultural resources is munitions use. Test and training would occur on offshore waters of the GOM and some of the proposed munitions testing and training activities have the potential to disturb the sediments and underwater cultural resources if present. In the case of underwater and surface detonations, it is unlikely that detonation overpressure generated by these munitions could potentially impact sediments or structures on the seafloor. It is more likely that debris or UXO from ordnance or portions of destroyed target boats could sink and directly impact sediments containing cultural resources or likewise affect any shipwrecks present.

In 2013, Eglin AFB Cultural Resources Office conducted a remote sensing survey around the existing live air-to-surface target area using side-scan sonar, a magnetometer, and a subbottom profiler to confirm the presence or absence of potential historic shipwrecks (Hanks, 2013). The results of this survey were that all magnetic anomalies recorded were likely modern debris and it was recommended that neither avoidance nor further investigation was necessary. In summary, no adverse effects to cultural resources are anticipated under the Proposed Action.

Alternative 1

Effects to cultural resources would be identical to those discussed under the Proposed Action with the exception of the expansion of the live air-to-surface target location to include any point within a 5-mile radius of the existing live air-to-surface target location described for Maritime WSEP missions above. An alternative target location could be chosen anywhere within the 5-mile radius zone.

Should the Air Force expand or move the current air-to-surface target area from its current location to a new location as proposed, a detailed analysis and remote sensing survey would be required for any new live air-to-surface target areas. Consultation with SHPO and completion of the Section 106 process would be required. Should historic properties be identified within this survey area, avoidance of the resource or other additional mitigation measures would be necessary. Until the Section 106 process is complete, there is a danger of direct adverse effects to any cultural resources present in the new target area.

No Action Alternative

No adverse effects to cultural resources are anticipated under the No Action Alternative. Under the No Action Alternative only those missions authorized as part of the 2002 PEA would be authorized. Any current or future planned test and training activities would require additional NEPA and NHPA consideration if continued or proposed.

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4. CUMULATIVE IMPACTS

4.1 PAST, PRESENT AND REASONABLY FORESEEABLE FUTURE ACTIONS

Past, present and reasonably foreseeable future actions with the potential for cumulative impacts include other military testing and training, commercial and recreational fishing, maritime transportation, scientific research and oil and gas exploration and operations. The Naval Surface Warfare Center, Panama City Division (NSWC PCD), researches, develops, tests and evaluates mine warfare systems, naval special warfare systems, diving and life support systems, and amphibious/expeditionary maneuver warfare systems in the coastal environment. NSWC PCD missions do occur within the EGTTR but are analyzed in separate NEPA documents prepared by the Navy.

4.2 CUMULATIVE IMPACTS

Safety/Restricted Access

In addition to closures from the Proposed Action, areas and resources of the EGTTR may also be temporarily closed or inaccessible to the public from seasonal fishing limitations, other military activities such as those of the NSWC PCD, and catastrophic events like hurricanes or major oil spills. In the EGTTR, NSWC PCD and Air Force activities would have a potential cumulative restricted access impacts if missions occurred at the same time and together closed off to the public a greater combined area. Military actions that require closures are normally scheduled during the week and avoid peak tourist times such as holiday weekends and tournaments. Significant cumulative impacts are not anticipated.

Physical Resources

The Proposed Action and alternatives involve incidental expenditure of chemical materials and debris into the water column and onto the seafloor. However, chemical, physical, or biological changes to sediments or water quality would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses. Chemical materials include metals associated with weapons and targets, explosive byproducts and, in some cases, petroleum products. Past and previous actions have been analyzed through NEPA documentation for effects to physical resources, and results indicate that the quantity of explosive byproducts and petroleum products cumulatively expended is small and results in overall insignificant effects to water or sediment quality.

Chemical materials are quickly dispersed by waves and currents and are transformed by various processes such as assimilation into the carbonate system, metabolism and assimilation by microbial organisms, release in gaseous form to the atmosphere, and by photic and microbial degradation. Metal fragments from weapons and targets that sink to the seafloor may result in an elevated concentration of metal ions near the fragments. However, the contribution of metals resulting from the test and training activities are not expected to affect a significant portion of Gulf habitat, and the metal fragments corrode and degrade over time.

The quantity of debris is not considered sufficient to significantly affect the seafloor by scouring. Known hard bottom habitat is avoided. There would be no significant cumulative impact to physical resources due to live air-to-surface weapons testing and training. Most expendables are inert and/or become submerged in sandy sediment or encrusted in biologicals. Furthermore, in general, these short- or long-term impacts would be spaced out spatially and temporally. For example, Air Force detonations would not occur near oil and gas exploration operations and typically do not occur during the most active recreational use seasons. Therefore, cumulative impacts are not likely to be significant.

Biological Resources

Cumulative impacts to biological resources could occur if the species or habitats impacted by the Proposed Action would also be affected by other military, industrial, commercial, or recreational uses of the northern GOM.

The U.S. Navy conducts various operations in the Gulf that involve detonations and sonar operation, which may result in effects to marine species related to pressure and noise. Navy activities may occur throughout the northeastern GOM but may be concentrated in the Panama City, Pensacola, New Orleans, and Corpus Christi Operating Areas. Individuals of marine mammal, sea turtle, and fish species affected by the Proposed Action of this REA could be similarly impacted by Navy activities, with potential impacts including mortality, injury, hearing effects, and behavioral effects. Navy actions with the potential to affect protected marine species must undergo evaluation pursuant to the MMPA and/or ESA and, similar to this REA, NMFS typically requires monitoring and mitigation measures to reduce the potential for impacts. Due to the sporadic occurrence of many species in any given area and the required protection measures, significant cumulative impacts due to Navy activities are not expected.

The Bureau of Ocean Energy Management regulates many activities related to natural gas and oil exploration and extraction in the northern GOM. While most activities of this nature take place offshore of Alabama, Louisiana, and Texas, there is potential for large mobile marine species such as dolphins and turtles to move throughout the northern Gulf and be affected by oil and gas as well as Air Force activities. Seismic airguns that are used by the industry to map the seafloor, produce impulsive noise. Water quality can be affected by the use of survey vessels or other equipment through incidental release of petroleum products (gasoline, diesel fuel, oil, etc.). In addition, accidents such as the Deepwater Horizon event may release materials with the potential to move with water currents and harm water and sediment quality as well as benthic organisms some distance from the original site. Extensive mitigation, monitoring, and other protective measures are required during oil and gas activities. Although still possible, these measures decrease the likelihood of multiple impacts to individual animals or specific habitat areas.

Protected fish species may be intentionally or unintentionally impacted during commercial and recreational fishing. However, regulatory limits (seasonal restrictions, size limits, etc.) on commercial and recreational fishing, and targeting of specific species and seasons during commercial fishing, decrease the potential for substantial impacts to any fish population. Sea turtles are susceptible to capture in shrimp trawling nets, but required protections such as Turtle Excluder Devices have substantially decreased injury and mortality associated with shrimp

fishing. Cumulative impacts to biological resources resulting from commercial and recreational fishing would not be significant.

Socioeconomic Resources

Restricted access associated with past, present, and foreseeable actions would result in additional closures of portions of the EGTTR potentially having a cumulative socioeconomic impact on recreational and commercial fisherman. In addition, increased military activities along with potential regulations on reduced fishing limits, reduced seasons for certain fish species, and natural and manmade disasters (e.g., hurricanes, oil spills) could result in more difficulty in planning fishing activities, which could affect commercial fishing income. Access restrictions due to EGTTR missions would continue to be temporary, lasting approximately less than a half day. Continued coordination between the Air Force and fishermen, and advanced notification of testing times and dates through the use of NOTMARs and other media sources, would allow time for recreational and commercial fisherman to plan accordingly which could help minimize costs. Also, the Air Force would continue to employ commercial fishing boats to help maintain the safety danger zone, which could alleviate the potential loss of income for some during testing activities. Through continued implementation of advance communication and coordination management practices, the potential for significant cumulative impacts to socioeconomic resources are anticipated to be minimal.

Cultural Resources

Damage to the nature, integrity, and spatial context of cultural resources can have a cumulative impact if the initial act is compounded by other similar losses or impacts. The alteration or damage to underwater resources or the disturbance of shipwrecks may incrementally impact the maritime resources around Eglin AFB in Florida coastal waters.

Potential hazards to seafloor resources in addition to the Proposed Action would most likely come from direct physical contact to resources during recreational activities in the Gulf. Although the possibility for direct impact to a specific resource is remote (given the vast area of the Gulf where these activities take place), the potential for diving activities or boat anchors to damage resources does exist. There is no way at present to assess or mitigate potential damage from these activities.

Within the area of potential effect, the most likely candidate to cumulatively damage potential resources is the Proposed Action and currently occurring activities. These proposed and ongoing test and training activities, which involve potentially impactful munitions usage, are guided by current operating instructions, such as Eglin AFB Instruction 13-212. These operating instructions, as well as standard operating procedures set forth in Eglin AFB *Integrated Cultural Resources Management Plan*, would be followed during project implementation. If other past, present and future projects follow this guidance and also complete the Section 106 process, given the required coordination with users and tenants of Eglin and 96 CEG/CEIEA Cultural Resources Office, required mitigation and BMPs, as well as any measures recommended by the SHPO, mission activities are not expected to contribute to cumulative impacts to historic properties within the EGTTR.

4.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Implementation of the Proposed Action would irretrievably commit the use of nonrenewable resources such as fuel and materials contained in expended items and targets. Some components of targets would be retrieved and reused; however expended munitions would not. The Proposed Action would inevitably require the use of some nonrenewable resources. However, the action is not expected to result in the destruction or degradation of environmental resources to the point that their use is appreciably limited presently or in the future.

5. MANAGEMENT PRACTICES

The management practices discussed in this section are currently or historically observed measures to offset or limit potential impacts to people or natural and cultural resources. The Air Force will continue to implement these measures in carrying out the testing and training missions of the Proposed Action and alternatives.

5.1 SAFETY

Management practices related to safety are described in detail in various portions of Section 3.1, *Safety*. A comprehensive summary list of these practices is provided below.

- When safety hazard areas are to be activated, the public will be notified that the affected airspace is closed to commercial and private use through coordination with the controlling agency for that airspace, and by providing a Notice to Airmen (NOTAM).
- When safety hazard areas are to be activated, a Notice to Mariners (NOTMAR) will be issued in advance of each mission and will include a description of the hazard, mission area location, and time frame of closure. The NOTMAR would be broadcast on channel 16 through the U.S. Coast Guard.
- When safety hazard areas are to be activated, 96 RANSS personnel will distribute at local public docks flyers explaining the closure, and diagramming the area to be closed.
- When safety hazard areas are activated, mission support vessels will establish a safety zone to protect mission personnel and the public. Recreational and commercial vessels will be excluded from the safety zone, and missions will not proceed until the zone is declared free of unauthorized personnel. The size of the safety zone will be determined by the Eglin Safety Office and will depend on factors such as the type of munition, method of delivery, etc.
- When safety hazard areas are activated, participating aircraft will survey the mission area before munition launch or drop when appropriate.
- When safety hazard areas are activated and when feasible, mission personnel located in Eglin's CCF on main base will view live video feed before and during test activities, and missions will not proceed until the target area is confirmed to be clear of unauthorized vessels.
- Eglin Range personnel will retrieve to the extent practicable damaged targets and target debris.
- UXO remaining on floating target vessels will be disposed of by Eglin EOD.
- The Eglin Safety Office Risk Management Board will review each proposed test or training mission in advance to identify risks. Missions considered "high risk" will be elevated to the base commander for further review.

5.2 SOCIOECONOMIC RESOURCES

- Provide a NOTMAR in advance of each mission area closure to minimize the economic impact to commercial and recreational fishing vessels.
- Incorporate local charter vessels in EGTTR missions when feasible.

5.3 BIOLOGICAL RESOURCES

Management practices related to biological resources consist of searches of potential mission sites, avoidance of certain bottom features, and surveys and other protection measures for marine species. Detailed information on surveys and other related actions is provided in the Letter of Authorization request submitted to NMFS pursuant to the MMPA, the Biological Assessment submitted to NMFS pursuant to the ESA, and the Biological Opinion prepared by NMFS pursuant to the ESA. A comprehensive summary list of these activities is provided below.

- Avoid locating missions in areas of known hard bottom, artificial reefs, and shipwrecks.
- Investigate alternate air-to-surface bomb and missile target sites using side-scan sonar, a magnetometer, and subbottom profiler. Avoid any alternate areas where hard bottom, artificial reefs, or shipwrecks are detected.
- For each air-to-surface mission using live bombs or missiles, trained observers will conduct pre- and post-mission monitoring for protected marine species (dolphins and sea turtles) and indicators of these species. The size of the survey area will generally be determined by the amount of explosive material used.
- Live air-to-surface missions will be delayed or rescheduled if the sea state is such that protected marine species monitoring cannot be conducted.
- When air-to-surface bombs or missiles will be expended, participating aircraft will survey the mission area before munition launch or drop when appropriate.
- When air-to-surface bombs or missiles will be expended and when feasible, mission personnel located in Eglin's CCF on main base will view live video feed before and during test activities, and missions will not proceed until the target area is confirmed to be clear of protected species.
- For gunnery missions involving AC-130 or CV-22 aircraft, aircrews will conduct pre-mission surveys for protected species.
- For gunnery missions involving AC-130 or CV-22 aircraft, aircrews will use 105 mm training rounds at night and will implement ramp-up procedures.
- Avoid large *Sargassum* mats or drift lines.

5.4 CULTURAL RESOURCES

- Conduct a cultural resource survey prior to establishing a new GRATV anchoring location. Surveys may require side-scan sonar, a magnetometer, and sub-bottom profiler to detect the presence of cultural resources.

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APPENDIX A

COASTAL ZONE MANAGEMENT ACT (CZMA) CONSISTENCY DETERMINATION

FEDERAL AGENCY COASTAL ZONE MANAGEMENT ACT (CZMA) CONSISTENCY DETERMINATION

This document provides the State of Florida with the U.S. Air Force's Consistency Determination under CZMA Section 307 and 15 C.F.R. Part 930 sub-part C. The information in this Consistency Determination is provided pursuant to 15 C.F.R. Section 930.39 and Section 307 of the Coastal Zone Management Act, 16 U.S.C. § 1456, as amended, and its implementing regulations at 15 C.F.R. Part 930.

This federal consistency determination addresses current and anticipated operational impacts captured within the *Eglin Gulf Test and Training Range (EGTTR), Range Environmental Assessment (REA)*, Eglin Air Force Base (AFB), Florida.

Proposed Federal Agency Action:

The Proposed Action represents a continuation of all activities described in the 2002 *EGTTR Programmatic Environmental Assessment (PEA)*, plus additional activities that have become necessary or are expected to become necessary for Eglin AFB to fulfill its mission since completion of the 2002 PEA. The actions previously analyzed in 2002 include air-to-air, air-to-surface, surface-to-surface, and other miscellaneous types of missions. A detailed description of each of these missions is provided in *Section 2.5 of the REA*.

The additional test and training activities that would be conducted in the EGTTR consist primarily of air-to-surface missions, although a few other types of missions would be included. Many of the missions would include using live munitions. Each type of test, training, and support activity and the specific organizations associated with operations are described in *Sections 2.2.1 through 2.2.9 of the REA*.

Federal Consistency Review:

Statutes addressed as part of the Florida Coastal Zone Management Program consistency review and considered in the analysis of the Proposed Action are discussed in the following table.

Pursuant to 15 C.F.R. § 930.41, the Florida State Clearinghouse has 60 days from receipt of this document in which to concur with or object to this Consistency Determination, or to request an extension, in writing, under 15 C.F.R. § 930.41(b). Florida's concurrence will be presumed if Eglin AFB does not receive its response on the 60th day from receipt of this determination.

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
Chapter 161 *Beach and Shore Preservation*	The Proposed Action would not affect beach and shore management, specifically as it pertains to: • The Coastal Construction Permit Program. • The Coastal Construction Control Line (CCCL) Permit Program. The Proposed Action would not result in significant adverse impacts to beaches and shores of the state, as described in *Section 3.1 and 3.2 of the REA*. Potential issues resulting from test and training missions to beaches and shores include debris, and unexploded ordnance (UXO). There is a potential for debris to wash ashore and become litter on the beach; however, due to the fact that debris would be distributed over a large area of the Gulf of Mexico (GOM) and that debris cleanup would occur after the mission, the potential to impact beaches and shores is considered low. UXO may fall within the mission area or may land in or migrate to other areas used by the public; however the frequency of dudded munitions is low. The potential for UXO burial and/or migration is dependent upon factors such as bottom topography, substrate characteristics, and local water currents, which may vary in intensity and direction over time. In some cases, submerged UXO would corrode and degrade over time in the saltwater environment or become entombed within the seabed. UXO may also be subject to concretion, whereby the munition becomes encased by minerals, metals, or biogenic accretion. In addition, the Proposed Action area is characterized by stable bathymetry and low energy, thus migration of UXO shoreward is not expected to occur. Therefore, the Proposed Action would be consistent with Florida's statutes and regulations regarding the protection of beaches and shores of the state.	This statute provides policy for the regulation of construction, reconstruction, and other physical activities related to the beaches and shores of the state. Additionally, this statute requires the restoration and maintenance of critically eroding beaches.

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
Chapter 163, Part II *Growth Policy, County and Municipal Planning: Land Development Regulation*	The Proposed Action would not affect local government comprehensive plans.	Provide for the implementation of comprehensive planning programs to guide and control future development of the state.
Chapter 186 *State and Regional Planning*	The Proposed Action would not affect state plans for water use, land development, or transportation.	Provides direction for the delivery of governmental services, a means for defining and achieving the specific goals of the state, and a method for evaluating the accomplishment of those goals in regards to the state comprehensive plan.
Chapter 252 *Emergency Management*	The Proposed Action would not affect the state's vulnerability to natural disasters. The Proposed Action would not affect emergency response and evacuation procedures.	Directs the state to reduce the vulnerability of its people and property to natural and manmade disasters; prepare for, respond to and reduce the impacts of disasters; and decrease the time and resources needed to recover from disasters.
Chapter 253 *State Lands*	The Proposed Action would not result in significant adverse impacts to the conservation, protection, or disposition of state lands. As described in *Section 3.2 of the REA*, there would be no significant impacts to physical resources. Impacts to water column and substrate quality due to chemical materials and metals from expendables would be minor. Detonations would not be of sufficient strength to cause seafloor cratering. Scouring of the seafloor by debris pieces would be minor. Management practices identified in *Section 5 of the REA* would be implemented to minimize any potential impacts to state lands. Therefore the Proposed Action would be consistent with Florida's statutes and regulations regarding the acquisition, administration, management, control, supervision, conservation, protection, and disposition of public lands.	Addresses the acquisition, administration, management, control, supervision, conservation, protection, and disposition of all state lands.
Chapter 258 *State Parks and Preserves*	The Proposed Action would not affect the state's management of state parks, aquatic preserves or recreational areas.	Addresses the state's administration of state parks, aquatic preserves, and recreation areas.

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
Chapter 259 *Land Acquisitions for Conservation or Recreation*	For public safety, missions would not proceed until the target area is cleared of unauthorized vessels; see *Section 3.1 of the REA*. In addition, management practices identified in *Section 5 of the REA* would be implemented to avoid conflicts with the public. The Proposed Action would not result in significant impacts with regard to safety or restricted access to public lands. Therefore the Proposed Action would be consistent with Florida's statutes and regulations regarding the management of conservation and recreation on state lands.	Addresses public ownership of natural areas for purposes of maintaining the state's unique natural resources; protecting air, land, and water quality; promoting water resource development to meet the needs of natural systems and citizens of this state; promoting restoration activities on public lands; and providing lands for natural resource based recreation.
Chapter 260 *Florida Greenways and Trails Act*	The Proposed Action would not affect the Greenways and Trails Program.	Statewide system of greenways and trails established in order to conserve, develop, and use the natural resources of Florida for healthful and recreational purposes.
Chapter 267 *Historical Resources*	The part of the Proposed Action that has the greatest potential to impact cultural resources is munitions use; see *Section 3.5 of the REA*. There is the potential that debris or UXO could sink and directly impact sediments containing cultural resources or likewise affect any shipwrecks present. In 2013, Eglin AFB Cultural Resources Office conducted a remote sensing survey around the existing live air-to-surface target area using sidescan sonar, a magnetometer, and a subbottom profiler. The results of this survey suggested that neither avoidance nor further investigation was necessary. No adverse effects to cultural resources are anticipated under the Proposed Action. If an alternate site is selected for mission operations, then an additional survey for cultural resources would be required through the Eglin Cultural Resources Office which would consult with the State Historic Preservation Officer (SHPO) and complete Section 106 consultation. Therefore the Proposed Action would be consistent with Florida's statutes and regulations regarding the state's archaeological and historical resources.	Addresses the management and preservation of the state's archaeological and historical resources.
Chapter 288 *Commercial Development*	The Proposed Action would not affect future business opportunities on state lands,	Promotes and develops general business, trade, and tourism

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
and Capital Improvements	or the promotion of tourism in the region.	components of the state economy
Chapter 334 *Transportation Administration*	The Proposed Action would not affect transportation administration.	Addresses the state's policy concerning transportation administration.
Chapter 339 *Transportation Finance and Planning*	The Proposed Action would not affect the finance and planning needs of the state's transportation system.	Addresses the finance and planning needs of the state's transportation system.
Chapter 373 *Water Resources*	Potential impacts associated with the Proposed Action are the release of materials into the water that then disperse, react, or dissolve; the deposition of materials on the ocean bottom and any subsequent interactions with sediment or the accumulation of such materials over time; the deposition of materials or substances on the ocean bottom and any subsequent interaction with the water column; and the deposition of materials on the ocean bottom and any subsequent disturbance of that sediment or the creation of turbidity (see *Section 3.2 of the REA*). Potential impacts on sediment and water quality from testing and training activities involving materials with metal components would occur over a long period, but the impact would be primarily contained to the area immediately surrounding the metal object on the seafloor. The majority of these components would become quickly buried in sediment. If not, they would likely become encrusted with sea life or covered in a corrosive layer. This would cause metals to corrode very slowly over many years, releasing only small quantities of metal compounds into the water or surrounding sediment. Neither state nor federal standards or guidelines would be exceeded. Furthermore, management practices identified in *Section 5 of the REA* would be implemented to minimize potential impacts to water resources. Therefore the Proposed Action would be consistent with Florida's statutes and regulations regarding the water resources of the state.	Addresses sustainable water management; the conservation of surface and ground waters for full beneficial use; the preservation of natural resources, fish, and wildlife; protecting public land; and promoting the health and general welfare of Floridians.
Chapter 375 *Outdoor Recreation and Conservation Lands*	The Proposed Action would not affect opportunities for recreation on state lands.	Addresses the development of a comprehensive multipurpose outdoor recreation plan, with the purpose to

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
		document recreational supply and demand, describe current recreational opportunities, estimate the need for additional recreational opportunities, and propose the means to meet the identified needs.
Chapter 376 *Pollutant Discharge Prevention and Removal*	Potential impacts from debris and UXO resulting from the Proposed Action are analyzed in *Section 3.1 and 3.2 of the REA*. As the Proposed Action area is characterized by stable bathymetry and low energy, migration of UXO shoreward is not expected to occur. Floating target debris would be retrieved. Therefore the Proposed Action would be consistent with Florida's statutes and regulations regarding the transfer, storage, transportation of pollutants, and cleanup of pollutant discharges.	Regulates transfer, storage, and transportation of pollutants, and cleanup of pollutant discharges.
Chapter 377 *Energy Resources*	The Proposed Action would not affect energy resource production, including oil and gas, and/or the transportation of oil and gas.	Addresses regulation, planning, and development of the energy resources of the state; provides policy to conserve and control the oil and gas resources in the state.
Chapter 379 *Fish and Wildlife Conservation*	Potential impacts on biological resources, including sensitive species are analyzed in *Section 3.4 of the REA*. Marine fish may be injured or killed by detonations, but the number would be negligible relative to overall populations. A small number of fish could be affected by debris ingestion or water quality effects. Activities would occur outside the primary distribution range of federally protected fish species, and Gulf sturgeon critical habitat would not be affected. Detonations would not significantly affect benthic communities. Known hard bottom habitats and artificial reefs would be avoided. Essential fish habitat and other protected marine habits would not be significantly impacted. Significant impacts to marine birds, including federally listed and migratory species, are not expected. Marine mammals and sea turtles could be exposed to noise or blast pressure resulting in mortality, injury, or harassment. Effects to marine mammals and sea turtles resulting from debris and boat strikes/physical	Establishes the framework for the management and protection of the state of Florida's wide diversity of fish and wildlife resources.

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
	disturbance would not be significant. In addition, mitigation measures resulting from the Endangered Species Act (ESA) Section 7 consultation, the Essential Fish Habitat consultation, and the Letter of Authorization (LOA) for the Marine Mammal Protection Act (MMPA) with the National Marine Fisheries Service (NMFS) would be implemented to reduce impacts to protected species and their habitat. Therefore, the Proposed Action would be consistent with Florida's statutes and regulations regarding the protection of fish and wildlife resources of the state.	
Chapter 380 *Land and Water Management*	The Proposed Action would not affect development of state lands with regional (i.e., more than one county) impacts. The Proposed Action would not include changes to coastal infrastructure such as capacity increases of existing coastal infrastructure, or use of state funds for infrastructure planning, designing or construction.	Establishes land and water management policies to guide and coordinate local decisions relating to growth and development.
Chapter 381 *Public Health, General Provisions*	The Proposed Action would not affect the state's policy concerning the public health system.	Establishes public policy concerning the state's public health system.
Chapter 388 *Mosquito Control*	The Proposed Action would not affect mosquito control efforts.	Addresses mosquito control efforts in the state.
Chapter 403 *Environmental Control*	The Proposed Action would release emissions from munitions use, surface craft, and aircraft over a large area, mostly beyond state waters and within the territorial sea. Emissions from EGTTR operations would not be significant (see *Section 1.5.1 of the REA*). The Proposed Action would not have significant impacts to the water quality from the release of expendables (see *Section 3.2 of the REA*). As the Proposed Action area is characterized by stable bathymetry and low energy, migration of UXO shoreward is not expected to occur. Floating target debris would be retrieved (see *Section 3.1 and 3.2 of the REA*). Therefore the Proposed Action would be consistent with the State's policies	Establishes public policy concerning environmental control in the state.

Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
	concerning air quality, water quality, pollution control, solid waste management, and other environmental control efforts.	
Chapter 553 *Building and Construction Standards*	The Proposed Action would not include construction of buildings.	Addresses building construction standards and provides for a unified Florida Building Code.
Chapter 582 *Soil and Water Conservation*	The Proposed Action would not affect soil and water conservation efforts.	Provides policy regarding the control and prevention of soil erosion.
Chapter 597 *Aquaculture*	The Proposed Action would not affect state aquaculture or the conservation of aquatic resources.	Establishes public policy concerning the cultivation of aquatic organisms of the state. Addresses state aquaculture plan which provides for the coordination and prioritization of state aquaculture efforts, the conservation and enhancement of aquatic resources and provides mechanisms for increasing aquaculture production.

APPENDIX B

PUBLIC AND AGENCY REVIEW

B.1 PUBLIC NOTIFICATION

In compliance with the National Environmental Policy Act, Eglin Air Force Base (AFB) announces the availability of the *Eglin Gulf Test and Training Range (EGTTR) Draft Range Environmental Assessment*, and Draft Finding of No Significant Impact (FONSI), for public review.

The Proposed Action represents a continuation of all activities described in the 2002 PEA, plus additional activities that have become necessary or are expected to become necessary for Eglin AFB to fulfill its mission since completion of the 2002 PEA. The actions previously analyzed in 2002 include air-to-air, air-to-surface, surface-to-surface, and other miscellaneous types of missions. The additional test and training activities that would be conducted in the EGTTR consist primarily of air-to-surface missions, although a few other types of missions would be included. Many of the missions would include using live munitions.

Your comments on this Draft Range Environmental Assessment (REA) are requested. Letters or other written or oral comments provided may be published in the Final REA. As required by law, comments will be addressed in the Final REA and made available to the public. Any personal information provided will be used only to identify your desire to make a statement during the public comment period or to fulfill requests for copies of the Final EA or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of the Final REA. However, only the names and respective comments of respondent individuals will be disclosed. Personal home addresses and phone numbers will not be published in the Final REA.

Copies of the Draft REA and Draft FONSI may be reviewed online at www.eglin.af.mil/eglindocuments.asp from Aug. 19, 20015 until Sept. 19, 2015. Local libraries have Internet access, and librarians can assist in accessing this document. Comments must be received by Sept. 22, to be included in the Final REA.

For more information or to comment on these proposed actions, contact: Mike Spaits, 96 TW Public Affairs, 101 West D Ave., Ste. 238, Eglin AFB, Florida 32542 or email: michael.spaits@us.af.mil. Tel: (850) 882-2836; Fax: (850) 882-4894.

B.2 PUBLIC COMMENT RESPONSE

DRAFT FINAL EGLIN GULF TEST AND TRAINING RANGE ENVIRONMENTAL ASSESSMENT

Public Comment	Comment Response
The scope of activities for Alternative 1 are exceeding the levels that may be covered under an Environmental Assessment. An Environmental Impact Statement is required under the National Environmental Policy Act.	Thank you for your comment. The CEQ regulations do not specify when an EA versus an EIS is required based on a level of activity.
This document is deficient in that it does not discuss why the level of activity does not rise to the level requiring an Environmental Impact Statement.	Thank you for your comment. The CEQ regulations do not require an explanation in an EA of why in EIS is not prepared. If the EA finds the proposed action would have significant impacts, then an EIS would be prepared.
To increase the level of activity above current levels will result in a significant impact. On page 2-21 it is noted that the Navy may bring an aircraft carrier into the area to conduct Naval Air Operations. Since aircraft carriers have conducted Naval Air Operations in the affected area in the past it is reasonable to assume that it [will] occur in the future. This document is deficient in that these operations and those of the attendant vessels are not analyzed or captured in Table 2-14 or Table 3-1. This document should compare the extent of Naval Air Operations at other comparable ranges with the actions defined in the preferred alternative to justify the draft Finding of No Significant Impact.	Thank you for your comment. Navy carrier operations are analyzed under the *Atlantic Fleet Test and Training EIS*, prepared by NAVFAC Atlantic. Those actions are outside the scope of this EA. In the past, live bomb training at Eglin AFB that was associated with Navy COMPTUEX and JTFEX training was analyzed under separate Air Force NEPA analysis, while the carrier activity was covered under Navy NEPA.
This document is deficient in that no search for records of munitions debris washing ashore north of the affected area was conducted after hurricanes or unusually strong storms at local military or Coast Guard bases to validate the statement(s) that there is no history of high explosive debris migration.	Thank you for your comment. The authors of this document are aware that items dropped in nearshore environments where bottom sediments are in flux can and do wash ashore. Where bathymetry is stable, such as at the GRATV location, items will likely remain in place as there are not sufficient forces at that depth to cause migration.
This document is deficient in that the six statements from section 3.1.3 Environmental Consequences below illustrate the lack of understanding of the migration of UXO. The question of the final resting place(s) of the UXO is only speculated and not answered with significant statistical data. This is another instance in which the preferred alternative exceeded the limits of activities that may be covered by an Environmental Assessment. 1. Location with the possible exception of extreme weather events. 2. However in the absence of site-specific information (field studies or modeling) conclusion statements are difficult. 3. UXO may fall within the mission area or may land in or migrate to' other areas used by the public. 4. However, no hurricanes or unusually strong storms occurred at any of the test areas during the studies and actual field investigation of UXO items during such events was therefore not available.	The analysis presents the most current information based on ongoing research into this area. Preliminary findings state that for areas with a stable bathymetry, meaning the depth does not fluctuate over time, objects will tend to remain stationary or buried. The analysis cites the recent works of Wilson et al., 2009; Wilson et al., 2008; Wilson et al., 2006; Calantoni, 2014; Jenkins et al., 2015; SERDP and ESTCP, 2010; and SERDP and ESTCP, 2015. 1. This statement identifies the potential for migration, whereas the analysis discusses the various processes and physical conditions that make migration unlikely. 2. It should be noted that all of the test cases occurred in areas where wave energy interacted with the seafloor, causing movement of sediments and changes in bathymetry. 3. Concur, the effects of a hurricane on an object at 15 miles/100 feet depth have not been modeled or studied to our knowledge. 4. Studies are ongoing and the EA analysis relies on preliminary findings as the best available science.

Public Comment	Comment Response
5. The effects of hurricanes or strong tropical storms on UXO movement off Eglin are unknown. 6. As noted above computer simulations of the Washington State area suggested shoreward movement. Considering all the above information it may be speculated that significant shoreward UXO migration would not be expected from the GRATV target.	5. Concur, however, preliminary findings in UXO migration studies suggest no movement if bathymetry remains stable. Analysis is reliant upon preliminary findings that stable bathymetry means stable position.
High explosive munitions will be placed at a depth that is reasonably accessible to recreational level divers with no permanent safeguards for removal by terrorists for use in improvised explosive devices. This document is deficient because no analysis of the risks associated with this hazard are presented in this document.	Munitions that do not detonate are not likely to be found by anyone. Water depth is about 100 feet and targets are not located at artificial reefs or dive spots. A member of the public would have no knowledge on munition characteristics, whether live or inert, or the location at which it entered the water.
A scenario in which a full size drone is destroyed over the Gulf of Mexico should be developed in which a fuel sheen watch is initiated over the area for several hours to ensure that the fuel inside the aircraft does not rise to the surface. This document is deficient in that it does not analyze the fate of the fuel in full size drones and whether it travels into the water column as fuselage parts containing fuel sink. F-16 aircraft carry fuel in many internal fuselage compartments and it is reasonable to assume that QF-16 drones carry fuel in the same configuration. No analysis of the quantity or fate of this fuel is presented in this document.	Fuel fate and effects were discussed in the 2002 EGTTR PEA, and as it was found not to be significant was not re-analyzed in this REA. A statement has been added to Section 1.5.1: "The potential for fuel contamination from aircraft was addressed in the 2002 EGTTR PEA and found not to be significant (U.S. Air Force, 2002). That analysis is incorporated here by reference."
Targets and the associated running gear that sink may be attractive targets for salvage divers. This document is deficient in that it develops no provisions or mitigating factors that would effectively warn these divers of the inherent dangers from UXO.	Thank you for your comment. The authors do not recognize this as a likely scenario for several reasons: (1) intact targets are re-used or disposed of on land, (2) those that sink are already stripped bare and are mostly wood and fiberglass, (3) UXO incidents are low and UXO is likely to bury, making it unavailable, and (4) the GRATV area is not a dive destination.
Who is the "we" mentioned on page D-9 line 44 and D-18 line 30?	Leidos, specifically the acoustician, Dr. Bob Bieri. The text has been changed to "Leidos".

B.3 AGENCY REVIEW

Florida Department of Environmental Protection

Marjory Stoneman Douglas Building
3900 Commonwealth Boulevard
Tallahassee, Florida 32399-3000

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Jonathan P. Steverson
Secretary

September 17, 2015

Ms. April Lawrence
96 CEG/CEIEA
Department of the Air Force
501 DeLeon Street, Suite 101
Eglin AFB, FL 32542-5105

RE: Department of the Air Force – Draft Range Environmental Assessment for Eglin Gulf Test and Training Range (EGTTR) – Eastern Gulf of Mexico
SAI # FL201507207365C

Dear Ms. Lawrence:

The Florida State Clearinghouse has coordinated a review of the Draft Range Environmental Assessment (REA) under the following authorities: Presidential Executive Order 12372; Section 403.061(42), *Florida Statutes*; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

Based on the information contained in the Draft REA and enclosed state agency comments, the state has determined that the proposed federal activities are consistent with the Florida Coastal Management Program (FCMP). The state's continued concurrence will be based on the activities' compliance with FCMP authorities, including federal and state monitoring of the activities to ensure their continued conformance, and the adequate resolution of any issues identified during subsequent reviews.

Thank you for the opportunity to review the draft document. Should you have any questions regarding this letter, please don't hesitate to contact me at Lauren.Milligan@dep.state.fl.us or (850) 245-2170.

Yours sincerely,

Lauren P. Milligan

Lauren P. Milligan, Coordinator
Florida State Clearinghouse
Office of Intergovernmental Programs

Enclosures

cc: Tim Parsons, DOS

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Department of Environmental Protection

"More Protection, Less Process"

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Project Information	
Project:	FL201507207365C
Comments Due:	09/01/2015
Letter Due:	09/18/2015
Description:	DEPARTMENT OF THE AIR FORCE - DRAFT RANGE ENVIRONMENTAL ASSESSMENT FOR EGLIN GULF TEST AND TRAINING RANGE (EGTTR) - EASTERN GULF OF MEXICO.
Keywords:	USAF - DREA, EGLIN GULF TEST AND TRAINING RANGE - EASTERN GULF OF MEXICO.
CFDA #:	12.200

Agency Comments:
ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
No Comments
STATE - FLORIDA DEPARTMENT OF STATE
The DOS advises that, since measures consistent with NEPA and federal consistency requirements are in place for historic resource surveys to locate and evaluate historic sites and properties, and for the avoidance of adverse impacts to significant resources, historic resource concerns are adequately addressed.
FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
NO COMMENT BY BRYAN PHILLIPS ON 8/24/15.

For more information or to submit comments, please contact the Clearinghouse Office at:

3900 COMMONWEALTH BOULEVARD, M.S. 47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2170
FAX: (850) 245-2189

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FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Florida State Clearinghouse
Agency Contact and Coordinator (SC11)
3900 Commonwealth Blvd. MS-47
Tallahassee, Florida 32399-3000

July 23, 2015

RE: DHR Project File No.: 2015-3532/ Received by DHR: July 22, 2015
Application No.: SAI FL201507207365C
Project: *Draft Range Environmental Assessment for Eglin Gulf Test and Training Range (EGTTR)*

Dear Ms. Milligan:

The Florida State Historic Preservation Officer reviewed the referenced project for possible effects on historic properties listed, or eligible for listing, on the *National Register of Historic Places*. The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties*.

We reviewed the information submitted regarding the test and training activities within the Eglin Gulf Test and Training Range. Since measures consistent with NEPA and federal consistency requirements are in place for historic resource surveys to locate and evaluate historic sites and properties, and for the avoidance of adverse impacts to significant resources, it is the opinion of this agency that historic resource concerns are adequately addressed.

If you have any questions, please contact Mary Berman, Historic Sites Specialist, by email at Mary.Berman@*dos.myflorida.com*, or by telephone at 850.245.6333 or 800.847.7278.

Sincerely,

Robert F. Bendus, Director
Division of Historical Resources
& State Historic Preservation Officer

VIVA FLORIDA

Division of Historical Resources
R.A. Gray Building • 500 South Bronough Street• Tallahassee, Florida 32399
850.245.6333 • 850.245.6439 (Fax) dos.myflorida.com/historical/
Promoting Florida's History and Culture VivaFlorida.org

Historical Resources

APPENDIX C

CONSULTATIONS

C.1 BIOLOGICAL ASSESSMENT

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 96TH TEST WING (AFMC)
EGLIN AIR FORCE BASE FLORIDA

Mr. Bruce Hagedorn
Chief, Eglin Natural Resources
96 CEG/CEIEA
501 De Leon Street, Suite 101
Eglin AFB, FL 32542-5133

SEP 16 2015

Mr. David Bernhart
Protected Resources Division
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

Dear Mr. Bernhart:

This letter and attached document is being submitted to the National Marine Fisheries Service to initiate a formal consultation under Section 7 of the Endangered Species Act (ESA) for activities described under the Preferred Alternative in the Eglin Gulf Test and Training Range (EGTTR) Environmental Assessment. The Programmatic Biological Assessment analyzes potential impacts to loggerhead sea turtles, Kemp's ridley sea turtles, leatherback sea turtles, and green sea turtles, as well as essential fish habitat.

The Proposed Action primarily includes air-to-surface testing and training activities in the EGTTR (Gulf of Mexico) proposed to occur over the next five years. Inert and live ordnance may be deployed from multiple types of aircraft against various types of targets including stationary and remotely controlled boats, inflatable targets, and marking flares. Net explosive weight of the live munitions ranges from 0.067 to 945 pounds, and detonations may occur in the air, at the water surface or approximately 10 feet below the surface. Potential impacts to protected species from physical disturbance, boat strikes, debris, and acoustic impacts from detonations have been assessed. Based on this analysis, Eglin Natural Resources has determined that the Proposed Action **may affect, and is likely to adversely affect** loggerhead, Kemp's ridley, leatherback, and green sea turtles **and will not adversely modify** loggerhead sea turtle critical habitat. Adherence to the mitigation measures outlined in Chapter 5 of the BA is expected to significantly reduce the potential for adverse impacts to sea turtle populations.

If you have any questions regarding this Programmatic Biological Assessment or any of the proposed activities, please do not hesitate to contact either Mr. Rodney Felix at (850) 883-1153 or myself at (850) 882-8391.

Sincerely,

Bruce Hagedorn
BRUCE W. HAGEDORN, GS-13

ATTACHMENT: Eglin Gulf Test and Training Range Programmatic Biological Assessment and Essential Fish Habitat Assessment.

EGLIN GULF TEST AND TRAINING RANGE

PROGRAMMATIC BIOLOGICAL ASSESSMENT AND ESSENTIAL FISH HABITAT ASSESSMENT

EGLIN AIR FORCE BASE, FLORIDA

Submitted To:

Protected Resources Division
NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg FL 33701

Submitted By:

Department of the Air Force
96 CEG/CEIEA Natural Resources Office
501 DeLeon Street, Suite 101
Eglin AFB, FL 32542-5133

AUGUST 2015

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

<	less than
>	greater than
2002 PEA	*Eglin Gulf Test and Training Range Final Programmatic Environmental Assessment*
413 FLTS	413th Flight Test Squadron
780 TS	780th Test Squadron
780 TS/OGMT	780th Test Squadron
8 SOS	8th Special Operations Squadron
86 FWS	86 Fighter Weapons Squadron
96 RANSS	96th Range Support Squadron
96 TW	96th Test Wing
96 TW/SEU	Eglin Test and Range Safety Office
A3	Air Force Operations, Plans and Requirements
AFB	Air Force Base
AFI	Air Force Instruction
AFOTEC	Air Force Operational Test and Evaluation Center
AFSOC	Air Force Special Operations Command
AGL	above ground level
AGM	air-to-ground missile
AIM	air intercept missile
APKWS	Advanced Precision Kill Weapon System
ASEP	Advanced Systems Employment Project
BA	Biological Assessment
BDU	Bomb, Dummy Unit
C	Celcius
cal	caliber
CBU	Cluster Bomb Unit
CCF	Eglin Central Control Facility
CEQ	Council on Environmental Quality
CFR	Council on Environmental Quality
cm	centimeters
CO	carbon monoxide
CO_2	carbon dioxide
CONEX	Container Express
CSA	Continental Shelf Associates
CV	Coefficient of Variation
dB	decibels
dB re 1 µPa	decibels referenced to 1 micropascal
DON	Department of the Navy
DPS	Distinct Population Segments
EA	Environmental Assessment
EEZ	Economic Exclusion Zone
EFH	Essential Fish Habitat
EGTTR	Eglin Gulf Test and Training Range
EIS	environmental impact statement
EO	Electro Optical
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
F	Fahrenheit
FWRI	Fish and Wildlife Research Institute
FMP	Fishery Management Plan
FMU	fuse munition unit
FR	*Federal Register*
ft	Feet
FU	full up round

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS, CONT'D

GBU	Guided Bomb Unit
GI	gastrointestinal
GMFMC	Gulf of Mexico Fishery Management Council
GPS	global positioning system
GRATV	Gulf Range Armament Test Vessel
GSMFC	Gulf States Marine Fisheries Commission
HAAWC	High Altitude Anti-Submarine Warfare Weapon Capability
HAPC	Habitat Area of Particular Concern
HE	high explosive
HEI	high explosive incendiary
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HOB	height of burst
HSMST	High Speed Maneuverable Surface Target
Hz	Hertz
IDS	Infrared Detection Sets
ILAST	Integrated Laser Targeting
IMV	Instrumented Measurement Vehicle
in	Inch
INRMP	Integrated Natural Resources Management Plan
IR	Infrared
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
JUON	Joint Urgent Operational Need
Kg	kilogram
KIAS	Knots Indicated Air Speed
km	kilometers
km^2	square kilometers
lbs	pounds
LJDAM	Laser Joint Direct Attack Munition
LOAL	Lock On After Launch
LOBL	Lock On Before Launch
LSDB	Laser Small Diameter Bombs
mg/L	milligrams per liter
MK or Mk	Mark
mm	millimeter
MMPA	Marine Mammal Protection Act
ms	milliseconds
MSA	Magnuson-Stevens Fishery Conservation and Management Act
N/A	not applicable
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NFFO	North Florida Field Office
NM	nautical mile
NM^2	square nautical mile
NMFS	National Marine Fisheries Service
NOTMAR	Notice to Mariners
NSWC	Naval Surface Warfare Center
NWA DPS	Northwest Atlantic Distinct Population Segments
PBX	plastic-bonded explosive
PCB	polychlorinated biphenyls
PGU	Projectile Gun Unit
pH	potential of hydrogen (a measure of acidity)
psi	pounds per square inch
PSW	Precision Strike Weapon

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS, CONT'D

PTS	permanent threshold shift
RDX	research department explosive
REA	Range Environmental Assessment
SDB	Small-Diameter Bomb
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
SOCOM	Special Operations Command
SOPGM	Stand-Off Precision Guided Munitions
SST	Sea Surface Temperature
T&E	Threatened & Endangered
TEWG	Turtle Expert Working Group
TM	telemetry
TNT	2,4,6-trinitrotoluene
TP	target practice
TR	training round
TTP	tactics, techniques, and procedures
TTS	temporary threshold shift
TV	television
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VHF	very high frequency
WCMD	Wind-Corrected Munitions Dispenser
WSEP	Maritime Weapons System Evaluation Program
ZOI	Zone of Impact

EXECUTIVE SUMMARY

The purpose of this document is to support the consultation process for the Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) for the Proposed Action in the *Eglin Gulf Test and Training Range (EGTTR) Range Environmental Assessment* (REA). Compliance with the Marine Mammal Protection Act will be accomplished by submitting an incidental take permit request (Letter of Authorization). Actions covered in the REA primarily include air-to-surface testing and training over the Gulf of Mexico.

Air-to-surface missions involve the use of multiple types of live and inert munitions (bombs, missiles, rockets, and gunnery rounds) against surface targets in the EGTTR. The ordnance may be delivered by multiple types of aircraft including fighter jets, bombers, and gunships. The targets will vary by mission type but may consist of stationary, towed, or remotely controlled boats, inflatable targets, or marking flares. Net explosive weight of the munitions ranges from 0.067 to 945 pounds and detonations may occur in the air, at the water surface, or approximately 10 feet below the surface. Test and training missions may occur during any time of the year. Missions using live bombs, missiles, and rockets will be conducted only during daylight hours, while live gunnery missions may occur during day or night. Gunnery missions and surface and subsurface detonations of live bombs, missiles, and rockets will only occur shoreward of the 200-meter isobath. Missile tests that involve only in-air detonations may occur anywhere in the EGTTR, although these activities are typically conducted relatively close to shore. Most of the activities will occur at a target location approximately 17 miles offshore of Santa Rosa Island, in a water depth of about 35 meters (115 feet).

Acoustic modeling of surface and subsurface detonations indicates the potential for mortality, injury, and non-injurious harassment to sea turtle species in the absence of mitigation measures. Potential takes, described in Section 4, represent the maximum expected number of animals that could be affected. Mortality is calculated as 13 (loggerhead), 3 (leatherback), 7 (Kemp's ridley), and 6 (green) sea turtles annually. Modeling indicates that about 101 turtles could be injured annually, and about 185 turtles could experience non-injurious harassment. The mitigations outlined in Section 5 are expected to decrease the number of individuals actually impacted.

Other species listed under the ESA with potential occurrence in the northern Gulf of Mexico include two marine mammal (sperm whale and Florida manatee), two fish (Gulf sturgeon and smalltooth sawfish), and three bird (piping plover, wood stork, and bald eagle) species. However, it is highly unlikely that these species would be found in the areas used for Eglin's air-to-surface test and training missions due to typical habitat usage and distribution. In addition, no designated critical habitat for any listed species would be affected. Therefore, these species are not included in this document.

Essential Fish Habitat (EFH) in the affected area consists of bottom structures, hard bottom, other substrates, and the water column. Habitat Areas of Particular Concern (HAPC) near the location of most activities include bluefin tuna habitat and Madison and Swanson closed areas. Air-to-surface missions could potentially impact EFH and these HAPCs by physical impacts to bottom structures and sediment, and by alteration of water quality through introduction of metals, chemical materials, and debris. There are no known bottom structures at the primary test area, and alternate locations used for most missions involving live bombs and missiles would be

surveyed by side-scan sonar, magnetometer, and subbottom profiler so that bottom structures could be avoided. Explosion byproducts, petroleum products, and battery acid deposited in the water or on substrates could have temporary and localized effects but would be quickly dispersed and diluted by water currents. Metals, explosives associated with unexploded ordnance (UXO), and plastics could be present at mission sites for long time periods, but effects to sediments and the water column would be limited to a small area around such items. Solid items could become corroded, encrusted, or covered with sediment, and constituents of unconsumed explosives would be subject to several physical, chemical, and biological processes that render the materials harmless or would otherwise dissipate them to undetectable levels. Vessel anchors and debris moved along the seafloor would result in only minor and temporary effects to sediments. The pressure waves associated with underwater explosions are not expected to disturb sediments on the seafloor. Therefore, air-to-surface mission activities described in this document will not adversely affect EFH or HAPCs. In addition, there would not likely be substantial impacts to any managed fish species resulting from mission activities.

The National Marine Fisheries Service (NMFS) would be notified immediately if any of the actions considered in this biological assessment were modified or if additional information on listed species became available, as a re-initiation of consultation may be required. If impacts to listed species or protected habitats occurred beyond what has been considered in this assessment, all operations would cease and NMFS would be notified. Any modifications or conditions resulting from consultation with NMFS would be implemented prior to commencement of activities.

1. INTRODUCTION

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

This Biological Assessment (BA) and Essential Fish Habitat (EFH) Assessment is being submitted to fulfill requirements under Section 7 of the *Endangered Species Act* (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA). This document addresses air-to-surface test and training missions using live ordnance in the Eglin Gulf Test and Training Range (EGTTR), as described in the *EGTTR Range Environmental Assessment* (REA) (in preparation). This BA and EFH Assessment document is meant to initiate the formal consultation process with the National Marine Fisheries Service (NMFS) pursuant to Section 7 of the ESA and the requirements of the MSA. The objectives of this BA and EFH Assessment are to:

- Document all federally listed threatened and endangered (T&E) species and EFH that potentially occur within the affected area.
- Identify the actions, as described in the associated REA, which have the potential to impact, either beneficially or adversely, the documented species and EFH.
- Determine and quantify, to the extent possible, what effects these activities would likely have on federally listed species and EFH.

The Proposed Action of the associated REA consists of multiple types of missions involving use of live ordnance (bombs, missiles, rockets, gunnery rounds) fired at or dropped on targets located at the Gulf of Mexico surface. The actions are described in detail in Section 2.

1.2 SCOPE OF THE PROPOSED ACTION

Air-to-surface activities included in this document correspond to the missions described as the Proposed Action in the associated *Eglin Gulf Test and Training REA*. All activities will take place within the EGTTR, which is defined as the airspace over the Gulf of Mexico scheduled by Eglin Air Force Base (AFB), beginning at a point 3 nautical miles (NM) from shore. This airspace is controlled by the Federal Aviation Administration, but scheduled by Eglin. The EGTTR is subdivided into blocks consisting of Warning Areas W-155, W-151, W-470, W-168, and W-174, as well as Eglin Water Test Areas 1 through 6 (Figure 1-1). Most of the blocks are further subdivided into smaller airspace units for scheduling purposes (for example, W-151A, B, C, and D). Warning Area W-155 is controlled by the U.S. Navy but is used occasionally to support missions scheduled through Eglin. Over 102,000 square nautical miles (NM^2) of Gulf of Mexico surface waters occur under the EGTTR airspace. However, most of the activities described in this document will occur in W-151, and the great majority will occur specifically in sub-area W-151A due to its proximity to shore. Descriptive information for all of W-151 and for W-151A specifically is provided below.

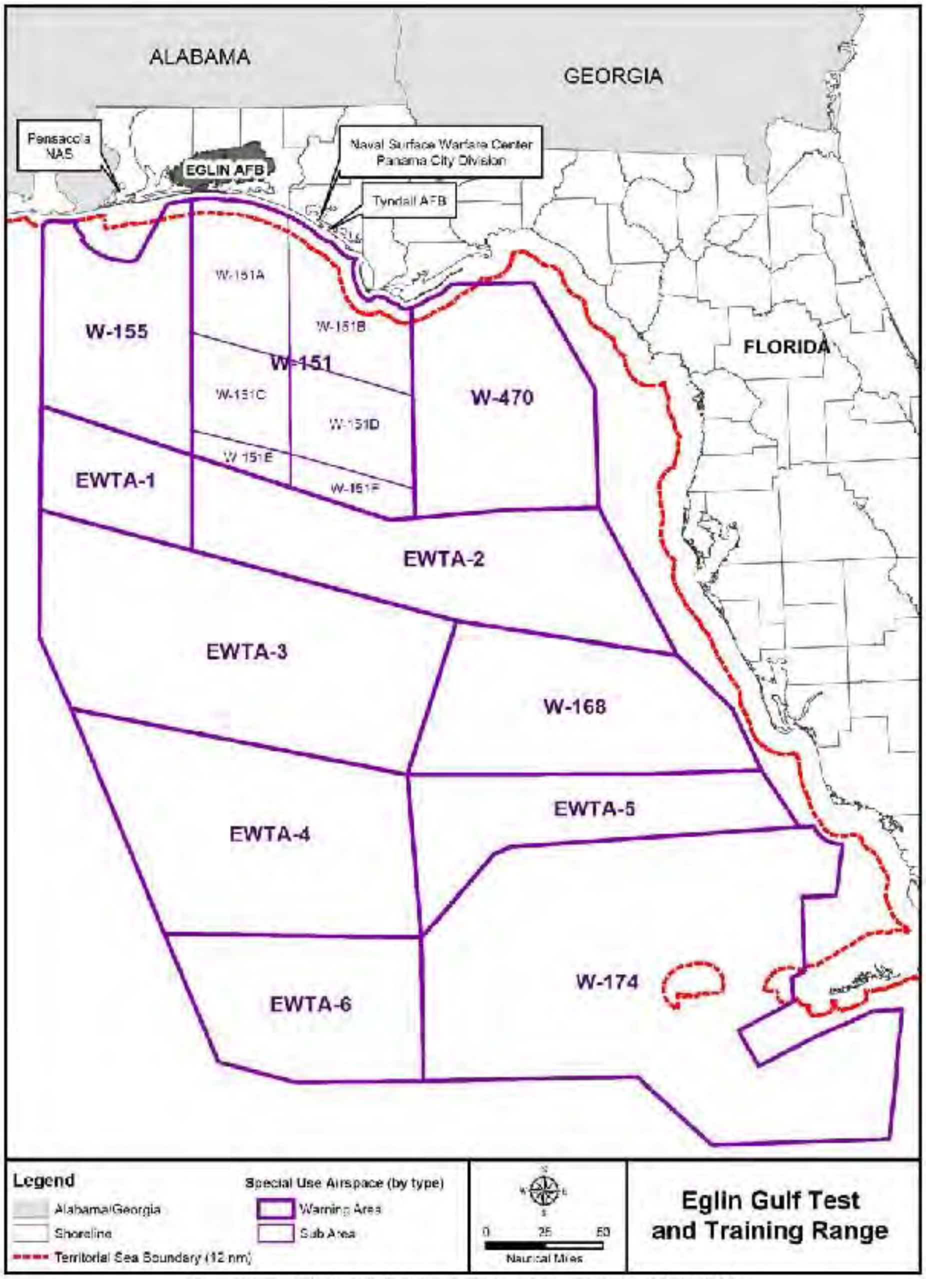

Figure 1-1. Eglin Gulf Test and Training Range (EGTTR)

W-151

The inshore and offshore boundaries of W-151 are roughly parallel to the shoreline contour. The shoreward boundary is 3 NM from shore, while the seaward boundary extends approximately 85 to 100 NM offshore, depending on the specific location. W-151 covers a surface area of approximately 10,247 NM^2 (35,145 square kilometers [km^2]), and includes water depths ranging from about 20 to 700 meters (66 to 2,297 feet). This range of depth includes continental shelf and slope waters. Approximately half of W-151 lies over the shelf.

W-151A

W-151A, which occurs directly south of Eglin AFB, extends approximately 60 NM offshore and has a surface area of 2,565 NM^2 (8,797 km^2). Water depths range from about 30 to 350 meters (98 to 1,148 feet) and include continental shelf and slope zones. However, most of W-151A occurs over the continental shelf, in water depths less than 250 meters (820 feet). Most of the air-to-surface missions described in Section 1 occur in the shallower, northern inshore portion of the sub-area, in a water depth of about 35 meters (115 feet).

The missions, which are described in detail in Section 2, may occur during any season or month. Missions involving the use of live bombs and missiles will occur during daylight hours. However, some activities, such as gunnery training, may occur during day or night.

1.3 FEDERALLY LISTED SPECIES POTENTIALLY IN THE ACTION AREA

Several species protected under the ESA have potential occurrence in the northeastern Gulf of Mexico, including marine mammals, sea turtles, fish, and birds (Table 1-1). Bird species include the bald eagle (*Haliaeetus leucocephalus*), which has been removed from the endangered species list but remains protected under the federal *Bald and Gold Eagle Protection Act*. All marine mammals receive protection under the *Marine Mammal Protection Act of 1972* (MMPA). Impacts to marine mammals have been addressed in a separate Letter of Authorization request submitted to NMFS's Office of Protected Resources. Although all the species listed in Table 1-1 have potential occurrence in the northern Gulf, some have only a negligible probability of occurring within the areas used for air-to-surface missions. A discussion of listed species, including an explanation for excluding some species from further consideration, is provided in Section 3.

Table 1-1. Federally Protected Species with Potential Occurrence in the Northeastern Gulf of Mexico

Species Common Name	Species Scientific Name	Federal Status
Marine Mammals		
Sperm whale	*Physeter macrocephalus*	Endangered
Florida manatee	*Trichechus manatus latirostris*	Endangered
Sea Turtles		
Loggerhead sea turtle	*Caretta caretta*	Threatened
Green sea turtle	*Chelonia mydas*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered

Table 1-1. Federally Protected Species with Potential Occurrence in the Northeastern Gulf of Mexico, Cont'd

Species Common Name	Species Scientific Name	Federal Status
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Fish		
Gulf sturgeon	*Acipenser oxyrhynchus desotoi*	Threatened
Smalltooth sawfish	*Pristis pectinata*	Endangered
Birds		
Piping plover	*Charadrius melodus*	Threatened
Wood stork	*Mycteria Americana*	Threatened
Bald eagle	*Haliaeetus leucocephalus*	BGEPA

BGEPA = Protected by the Bald and Golden Eagle Protection Act

1.4 APPLICABLE REGULATORY REQUIREMENTS AND COORDINATION

The acts and regulations described below are applicable to the activities included in this document.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental consequences of proposed actions in the decision-making process (42 U.S. Code [USC] 4321, et seq). The Council on Environmental Quality (CEQ) was established under NEPA to implement and oversee federal policy in this process. In 1978, the CEQ issued regulations implementing the NEPA process under Title 40, Code of Federal Regulations (CFR), Parts 1500–1508. The CEQ regulations require that the federal agency considering an action evaluate or assess the potential consequences of the action or alternatives to the action, which may result in the need for an Environmental Assessment (EA) or environmental impact statement (EIS). Under 40 CFR:

- An EA must briefly provide sufficient evidence and analysis to determine whether a finding of no significant impact or EIS should be prepared.
- An EA must facilitate the preparation of an EIS if required.

The proposed activities addressed in this document constitute a federal action and, therefore, must be assessed in accordance with NEPA. To comply with NEPA, as well as other pertinent environmental requirements, the decision-making process for the Proposed Action must include the development of an EA to address the environmental issues related to the proposed activities. The Air Force Environmental Impact Analysis Process is accomplished via procedures set forth in CEQ regulations and 32 CFR Part 989. Eglin AFB has prepared the associated *Eglin Gulf Test and Training REA* (in preparation) pursuant to NEPA requirements.

Executive Order 12114

Executive Order 12114, *Environmental Impacts Abroad of Major Federal Actions*, directs federal agencies to provide for informed environmental decision making for major federal actions outside the United States and its territories. Presidential Proclamation 5928, issued

December 27, 1988, extended the exercise of U.S. sovereignty and jurisdiction under international law to 12 NM; however, the proclamation expressly provides that it does not extend or otherwise alter existing federal law or any associated jurisdiction, rights, legal interests, or obligations. Thus, as a matter of policy, the Air Force analyzes environmental effects and actions within 12 NM under NEPA (an EA) and those effects occurring beyond 12 NM under the provisions of Executive Order 12114. Most of the actions described in this document will occur beyond the 12 NM boundary.

Endangered Species Act of 1973

The purpose of the ESA, as amended, is to protect fish, wildlife, and plant species currently in danger of extinction and those species that may become so in the foreseeable future. The ESA states that "…it is unlawful for any person subject to the jurisdiction of the United States to…*take* any such species within the United States or the territorial sea of the United States" or *take* any such species upon the high seas." The term *take* is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Each federal agency is required to review its actions at the earliest possible time to determine whether any action it authorizes, funds, or carries out may affect listed species or critical habitat. If such a determination is made, consultation with the appropriate agency is required.

The U.S Fish and Wildlife Service (USFWS) and NMFS share responsibilities for administering the Act, with NMFS generally coordinating ESA activities for marine and anadromous species (e.g., sturgeon, sawfish) and the USFWS coordinating ESA activities for terrestrial and freshwater species. ESA responsibilities regarding sea turtles are further split between the two agencies; NMFS coordinates activities that could impact turtles in the marine environment, while the USFWS is responsible for turtle nesting activities. Activities associated with the air-to-surface missions described in this document will only affect offshore marine areas. Therefore, consultation with NMFS is applicable.

Magnuson-Stevens Fishery Conservation and Management Act

The MSA governs commercial fishing within the U.S. Exclusive Economic Zone (from state waters to about 200 NM offshore). The MSA requires that federal agencies consult with NMFS for any actions authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH for any managed fishery. EFH is defined as the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. "Substrate" is defined as sediment, hardbottom, underwater structures, and associated biological communities, and includes artificial reefs and shipwrecks. "Waters" are defined as aquatic areas and their chemical and biological properties (i.e., water quality). Thus, analyses of effects should consider physical, chemical, and biological properties of water such as nutrients, turbidity, and oxygen concentrations. Impacts that result in a reduction of quality or quantity of EFH are defined as adverse. Adverse effects may be direct, such as physical disruption or contamination, or indirect, such as loss of prey or reduction in fecundity. Federal agencies are required to consult with NMFS for actions that may adversely affect EFH. If applicable, NMFS provides recommendations to the agency for avoiding or mitigating potential impacts. The agency must then respond to NMFS regarding the recommendations.

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2. DESCRIPTION OF THE PROPOSED ACTION

Due to threats to national security, increased testing and training missions involving air-to-surface activities have been directed by the Department of Defense. In this document, air-to-surface activities refer to the firing or dropping of munitions including bombs, missiles, rockets, and gunnery rounds from aircraft toward targets located on the Gulf of Mexico surface. Depending on the requirements of a given mission, munitions may be inert (contain no or very little explosive charges) or live (contain explosive charges). Live munitions may detonate above, at, or slightly below the water surface. As described in the associated *Eglin Gulf Test and Training REA* (in preparation), the Air Force has determined that other types of activities, primarily air-to-air testing and training, would result in only a negligible risk of harm to marine species, and these missions are therefore not included in the current Biological Assessment. All activities described in this document will occur within the boundaries of the EGTTR, which is described in Section 1.2. In most cases, missions consisting of live bombs, missiles, and rockets that detonate at or below the water surface will occur at a site in W-151A that has been designated specifically for these types of activities. This site is located approximately 17 miles offshore from Santa Rosa Island, at a water depth of about 35 meters (115 feet). Typically, test data collection is conducted from an instrumentation barge known as the Gulf Range Armament Test Vessel (GRATV) (Figure 2-1) anchored on-site, which provides a platform for cameras and weapon-tracking equipment. Therefore, the mission area is referred to as the GRATV target location. The target location site within W-151A is shown on Figure 2-2. It should be noted that alternative site locations may be selected within a 5-mile radius around the GRATV point. This alternative area is shown on Figure 2-2 as the Alternative Target Location Area. Gunnery operations are limited to occur only over continental shelf waters (shoreward of the 200-meter bathymetry line) in W-151. Missions that involve only in-air detonations may occur anywhere in the EGTTR, but are typically conducted in W-151. Detailed descriptions for each individual mission activity are included in the following sections, organized by action proponent.

Figure 2-1. Gulf Range Armament Test Vessel (GRATV) (Instrumentation Barge)

Description of the Proposed Action

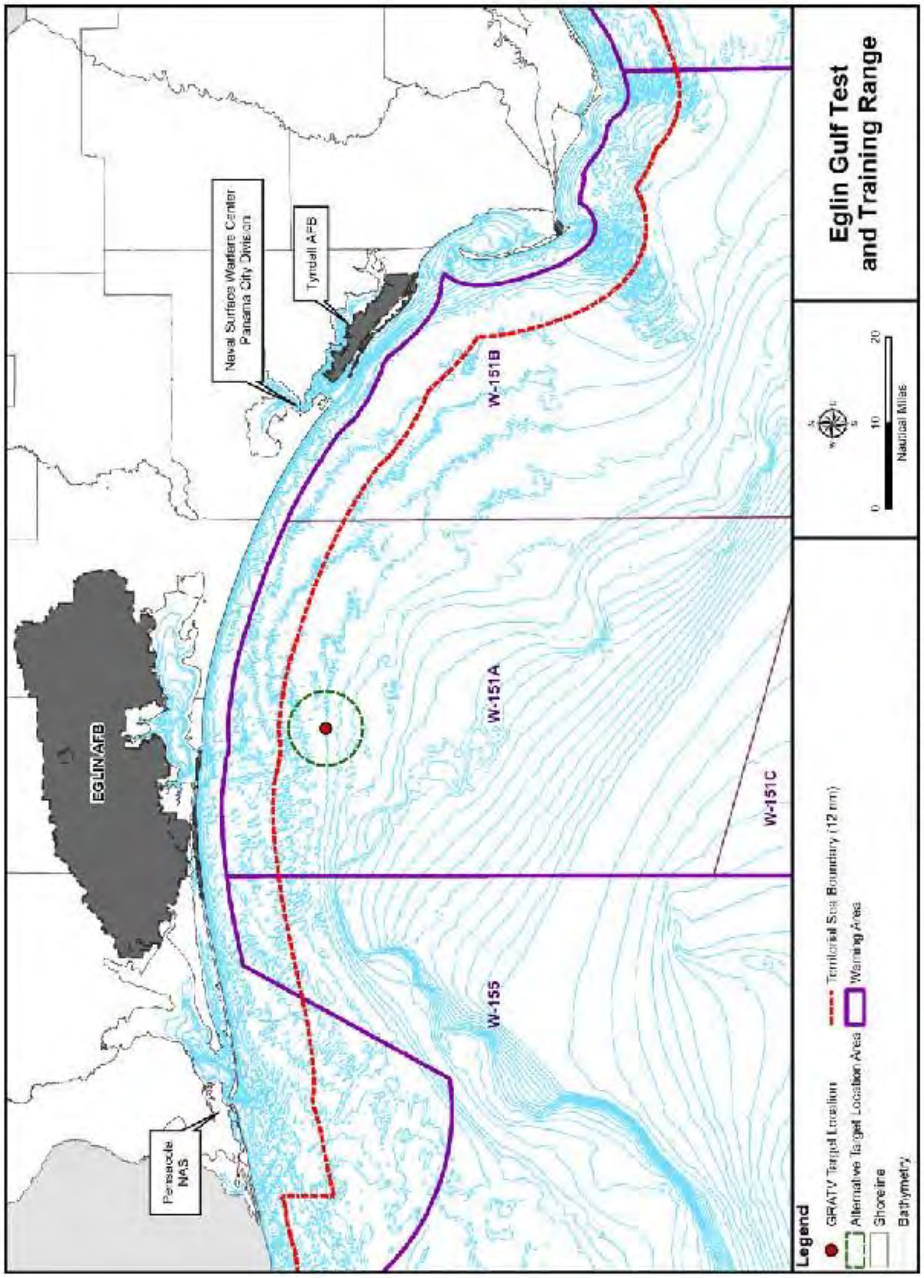

Figure 2-2. GRATV Target Location

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2.1 86 FWS MARITIME WEAPONS SYSTEM EVALUATION PROGRAM

Live and Inert Munitions Testing

The 86th Fighter Weapons Squadron (86 FWS) proposes to continue the use of multiple types of live and inert munitions in the EGTTR against small boat targets for their Maritime Weapons System Evaluation Program (WSEP) Operation Testing Program. The purpose of the testing is to continue the development of tactics, techniques, and procedures (TTP) for U.S. Air Force strike aircraft to counter small maneuvering hostile surface vessels (Figure 2-3). Damage effects of these munitions must be known to generate TTPs to engage small moving boats. The test objectives are to (1) develop TTPs to engage small boats in all weather; and (2) determine the impact of TTPs on Combat Air Force training. The test results would be used to develop publishable TTPs for inclusion in Air Force TTP 3-1 series manuals. Maritime WSEP testing is considered a high national defense priority.

Figure 2-3. Intact Small Boat Targets in the EGTTR

Maritime WSEP activities involve using multiple types of aircraft with inert and live munitions in the EGTTR, including bombs, missiles, and gunnery rounds (Table 2-1). Because the focus of the tests would be weapon/target interaction, no particular aircraft would be specified for a given test as long as it met the delivery requirements. Various U.S. Air Force active duty units, National Guard, Navy, and Air Force reserve units would participate as interceptors and weapons release aircrews, with multiple types of aircraft typically operating within the same airspace.

Tests would be conducted at the GRATV target location in various sea states and weather conditions, up to a wave height of 4 feet. Live munitions would be deployed against static (anchored), towed, and remotely controlled boat targets. Static and controlled targets would consist of stripped boat hulls with plywood simulated systems and, in some cases, heat sources. Moving targets would be towed by remotely controlled High Speed Maneuverable Surface Target (HSMST) boats. Damaged boats would be recovered for data collection. Test data collection would be conducted from the GRATV. HSMST boats would be remotely controlled from a facility on Eglin Main Base and would follow set track lines with specific waypoints at least 2 to 3 NM away from the GRATV. Additional air assets such as chase aircraft or

unmanned aerial vehicles would transit to the target area and set up flight orbits to provide aerial video of the mission site including weapon impacts on boat targets and assisting with range clearing activities. Missions would be controlled from the Eglin Central Control Facility (CCF) on Main Base.

Table 2-1. Maritime WSEP Munitions and Example Aircraft

Munitions	Aircraft
AGM-114 (Hellfire)	F-15 fighter aircraft
AGM-176 (Griffin)	F-16 fighter aircraft
AGM-65 (Mavericks)	F-18 fighter aircraft
AIM-9X	F-22 fighter aircraft
BDU-56	F-35 fighter aircraft
CBU-105 (WCMD)	AC-130 gunship
GBU-12/GBU-54	A-10 fighter aircraft
GBU-10/GBU-24	B-1 bomber aircraft
GBU-31	B-52 bomber aircraft
GBU-38	B-2 bomber aircraft
PGU-13/B	MQ-1
PGU-27	MQ-9
2.75 in Rockets	
7.62mm/50 Cal	
GBU-39 (Laser SDB)	
GBU-53 (SDB II)	

AGM = air-to-ground missile; AIM = air intercept missile; BDU = Bomb, Dummy Unit; CBU= Cluster Bomb Unit; GBU = Guided Bomb Unit; mm = millimeters; PGU = Projectile Gun Unit; SDB = Small Diameter Bomb; WCMD = Wind-Corrected Munitions Dispenser

Live munitions would be set to detonate either in the air, instantaneously upon contact with a target boat, or after a slight delay (up to 10 millisecond) after impact, which would correspond to a water depth of about 5 to 10 feet. The annual number, height or depth of detonation, explosive material, and net explosive weight (NEW) of each munition associated with Maritime WSEP is provided in Table 2-2. The quantity of live munitions tested is considered necessary to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable confidence level regarding munitions capabilities.

In addition to the live munitions described above, 86 FWS also proposes to expend inert munitions in W-151. The expected number of each munition type expended during a typical year is included in Table 2-2. Use of inert munitions was analyzed in the 2002 *Eglin Gulf Test and Training Range Final Programmatic Environmental Assessment* (the "2002 PEA") and found to have no significant environmental impact (U.S. Air Force, 2002). Therefore, there is no particular limit on the number of inert items that may be expended, and actual numbers may vary somewhat from those shown in the table. However, the items are included in the REA in order to document the programmatic use of the EGTTR.

Description of the Proposed Action

Table 2-2. Maritime WSEP Annual Munitions Use in the EGTTR

Type of Munition	Number of Munitions	Detonations Scenario	Warhead – explosive material	Net Explosive Weight
GBU-10 or GBU-24	2	Surface or Subsurface	MK-84 - Tritonal	945 lbs
GBU-12 or GBU-54 (LJDAM)	6	Surface or Subsurface	MK-82 - Tritonal	192 lbs
AGM-65 (Maverick)	6	Surface	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
CBU-105	4	Airburst	10 BLU-108 submunitions with 4 projectiles, parachute, rocket motor & altimeter. 10.69 lbs NEW/submunition (includes 2.15 lbs/projectile)	107.63 lbs
GBU-39 (LSDB)	4	Airburst, Surface or Subsurface	AFX-757 (Insensitive munition)	37 lbs
AGM-114 (Hellfire)	30	Airburst or Surface, Subsurface	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge.	20 lbs
GBU-53 (SDB II)	4	Airburst, Surface or Subsurface	PBX-N-109 Aluminized Enhanced Blast, Scored Frag Case, Copper Shape Charge	22.84 lbs
AGM-176 (Griffin)	10	Airburst or Surface	Blast fragmentation	4.58 lbs
Rockets (including APKWS)	100	Surface	Comp B-4 HEI	10 lbs
PGU-13 HEI 30 mm	1,000	Surface	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1 lbs
AIM-9X	4	Surface	PBXN-3	68 lbs
GBU-10	21	Inert	N/A	N/A
GBU-12	27	Inert	N/A	N/A
GBU-24	17	Inert	N/A	N/A
GBU-31	6	Inert	N/A	N/A
GBU-38	3	Inert	N/A	N/A
GBU-54	16	Inert	N/A	N/A
BDU-56	13	Inert	N/A	N/A
AIM-9X	3	Inert	N/A	N/A
PGU-27	46,000	Inert	N/A	N/A

AGM = air-to-ground missile; AIM = air intercept missile; APKWS = Advanced Precision Kill Weapon System; BDU = Bomb, Dummy Unit; CBU = Cluster Bomb Unit; GBU = Guided Bomb Unit; HEI = high explosive incendiary; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bombs; MK = mark; mm = millimeters; N/A = not applicable; NEW = net explosive weight; PBX = plastic-bonded explosive; PGU = Projectile Gun Unit; RDX = research department explosive; SDB = Small Diameter Bomb

Description of the Proposed Action

Pre-Test Target Area Clearance Procedures for Public Safety and Protected Marine Species

A human safety zone will be established around the test area prior to each mission, and will be enforced by up to 20 to 25 safety boats. The size of this zone will vary, depending upon the particular munition and delivery method used in a given test. A composite safety footprint has been developed for previous tests using live munitions, and incorporated the average of all munitions deployed. This composite safety footprint consisted of a circle with a 29 mile-wide diameter circle (14.5 mile-wide radius), which was converted to an octagon shape for ease of support vessel placement and range clearance. The GRATV is located approximately 2 miles north of the center of the octagon. Other than the types of vessels identified in 33 CFR 334.720, all nonparticipating vessels (such as recreational fishing vessels) will be excluded from entering the safety footprint while it is active, which is expected to be up to four hours per mission on test days (multiple munitions may be deployed within the four-hour time period). The Eglin Test and Range Safety Office (96 TW/SEU) will position the safety support vessels around the safety footprint to ensure commercial and recreational boats do not accidentally enter the area. Before delivering the ordnance, mission aircraft may make a dry run (no munitions deployed) over the target area to ensure that it is clear of nonparticipating vessels, although this action is not necessarily performed before all releases. The Eglin Test and Range Safety Office will monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. To inform the public, the Eglin Test and Range Safety Office will request that the Coast Guard release a Notice to Mariners (NOTMAR) prior to the closure of the safety footprint around the target location. In addition, 96th Range Support Squadron (96 RANSS) personnel will also distribute flyers with maps at public docks and to vessels in Destin Pass showing the closed area and explaining why it is closed.

In addition to actions carried out to ensure human safety during live missions, measures designed to avoid or minimize impacts to protected marine species have been developed in cooperation with NMFS. A separate zone around the target will be established for marine species protection, based on the distance to which energy- and pressure-related impact zones could extend for the various types of live ordnance. The dimensions of this zone will be different than those of the human safety zone and will depend on the specific munitions being released that day. Trained marine species observers will survey the protection zone before each mission.

Up to four video cameras will also be positioned on the GRATV anchored on-site. The cameras will primarily be used to document the weapons' performance against targets, but could also be used to monitor for the presence of unauthorized vessels and protected species. An Eglin Natural Resources representative will be located in Eglin's CCF on Main Base, along with mission personnel, to view the live video feed before and during test activities. All cameras have a zoom capability of up to at least a 300 millimeter (mm) equivalent. At this setting, when targets are at a distance of 2 NM from the GRATV, the field of view would be 195 feet by 146 feet. Video observers can detect an item with a minimum size of 1 square foot up to 4,000 meters away. The Air Force is in the process of acquiring cameras with even greater zoom capability (up to a 1,200 mm zoom lens). Missions will not proceed until the target area is confirmed to be clear of protected species (when live munitions are used) and unauthorized vessels. In addition, the test will not be conducted if all video cameras are not operational. Refer to Section 5, *Mitigations*, for a full description of monitoring methods and procedures.

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Post-Test Activities

Potential post-test activities consist of Air Force Explosive Ordnance Disposal (EOD) personnel detonating in place any munitions components or items remaining on the target boats that would be considered unexploded ordnance (UXO), debris retrieval, and post-mission protected species surveys. Unexploded bombs, missiles, or other similarly large items would sink to the seafloor and would not be recovered or detonated. However, smaller unexploded items such as cluster bomb submunitions could remain intact on target boats. Each CBU-105 contains 10 submunition cylinders, and each cylinder contains 4 sub-submunitions (skeets), which fire inert projectiles. Therefore, there is a total of 40 skeets per bomb. On test days involving the release of CBU-105s, the Eglin EOD team would be on hand to inspect floating targets and identify and render safe any UXO, including fuses, classified components, or intact munitions. In the rare instance that UXO cannot be removed, proper disposal methods would be employed (typically accomplished by use of C-4 explosive) (Figure 2-4); however, these types of scenarios are not considered likely. Once the area has been cleared by the Eglin EOD team (typically one hour after the release of CBU-105s), the range will be re-opened for the debris clean-up team and the protected species survey vessels (when live munitions are used). Depending on the specific weapon system used and the location or position of the UXO, the test area could be closed for an extended period of time.

Figure 2-4. Target Boat After Unexploded Ordnance Disposal with C-4 Explosive

Following completion of the live mission (and declaration of the target area by EOD as safe, when applicable), several Air Force vessel crews would engage in target debris retrieval. Large, mostly intact damaged target vessels may be towed, while smaller pieces of debris would be netted or lifted aboard Air Force vessels and taken to shore for disposal. Figure 2-5 shows debris and damaged target vessels from a similar exercise conducted in 2013. The Air Force would also conduct post-mission monitoring for protected species once the range is confirmed to be safe to enter.

Figure 2-5. Debris and Target Vessels from Previous Similar Mission

Pre-test and post-test management actions, including human safety zone enforcement and protected species protection measures, are described in detail in Section 5, *Mitigations*.

Swarm Missions

To counter small boat threats, aircrews would test and train in performing electronically simulated targeting and attack techniques (no ordnance is used, either live or inert) against groups of fast moving, human-piloted boats simulating a coordinated attack on an objective in the Gulf of Mexico. These missions are called "swarm" missions due to the number of boats involved. The target fleet typically consists of up to 30 boats (the actual number may vary) divided into multiple squadrons of 4 or 5 boats that travel along predetermined transects and possibly perform predetermined maneuvers as directed by Air Force personnel. The boats would range in size from 20 to 45 feet and would travel at speeds of 20 to 40 knots, depending on sea state. Additional numbers of vessels, formations and maneuvers are possible depending on real-world threats and situations.

Aircraft would be directed in the CCF by the 86 FWS mission director. Aircraft would perform tactical maneuvers including dives, dive recoveries, and pull-up procedures in accordance with aircraft 3-1 manuals and Air Force Instruction (AFI) 11-214 publications. Aircraft would fly no lower than altitudes specified in AFI 11-214 and 3-1 manuals commensurate with the simulated weapon delivery. Aircraft would not carry bombs, and aircraft guns would be mechanically "safed" (unable to fire). Due to the lack of munitions (live or inert), the pre- and post-mission activities described for live testing would not be required. Specifically, there would be no need for safety zone establishment, EOD clearance, debris retrieval, or protected species surveys.

2.2 ADVANCED SYSTEMS EMPLOYMENT PROJECT

The proposed Advanced Systems Employment Project (ASEP) action includes evaluating upgrades to numerous research and development, as well as Air Force hardware and software, initiatives. F-16, F-15E, and BAC1-11 aircraft would be used to deploy a variety of pods, air-to-air missiles, bombs, and other munitions. Many of the missions are conducted over Eglin land ranges. However, inert instrumented Mk-84 Joint Direct Attack Munition (JDAM) bombs would be expended in W-151. Bombs would be dropped on target boats located 20 to 25 miles offshore. A maximum of 12 over-water missions could be conducted annually, although the number could be as low as 4. There would be no live ordnance associated with ASEP actions in the EGTTR.

2.3 AIR FORCE SPECIAL OPERATIONS COMMAND TRAINING

The Air Force Special Operations Command (AFSOC) conducts various training activities with multiple types of munitions in nearshore waters of the EGTTR (W-151). Training activities include air-to-surface gunnery, small diameter bomb, and missile proficiency training. The following subsections describe the proposed actions included in this BA.

AC-130 Air-To-Surface Gunnery

Air-to-surface gunnery missions involve firing of live gunnery rounds at targets on the water surface in the EGTTR. Ordnance used in this training includes 25 mm high explosive incendiary (HEI), 30 mm HEI, 40 mm HEI, and 105 mm HEI rounds. NEW ranges from about 0.07 to 4.7 pounds. The training round (TR) variant was developed as a means to mitigate acoustic impacts on marine mammals that could not be adequately surveyed at night by aircraft sensors. Today's AC-130 sensors allow for effective nighttime visual surveys but with reduced explosive material the TR rounds remain a valuable mitigation for reducing acoustic impacts.

Water ranges within the EGTTR that are typically used for gunnery operations include W-151A, W-151B, W-151C, and W-151D. However, W-151A is the most frequently used water range due to its proximity to Hurlburt Field (where the gunnery flights originate). AC-130s normally transit from Hurlburt Field to the water ranges at a minimum of 4,000 feet above surface level. Potential target sites are typically established at least 15 miles from the coast (beyond the 12 NM territorial sea boundary). Targets consist of either an MK-25 floating flare or an inflatable target. For missions where flares are used, the aircrew scans a 5-NM radius around the potential target area to ensure it is clear of surface craft, protected species, and other objects that would make the site unsuitable. Scanning is accomplished using radar, Electro Optical (EO), infrared (IR) sensors, and visual means. An alternative area is selected if any non-mission vessels are detected within the 5 NM search area, or if protected marine species were sighted within the injury impact zone (see Section 5, *Mitigations*, for a full description of survey methods and impact zones). Once the scan is completed, the marking flare is dropped onto the water surface. The flare's burn time is typically 10 to 20 minutes, but could be less if actually hit by one of the rounds. However, flares may burn as long as 40 minutes.

Missions using an inflatable target proceed under the same general protocol. A tow boat transits to a potential target site located at least 15 miles from the coast. The AC-130 then arrives at the

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site and, as with missions using flares, the aircrew scans an appropriate area around the potential target area (5 NM radius for non-mission vessels and a protected species survey zone as specified in Section 5) using visual observation and the aircraft's sensors. An alternative area would be selected if any protected marine species or non-mission vessels were detected within the applicable search areas. Once the scan is complete, the 20-foot target is inflated and deployed into the water. The tow boat then proceeds to pull the target, which is attached to a 2,200-foot cable. The target continues to float even when struck by ordnance and deflated. After the mission, the tow boat recovers any debris produced by rounds striking the target, although little debris is expected.

After target deployment, the firing sequence is initiated. A typical gunship mission lasts approximately five hours without air-to-air refueling, and six hours when refueling is accomplished. A typical mission includes:

- 30 minutes to take off and perform airborne sensor alignment; align visual sensor and EO to heads-up display.
- 1½ to 2 hours of dry fire (no ordnance expended); this time includes transition time.
- 1½ to 2 hours of live fire; this time includes clearing the area and transiting to and from the range; actual firing activities typically do not exceed 30 minutes.
- 1 hour air-to-air refueling, if included in the mission.
- 30 minutes transition work (takeoffs, approaches, landings, and pattern work).

The guns are fired during the live fire phase of the mission. The actual firing can last from 30 to 90 minutes but is typically completed in 30 minutes. The number and type of munitions deployed during a mission varies with each type of mission flown. Training rounds for the 105-mm ammunition are used during nighttime training.

Live fire events are continuous, with pauses during the firing usually well under a minute and rarely from two to five minutes. Firing pauses would only exceed 10 minutes in one of the following situations: (1) surface boat traffic caused the mission to relocate; (2) aircraft, gun, or targeting system malfunction occurs; or (3) more flares needed to be deployed. The Eglin Test and Range Safety Office has described the gunnery missions as having 95 percent containment within a 5-meter radius around the target (i.e., 95 percent of the rounds strike the water within 5 meters of the target).

Gunnery missions may occur any season of year, during daytime or nighttime hours. As a conservation measure to avoid impacts to the federally listed sperm whale and other deep water marine mammal species, AFSOC has agreed to conduct all gunnery missions within (shoreward of) the 200-meter water depth contour, which transects portions of W-151A, W-151D, and W-151F. All of W-151B lies shoreward of the shelf break (Figure 2-6).

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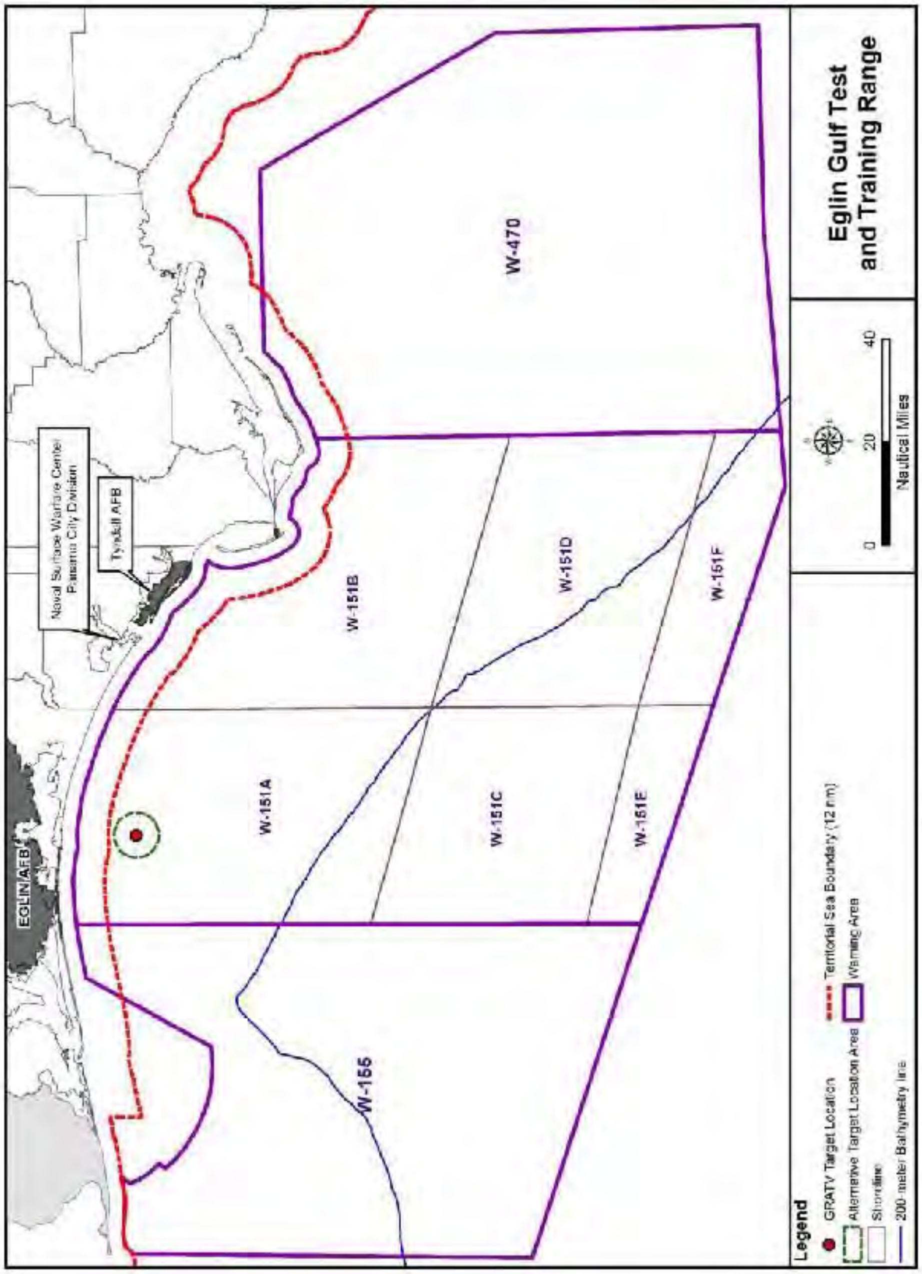

Figure 2-6. 200-Meter Isobath Boundary

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The quantity of live rounds expended is based on estimates provided by AFSOC regarding the annual number of missions and number of rounds per mission. The 105 mm FU rounds are typically used during daytime missions, while 105 mm TR are always used at night. The total anticipated number of missions and rounds that will be expended for daytime and nighttime activities annually is shown in Table 2-3.

Table 2-3. Summary of Annual AFSOC AC-130 Gunnery Operations

Category	Expendable	Number of Missions	Rounds per Mission	Quantity
Daytime Missions	105 mm HE (FU)	25	30	750
	40 mm HE		64	1,600
	30 mm HE		500	12,500
	25 mm HE		560	14,000
Nighttime Missions	105 mm HE (TR)	45	30	1,350
	40 mm HE		64	2,880
	30 mm HE		500	22,500
	25 mm HE		560	25,200
Total		**70**		**80,780**

AFSOC = Air Force Special Operations Command; FU = full up; HE = High Explosive; mm = millimeter; TR = training round

Measures designed to avoid or minimize potential impacts to protected marine species (primarily marine mammals and sea turtles) are summarized here and described in detail in Section 5. The primary management measure consists of pre- and post-mission visual monitoring, which may also be supplemented with IR and EO monitoring as applicable. After arriving at the target site, aircrews will commence visual scans and continue observing during ascending orbits until reaching operational altitude. Monitoring will continue throughout the mission and during a post-mission descent to an altitude of approximately 6,000 feet. If protected species are detected at any time, the mission will halt immediately and relocate as necessary or be suspended until the animal(s) have left the area. Additional management measures include sea state restrictions, use of the 105 mm TR at night, use of ramp-up procedures (beginning with the smallest round during calibration and proceeding to increasingly larger rounds), and complying with the requirement to conduct all missions shoreward of the 200-meter isobath. No mortality or injury to protected marine species has been documented as a result of previous AFSOC gunnery missions.

Small Diameter Bomb and Griffin/Hellfire Missile Training

AFSOC has been tasked to develop TTPs and training for strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. Training involves the use of live air-to-ground (AGM)-114P/R Hellfire Missiles, AGM-176 Griffin Missiles, and GBU-39 small diameter bomb (SDB) munitions in the EGTTR against small towed boats. AFSOC expects to expend up to 100 AGM-114P/R missiles, 200 AGM-176 missiles, and 30 guided bomb unit (GBU)-39 laser or global positioning system (GPS)-guided SDBs annually. All of these weapons are capable of airburst, point, or delayed fuzing detonations. However, only airburst detonations will occur under the Proposed Action.

The capability to counter small vessels is categorized as a Joint Urgent Operational Need (JUON). A JUON is defined as an urgent operation need identified by a combatant commander

that, if not addressed immediately, will seriously endanger personnel or pose a major threat to ongoing operations. Currently, the majority of AFSOC crews deploy into combat with no actual experience in AGM-176, AGM-114P/R, or GBU-39 weapons delivery, significantly increasing the potential to miss their intended targets during combat missions.

Management practices, described in detail in Section 5, would be implemented for live detonations. Because all munitions would be detonated in the air, no protected species surveys would be necessary. However, human safety measures would be carried out. The specific measures would depend on the mission location (GRATV target location, beyond the 200-meter isobaths, etc.).

CV-22 Training

The 8th SOS proposes to conduct CV-22 training in W-151 (primarily W-151A and W-151F), which would involve the firing of .50 caliber (cal)/7.62 mm ammunition at flares floating on the water surface. There would be approximately 50 training missions annually, with 300 each of .50 cal and 7.62 mm rounds used per mission. Therefore, a total of 30,000 rounds would be expended annually. Flight procedures for CV-22 training would be similar to those described for AC-130 gunnery missions above, except that CV-22 aircraft typically operate at much lower altitudes (100 to 1,000 feet above surface level) than AC-130 gunships. Aircrews would maintain Visual Flight Rules cloud clearances and a minimum altitude of 100 feet above water height at all times. Weather must be sufficient to maintain a 3-NM clearance around the target area. Live fire would be conducted only when sea surface conditions do not exceed Beaufort sea state 4 (wind speed 16 knots, wave height 3 feet, fairly frequent white caps). Similar to AC-130 missions, crews would conduct a visual survey of the target area (3 NM radius for non-mission vessels and a protected species zone based on requirements described in Section 5) at a maximum altitude of 1,000 feet to ensure the area is clear of protected species and indicators before live fire begins. Pre- and post- live-fire clearing searches are anticipated to take about five minutes to accomplish. After live-fire operations, the crew would scan the target area utilizing all available visual scanners and operable sensors for any injured or dead marine species. Missions would only be conducted shoreward of the 200-meter depth contour, as described for AC-130 gunnery training above.

Summary of AFSOC Activities in the EGTTR

Table 2-4 summarizes all AFSOC live air-to-surface training operations in the EGTTR.

Table 2-4. Total Annual AFSOC Air-to-Surface Training Operations

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
7.62 mm/.50 cal	N/A	30,000	N/A	W-151A, W-151F
25 mm	0.067 lbs	39,200	Surface	W-151A, W-151B, W-151D
30 mm	0.1 lbs	35,000	Surface	
40 mm	0.87 lbs	4,480	Surface	
105 mm FU	4.7 lbs	750	Surface	
105 mm TR	0.35 lbs	1,350	Surface	
AGM-176 (Griffin missile)	4.58 lbs	200	Airburst	W-151

Table 2-4. Total Annual AFSOC Air-to-Surface Training Operations, Cont'd

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
AGM-114P/R (Hellfire missile)	20 lbs	100	Airburst	
GBU-39 (SDB I)	37 lbs	30	Airburst	

AGM = Air-to-Ground Missile; cal = caliber; FU = full up; GBU = Guided Bomb Unit; lbs = pounds; mm = millimeter; N/A = not applicable; SDB = Small Diameter Bomb; TR = training round

2.4 413TH FLIGHT TEST SQUADRON

The United States Special Operations Command (SOCOM) has requested the 413th Flight Test Squadron (413 FLTS) to demonstrate the feasibility and capability of the Precision Strike Package and the Stand-Off Precision Guided Munitions (SOPGM) missile system on the AC-130 aircraft. SOCOM, in conjunction with Air Force Operations, Plans and Requirements (A3) Operations at Wright-Patterson AFB, is fielding the new AC-130J for flight characterization, as well as testing and evaluation. AFSOC is integrating some of the same weapons on the AC-130W. Therefore, the activities described below for the 413 FLTS may involve either of these aircraft variants.

AC-130J Precision Strike Package Testing

The proposed AC-130J gunnery testing associated with the 413 FLTS's Precision Strike Package would be similar to that described above for AFSOC AC-130 gunnery training in terms of location and general procedures. Testing would occur in W-151A and would involve firing either (1) projectile gun unit (PGU)-44/B (105 mm high explosive [HE] with fuse munition unit (FMU)-153/B point detonation/delay fuse) or PGU-43B Target Practice (TP) rounds (105 mm TR) from a 105 mm M102 (U.S. Air Force designation M137A1) light-weight Howitzer cannon, or (2) PGU-13 HEI, PGU-46 HEI rounds, or PGU-15 TP rounds (inert) from a 30 mm GAU-23/A gun system. A MK-25 flare would be dropped prior to firing and used as a target. Management measures would be the same as those described for AFSOC's AC-130 gunnery missions. Table 2-5 shows types of rounds fired, as well as the total number of missions and rounds proposed to be expended each year. All missions are conducted shoreward of the continental shelf break (see Figure 2-6).

Table 2-5. Summary of 413 FLTS Precision Strike Package Gunnery Testing

Expendable	Net Explosive Weight	Number of Missions per year	Rounds per mission	Total number of rounds per year
PGU-13/46 (30 mm)	0.1 lbs	3	33	99
PGU-44 (105 mm FU)	4.7 lbs	4	15	60
PGU-43B TP (105 mm TR)	0.35 lbs	4	15	60

413 FLTS = 413th Flight Test Squadron; FU = full up; lbs = pounds; mm = millimeter; PGU = Projectile Gun Unit; TP = target practice; TR = training round

AC-130J and AC-130W Stand-Off Precision Guided Munitions Testing

The SOPGMs proposed for use in this testing include AGM-176 Griffin missiles, AGM-114 Hellfire missiles, GBU-39/B SDBs, and GBU-39B/B Laser Small Diameter Bombs (LSDBs). The purpose of this testing is to demonstrate the feasibility and capability of the SOPGMs on AC-130 aircraft. Initial actions will consist of various ground tests (not included as part of this BA), including systems testing and static drops. After ground testing is completed, captive carry, store separation, and weapon employment tests will be conducted. Captive-carry missions will be conducted with an Instrumented Measurement Vehicle (IMV) to collect environmental data or an inert telemetry (TM) missile in order to evaluate the integration of the SOPGM with the AC-130J. Store separation missions will require a TM missile with an inert warhead and a live motor, if applicable, to verify that the weapon can be employed without significant risk to the aircraft.

Weapon employment missions will be flown using any combination of inert and/or live weapons for a final end-to-end check of the system. Missions may be conducted over land or water ranges, with water ranges used for SDB/LSDB and Griffin missile tests. It is expected that over-water testing would be conducted at the GRATV target location. The target will be laser designated with a standard range instrumentation designator. Plywood targets, as well as stationary and moving vehicles, will be used for the end-to-end functionality tests. They will be set up so that the Integrated Laser Targeting (ILAST) camera can capture the laser spot on the target, and so that the high-speed digital video can record the impact. The ILAST cameras and digital cameras will be mounted in such a way as to have a clear view of the target while being a safe distance from any debris from the impact.

Similar to preceding mission descriptions, pre- and post-test surveys will be conducted within the applicable human and protected species safety zones. Surveys would be conducted from vessels, aircraft, and possibly live video feed. Survey requirements are described in detail in Section 5. Table 2-6 shows the annual number of munitions expended annually for SOPGM testing. It is noted that the 413 FLTS provided the number of munitions required per fiscal year over a span of four years. The numbers in the table represent the average per year (total number divided by four).

Table 2-6. Summary of 413 FLTS SOPGM Annual Testing

Expendable	Net Explosive Weight	Approximate Number Released/Year*	Detonation Scenario
AGM-176 (Griffin)	4.58 lbs	10	Surface
AGM-114 (Hellfire)	20 lbs	10	Surface
GBU-39 (SDB I)	37 lbs	6	Surface
GBU-39 (LSDB)	37 lbs	10	Surface

AGM = Air-to-Ground Missile; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb; SOPGM = Stand-Off Precision Guided Munitions
*Total number of munitions over a four-year period divided by four

Total expendables released annually in the EGTTR under 413 FLTS air-to-surface testing operations are shown in Table 2-7.

Table 2-7. Total Annual 413 FLTS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
30 mm	0.1 lbs	99	Surface	W-151A
105 mm FU	4.7 lbs	60	Surface	
105 mm TR	0.35 lbs	60	Surface	
AGM-176 (Griffin)	4.58 lbs	10	Surface	W-151
AGM-114 (Hellfire)	20 lbs	10	Surface	
GBU-39 (SDB I)	37 lbs	6	Surface	
GBU-39 (LSDB)	37 lbs	10	Surface	

413 FLTS = 413th Flight Test Squadron; AGM = Air-to-Ground Missile; FU = full up; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb; TR = training round

2.5 780TH TEST SQUADRON

Testing activities conducted by the 780th Test Squadron (780 TS) include Precision Strike Weapon (PSW), Longbow missile littoral testing, and several other various future actions. Each activity category is described below.

Precision Strike Weapon

The U.S. Air Force Life Cycle Management Center and U.S. Navy, in cooperation with the 780 TS, conduct PSW test missions utilizing resources within the Eglin Military Complex, including sites in the EGTTR. The weapons used in testing are the AGM-158 A and B (Joint Air-to-Surface Standoff Missile [JASSM]) and the GBU-39/B (SDB I).

The JASSM (Figure 2-7) is a precision cruise missile designed for launch from outside area defenses against hardened, medium-hardened, soft, and area type targets. The JASSM has a range of more than 200 NM and carries a 1,000-pound warhead. The JASSM has approximately 300 pounds of 2,4,6-trinitrotoluene (TNT) equivalent NEW. The specific explosive used is AFX-757, a type of plastic bonded explosive (PBX). The JASSM would be launched more than 200 NM from the target location. Platforms for the launch include B-1, B-2, B-52, F-16, F-18, and F-15E aircraft. Launch from the aircraft would occur at altitudes greater than 25,000 feet. The JASSM would cruise at altitudes greater than 12,000 feet for the majority of the flight profile until making the terminal maneuver toward the target.

The SDB (Figure 2-8) is a guided bomb that is an important element of the Air Force's Global Strike Task Force. The SDB I carries a 217-pound warhead with approximately 37 pounds NEW. The explosive used is AFX-757. The SDB I may be launched from over 50 NM away from the target location. Platforms for the launch include F-15E, F-16, and AC-130W aircraft. Launch from the aircraft occurs at altitudes greater than 5,000 feet above ground level (AGL). The SDB I then commences a non-powered glide to the intended target.

Figure 2-7. Joint Air-to-Surface Stand-off Missile (JASSM)

Figure 2-8. Small-Diameter Bomb (SDB)

Up to two live and four inert JASSM missiles per year may be launched to impact a target at the GRATV target location. The JASSM missile would detonate upon impact with the target. Although impact would typically occur about 5 feet [1.5 meters] above the water surface, detonations are assumed to occur at the water surface for purposes of impacts analysis.

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Additionally, up to 6 live and 12 inert SDBs could also be deployed against targets in the same target area. Two SDB-Is may be launched simultaneously during two of the live missions and four of the inert missions. Detonation of the SDBs would occur under one of two scenarios:

- Detonation upon impact with the target
- Height of burst (HOB) test, which involves detonation 7 to 14 feet (2.2 to 4.5 meters) in the air above the surface target

There would generally be only one detonation per test event, and thus no more than one detonation in any 24-hour period. In instances of a simultaneous SDB launch scenario, two bombs are deployed from the same aircraft at nearly the same time to strike the same target. It is expected that the bombs would strike the target within five seconds or less of each another. Under this scenario, the detonations are considered a single event (NEW is doubled) for the purpose of acoustic modeling and marine species impacts analysis. Modeling both detonations as a single event results in a conservative impact estimate. Refer to Appendix A for a complete description of the acoustic modeling conducted in support of this document. PSW munitions are shown in Table 2-8.

Table 2-8. Summary of Annual Precision Strike Weapon Tests

Weapon	Number of Live Tests/Year	Number of Live Munitions Released	Number of Inert Tests/Year	Number of Inert Munitions Released
AGM-158 (JASSM)	2	2	4	4
GBU-39 (SDB I) Single Launch	2	2	4	4
GBU-39 (SDB I) Simultaneous Launch	2	4	4	8

AGM = Air-to-Ground Missile; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; SDB = Small Diameter Bomb

Chase aircraft (F-15, F-16, and/or T-38) will accompany each launch. These aircraft will follow the test items during captive carry and free flight but will not follow either item below a predetermined altitude as directed by Flight Safety. Other assets on site may include an E-9 turboprop aircraft circling around the target location. Tanker aircraft including KC-10s and KC-135s would also be used. The GRATV may also be on location to hold instrumentation, and would be anchored up to 1,000 feet away from the target location.

Based on availability, one of two potential target types are used during PSW tests. The first is a Container Express (CONEX) target (Figure 2-9) that consists of up to five containers strapped, braced, and welded together to form a single structure. The dimensions of each container are approximately 8 feet by 8 feet by 40 feet. Each container contains 200 55-gallon steel drums (filled with air and sealed) to provide buoyancy. The second type of target is a hopper barge, which is a non-self-propelled vessel typically used for transportation of bulk cargo (Figure 2-10). A typical hopper barge is approximately 30 feet by 12 feet by 125 feet. The targets are held in place by a four-point anchoring system using cables.

Figure 2-9. Example of a CONEX Target

Figure 2-10. Typical Hopper Barge

The CONEX target is constructed on land and shipped to the target location two to three days prior to the test. The barge target is also stationed at the target location two to three days prior to the test. During an inert mission, the JASSM passes through the target and the warhead sinks to the bottom of the Gulf. Immediately following impact, the JASSM recovery team will pick up surface debris originating from the missile and target. Depending on the test schedule, the target may remain in the Gulf of Mexico for up to one month at a time. If the target is significantly damaged, and it is deemed impractical and unsafe to retrieve it, the target remains may be sunk through coordination with the U.S. Coast Guard or Tyndall AFB. Coordination with the U.S. Army Corps of Engineers would be required prior to sinking a target.

PSW test activities occur in W-151 at the GRATV target location. Targets are located in approximately 115 to 120 feet of water, 17 miles offshore of Test Area A-3 on Santa Rosa Island. This area is the same as the Maritime WSEP test site. Test missions may occur during any time of the year, but during daylight hours only.

Description of the Proposed Action

PSW missions are currently authorized to be conducted in the EGTTR. An EA was prepared and completed in November 2005 (U.S. Air Force, 2005). In association with that EA, a Biological Opinion was issued by the NMFS on March 14, 2005 (Consultation No. F/SER/2004/00223) in accordance with the ESA. Since then, new acoustic thresholds and criteria have been adopted by NMFS to analyze acoustic impacts to marine species from exposure to explosive sources. The analysis in Section 4 incorporates these new requirements. All mitigation and monitoring requirements are described in detail in Section 5, *Mitigations*.

In addition to the above description, future (Phase 2) testing of the JASSM and SDB is planned by the Air Force Operational Test and Evaluation Center (AFOTEC) (Table 2-9. AFOTEC proposes to expend two live and one inert GBU-53 (SDB II) weapons in the EGTTR. The live weapons would be deployed against moving boats with a length of 30 to 40 feet, while the inert weapon would be used against a smaller fiberglass boat. Details of Phase 2 JASSM testing are currently unknown; this testing is therefore not included as part of the Proposed Action of this BA.

Table 2-9. Summary of Phase 1 and Phase 2 Precision Strike Weapon Live Tests

Weapon	Net Explosive Weight	Number of Live Munitions Released	Number of Inert Munitions Released
AGM-158 (JASSM)	300 lbs	2	4
GBU-39 (SDB I)	37 lbs	2	4
GBU-39 (SDB I) Simultaneous Launch*	74 lbs	2	4
GBU-53 (SDB II)	22.84 lbs	2	1

AGM = Air-to-Ground Missile; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; lbs = pounds; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

Longbow Littoral Testing

The 780th Test Squadron (780 TS/OGMT) proposes to collect data on the ability of the Longbow missile (AGM-114L) to track and impact moving boat targets in both the Lock On Before Launch (LOBL) and Lock On After Launch (LOAL) modes, and at varying launch elevation angles. A secondary objective of the tests is to acquire telemetry data to evaluate tracking quality. Missiles are typically launched from an Avenger system (a mobile missile launch system) mounted to a High Mobility Multipurpose Wheeled Vehicle (HMMWV). The HMMWV is located either at the shoreline of Eglin's Santa Rosa Island property or on a barge or boat in W-151A. Missiles could also be launched from an AH-64D Apache helicopter. Missiles launched from Santa Rosa Island are outside the EGTTR boundary and are therefore not included in this BA. The targets consist of small (approximately 25 feet in length), remotely controlled fiberglass boats. The distance of the targets from the missile launch site is either 1.5 or 4 kilometers (km) (0.9 or 2.5 miles).

Up to 16 live Longbow missiles could be launched annually in the EGTTR (Table 2-10). The NEW of each missile is 35.95 pounds. All missiles will contain a proximity fuse, with detonations occurring at a minimum height of 1 to 3 meters (3.3 to 9.8 feet) above the water. There will be no detonations below the surface. Management actions include human safety zone clearance and pre- and post-mission protected marine species surveys, as described in Section 5.

Table 2-10. Annual Longbow Munitions

Type of Munition	Total Number of Live Munitions	Detonation Location	Warhead – Explosive Material	Net Explosive Weight
AGM-114 L (Longbow)	16	1 to 3 meter height (airburst)	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge	35.95 lbs

AGM = Air-to-Ground Missile; lbs = pounds

Future Actions

The 780 TS plans to conduct other various testing activities that involve targets on the water surface in the EGTTR. Many of the missions will target small boats or barges. Weapons will primarily be delivered by aircraft, although a rail gun will be used for one test. Live warheads will be used for some missions, while others will involve inert warheads with a live fuse (typically contains a very small NEW). Total munitions for the five-year period of 2017 to 2021 are listed in Table 2-11. As with the preceding missions using live weapons, safety zone enforcement and pre- and post-mission marine species monitoring will be required.

Table 2-11. 780 TS Annual Munitions, Other Future Actions

Munition	Net Explosive Weight (pounds)	Number of Releases	Proposed Location	Target Type	Detonation Type
Joint Air-Ground Missile	27.41	2	W-151 (subareas A, S5, and S6)	HSMST or Boston Whaler type boat	1 – Point Detonation 1 - Airburst
Navy Rail Gun	Inert	19	W-151	Barge	Penetrating Rod
	1	5	W-151	Barge	Airburst
JDAM – Extended Range	Inert	3	W-151	Water surface (2) Barge (1)	Inert
Navy HAAWC	Inert	2	W-151	Water surface	Inert
Laser SDB	0.4 (fuse)	4 maximum	W-151A	Small boats	Airburst or Surface
SDB II Guided Test Vehicle	0.4 (fuse)	4	W-151A	Small boats	Surface

780 TS = 780 Test Squadron; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; HSMST = High Speed Maneuverable Surface Target; JDAM = Joint Direct Attack Munition; SDB = Small Diameter Bomb

Summary of Combined 780th Test Squadron Activities

Total expendables proposed to be released annually in the EGTTR under 780 TS air-to-surface testing operations, including PSW, Longbow, and other various missions, are shown in Table 2-12.

Table 2-12. Total Annual 780 TS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
Live AGM-158 (JASSM)	300 lbs	2	Surface	W-151A
Inert AGM-158 (JASSM)	N/A	4	N/A	
Live GBU-39 (SDB I)	37 lbs	2	Surface	
Inert GBU-39 (SDB I)	N/A	4	N/A	

Table 2-12. Total Annual 780 TS Air-to-Surface Testing Activities, Cont'd

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
Live GBU-39 (SDB I) Simultaneous Launch*	74 lbs	2	Surface	
Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	4	N/A	
Live GBU-53 (SDB II)	22.84 lbs	2	Surface	
Inert GBU-53 (SDB II)	N/A	1	N/A	
AGM-114 L (Longbow)	35.95 lbs	16	Airburst	
Joint Air-to-Ground Missile	27.41 lbs	1	Surface	W-151 (various sub-areas including but not limited to A, S5, and S6)
		1	Airburst	
Live Navy Rail Gun	1	1	Airburst	
Inert Navy Rail Gun	N/A	19	N/A	
JDAM Extended Range	N/A	3	N/A	
Navy HAAWC	N/A	2	N/A	
Inert GBU-39 (LSDB) with live fuse	0.4 lbs	4	Airburst or surface	
Inert GBU-53 (SDB II with live fuse)	0.4 lbs	4	Surface	

780 TS = 780th Test Squadron; AGM = air-to-ground missile; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; JDAM = joint direct attack munition; lbs = pounds; LSDB = Laser Small Diameter Bomb; N/A = not applicable; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

2.6 96 TW INERT MUNITIONS

The 96th Test Wing (96 TW), Eglin's host wing, provides developmental test and evaluation for a wide variety of air-delivered weapons and other systems. The 96 TW proposes to expend approximately nine inert bombs yearly in the EGTTR. The weight of each bomb would be 2,000 pounds, but there would be no warhead. Use of inert munitions was analyzed in the 2002 PEA and found to have no significant environmental impact. Therefore, there is no limit on the number of inert items that may be expended, and actual numbers used by the 96 TW may vary. However, the bombs are included in the REA in order to document the programmatic use of the EGTTR.

2.7 96 OPERATIONS GROUP

The 96 Operations Group, which conducts the 96 TW's primary missions of developmental testing and evaluation of conventional munitions, and command and control systems, anticipates support of air-to-surface missions for several user groups on an infrequent basis. Sub-surface detonations would be at 5 to 10 feet below the surface. Projected annual munitions expenditures and detonation scenarios are listed in Table 2-13.

Table 2-13. Annual Munitions for 96th Operations Group Support

Munition	Net Explosive Weight (lbs)	Detonation Scenario	Number of Annual Releases
GBU-10 or GBU-24	945	Subsurface	1
GBU-12 or GBU-54	192	Subsurface	1
AGM-65 (Maverick)	86	Surface	2
GBU-39 (SDB I or LSDB)	37	Subsurface	4
AGM-114 (Hellfire)	20	Subsurface	20
105 mm full-up	4.7	Surface	125
40 mm	0.9	Surface	600
Live fuse	0.4	Surface	200
30 mm	0.1	Surface	5,000

AGM = Air-to-Ground Missile; GBU = Guided Bomb Unit; lbs = pounds; mm = millimeter; SDB = Small Diameter Bomb

2.8 SUMMARY OF EXPENDABLES USED IN AIR-TO-SURFACE TESTING AND TRAINING

Table 2-14 shows the inclusive list of munitions expendables associated with all air-to-surface test and training missions included in the Proposed Action of the *Eglin Gulf Test and Training REA*. The list incorporates all missions currently conducted or planned by the 86 FWS, ASEP, AFSOC, 413 FTS, 780 TS, 96 TW, and 96 OG.

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
86 FWS/Maritime WSEP Live Munitions	GBU-10 or GBU-24	945	Surface or subsurface	2
	GBU-12 or GBU-54 (LJDAM)	192	Surface or subsurface	6
	AGM-65 (Maverick)	86	Surface	6
	CBU-105	107.63	Airburst	4
	GBU-39 (LSDB)	37	Airburst, Surface, or Subsurface	4
	AGM-114 (Hellfire)	20	Airburst, Surface, or Subsurface	30
	GBU-53 (SDB II)	22.84	Airburst, Surface, or Subsurface	4
	AGM-176 (Griffin)	4.58	Airburst or Surface	10
	2.75-in Rockets (including APKWS)	10	Surface	100
	PGU-13 HEI (30 mm)	0.1	Surface	1,000
	AIM-9X	68	Surface	4
86 FWS/Maritime WSEP Inert Munitions	GBU-10	N/A	N/A	21
	GBU-12	N/A	N/A	27
	GBU-25	N/A	N/A	17
	GBU-31	N/A	N/A	6
	GBU-38	N/A	N/A	3
	GBU-54	N/A	N/A	16
	BDU-56	N/A	N/A	13

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR, Cont'd

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
	AIM-9X	N/A	N/A	3
	PGU-27	N/A	N/A	46,000
ASEP	Mk-84 Bomb (inert)	N/A	N/A	12
AFSOC/Air-to-Surface Training Operations	7.62 mm/.50 cal	N/A	N/A	30,000
	25 mm	0.067	Surface	39,200
	30 mm	0.1	Surface	35,000
	40 mm	0.87	Surface	4,480
	105 mm FU	4.7	Surface	750
	105 mm TR	0.35	Surface	1,350
	AGM-176 (Griffin)	4.58	Airburst	200
	AGM-114P/R (Hellfire)	20	Airburst	100
	GBU-39 (SDB I)	37	Airburst	30
413 FLTS/Air-to-Surface Testing Activities	30 mm	0.1	Surface	99
	105 mm FU	4.7	Surface	60
	105 mm TR	0.35	Surface	60
	AGM-176 (Griffin)	4.58	Surface	10
	AGM-114 (Hellfire)	20	Surface	10
	GBU-39 (SDB I or LSDB)	37	Surface	16
780 TS/Air-to-Surface Testing Activities	Live AGM-158 (JASSM)	300	Surface	2
	Inert AGM-158 (JASSM)	N/A	N/A	4
	Live GBU-39 (SDB I)	37	Airburst or Surface	2
	Inert GBU-39 (SDB I)	N/A	N/A	4
	Live GBU-39 (SDB I) Simultaneous Launch*	74	Airburst or Surface	2
	Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	N/A	4
	Live GBU-53 (SDB II)	22.84	Surface	2
	Inert GBU-53 (SDB II)	N/A	N/A	1
	AGM-114 L (Longbow)	35.95	Airburst	16
	Joint Air-to-Ground Missile	27.41	Surface	1
			Airburst	1
	Live Navy Rail Gun	1	Airburst	1
	Inert Navy Rail Gun	N/A	N/A	19
	JDAM Extended Range	N/A	N/A	3
	Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	N/A	N/A	2
	Inert GBU-39 (LSDB) with live fuse	0.4	Airburst or surface	4
	Inert GBU-53 (SDB II with live fuse)	0.4	Surface	4
96 TW Inert Munitions	Bomb (2,000 pounds)	N/A	N/A	9
96 Operations Group	GBU-10 or GBU-24	945	Subsurface	1
	GBU-12 or GBU-54	192	Subsurface	1
	AGM-65 (Maverick)	86	Surface	2
	GBU-39 (SDB I or LSDB)	37	Subsurface	4
	AGM-114 (Hellfire)	20	Subsurface	20

Table 2-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR, Cont'd

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
	105 mm full-up	4.7	Surface	125
	40 mm	0.9	Surface	600
	Live fuse	0.4	Surface	200
	30 mm	0.1	Surface	5,000

413 FLTS = 413th Flight Test Squadron; 86 FWS = 86th Fighter Weapons Squadron; 96 TW = 96th Test Wing; AFSOC = Air Force Special Operations Command; AGM = air-to-ground missile; AIM = air intercept missile; APKWS = Advanced Precision Kill Weapon System; ASEP = Advanced Systems Employment Project; BDU = Bomb, Dummy Unit; cal = caliber; CBU = Cluster Bomb Unit; FU = full up; GBU = Guided Bomb Unit; HEI = high explosive incendiary; JASSM = Joint Air-to-Surface Standoff Missile; JDAM = joint direct attack munition; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bomb; Mk = mark; mm = millimeter; ms = millisecond; N/A = Not Applicable; NEW = net explosive weight; PGU = Projectile Gun Unit; SDB = Small Diameter Bomb; TR = training round; WSEP = Weapons System Evaluation Program
*NEW is doubled for each simultaneous launch

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3. SPECIES AND ESSENTIAL FISH HABITAT DESCRIPTIONS

A total of 12 federally protected species are identified in Section 1.3 as having potential occurrence in the northeastern Gulf of Mexico, including 2 marine mammal, 5 sea turtle, 2 fish, and 3 bird species. Although all generally occur in the northeastern Gulf of Mexico, it is highly unlikely that eight of these species would be found in the areas used specifically for Eglin's air-to-surface test and training missions described in Section 2. Federally protected species that have been excluded from further consideration in this BA are summarized below.

The two species of marine mammals that are protected under the ESA are the sperm whale and Florida manatee. The sperm whale has consistent occurrence in portions of the northern Gulf, but is found farther offshore, generally over the continental slope in water depths greater than 600 meters (1,969 feet). In order to prevent impacts to the sperm whale, no live air-to-surface activities with detonations occurring at or below the water surface will be conducted beyond the 200-meter isobath (considered to represent the continental shelf break). The Florida manatee primarily inhabits coastal and inshore waters and is rarely sighted offshore. The EGTTR boundary is 3 miles offshore, and most missions occur at least 15 miles from the coast. Therefore, manatee occurrence in affected areas is considered unlikely.

The hawksbill sea turtle inhabits the northern Gulf of Mexico, but is considered to have limited occurrence in the northern Gulf, including areas off the Florida panhandle. For example, there were only five reported hawksbill strandings in the area during the 10-year period from 2003–2012 (NMFS, 2013). Therefore, this species is not considered a regular inhabitant of the proposed air-to-surface mission areas and has been eliminated from further analysis.

The Gulf sturgeon is an anadromous fish found in riverine, estuarine, and nearshore marine environments of coastal states along the Gulf of Mexico. Adult Gulf sturgeon occupy fresh water during the warm months, when spawning occurs, and migrate into estuarine and marine waters in the fall to forage and overwinter. When in the open Gulf, sturgeon are generally thought to remain near the shoreline, although factors such as water depth or prey distribution may be more important factors than distance from land. For example, Gulf sturgeons have been observed off the Suwannee River area as far as 9 NM (16.7 km) from shore (USFWS and NMFS, 2003).

Eglin AFB has studied Gulf sturgeon occurrence and distribution near the northern boundary of the EGTTR for several years. Initial results showed that sturgeons remained very close to shore off Santa Rosa Island (within 1,000 meters, or 0.6 mile). However, a more offshore distribution was noted during the last year of study, when over 80 percent of sturgeon detections were recorded at a receiver 1,250 meters from shore. Given the commonly cited detection range of 500 meters, some number of sturgeons could have been at least 1,750 meters (approximately 1 mile) from shore. The extent of the offshore distribution could not be determined because receivers were not placed farther out in the Gulf. However, the 1,750 meter (1 mile) distance does not approach the EGTTR boundary 3 miles offshore from the Florida Gulf coast or the primary air-to-surface test area located 17 miles offshore. The USFWS has designated critical habitat for the Gulf sturgeon in several habitat types, including the nearshore Gulf of Mexico.

Species and EFH Descriptions

Nearshore habitat extends from the mean high water line out to 1 NM (1.9 km) offshore, which is well outside the area affected by air-to-surface missions.

The smalltooth sawfish, once common throughout the Gulf of Mexico from Texas to Florida, is currently distributed primarily throughout peninsular and southern Florida. The species is only commonly found in the Everglades and in shallow areas with mangrove forests in Florida Bay and the Florida Keys, as well as off southern Florida. Sawfish are considered to typically reside within 1 NM (1.9 km) of the shore in estuaries, shallow banks, sheltered bays, and river mouths, although larger adults may occur in water depths of over 200 feet (Poulakis and Seitz, 2004). Occasionally, they are found offshore on reefs or wrecks and over hard or mud bottoms. Based on currently documented distribution, the likelihood of sawfish occurring 15 to 20 miles offshore in the GRATV target location is considered remote.

The three federally protected bird species (piping plover, wood stork, and bald eagle) are unlikely to occur within air-to-surface test and training areas. None of these species would typically be found on the marine water surface or in association with target boats in the mission areas. Direct impacts would be limited to possible encounters of birds flying through a test or training area at the same time a detonation occurred, at a height above the water that placed them in the blast radius, and to direct strikes by weapons in flight. The possibility of such scenarios is considered remote. In addition, other than possibly during migratory flights, the species are not typically sighted 15 to 20 miles offshore. Critical habitat has been designated for the piping plover on Santa Rosa Island, the land mass nearest the GRATV target location. However, critical habitat would not be affected.

Species and habitats evaluated in this document include four sea turtle species and EFH. These resources are described in the following sections.

3.1 SEA TURTLES

All sea turtle species included in this BA except the loggerhead are classified under the ESA as endangered. The loggerhead is classified as threatened. Sea turtles spend their lives at sea and rarely come ashore except to nest and, in rare circumstances, to bask. The number of sea turtles decreased significantly during the twentieth century. Factors contributing to this decline include the negative influence of beach lighting on nesting and hatching behavior, erosion control practices, off-road vehicle use, predator activities, and illegal egg harvesting.

Sea turtle nesting activity in Florida is documented by the Florida Fish and Wildlife Conservation Commission for the loggerhead, green, and leatherback sea turtle. Of these species, the loggerhead is the most prolific, with Florida accounting for over 90 percent of nesting in the United States (Fish and Wildlife Research Institute [FWRI], 2012). The majority of sea turtle nesting occurs along the southeastern Florida peninsula. For example, in 2014 there were 48,408 combined loggerhead nests in Brevard and West Palm Beach Counties, compared to 106 nests for Santa Rosa, Okaloosa, and Walton Counties (the three counties in which Eglin AFB lies). Sea turtle nesting data for these three counties are provided in Table 3-1. Although the State website does not list nesting activity for leatherback or Kemp's ridley sea turtles in the

northern Gulf, Eglin AFB reports that these two species occasionally nest on military-controlled beaches of Santa Rosa Island.

Table 3-1. Sea Turtle Nesting Data for Counties Surrounding Eglin Air Force Base, 2014

County	Survey Length in km (mi)	Loggerhead Sea Turtle Nests	Loggerhead Sea Turtle Non-Nesting Emergences	Green Sea Turtle Nests	Green Sea Turtle Non-Nesting Emergences	Leatherback Sea Turtle Nests	Leatherback Sea Turtle Non-Nesting Emergences
Santa Rosa	11.2 (7.00)	12	4	0	0	0	0
Okaloosa	38.0 (23.6)	34	23	0	1	0	0
Walton	48.7 (30.3)	60	40	5	2	0	0

Source: FWRI, 2015
km = kilometers; mi = miles

3.1.1 Loggerhead Sea Turtle - Northwest Atlantic Ocean Distinct Population Segment

The loggerhead sea turtle was listed as a threatened species throughout its range on July 28, 1978. NMFS and the USFWS have published a final rule designating nine Distinct Population Segments (DPS) for loggerhead sea turtles (76 FR 58868, September 22, 2011; effective October 24, 2011). The Northwest Atlantic DPS (NWA DPS) is the only one that coincides with the GRATV target location and associated activities described in Section 2, and, therefore, is the only one considered in this BA.

Description, Distribution, and Population Structure

The loggerhead turtle is a large, hard-shelled sea turtle. The mean straight carapace length of adults is approximately 92 centimeters (cm) (36 inches [in]), and the average weight is 116 kilograms (kg) (256 pounds [lbs]) (NMFS and USFWS, 1991a). This species inhabits continental shelf and estuarine environments throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd, 1988). The majority of nesting occurs along the western boundaries of the Atlantic and Indian Oceans (National Research Council, 1990). Loggerhead turtles are not as dependent upon nearshore waters as some other species (greens and hawksbills), and the expected distribution thus extends from the shoreline past the continental shelf break into waters of the continental slope. On average, loggerhead turtles spend over 90 percent of their time underwater (Department of the Navy [DON], 2007). Routine dive depths of 9 to 22 meters (29.5 to 72 feet) have been recorded, and dives of up to 233 meters (764 feet) have been recorded for a post-nesting female loggerhead. Routine dives typically last from 4 to 172 minutes.

In the western North Atlantic, loggerhead nesting occurs primarily along the U.S. coast from southern Virginia to Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, and in areas of the Bahamas, Cuba, Central and South America, and the eastern Caribbean Islands. Non-nesting adult females occur throughout the species' U.S. coastal range and the Caribbean Sea. Little is known about the distribution of adult males. Aerial surveys suggest that about 12 percent of loggerheads in U.S. waters occur in the eastern Gulf of Mexico; the majority (54 percent) occurs along the southeast U.S. Atlantic coast (NMFS, 2013). Shallow water habitats with large expanses of open ocean access provide foraging habitat for adult loggerheads, while juveniles are found in enclosed,

shallow water estuarine environments not frequented by adults (NMFS, 2013). Benthic, immature loggerheads are known to migrate between northern and southern areas off the U.S. coast as water temperatures seasonally rise and fall (NMFS, 2013).

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to southern peninsular Florida, and along the Florida Gulf coast. Previously, NMFS recognized at least five Western Atlantic loggerhead subpopulations. The Florida Panhandle nesting subpopulation was considered to consist of individuals occurring at Eglin AFB and beaches near Panama City, Florida. However, the recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula (and presumably other areas of Florida as well) and that subpopulation boundaries could not be designated based on genetic differences. Therefore, the recovery plan uses a combination of nesting densities, geographic separation, geopolitical boundaries, and genetic differences to identify recovery units. The Northern Gulf of Mexico Recovery Unit (Franklin County, Florida through Texas) is the unit associated with the air-to-surface test and training area.

Life History

Loggerhead sea turtles reach maturity between 20 and 38 years of age, although the age appears to vary widely among populations (NMFS-Southeast Fisheries Science Center [SEFSC], 2001; (NMFS, 2013). The mating season occurs from late March to early June, and eggs are laid throughout the summer months. Female loggerheads deposit an average of 4.1 nests per nesting season (Murphy and Hopkins, 1984) and have an average remigration interval of 3.7 years (NMFS, 2013). Mean clutch size along the southeastern U.S. coast varies from 100 to 126 eggs (Dodd, 1988).

Loggerhead sea turtles are generally thought to circumnavigate the North Atlantic Gyre as pelagic post-hatchlings and early juveniles (often occurring in *Sargassum* drift lines or other convergence zones), and may lead a pelagic existence for as long as 7 to 12 years (Bolten et al., 1998). At some point, individuals apparently shift to a different midwater feeding habitat; in the eastern North Atlantic Ocean, it is believed to be the waters surrounding the Azore and Madeira Islands. Other oceanic waters include the Grand Banks (Newfoundland, Canada) and the Mediterranean Sea. As later juveniles and adults, loggerheads most often occur on the continental shelf and shelf edge of the U.S. Atlantic and Gulf coasts; they are also known to inhabit coastal estuaries and bays along both coasts (CETAP, 1982; Shoop and Kenney, 1992). However, the results of recent studies suggest that not all loggerhead turtles follow the model described above (NMFS, 2013). These studies suggest some turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized, or move back and forth between pelagic and coastal habitats (Witzell, 2002). Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd, 1988). Sub-adult and adult loggerheads, primarily found in coastal waters, prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Abundance and Trends

Although the loggerhead is the most commonly sighted sea turtle in the southeastern United States, there currently is not a reliable estimate of population size in the western North Atlantic Ocean. The SEFSC has developed a preliminary demographic model to predict population trajectories (NMFS, 2013). One of the most robust results estimated an adult female population size for the western North Atlantic of between 20,000 and 40,000 individuals, with a low likelihood of being up to 70,000. Numbers of nests and nesting females can vary widely from year to year. However, nesting beach surveys can under some circumstances provide a reasonable estimate of trends in the adult female population (assuming strong nest site fidelity). Loggerhead nesting at all combined Florida index beaches declined significantly for the NWA DPS between 1989 and 2008. However, nesting has increased substantially since that time, such that the overall nesting trend from 1989 to 2012 is approximately zero (no gain or loss) (NMFS, 2013). There was a near record level of nests in 2012. Nesting for the Northern Gulf of Mexico Recovery Unit showed a significant declining trend of 4.7 percent from 1997 to 2008. Nesting on Florida Panhandle index beaches specifically, which represents the majority of nesting for this recovery unit, generally declined between 1997 and 2011 (with a notable exception in 2008). However, nesting in 2012 and 2013 increased to levels comparable to the late 1990s, with a record level in 2012.

A recent study conducted between 2010 and 2012 used satellite telemetry to tag and track the movements of 39 adult female loggerheads from nesting beaches at three sites in Florida and Alabama (Hart et al., 2013). The results of this study have indicated that female loggerheads from this subpopulation make longer movements during the inter-nesting period than previously thought and may regularly utilize nesting beaches from different geographic areas within the same reproductive season, which demonstrates a significantly lower nest-site fidelity level than previously reported (Hart et al., 2013).

Threats

Loggerhead sea turtles are exposed to a variety of threats, as described by NMFS (2013). Cold stunning is a natural event that may result in mortality. The greatest anthropogenic threat to the NWA DPS is fishery bycatch. Domestic fishery operations that result in capture, injury, and mortality to sea turtles of various life stages include pelagic longline, shrimp, trawl, gill net, purse seine, hook-and-line, pound net, and trap fisheries. In addition, loggerheads are exposed to direct and incidental impacts due to foreign fishing operations including longline, trawl, and gill net fisheries.

Loggerhead sea turtles are also affected by non-fishery impacts in marine and terrestrial environments. Construction and maintenance of Federal navigation channels in nearshore U.S. waters can result in turtle mortality due to entrainment in dredges. Turtles may also be entrained in the cooling systems of electrical plants. Other nearshore threats include vessel operations, military exercises (including detonations), oil and gas activities, and scientific research activities.

Coastal development may affect sea turtles through habitat alteration and nesting interference. The placement of buildings, pilings, and beach armoring materials, as well as sand removal or beach renourishment, may remove nesting beach habitat, change thermal profiles, and increase

erosion. Artificial lighting associated with coastal development may also interfere with nesting behavior and may result in hatchling disorientation. Additional terrestrial threats include predation by land animals, direct egg and adult harvest (mostly in foreign countries), and introduction of pollutants such as pesticides, hydrocarbons, and organochlorides into marine waters.

There have been actions implemented to reduce anthropogenic impacts to sea turtles, particularly since the early 1990s. These actions include lighting ordinances, predation control, nest relocations, and measures to reduce mortality resulting from various fisheries and other marine activities. Use of Turtle Excluder Devices has significantly decreased impacts due to shrimp trawling in the United States, although trawling is still one of the largest sources of anthropogenic loggerhead mortality.

Critical Habitat Designation

On July 10, 2014, the USFWS and NMFS issued Final Rules to designate critical habitat for the NWA DPS of the loggerhead sea turtle (79 *Federal Register* [FR] 39755 and 79 FR 39855, effective August 11, 2014). Under the USFWS rule, approximately 1,102 km (685 miles) of loggerhead sea turtle nesting beaches in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi are included in the terrestrial component of critical habitat. The nesting beaches on Eglin AFB are exempt because Eglin's Integrated Natural Resources Management Plan (INRMP) already incorporates measures that provide a benefit for the species.

Under the NMFS rule, 38 occupied marine areas within the range of the NWA DPS are included in the marine component of critical habitat and contain at least one or a combination of the following habitat types: nearshore reproductive habitat, winter area, breeding area, constricted migratory corridor, and *Sargassum* habitat. Of those, only nearshore reproductive habitat and *Sargassum* habitat areas were designated in the northern Gulf of Mexico.

Nearshore reproductive habitat describes nearshore waters adjacent to nesting beaches that are used by hatchlings to move into the open-water environment as well as by nesting females to transit between beach and open water. This includes nearshore waters out to 1.6 km (1 mile) offshore. The identification of nearshore reproductive habitat was based primarily on location of beaches identified as high density nesting beaches by the USFWS and beaches adjacent to the high density nesting beaches that serve as expansion areas. As a result, 36 units of nearshore reproductive critical habitat have been identified. This includes waters off three high density/expansion nesting beaches not designated as terrestrial critical habitat by the USFWS because they occur on military lands with an associated INRMP in place. Since Eglin's INRMP does not address waters off the nesting beaches on Santa Rosa Island, nearshore reproductive habitat has been designated from the shoreline of these beaches out to 1.6 km (1 mile) in the Gulf.

The *Sargassum* habitat portion of the marine designation consists of the western Gulf of Mexico from the 10-meter bathymetry line starting at the mouth of the Mississippi River and proceeding west and south to the outer boundary of the U.S. Economic Exclusion Zone (EEZ). The southern boundary is the U.S. EEZ from the 10-meter bathymetry line off of Texas to the Gulf of Mexico-Atlantic Ocean border. The eastern edge follows the 10-meter bathymetry line from the mouth of

the Mississippi River then goes in a straight line to the northernmost boundary of the Loop Current and follows along its eastern edge to the Gulf of Mexico-Atlantic Ocean border.

Nearshore reproductive habitat and *Sargassum* habitat designations are shown in relation to W-151 and the GRATV target location on Figure 3-1. Neither of these habitat types overlaps with areas typically used for or substantially affected by live air-to-surface test or training missions. Therefore, loggerhead sea turtle critical habitat would not be adversely affected and is not discussed further in this BA.

3.1.2 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered throughout its entire range on December 2, 1970, under the *Endangered Species Conservation Act of 1969* (a precursor to the ESA). The Kemp's ridley is considered the most imperiled of the world's sea turtles (USFWS and NMFS, 1992).

Description, Distribution, and Population Structure

The Kemp's ridley is the smallest living sea turtle. The straight carapace length is approximately 65 cm (26 in) and adults weigh less than 45 kg (99 lbs) (USFWS and NMFS, 1992). Adult Kemp's ridley shells are almost circular. Few data are available on the maximum dive duration. Satellite-tagged juveniles showed different mean surface intervals and dive depths depending on whether they are located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals) (DON, 2007). Dive times range from a few seconds to a maximum of 167 minutes; routine dives last between 16.7 and 33.7 minutes. Kemp's ridleys spend between 89 and 96 percent of their time submerged.

Adults have a very restricted distribution relative to other sea turtles, occurring mostly in shallow nearshore waters of the Gulf of Mexico (although adults are sometimes sighted along the eastern U.S. coast). Post-pelagic turtles can be found over crab-rich sandy or muddy bottoms. Nesting is generally limited to beaches of the western Gulf of Mexico, primarily in the Mexican state of Tamaulipas, although a few nests have also been recorded in Florida and the Carolinas (Meylan et al., 1995). Kemp's ridleys nest in daytime aggregations known as "arribadas," primarily at Rancho Nuevo, Mexico; most nesting occurs in this single locality (NMFS, 2013). The Kemp's ridley is a rare nester on Eglin beaches and was documented for the first time in 2008 when three nests were deposited on Santa Rosa Island. Nesting has continued since that time.

Life History

Kemp's ridley sea turtles reach maturity at 7 to 15 years of age. Although some turtles nest annually, the remigration rate is approximately two years. Nesting generally occurs from April to July. Females lay approximately 2.5 nests per season with each nest containing about 100 eggs (Márquez, 1994). The species remains in the post-hatchling pelagic stage from one to four years, and in the benthic immature stage for approximately seven to nine years (Schmid and Witzell, 1997).

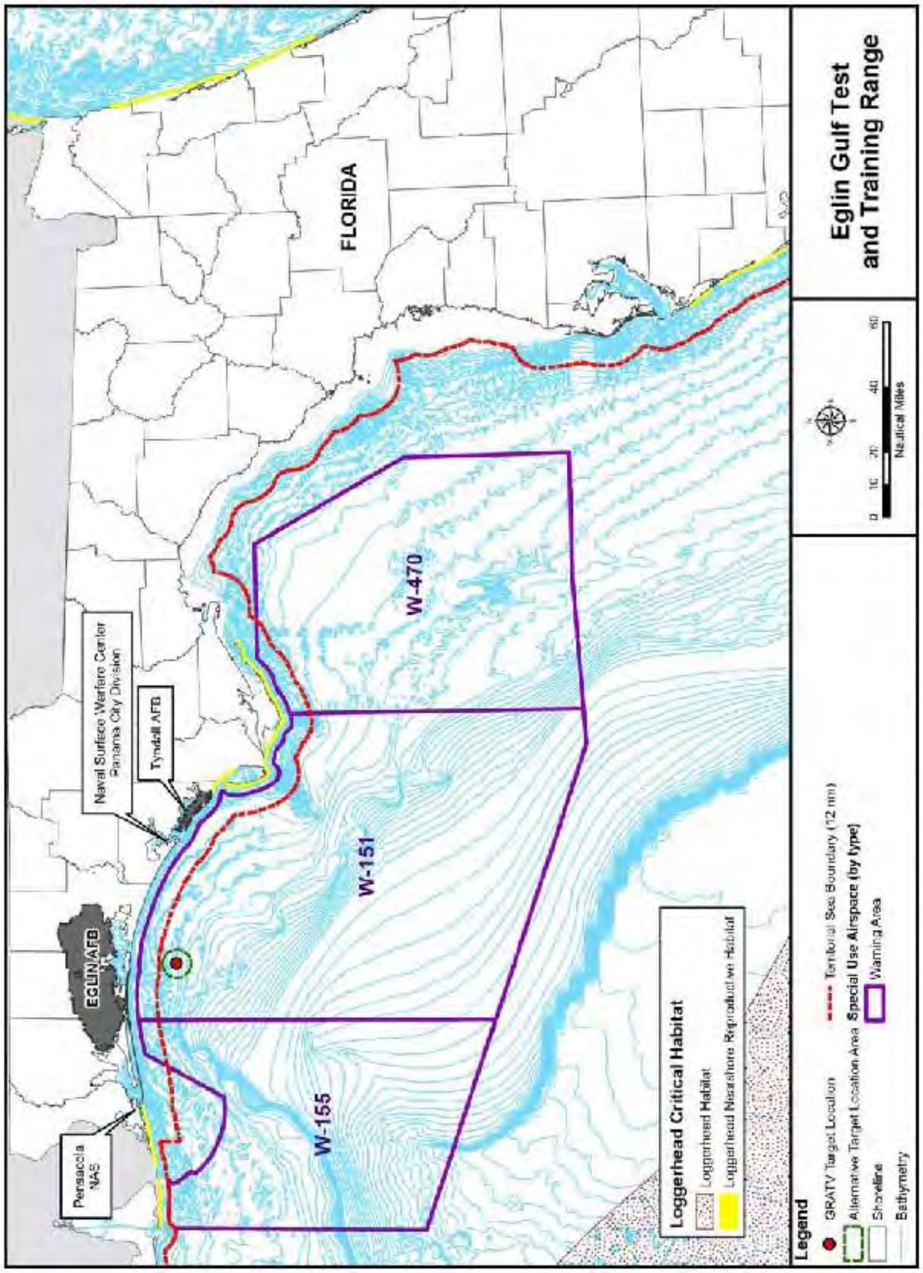

Figure 3-1. Marine Component of Loggerhead Critical Habitat Designation

Species and EFH Descriptions

Little is known of the movements of the post-hatching, planktonic stage of Kemp's ridleys within the Gulf of Mexico, although the turtles are assumed to associate with *Sargassum* seaweed. Post-hatchlings and small juveniles may be retained in the northern Gulf until migrating inshore to demersal habitats or may be carried south in the Loop Current where they may become entrained in the Florida Current and Gulf Stream (Musick and Limpus, 1997). Once they reach a size of approximately 20 to 30 cm (8 to 12 in), or about two years of age, the turtles migrate to neritic developmental habitats along the U.S. Atlantic and Gulf coasts, where they spend the majority of their lives as large juveniles and adults. Atlantic juveniles/subadults travel northward with seasonal warming to feed in coastal waters from Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick, 1985; Henwood and Ogren, 1987; Ogren, 1989).

Adult Kemp's ridleys primarily occupy neritic habitats that typically contain muddy or sandy bottoms where prey can be found. The diet of post-pelagic turtles consists primarily of crabs, with a preference for portunid crabs (NMFS, 2013). Stomach contents of Kemp's ridleys along the lower Texas coast consisted mostly of nearshore crabs and mollusks, in addition to fish, shrimp, and other foods likely scavenged from shrimping operations (NMFS, 2013). Highly suitable habitats identified in the Gulf of Mexico include the western coast of Florida (particularly the Cedar Keys area), the eastern coast of Alabama (including Mobile Bay), the mouth of the Mississippi River, and coastal waters off western Louisiana and eastern Texas.

Abundance and Trends

Of the seven existing sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. The adult female population was estimated to be in excess of 40,000 individuals in 1947, but nesting numbers were below 1,000 by the mid-1980s. However, increased nesting in the 1990s suggested that the decline had stopped, and the population is currently increasing (NMFS, 2013). The number of nests observed at Rancho Nuevo and nearby beaches increased between 1985 and 1999, and data from all Mexican beaches show that the number of nests increased from 7,147 to 21,797 between 2004 and 2012 (a substantial decline occurred in 2010) (NMFS, 2013). A small nesting population is apparently emerging in the United States (primarily in Texas), with the number of nests increasing from 6 in 1996 to 209 in 2012 (NMFS, 2013).

Recent modeling suggests that Kemp's ridley populations may increase substantially in the future. Heppell et al. (2005) suggest that the population is expected to increase at least 12 to 16 percent per year, and that the population could reach at least 10,000 females nesting on Mexico beaches by 2015. Modeling reported by NMFS et al. (2011) predicts that the population is expected to increase 19 percent per year. Approximately 25,000 nests would be needed to reach an estimated 10,000 nesting females (based on an average 2.5 nests per nesting female). Despite the nesting decline in 2010, the nearly 22,000 nests recorded in 2012 suggest that the models may reasonably forecast actual population increases. However, as with any model, future data will be needed to confirm the projected population trajectory.

Threats

Threats to the Kemp's ridley sea turtle are generally the same as those described for the loggerhead sea turtle.

3.1.3 Green Sea Turtle

The green sea turtle was listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered. NMFS currently recognizes 11 DPS, and the air-to-surface activities described in this document coincide with the range of the North Atlantic DPS. On March 23, 2015, NMFS proposed to change the status of the green turtle North Atlantic DPS from endangered to threatened. The public comment period for the proposed change extended until late June 2015.

Description, Distribution, and Population Structure

The green sea turtle is the largest hard-shelled sea turtle. Adults commonly reach 100 cm (39.4 in) in carapace length and 150 kg (331 lbs) in weight (NMFS and USFWS, 1991b). The species is considered a tropical herbivore. Green turtles typically make dives shallower than 30 meters (98 feet); however, a maximum dive depth of 110 meters (361 feet) has been recorded in the Pacific Ocean. The maximum dive time recorded for a subadult green turtle is 66 minutes, with routine dives ranging from 9 to 23 minutes.

Green turtles are distributed circumglobally in tropical and subtropical waters (NMFS and USFWS, 1991b). Green turtles have been seen in the open ocean and can likely traverse an entire ocean basin during their life cycle. Nesting occurs in more than 80 countries worldwide (Hirth and USFWS, 1997). The two largest nesting populations are found at Tortuguero (Caribbean coast of Costa Rica) and Raine Island (Great Barrier Reef in Australia). In the United States, nesting occurs from Texas to North Carolina, as well as the U.S. Virgin Islands and Puerto Rico (NMFS and USFWS, 1991b; Dow et al., 2007). However, the great majority of nesting in the United States occurs in southeastern Florida, particularly Brevard to Broward Counties. The green turtle nesting aggregation in Florida is recognized as a regionally significant colony (USFWS North Florida Field Office [NFFO], 2009a).

In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern U.S. include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty, 1984; NMFS, 2013); the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (NMFS, 2013); Florida Bay and the Florida Keys (Schroeder and Foley, 1995); the Indian River Lagoon system in Florida (NMFS, 2013); and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart, 1992; Wershoven and Wershoven, 1992). The summer developmental habitat also encompasses estuarine and coastal waters from North Carolina to Long Island Sound (Musick and Limpus, 1997). Additional important foraging areas in the western Atlantic include coastal areas of Puerto Rico, Cuba, Nicaragua, Panama, Colombia, and Brazil (Hirth, 1971), and the northwestern coast of the Yucatán Peninsula.

Adults are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs (Hays et al., 2001) and are known to migrate seasonally between northern and southern areas. The existence of regional subpopulations is supported by genetic data. However, turtles from different nesting origins are commonly found mixed together on foraging grounds throughout the species' range.

Life History

Green sea turtles have slow growth rates (Green, 1993; McDonald-Dutton and Dutton, 1998) and do not reach maturity until 20 to 50 years of age (Hirth and USFWS, 1997; NMFS, 2013). The slow growth rate is believed to be a consequence of the largely herbivorous, low-energy diet (NMFS, 2013). Upon reaching maturity, females return to natal beaches to lay eggs (NMFS, 2013) and can migrate hundreds to thousands of kilometers between foraging and nesting areas.

In the southeastern United States, nesting occurs between June and September, with peak activity in June and July (Witherington and Ehrhart, 1989). Females nest every two to four years (Balazs, 1983), laying three to four clutches per nesting year (Johnson and Ehrhart, 1996). Mean clutch size is about 110 to 115 eggs (136 eggs in Florida). After emerging, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to reside for three to seven years, feeding close to the surface on a variety of marine algae and prey items associated with drift lines and other debris. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging habitats (protected lagoons and open coastal areas rich in sea grass and marine algae). Adult green turtles feed almost exclusively on sea grasses and algae in shallow bays, lagoons, and reefs (NMFS, 2013), although some populations also feed heavily on invertebrates (NMFS, 2013). While in coastal habitats, green turtles exhibit foraging and nesting ground site fidelity and are able to return to these sites if displaced (NMFS, 2013). Generally, adults are only occasionally found in the northern Gulf of Mexico. Most adult females off Florida appear to reside in nearshore foraging areas throughout the Florida Keys and in waters southwest of Cape Sable, with some post-nesting turtles also residing in Bahamian waters (NMFS and USFWS, 2007a).

Abundance and Trends

A summary of worldwide nesting data (NMFS and USFWS, 2007a) suggests that, of the 23 nesting sites where trends were discernible, 10 were increasing, 9 were stable, and 4 were decreasing. Generally, the Pacific, Western Atlantic, and Central Atlantic regions appeared to show more positive trends, while the Southeast Asia, Eastern Indian Ocean, and possibly the Mediterranean Sea regions appeared to show more negative trends. The Atlantic Ocean regions had the most positive changes in abundance.

The green turtle five-year status review identified eight geographic areas considered to be primary sites for nesting in the Atlantic/Caribbean, and reviewed the nest count trend for each (NMFS and USFWS, 2007a). The sites include (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagós Archipelago, Guinea-Bissau. Nesting at all sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagós Archipelago, where insufficient data were

available to assess trends. Similar results were found for nesting sites in the Atlantic, including sites on Florida beaches (NMFS, 2013). The largest known nesting assemblage in the Atlantic Ocean occurs at Tortuguero, Costa Rica. There appears to be an increasing trend at this site since monitoring began in the early 1970s. Emergences increased from about 41,250 annually (1971 to 1975) to an average of 72,200 (1992 to 1996) (NMFS, 2013). Similarly, increasing trends were reported between 1999 and 2003 (NMFS, 2013).

In the continental United States, green turtle nesting occurs along the Atlantic coast, primarily along central and southeast Florida (NMFS, 2013). Nesting has increased along the Atlantic coast of Florida, occurring on beaches where only loggerhead nesting was observed in the past. Nesting also occurs occasionally along the Gulf coast of Florida, including the Florida Panhandle (Meylan et al., 1995). Eglin AFB property supports the highest number of green sea turtle nests in northwest Florida. More recently, nesting has been documented on beaches of North Carolina, South Carolina, and Georgia.

Index beaches have been established in Florida in order to standardize data collection methods and effort on key nesting beaches. Since establishment of these beaches in 1989, the green turtle nesting pattern has consisted of biennial peaks with a generally positive trend. Between 1989 and 2012, nest counts across Florida have increased substantially, from a low of 267 in the early 1990s to a high of over 25,000 in 2013. Modeling by Chaloupka et al. (2008) suggests that the Florida nesting stock at the Archie Carr National Wildlife Refuge is growing at an annual rate of 13.9 percent.

There are no reliable abundance estimates for immature green sea turtles in the coastal areas of the southeastern United States, where they come to forage. A significant increase in abundance has been documented in the Indian River Lagoon area (NMFS, 2013). It is likely that immature turtles foraging in the southeastern United States come from multiple genetic stocks. Therefore, the status in the southeastern United States may be surmised from trends of the main regional nesting beaches (Florida, Yucatán, and Tortuguero).

Threats

Threats to the green sea turtle are generally the same as those described for the loggerhead sea turtle. However, green turtles are apparently more affected by fibropapillomatosis disease than other sea turtle species.

3.1.4 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its entire range on June 2, 1970, (35 FR 8491) under the *Endangered Species Conservation Act of 1969* (precursor to the ESA).

Description, Distribution, and Population Structure

The leatherback sea turtle is the largest sea turtle in the world. Mature adults can reach lengths of over 2 meters and weigh close to 900 kg (2,000 lbs), although adults typically weigh between 200 and 700 kg (441 and 1,543 lbs) (NMFS and USFWS, 1992). The leatherback is the only sea turtle that lacks a hard, bony shell. The carapace is approximately 4 cm thick and consists of a

leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged carapace and large flippers make the leatherback well equipped for long distance foraging migrations. Unlike other sea turtles which feed on hard-bodied prey, leatherbacks have pointed tooth-like cusps and sharp edged jaws that are used to consume soft-bodied pelagic prey such as jellyfish and salps (NMFS, 2013). The mouth and throat also have backward-pointing spines that help retain gelatinous prey.

The leatherback sea turtle is a far-ranging species with a broad thermal tolerance (NMFS and USFWS, 1995), foraging in temperate and subpolar regions worldwide and undergoing extensive migrations to and from tropical nesting beaches. In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS-SEFSC, 2001). Leatherbacks nest in the western Atlantic from the southeastern United States to southern Brazil, and in the eastern Atlantic from Mauritania to Angola. The most significant nesting beaches in the Atlantic, and perhaps in the world, are located in French Guiana and Suriname (NMFS-SEFSC, 2001).

Previous genetic analyses suggested that there were at least three genetically distinct nesting populations within the Atlantic basin. More recent genetic analyses, along with tagging data, have resulted in the identification of seven breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (Turtle Expert Working Group [TEWG], 2007). General differences in migration patterns and foraging grounds may occur between the groups, although data supporting this hypothesis are limited.

The leatherback is the deepest diving sea turtle, but the species may also enter shallow waters to locate prey items. The average dive depths from tagging studies off the continental shelf of St. Croix are 35 to 122 meters (115 to 400 feet), with estimated maximum depths of over 1,000 meters (3,281 feet) (DON, 2007). Typical dive durations average 6.9 to 14.5 minutes per dive, with a maximum of 42 minutes. Routine dive lengths around St. Croix can range from 4 to 14.5 minutes. The maximum known dive length for a subadult is 7.7 minutes.

Life History

Leatherbacks are long-lived. The age at which leatherbacks reach sexual maturity is unclear, with estimates varying widely from 3 to 29 years (NMFS, 2013). Females lay up to 10 nests during the nesting season (March through July in the United States) at two- to three-year intervals, with 100 or more eggs in each clutch. However, up to about 30 percent of the eggs can be infertile. Hatching occurs after 60 to 65 days. Leatherbacks forage in coastal waters but appear to remain primarily pelagic through all life stages (NMFS, 2013).

There is limited information about the oceanic distribution of post-hatchling and early juvenile leatherbacks. These life stages are generally restricted to waters with temperatures greater than 26 degrees Celsius (°C) (79 Fahrenheit [°F]) and, in contrast to other sea turtle species, they are likely not associated with *Sargassum* (NMFS and USFWS, 1992; Eckert, 2002). Late juvenile and adult leatherback turtles are known to range from mid-ocean to the continental shelf and nearshore waters (Schroeder and Thompson, 1987; Shoop and Kenney, 1992). Juvenile and adult foraging habitats include both coastal feeding areas in temperate waters and offshore feeding areas in tropical waters. The distribution and movement of adult leatherbacks appear to

be linked to seasonal availability of prey and to requirements of the reproductive cycle (Collard, 1990; Davenport and Balazs, 1991). The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (NMFS and USFWS, 1995).

Abundance and Trends

The status of the Atlantic leatherback population is generally less clear than that of the Pacific population, which has shown dramatic declines at many nesting sites (NMFS, 2013). However, data collection and analyses by the Leatherback Turtle Expert Working Group (i.e., the TEWG) has provided some information (TEWG, 2007). The Southern Caribbean/Guianas stock, which includes the Guianas, Trinidad, Dominica, and Venezuela, is the largest known Atlantic leatherback nesting aggregation (TEWG, 2007). Past analyses showed that the nesting aggregation in French Guiana had been declining at about 15 percent per year since 1987 (NMFS-SEFSC, 2001). However, from 1979 to 1986, the number of nests was increasing at about 15 percent annually, which could indicate that the decline was part of a natural nesting cycle that coincides with the erosion cycle of Guiana beaches described by NMFS (2013). The cycle of beach erosion and reformation may result in shifting nesting beach locations throughout the region. It is possible that the Guianas and possibly Trinidad should be viewed as one population. Genetics studies support this hypothesis and have resulted in designation of the Southern Caribbean/Guianas stock. The TEWG has determined that the stock had demonstrated a long-term, positive population growth rate.

The Western Caribbean stock includes nesting beaches from Honduras to Colombia, with the most intense nesting occurring in Costa Rica, Panama, and Colombia (NMFS, 2013). Data from three index nesting beaches in the region suggest the nesting population likely did not grow between 1995 and 2005 (TEWG, 2007). Other modeling (of Tortuguero only) indicates a possible 67.8 percent decline between 1995 and 2006 (NMFS, 2013).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico, the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG, 2007). Similarly, the average annual growth rate was approximately 1.1 and 1.2 percent at the primary nesting beach on St. Croix and on Tortola, respectively, during the timeframe of the 1980s through the mid-2000s (TEWG, 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800 and 900 per year in the 2000s following totals of fewer than 100 nests annually in the 1980s (NMFS, 2013). Using data from the index nesting beach surveys, the TEWG (2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, followed by 265, 615, 552, and 625 nests over the next four years (NMFS, 2013). This pattern is thought to demonstrate a cyclical nesting pattern, similar to the biennial nesting cycle of green turtles. The overall trend shows rapid growth on Florida's east coast. Only infrequent nesting activity has been documented in northwest Florida. Until the spring of 2000, the only confirmed leatherback nesting in this region was in Franklin and Gulf Counties. In May and June 2000, nesting was documented for the first time in Okaloosa County

on Eglin AFB's Santa Rosa Island property. Since then, one leatherback nest was found on Eglin's property in 2012.

The West African leatherback nesting stock is a large and important aggregation, but has not been well studied. Nesting occurs in various countries along Africa's Atlantic coast, but is generally undocumented. Gabon supports a large amount of nesting, with at least 30,000 nests in one season (Fretey et al., 2007). Due to the lack of survey effort and data collection, trend analyses are not available.

Two other small but growing nesting stocks utilize the beaches of Brazil and South Africa. The TEWG found a positive growth rate of about one percent for the Brazil and South Africa stocks between 1988 and 2003.

There is currently not a reliable estimate of total population size for Atlantic leatherback sea turtles due to inconsistent data. In 1996, the entire Western Atlantic population was characterized as stable at best (NMFS, 2013), with a population of about 18,800 nesting females. Estimates of the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 adult females. This is consistent with the estimate of 34,000 to 95,000 total adults determined by the TEWG (2007).

Threats

Threats to the leatherback sea turtle are generally the same as those described for the loggerhead sea turtle. However, leatherbacks seem to be more vulnerable to entanglement in fishing gear than other sea turtle species. This may be the result of body type, attraction to gelatinous organisms and algae that collect on buoys and buoy lines, method of locomotion, and possibly attraction to the lightsticks used in longline fisheries. In addition, leatherback turtles may be more prone to ingestion of marine debris due to their predominantly pelagic existence and tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migrating (Shoop and Kenney, 1992; NMFS, 2013).

3.1.5 Juveniles/Hatchlings

In addition to adult turtles, hatchlings are present at certain times of the year. Loggerhead turtles nest every year on Santa Rosa Island, and green turtles typically nest every other year. Leatherback and Kemp's ridley turtles nest on the island infrequently. Nesting generally occurs between May and August, and the incubation period is approximately 60 days. Once hatchlings reach the Gulf of Mexico, some likely become associated with floating mats of *Sargassum*. The mats provide cover and a wide variety of food.

3.2 ESSENTIAL FISH HABITAT

The MSA established jurisdiction over marine fishery resources within the U.S. EEZ. The Act mandated the formation of eight fishery management councils, which function to conserve and manage certain fisheries within their geographic jurisdiction. The councils are required to

prepare and maintain a Fishery Management Plan (FMP) for each managed fishery. The Gulf of Mexico Fishery Management Council (GMFMC) manages fisheries located within federal waters of the EGTTR boundary. Amendments contained in the *Sustainable Fisheries Act of 1996* (Public Law 104-267) require the councils to identify EFH for each fishery covered under a FMP. EFH is defined as the waters and substrate necessary for spawning, breeding, or growth to maturity (16 USC 1802[10]). The term "fish" is defined as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds."

In addition to the GMFMC, the Gulf States Marine Fisheries Commission (GSMFC) and NMFS also have management responsibilities for certain fisheries. The GSMFC is an organization of five states from the Gulf coast of Florida to Texas that manages fishery resources in state waters. The GSMFC provides coordination and administration for a number of cooperative state/federal marine fishery resources. NMFS has jurisdiction over highly migratory species in federal waters of the Gulf of Mexico.

The GMFMC manages seven fishery resources in the Gulf of Mexico. The Coastal Migratory Pelagics management unit consists of king mackerel, Spanish mackerel, cobia, dolphin, little tunny, cero mackerel, and bluefish. The coral and coral reef FMP includes over 300 coral species. The reef fish FMP includes 31 species of snappers, groupers, tilefishes, jacks, triggerfishes, and wrasses. Fish in that FMP are generally demersal subtropical species that utilize similar habitats and are harvested by similar methods, both recreationally and commercially. Shrimp species include brown, white, pink, and royal red. The spiny lobster fishery is managed jointly by the GMFMC and the South Atlantic Fishery Management Council, with the GMFMC acting as the lead council. The Highly Migratory Species Managed management unit consists of 49 species of tuna, swordfish, billfish, and sharks that often migrate over long distances. The managed species, species groups, and associated EFH are shown in Table 3-2.

Table 3-2. Fish Species, Management Units, and Essential Fish Habitat in the Gulf of Mexico

Species or Management Unit	Essential Fish Habitat
Coastal Migratory Pelagics (7 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council (GMFMC) and the South Atlantic Fishery Management Council, from estuarine waters out to depths of 100 fathoms.
Coral and Coral Reefs (over 300 species)	The total distribution of coral species and life stages throughout the Gulf of Mexico including the East and West Flower Garden Banks, Florida Middle Grounds, southwest tip of the Florida reef tract, and predominant patchy hardbottom offshore of Florida from approximately Crystal River south to the Keys, and scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge.
Red Drum	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from Vermilion Bay, Louisiana to the eastern edge of Mobile Bay, Alabama out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms.

Species and EFH Descriptions

Table 3-2. Fish Species, Management Units, and Essential Fish Habitat in the Gulf of Mexico, Cont'd

Species or Management Unit	Essential Fish Habitat
Reef Fish (31 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.
Shrimp (4 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.
Spiny Lobster	Gulf of Mexico waters and substrates extending from Tarpon Springs, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council out to depths of 15 fathoms.
Stone Crab	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; waters and substrates extending from Sanibel, Florida, to the boundary between the areas covered by the GMFMC and the South Atlantic Fishery Management Council from estuarine waters out to depths of 15 fathoms.
Highly Migratory Species (49 species)	Coastal to offshore water column throughout the Gulf of Mexico, out to the Exclusive Economic Zone boundary.

Source: GMFMC, 2004; NMFS, 2009

In addition to EFH, the MSA also requires identification of Habitat Areas of Particular Concern (HAPCs). HAPCs are subsets of EFH that are rare, especially ecologically important, particularly susceptible to human-induced degradation, or located in environmentally stressed areas. HAPCs located off Florida include bluefin tuna spawning habitat (NMFS, 2014), Madison and Swanson closed areas, Florida Middle Ground, Pulley Ridge, and Tortugas North and South Ecological Reserves. Of these, only bluefin tuna habitat and the Madison and Swanson sites are located near the affected area (Figure 3-2 and Figure 3-3).

Most air-to-surface missions using live ordnance do not occur over these areas. However, bluefin tuna spawning, egg, and larvae habitat is delineated in the study area beyond the 100 meter (328 feet) depth contour. Therefore, some AC-130 and CV-22 gunnery training missions (conducted by AFSOC and 413 TS) and AFSOC missile tests (airburst only) could occur over tuna spawning habitat. Gunnery training is allowed at any location out to the 200 meter (656 feet) depth contour, which includes portions of W-151A, W-151B, W-151D, and W-151F. Airburst missile tests may occur beyond this depth contour. Gunnery missions and AFSOC airburst missile tests could also occur over the Madison and Swanson closed areas when W-151B or W-151D is used. However, use of these areas would be infrequent, as most AFSOC missions occur in W-151A. Additional HAPCs located in the Gulf of Mexico (but not off Florida) include East and West Flower Garden Banks and the following reefs and banks: Stetson, Sonnier, MacNeil, 29 Fathom, Rankin Bright, Geyer, McGrail, Bouma, Rezak Sidner, Alderdice, and Jakkula (GMFMC, 2010). These areas would not be affected by air-to-surface activities.

Species and EFH Descriptions

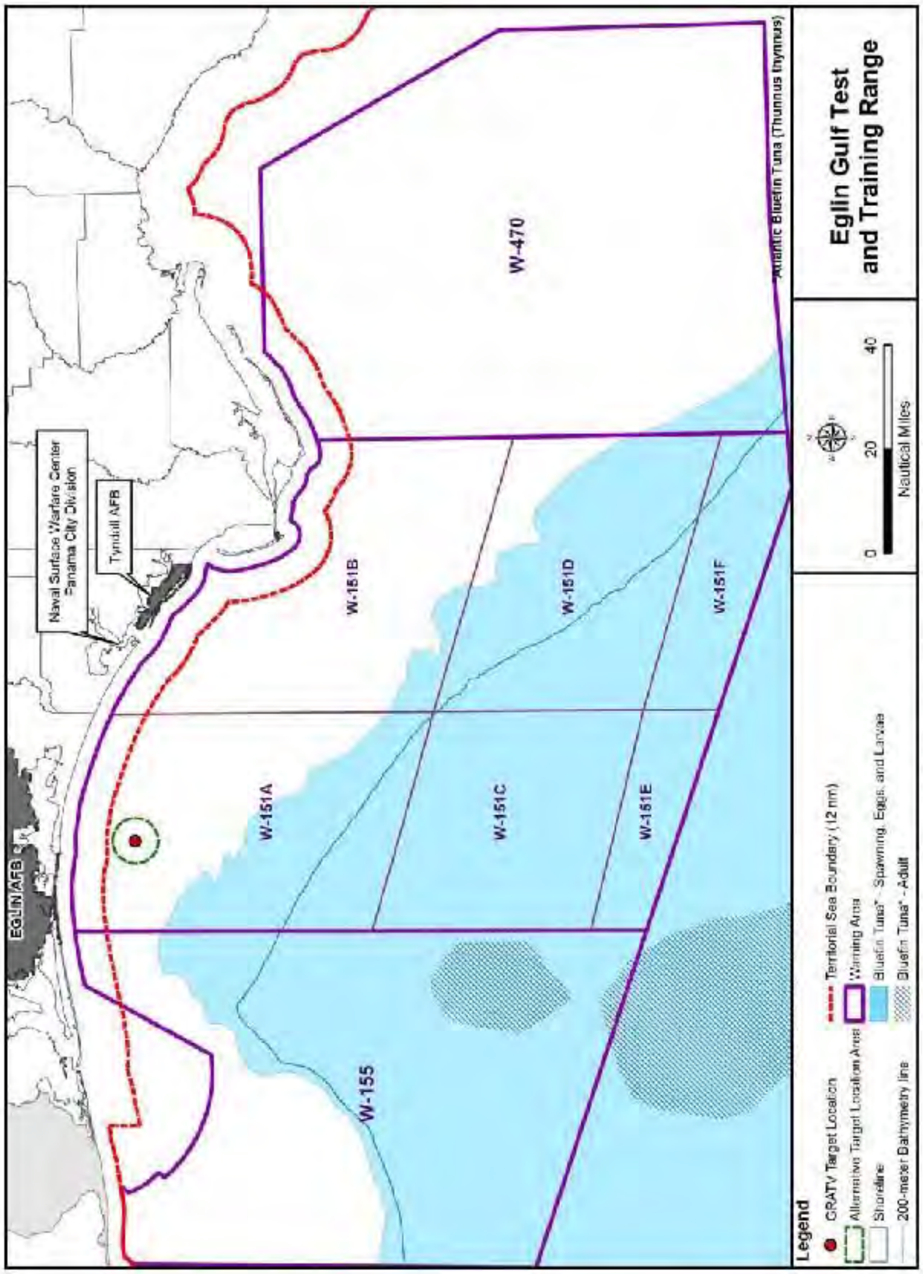

Figure 3-2. Bluefin Tuna Spawning Habitat

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Final Programmatic Biological Assessment and Essential Fish Habitat Assessment
Eglin Air Force Base, Florida

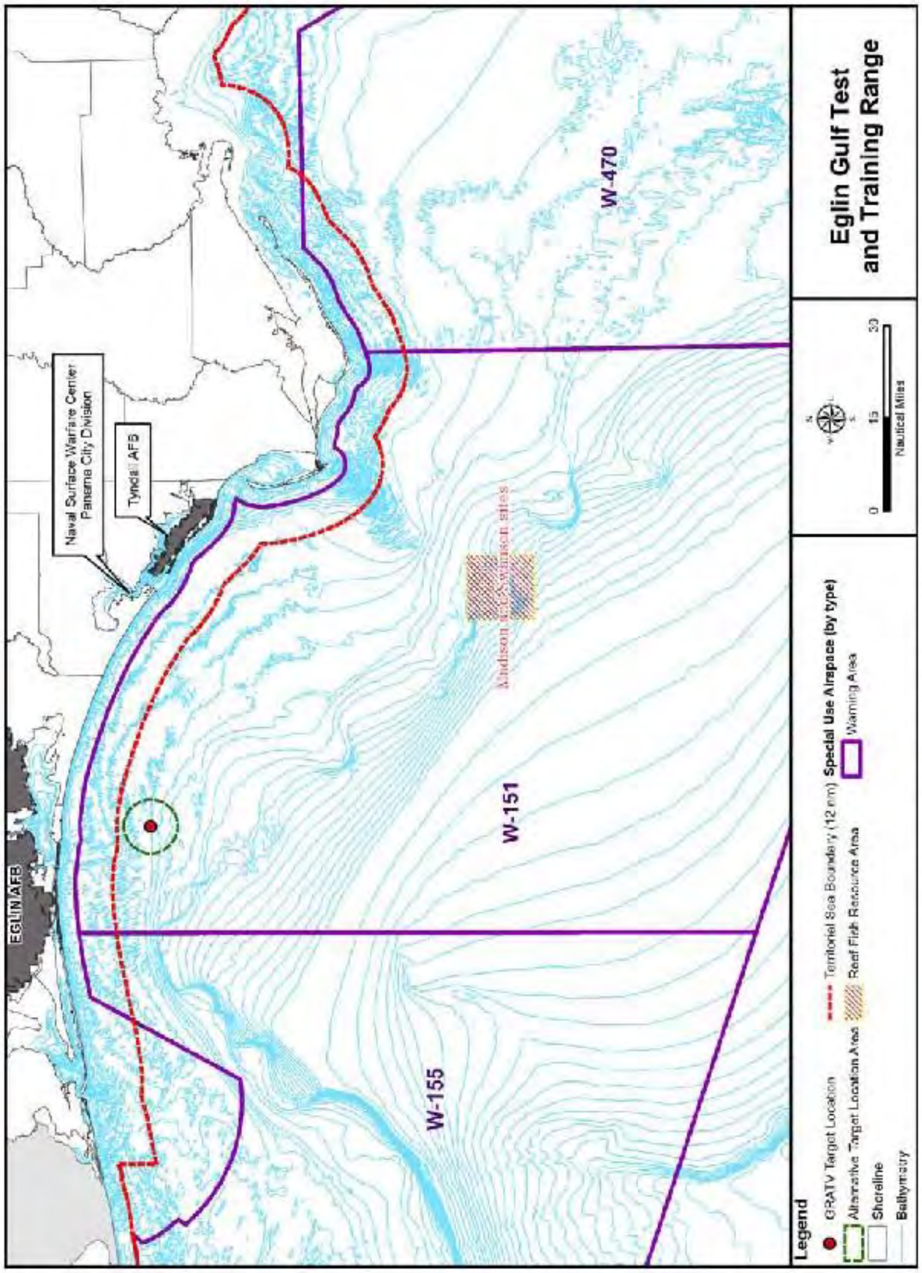

Figure 3-3. Madison and Swanson Closed Areas

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4. DETERMINATION OF EFFECTS

4.1 SEA TURTLES

Sea turtles could be impacted during air-to-surface test and training activities by physical disturbance/boat strikes, debris, and effects from noise and overpressure produced by detonations. Due to sea turtles' generally dispersed distribution and relatively short surface intervals, the possibility of direct strikes by munitions is considered low and is not considered further.

4.1.1 Physical Disturbance and Boat Strikes

The potential for ordnance to physically strike sea turtles was evaluated in the 2002 PEA. The analysis concluded the potential for a direct strike was improbable even before taking into consideration that units actively survey and avoid marine species, target specific items, and that animals spend most of the time submerged. While the quantity of expended gunnery rounds and inert bombs and missiles would increase somewhat under currently proposed actions, the probability of a direct strike remains remote due to the dispersed distribution of turtles and the frequency of test and training missions. Potential impacts resulting from direct munition strikes are not considered further.

Physical Disturbance

Depending on the specific mission, a relatively large number of boats could be present in a test or training area, including target boats, safety boats, swarm mission boats, and other mission-related support vessels. Boats could be stationary or moving at various speeds at any given time. Physical disturbance refers to the reaction of a turtle in response to operation or approach of such vessels (excluding physical strikes). The effects would depend on several factors such as speed and direction of the boat, location of the turtle in the water column, and distance between boat and turtle. The distance, noise level, or change in water pressure required to alert a turtle to an approaching vessel is unknown. However, it is assumed that at some point an animal would become aware of the threat and respond by attempting to dive or swim away. These reactions could interrupt other, potentially important activities (feeding, resting, etc.) and would require energy expenditure. Although an avoidance response would cause a behavioral change and reduce the amount of energy available for other biological functions, physical threats would be infrequent and brief in duration, and the energy expense is likely within the normal range experienced by a sea turtle over a short time period. Therefore, physical disturbance **may affect, but is not likely to adversely affect**, sea turtles.

Boat Strikes

In addition to disturbance, there is also potential for direct boat strikes of turtles swimming or feeding at or just beneath the surface. The effects of a direct strike could range from slight injury to death. Propeller wounds have been increasingly noted among loggerheads found dead or debilitated in Florida. The number and speed of vessels operated in an area may be considered in assessing collision risk. The activity with the greatest potential for impact would be swarm

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missions, where 25 to 30 boats would be operated in a small area at relatively high speeds (up to 30 knots). A typical scenario would involve up to three swarm missions per year, with up to four days per mission and three to four hours of boat operation per day. However, a greater number of missions could occur per year, depending on need and scheduling availability. Other missions would involve lower numbers of boats and/or boats operated at lower speeds. Although the number of boats associated with air-to-surface testing and training would not appreciably change the typical overall background level of boat traffic in the area, where a large number of recreational and commercial fishing boats regularly operate, there is an increased chance for turtles present during swarm missions to be struck. Because of the intermittent schedule of swarm missions and other missions involving surface vessels, the scattered distribution of turtles at sea, and the fact that turtles are submerged about 90 percent of the time, the probability of boat strikes during any particular mission is considered low and no population-level impacts would be expected. Mitigation measures identified in Section 5 of this document include the requirement to avoid large *Sargassum* mats. This requirement would further decrease the potential for hatchling, juvenile, and adult turtles to be struck. Therefore, direct boat strikes **may affect, but are not likely to adversely affect**, sea turtles.

4.1.2 Debris

Gunnery rounds and fragments of exploded bombs and missiles are expected to pass through boats and other targets and settle on the Gulf floor. In addition, pieces of damaged targets could be suspended in the water column or sink to the bottom. Other debris includes plastic, plywood, and parachutes (associated with CBU-105 submunitions) that may float in the water column or settle to the seafloor. Sea turtle ingestion of plastics and other discarded items is well documented and may cause injury or death. Impacts may be direct or indirect. For example, debris may become lodged in the digestive tract and affect turtles by decreasing the ability to feed and absorb nutrients. Turtles may also become entangled in items such as parachutes or parachute cords.

The potential for ingestion of debris is a function of the amount of debris generated, location of the debris, and sea turtle feeding methods. Floating materials such as target debris could be eaten by turtles that feed at or near the surface, such as the leatherback, while items such as munitions on the seafloor could be ingested by other species. After missions involving boat targets are completed, boat crews would clean up the area by removing floating debris by hand or with a dip net. While these efforts would remove some portion of floating debris (particularly larger debris), it is likely that numerous pieces small enough to be ingested by a turtle would remain on the water. If ingested, effects to an individual turtle would depend on the size and shape of the debris item relative to the size of the animal. Debris pieces could either pass through the digestive tract without incident, cause temporary disruption of feeding and digestion processes, or become permanently encapsulated by the stomach lining. The probability of a turtle encountering and eating floating debris would be decreased due to items on the surface being dispersed by currents and wind, and to the patchy distribution of turtles in the northern Gulf of Mexico.

Gunnery rounds and some other types of small debris would sink to the seafloor where they could be ingested by bottom-feeding turtles including the loggerhead, Kemp's ridley, and green turtle. Potential effects to an animal's health would be the same as those described for floating

debris above. In general, the seafloor in the area where most air-to-surface activities would occur is sandy with little relief and few bottom features. Therefore, food items for the various turtle species (submerged vegetation, benthic invertebrates, etc.) occurs sporadically and is probably of low density. These factors would decrease the likelihood of turtles foraging in the area and ingesting mission debris. AFSOC gunnery missions would result in the greatest number of gunnery rounds deposited on the seafloor. These missions could occur throughout much of W-151A, and rarely in W-151B, W-151D, or W-151F; therefore, the likelihood of rounds being present in any given area is low. Many of the other missions would occur at the GRATV target location. Eventually, debris would accumulate in the area and could function as habitat for the benthic species on which turtles feed, thereby possibly increasing turtle occurrence and the potential to ingest smaller debris items. Over time, debris pieces may become covered by sediment or colonized by attaching and encrusting organisms, which would reduce the potential for ingestion. Overall, substantial impacts to any sea turtle population are not anticipated.

Based on the projected expenditure of four CBU-105 munitions annually, with 10 submunitions and parachutes per munition, there could be 40 parachutes deposited in the Gulf of Mexico per year. Turtles could become entangled in the parachute or attached cords/lines while feeding at the surface, water column, or seafloor, or could swim into the parachute as it sinks. An entangled individual might be able to free itself. It is also possible that material could remain wrapped around an animal, resulting in behavioral impacts, injury, decreased feeding ability, or death. The rate at which parachutes would sink, and, therefore, the proportion of time they would be at the surface/water column/seafloor, is unknown. However, it is assumed that many of the parachutes would move some distance because of wind and water currents and that all would eventually sink to the bottom. After sinking, parachutes would become encrusted and/or covered by sediments, although cycles of covering/exposure could occur due to currents. It is possible that individuals of any sea turtle species occurring in the northern Gulf of Mexico could become entangled in parachute debris. However, due to the relatively low number of parachutes used, patchy distribution of turtles, and eventual covering on the seafloor, it is not expected that there would be population-level effects to any species.

In summary, debris produced during air-to-surface missions **may affect, but is not likely to adversely affect**, sea turtles.

4.1.3 Detonations

Sea turtles spend most of their lives at sea, coming ashore only to nest and, in rare circumstances and locations, to bask. When at the water surface, sea turtles are mostly submerged. This makes turtles difficult to locate visually and also exposes them to effects of underwater explosions. Similar to other marine species, the susceptibility of sea turtles to mortality, injury, or harassment resulting from underwater detonations is influenced by factors such as animal size, animal and detonation depth, and distance between the animal and detonation. Near the detonation point, animals may be affected primarily by the shock wave, with typical effects including compression of gas-containing structures (e.g., lungs, gastrointestinal [GI] tract), large pressure changes across tissue interfaces, and concussive effects (e.g., bone fractures). Pressure may also result in effects to the auditory system such as ear drum rupture.

Determination of Effects

Noise produced by an underwater explosion may cause other hearing effects including hearing threshold shifts. A threshold shift occurs when intense sound causes fatigue or damage to the auditory system, resulting in a shift in the sound level that can be heard at a given frequency. That is, at the affected frequency, sound must be louder to be heard compared to the hearing ability before the shift. Such a shift may be temporary (called temporary threshold shift, or TTS) or permanent (permanent threshold shift, or PTS). At greater distances from the detonation, noise may cause stress or disruption of natural behaviors. Startle reactions may include increased surfacing, rapid swimming, or diving (NMFS, 2013). Noise due to mission activities may affect habitat quality such that important biological behaviors may be disrupted (e.g., feeding, mating, and resting), and turtles may avoid the test area because of the noise. The magnitude of those effects may be affected by the frequency, periodicity, duration, and intensity of the sounds, as well as the behavior of the animals during the exposure.

Compared to other species such as marine mammals, little is known about the role of sound and hearing in sea turtle survival, or the effects of human-caused noise. However, the results of various investigations indicate that sea turtles are most sensitive to low frequency sounds. Best sensitivities were found from 200 to 700 hertz (Hz) for the green turtle (Ridgway et al., 1969) and around 250 Hz for juvenile loggerheads (DON, 2008). The effective hearing range for marine turtles is generally considered to be between 100 and 1,000 Hz (DON, 2008; Lenhardt, 1994; Ridgway et al., 1969). Hearing thresholds below 100 Hz were found to increase rapidly (Lenhardt, 1994). Additionally, calculated in-water hearing thresholds at best frequencies (100 to 1,000 Hz) appear to be high, at 160 to 200 decibels referenced to 1 micropascal (dB re 1 µPa) (Lenhardt, 1994; Lenhardt, 2008). A study on the effects of airguns on sea turtle behavior also suggests that they are most likely to respond to low-frequency sounds (McCauley et al., 2000). Green and loggerhead turtles noticeably increased their swimming speed, as well as swimming direction, when received levels reached 166 dB re 1 µPa, and their behavior became increasingly erratic at 175 dB re 1 µPa (McCauley et al., 2000). There is no information regarding the long-term consequences of these disturbances, but short-term disruption in normal behaviors and temporary abandonment of habitat is likely in response to some noises produced by munitions testing.

Three sources of information are necessary for estimating potential pressure and noise effects on sea turtles: (1) the zone of influence, which is the distance from the explosion to which particular levels of impact would extend; (2) the density of animals within the zone of influence; and (3) the number of detonations (events). These components are discussed in further detail below. Appendix A contains a description of the acoustic modeling methodology used to determine the number of sea turtles potentially impacted by air-to-surface activities. Noise and pressure effects are evaluated only for detonations occurring at and beneath the water surface. In-air detonations are not included in impacts analysis because of the negligible transmission of energy and pressure across the air/water interface.

Zone of Influence

The Zone of Influence (ZOI) is defined as the area or volume of ocean in which sea turtles could be exposed to various pressure or noise energy levels caused by exploding ordnance. The pressure and energy levels considered to be of concern are defined in terms of metrics, criteria, and thresholds. A metric is a technical standard of measurement that describes the noise and

pressure at a given location. Criteria refer to the types of possible impact and include mortality, injury, and other types of physical and behavioral effects. A threshold is the level of pressure or noise above which the impact criteria are reached. Until recently, there were no acoustic energy or pressure impact thresholds defined specifically for sea turtles, and in the absence of such information, the thresholds used for marine mammal analysis were typically applied. Potential behavioral effects are not quantified here, but it is assumed that most responses would be short-term avoidance reactions. Appendix A provides additional discussion on sea turtle behavioral reactions to various noise levels.

The following criteria and threshold levels for underwater detonations used in the analysis are defined as follows:

- *Mortality*: mortal injury, cracked shell, or lung/intestinal/organ damage.
- *Injury*: potentially lethal physical injuries, prolonged immobilization by stunning, or auditory trauma.
- *Impairment*: temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization).

Based on this information and other research examining the effects of underwater detonations and airgun operation on turtles and other vertebrates (e.g., Richmond et al., 1973; DeRuiter and Doukara, 2012; Finneran and Jenkins, 2012), NMFS has defined the impact threshold levels shown in Table 4-1. Thresholds are defined in terms of both the peak noise level (in decibels [dB]) and pressure in pounds per square inch (psi). Although there has been recent effort to address turtle-specific thresholds, there are currently no experimental or modeling data sufficient to support development of physiological thresholds. Therefore, mortality, primary blast injury, and auditory effects continue to be based on marine mammal thresholds (low frequency functional group where applicable). Mortality and blast injury thresholds are based on the GI tract injury threshold used for marine mammals; TTS and PTS thresholds are based on those used for low frequency functional hearing group cetaceans.

Table 4-1. Sea Turtle Exposure Thresholds for Single Underwater Detonation Events

Mortality	Injury	Impairment
>237 dB (peak)	>229 dB (peak)	>224 dB (peak)
102 psi	40 psi	23 psi

> = greater than; dB = decibels; psi = pounds per square inch

An acoustic model incorporating the above information was used to calculate the maximum estimated range, or radius, from the detonation point to which the various thresholds would extend (see Appendix A for a more detailed description of the model and outputs). Thresholds are defined in terms of peak dB and psi for all criteria. These ranges were used to calculate the total area of the ZOI for each munition and detonation scenario.

Sea Turtle Density

Sea turtle density estimates were obtained from two sources. Estimates for the loggerhead, Kemp's ridley, and leatherback were obtained from a habitat modeling project conducted for portions of the EGTTR, as described by Garrison (2008). As part of the modeling effort,

personnel from NOAA Fisheries' SEFSC conducted line transect aerial surveys of the continental shelf and coastal waters of the eastern Gulf of Mexico during winter (February 2007; water temperatures of 12–15°C) and summer (July/August 2007; water temperatures greater than 26°C). The surveys covered nearshore and continental shelf waters (to a maximum depth of 200 meters), with the majority of effort concentrated in waters from the shoreline to 20 meters depth. Marine species encounter rates during the surveys were generally corrected for sighting probability and the probability that animals were available on the surface to be seen. The survey data were combined with remotely sensed environmental data/habitat parameters (water depth, sea surface temperature [SST], and chlorophyll-*a* concentration) to develop habitat models. The technical approach, described as Generalized Regression and Spatial Prediction, spatially projects the species-habitat relationship based on distribution of environmental factors, resulting in predicted densities for un-sampled locations and times. The spatial density model can therefore be used to predict relative density in unobserved areas and at different times of year based on SST and chlorophyll datasets derived from satellite data. Similarly, the spatial density model can be used to predict relative density for any sub-region within the surveyed area.

Garrison (2008) produced sea turtle density estimates at various spatial scales within the EGTTR. At the largest scale, density data were aggregated into four principal strata categories: North-Inshore, North-Offshore, South-Inshore, and South-Offshore. These densities were provided in the published survey report. It should be noted that these aggregated densities were not corrected for the availability of turtles at the surface, and the resulting negative bias is likely large. Unpublished densities were also provided to Eglin AFB for smaller blocks (sub-areas) corresponding to airspace units, and a number of these sub-areas were combined to form larger zones. Densities in these smaller areas were provided in Excel© spreadsheets by the report author. Unlike the aggregated estimates, sub-area densities were corrected for animal surface availability.

For both large areas and sub-areas, regions occurring entirely within waters deeper than 200 meters were excluded from predictions, and those straddling the 200 meter isobath were clipped to remove deep water areas. In addition, because of limited survey effort, density estimates beyond 150 meters water depth are considered invalid. The environmental conditions encountered during the survey periods (February and July/August) do not necessarily reflect the range of conditions potentially encountered throughout the year. In particular, the transition seasons of spring (April–May) and fall (October–November) have a very different range of water temperatures. Accordingly, for predictions outside of the survey period or geographical range, it is necessary to evaluate the statistical variance in predicted values when attempting to apply the model. The coefficient of variation (CV) of the predicted quantity is used to measure the validity of model predictions. According to Garrison (2008), the best predictions have CV values of approximately 0.2. When CVs approach 0.7, and particularly when they exceed 1.0, the resulting model predictions are extremely uncertain and are considered invalid.

Due to difficulties in distinguishing green and hawksbill sea turtles from the air, these two species were combined into a Green/Hawksbill category. Habitat modeling resulted in prediction of relatively high densities of this species category in warm, offshore waters of the northern Gulf of Mexico. However, Garrison (2008) cautions that this prediction is highly suspect, and that these results should only be applied from southwestern Florida to the Dry

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Tortugas. Therefore, habitat modeling results for the green sea turtle are not used in this document. Model results for leatherback turtles are also less reliable due to overall low observation numbers, but Garrison (2008) does not suggest discounting leatherback density estimates in the northern Gulf.

Density estimates for green sea turtles are derived from Epperly et al. (2002). Although the publication focuses on sea turtle bycatch, aerial surveys were conducted in conjunction with the studies. The surveys were conducted by NMFS personnel each autumn between 1992 and 1996. Results were stratified into inshore (0 to 10 fathoms) and offshore (10 to 40 fathoms) areas, as well as into western and eastern geographic zones. The eastern offshore stratum is most applicable to the affected air-to-surface mission area. Results were also presented for upper and lower 95 percent confidence intervals. The density corresponding to the upper confidence interval of the 10 to 40 fathom stratum is used in this document. Density estimates were not adjusted for sighting or availability bias, likely resulting in underestimation of true density; therefore, the authors presented the values as minimum density estimates. To account for the potential for negative bias associated with sighting and availability bias, Eglin AFB adjusted the minimum density estimate for green sea turtles. Time spent at the surface is likely influenced by factors such as species, age of the animal, geographic location, behavioral activity, time of day and others. Some researchers (e.g., Cardona et al., 2005; Polovina et al., 2003; Polovina et al., 2004) have reported various sea turtle species spending up to 35 to 40 percent of their time at the surface. However, Renaud and Carpenter (1994) found that four tagged loggerhead individuals in the Gulf of Mexico were submerged 90 to 95 percent of the time, depending on the season. Considering the above information, Eglin has adjusted the green turtle density estimate based on a 90 percent dive profile (i.e., sea turtles are assumed to spend an average of 90 percent of their time underwater and 10 percent of their time at the surface).

Based upon the preceding discussion, density estimates shown in Table 4-2 for loggerhead, Kemp's ridley, and leatherback sea turtles correspond to the average of the median monthly densities provided by Garrison (2008) for sub-area 137 (Figure 4-1). Within this block, density values were provided based upon one-year and five-year monthly averages for SST and chlorophyll. The five-year average is considered preferable and is used in this document.

Table 4-2. Sea Turtle Density Estimates

Species	Density Estimate (animals per km^2)	
	Summer (May – October)	Winter (November – April)
Loggerhead sea turtle[1]	0.708*	2.565*
Kemp's ridley sea turtle[1]	0.052	1.107
Leatherback sea turtle[1]	0.321**	0.276**
Green sea turtle[2]	0.165	0.165

[1]Source: Garrison, 2008; adjusted for observer and availability bias by author
[2]Source: Epperly et al., 2002; not adjusted for sighting or availability bias by the authors, but adjusted by Eglin AFB
km = kilometers
* May and November density estimates not included in the seasonal average calculations due to unacceptably high coefficient of variation (CV) values.
** May, June, September, October, November, and December density estimates not included in the season average calculations due to unacceptably high CV values.

Determination of Effects

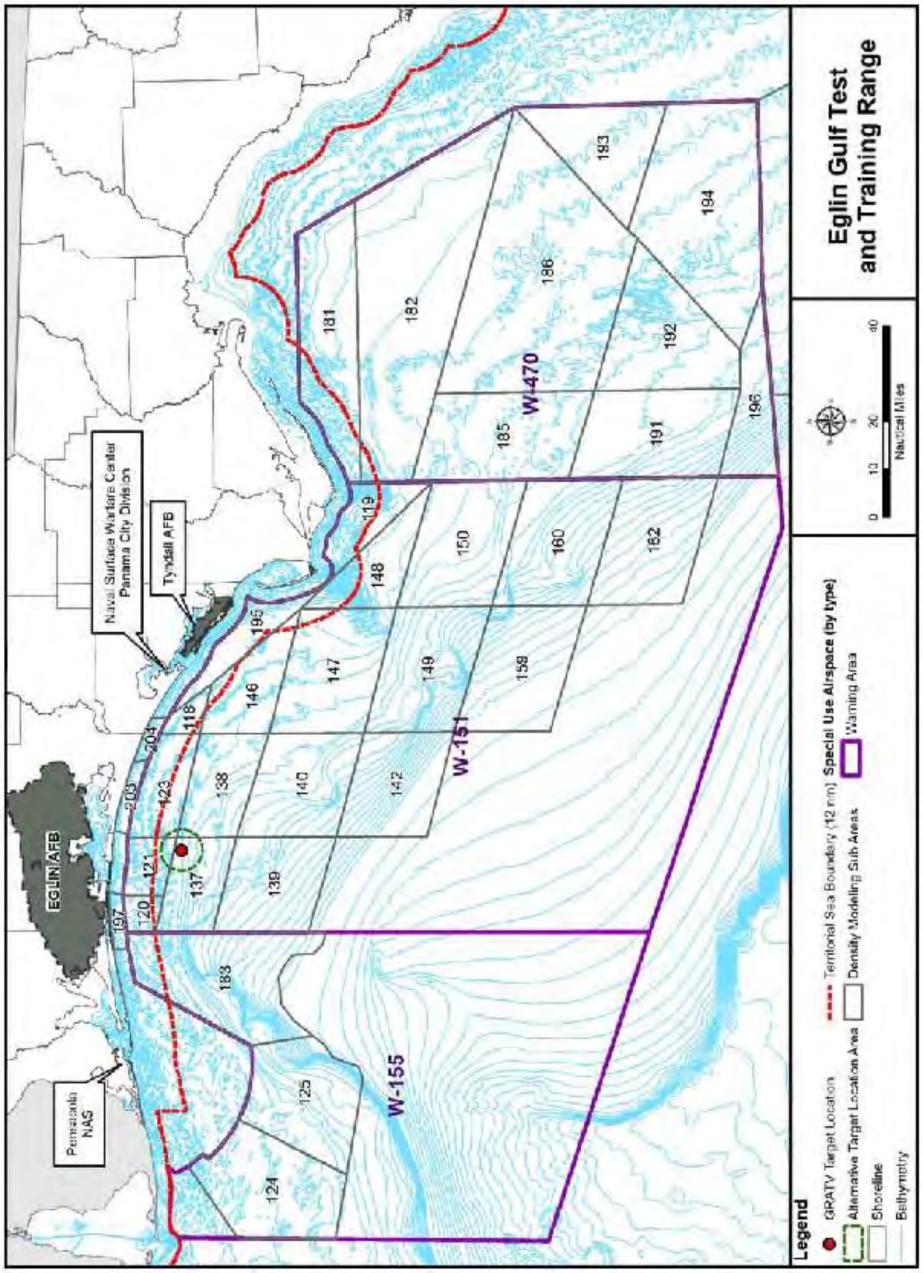

Figure 4-1. Sub-Areas Included in Garrison (2008)

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Given that missions involving live fire may occur at any time of the year, and water temperature affects noise propagation and the results of acoustic modeling, separate density estimates for each species are presented for summer (May to October) and winter (November to April). In the absence of specific information on mission timing, it is assumed that half of the missions would occur in summer and half would occur in winter. The monthly density estimates from months with unacceptably high CVs were not included in the seasonal density estimate calculations. Those monthly densities were omitted from seasonal density estimates in favor of averaging the remaining monthly densities in which we had higher confidence in their predicted densities (CV < 0.7), and are shown in Table 4-2.

Green sea turtle density is derived from Epperly et al. (2002), which does not include seasonal data. Therefore, the same estimate is used for summer and winter in the acoustic model.

Density is nearly always reported for an area (e.g., animals per square kilometer). Density estimates usually assume that animals are uniformly distributed within the affected area, even though this is likely rarely true. Sea turtles may be clumped in areas of greater importance; for example, animals may be more concentrated in areas of greater food availability. However, because there are usually insufficient data to calculate density for small areas, an even distribution is typically assumed.

In addition, assuming that marine animals are distributed evenly within the water column does not accurately reflect behavior. Databases of behavioral and physiological parameters obtained through tagging and other technologies have demonstrated that marine animals use the water column in various ways. Some species conduct regular deep dives while others may engage in much shallower dives, regardless of bottom depth. The assumption that all species are evenly distributed from surface to bottom is almost never accurate and can present a distorted view of species distribution in any region. Therefore, a depth distribution adjustment is applied to sea turtle densities in this document (Table 4-3). By combining turtle density with depth distribution information, a three-dimensional density estimate is possible. These estimates allow more accurate modeling of potential sea turtle exposures from explosive sources. Refer to Appendix A for a more detailed description of the acoustic modeling methodology.

Table 4-3. Sea Turtle Depth Distribution

Species	Depth Distribution	Reference
Leatherback sea turtle	28% at <6 m, 36% at 6–12 m, 24% at 13–51 m, 7% at 52–102 m, 3% at 103–150 m, and 2% at >150 m	Eckert (2006)
Loggerhead sea turtle	33% at <1 m, 15% at 1–3 m, 12% at 4–6 m, 8% at 7–10 m, 25% at 11–25 m, and 7% at >25 m	Dellinger and Freitas (2001)
Other hard-shelled sea turtles (Kemp's ridley and green)	33% at <1 m, 15% at 1–3 m, 12% at 4–6 m, 8% at 7–10 m, 25% at 11–25 m, and 7% at >25 m	Dellinger and Freitas (2001)

< = less than; m = meters

Number of Events

The number of events generally corresponds to the number of live ordnance items used, which is provided in Table 2-14, Section 2.6). Exceptions include 25, 30, and 40 mm gunnery rounds, and simultaneous SDB launches. In cases of multiple detonations in close proximity occurring

over a very short time (from less than a second to a few seconds), pressure and energy impacts may be modeled differently. As discussed in Section 2.5, a simultaneous launch event of two SDBs is modeled as one detonation with double the NEW of a single SDB, although the bombs may detonate a few seconds apart (five seconds or less). This assumption is conservative because, in reality, pressure would only double if (1) the bombs detonated at exactly the same time and point in the water, or (2) the pressure waves intersected with each other. The bombs would not detonate at exactly the same time and place and, as discussed in the acoustic modeling description (Appendix A), the probability of multiple pressure waves intersecting at any given point in the ocean is negligible. The assumption is similarly conservative for the positive impulse metric. The 25, 30, and 40 mm gunnery rounds are fired in bursts, with about 6 to 65 rounds fired per second, depending on the munition. The typical number of rounds per burst for each munition is shown in Table 4-4.

Table 4-4. Number of Gunnery Rounds Fired per Burst

Gunnery Round	Number Rounds Fired per Burst
25 mm	100
30 mm	20
40 mm	20

mm = millimeter

For gunnery bursts, pressure is not added for each round. The number of animals affected by pressure (peak pressure and positive impulse) is reduced by one per number of rounds per burst. It is assumed that all rounds in a burst affect the same animal population, and that the population is refreshed between bursts. Total energy (sound exposure level, or SEL) metrics are treated differently, with energy increased by the number of rounds per burst. However, energy metrics are currently not applied to sea turtle impact analysis. Refer to Appendix A for a complete description of the acoustic modeling used for impacts analysis in this document. It is noted that the 7.62 mm and .50 cal rounds do not contain HE material and thus do not detonate or introduce energy or pressure into the water column. Therefore, these rounds are not included in the analysis.

Exposure Estimates

Based on the acoustic modeling described in Appendix A, Table 4-5 provides the maximum estimated range, or radius, from the detonation point to which the various thresholds extend. In addition to estimating takes, the ranges are also used for developing monitoring requirements, which are discussed further in Section 5. As described earlier, only detonations at or below the water surface are analyzed; in-air detonations are not included in the analysis because energy and pressure transfer across the air-water interface is considered negligible. In almost all instances, summer and winter ranges are the same. In a few cases, there is a seasonal difference of 1 meter, and the larger of the two is presented in the table. These ranges are used to calculate the total area of the ZOIs, which are then combined with density estimates and the number of events to provide an estimate of the number of sea turtles potentially exposed to the various impact thresholds. Exposure estimates do not take into account the required mitigation and monitoring measures described in Section 5 of this document.

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Table 4-5. Threshold Radii (in meters) for EGTTR Air-to-Surface Testing and Training Ordnance

Munition	NEW (lbs)	Detonation Scenario	Mortality	Injury	Impairment
GBU-10 or GBU-24	945	Surface	340	770	1,280
		Subsurface	343	771	1,281
AGM-158 (JASSM)	300	Surface	231	524	873
GBU-12 or GBU-54	192	Surface	198	452	752
		Subsurface	201	453	753
AGM-65 (Maverick)	86	Surface	150	345	575
GBU-39 (Double)	74	Surface	142	328	546
AIM-9X	68	Surface	138	319	532
GBU-39 (SDB I or LSDB)	37	Surface	112	259	433
		Subsurface	116	262	435
Joint Air-to-Ground Missile	27.41	Surface	102	234	392
GBU-53 (SDB II)	22.84	Surface	95	220	368
		Subsurface	99	223	370
AGM-114 (Hellfire)	20	Surface	92	211	352
		Subsurface	95	213	354
AGM-176 (Griffin)	4.58	Surface	55	129	216
2.75 Rockets	10	Surface	72	167	279
105 mm FU	4.7	Surface	56	130	218
40 mm burst	0.87	Surface	33	74	124
Live fuse	0.4	Surface	26	57	95
105 mm TR	0.35	Surface	24	55	91
30 mm burst	0.1	Surface	16	36	60
25 mm burst	0.067	Surface	14	32	53

AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; EGTTR = Eglin Gulf Test and Training Range; GBU = Guided Bomb Unit; FU = full up; JASSM = Joint Air-to-Surface Standoff Missile; lbs = pounds; LSDB = Laser Small Diameter Bomb; mm = millimeter; NEW = net explosive weight; SDB = Small Diameter Bomb; TR = training round

Table 4-6 indicates the resulting total number of sea turtles potentially affected under the various metrics in the absence of mitigation measures. The numbers represent total impacts for all detonations combined. Mortality was calculated as 13 loggerhead, 7 Kemp's ridley, 3 leatherback, and 6 green sea turtles. Implementation of the mitigation and monitoring measures outlined in Section 5 may decrease the number of takes estimated in the table.

Table 4-6. Number of Sea Turtles Potentially Affected by Air-to-Surface Testing and Training Missions in the EGTTR

Species	Mortality	Injury	Impairment
Loggerhead turtle	13	46	84
Kemp's ridley turtle	7	22	41
Leatherback turtle	3	11	22
Atlantic Green turtle	6	22	40
Total*	**29**	**101**	**187**

EGTTR = Eglin Gulf Test and Training Range
*Number of animals impacted by higher thresholds subtracted from less impactive thresholds

The table indicates the potential for mortality and a range of other physical effects in the absence of mitigation measures. The mitigation and monitoring requirements described in Section 5

would afford some protection for sea turtles. Observers would look for turtles as well as other protected marine species during pre- and post-mission surveys. In addition, Eglin's marine species observer training course requires missions involving surface or underwater detonations to be delayed or moved if potential sea turtle indicators are present (large *Sargassum* mats or large jellyfish schools). Visual surveys conducted from boats are likely to be of limited effectiveness due to difficulties in sighting turtles, and in most cases it would not be possible to track a turtle that is sighted and then submerges. Therefore, noise and pressure effects due to detonations at or under the water surface **may affect, and are likely to adversely affect,** sea turtles. Activities involving live air-to-surface missions would not occur within loggerhead sea turtle nearshore reproductive critical habitat or *Sargassum* marine critical habitat. In addition, critical habitat would not be significantly affected by debris or water quality alteration. Therefore, **loggerhead sea turtle critical habitat would not be adversely modified**.

4.2 ESSENTIAL FISH HABITAT

The MSA requires federal agencies to assess potential impacts to EFH for managed commercial fisheries. Adverse impacts to EFH are defined as those that reduce quality and/or quantity of EFH. The EFH constituents identified in Table 3-2 include estuaries, coral/hardbottom, all other substrates, and the water column. Each of these constituents, as well as potential effects to HAPCs, is discussed below.

4.2.1 Bottom Structures

Live air-to-surface missions would not occur in estuaries, and coral reefs are not known in the affected area. Therefore, these resources would not be directly affected. Although bottom structure is not known to occur at the GRATV target location, hard bottom areas and shipwrecks occur within W-151A and artificial reefs occur within the 5-mile alternate target area (Figure 4-2). If missions need to be moved to an alternate location within the buffer area, a remote sensing survey would be required in a one-square-mile area around the new target site, using side-scan sonar, a magnetometer, and a subbottom profiler. The survey would be conducted to confirm the presence or absence of bottom structure such as artificial reefs and shipwrecks. The GRATV would not be positioned in an area if bottom structures are detected. Although missions will be planned to avoid these habitats, there is some potential for debris to be carried by water currents and cause some minimal damage. However, the potential for such a scenario to cause significant damage in considered low, and effects to hard bottom habitat, artificial reefs, or shipwrecks are not expected. As numerous target boats are impacted over time, there is potential for large target pieces to settle to the seafloor, become stationary, and provide long-term habitat for encrusting organisms, fish, and other marine fauna, thereby providing a beneficial impact to EFH.

4.2.2 Other Substrates and the Water Column

Impacts to other substrate and the water column could occur due to metals and chemical materials (munitions, explosive material, explosion byproducts, and other materials), detonation effects, debris, and anchoring of the GRATV and target boats.

Determination of Effects

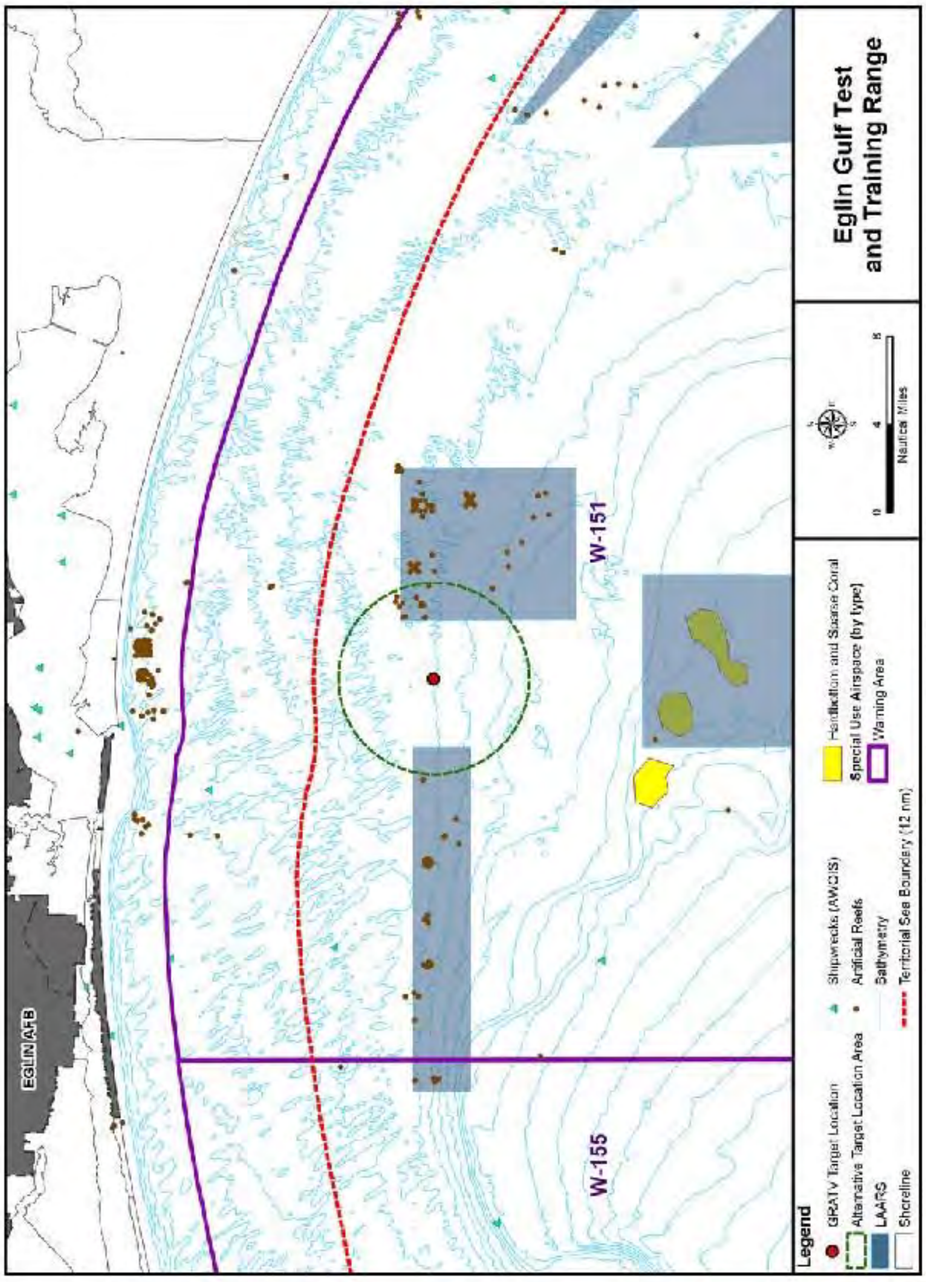

Figure 4-2. Hard Bottom Habitat, Artificial Reefs, and Shipwrecks near the Study Area

Metals

Various metals would be introduced into the water column through expended munitions. The casings, fins, or other parts of large munitions such as bombs and missiles are typically composed primarily of steel but usually also contain small amounts of lead, manganese, phosphorus, sulfur, copper, nickel, and several other metals (U.S. Navy, 2013). Many smaller caliber rounds contain aluminum, copper, and zinc. Aluminum is also present in some explosive materials such as tritonal and PBXN-109. Lead is present in batteries typically used in vessels such as the remotely controlled target boats. Many metals occur naturally in seawater at varying concentrations and some, such as aluminum, would not necessarily be detrimental to the substrate or water column. However, at high concentrations, a number of metals (e.g., lead) may be toxic to microbial communities in the substrate.

Munitions and other metal items would sink to the seafloor and would typically undergo one of three processes: (1) enter the sediment where there is reduced oxygen content, (2) remain exposed on the ocean floor and begin to react with seawater, or (3) remain exposed on the ocean floor and become encrusted with marine organisms. The rate of deterioration would therefore depend on the specific composition of an item and its position relative to the seafloor/water column. Munitions located deep in the sediment would typically undergo slow deterioration. Some portion of the metal ions would become bound to sediment particles. Metal materials exposed to seawater would begin to slowly corrode. This process typically creates a layer of corroded material between the seawater and metal, which slows the movement of the metal ions into the adjacent sediment and water column. Therefore, elevated levels of metals in sediment would be restricted to a small zone around the munitions, and releases to the overlying water column would be diluted. A similar process would occur with munitions that become covered by marine growth. Direct exposure to seawater would be reduced, thereby decreasing the rate of corrosion.

Munitions that come to rest on the seafloor would slowly corrode, and would release small amounts of metals to adjacent sediment and the water column. Metal particles that migrate into the water column would be diluted by diffusion and water movement. Elevated concentrations would be localized and would not be expected to significantly affect overall local or regional water quality. This expectation is supported by the results of two U.S. Navy studies related to munitions use and water quality, as summarized in U.S. Navy (2013). In one study, water quality sampling for lead, manganese, nickel, vanadium, and zinc was conducted at a shallow bombing range in Pamlico Sound off North Carolina immediately following a bomb training event with inert practice munitions. With the exception of nickel, all water quality parameters tested were within the state limits. The nickel concentration was significantly higher than the state criterion, although the concentration did not differ significantly from a control site located outside the bombing range. This suggests that bombing activities may not have been responsible for the elevated nickel concentration. The second study, conducted by the U.S. Marine Corps, included sediment and water quality sampling for 26 munitions constituents at several water training ranges. Metals included lead and magnesium. No levels were detected above screening values used at the water ranges.

Determination of Effects

Explosives and Explosion Byproducts

Chemical materials with potential to affect substrates and the water column include explosives, explosion byproducts, and fuel, oil, and other fluids (including battery acid) associated with vessel operations and the use of remotely controlled target boats. Explosives are complex chemical mixtures that may affect water or sediment quality through the byproducts of their detonation and the distribution of unconsumed explosives. Some of the more common types of explosive materials used in air-to-surface activities include tritonal and research department explosive (RDX). Tritonal is primarily composed of TNT. Discussion in the remainder of this section will therefore consider TNT and RDX to be representative of all explosives. During detonation, energetic compounds may undergo high-order (complete) detonation, low-order (incomplete) detonation, or may fail to detonate altogether. High-order detonations consume almost all of the explosive material, with the remainder released into the environment as discrete particles. Analysis of live-fire detonations on terrestrial ranges have indicated that over 99.9 percent of TNT and RDX explosive material is typically consumed during a high-order detonation (U.S. Army Corps of Engineers, 2003). Pennington et al. (2006) reported a median value of 0.006 percent and 0.02 percent for TNT and RDX residue, respectively, remaining after detonation. The annual total NEW for all combined munitions is 30,488 pounds. Using the more conservative (higher) value of 0.02 percent for residual material, a total of about 6.1 pounds of explosive material could be deposited into the EGTTR annually. For purposes of analysis, it may be conservatively assumed that all residual materials are deposited simultaneously and remain within W-151A, and within the top 10 feet of the water column (10 feet is the maximum detonation scenario for any munition). In this case, the resulting concentration of explosive material would be about 8×10^{-8} milligrams per liter (mg/L). In reality, the materials would be dispersed throughout a larger surface area and water volume by currents, waves, and wind (for in-air detonations). Although there are no regulatory standards specifically for explosive materials in marine waters, this value may be compared to the Department of Defense Range and Munitions Use working group marine screening value for the amount of C-4 (another type of explosive composed of mostly RDX) remaining after detonation (as provided in U.S. Navy, 2013). The screening value is 5 mg/L, which is many orders of magnitude greater than the concentration calculated above.

Various byproducts are produced during and immediately after detonation of TNT and RDX. During the brief time that a detonation is in progress, intermediate products may include carbon ions, nitrogen ions, oxygen ions, water, hydrogen cyanide, carbon monoxide, nitrogen gas, nitrous oxide, cyanic acid, and carbon dioxide (Becker, 1995). However, reactions quickly occur between the intermediates, and the final products consist mainly of carbon (i.e., soot), carbon dioxide (CO_2), water, carbon monoxide (CO), and nitrogen gas (Naval Surface Warfare Center [NSWC] Panama City Division, 1975). These substances are natural components of seawater. Other products, occurring at substantially lower concentrations, include hydrogen, ammonia, methane, and hydrogen cyanide, among others.

After detonation, the residual explosive materials and detonation byproducts would be dispersed throughout the northern Gulf of Mexico by diffusion and by the action of wind, waves, and currents. A portion of the carbon compounds, such as CO and CO_2, would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds would be metabolized or assimilated by phytoplankton and

bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be released to the atmosphere. In addition, many of the detonations would occur in the air or at the water surface. In these cases, some portion of the byproducts could be widely distributed by wind. Given that the residual concentration of explosive material would be small, that most of the explosion byproducts would be harmless or natural seawater constituents, and that byproducts would dissipate or be quickly diluted, impacts resulting from high-order detonations would be negligible.

Low-order detonations consume a lower percentage of the explosive, and, therefore, a portion of the material is available for release into the environment. If the ordnance fails to detonate, the entire amount of energetic compound remains largely intact and is released to the environment over time as the munition casing corrodes. The likelihood of incomplete detonations is not quantified; however, the portion of munitions that could fail to detonate (i.e., duds) has been estimated at between about 3 and 5 percent (U.S. Army Corps of Engineers, 2007; Rand Corporation, 2005). Due to the potential dud rate, number of live munitions included in the 2015 REA, and NEW in each munition, an un-estimable but small amount of explosive material (TNT and RDX, among others) could enter the EGTTR annually through unexploded munitions. However, most of this material would not be available to the marine environment immediately. Explosive material would diffuse into the water through screw threads, cracks, or pinholes in the munition casings. Therefore, movement of explosive material into the water column would likely be a slow process, potentially ranging from months to decades.

After leaving the munition casing, explosive material would enter the sediment or water column. Similar to the discussion of explosive byproducts above, chemical materials in the water column would be dispersed by currents and would eventually become uniformly distributed throughout the northern Gulf of Mexico. Explosive materials in the water column would also be subject to biotic (biological) and abiotic (physical and chemical) transformation and degradation, including hydrolysis, ultraviolet radiation exposure, and biodegradation. The results of a recent investigation suggest that TNT is rapidly degraded in marine environments by biological and photochemical processes (Walker et al., 2006). Marine ecosystems are generally nitrogen-limited compared to freshwater systems, and marine microbes such as bacteria may therefore readily use TNT metabolites (e.g., ammonia and ammonium). TNT that is not biodegraded may sorb (bind to by absorption or adsorption) onto particulates, break down into dissolved organic matter, or dissolve into the water column. TNT is also subject to photochemical degradation, known as photolysis, whereby the ultraviolet component of sunlight degrades the compound into products similar to those produced by biodegradation. Photolysis is more effective in waters of shallower depth and/or with greater clarity. Uptake and metabolism of TNT has also been noted in phytoplankton. It is assumed that similar processes could affect other explosives such as RDX.

The results of studies of UXO in marine environments generally suggest that there is little overall impact to water quality resulting from the leaching of explosive material. Various researchers have studied an area in Halifax Harbor, Nova Scotia, where UXO was deposited in 1945. Rodacy et al. (2000) reported that explosives signatures were detectable in 58 percent of water samples, but that marine growth was observed on most of the exposed ordnance. TNT metabolites, suspected to result from biological decomposition, were also detected. In an earlier

study (Darrach et al. 1998), sediment collected near unexploded (but broken) ordnance did not indicate the presence of TNT, whereas samples near intact ordnance showed trace explosives in the range of low parts per billion or high parts per trillion. The authors concluded that, after 50 years, the contents of broken munitions had dissolved, reacted, biodegraded, or photodegraded, and that intact munitions appear to be slowly releasing their contents through corrosion pinholes or screw threads.

Hoffsommer et al. (1972) analyzed seawater (as well as sediment and ocean floor fauna) at known munition dumping sites off Washington State and South Carolina for the presence of TNT, RDX, tetryl, and ammonium perchlorate. None of these materials were found in any of the samples. Walker et al. (2006) sampled seawater and sediment at two offshore sites where underwater demolition was conducted using 10-pound charges of TNT and RDX. Residual TNT and RDX were below the detection limit in seawater, including samples collected in the plume within five minutes of detonation.

Other Chemical Materials

Additional materials produced during air-to-surface activities would include petroleum products (primarily fuel and oil in target boats), battery acid, and plastics. Increased use of remotely controlled target boats and mission support vessels would increase the potential for fuel, oil, and battery acid to be deposited in the water (primarily through destruction of target boats). When hydrocarbons enter the ocean, the lighter-weight components evaporate, degrade by sunlight, and undergo chemical degradation. Many constituents are also consumed by microbes. Higher-weight molecular compounds are more resistant to degradation and tend to persist after these processes have occurred, nevertheless, microbial breakdown of polychlorinated biphenyls (PCBs) does occur in estuarine and marine sediments (Agency for Toxic Substances and Disease Registry, 2000). In addition, currents would disperse any hydrocarbons produced during test and training activities. It is anticipated that potential impacts to water quality due to petroleum-based products would be insignificant. Similarly, battery acid, while possibly having a temporary and local effect on the water column, would be quickly dispersed and diluted by water currents.

Missions that involve target boat destruction could result in generation of plastic or fiberglass debris. Because of their buoyancy and resistance to degradation, many types of plastic float and may travel long distances in the ocean (U.S. Commission on Ocean Policy, 2004). Plastics may serve as vehicles for transport of various pollutants, whether by binding them from seawater or from the constituents of the plastics themselves. However, it is anticipated that plastic items would eventually break down into smaller particles due to photolysis and mechanical wear (Law et al., 2010). Plastics may also wash ashore over time. In addition, for some missions involving target boat destruction, the Air Force would perform debris cleanup at the water surface.

Debris and Anchoring Effects

Direct physical impacts to the seafloor could occur due to debris and anchoring of the GRATV and target boats. Debris deposited on the seafloor would include spent munitions fragments, UXO (in the case of dud munitions), and pieces of the target boats (fiberglass, plywood, plastics, etc.). Debris would not appreciably affect the sandy seafloor. Debris moved by water currents

could scour the bottom, but sediments would quickly refill any affected areas, and overall effects to benthic communities would be minor. Large pieces of debris would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Target boats have foam-filled hulls and most of the pieces are designed to float in order to facilitate collection for damage assessment. Overall, the quantity of material deposited on the seafloor would be small compared to other sources of debris in the Gulf of Mexico.

The GRATV would be anchored to the seafloor with four anchors, one on each corner of the barge. The anchors would cover a small area of sandy seafloor habitat immediately surrounding the GRATV. In addition, water currents flowing around the anchors would likely cause some scouring of the substrate. These actions would cover a small area of sandy substrate and could result in mortality, injury, or displacement of benthic organisms. However, the area of affected seafloor would be insignificant compared to the amount of available similar habitat in the vicinity of the mission area, and in the nearshore waters of the northeastern Gulf of Mexico generally. In addition, the GRATV would leave the area after test missions are completed (about one to two weeks), and water currents would redistribute sediments. Effects due to anchoring of target boats would be similar, and would not result in substantial impacts to the substrate.

Detonation Effects

Detonations in the water column of sufficient strength to produce pressure waves reaching the seafloor would displace sediments and possibly cause cratering. Equations for determining the radius of a crater due to underwater explosions on the seafloor are provided by O'Keefe and Young (1984). However, the equations for seafloor detonations cannot be directly applied to detonations in the water column. In this case, the radius of the explosive gas bubble may be considered a reasonable estimate of the likelihood of a detonation affecting the seafloor. If the radius extends to the seafloor, then impacts to the sediment would likely occur. If, however, the radius does not reach the bottom, then no impacts to sediment would be expected.

Swisdak (1978) provides the equation for the maximum radius of a gas bubble as:

$A_{max} = (J)\,(W^{.33}/[H+H_o]^{.33})$, where
A_{max} = maximum bubble radius (m)
J = bubble coefficient, which for TNT is 3.5 $m^{4/3}/kg^{1/3}$
W = charge weight (kilograms [kg])
H = depth of explosion (m)
H_o = atmospheric head, which equals 10 m

The largest NEW among the air-to-surface mission would be 954 pounds (428.6 kg). The maximum depth of underwater detonations is 10 feet (1.5 or 3 meters) beneath the surface. Because water pressure increases as the depth increases, the gas bubble caused by an explosion would be largest at shallower depths. For the purposes of analysis, 945 pounds of NEW detonated 5 feet beneath the surface is considered. Using these values in the equation above, the maximum bubble radius would be 11.5 meters (38 feet). Given the water depth at the target location to be approximately 35 meters (115 feet), the explosive bubble radius would not extend to the seafloor. In addition, the bubble radius is larger than the detonation depth, which would

result in a venting of explosive gas at the surface. Thus, sediment displacement from underwater detonations is not expected.

4.2.3 Habitat Areas of Particular Concern

Most live air-to-surface activities would not occur over HAPCs. In these cases, only indirect effects are possible, such as degraded water being moved from mission sites into HAPCs by currents. However, as discussed in the preceding sections, impacts to water quality in the northern Gulf of Mexico resulting from air-to-surface activities would be negligible, and, therefore, there would be no adverse impacts to HAPCs.

Some types of missions have the potential to occur directly over waters associated with HAPCs. AC-130 and CV-22 gunnery training, conducted by AFSOC and the 413 TS, may be conducted from 15 miles offshore to the 200-meter isobath. Almost all of these missions occur in W-151A, although AFSOC may occasionally use W-151B, W-151D, or W-151F due to scheduling conflicts. AFSOC missile testing (airburst only) may occur beyond the 200-meter isobath in any area of the EGTTR, although W-151 would primarily be used. These missions may occur over bluefin tuna spawning habitat and the Madison and Swanson closed areas. As these missions have no specific site requirements, they are conducted in various dispersed locations of the northern Gulf. No significant accumulation of gunnery casings or missile debris is expected in any area. Metals and chemical materials resulting from gunnery and missile use would result in only minor impacts to sediment or water quality, as discussed previously. The potential to physically strike managed fish species is considered low and would only occur if fish were in the training area, at or near the water surface at the time live fire was conducted.

4.2.4 Summary of Potential Impacts to Essential Fish Habitat

To summarize the detailed discussions above, air-to-surface missions in the EGTTR could potentially impact EFH and a small number of HAPCs by physical impacts to bottom structures and sediment, and by alteration of water quality through introduction of metals, chemical materials, and debris. There are no known bottom structures at the primary test area, and alternate locations used for most missions involving live bombs and missiles would be surveyed by side-scan sonar, magnetometer, and subbottom profiler so that bottom structures could be avoided. Explosion byproducts, petroleum products, and battery acid deposited in the water or on substrates could have temporary and localized effects but would be quickly dispersed and diluted by water currents. Metals, explosives associated with UXO, and plastics could be present at mission sites for long time periods, but effects to sediments and the water column would be limited to a small area around such items. Solid items could become corroded, encrusted, or covered with sediment, and constituents of unconsumed explosives would be subject to several physical, chemical, and biological processes that render the materials harmless or would otherwise dissipate them to undetectable levels. Vessel anchors and debris moved along the seafloor would result in only minor and temporary effects to sediments. The pressure waves associated with underwater explosions are not expected to disturb sediments on the seafloor. Therefore, air-to-surface mission activities described in this document **will not adversely affect EFH**.

Determination of Effects

4.2.5 Managed Fish Species

As discussed in the associated EGTTR REA, marine fish in general could potentially be impacted by noise or pressure resulting from detonations, ingestion of debris, and alteration of water and sediment quality. Some portion of affected fish could include species managed by the GMFMC and/or NMFS (identified in Section 3.2). Detonations at or below the water surface may generate overpressure (shock waves) and noise that move through the water column for some distance. The resulting effects to fish could include blast injury, barotrauma, hearing effects, and stress or behavioral reactions. Shock waves are often lethal to fish near a detonation (Continental Shelf Associates [CSA], 2004). At greater distance from the detonation point, the extent of mortality or injury depends on a number of factors such as fish size, body shape, and orientation in the water column (e.g., Keevin and Hempen, 1997; Lewis, 1996; O'Keeffe and Young, 1984; Wright, 1982). Modeling used to predict safe ranges for fish (e.g., Young, 1991; O'Keeffe and Young, 1984) suggest the potential for fish located within a few hundred feet of an underwater detonation to be killed. Injury, hearing effects, and behavioral effects may occur at greater distances. The number of fish affected would depend on the local population density at the time of detonation, in addition to other factors such as fish size and position in the water. Variations in fish abundance, distribution, species composition, and distance from the detonation point make it very difficult to predict the number of fish affected at any specific site. Fish populations could increase over time in areas where target boats are frequently struck due to large target pieces settling on the seafloor and becoming artificial reef habitat. Multiple debris pieces in close proximity could increase the potential for fish occurrence. Populations of some fish species could also increase temporarily if individuals were to congregate under the GRATV or anchored target boats.

Most fish species experience large numbers of natural mortalities, and a relatively small level of additional mortality caused by test and training missions would not likely affect populations as a whole. Many missions involve inert munitions or detonation of live munitions in the air or at the water surface. These scenarios would result in substantially less potential for mortality. Missions involving underwater detonations would be spread over time. Generally, it is not expected that large numbers of fish would be killed, injured, or harassed as a result of underwater detonations, or that any population would be significantly affected. As a reference point, monitoring during the shock trial of the Navy destroyer *USS John Paul Jones*, in which a 10,000-pound charge was detonated underwater, revealed about 100 dead fish (presumably at the surface; underwater surveys were not reported) (DON, 1998). Behavioral changes are not expected to have lasting effects on the survival, growth, or reproduction of fish populations.

Projectiles such as gunnery rounds, small fragments of exploded ordnance, and small pieces of target debris could sink to the seafloor and be ingested by fish that forage for food items on or within the sediment. Similarly, floating pieces of debris resulting from target boat strikes, such as small fiberglass or plywood particles, could be ingested by fish that feed at the water surface. Overall, the potential for ingesting mission-related debris would be limited to individual fish that might consume an item and experience a negative (injurious) effect. While ingestion of debris could result in lethal or sub-lethal effects to a small number of individuals, the likelihood of a fish encountering an expended item is low based on the dispersed nature of the materials, particularly debris that floats on the water surface. Furthermore, an encounter may not lead to ingestion, and ingestion would not necessarily cause injury. The number of fish potentially

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impacted would be low compared to overall population numbers, and population-level effects would not be expected.

Managed fish species could potentially be impacted due to degradation of water and sediment quality resulting from deposition of chemical materials and metals. Chemical materials and metals would enter the water column in the form of explosive material, detonation byproducts, metals from munitions casings and fragments, and petroleum products. However, as discussed previously, these materials would have an overall negligible effect on water and sediment quality and would not result in degradation of the physical marine environment. No effects to the health or viability of fish populations would be expected.

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5. MITIGATIONS

5.1 INTRODUCTION

Mitigations are measures taken to lessen or eliminate the impacts of an action. As defined in CEQ Regulations (40 CFR §1508.20), mitigation includes the following:

- Avoiding the impact altogether by not taking a certain action or part of an action
- Minimizing impacts by limiting the degree of magnitude of the action and its implementation
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- Reducing or eliminating the impact over time through preservation and maintenance operations during the life of the action
- Compensating for the impact by replacing or providing substitute resources or environments

Mitigations may include any supplemental activities that to help reduce or eliminate the potential impacts (i.e., incidental takes) to marine resources. The Air Force recognizes the importance of such "in-place" mitigations and is aware that NMFS recommends an approved mitigation plan that outlines the scope and effectiveness of the proposed activity's mitigations.

5.2 IMPACT MINIMIZATION

The potential sea turtle exposures discussed in Section 4 represent the maximum expected number of animals that could be affected. The impact estimates do not take into account measures that will be employed to minimize impacts to sea turtles and other marine species (some of these measures will help ensure human safety of mission participants and non-participants as well). Mitigation measures consist of employing trained observers to visually monitor for the presence of sea turtles and sea turtle indicators (e.g., large jellyfish aggregations and *Sargassum* mats). Monitoring procedures are described in the following subsections and will be implemented as described in Section 5.3.

5.2.1 Trained Observers

All monitoring will be conducted by personnel who have completed Eglin's Marine Species Observer Training Course that was developed in cooperation with the NMFS. This training includes a summary of environmental laws, consequences of noncompliance, description of an observer's role, pictures and descriptions of protected species and protected species indicators, survey methods, monitoring requirements, and reporting procedures. The training will be provided to user groups either electronically or in-person by an Eglin Natural Resources Office representative. Any person acting as an observer for a particular mission must have completed the training within one year of the mission. Names of personnel who have completed the training will be submitted to the Eglin Natural Resources Office along with the date of completion. In cases where multiple survey platforms are required to cover large survey areas, a Lead Biologist

will be designated to head up all monitoring efforts and coordinate sighting information with the Test Director or Safety Officer (see Section 5.3.1).

5.2.2 Pre- and Post-Mission Monitoring

For each live mission with surface or sub-surface detonation, at a minimum pre- and post-mission monitoring will be required from a given platform based on each specific mission. The purposes of pre-mission monitoring are to (1) evaluate the mission site for environmental suitability, and (2) verify that the ZOI is free of visually detectable sea turtles and potential sea turtle indicators. The duration of pre-mission surveys will depend on the area required to be surveyed, survey platforms (vessels versus aircraft), and any potential lapse in time between the end of the surveys to the beginning of the mission. This lapse would typically occur when survey vessels are required to vacate the human safety zone prior to the aircraft releasing the munitions. All sea turtle sightings, number of individuals, location, and behavior of the animals will be documented on report forms that will be submitted to the Eglin Natural Resources Office after each mission. Missions may be postponed, relocated, or cancelled based on the presence of protected species within the survey areas.

Post-mission monitoring is designed to determine the effectiveness of pre-mission mitigation by reporting sightings of any dead or injured sea turtles. The duration of post-mission surveys will vary based on survey platform and any potential time lapse between the last detonation of the mission and when the post-mission surveys can begin. This lapse would typically occur when survey vessels are stationed on the perimeter of the human safety zone and are required to wait until the range has been declared clear. Similar to pre-mission surveys, all sightings would be properly documented on report forms and submitted to the Eglin Natural Resources Office.

If any sea turtles are killed or injured as a result of the mission, the Eglin Natural Resources Office would be contacted immediately. Observers would document the species or description of the animal, location, behavior, and if practicable take pictures and maintain visual contact with the animal(s). The Eglin Natural Resources Office would then contact the Sea Turtle Stranding and Salvage Network state coordinator and the Florida Fish and Wildlife Conservation Commission Wildlife Alert Hotline and either await further instructions or until a response team has arrived on site, if feasible. Last known GPS points would be provided to the Stranding Coordinator.

5.2.3 Sea State Conditions

Weather conducive to sea turtle monitoring is required to effectively implement the pre- and post-mission surveys. Wind speed and the resulting surface conditions of the Gulf are critical factors affecting observation effectiveness. Higher winds typically increase wave height and create "white cap" conditions, both of which limit an observer's ability to locate marine species at or near the surface. Air-to-surface missions will be delayed or rescheduled if the sea state is greater than number 4 of Table 5-1 at the time of the mission. Protected species observers or the Lead Biologist will make the final determination of whether or not conditions are conducive to sighting protected species. In addition, the missions will occur no earlier than two hours after sunrise and no later than two hours prior to sunset to ensure adequate daylight for pre- and post-

mission monitoring, with the exception of AFSOC and 413th FLTS gunnery missions. In those cases, aircrews will utilize aircraft instrumentation and sensors to monitor the area.

Table 5-1. Sea State Scale for EGTTR Pre-Mission Surveys

Sea State Number	Sea Conditions
0	Flat calm, no waves or ripples.
1	Light air, winds 1–2 knots; wave height to 1 foot; ripples without crests.
2	Light breeze, winds 3–6 knots; wave height 1–2 feet; small wavelets, crests not breaking.
3	Gentle breeze, winds 7–10 knots; wave height 2–3.5 feet; large wavelets, scattered whitecaps.
4	Moderate breeze, winds 11–16 knots; wave height 3.5–6 feet; breaking crests, numerous whitecaps.

EGTTR = Eglin Gulf Test and Training Range

Visibility is also a critical factor for flight safety issues when aerial surveys are being conducted. Therefore, a minimum ceiling of 305 meters (1,000 feet) and visibility of 5.6 km (3 NM) is required to support monitoring efforts and flight safety concerns.

5.2.4 Determination of Survey Areas

Eglin is seeking to obtain authorizations under the MMPA for incidental takes of marine mammals resulting from this proposed action. Under the MMPA consultation, monitoring procedures for marine mammals are being developed that would also apply to sea turtles. The ranges that are presented in Section 6.6 of Eglin's Request for an LOA represent a radius of impact for a given threshold of each munition/detonation scenario. These ranges will be used for determining the size of the area required to be monitored during pre-mission surveys for each activity. For missions involving live munitions other than gunnery rounds, an area extending out to the Atlantic spotted dolphin Level A PTS Harassment range for the largest munition being released during that mission is proposed to be monitored for marine mammals prior to release of the first live ordnance. Depending on the mission, the corresponding radius could be between 46 meters for a live fuse surface detonation with 0.4 lbs NEW up to 2,156 meters for a GBU-10 subsurface detonation with 945 lbs NEW. Comparing these ranges to those presented in Section 4.1.3 of this BA, impairment impact ranges for sea turtles are larger than the Atlantic spotted dolphin Level A PTS Harassment ranges for some munitions. In these cases, the larger of the two ranges will be monitored. This would help ensure that no sea turtles will be within Impairment, Injury, and Mortality zones during a live detonation event. For missions that will experience a time delay to account for survey platforms evacuating the human safety zone after pre-missions surveys are completed, Eglin proposes to include a buffer to the survey area that would extend to the Atlantic spotted dolphin Level B TTS Harassment zone for the largest munition being released during that mission. In all cases, this would more than double the survey area from that of the Level A PTS zone, ranging from a 126 up to 461 percent increase in survey area. This buffer will mitigate the potential for any protected species (marine mammal or sea turtle) outside the area during pre-mission surveys swimming into their respective Injury or Mortality zones during a mission.

However, missions that consist solely of gunnery testing and training operations will actually survey larger areas based on previously established safety profiles and their ability to conduct aerial surveys of large areas from mission aircraft. These ranges are shown in Table 5-2. Monitoring procedures for gunships are described in Section 5.3.2.

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Table 5-2. Monitoring Area Radii for Gunnery Missions

Aircraft	Gunnery Round	Monitoring Area	Monitoring Altitude	Operational Altitude
AC-130 Gunship	25-mm, 30-mm, 40-mm, 105-mm (FU and TR)	5 NM (9,260 m)	6,000 ft	15,000 – 20,000 ft
CV-22 Osprey	.50 cal, 7.62 mm	3 NM (5,556 m)	1,000 ft	1,000 ft

cal = caliber; ft = feet; FU = full up; m = meters; mm = millimeter; NM = nautical miles; TR = training round

5.3 DESCRIPTION OF MONITORING ACTIVITIES

The following monitoring options have been developed to support various types of air-to-surface mission activities that may be conducted in the EGTTR. Eglin users covered by this Section 7 consultation must meet specific test or training objectives, safety requirements, and have different assets available to execute the pre- and post-mission surveys. The monitoring options and mitigation measures described in the subsections below balances all mission-essential parameters with measures that will provide adequate protection to sea turtles.

5.3.1 Vessel Based Monitoring

Pre-mission surveys conducted from surface vessels will typically begin at sunrise. Trained observers will be aboard designated vessels to conduct protected species surveys before and after each mission. These vessels will be dedicated solely to monitoring for protected marine species and species indicators during the pre-mission surveys. For missions that require multiple vessels to conduct surveys based on the size of the survey area, a Lead Biologist will be designated to coordinate all survey efforts, compile sighting information from the other vessels, function as the point of contact between the survey vessels and Tower Control, and provide final recommendations to the Safety Officer/Test Director on the suitability of the mission site based on environmental conditions and survey results.

Survey vessels will run pre-determined line transects, or survey routes, that will provide sufficient coverage of the survey area. Monitoring activities will be conducted from the highest point feasible on the vessels (Figure 5-1). There will be at least two dedicated observers on each vessel, and they will utilize optical equipment with sufficient magnification to allow observation of surfaced animals.

Figure 5-1. Marine Species Observer Example

Roles and Responsibilities

All sighting information from pre-mission surveys will be communicated to the Lead Biologist on a pre-determined radio channel to reduce overall radio chatter and potential confusion. After compiling all the sighting information from the other survey vessels, the

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Lead Biologist will inform Tower Control on whether the area is clear of protected species or not. If the range is not clear, the Lead Biologist will provide recommendations on whether the mission should be delayed or cancelled. A mission delay recommendation would occur, for example, if a small number of protected species are in the ZOI but appear to be on a heading away from the mission area. The delay would continue until the Lead Biologist has confirmed that the animals are no longer in the ZOI and traveling on a heading away from the mission site. On the other hand, a mission cancellation recommendation could occur if one or more protected species in the ZOI are found and there is no indication that they would leave the area on their own preference within a reasonable timeframe. Tower Control will relay the Lead Biologist's recommendation to the Safety Officer. The Safety Officer and Test Director will collaborate regarding range conditions based on the information provided by the Lead Biologist and the status of range clearing vessels. Ultimately, the Safety Officer will have final authority on decisions regarding delays and cancellations of missions.

Human Safety Zone Enforcement

For missions that occur relatively close to shore and therefore have the potential to endanger civilian boat traffic, a large number of range clearing boats (approximately 20 to 25) will be stationed around the mission site to prevent non-participating vessels from entering the human safety zone. Based on a composite footprint from previous similar missions, range clearing boats would be located approximately 24 kilometers (15 miles) from the detonation point (Figure 5-2). Actual distance will vary based on the type the munition being deployed and its release parameters. These range clearing boats are typically at their guard stations (as shown in the figure below) by sunrise before commercial and recreational boaters have an opportunity to enter the safety zone. Two range clearing boats are stationed in the East Pass to distribute flyers and maps to civilian boaters as they exit the pass and enter the Gulf, informing them of the area closures.

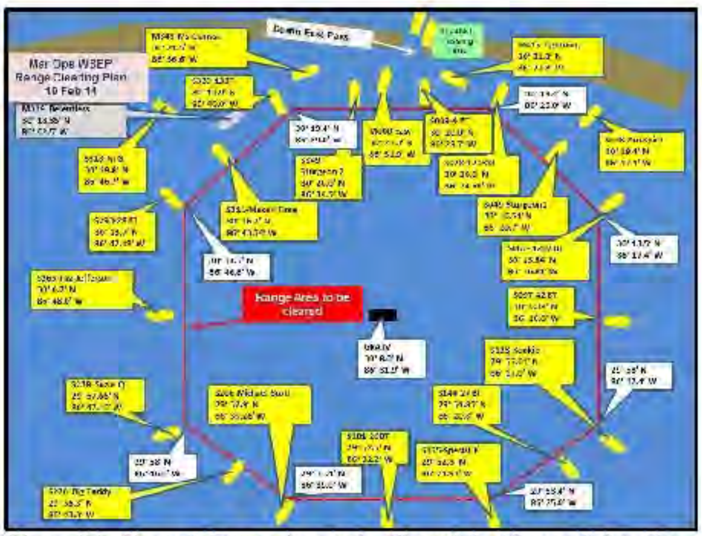

Figure 5-2. Example Range Area to be Cleared for Human Safety Zone

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Survey vessels are also required to abide by the human safety zone enforcement. When feasible, they typically aim to complete the pre-mission surveys at least 30 minutes prior to mission start time to transit from the end point of their survey routes to the safety zone periphery. Observers will continue monitoring for sea turtles from outside the safety zone during the mission, but effectiveness will be limited as each vessel will remain at a designated station to assist with range clearing activities. Additional measures are taken to address this time lapse, which may include surveying an additional buffer area (as described in Section 5.2.4) or employing supplemental monitoring as described later in this section.

Air Force Support Vessels

Air Force support vessels will consist of a combination of Air Force and civil service/civilian personnel responsible for mission site/target set up and range clearing activities. Air Force personnel will be within the mission area (on boats and the GRATV) for each mission well in advance of weapon deployment, typically near sunrise. They will perform a variety of tasks including target preparation, equipment checks, etc., and will opportunistically observe for sea turtles and indicators as feasible throughout test preparation. However, such observations are considered incidental and would only occur as time and schedule permits. Any sightings would be relayed to the Lead Biologist.

The Eglin Safety Officer, in cooperation with the Santa Rosa Island Tower Control at Test Site A-13B and CCF, will coordinate and manage all range clearing efforts and be in direct communication with the survey vessel team, typically through the Lead Biologist. All support vessels will be in radio contact with one another and with Tower Control on the government VHF channel 81a or 82a. The Safety Officer will monitor all radio communications, but Tower will relay messages between the vessels and the Safety Officer. The Safety Officer and Tower Control will also be in continual contact with the Test Director throughout the mission and will convey information regarding range clearing progress and protected species survey status. Final decisions regarding mission execution, including possible mission delay or cancellation based on protected species sightings or civilian boat traffic interference, will be the responsibility of the Safety Officer, with concurrence from the Test Director.

5.3.2 Aerial Based Monitoring

Aircraft typically provide an excellent viewing platform for detection of sea turtles at or near the surface. Depending on the mission, the aerial survey team would either consist of Eglin Natural Resources personnel or their designees aboard a non-mission aircraft or the mission aircrew who will subsequently conduct the mission. A description of each follows.

Non-Mission Aircraft

For non-mission aircraft, the pilot will be instructed in protected marine species survey techniques and will be familiar with marine species expected to occur in the area. One person in the aircraft would act as data recorder and is responsible for relaying the location, species (if possible), direction of movement, and number of animals sighted to the Lead Biologist. The aerial team will also identify protected species indicators such as large schools of fish and large, active groups of birds. Pilots will fly the aircraft in such a manner that the entire ZOI (and a

buffer, if required) will be monitored. Sea turtle sightings from the aerial survey team will be compiled by the Lead Biologist and communicated to the Test Director or Safety Officer. Similar to survey vessel requirements, all non-mission personnel will be required to exit the human safety zone before the mission can commence. As a result, the ZOI may not be monitored up to immediate deployment of live weapons. Due to this fact, the aerial team may be required to survey an additional buffer zone (as described in Section 5.2.4), unless other monitoring assets, such as live video monitoring, can be employed.

Mission Aircraft

Some mission aircraft have the capability to conduct aerial surveys immediately prior to releasing munitions. In those instances, aircrews who have completed the marine species observer training will conduct several dry passes over the target area to ensure the area is clear of all protected species. For mission aircraft that fall under this category, aircrews will operate at reasonable and safe altitudes (dependent on the aircraft) appropriate to either visually scan the sea surface or will utilize available instrumentation and sensors to detect protected species. Typical missions that would fall under this category are air-to-surface gunnery operations from AC-130 and CV-22 gunships. In some cases, other aerial platforms may be available to supplement monitoring activities for pre-mission surveys and during the missions.

AC-130 and CV-22 Gunship Procedures

After arriving at the mission site and prior to initiating firing events, gunships will conduct at least two complete orbits around the survey area at a minimum safe airspeed around the mission site at the appropriate monitoring altitude. Provided that sea turtles (and other protected species or indicators) are not detected, the aircraft will then begin the ascent to operational altitude, continuing to orbit the target area as it climbs. The initial orbits occur over a time frame of approximately 10 to 15 minutes. Monitoring for sea turtles, vessels, and other objects will continue throughout the mission. If a towed target is used, mission personnel will ensure that the target remains in the center portion of the survey area to ensure gunnery impacts would not extend past the ZOI area.

During the low-altitude orbits and climb, the aircrew will visually scan the sea surface within the aircraft's orbit circle for the presence of sea turtles. Primary emphasis for the surface scan will be upon the flight crew in the cockpit and personnel stationed in the tail observer bubble and starboard viewing window. During nighttime missions, crews will use night vision goggles during observation. In addition to visual surveys, aircraft optical and electronic sensors will also be used for site clearance. AC-130 gunships are equipped with low-light television (TV) cameras and AN/AAQ-26 Infrared Detection Sets (IDS). The TV cameras operate in a range of visible and near-visible light. Infrared systems are capable of detecting differences in temperature from thermal energy (heat) radiated from living bodies, or from reflected and scattered thermal energy. In contrast to typical night-vision devices, visible light is not necessary for object detection. IR systems are equally effective during day or night use. The IDS is capable of detecting very small thermal differences. See the Notice of Incidental Harassment Authorization (73 FR 246, December 22, 2008) for a further description of AC-130 sensor capabilities. CV-22 aircraft have similar visual scanners and operable sensors; however, they

operate at much lower altitudes than the AC-130 gunships, and no HE rounds will be fired from these aircraft.

If any sea turtles are detected during pre-mission surveys or during the mission, activities will be immediately halted until the ZOI area is clear of all protected species, or the mission will be relocated to another target area. If the mission is relocated, the pre-mission survey procedures will be repeated. In addition, if multiple firing missions are conducted within the same flight, clearance procedures will precede each mission.

Gunship crews will conduct a post-mission survey beginning at the operational altitude and proceeding through a spiraling descent to the designated monitoring altitude. It is anticipated that the descent will occur over a three- to five-minute time period. During this time, aircrews will use the similar equipment and instrumentation to scan the water surface for animals that may have been impacted during the gunnery exercise. During daytime missions, visual scans will be used as well.

Other Mission Aircraft

For missions other than gunnery activities, at least two ordnance delivery aircraft will typically participate in each live weapon release. Prior to the release, Air Force pilots aboard mission aircraft may make a dry run over the target area to ensure it is clear of non-participating vessels before ordnance is deployed. Observation effectiveness may vary among aircraft types. Jets will fly at a minimum speed of 300 knots indicated air speed (approximately 345 miles per hour, depending on atmospheric conditions) and at a minimum altitude of 1,000 feet (305 meters). Due to the limited flyover duration and potentially high speed and altitude, observation for marine species would probably be only marginally effective at best, and pilots will, therefore, not participate in species surveys.

5.3.3 Video Based Monitoring

Video-based monitoring may be accomplished via live high-definition video feed transmitted to CCF. Video monitoring typically facilitates data collection for the mission, but can also allow remote viewing of the area for determination of environmental conditions and the presence of marine species up to the release time of live munitions. There are multiple sources of video that can be streamed to multiple monitors within CCF. When authorized for specific missions (e.g., Maritime WSEP), a trained marine species observer from the Eglin Natural Resources Office will monitor all live video feed transmitted to CCF and will report any sea turtle sightings to the Safety Officer, who will also be at CCF. Employing this measure typically resolves any time lapses incurred from survey vessels or aircraft leaving the safety zone after pre-mission surveys are completed but before the mission can begin.

The primary platform for video monitoring would be through the GRATV. Four video cameras are typically positioned on the GRATV (anchored on-site) to allow for real-time monitoring and data collection during the mission. The cameras will also be used to monitor for the presence of protected species. Zoom capabilities for the cameras were summarized in Section 2.1. The GRATV will typically be located about 183 meters (600 feet) from the target area, which is well

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within the zooming capability ranges of the video cameras. Representative screen shots from three different cameras are shown in Figure 5-3 through Figure 5-5.

Figure 5-3. Representative Screen Shot Camera 1

Figure 5-4. Representative Screen Shot Camera 2

Figure 5-5. Representative Screen Shot Camera 3

Supplemental video monitoring can also be accomplished through the employment of additional aerial assets. Eglin's Aerostat Balloon provides aerial imagery of weapon impacts and instrumentation relay. When utilized, it is tethered to a boat anchored near the GRATV, but outside weapon impact areas. The balloon can be deployed to an altitude up to 2,000 feet above sea level. It is equipped with a high-definition camera system that is remotely controlled to pivot and focus on a specific target or location within the mission site. The video feed from the camera system is transmitted to CCF. Eglin may also employ other assets such as Intelligence, Surveillance, and Reconnaissance aircraft to provide real-time imagery or relay targeting pod videos from mission aircraft. Unmanned aerial vehicles may also be employed to provide aerial video surveillance. While each of these platforms may not be available for all missions, they

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typically can be used in combination with each other and with the GRATV cameras to supplement sea turtle monitoring efforts.

Even with a variety of platforms potentially available to supply video feeds to CCF, the entire ZOI may not be visible for the entire duration of the mission. However, the targets and immediately surrounding areas will typically be in the field of view of the GRATV cameras and the observer will be able to identify any protected species that may enter the target area before weapon releases. In addition, the observer will be able to determine if any animals were injured immediately following the detonations. Should a protected marine species be detected on the live video, the weapon release can be stopped almost immediately because the video camera observer is in direct contact with Test Director and Safety Officer at CCF.

The protected species survey vessels and the video camera observer will have open lines of communication to facilitate real-time reporting of sea turtle sightings and other relevant information, such as safety concerns and presence of non-participating vessels in the human safety zone. Direct radio communication between all surface vessels, GRATV personnel, and the Tower Control will be maintained throughout the mission. The Range Safety Officer will monitor all radio communications from CCF and information between the Safety Officer and the support vessels will be relayed via Tower Control.

5.4 OPERATIONAL MITIGATION MEASURES FOR GUNNERY ACTIONS

Eglin AFB has identified and required implementation of three operational mitigation measures for gunnery missions, including development of the 105-mm TR, use of ramp-up procedures, and eliminating missions conducted over waters beyond the continental shelf. The largest type of ammunition used during gunnery missions is a 105-mm round, which contains 4.7 pounds of HE (high explosive). This is several times more HE than that found in the next largest round (40 mm). As a mitigation technique, the Air Force developed a 105-mm TR that contains only 0.35 pounds of HE. The training round was developed to substantially reduce the risk of harassment during nighttime operations, when visual surveying for protected species was of limited effectiveness (monitoring by use of the AC-130's instrumentation, however, as described in Section 5.3.2 above, is effective at night).

Ramp-up procedures refer to the process of beginning with the least impactive action and proceeding to subsequently more impactive actions. In the case of air-to-surface gunnery activities, ramp-up procedures entail beginning a mission with the lowest caliber munition and proceeding to the highest, which means the munitions would be fired in the order of 25 mm, 40 mm, and 105 mm. The rationale for the procedure is that this process may allow marine species to perceive steadily increasing noise levels and to react, if necessary, before the noise reaches a threshold of significance.

The AC-130 gunships' weapons are used in two phases. First, the guns are checked for functionality and calibrated. This step requires an abbreviated period of live fire. After the guns are determined to be ready for use, the aircraft deploys a flare onto the water surface as a target,

and the mission proceeds under various test and training scenarios. This second phase involves a more extended period of live fire and can incorporate use of one or any combination of the munitions available (25 mm, 40 mm, and 105 mm rounds).

The ramp-up procedure will be required for the initial calibration phase and, after this phase, the guns may be fired in any order. Eglin AFB believes this process will allow marine species the opportunity to respond to increasing noise levels. If an animal leaves the area during ramp-up, it is unlikely to return while the live-fire mission is proceeding. This protocol provides a more realistic training experience for aircrews. In combat situations, gunship crews would not necessarily fire the complete ammunition load of a given caliber gun before proceeding to another gun. Rather, a combination of guns might be used as required by real-time situations. An additional benefit of this protocol is that mechanical or ammunition problems on an individual gun can be resolved while live fire continues with functioning weapons. This diminishes the possibility of a lengthy pause in live fire which, if greater than 10 minutes, would necessitate re-initiation of protected species surveys.

Many marine mammal species found in the Gulf of Mexico, including the federally listed sperm whale, occur with greater regularity in waters over and beyond the continental shelf break. As a conservation measure to avoid impacts to the sperm whale, AFSOC has agreed to conduct all gunnery missions within (shoreward of) the 200-meter isobath, which is considered to be the shelf break in this document. This measure will incidentally provide greater protection to several other species as well. The 200-meter depth contour is shown on Figure 2-6 in Section 2.

5.5 COORDINATION WITH EGLIN NATURAL RESOURCES FOR IMPLEMENTATION OF MONITORING REQUIREMENTS

Prior to conducting live missions, proponents will coordinate with the Eglin Natural Resources Office to be briefed on their mitigation and monitoring requirements. Throughout coordination efforts, mission assets available for monitoring will be identified and an implementation plan will be developed. Based on the assets, survey routes will be designed to incorporate the size of the monitoring area and whether a buffer will be required. Training and reporting requirements will also be communicated to the proponents.

5.5.1 Monitoring Options Proposed to be Employed by Known Proponents and Missions

The following table lists known proponents (based on mission descriptions provided in Section 2) and the monitoring platforms that may be employed for sea turtle monitoring before, during, and after live air-to-surface missions. As stated above, coordination with proponents before live missions will ensure these options are still available as well as any changes to assets or mission capabilities for new proponents that would fall under this authorization. The Eglin Natural Resources Office will ensure all practical measures will be implemented to the maximum extent possible to comply with the mitigation and monitoring requirements while meeting mission objectives.

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Table 5-3. Monitoring Options Available for Live Air-to-Surface Mission Proponents Operating in the EGTTR

Mission (see Section 2 for complete description)	Monitoring Platform Vessel	Aerial	Video
86 FWS Maritime Weapons System Evaluation Program (WSEP)	■		■
Air Force Special Operations Command (AFSOC) Training			
Air-to-Surface Gunnery		■	
Small Diameter Bomb/Griffin Missile Training		■	
CV-22 Training		■	
413th Flight Test Squadron (FLTS)			
AC-130J Precision Strike Package Testing		■	
AC-130J Stand-Off Precision Guided Munitions Testing		■	
780th Test Squadron			
Precision Strike Weapon	■	■	
Longbow Littoral Testing	■		

86 FWS = 86th Fighter Weapons Squadron; EGTTR = Eglin Gulf Test and Training Range

5.5.2 Example Mitigation Plan

This section is an example mitigation plan that would generally be applicable to air-to-surface missions incorporating vessel-based pre-mission surveys and video monitoring. While most or all of the described elements could be implemented for many missions, there may be instances where specific actions are not feasible. However, the detailed plan is provided here to illustrate the types of actions that would typically be employed. All mitigation activities will be regulated by Air Force safety parameters. Any mission may be delayed or cancelled due to technical issues or range clearing issues. Should a delay occur during pre-mission surveys, all mitigation procedures would continue either for the duration of the delay or until the mission is cancelled. To ensure the safety of survey personnel, the team will depart the mission area approximately 30 minutes before live ordnance delivery is scheduled to begin. Stepwise mitigation procedures are outlined below.

(a) Sunrise or Two Hours Prior to Mission:

Air Force range clearing vessels and protected species survey vessels will be on-site at least two hours prior to the mission. The Lead Biologist on board one survey vessel will assess the overall suitability of the mission site based on environmental conditions (sea state) and presence/absence of sea turtle indicators. This information will be communicated to Tower Control and relayed to the Safety Officer in CCF.

(b) One and One-Half Hours Prior to Mission – Commence Pre-Mission Surveys:

Vessel-based surveys will begin approximately 1.5 hours prior to live weapon deployment. Surface vessel observers will survey the ZOI and relay all marine species and indicator sightings, including the time of sighting, GPS location, and direction of travel, if known, to the Lead Biologist. The Lead Biologist will document all sighting information on report forms to be submitted to the Eglin Natural Resources Office after each mission. Surveys will continue for approximately one hour or until the entire ZOI has been adequately surveyed, whichever occurs first. During this time, Air Force personnel in the mission area will also observe for marine species as feasible. If sea

turtles or indicators are observed within the ZOI, the range will be declared "fouled," a term that signifies to mission personnel that conditions are such that a live ordnance drop cannot occur (e.g., protected species or civilian vessels are in the mission area). If no sea turtles or indicators are observed, the range will be declared clear of protected species.

(c) One-Half Hour Prior to Mission:

At approximately 30 minutes to one hour prior to live weapon deployment, marine species observers will be instructed to leave the mission site and remain outside the safety zone, which on average will be 15 miles from the detonation point. The actual size is determined by weapon NEW and method of delivery. The survey team will continue to monitor for protected species while leaving the area. As the survey vessels leave the area, marine species monitoring of the immediate target areas will continue at CCF through the live video feed received from the high definition cameras on the GRATV. Once the survey vessels have arrived at the perimeter of the safety zone (approximately 30 minutes after being instructed to leave, depending on actual travel time) the range will be declared "green" and mission will be allowed to proceed, assuming all non-participating vessels have left the safety zone as well.

(d) Execution of Mission:

Immediately prior to live weapon drop, the Test Director and Safety Officer will communicate to confirm the results of sea turtle surveys and the appropriateness of proceeding with the mission. The Safety Officer will have final authority to proceed with, postpone, or cancel the mission. The mission would be postponed if:

1. Any sea turtle is visually detected within the ZOI. Postponement would continue until the animal(s) that caused the postponement is:
    a. Confirmed to be outside of the ZOI on a heading away from the targets, or
    b. Not seen again for 30 minutes and presumed to be outside the Impairment ZOI due to the animal swimming out of the range.
2. Large aggregations of jellyfish or large floating mats of *Sargassum* are observed within the ZOI. Postponement would continue until these potential indicators are confirmed to be outside the ZOI.
3. Any technical or mechanical issues related to the aircraft or target boats.
4. Non-participating vessels enter the human safety zone prior to weapon release.

In the event of a postponement, protected species monitoring would continue from CCF through the live video feed.

(e) Completion of the Mission – Commence Post-Mission Surveys:

Post-detonation monitoring surveys will commence once the mission has ended or, if required, as soon as EOD personnel declare the mission area safe. Vessels will move into the survey area from outside the safety zone and monitor for at least 30 minutes, concentrating on the area down-current of the test site. If boat targets have been struck

by weapons, this area is easily identifiable because of the floating debris in the water from the impacted targets. Up to 10 Air Force support vessels will clean debris and collect damaged targets from this area, thus spending many hours in the area once the mission is completed. All vessels will be instructed to report any dead or injured sea turtles to the Lead Biologist.

5.6 MITIGATION EFFECTIVENESS

The effectiveness of the mitigation measures described above depends largely on the ability to visually locate sea turtles at or near the water surface, as visual observation is the primary measure used. NMFS has evaluated the effectiveness of visual observation for a similar previous Air Force action in the same area of the Gulf (PSW testing). Mitigation effectiveness estimates for PSW testing was primarily based on aerial surveys, with supplemental surveys conducted from boats and video cameras. Similar to many of the air-to-surface activities described in this document, observers were required to leave the mission area one hour prior to detonation due to human safety requirements. Under such a scenario, NMFS estimated the mitigation effectiveness to be 30 percent. That is, the number of sea turtle takes estimated for each criterion could reasonably be reduced by 30 percent. Aerial surveys are not feasible for all missions evaluated in this BA, and observation will be conducted from vessels and video cameras. Therefore, survey effectiveness is not quantified in this document but is likely less than the 30 percent estimated for PSW testing.

6. SUMMARY OF CONCLUSIONS

Based on the analysis in Section 4, sea turtles are likely to be adversely affected due to underwater detonations during air-to-surface missions in the EGTTR. Adherence to mitigation measures, as described in Section 5, may help to reduce the potential for adverse impacts to sea turtle populations. The quality and/or quantity of EFH (including HAPCs) would not be reduced due to physical impacts; deposition of metals, explosives and explosion byproducts, other chemical materials, or debris; or anchoring effects. The potential accumulation of target pieces and other items in the area could have a beneficial impact on EFH by providing habitat for encrusting organisms, fish, and other marine species.

NMFS would be notified immediately if any of the actions considered in this BA were modified or if additional information on listed species or EFH became available, as a re-initiation of consultation may be required. If impacts to listed species occurred beyond what has been considered in this assessment, all operations would cease and NMFS would be notified. Any modifications or conditions resulting from consultation with NMFS would be implemented prior to commencement of activities. The Eglin Natural Resources Office believes this fulfills all requirements of the MSA and Section 7 of the ESA, and that no further action is necessary.

Summary of Conclusions

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8. REVIEW OF LITERATURE AND OTHER PERTINENT INFORMATION

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APPENDIX A

ACOUSTIC MODELING METHODOLOGY

Eglin Air Force Base
Eglin Gulf Test and Training Range (EGTTR)
MMPA and ESA Acoustic Impact Modeling: Modeling Appendix

Submitted by:
Leidos

To:
Eglin Natural Resources
96 CEG/CEIEA
Eglin Air Force Base, FL

In response to tasking associated with:
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APPENDIX A
MMPA AND ESA ACOUSTIC IMPACT MODELING

A.1 BACKGROUND AND OVERVIEW

A.1.1 Federal Regulations Affecting Marine Animals

All marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

The Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of their ecosystems. A "species" is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. Some marine mammals, already protected under MMPA, are also listed as either endangered or threatened under ESA, and are afforded special protections. In addition, all sea turtles are protected under the ESA.

Actions involving sound in the water may have the potential to harass marine animals in the surrounding waters. Demonstration of compliance with the MMPA and ESA, using best available science, has been assessed using criteria and thresholds accepted or negotiated, and described here.

Sections of the MMPA (16 USC 1361 et seq.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity, other than commercial fishing, within a specified geographical region. Through a specific process, if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted if National Marine Fisheries Service (NMFS) finds that the taking will have no more than a negligible impact on the species or stock(s), will not have an immitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and that the permissible methods of taking, and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth.

NMFS has defined negligible impact in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

Subsection 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. The National Defense Authorization Act of 2004 (NDAA) (Public Law 108-136) removed the small numbers limitation and amended the definition of "harassment" as it applies to a military readiness activity to read as follows:

> (i) *any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or*
> (ii) *any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].*

The primary potential impact to marine mammals from underwater acoustics is Level A and Level B harassment, as defined by the MMPA from noise. Potential impacts to sea turtles from underwater acoustic exposure are primarily behavioral responses and impairment, with some potential for injury, and a very small potential for mortality.

A.1.2 Development of Animal Impact Criteria

A.1.2.1 Marine Mammals

For explosions of ordnance planned for use in the Eglin Gulf Test and Training Range (EGTTR) Study Area, in the absence of any mitigation or monitoring measures, there is a small chance that a marine mammal could be injured or killed when exposed to the energy generated from an explosive force. Analysis of noise impacts is based on criteria and thresholds initially presented in U.S. Navy Environmental Impact Statements for ship shock trials of the Seawolf submarine and the Winston Churchill (DDG 81), and subsequently adopted by NMFS.

Lethal impact determinations currently incorporate species-specific thresholds that are based on the level of impact that would cause extensive lung injury from which one percent of exposed animals would not recover (Finneran and Jenkins, 2012). The threshold represents the expected onset of mortality, where 99 percent of exposed animals would be expected to survive. The lethal exposure level of blast noise, associated with the positive impulse pressure of the blast, is expressed as Pascal-seconds (Pa·s) and is determined using the Goertner (1982) modified positive impulse equation. This equation incorporates sound propagation, source/animal depths, and the mass of a newborn calf of the affected species. The Goertner equation used in the acoustic model to develop mortality impact analysis, is as follows:

$$I_M(M,D) = 91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$$

$I_M(M,D)$	mortality threshold, expressed in terms of acoustic impulse (Pa·s)
M	Animal mass (Table D-1)
D	Water depth (m)

Non-lethal injurious impacts (Level A Harassment) are defined in those documents as permanent (auditory) threshold shift (PTS), gastro-intestinal (GI) tract damage, and the onset of slight lung injury. Two thresholds are used for PTS, one based on sound exposure level (SEL) and the other on the sound pressure level (SPL) of an underwater blast. Thresholds follow the approach of Southall et al. (2007). The threshold producing either the largest Zone of Influence (ZOI) or higher exposure levels is then used as the more protective of the dual thresholds. In most cases, the weighted total EFD is more conservative that the largest EFD in any single 1/3-octave band used in earlier models. Type II weighting functions are for each functional hearing group. The threshold for the Type II weighted EFD is 187 decibels referenced to 1 microPascal-squared – seconds (dB re 1 μPa^2-s); the threshold for peak pressure is 46 pounds per square inch (psi) or 230 dB re 1 μPa.

The criteria for slight injury to the GI tract was found to be a limit on peak pressure and independent of the animal's size (Goertner, 1982). A threshold of 103 psi (237 dB re 1 μPa) is used for all marine mammals. This level at which slight contusions to the GI tract were reported from small charge tests (Richmond *et al.,* 1973).

The criteria for onset of slight lung injury were established using partial impulse because the impulse of an underwater blast wave was the parameter that governed damage during a study using mammals, not peak pressure or energy (Yelverton, 1981). Goertner (1982) determined a way to calculate impulse values for injury at greater depths, known as the Goertner "modified" impulse pressure. Those values are valid only near the surface because as hydrostatic pressure increases with depth, organs like the lung, filled with air, compress. Therefore the "modified" impulse pressure thresholds vary from the shallow depth starting point as a function of depth.

The shallow depth starting points for calculation of the "modified" impulse pressures are mass-dependent values derived from empirical data for underwater blast injury (Yelverton, 1981). During the calculations, the lowest impulse and body mass for which slight, and then extensive, lung injury found during a previous study (Yelverton et al, 1973) were used to determine the positive impulse that may cause lung injury. The Goertner model is sensitive to mammal weight such that smaller masses have lower thresholds for positive impulse so injury and harassment will be predicted at greater distances from the source for them. The equation used for determination of slight lung injury is:

$$I_s(M,D) = 39.1M^{1/3}\left(1 - \frac{D}{10.1}\right)^{1/2},$$

where M is animal mass (kg), D is animal depth (m), and the units of I_s are Pa-s.

Level B (non-injurious) Harassment includes temporary (auditory) threshold shift (TTS), a slight, recoverable loss of hearing sensitivity. One criterion used for TTS, the total Type II weighted energy flux density of the signal, is a threshold of 172 dB re 1 μPa^2-s for toothed whales (e.g., dolphins). A second criterion, a maximum allowable peak pressure of 23 psi (224 dB re 1 μPa), has recently been established by NMFS to provide a more conservative range for TTS when the explosive or animal approaches the sea surface, in which case explosive energy is reduced, but the peak pressure is not. NMFS applies the more conservative of these two.

For multiple successive explosions, the acoustic criterion for non-TTS behavioral disturbance is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The threshold for behavioral disturbance is set 5 dB below the Type II weighted total EFD-based TTS threshold, or 167 dB re 1 μPa^2-s. This is based on observations of behavioral reactions in captive dolphins and belugas occurring at exposure levels ~ 5 dB below those causing TTS after exposure to pure tones (Finneran and Schlundt, 2004; Schlundt et al., 2000).

Table A-1 summarizes the current threshold levels for marine mammals used to analyze explosives identified for use in the EGTTR study area.

Table A-1. Explosives Threshold Levels for Marine Mammals

	Level A Harassment				Level B Harassment	
Mortality*	**Slight Lung Injury***	**GI Tract Injury**	**PTS**	**TTS**	**Behavioral**
$91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	$39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	Unweighted SPL: 237 dB re 1 μPa	Weighted SEL: 187 dB re 1 μPa^2·s Unweighted SPL: 230 dB re 1 μPa	Weighted SEL: 172 dB re 1 μPa^2·s Unweighted SPL: 224 dB re 1 μPa (23 psi peak pressure)	Weighted SEL: 167 dB re 1 μPa^2·s

M = Animal mass based on species (kilograms); D = Water depth (meters); dB re 1 μPa = decibels referenced to 1 microPascal; dB re 1 μPa^2·s = decibels reference to 1 microPascal-squared – seconds; GI = gastrointestinal; PTS = permanent threshold shiftSEL = sound exposure level; ; TTS = temporary threshold shift; SPL = sound pressure level
*Expressed in terms of acoustic impulse (Pacsal – seconds [Pa·s])

A.1.2.2 Sea Turtles

The sound sources will be located in an area that is inhabited by species listed as threatened or endangered under the ESA (16 USC §§ 1531-1543), including sea turtles. Operation of the

sound sources, that is, transmission of acoustic signals in the water column, could potentially cause harm or harassment to listed species.

"Harm" defined under ESA regulations is "…an act which actually kills or injures…" (50 CFR 222.102) listed species. "Harassment" is an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

If a federal agency determines that its proposed action "may affect" a listed species, it is required under Section 7 of the ESA to consult, either formally or informally, with the appropriate regulator. Such consultations would likely be concluded favorably, subject to requirements that the activity will not appreciably reduce the likelihood of the species' survival and recovery and impacts are minimized and mitigated. If appropriate, the Air Force would initiate formal interagency consultation by submitting a Biological Assessment to NMFS, detailing the proposed action's potential effects on listed species and their designated critical habitats. Consultation would conclude with NMFS' issuance of a Biological Opinion (BO) that addresses the issues of whether the project can be expected to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. Within the BO, an Incidental Take Statement is included and identifies the anticipated number of incidental "takes" that are authorized.

Until recently, there were no acoustic energy or pressure impact thresholds defined specifically for ESA-listed sea turtles, and in the absence of such information the thresholds used for marine mammal analysis were typically applied. However, NMFS has recently undertaken a more detailed investigation of the effects of underwater detonations on turtles and provided the following summary of potential behavioral responses at various peak dB levels (Table A-2).

Table A-2. Range of Sea Turtle Behavioral Responses at Multiple Underwater Noise Levels

dB Level (Peak) Range	Response Category	Number of Animals Potentially Affected
110 – 160	Discountable effects; minor response possible, but within the range of normal behaviors.	Very few
>160 – 200	Some swimming and diving response, becoming stronger and more frequent at higher dB levels.	Few at 160 dB; most at 200 dB
>200 – 220	Strong avoidance response.	Some to all at 220 dB
>220	Intolerable.	All individuals

dB = decibel

NMFS has also recently developed five criteria and threshold levels for sea turtle impacts from underwater detonations. The criteria are defined as follows:

- *Mortality*: mortal injury, cracked shell, or lung/intestinal/organ damage.
- *Injury*: potentially lethal physical injuries, prolonged immobilization by stunning, or auditory trauma.

- *Impairment*: temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization).
- *Disturbance*: habitat displacement, increased swimming speed, or increased heart rate.
- *Onset of Behavioral Response*: brief response to a single explosion, startle responses including diving and swimming.

Based on this information and other research examining the effects of underwater detonations and airgun operation on turtles and other vertebrates (e.g., Richmond et al., 1973; DeRuiter and Doukara, 2012; Finneran and Jenkins, 2012), NMFS has defined the impact threshold levels shown in Table A-3. Thresholds are defined in terms of both the peak noise level (in dB) and pressure in pounds per square inch (psi). Although there has been recent effort to address turtle-specific thresholds, there are currently no experimental or modeling data sufficient to support development of physiological thresholds. Therefore, mortality, primary blast injury, and auditory effects continue to be based on marine mammal thresholds (low frequency functional group where applicable). Mortality and blast injury thresholds are based on the GI tract injury threshold used for marine mammals; TTS and PTS thresholds are based on those used for low frequency functional hearing group cetaceans. However, turtle-specific behavioral responses to impulsive sounds (airguns) have been documented in the literature (e.g., McCauley et al., 2000) and have been incorporated by NMFS into behavioral categories. The disturbance threshold is considered to approximate a sub-TTS, high level behavioral response.

Table A-3. Sea Turtle Exposure Thresholds for Single Underwater Detonation Events

Mortality	Injury	Impairment	Disturbance	Onset of Behavioral Response
>237 dB (peak)	>229 dB (peak)	>224 dB (peak)	>218 dB (peak)	>180 dB (peak)
102 psi	40 psi	23 psi	12 psi	0.14 psi

dB = decibel; psi = pounds per square inch

Work is ongoing in the scientific community to refine the threshold criteria in response to new information about marine animal biology. The new modeling described here uses more conservative thresholds than were used in previous studies. Models were implemented in a way that allows the threshold criteria to be varied (over a realistic range of values). New results can be generated if the current criteria change.

A.2 EXPLOSIVE ACOUSTIC SOURCES

A.2.1 Acoustic Characteristics of Explosive Sources

The acoustic sources employed at the EGTTR study area are categorized as broadband explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). Detailed descriptions of the sources in the EGTTR study area are provided in this subsection.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive weight (or NEW) accounts for the first two parameters. The NEW of an explosive is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

A.2.2 Animal Harassment Effects of Explosive Sources

The harassments expected to result from these sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following. Let A represent the impact area (that is, the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N explosives is merely NA regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of detonations spaced closely in time, while the energy metrics increase at a rate of $N^{1/2}$ (under spherical spreading loss only) or less.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. As with detonations, if bursts are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N bursts is merely NA, where A is the impact area of a single burst, regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis. A more detailed description of pressure and energy considerations resulting from munition bursts is provided in Section A.2.3 below.

Explosives are modeled as detonating at depths ranging from the water surface to 10 feet below the surface, as provided by Government-Furnished Information. Impacts from above surface detonations were considered negligible and not modeled.

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breach the surface with some of the acoustic energy escaping the water column. We model surface detonations as occurring 1' below the water surface. The source levels have not been adjusted for possible venting nor does the subsequent analysis attempt to take this into account.

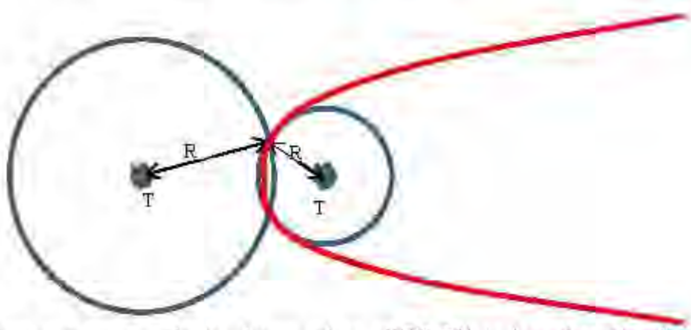
A.2.3 Zone of Influence: Per-Detonation Versus Net Explosive Weight Combination

It may be considered why and when it is appropriate to treat rounds within a burst as separate events, rather than combining the NEW of all rounds and treating it as a single, larger event. The basic information necessary to address this issue is provided below.

Peak Pressure and Positive Impulse

Peak pressures add if two (or more) impulses reach the same point at the same time. Since explosive rounds go off at different times and locations, this will only be true for a small set of points. This problem is mathematically the same as the passive sonar problem of localizing a sound source based on the time difference of arrival (TDOA) of a signal reaching two receivers. The red curve in the figure (half of a hyperbola) represents the set of all point where

R1 – R2 = c*(T2 – T1), for
c = the speed of sound in water, and
T1 and T2 being the detonation times of the two rounds :



Such a curve can only be drawn when c*(T2-T1) is less than the distance between the two explosions. If, for instance, 30 rounds/second are fired (and the difference in impact time is assumed to be roughly the distance in firing time), then the peak impact pressure from the first round will have traveled 1,500 m/s * 1/30 sec = 50 m. If the second round hits less than 50 m from the first round, the impact wave from the second round will never catch the impact wave from the first.

In the first case (loose grouping), the pressures will only add along a curve with very narrow width and negligible volume. The pressure on this curve less than twice the pressure of the closest round, as it will be the pressure at R2 and at (R2+c*dT). In the second case (tight grouping), the pressures will never add.

If this logic is extended to a many-shot burst, the logic becomes even more persuasive. For the impulse peak from a third shot to interact with the peaks from the first two using the 30 round/sec assumption, it would have to impact the water more than 100 m away from the impact of the first round and more than 50 m away from the impact of the second round. Even in that case, there would be at most two places in the ocean where the curve from the 1st and 3rd impacts would meet the curve from 2nd and 3rd explosions (and the travel distances would have to be 50 m longer for one and 100 m longer for the other). In summary:

- There would be 0 to 4 directions where a curve (a hyperbola approaches an asymptotic line far from the source) of negligible thickness, and volume would have less than two times the pressure from the closest source
- There would be 0 to 2 very small points with no extent in range or bearing where one would see less than three times the pressure from the closest source
- In every other part of the zone of influence (ZOI), the impulse from each round would be received separately by any animal present

For the 4th round and any subsequent round, another curve could be added, if it was far enough away from the previous shots so that their peak had not already passed the impact point. However, this new curve would intersect with the previous 2 curves at a different location than where the first two curves intersected. No matter how many rounds are fired, there would not be any point in the ocean where more than 3 peaks arrive at the same time. These points would have almost no volumetric extent and required range increases from the closest source of N*dt*c, where N is the difference in shot number and dt is the time between shots.

If the rate of fire is increased, there is a decrease in the additional required separation in order to have any coherent increase in pressure or positive impulse. However, the end result is that almost all of the ocean experiences only one pressure peak at a time.

If the rounds are far enough apart in space and close enough in time, there will be curves where sequential rounds add coherently; however,

- They will not occupy any significant volume, and
- They will be less than a factor of 2 above the pressure or positive impulse of the nearest source.

Contrast this with the alternative assumption that pressures from separate rounds be added. This models the event as if all rounds went of exactly at the same place and exactly at the same time. That is the only way that travelling pressure peaks from separate rounds would go through space together and add pressures at all points. This is not realistic and would over-estimate pressure and positive impulse metrics by a factor equal to the number of rounds in the burst, which could be 10 or 20 dB in pressure levels.

Energy Metrics

Energy metrics accumulate the integral of the power density of each explosion over the duration of the impulse. Thus, even though the peaks from separate explosions arrive at different times, the energy from all of their arrivals will be added. If you fire N_{burst} rounds close together in a burst, the energy from all of the rounds will add and the sound exposure level will be $10*\log10(N_{burst})$ higher than if a single shot had been fired. The area affected, A_{burst}, would be larger than the area, A_1 affected by a single shot, because additional transmission loss would be needed to reduce the larger energy level to a given threshold.

The alternative assumption is that each round sees a fresh population and the area affected by N single bullets is $N*A_1$.

The single-shot assumption is more conservative as long as $A_{burst} < N*A_1$. This is true as long as the power density falls off faster than $1/R^2$. Simple modeling generally limits the pressure to a maximum decrease of $1/R^2$, for spherical spreading, and a minimum decrease of 1/R, for cylindrical spreading (where the sound wave has already reached the bottom so the pressure is assumed to spread only in range and not in depth). Since power density is proportional to the square of the pressure, these limits correspond to power drop off of $1/R^4$ and $1/R^2$ respectively. Thus, the single shot assumption is the most conservative and creates the largest total impact area for a given number of bullets.

A.3 ENVIRONMENTAL CHARACTERIZATION

A.3.1 Important Environmental Parameters for Estimating Animal Harassment

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular source activity. In turn, propagation loss as a function of range depends on a number of environmental parameters including:

- Water depth;
- Sound speed variability throughout the water column;
- Bottom geo-acoustic properties; and
- Surface roughness, as determined by wind speed.

Due to the importance that propagation loss plays in Anti-Submarine Warfare, the Navy has, over the last four to five decades, invested heavily in measuring and modeling these environmental parameters. The result of this effort is the following collection of global databases containing these environmental parameters, which are accepted as standards for Navy modeling efforts. Table A-4 contains the version of the databases used in the modeling for this report.

Table A-4. Navy Standard Databases Used in Modeling

Parameter	Database	Version
Water Depth	Digital Bathymetry Data Base Variable Resolution	DBDBV 6.0
Ocean Sediment	Re-packed Bottom Sediment Type	BST 2.0
Wind Speed	Surface Marine Gridded Climatology Database	SMGC 2.0
Temperature/Salinity Profiles	Generalized Digital Environment Model	GDEM 3.0

The sound speed profile directs the sound propagation in the water column. The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. If the sound speed minimum occurs within the water column, more sound energy can travel further without suffering as much loss (ducted propagation). But if the sound speed minimum occurs at the surface or bottom, the propagating sound interacts more with these boundaries and may become attenuated more quickly. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled to demonstrate the extent of the difference.

Losses of propagating sound energy occur at the boundaries. The water-sediment boundary defined by the bathymetry can vary by a large amount. In a deep water environment, the interaction with the bottom may matter very little. In a shallow water environment the opposite is true and the properties of the sediment become very important. The sound propagates through the sediment, as well as being reflected by the interface. Soft (low density) sediment behaves more like water for lower frequencies and the sound has relatively more transmission and relatively less reflection than a hard (high density) bottom or thin sediment.

The roughness of the boundary at the water surface depends on the wind speed. Average wind speed can vary seasonally, but could also be the result of local weather. A rough surface scatters the sound energy and increases the transmission loss. Boundary losses affect higher frequency sound energy much more than lower frequencies.

A.3.2 Characterizing the Acoustic Marine Environment

The environment for modeling impact value is characterized by a frequency-dependent bottom definition, range-dependent bathymetry and sound velocity profiles (SVP), and seasonally varying wind speeds and SVPs. The bathymetry database is on a grid of variable resolution.

The sound velocity profile database has a fixed spatial resolution storing temperature and salinity as a function of time and location. The low frequency bottom loss is characterized by standard definition of geo-acoustic parameters for then given sediment type of sand. The high frequency

bottom loss class is fixed to match expected loss for the sediment type. The area of interest can be characterized by the appropriate sound speed profiles, set of low frequency bottom loss parameters, high frequency bottom loss class, and HFEVA very-high frequency sediment type for modeled frequencies in excess of 10 kHz.

Generally seasonal variation is sampled by looking at summer and winter cases. Ordnance usage was assumed to be spread equally between summer and winter environments.

Impact volumes in the operating area are then computed using propagation loss estimates and the explosives model derived for the representative environment.

A.3.3 Description of the Eglin Gulf Test and Training Range Area Environment

The EGTTR Study Area is located off the coast of Florida in the Gulf of Mexico. It is an area that slopes from shallow waters near the coast to deeper waters offshore. The bottom is characterized as sandy sediment according to the Bottom Sediments Type Database. Environmental values were extracted from unclassified Navy standard databases in a radius of 50 km around the center point at

N 30° 08.5' W 86° 28'

The Navy standard database for bathymetry has a resolution of 0.05 minutes in the Gulf of Mexico; see Figure A-1. Mean and median depths from DBDBV in the extracted area are 47 and 112 meters, respectively.

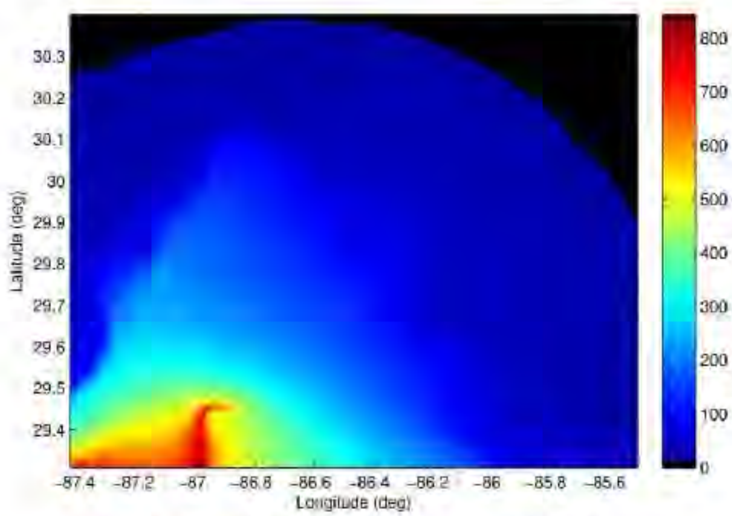


Figure A-1. Bathymetry (in meters) for the EGTTR Study Area Representative Environment

The seasonal variability in wind speed was modeled as 8.6 knots in the summer and 13.02 knots in the winter.

Example input of range-dependent bathymetry is depicted in Figure A-2 for the due-north bearing.

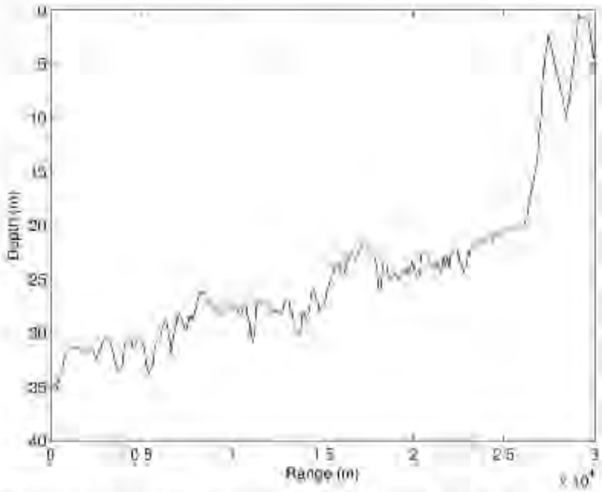


Figure A-2. Bathymetry due-North of the EGTTR Study Area Center Point

A.4 MODELING IMPACT ON MARINE ANIMALS

Many underwater actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

Estimating the number of animals that may be injured or otherwise harassed in a particular environment entails the following steps.

- For the relevant environmental acoustic parameters, transmission loss (TL) estimates are computed, sampling the water column over the appropriate depth and range intervals. TL calculations are also made over disjoint one-third octave bands for a wide range of frequencies with dependence in range, depth, and azimuth for bathymetry and sound speed. TL computations were sampled with 40 degree spacing in azimuth.
- The Type II weighted total accumulated energy within the waters where the source detonates is sampled over a volumetric grid. At each grid point, the received energy from each source emission is modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate

metric is similarly modeled for each emission. The maximum value of that metric over all frequencies and emissions, is stored at each grid point.

- The impact volume for a given threshold is estimated by summing the incremental volumes represented by each grid point sampled in range and depth for which the appropriate metric exceeds that threshold, and accumulated over all modeled bearings. Histograms representing impact volumes as a function of (possibly depth-dependent) thresholds, are stored in a spreadsheet for dynamic changes of thresholds.
- Finally, the number of harassments is estimated as the inner-product of the animal density depth profile and the impact volume and scaled by user-specifiable surface animal densities.

This section describes in detail the process of computing impact volumes.

A.4.1 Calculating Transmission Loss

Transmission loss (TL) was pre-computed for both seasons for thirty non-overlapping frequency bands. The 30 bands had one-third octave spacing around center frequencies from 50 Hz to approximately 40.637 kHz. In the previous report, TL was computed at only seven frequencies. The broadband nature of the sources has been well covered in this report. The TL was modeled using the Navy Standard GRAB V3 propagation loss model (Keenan, 2000) with CASS v4.3

The transmission loss results were interpolated onto a variable range grid with logarithmic spacing. The increased spatial resolution near the source provided greater fidelity for estimates.

The transmission loss was calculated from the source depth to an array of output depths. The output depths were the mid-points of depth intervals matching GDEM's depth sampling. For water depths from surface to 10 m depth, the depth interval was 2 m. Between 10 m and 100 m water depth, the depth interval was 5 m. For waters greater than 100 m, the depth interval was 10 m. For the EGTTR study area environment, there were thirty depths (1, 3, 5, 7, 9, 12.5, 17.5, 22.5, 27.5, 32.5, 37.5, 42.5, 47.5, 52.5, 57.5, 62.5, 67.5, 72.5, 77.5, 82.5, 87.5, 92.5, 97.5, 105, 115, 125, 135, 145, 155, 160, all in meters) representing depth-interval midpoints. The output depths represent possible locations of the animals and are used with the animal depth distribution to better estimate animal impact. The depth grid is used to make the surface image interference correction and to capture the depth-dependence of the positive impulse threshold.

An important propagation consideration at low frequencies is the effect of surface-image interference. As either source or target approach the surface, pairs of paths that differ by a single surface reflection set up an interference pattern that ultimately causes the two paths to cancel each other when the source or target is at the surface. A fully coherent summation of the eigenrays produces such a result but also introduces extreme fluctuations that would have to be highly sampled in range and depth, and then smoothed to give meaningful results, and would be inappropriate in representing a broad one-third octave band of the spectrum. An alternative approach is to implement what is sometimes called a semi-coherent summation. A semi-coherent sum attempts to capture significant effects of surface-image interference (namely the reduction of the field due to destructive interference of reflected paths as the source or target

approach the surface) without having to deal with the more rapid fluctuations associated with a fully coherent sum. The semi-coherent sum is formed by a random phase addition of paths that have already been multiplied by the expression:

$$\sin^2\left(\frac{4\pi f z_s z_a}{c^2 t}\right)$$

where f is the frequency, z_s is the source depth, z_a is the animal depth, c is the sound speed and t is the travel time from source to animal along the propagation path. For small arguments of the sine function this expression varies directly as the frequency and the two depths. It is this relationship that causes the propagation field to go to zero as the depths approach the surface or the frequency approaches zero.

A.4.2 Computing Impact Volumes

This section and the next provide a detailed description of the approach taken to compute impact volumes for explosives. The impact volume associated with a particular activity is defined as the volume of water in which some acoustic metric exceeds a specified threshold. The product of this impact volume with a volumetric animal density yields the expected value of the number of animals exposed to that acoustic metric at a level that exceeds the threshold. The acoustic metric can either be an energy term (weighted or un-weighted energy flux density, either in a limited frequency band or across the full band) or a pressure term (such as peak pressure or positive impulse). The thresholds associated with each of these metrics define the levels at which half of the animals exposed will experience some degree of harassment (ranging from behavioral change to mortality).

Impact volume is particularly relevant when trying to estimate the effect of repeated source emissions separated in either time or space. Impact range, which is defined as the maximum range at which a particular threshold is exceeded for a single source emission, defines the range to which marine mammal activity is monitored in order to meet mitigation requirements.

The effective energy source level is modeled directly for the sources to be used at the BT-9 target area. The energy source level is comparable to the model used for other explosives (Arons (1954), Weston (1960), McGrath (1971), Urick (1983), Christian and Gaspin (1974)). The energy source level over a one-third octave band with a center frequency of f for a source with a net explosive weight of w pounds is given by:

$$\text{ESL} = 10\log_{10}(0.26 f) + 10\log_{10}(2\, p_{max}^2 / [1/\theta^2 + 4\pi^2 f^2]) + 197 \text{ dB}$$

where the peak pressure for the shock wave at one meter is defined as

$$p_{max} = 21600\,(w^{1/3} / 3.28)^{1.13} \text{ psi} \qquad \text{(B-1)}$$

and the time constant is defined as:

$$\theta = [(0.058)\,(w^{1/3})\,(3.28 / w^{1/3})^{0.22}] / 1000 \text{ sec} \qquad \text{(B-2)}$$

For each season and explosive source, the amount of energy in the water column is calculated. The propagation loss for each frequency, expressed as a pressure term, modulates the sound energy found at each point on the grid of depth (uniform spacing) and range (logarithmic spacing). If a threshold is exceeded at a point, the impact volume at an annular sector is added to the total impact volume. The impact volume at a point is calculated exactly using the depth interval, the range interval of the point, and the slice of a sphere centered where the range is zero.

A.4.3 Effects of Metrics on Impact Volumes

The impact of explosive sources on marine wildlife is measured by three different metrics, each with its own thresholds. The energy metric, the peak pressure metric, and the "modified" positive impulse metric are discussed in this section. The energy metric, using the Type II weighted total energy, is accumulated after the explosive detonation. The other two metrics, peak pressure and positive impulse, are not accumulated but rather the maximum levels are taken.

Energy Metric

The energy flux density is sampled at several frequencies in one-third-octave bands. The total weighted energy flux at each range/depth combination is obtained by summing the product of the Type II frequency weighting function, $W_{II}(f)$, and the energy flux density at each frequency. The type II weighting function in dB is given by:

$$\boldsymbol{W_{II}(f) = maximum\big(G_1(f), G_{12}(f)\big)}, \text{ where}$$

$$\boldsymbol{G_1(f) = K_1 + 20log_{10}\left[\frac{b_1^2 f^2}{(a_1^2+f^2)(b_1^2+f^2)}\right]}, \text{ and}$$

$$G_2(f) = K_2 + 20log_{10}\left[\frac{b_2^2 f^2}{(a_2^2+f^2)(b_2^2+f^2)}\right].$$

The component lower cutoff frequencies, a1, upper cutoff frequencies, b, and gain, K, are a function of the functional hearing group. Parameters used for cetaceans are given in Table A-5.

Table A-5. Parameters used for Cetaceans

Functional Hearing Group	K_1(dB)	a_1(Hz)	b_1(Hz)	K_2(dB)	a_2(Hz)	b_2(Hz)
LF cetaceans	-16.5	7	22,000	0.9	674	12,130
MF cetaceans	-16.5	150	160,000	1.4	7,829	95,520
HF cetaceans	-19.4	200	180,000	1.4	9,480	108,820

Note that because the weightings are in dB, we will actually weight each frequency's EFD by $10^{(W_{II}(f)/10)}$, sum the EFDs over frequency and then convert the weighted total energy to back to dB, with level = 10 $\log_{10}$(total weighted EFD).

Peak Pressure Metric

The peak pressure metric is a simple, straightforward calculation at each range/animal depth combination. First, the transmission pressure ratio, modified by the source level in a one-third-octave band, is summed across frequency. This averaged transmission ratio is normalized by the total broadband source level. Peak pressure at that range/animal depth combination is then simply the product of:

- The square root of the normalized transmission ratio of the peak arrival,
- The peak pressure at a range of one meter (given by equation B-1), and
- The similitude correction (given by $r^{-0.13}$, where r is the slant range).

If the peak pressure for a given grid point is greater than the specified threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

"Modified" Positive Impulse Metric

The modeling of positive impulse follows the work of Goertner (Goertner, 1982). The Goertner model defines a "partial" impulse as

$$\int_0^{T_{min}} p(t)\, dt$$

where $p(t)$ is the pressure wave from the explosive as a function of time t, defined so that $p(t) = 0$ for $t < 0$. This similitude pressure wave is modeled as

$$p(t) = p_{max}\, e^{-t/\theta}$$

where p_{max} is the peak pressure at one meter (see, equation B-1), and θ is the time constant defined in equation A-2.

The upper limit of the "partial" impulse integral is

$$T_{min} = \min\ \{T_{cut},\ T_{osc}\}$$

where T_{cut} is the time to cutoff and T_{osc} is a function of the animal lung oscillation period. When the upper limit is T_{cut}, the integral is the definition of positive impulse. When the upper limit is defined by T_{osc}, the integral is smaller than the positive impulse and thus is just a "partial" impulse. Switching the integral limit from T_{cut} to T_{osc} accounts for the diminished impact of the positive impulse upon the animals lungs that compress with increasing depth and leads to what is sometimes call a "modified" positive impulse metric.

The time to cutoff is modeled as the difference in travel time between the direct path and the surface-reflected path in an isovelocity environment. At a range of r, the time to cutoff for a source depth z_s and an animal depth z_a is

$$T_{cut} = 1/c \ \{ [r^2 + (z_a + z_s)^2]^{1/2} - [r^2 + (z_a - z_s)^2]^{1/2} \}$$

where c is the speed of sound.

The animal lung oscillation period is a function of animal mass M and depth z_a and is modeled as

$$T_{osc} = 1.17\ M^{1/3}\ (1 + z_a/33)^{-5/6}$$

where M is the animal mass (in kg) and z_a is the animal depth (in feet).

The modified positive impulse threshold is unique among the various injury and harassment metrics in that it is a function of depth and the animal weight. So instead of the user specifying the threshold, it is computed as $K\,(M)^{1/3}\ (1 + z_a/33)^{1/2}$. The coefficient K depends upon the level of exposure. For the onset of slight lung injury, K is 39.1; for the onset of extensive lung hemorrhaging (1% mortality), K is 91.4.

Although the thresholds are a function of depth and animal weight, sometimes they are summarized as their value at the sea surface for a typical dolphin calf (with an average mass of 12.2 kg). For the onset of slight lung injury, the threshold at the surface is approximately 13 psi-msec; for the onset of extensive lung hemorrhaging (1% mortality), the threshold at the surface is approximately 31 psi-msec.

As with peak pressure, the "modified" positive impulse at each grid point is compared to the derived threshold. If the impulse is greater than that threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

A.5 ESTIMATING ANIMAL HARASSMENT

A.5.1 Distribution of Animals in the Environment

Species densities are usually reported by marine biologists as animals per square kilometer. This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector specifies the volume of water ensonified above the specified threshold in each depth interval. A corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth.

The following bottlenose dolphin (summer profile) example demonstrates the method used to account for three-dimensional analysis by merging the depth distributions with user-specifiable surface densities. Bottlenose dolphins are distributed with:

- 19.2% in 0-10 m,
- 76.8% in 10-50 m,
- 1.7% in 50-100 m, and
- 2.3% in 100-165 m.

The impact volume vector is sampled at 30 depths over the maximally 165 meter water column. Since this is a finer resolution than the depth distribution, densities are apportioned uniformly over depth intervals. For example, 19.2% of bottlenose dolphins are in the 0-10 meter interval, so approximately

- 3.84% are in 0-2 meters,
- 3.84% are in 2-4 meters,
- 3.84% are in 4-6 meters,
- 3.84% are in 6-8 meters, and
- 3.84% are in 8-10 meters.

Similarly, 76.8% are in the 10-50 m interval, so approximately

- 9.60% are in 10 - 15 meters,
- 9.60% are in 15 - 20 meters,
- 9.60% are in 20 - 25 meters,
- etc.

A.5.2 Harassment Estimates

Impact volumes for all depth intervals are scaled by their respective depth densities, divided by their depth interval widths, summed over the entire water column and finally converted to square kilometers to create impact areas. The spreadsheet allows a user-specifiable surface density in animals per square kilometer, so the product of these quantities yields expected number of animals in ensonified water where they could experience harassment.

Since the impact volume vector is the volume of water at or above a given threshold per unit operation (e.g. per detonation, or clusters of munitions explosions), the final harassment count for each animal is the unit operation harassment count multiplied by the number of units deployed.

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

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C.2 MMPA LETTER OF AUTHORIZATION

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 96TH TEST WING (AFMC)
EGLIN AIR FORCE BASE FLORIDA

Mr. Bruce Hagedorn
Chief, Eglin Natural Resources
96 CEG/CEIEA
501 De Leon Street, Suite 101
Eglin AFB, FL 32542-5133

SEP 16 2015

Ms. Jolie Harrison
Division Chief, Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

Dear Ms. Harrison:

This letter and attached document is being submitted to the National Marine Fisheries Service to request a Letter of Authorization (LOA) in accordance with Section 101(a)(5)(A) of Marine Mammal Protection Act of 1972 for activities described under the Preferred Alternative in the Eglin Gulf Test and Training Range (EGTTR) Environmental Assessment. The attached LOA Request analyzes potential impacts to bottlenose dolphins and Atlantic spotted dolphins.

The Proposed Action primarily includes air-to-surface testing and training activities in the EGTTR (Gulf of Mexico) proposed to occur over the next five years. Inert and live ordnance may be deployed from multiple types of aircraft against various types of targets including stationary and remotely controlled boats, inflatable targets, and marking flares. Net explosive weight of the live munitions ranges from 0.067 to 945 pounds, and detonations may occur in the air, at the water surface or approximately 10 feet below the surface. Potential impacts to marine mammals from physical disturbance, boat strikes, debris, and acoustic impacts from detonations have been assessed.

Eglin Natural Resources is requesting small numbers of takes of bottlenose dolphins and Atlantic spotted dolphins by mortality, Level A (tympanic-membrane [TM] rupture) harassment, Level B (Temporary Threshold Shift [TTS]) harassment, and Level B behavioral harassment. Adherence to the monitoring and mitigation measures in Chapter 11 of the application is expected to significantly reduce the potential for impacts. The NMFS will be notified immediately if any of the components of this proposed action are modified. Any modifications or conditions resulting from consultation or permitting with the NMFS will be implemented prior to commencement of activities.

Due to the elongated timeline for obtaining a LOA and Department of Defense's need to continue testing and training activities in the EGTTR during the LOA rulemaking process, an Incidental Harassment Authorization (IHA) will be submitted in addition to this LOA Request. The IHA request is a stopgap for a critical set of missions planned between 2016 and 2017 in the EGTTR and is meant to provide MMPA coverage for these activities until the rulemaking process is completed and the LOA is issued. Without this stopgap IHA the military mission will be impeded.

Eglin Natural Resources believes this submittal fulfills all requirements for the permitting process to proceed. If you have any questions regarding this LOA Request or any of the proposed activities, please do not hesitate to contact either Mr. Rodney Felix at (850) 883-1153 or myself at (850) 882-8391.

Sincerely,

BRUCE W. HAGEDORN, GS-13

ATTACHMENT: Request for a Letter of Authorization for the Incidental Taking of Marine Mammals Resulting from Testing and Training Activities Conducted in the Eglin Gulf Test and Training Range

REQUEST FOR A LETTER OF AUTHORIZATION FOR THE INCIDENTAL TAKING OF MARINE MAMMALS RESULTING FROM TESTING AND TRAINING ACTIVITIES CONDUCTED IN THE EGLIN GULF TEST AND TRAINING RANGE (EGTTR)

EGLIN AIR FORCE BASE, FLORIDA

Submitted To:

Office of Protected Resources
National Marine Fisheries Service (NMFS)
1315 East-West Highway
Silver Spring, MD 20910-3226

Submitted By:

Department of the Air Force
96 CEG/CEIEA
Eglin Natural Resources
501 DeLeon Street, Suite 101
Eglin AFB, FL 32542-5133

AUGUST 2015

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LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

96 RANSS	96th Range Support Squadron
96 TW	96th Test Wing
96 TW/SEU	96th Test Wing/Eglin Test and Range Safety Office
AFB	Air Force Base
AGL	above ground level
AFOTEC	Air Force Operational Test and Evaluation Center
AFSOC	Air Force Special Operations Command
AGM	Air-to-Ground Missile
ASEP	Advanced Systems Employment Project
BA	Biological Assessment
cal	caliber
CBU	Cluster Bomb Unit
CCF	Central Control Facility
CONEX	Container Express
CV	Coefficient of Variation
dB re 1 µPs²-s	decibel referenced to one squared microPascal-second
E	Endangered
EA	Environmental Assessment
EFD	Energy Flux Density
EFH	Essential Fish Habitat
EGTTR	Eglin Gulf Test and Training Range
EO	Electro Optical
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
FLTS	Flight Test Squadron
FMC	Fishery Management Council
FMP	Fishery Management Plan
FU	full up round
FWS	Fighter Weapons Squadron
ft	feet
GBU	Guided Bomb Unit
GMFMC	Gulf of Mexico Fishery Management Council
GRATV	Gulf Range Armament Test Vessel
GSMFC	Gulf States Marine Fisheries Commission
HAPC	Habitat Area of Particular Concern
HEI	High Explosive Incendiary
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HOB	height of burst
HSMST	High Speed Maneuverable Surface Target
ILAST	Integrated Laser Targeting
in	inch
in-lb/in²	inch-pound per square inch
IMV	Instrumented Measurement Vehicle
IR	infrared
J/in²	Joules per square inch
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
JUON	Joint Urgent Operational Need
kg	kilogram
kHz	kilohertz
KIAS	knots indicated air speed
km	kilometer
km²	square kilometer
lbs	pounds

August 2015 **Request for a Letter of Authorization for the Incidental Taking of Marine Mammals Resulting from Testing and Training Activities in the EGTTR Eglin Air Force Base, Florida** **Page iv**

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS, CONT'D

LJDAM	Laser Joint Direct Attack Munition
LOA	Letter of Authorization
LOAL	Lock On After Launch
LOBL	Lock On Before Launch
LSDB	Laser Small Diameter Bomb
m	meters
mi	mile
min	minute
mm	millimeter
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEW	net explosive weight
NM	nautical mile
NM^2	square nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOTMAR	Notice to Mariners
Pa-s	Pascal-second
PBR	Potential Biological Removal
PEA	Programmatic Environmental Assessment
PGU	Projectile Gun Unit
psi-msec	pounds per square inch-millisecond
PSW	Precision Strike Weapon
PTS	Permanent Threshold Shift
REA	Range Environmental Assessment
SDB	Small Diameter Bomb
SEFSC	Southeast Fisheries Science Center
SOCOM	United States Special Operations Command
SOPGM	Stand-Off Precision Guided Munitions
SST	Sea Surface Temperature
T	Threatened
TA	Test Area
TD&E	Test Development and Evaluation
TM	telemetry
TR	Training Round
TS	Test Squadron
TTP	Tactics, Techniques, and Procedures
TTS	Temporary Threshold Shift
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded Ordnance
WSEP	Weapons System Evaluation Program
ZOI	Zone of Influence

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EXECUTIVE SUMMARY

With this submittal, Eglin Air Force Base (AFB) requests a Letter of Authorization (LOA) for the incidental taking, but not intentional taking (in the form of noise-related and/or pressure-related impacts), of marine mammals incidental to air-to-surface testing and training missions conducted in the Eglin Gulf Test and Training Range (EGTTR), as permitted by the Marine Mammal Protection Act (MMPA) of 1972, as amended. Air-to-surface missions consist of the activities described in the Proposed Action of the *Eglin Gulf Test and Training Range Environmental Assessment* (REA), and presented in Section 1 of this document.

The missions may expose cetaceans within the EGTTR to noise or pressure levels currently associated with mortality, Level A harassment, and Level B harassment. Noise and pressure metrics associated with exploding ordnance were determined to be the only activities with potential for significant impacts to marine species, as analyzed in the associated REA. Air-to-surface missions involve the use of multiple types of live and inert munitions (bombs, missiles, rockets, and gunnery rounds) against surface targets in the EGTTR. The ordnance may be delivered by multiple types of aircraft including fighter jets, bombers, and gunships. The targets will vary by mission type but may consist of stationary, towed, or remotely controlled boats, inflatable targets, or marking flares. Net explosive weight of the munitions ranges from 0.067 to 945 pounds and detonations may occur in the air, at the water surface, or approximately 10 feet below the surface. Test and training missions may occur during any time of the year. Missions using live bombs, missiles, and rockets will be conducted only during daylight hours, while live gunnery missions may occur during day or night. Gunnery missions and surface and subsurface detonations of live bombs, missiles, and rockets will only occur shoreward of the 200-meter isobath. Missile tests that involve only in-air detonations may occur anywhere in the EGTTR, although these activities are typically conducted relatively close to shore. Most of the activities will occur at a target location approximately 17 miles offshore of Santa Rosa Island, in a water depth of about 35 meters (115 feet).

The potential takes outlined in Section 6 represent the maximum expected number of animals that could be affected. Mitigation measures will be employed to substantially decrease the number of animals potentially affected, particularly within the mortality and Level A harassment zones. Using the most applicable density estimates for each species, the zone of influence (ZOI) of each type of ordnance deployed, and the total yearly number of planned detonations, an estimate of the potential number of animals exposed to noise and/or pressure thresholds was analyzed using the most recent guidance provided by National Marine Fisheries Service (NMFS) (Finneran and Jenkins, 2012). Without mitigation measures in place, the total number of marine mammals potentially exposed to the impulse pressure level associated with mortality is approximately two animals, including 1.39 bottlenose dolphins, 0.48 Atlantic spotted dolphins, and 0.08 unidentified dolphins. A maximum of up to approximately 213 individuals (bottlenose, Atlantic spotted, and unidentified dolphin species combined) could potentially be exposed to injurious (permanent threshold shift) Level A harassment. A maximum of approximately 9,985 dolphins could potentially be exposed to non-injurious (temporary threshold shift) Level B harassment. Approximately 17,992 animals could potentially be exposed to noise corresponding to the behavioral harassment threshold. It is anticipated that mitigation measures, identified in Section 11, will reduce the probability of all forms of take.

Executive Summary

Marine mammal species potentially affected by air-to-surface activities in the EGTTR include four bottlenose dolphin stocks and one Atlantic spotted dolphin stock. The primary target site is located in an area associated with the Northern Gulf of Mexico spotted dolphin stock, which is not considered strategic. The test site is located within a depth range corresponding to the Northern Gulf of Mexico Continental Shelf stock of bottlenose dolphins (20 to 200 meters depth), which is not a strategic stock. Other bottlenose dolphin strategic stocks are identified in relatively close proximity and could possibly enter the test area. Three bay, sound, and estuary stocks, as well as the Northern Coastal stock (shoreline to 20 meters water depth), occur near the target location and are considered strategic. Individuals from the Oceanic stock, which is not considered strategic, are unlikely to enter the test area, as this stock is defined beyond the 200 meter isobath.

The information and analyses provided in this application are presented to fulfill the permit request requirements of Title I, Sections 101(a)(5)(A) and 101(a)(5)(F) of the MMPA.

1. DESCRIPTION OF ACTIVITIES

Due to threats to national security, increased testing and training missions involving air-to-surface activities have been directed by the Department of Defense. In this document, air-to-surface activities refer to the firing or dropping of munitions including bombs, missiles, rockets, and gunnery rounds from aircraft toward targets located on the Gulf of Mexico surface. Depending on the requirements of a given mission, munitions may be inert (contain no or very little explosive charges) or live (contain explosive charges). Live munitions may detonate above, at, or slightly below the water surface. As described in the associated *Eglin Gulf Test and Training Range (EGTTR) Range Environmental Assessment* (REA) (in preparation), the Air Force has determined that other types of activities, primarily air-to-air testing and training, would result in only a negligible risk of harm to marine mammals, and these missions are therefore not included in the current LOA request. All activities described in this document will occur within the boundaries of the EGTTR, which is shown in Figure 1-2. The EGTTR is subdivided into various Warning Areas and Water Test Areas, with many of these blocks divided into smaller sections. The EGTTR is described in more detail in Section 2, *Duration and Location of the Activities*.

In most cases, missions consisting of live bombs, missiles, and rockets that detonate at or below the water surface will occur at a site in W-151A that has been designated specifically for these types of activities. This site is located approximately 17 miles offshore from Santa Rosa Island, at a water depth of about 35 meters (m) (115 feet [ft]). Typically, test data collection is conducted from an instrumentation barge known as the Gulf Range Armament Test Vessel (GRATV) (Figure 1-1) anchored on-site, which provides a platform for cameras and weapon-tracking equipment. Therefore, the mission area is referred to as the GRATV target location. The target location site within W-151A is shown on Figure 1-3. It should be noted that alternative site locations may be selected within a 5-mile radius around the GRATV point. This alternative area is shown on Figure 1-3 as the Alternative Target Location Area. Gunnery operations are limited to occur only over continental shelf waters (shoreward of the 200-meter bathymetry line). Missions that involve only in-air detonations may occur anywhere in the EGTTR, but are typically conducted in W-151. Detailed descriptions for each individual mission activity are included in the following sections, organized by action proponent. Detonations of live munitions at or below the water surface have the potential to affect marine mammals that may be present in the action area.

Figure 1-1. Gulf Range Armament Test Vessel (GRATV)

Description of Activities

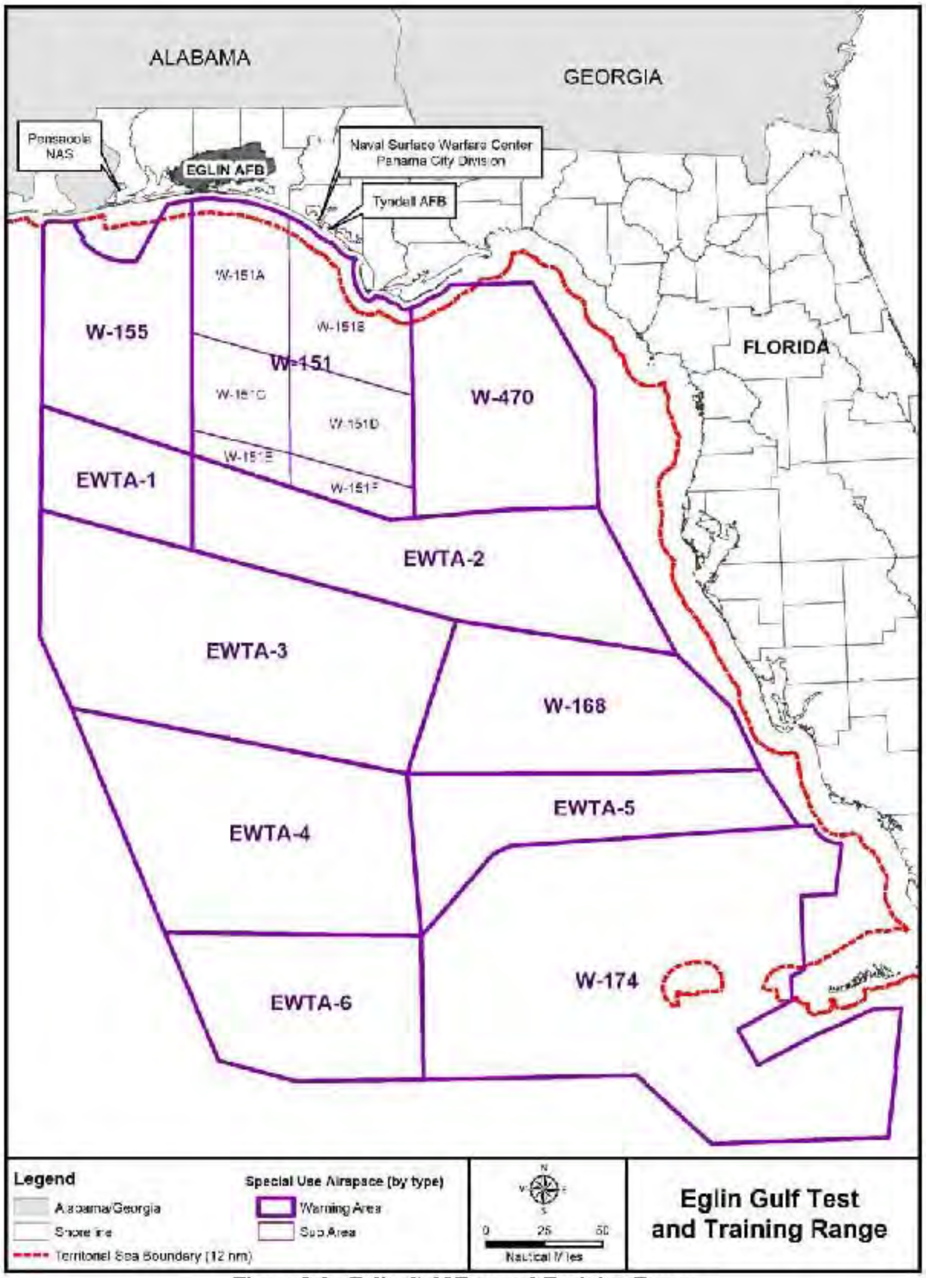

Figure 1-2. Eglin Gulf Test and Training Range

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Description of Activities

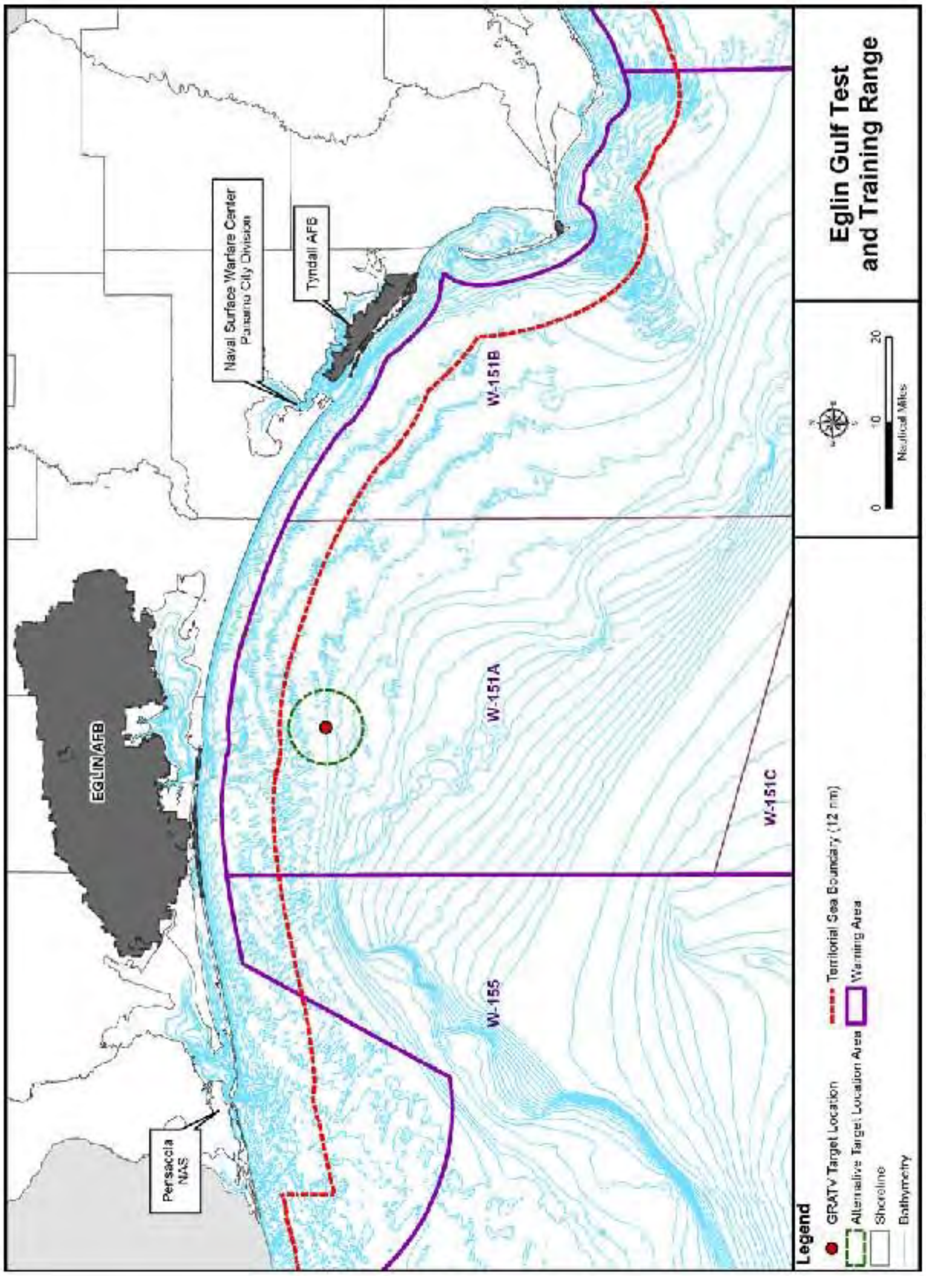

Figure 1-3. GRATV Target Location

Description of Activities

1.1 86TH FIGHTER WEAPONS SQUADRON MARITIME WEAPONS SYSTEM EVALUATION PROGRAM

Live and Inert Munitions Testing

The 86th Fighter Weapons Squadron (86 FWS) proposes to continue the use of multiple types of live and inert munitions in the EGTTR against small boat targets for the Maritime Weapons System Evaluation Program (WSEP) Operational Testing Program. The purpose of the testing is to continue the development of tactics, techniques and procedures (TTP) for U.S. Air Force strike aircraft to counter small maneuvering surface vessels (Figure 1-4) in order to better protect vessels or other assets from small boat threats. Damage effects of these munitions must be known to generate TTPs to engage small moving boats. The test objectives are to (1) develop TTPs to engage small boats in all weather; and (2) determine the impact of TTPs on Combat Air Force training. The test results would be used to develop publishable TTPs for inclusion in Air Force TTP 3-1 series manuals. Maritime WSEP testing is considered a high national defense priority.

Figure 1-4. Intact Small Boat Targets in the EGTTR

Maritime WSEP activities involve the use of multiple types of aircraft with inert and live munitions in the EGTTR, including bombs, missiles, and gunnery rounds (Table 1-1). Because the focus of the tests would be weapon/target interaction, no particular aircraft would be specified for a given test as long as it met the delivery requirements. Various U.S. Air Force active duty units, National Guard, Navy, and Air Force reserve units would participate as interceptors and weapons release aircrews, with multiple types of aircraft typically operating within the same airspace.

Tests would be conducted at the GRATV target location in various sea states and weather conditions, up to a wave height of 4 ft. Live munitions would be deployed against static (anchored), towed, and remotely controlled boat targets. Static and controlled targets would consist of stripped boat hulls with plywood simulated systems and, in some cases, heat sources. Moving targets would be towed by remotely controlled High Speed Maneuverable Surface Target (HSMST) boats. Damaged boats would be recovered for data collection. Test data

Description of Activities

collection would be conducted from the GRATV. HSMST boats would be remotely controlled from a facility on Eglin main base and would follow set track lines with specific waypoints at least 2 to 3 nautical miles (NM) away from the GRATV. Additional air assets such as chase aircraft or unmanned aerial vehicles would transit to the target area and set up flight orbits to provide aerial video of the mission site including weapon impacts on boat targets and assisting with range clearing activities. Missions would be controlled from the Eglin Central Control Facility (CCF) on the main base.

Table 1-1. Maritime WSEP Munitions and Example Aircraft

Munitions	Aircraft
AGM-114 (Hellfire)	F-15 fighter aircraft
AGM-176 (Griffin)	F-16 fighter aircraft
AGM-65 (Mavericks)	F-18 fighter aircraft
AIM-9X	F-22 fighter aircraft
BDU-56	F-35 fighter aircraft
CBU-105 (WCMD)	AC-130 gunship
GBU-12/GBU-54	A-10 fighter aircraft
GBU-10/GBU-24	B-1 bomber aircraft
GBU-31	B-52 bomber aircraft
GBU-38	B-2 bomber aircraft
PGU-13/B	MQ-1
PGU-27	MQ-9
2.75 in Rockets	
7.62mm/50 Cal	
GBU-39 (Laser SDB)	
GBU-53 (SDB II)	

AGM = air-to-ground missile; AIM = air intercept missile; BDU = Bomb, Dummy Unit; GBU = Guided Bomb Unit; PGU = Projectile Gun Unit; CBU= Cluster Bomb Unit; WCMD = Wind-Corrected Munitions Dispenser; mm=millimeters; SDB = Small Diameter Bomb

Live munitions would be set to detonate either in the air, instantaneously upon contact with a target boat, or after a slight delay (up to 10 millisecond) after impact, which would correspond to a water depth of about 5 to 10 ft. The annual number, height or depth of detonation, explosive material, and net explosive weight (NEW) of each live munition associated with Maritime WSEP is provided in Table 1-2. The quantity of live munitions tested is considered necessary to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable confidence level regarding munitions capabilities.

In addition to the live munitions described above, 86 FWS also proposes to expend inert munitions in W-151. The expected number of each munition type expended during a typical year is included in Table 1-2. Use of inert munitions was analyzed in the 2002 *Eglin Gulf Test and Training Range (EGTTR) Programmatic Environmental Assessment* (2002 PEA) and found to have no significant environmental impact (U.S. Air Force, 2002). Therefore, there is no particular limit on the number of inert items that may be expended, and actual numbers may vary somewhat from those shown in the table. However, the items are included in this LOA in order to document the programmatic use of the EGTTR.

Table 1-2. Maritime WSEP Munitions Use in the EGTTR

Type of Munition	# Munitions	Detonations Scenario	Warhead – Explosive Material	Net Explosive Weight
GBU-10 or GBU-24	2	Surface or Subsurface	MK-84 - Tritonal	945 lbs
GBU-12 or GBU-54 (LJDAM)	6	Surface or Subsurface	MK-82 - Tritonal	192 lbs
AGM-65 (Maverick)	6	Surface	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
CBU-105	4	Airburst	10 BLU-108 submunitions with 4 projectiles, parachute, rocket motor & altimeter. 10.69 lbs NEW/submunition (includes 2.15lbs/projectile)	107.63 lbs
GBU-39 (LSDB)	4	Airburst, Surface or Subsurface	AFX-757 (Insensitive munition)	37 lbs
AGM-114 (Hellfire)	30	Airburst or Surface, Subsurface	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge.	20 lbs
GBU-53 (SDB II)	4	Airburst, Surface or Subsurface	PBX-N-109 Aluminized Enhanced Blast, Scored Frag Case, Copper Shape Charge	22.84 lbs
AGM-176 (Griffin)	10	Airburst or Surface	Blast fragmentation	4.58 lbs
Rockets (including APKWS)	100	Surface	Comp B-4 HEI	10 lbs
PGU-13 HEI 30 mm	1,000	Surface	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1 lbs
AIM-9X	4	Surface	PBXN-3	68 lbs
GBU-10	21	Inert	N/A	N/A
GBU-12	27	Inert	N/A	N/A
GBU-24	17	Inert	N/A	N/A
GBU-31	6	Inert	N/A	N/A
GBU-38	3	Inert	N/A	N/A
GBU-54	16	Inert	N/A	N/A
BDU-56	13	Inert	N/A	N/A
AIM-9X	3	Inert	N/A	N/A
PGU-27	46,000	Inert	N/A	N/A

AGM = air-to-ground missile; AIM = air intercept missile; BDU = Bomb, Dummy Unit; CBU = Cluster Bomb Unit; GBU = Guided Bomb Unit; HEI = high explosive incendiary; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bombs; MK = mark; mm = millimeters; PGU = Projectile Gun Unit; RDX = research department explosive; SDB = Small Diameter Bomb

Pre-Test Target Area Clearance Procedures for Public Safety and Protected Marine Species

A human safety zone will be established around the test area prior to each mission, and will be enforced by up to 20 to 25 safety boats. The size of this zone may vary, depending upon the

particular munition and delivery method used in a given test. A composite safety footprint has been developed for previous tests using live munitions, and incorporated the average of all munitions deployed. This composite safety footprint consisted of a circle with a 29 mile-wide diameter circle (14.5 mile-wide radius), which was converted to an octagon shape for ease of support vessel placement and range clearance. The GRATV is located approximately 2 miles north of the center of the octagon. Other than the types of vessels identified in 33 CFR 334.720, all non-participating vessels (such as recreational fishing vessels) will be excluded from entering the safety footprint while it is active, which is expected to be up to four hours per mission on test days (multiple munitions may be deployed within the four-hour time period). The Eglin Test and Range Safety Office (96 TW/SEU) will position the safety support vessels around the safety footprint to ensure commercial and recreational boats do not accidentally enter the area. Before delivering the ordnance, mission aircraft may make a dry run (no munitions deployed) over the target area to ensure that it is clear of non-participating vessels, although this action is not necessarily performed before all releases. The Eglin Test and Range Safety Office will monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. To inform the public, the Eglin Test and Range Safety Office will request that the Coast Guard release a Notice to Mariners (NOTMAR) prior to the closure of the safety footprint around the target location. In addition, the 96th Range Support Squadron (96 RANSS) personnel will also distribute flyers with maps at public docks and to vessels in Destin Pass showing the closed area and explaining why it is closed.

In addition to actions carried out to ensure human safety during live missions, measures designed to avoid or minimize impacts to protected marine species have been developed in cooperation with NMFS. A separate zone around the target will be established for marine species protection, based on the distance to which energy- and pressure-related impact zones could extend for the various types of live ordnance. The dimensions of this zone will be different than those of the human safety zone, and will depend on the specific munitions being released that day. Trained marine species observers will survey the protection zone before each mission.

Up to four video cameras will also be positioned on the GRATV anchored on-site. The cameras will primarily be used to document the weapons' performance against targets, but could also be used to monitor for the presence of unauthorized vessels and protected species. An Eglin Natural Resources representative will be located in Eglin's CCF on main base, along with mission personnel, to view the live video feed before and during test activities. All cameras have a zoom capability of up to at least a 300 millimeter (mm) equivalent. At this setting, when targets are at a distance of 2 NM from the GRATV, the field of view would be 195 ft by 146 ft. Video observers can detect an item with a minimum size of 1 square foot up to 4,000 meters away. The Air Force is in the process of acquiring cameras with even greater zoom capability (up to a 1200 mm zoom lens). Missions will not proceed until the target area is confirmed to be clear of protected species (when live munitions are used) and unauthorized vessels. In addition, the test will not be conducted if all video cameras are not operational.

Post-Test Activities

Potential post-test activities consist of Air Force Explosive Ordnance Disposal (EOD) personnel detonating in place any munitions components or items remaining on the target boats that would be considered unexploded ordnance (UXO), debris retrieval, and post-mission protected species surveys. Unexploded bombs, missiles, or other similarly large items would sink to the seafloor and would not be recovered or detonated. However, smaller unexploded items such as cluster bomb submunitions could remain intact on target boats. Each CBU-105 contains 10 submunition cylinders, and each cylinder contains 4 sub-submunitions (skeets), which fire inert projectiles. Therefore, there are a total of 40 skeets per bomb. On test days involving the release of CBU-105s, the Eglin EOD team would be on hand to inspect floating targets and identify and render safe any UXO, including fuzes, classified components, or intact munitions. In the rare instance that UXO cannot be removed, proper disposal methods would be employed (typically accomplished by use of C-4 explosive) (Figure 1-5); however these types of scenarios are not considered likely. Once the area has been cleared by the Eglin EOD team (typically one hour after the release of CBU-105s), the range will be re-opened for the debris clean-up team and the protected species survey vessels (when live munitions are used). Depending on the specific weapon system used and the location or position of the UXO, the test area could be closed for an extended period of time.

Figure 1-5. Target Boat after UXO Disposal with C-4 Explosive

Following completion of the live mission (and declaration of the target area by EOD as safe, when applicable), several Air Force vessel crews would engage in target debris retrieval. Large, mostly intact damaged target vessels may be towed, while smaller pieces of debris would be netted or lifted aboard Air Force vessels and taken to shore for disposal. Figure 1-6 shows debris and damaged target vessels from a similar exercise conducted in 2013. The Air Force would also conduct post-mission monitoring for protected species once the range is confirmed to be safe to enter.

Pre-test and post-test management actions, including human safety zone enforcement and protected species protection measures, are described in detail in Section 11, *Means of Affecting the Least Practicable Adverse Impacts*.

Figure 1-6. Debris and Target Vessels from Previous Similar Mission

Swarm Missions

To counter small boat threats, aircrews would test and train in performing electronically simulated targeting and attack techniques (no ordnance is used, either live or inert) against groups of fast moving, human-piloted boats simulating a coordinated attack on an objective in the Gulf of Mexico. These missions are called "swarm" missions due to the number of boats involved. The target fleet typically consists of up to 30 boats (the actual number may vary) divided into multiple squadrons of 4 or 5 boats that travel along predetermined transects and possibly perform predetermined maneuvers as directed by Air Force personnel. The boats would range in size from 20 to 45 ft and would travel at speeds of 20 to 40 knots, depending on sea state. Additional numbers of vessels, formations and maneuvers are possible depending on real-world threats and situations.

Aircraft would be directed in the CCF by the 86 FWS mission director. Aircraft would perform tactical maneuvers including dives, dive recoveries, and pull-up procedures in accordance with aircraft 3-1 manuals and AFI 11-214 publications. Aircraft would fly no lower than altitudes specified in AFI 11-214 and 3-1 manuals commensurate with the simulated weapon delivery. Aircraft would not carry bombs, and aircraft guns would be mechanically "safed" (unable to fire). Due to the lack of munitions (live or inert), the pre- and post-mission activities described for live testing would not be required. Specifically, there would be no need for safety zone establishment, EOD clearance, debris retrieval, or protected species surveys.

Description of Activities

1.2 ADVANCED SYSTEMS EMPLOYMENT PROJECT

The proposed Advanced Systems Employment Project (ASEP) action includes evaluating upgrades to numerous research and development, as well as Air Force hardware and software, initiatives. F16, F15E, and BAC1-11 aircraft would be used to deploy a variety of pods, air-to-air missiles, bombs, and other munitions. Many of the missions are conducted over Eglin land ranges. However, inert instrumented Mk-84 Joint Direct Attack Munition (JDAM) bombs would be expended in W-151 under the Proposed Action. Bombs would be dropped on target boats located 20 to 25 miles offshore. A maximum of 12 over-water missions could be conducted annually, although the number could be as low as 4. There would be no live ordnance associated with ASEP actions in the EGTTR.

1.3 AIR FORCE SPECIAL OPERATIONS COMMAND TRAINING

The Air Force Special Operations Command (AFSOC) conducts various training activities with multiple types of munitions in nearshore waters of the EGTTR (W-151). Training activities include air-to-surface gunnery and small diameter bomb/Griffin/Hellfire missile proficiency training. The following subsections describe the proposed actions included in this LOA request.

AC-130 Air-To-Surface Gunnery

Air-to-surface gunnery missions involve firing of live gunnery rounds at targets on the water surface in the EGTTR. Ordnance used in this training includes 25 mm high explosive incendiary (HEI), 30 mm HEI, 40 mm HEI, and 105 mm HEI rounds. NEW ranges from about 0.07 to 4.7 pounds. The Air Force has developed a 105 mm training round (TR) that contains less than 10 percent of the amount of explosive material contained in the 105 mm full up (FU) round. The TR variant was developed as a means to mitigate acoustic impacts on marine mammals that could not be adequately surveyed at night by aircraft sensors. Today's AC-130 sensors allow for effective nighttime visual surveys but with reduced explosive material the TR rounds remain a valuable mitigation for reducing acoustic impacts.

Water ranges within the EGTTR that are typically used for gunnery operations include W-151A, W-151B, W-151C, and W-151D. However, W-151A is the most frequently used water range due to its proximity to Hurlburt Field (where the gunnery flights originate). AC-130s normally transit from Hurlburt Field to the water ranges at a minimum of 4,000 ft above surface level. Potential target sites are typically established at least 15 miles from the coast (beyond the 12 NM territorial sea boundary). Such a location places most mission activities over shallower continental shelf waters where marine mammal densities are typically lower, and thus avoids the slope waters where more sensitive species (e.g., Endangered Species Act [ESA]-listed sperm whale) generally reside. Targets consist of either an MK-25 floating flare or an inflatable target. For missions where flares are used, the aircrew scans a 5-NM radius around the potential target area to ensure it is clear of surface craft, protected species, and other objects that would make the site unsuitable. Scanning is accomplished using radar, Electro Optical (EO), infrared (IR) sensors, and visual means. An alternative area is selected if any non-mission vessels or protected marine species are detected within the 5 NM search area. Once the scan is completed, the marking flare is dropped onto the water surface. The flare's burn time is typically 10 to

20 minutes, but could be less if actually hit by one of the rounds. However, flares may burn as long as 40 minutes.

Missions using an inflatable target proceed under the same general protocol. A tow boat transits to a potential target site located at least 15 miles from the coast. The AC-130 then arrives at the site and, as with missions using flares, the aircrew scans an appropriate area around the potential target area (5 NM radius for non-mission vessels and protected species) using visual observation and the aircraft's sensors. An alternative area would be selected if any protected marine species or non-mission vessels were detected within the search area. Once the scan is complete, the 20-foot target is inflated and deployed into the water. The tow boat then proceeds to pull the target, which is attached to a 2,200-foot cable. The target continues to float even when struck by ordnance and deflated. After the mission, the tow boat recovers any debris produced by rounds striking the target, although little debris is expected.

After target deployment, the firing sequence is initiated. A typical gunship mission lasts approximately five hours without air-to-air refueling, and six hours when refueling is accomplished. A typical mission includes:

- 30 minutes to take off and perform airborne sensor alignment; align visual sensor and EO to heads-up display.
- 1½ to 2 hours of dry fire (no ordnance expended); this time includes transition time.
- 1½ to 2 hours of live fire; this time includes clearing the area and transiting to and from the range; actual firing activities typically do not exceed 30 minutes.
- 1 hour air-to-air refueling, if included in the mission.
- 30 minutes transition work (takeoffs, approaches, landings, and pattern work).

The guns are fired during the live fire phase of the mission. The actual firing can last from 30 to 90 minutes but is typically completed in 30 minutes. The number and type of munitions deployed during a mission varies with each type of mission flown. The 105-mm TR variants are used during nighttime training.

Live fire events are continuous, with pauses during the firing usually well under a minute and rarely from two to five minutes. Firing pauses would only exceed 10 minutes in one of the following situations: 1) surface boat traffic caused the mission to relocate; 2) aircraft, gun, or targeting system malfunction occurs; or 3) more flares needed to be deployed. The 96 TW/SEU has described the gunnery missions as having 95 percent containment within a 5-meter radius around the target (i.e., 95 percent of the rounds strike the water within 5 meters of the target).

Gunnery missions could occur any season of year, during daytime or nighttime hours. As a conservation measure to avoid impacts to the federally listed sperm whale and other deep water marine mammal species, AFSOC would conduct all gunnery missions within (shoreward of) the 200-meter water depth contour, which transects portions of W-151A, W-151D, and W-151F. All of W-151B lies shoreward of the shelf break. As a further conservation measure, only the 105 mm TR would be used during nighttime missions.

Description of Activities

The quantity of live rounds expended would be based on estimates provided by AFSOC regarding the annual number of missions and number of rounds per mission. The 105 mm FU rounds would typically be used during daytime missions, while the 105 mm TR variants would always be used at night. The total anticipated number of missions and rounds that would be expended for daytime and nighttime activities annually is shown in Table 1-3.

Table 1-3. Summary of Annual AFSOC AC-130 Gunnery Operations

Category	Expendable	Number of Missions	Rounds per Mission	Quantity
Daytime Missions	105 mm HE (FU)	25	30	750
	40 mm HE		64	1,600
	30 mm HE		500	12,500
	25 mm HE		560	14,000
Nighttime Missions	105 mm HE (TR)	45	30	1,350
	40 mm HE		64	2,880
	30 mm HE		500	22,500
	25 mm HE		560	25,200
	Total	**70**		**80,780**

HE = High Explosive; TR = Training Round; FU = Full Up

Measures designed to avoid or minimize potential impacts to marine mammals are summarized here and described in detail in Section 11. The primary management measure would consist of pre- and post-mission visual monitoring, which could also be supplemented with IR and EO monitoring as applicable. After arriving at the target site, aircrews would commence visual scans and continue observing during ascending orbits until reaching operational altitude. Monitoring would continue throughout the mission and during a post-mission descent to an altitude of approximately 6,000 ft. If marine mammals are detected at any time, the mission would halt immediately and relocate as necessary or be suspended until the animal(s) have left the area. Additional management measures would include sea state restrictions, use of the 105 mm TR at night, use of ramp-up procedures (beginning with the smallest round during calibration and proceeding to increasingly larger rounds), and complying with the requirement to conduct all missions shoreward of the 200-meter isobath. No mortality or injury to protected marine species has been documented as a result of previous AFSOC gunnery missions.

On March 5, 2014, NMFS issued a 5-year LOA in accordance with the MMPA for AFSOC's air-to-surface gunnery activities. Since then, new acoustic thresholds and criteria have been adopted by NMFS to analyze impacts to marine mammals from exposure to explosive sources. The analysis in Section 6 is based on acoustic modeling that incorporates these new requirements.

Small Diameter Bomb and Griffin/Hellfire Missile Training

AFSOC has been tasked to develop TTPs and training for strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. Training involves the use of live AGM-114P/R Hellfire Missiles, AGM-176 Griffin Missiles, and GBU-39 small diameter bomb (SDB) munitions in the EGTTR against small towed boats. AFSOC expects to expend up to 100 AGM-114P/R missiles, 200 AGM-176 missiles, and 30 GBU-39 laser or GPS guided SDBs annually. All weapons are capable of airburst, point, or delayed fuzing detonations. However, only airburst detonations would occur under the proposed action.

Description of Activities

The capability to counter small vessels is categorized as a Joint Urgent Operational Need (JUON). A JUON is defined as an urgent operation need identified by a combatant commander that, if not addressed immediately, would seriously endanger personnel or pose a major threat to ongoing operations. Currently, the majority of AFSOC crews deploy into combat with no actual experience in AGM-176, AGM-114P/R, or GBU-39 weapons delivery, significantly increasing the potential to miss their intended targets during combat missions.

Management practices, described in detail in Section 11, would be implemented for live detonations. Because all munitions would be detonated in the air, no protected species surveys would be necessary. However, human safety measures would be carried out. The specific measures would depend on the mission location (GRATV target location, beyond the 200-meter isobaths, etc.).

CV-22 Training

The 8th Special Operations Squadron (SOS) proposes to conduct CV-22 training in W-151 (primarily W-151A and W-151F), which would involve the firing of .50 caliber (cal)/7.62 mm ammunition at flares floating on the water surface. There would be approximately 50 training missions annually, with 300 each of .50 cal and 7.62 mm rounds used per mission. Therefore, a total of 30,000 rounds would be expended annually. Flight procedures for CV-22 training would be similar to those described for AC-130 gunnery missions above, except that CV-22 aircraft typically operate at much lower altitudes (100 to 1,000 ft above surface level) than AC-130 gunships. Aircrews would maintain Visual Flight Rules cloud clearances and a minimum altitude of 100 ft above water height at all times. Weather must be sufficient to maintain a 3-NM clearance around the target area. Live fire would be conducted only when sea surface conditions do not exceed Beaufort sea state 4 (wind speed 16 knots, wave height 3 ft, fairly frequent white caps). Similar to AC-130 missions, crews would conduct a visual survey of the target area (3 NM radius for non-mission vessels and a protected species zone based on requirements described in Section 11) at a maximum altitude of 1,000 ft to ensure the area is clear of marine mammals and indicators before live-fire begins. Pre- and post-live fire clearing searches are anticipated to take about five minutes to accomplish. After live fire operations, the crew would scan the target area utilizing all available visual scanners and operable sensors for any injured or dead marine species. Missions would only be conducted shoreward of the 200-meter depth contour, as described for AC-130 gunnery training above.

Summary of AFSOC Activities in the EGTTR

Table 1-4 summarizes all AFSOC live air-to-surface training operations in the EGTTR.

Table 1-4. Total Annual AFSOC Air-to-Surface Training Operations

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
7.62 mm/.50 cal	N/A	30,000	N/A	W-151A, W-151F
25 mm	0.067 lbs	39,200	Surface	W-151A, W-151B, W-151D
30 mm	0.1 lbs	35,000	Surface	
40 mm	0.87 lbs	4,480	Surface	
105 mm FU	4.7 lbs	750	Surface	
105 mm TR	0.35 lbs	1,350	Surface	

Description of Activities

Table 1-4. Total Annual AFSOC Air-to-Surface Training Operations, Cont'd

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
AGM-176 (Griffin missile)	4.58 lbs	200	Airburst	
AGM-114P/R (Hellfire missile)	20 lbs	100	Airburst	W-151
GBU-39 (SDB I)	37 lbs	30	Airburst	

AGM = Air-to-Ground Missile; mm = millimeter; cal = caliber; N/A = not applicable; lbs = pounds; FU = full up; TR = Training Round; GBU = Guided Bomb Unit; SDB = Small Diameter Bomb

1.4 413TH FLIGHT TEST SQUADRON

The United States Special Operations Command (SOCOM) has requested the 413th Flight Test Squadron (413 FLTS) to demonstrate the feasibility and capability of the Precision Strike Package and the Stand-Off Precision Guided Munitions (SOPGM) missile system on the AC-130 aircraft. SOCOM, in conjunction with A3 Operations at Wright-Patterson Air Force Base (AFB), is fielding the new AC-130J for flight characterization, as well as testing and evaluation. AFSOC is integrating some of the same weapons on the AC-130W. Therefore, the activities described below for the 413 FLTS may involve either of these aircraft variants.

AC-130J Precision Strike Package Testing

The proposed AC-130J gunnery testing associated with the 413 FLTS's Precision Strike Package would be similar to that described above for AFSOC AC-130 gunnery training in terms of location and general procedures. Testing would occur in W-151A and would involve firing either 1) PGU-44/B (105 mm HE] with FMU-153/B point detonation/delay fuse) or PGU-43B Target Practice (TP) rounds (105 mm TR) from a 105 mm M102 (U.S. Air Force designation M137A1) light-weight Howitzer cannon, or 2) PGU-13 HEI, PGU-46 HEI rounds, or PGU-15 TP rounds (inert) from a 30 mm GAU-23/A gun system. A MK-25 flare would be dropped prior to firing and used as a target. Management measures would be the same as those described for AFSOC's AC-130 gunnery missions. Table 1-5 shows types of rounds fired, as well as total number of missions and rounds proposed to be expended each year. All missions are conducted shoreward of the continental shelf break (Figure 1-7).

Table 1-5. Summary of 413 FLTS Precision Strike Package Gunnery Testing

Expendable	Net Explosive Weight	Number of Missions per year	Rounds per mission	Total number of rounds per year
PGU-13/46 (30 mm)	0.1 lbs	3	33	99
PGU-44 (105 mm FU)	4.7 lbs	4	15	60
PGU-43B TP (105 mm TR)	0.35 lbs	4	15	60

FU = full up; lbs = pounds; mm = millimeter; PGU = Projectile Gun Unit; TP = target practice; TR = Training Round

Description of Activities

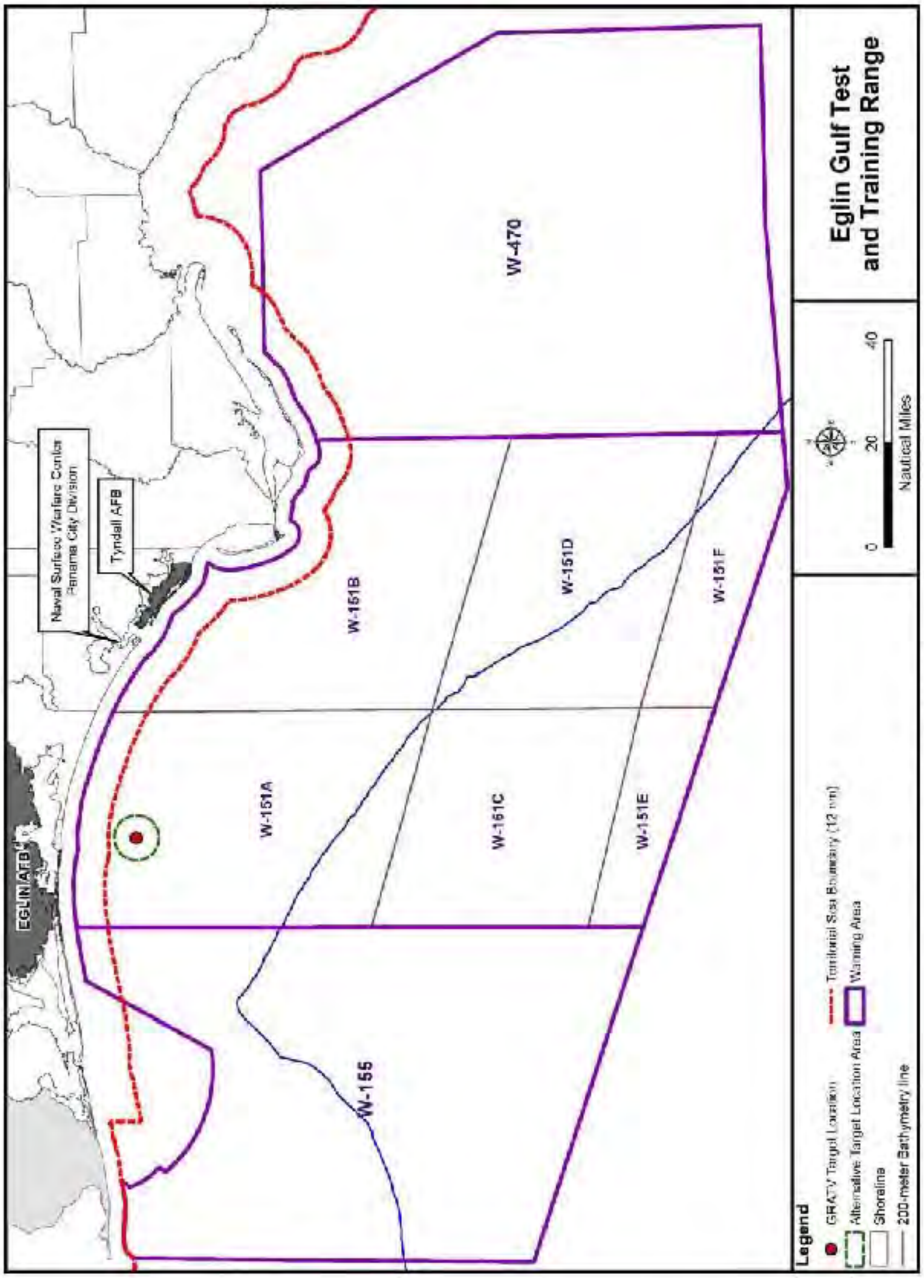

Figure 1-7. 200-Meter Isobath Boundary

Description of Activities

AC-130J and AC-130W Stand-Off Precision Guided Munitions Testing

The SOPGMs proposed for use in this testing include AGM-176 Griffin missiles, AGM-114 Hellfire missiles, GBU-39/B SDBs, and GBU-39B/B Laser Small Diameter Bombs (LSDBs). The purpose of this testing is to demonstrate the feasibility and capability of the SOPGMs on AC-130 aircraft. Initial actions would consist of various ground tests (not included as part of this LOA request) including systems testing and static drops. After ground testing is completed, captive carry, store separation, and weapon employment tests would be conducted. Captive-carry missions would be conducted with an Instrumented Measurement Vehicle (IMV) to collect environmental data or an inert telemetry (TM) missile in order to evaluate the integration of the SOPGM with the AC-130J. Store separation missions would require a TM missile with an inert warhead and a live motor, if applicable, to verify that the weapon can be employed without significant risk to the aircraft.

Weapon employment missions would be flown using any combination of inert and/or live weapons for a final end-to-end check of the system. Missions could be conducted over land or water ranges, with water ranges used for SDB/LSDB and Griffin missile tests. It is expected that over-water testing would be conducted at the GRATV target location. The target will be laser designated with a standard range instrumentation designator. Plywood targets, as well as stationary and moving vehicles, will be used for the end-to-end functionality tests. They will be set up so that the Integrated Laser Targeting camera (ILAST) can capture the laser spot on the target, and so that the high speed digital video can record the impact. The ILAST cameras and digital cameras will be mounted in such a way as to have a clear view of the target while being a safe distance from any debris from the impact.

Similar to preceding mission descriptions, pre- and post-test surveys will be conducted within the applicable human and protected species safety zones. Surveys would be conducted from vessels, aircraft, and possibly live video feed. Survey requirements are described in detail in Section 11. Table 1-6 shows the annual number of munitions expended annually for SOPGM testing. It is noted that the 413 FLTS provided the number of munitions required per fiscal year over a span of four years. The numbers in the table represent the average per year (total number divided by four).

Table 1-6. Summary of 413 FLTS SOPGM Annual Testing

Expendable	Net Explosive Weight	Approximate Number Released/Year*	Detonation Scenario
AGM-176 (Griffin)	4.58 lbs	10	Surface
AGM-114 (Hellfire)	20 lbs	10	Surface
GBU-39 (SDB I)	36 lbs	6	Surface
GBU-39 (LSDB)	36 lbs	10	Surface

AGM = Air-To-Ground Missile; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb

*Total number of munitions over a four-year period divided by four

Total expendables released annually in the EGTTR for all combined 413 FLTS air-to-surface testing operations are shown in Table 1-7.

Table 1-7. Total Annual 413 FLTS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
30 mm	0.1 lbs	99	Surface	W-151A
105 mm FU	4.7 lbs	60	Surface	
105 mm TR	0.35 lbs	60	Surface	
AGM-176 (Griffin)	4.58 lbs	10	Surface	W-151
AGM-114 (Hellfire)	20 lbs	10	Surface	
GBU-39 (SDB I)	37 lbs	6	Surface	
GBU-39 (LSDB)	37 lbs	10	Surface	

AGM = Air-To-Ground Missile; FU = full up; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb; TR = training round

1.5 780TH TEST SQUADRON

Testing activities conducted by the 780th Test Squadron (780 TS) include Precision Strike Weapon, Longbow missile littoral testing, and several other various future actions. Each activity category is described below.

Precision Strike Weapon

The U.S. Air Force Life Cycle Management Center and U.S. Navy, in cooperation with the 780 TS, conducts Precision Strike Weapon (PSW) test missions utilizing resources within the Eglin Military Complex, including sites in the EGTTR. The weapons used in testing are the AGM-158 A and B (Joint Air-to-Surface Standoff Missile [JASSM]), and the GBU-39/B (SDB I).

Figure 1-8. Joint Air-to-Surface Stand-off Missile (JASSM)

The JASSM (Figure 1-8) is a precision cruise missile designed for launch from outside area defenses against hardened, medium-hardened, soft, and area type targets. The JASSM has a range of more than 200 NM and carries a 1,000-pound warhead. The JASSM has approximately 300 pounds of 2,4,6-trinitrotoluene (TNT) equivalent NEW. The specific explosive used is AFX-757, a type of plastic bonded explosive (PBX). The JASSM would be launched more than 200 NM from the target location. Platforms for the launch would include B-1, B-2, B-52, F-16, F-18, and F-15E aircraft. Launch from the aircraft would occur at altitudes greater than 25,000 ft. The JASSM would cruise at altitudes greater than 12,000 ft for the majority of the flight profile until making the terminal maneuver toward the target.

Description of Activities

The SDB (Figure 1-9) is a guided bomb that is an important element of the Air Force's Global Strike Task Force. The SDB I carries a 217-pound warhead with approximately 37 pounds NEW. The explosive used is AFX-757. The SDB I may be launched from over 50 NM away from the target location. Platforms for the launch include F-15E, F-16, and AC-130W aircraft. Launch from the aircraft occurs at altitudes greater than 5,000 ft above ground level (AGL). The SDB I then commences a non-powered glide to the intended target.

Figure 1-9. Small-Diameter Bomb (SDB)

Up to two live and four inert JASSM missiles per year may be launched to impact a target at the GRATV target location. The JASSM missile would detonate upon impact with the target. Although impact would typically occur about 5 ft (1.5 m) above the water surface, detonations are assumed to occur at the water surface for purposes of impacts analysis.

Additionally, up to 6 live and 12 inert SDBs could also be deployed against targets in the same target area. Two SDB-Is could be launched simultaneously during two of the live missions and four of the inert missions. Detonation of the SDBs would occur under one of two scenarios:

- Detonation upon impact with the target.
- Height of burst (HOB) test, which involves detonation 7 to 14 ft (2.2 to 4.5 m) in the air above the surface target.

There would generally be only one detonation per test event, and thus no more than one detonation in any 24-hour period. In instances of a simultaneous SDB launch scenario, two bombs are deployed from the same aircraft at nearly the same time to strike the same target. It is expected that the bombs would strike the target within five seconds or less of each another. Under this scenario, the detonations are considered a single event (NEW is doubled) for the purpose of acoustic modeling and marine species impacts analysis. Modeling both detonations as a single event results in a conservative impact estimate. Refer to Appendix A for a complete description of the acoustic modeling conducted in support of this document. PSW munitions are shown in Table 1-8.

Table 1-8. Summary of Annual Precision Strike Weapon Tests

Weapon	# of Live Tests/Year	# of Live Munitions Released	# of Inert Tests/Year	# of Inert Munitions Released
AGM-158 (JASSM)	2	2	4	4
GBU-39 (SDB I) Single Launch	2	2	4	4
GBU-39 (SDB I) Simultaneous Launch	2	4	4	8

JASSM = Joint Air-To-Surface Stand-Off Missile; SDB = Small Diameter Bomb

Chase aircraft, consisting of F-15, F-16, and/or T-38, would accompany each launch. These aircraft would follow the test items during captive carry and free flight but would not follow either item below a predetermined altitude as directed by Flight Safety. Other assets on site could include an E-9 turboprop aircraft circling around the target location. Tanker aircraft including KC-10s and KC-135s would also be used. The GRATV could also be on location to hold instrumentation, and would be anchored up to 1,000 ft away from the target location.

Based on availability, one of two potential target types would be used during PSW tests. The first is a Container Express (CONEX) target (Figure 1-10) that consists of up to five containers strapped, braced, and welded together to form a single structure. The dimensions of each container are approximately 8 ft by 8 ft by 40 ft. Each container contains 200 55-gallon steel drums (filled with air and sealed) to provide buoyancy. The second type of target is a hopper barge, which is a non-self-propelled vessel typically used for transportation of bulk cargo (Figure 1-11). A typical hopper barge is approximately 30 ft by 12 ft by 125 ft. The targets are held in place by a four-point anchoring system using cables.

Figure 1-10. Example of a CONEX Target

Figure 1-11. Typical Hopper Barge

The CONEX target would be constructed on land and shipped to the target location two to three days prior to the test. The barge target would also be stationed at the target location two to three days prior to the test. During an inert mission, the JASSM would pass through the target and the warhead would sink to the bottom of the Gulf. Immediately following impact, the JASSM recovery team would pick up surface debris originating from the missile and target. Depending on the test schedule, the target could remain in the Gulf of Mexico for up to one month at a time. If the target is significantly damaged, and it is deemed impractical and unsafe to retrieve it, the target remains could be sunk through coordination with the U.S. Coast Guard or Tyndall AFB. Coordination with the U.S. Army Corps of Engineers would be required prior to sinking a target.

PSW test activities would occur in W-151 at the GRATV target location. Targets are located in approximately 115 to 120 ft of water, about 17 miles offshore of Test Area A-3 on Santa Rosa Island (actual distance could range from 15 to 24 miles offshore). This area is the same as the Maritime WSEP test site, which is located 17 miles offshore. Test missions could occur during any time of the year, but during daylight hours only.

PSW missions are currently authorized to be conducted in the EGTTR. An Environmental Assessment (EA) was prepared and completed in November 2005. In association with that EA, a Biological Opinion was issued by the USFWS on March 14, 2005 (Consultation No. F/SER/2004/00223) in accordance with the ESA. More recently, on March 5, 2014, NMFS issued a 5-year LOA in accordance with the MMPA for the 780th's PSW testing activities, as described above. Since then, new acoustic thresholds and criteria have been adopted by NMFS to analyze acoustic impacts to marine mammals from exposure to explosive sources. The analysis in Section 6 incorporates these new requirements. The 2014 LOA includes specific measures including pre- and post-test surveys, marine species observer training, and reporting requirements. All of these requirements are described in detail in Section 11, *Means of Affecting the Least Practicable Adverse Impacts*.

In addition to the above description, future (Phase 2) testing of the JASSM and SDB is planned by the Air Force Operational Test and Evaluation Center (AFOTEC) (Table 1-9). AFOTEC

proposes to expend two live and one inert GBU-53 (SDB II) weapons in the EGTTR. The live weapons would be deployed against moving boats with a length of 30 to 40 ft, while the inert weapon would be used against a smaller fiberglass boat. Details of Phase 2 JASSM testing are currently unknown; this testing is therefore not included as part of this LOA request.

Table 1-9. Summary of Phase 1 and Phase 2 Precision Strike Weapon Live Tests

Weapon	Net Explosive Weight	# of Live Munitions Released	# of Inert Munitions Released
AGM-158 (JASSM)	300 lbs	2	4
GBU-39 (SDB I)	37 lbs	2	4
GBU-39 (SDB I) Double Shot*	74 lbs	2	4
GBU-53 (SDB II)	22.84 lbs	2	1

AGM = Air-To-Ground Missile; GBU = Guided Bomb Unit; JASSM = Joint Air-To-Surface Standoff Missile; lbs = pounds; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

Longbow Littoral Testing

The 780 TS/OGMT proposes to collect data on the ability of the Longbow missile (AGM-114L) to track and impact moving boat targets in both the Lock On Before Launch (LOBL) and Lock On After Launch (LOAL) modes, and at varying launch elevation angles. A secondary objective of the tests is to acquire telemetry data in order to evaluate tracking quality. Missiles would be typically launched from an Avenger system (a mobile missile launch system) mounted to a High Mobility Multipurpose Wheeled Vehicle (HMMWV). The HMMWV would be located either at the shoreline of Eglin's Santa Rosa Island property or on a barge or boat in W-151A. Missiles could also be launched from an AH-64D Apache helicopter. Missiles launched from Santa Rosa Island would be outside the EGTTR boundary and are therefore not included in this LOA request. The targets consist of small (approximately 25 ft in length), remotely controlled fiberglass boats. The distance of the targets from the missile launch site would be either 1.5 or 4 kilometers (km) (0.9 or 2.5 miles).

Up to 16 live Longbow missiles could be launched annually in the EGTTR (Table 1-10). The NEW of each missile is 35.95 pounds. All missiles would contain a proximity fuse, with detonations occurring at a minimum height of 1 to 3 meters (3.3 to 9.8 ft) above the water. There would be no detonations below the surface. Management actions include human safety zone clearance and pre- and post-mission protected marine species surveys, as described in Section 11.

Table 1-10. Annual Longbow Munitions

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight
AGM-114 L (Longbow)	16	1 to 3 meter height (airburst)	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge.	35.95 lbs

AGM = Air-To-Ground Missile; lbs = pounds

Future Actions

The 780 TS plans to conduct other various testing activities that involve targets on the water surface in the EGTTR. Many of the missions would target small boats or barges. Weapons

would primarily be delivered by aircraft, although a rail gun would be used for one test. Live warheads would be used for some missions, while others would involve inert warheads with a live fuse (typically contains a very small NEW). Total future munitions for 780 TS are listed in Table 1-11. As with the preceding missions using live weapons, safety zone enforcement and pre- and post-mission marine species monitoring would be required.

Table 1-11. 780 TS Annual Munitions, Other Future Actions

Munition	Net Explosive Weight (pounds)	Number of Releases	Proposed Location	Target Type	Detonation Type
Joint Air-Ground Missile	27.41	2	W-151 (subareas A, S5, and S6)	HSMST or Boston Whaler type boat	1 – Point Detonation 1 - Airburst
Navy Rail Gun	Inert	19	W-151	Barge	Penetrating Rod
	1	5	W-151	Barge	Airburst
JDAM – Extended Range	Inert	3	W-151	Water surface (2) Barge (1)	Inert
Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	Inert	2	W-151	Water surface	Inert
Laser SDB	0.4 (fuse)	4 maximum	W-151A	Small boats	Airburst or Surface
SDB II Guided Test Vehicle	0.4 (fuse)	4	W-151A	Small boats	Surface

HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; HSMT = High Speed Maneuverable Surface Target; JDAM = Joint Direct Attack Munition; NEW = net explosive weight; SDB = Small Diameter Bomb

Summary of Combined 780th Test Squadron Activities

Total expendables proposed to be released annually in the EGTTR under the 780 TS air-to-surface testing operations, including PSW, Longbow, and other various missions, are shown in Table 1-12.

Table 1-12. Total Annual 780 TS Air-to-Surface Testing Activities

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
Live AGM-158 (JASSM)	300 lbs	2	Surface	W-151A
Inert AGM-158 (JASSM)	N/A	4	N/A	
Live GBU-39 (SDB I)	37 lbs	2	Surface	
Inert GBU-39 (SDB I)	N/A	4	N/A	
Live GBU-39 (SDB I) Simultaneous Launch*	74 lbs	2	Surface	
Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	4	N/A	
Live GBU-53 (SDB II)	22.84 lbs	2	Surface	
Inert GBU-53 (SDB II)	N/A	1	N/A	
AGM-114 L (Longbow)	35.95 lbs	16	Airburst	
Joint Air-to-Ground Missile	27.41 lbs	1	Surface	W-151 (various sub-areas including but not limited to A, S5, and S6)
		1	Airburst	
Live Navy Rail Gun	1	1	Airburst	
Inert Navy Rail Gun	N/A	19	N/A	

Description of Activities

Table 1-12. Total Annual 780 TS Air-to-Surface Testing Activities, Cont'd

Munition	Net Explosive Weight	Annual Releases	Detonation Scenario	Location
JDAM Extended Range	N/A	3	N/A	
Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	N/A	2	N/A	
Inert GBU-39 (LSDB) with live fuse	0.4 lbs	4	Airburst or surface	
Inert GBU-53 (SDB II with live fuse)	0.4 lbs	4	Surface	

AGM = air-to-ground missile; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; JDAM = joint direct attack munition; lbs = pounds; LSDB = Laser Small Diameter Bomb; N/A = not applicable; SDB = Small Diameter Bomb
*NEW is doubled for each simultaneous launch

1.6 96TH TEST WING INERT MUNITIONS

The 96th Test Wing (96 TW), Eglin's host wing, provides developmental test and evaluation for a wide variety of air-delivered weapons and other systems. The 96 TW proposes to expend approximately nine inert bombs yearly in the EGTTR. The weight of each bomb would be 2,000 pounds, but there would be no warhead. Use of inert munitions was analyzed in the 2002 PEA and found to have no significant environmental impact. Therefore, there is no limit on the number of inert items that may be expended, and actual numbers used by the 96 TW may vary. However, the bombs are included in this EA in order to document the programmatic use of the EGTTR.

1.7 OPERATIONS GROUP

The 96 Operations Group, which conducts the 96 TW's primary missions of developmental testing and evaluation of conventional munitions, and command and control systems, anticipates support of air-to-surface missions for several user groups on an infrequent basis. Sub-surface detonations would be at 5 to 10 ft below the surface. Projected annual munitions expenditures and detonation scenarios are listed in Table 1-13.

Table 1-13. Annual Munitions for 96th Operations Group Support

Munition	NEW (lbs)	Detonation Scenario	# Annual Releases
GBU-10 or GBU-24	945	Subsurface	1
GBU-12 or GBU-54	192	Subsurface	1
AGM-65 (Maverick)	86	Surface	2
GBU-39 (SDB I or LSDB)	37	Subsurface	4
AGM-114 (Hellfire)	20	Subsurface	20
105 mm full-up	4.7	Surface	125
40 mm	0.9	Surface	600
Live fuse	0.4	Surface	200
30 mm	0.1	Surface	5,000

AGM = air-to-ground missile; GBU = Guided Bomb Unit; lbs = pounds; LSDB = Laser Small Diameter Bomb; SDB = Small Diameter Bomb

1.8 SUMMARY OF EXPENDABLES USED IN AIR-TO-SURFACE TESTING AND TRAINING

Table 1-14 shows the inclusive list of munitions expendables associated with all air-to-surface test and training missions included in the Proposed Action of the *Eglin Gulf Test and Training Range Environmental Assessment*. The list incorporates all missions currently conducted or planned by the 86 FWS, ASEP, AFSOC, 413 FTS, and 780 TS.

Table 1-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	# of Annual Releases
86 FWS/ Maritime WSEP Live Munitions	GBU-10 or GBU-24	945	Surface or subsurface	2
	GBU-12 or GBU-54 (LJDAM)	192	Surface or subsurface	6
	AGM-65 (Maverick)	86	Surface	6
	CBU-105	107.63	Airburst	4
	GBU-39 (LSDB)	37	Airburst, Surface, or Subsurface	4
	AGM-114 (Hellfire)	20	Airburst, Surface, or Subsurface	30
	GBU-53 (SDB II)	22.84	Airburst, Surface, or Subsurface	4
	AGM-176 (Griffin)	4.58	Airburst or Surface	10
	2.75-in Rockets (including APKWS)	10	Surface	100
	PGU-13 HEI (30 mm)	0.1	Surface	1,000
	AIM-9X	68	Surface	4
86 FWS/ Maritime WSEP Inert Munitions	GBU-10	N/A	N/A	21
	GBU-12	N/A	N/A	27
	GBU-25	N/A	N/A	17
	GBU-31	N/A	N/A	6
	GBU-38	N/A	N/A	3
	GBU-54	N/A	N/A	16
	BDU-56	N/A	N/A	13
	AIM-9X	N/A	N/A	3
	PGU-27	N/A	N/A	46,000
ASEP	Mk-84 Bomb (inert)	N/A	N/A	12
AFSOC/Air-to-Surface Training Operations	7.62 mm/.50 cal	N/A	N/A	30,000
	25 mm	0.067	Surface	39,200
	30 mm	0.1	Surface	35,000
	40 mm	0.87	Surface	4,480
	105 mm FU	4.7	Surface	750
	105 mm TR	0.35	Surface	1,350
	AGM-176 (Griffin)	4.58	Airburst	200
	AGM-114P/R (Hellfire)	20	Airburst	100
	GBU-39 (SDB I)	37	Airburst	30
413 FLTS/Air-to-Surface Testing Activities	30 mm	0.1	Surface	99
	105 mm FU	4.7	Surface	60
	105 mm TR	0.35	Surface	60
	AGM-176 (Griffin)	4.58	Surface	10
	AGM-114 (Hellfire)	20	Surface	10

Description of Activities

Table 1-14. Summary of Expendables Proposed for Test and Training Missions in the EGTTR, Cont'd

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	# of Annual Releases
	GBU-39 (SDB I or LSDB)	37	Surface	16
780 TS/Air-to-Surface Testing Activities	Live AGM-158 (JASSM)	300	Surface	2
	Inert AGM-158 (JASSM)	N/A	N/A	4
	Live GBU-39 (SDB I)	37	Airburst or Surface	2
	Inert GBU-39 (SDB I)	N/A	N/A	4
	Live GBU-39 (SDB I) Simultaneous Launch*	74	Airburst or Surface	2
	Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	N/A	4
	Live GBU-53 (SDB II)	22.84	Surface	2
	Inert GBU-53 (SDB II)	N/A	N/A	1
	AGM-114 L (Longbow)	35.95	Airburst	16
	Joint Air-to-Ground Missile	27.41	Surface	1
			Airburst	1
	Live Navy Rail Gun	1	Airburst	1
	Inert Navy Rail Gun	N/A	N/A	19
	JDAM Extended Range	N/A	N/A	3
	Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	N/A	N/A	2
	Inert GBU-39 (LSDB) with live fuse	0.4	Airburst or surface	4
	Inert GBU-53 (SDB II with live fuse)	0.4	Surface	4
96 TW Inert Munitions	Bomb (2,000 pounds)	N/A	N/A	9
96 Operations Group	GBU-10 or GBU-24	945	Subsurface	1
	GBU-12 or GBU-54	192	Subsurface	1
	AGM-65 (Maverick)	86	Surface	2
	GBU-39 (SDB I or LSDB)	37	Subsurface	4
	AGM-114 (Hellfire)	20	Subsurface	20
	105 mm full-up	4.7	Surface	125
	40 mm	0.9	Surface	600
	Live fuse	0.4	Surface	200
	30 mm	0.1	Surface	5,000

AIM = air intercept missile; AFSOC = Air Force Special Operations Command; AGM = air-to-ground missile; ASEP = Advanced Systems Employment Project; BDU = Bomb Dummy Unit; CBU = Cluster Bomb Unit; FLTS = Flight Test Squadron; FU = Full up; FWS = Fighter Weapons Squadron; GBU = Guided Bomb Unit; HEI = high explosive incendiary; JASSM = Joint Air-to-Surface Standoff Missile; lbs = pounds; LJDAM = laser joint direct attack munition; LSDB = Laser Small Diameter Bombs; MK = mark; mm = millimeters; ms = millisecond; N/A = Not Applicable; PGU = Projectile Gun Unit; SDB = Small Diameter Bomb; TR = training round; TW = Test Wing; WSEP = Weapons System Evaluation Program.
*NEW is doubled for each simultaneous launch

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2. DURATION AND LOCATION OF THE ACTIVITIES

Due to the total number and variability in types of air-to-surface test and training missions included in this LOA request, missions may occur during any season or month. Missions involving the use of live bombs, missiles, and rockets will occur during daylight hours. However, some activities, such as gunnery training, may occur during day or night. Missions are typically conducted on weekdays, with one or two missions occurring per day. All activities will take place within the EGTTR, which is defined as the airspace over the Gulf of Mexico controlled by Eglin AFB, beginning at a point 3 NM from shore. This airspace is controlled by the Federal Aviation Administration, but scheduled by Eglin AFB. The EGTTR is subdivided into blocks consisting of Warning Areas W-155, W-151, W-470, W-168, and W-174, as well as Eglin Water Test Areas 1 through 6 (Figure 1-2). Most of the blocks are further sub-divided into smaller airspace units for scheduling purposes (for example, W-151A, B, C, and D). Warning Area W-155 is controlled by the U.S. Navy but is used occasionally to support missions scheduled through Eglin. Over 102,000 square nautical miles (NM^2) of Gulf of Mexico surface waters occur under the EGTTR airspace. However, most of the activities described in this document will occur in W-151, and the great majority will occur specifically in sub-area W-151A due to its proximity to shore (Figure 1-3). Descriptive information for all of W-151 and for W-151A specifically is provided below.

W-151

The inshore and offshore boundaries of W-151 are roughly parallel to the shoreline contour. The shoreward boundary is 3 NM from shore, while the seaward boundary extends approximately 85 to 100 NM offshore, depending on the specific location. W-151 covers a surface area of approximately 10,247 NM^2 (35,145 square kilometers [km^2]), and includes water depths ranging from about 20 to 700 m (66 to 2,297 ft). This range of depth includes continental shelf and slope waters. Approximately half of W-151 lies over the shelf.

W-151A

W-151A, which occurs directly south of Eglin AFB, extends approximately 60 NM offshore and has a surface area of 2,565 NM^2 (8,797 km^2). Water depths range from about 30 to 350 m (98 to 1,148 ft) and include continental shelf and slope zones. However, most of W-151A occurs over the continental shelf, in water depths less than 250 m (820 ft). Most of the air-to-surface missions described in Section 1 occur in the shallower, northern inshore portion of the sub-area (Maritime WSEP test site), in a water depth of about 35 m (115 ft).

As a conservation measure to avoid impacts to deep water marine mammal species, all gunnery missions will be conducted within (shoreward of) the 200-m water depth contour, which transects portions of W-151A, W-151D, and W-151F. All of W-151B lies shoreward of the shelf break. The 200-m contour is shown on Figure 1-7.

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3. MARINE MAMMAL SPECIES AND NUMBERS

Marine mammals that potentially occur within the northeastern Gulf of Mexico include numerous species of cetaceans and one sirenian, the Florida manatee (*Trichechus manatus latirostris*). Manatees primarily inhabit coastal and inshore waters, and are rarely sighted offshore. Most air-to-surface test and training missions will be conducted at least 15 miles off the coast. Therefore, manatee occurrence is considered unlikely in the EGTTR, and further discussion of marine mammal species is limited to cetaceans.

Up to 28 cetacean species occur in the northern Gulf of Mexico, from deep offshore waters to shallow estuarine environments. Distribution is influenced by factors such as prey availability and environmental conditions, among many others. Distribution in the northern Gulf may be broadly categorized as those species occurring over the continental shelf (typically considered to be water depths of about 100 to 200 m [328 to 656 ft] or less) and those occurring at and beyond the continental shelf break (water depths greater than about 200 m [656 ft]). Although AFSOC missile tests may occur beyond the 200-m (656 ft) isobath, the missions would involve in-air detonations only. Airbursts are not considered to affect marine mammals because there is little transmission of pressure or energy across the air/water interface. All other types of missions will occur in water depths of less than 200 m (656 ft). Therefore, only marine mammal species typically occurring over the continental shelf are included in this LOA request. Two species, the bottlenose dolphin (*Tursiops truncatus*) and Atlantic spotted dolphin (*Stenella frontalis*), are frequently sighted in shelf waters. Dwarf sperm whales (*Kogia sima*), pygmy sperm whales (*Kogia breviceps*), and rough-toothed dolphins (*Steno bredanensis*) are occasionally sighted over the shelf but are not considered regular inhabitants (Fulling et al., 2003; Davis et al., 2000). The remaining cetacean species are primarily considered to occur at and beyond the shelf break. Therefore, only the bottlenose dolphin and Atlantic spotted dolphin are included in this LOA request.

The number of marine mammals within the project area may be considered in terms of density. Bottlenose and spotted dolphin density estimates used in this document were obtained from two sources. Bottlenose dolphin estimates were obtained from a habitat modeling project conducted for portions of the EGTTR, as described by Garrison (2008). As part of the modeling effort, personnel from National Oceanic and Atmospheric Administration (NOAA) Fisheries' Southeast Fisheries Science Center (SEFSC) conducted line transect aerial surveys of the continental shelf and coastal waters of the eastern Gulf of Mexico during winter (February 2007; water temperatures of 12–15°Celsius [54–59° Fahrenheit) and summer (July/August 2007; water temperatures greater than 26°Celsius [79° Fahrenheit]). The surveys covered nearshore and continental shelf waters (to a maximum depth of 200 m [656 ft]), with the majority of effort concentrated in waters from the shoreline to 20 m [66 ft] depth. Marine species encounter rates during the surveys were corrected for sighting probability and the probability that animals were available on the surface to be seen. The survey data were combined with remotely sensed environmental data/habitat parameters (water depth, sea surface temperature [SST], and chlorophyll-*a* concentration) to develop habitat models. The technical approach, described as Generalized Regression and Spatial Prediction, spatially projects the species-habitat relationship based on distribution of environmental factors, resulting in predicted densities for un-sampled locations and times. The spatial density model can therefore be used to predict relative density

Marine Mammal Species and Numbers

in unobserved areas and at different times of year based on SST and chlorophyll datasets derived from satellite data. Similarly, the spatial density model can be used to predict relative density for any sub-region within the surveyed area.

Garrison (2008) calculated bottlenose dolphin density estimates at various spatial scales within the EGTTR. At the largest scale, density data were aggregated into four principal strata categories: North-Inshore, North-Offshore, South-Inshore, and South-Offshore. Densities for these strata were provided in the published survey report. Unpublished densities were also provided for smaller blocks (sub-areas) corresponding to military airspace units, and a number of these sub-areas were combined to form larger zones. Densities in these smaller areas were provided to Eglin AFB in Excel® spreadsheets by the report author.

For both large areas and sub-areas, regions occurring entirely within waters deeper than 200 m (656 ft) were excluded from predictions, and those straddling the 200 m isobath were clipped to remove deep water areas. In addition, because of limited survey effort, density estimates beyond 150 m (492 ft) water depth are considered invalid. The environmental conditions encountered during the survey periods (February and July/August) do not necessarily reflect the range of conditions potentially encountered throughout the year. In particular, the transition seasons of spring (April-May) and fall (October-November) have a very different range of water temperatures. Accordingly, for predictions outside of the survey period or geographical range, it is necessary to evaluate the statistical variance in predicted values when attempting to apply the model. The coefficient of variation (CV) of the predicted quantity is used to measure the validity of model predictions. According to Garrison (2008), the best predictions of bottlenose dolphin density estimates have CV values of approximately 0.2. When CVs approach 0.7, and particularly when they exceed 1.0, the resulting model predictions for bottlenose dolphin density estimates are extremely uncertain and are considered invalid.

Median density estimates corresponding to sub-area 137 (Figure 3-1) are used in this document because most of the air-to-surface testing and training missions that use live munitions would be conducted within this block. Even though Garrison (2008) provided densities based upon one year (2007) and five-year monthly averages for SST and chlorophyll, the five year average is considered preferable. Given that missions involving live ordnance may occur at any time of the year, and that water temperature affects noise propagation which influences the results of acoustic modeling, bottlenose dolphin density estimates are calculated for summer (May to October) and winter (November to April). In the absence of specific information on mission timing, it is assumed that half of the missions would occur in summer and half would occur in winter. The monthly density estimates from months with unacceptably high CVs were not included in the seasonal density estimate calculations. Those monthly densities were omitted from seasonal density estimates in favor of averaging the remaining monthly densities in which we had higher confidence in their predicted bottlenose dolphin densities (CV < 0.7), and are shown in Table 3-1.

Marine Mammal Species and Numbers

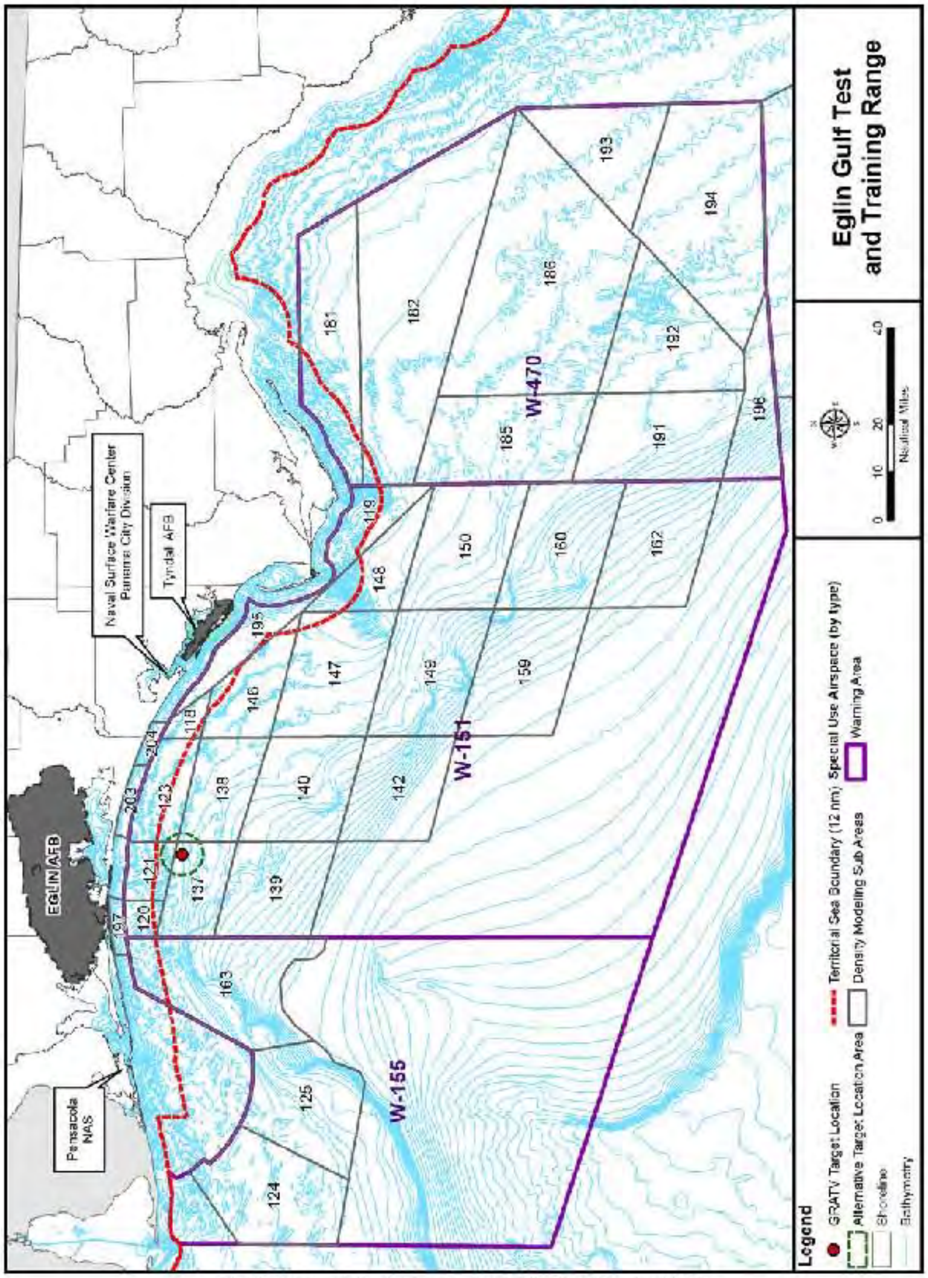

Figure 3-1. Sub-Areas Included in Garrison (2008)

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Marine Mammal Species and Numbers

Atlantic spotted dolphin density was derived from Fulling et al. (2003), which describes the results of mammal surveys conducted in association with fall ichthyoplankton surveys from 1998 to 2001. The surveys were conducted by SEFSC personnel from the U.S.-Mexico border to southern Florida, in water depths of 20 to 200 m (66 to 656 ft). Using the software program DISTANCE©, density estimates were generated for East and West regions, with Mobile Bay as the dividing point. The East region is used in this document. Densities were provided for Atlantic spotted dolphins and unidentified *T. truncatus*/*S. frontalis*. The unidentified *T. truncatus*/*S. frontalis* category is treated as a separate species group with a unique density. Density estimates from Fulling et al. (2003) were not adjusted for sighting probability (perception bias) or surface availability (availability bias) [g(0) = 1] in the original survey report, likely resulting in underestimation of true density. Perception bias refers to the failure of observers to detect animals, although they are present in the survey area and available to be seen. Availability bias refers to animals that are in the survey area, but are not able to be seen because they are submerged when observers are present. Perception and availability bias result in the underestimation of abundance and density numbers (negative bias).

In order to address negative bias, Eglin AFB has adjusted density estimates based on information provided in available literature. There are no published g(0) correction factors for Atlantic spotted dolphins. However, Barlow (2006) estimated g(0) for numerous marine mammal species near the Hawaiian Islands, including offshore pantropical spotted dolphins (*Stenella attenuata*). Separate estimates for this species were provided for group sizes of 1 to 20 animals [g(0) = 0.76], and greater than 20 animals [g(0) = 1.00]. Although Fulling et al. (2003) sighted some spotted dolphin groups of more than 20 individuals, the 0.76 value is used as a more conservative approach. Barlow (2006) provides the following equation for calculating density:

$$\text{Density (\# animals/km}^2) = \frac{(n)\ (S)\ (f_0)}{(2L)\ (g_0)}$$

Where: n = number of animal group sightings on effort

S = mean group size

f(0) = sighting probability density at zero perpendicular distance (influenced by species detectability and sighting cues such as body size, blows, and number of animals in a group)

L = transect length completed (km)

g(0) = probability of seeing a group directly on a trackline (influenced by perception bias and availability bias)

Because (n), (S), and (f_0) cannot be directly incorporated as independent values due to lack of original information, we substitute the variable $X_{species}$ which incorporates all three values, such that $X_{species} = (n)(S)(f_0)$ for a given species. This changes the density equation to:

$$D = \frac{X_{species}}{(2L)\ (g_0)}$$

Using the minimum density estimates provided in Fulling et al. (2003) for Atlantic spotted dolphins and solving for $X_{Spotted Dolphin}$:

$$0.201 = \frac{X_{Spotted\ Dolphin}}{(2)\ (816)\ (1.0)}$$

Marine Mammal Species and Numbers

$X_{SpottedDolphin} = 328.032.$

Placing this value of $X_{SpottedDolphin}$ and the revised g(0) estimate (0.76) in the original equation results in the following adjusted density estimate for Atlantic spotted dolphin:

$$D_{Adjusted} = \frac{328.032}{(2)(816)(0.76)}$$

$$D_{Adjusted} = 0.265$$

Using the same method, adjusted density for the unidentified *T. truncatus/S. frontalis* species group is 0.009 animals/km^2. There are no variances attached to either of these recalculated density values, so overall confidence in these values is unknown. Density estimates in Fulling et al. (2003) are not extrapolated to other months or seasons. Therefore, separate summer and winter density estimates are not available; the estimates provided for Atlantic spotted dolphin and unidentified *T. truncatus/S. frontalis* shown in Table 1-3 are used for all impact calculations.

Table 3-1. Marine Mammal Density Estimates

Species	Density Estimate (animals per km^2)	
	Summer (May – October)	Winter (November – April)
Bottlenose dolphin[1]	0.404*	2.560**
Atlantic spotted dolphin[2]	0.265	0.265
Unidentified bottlenose dolphin/Atlantic spotted dolphin[2]	0.009	0.009

[1]Source: Garrison, 2008; adjusted for observer and availability bias by the author
[2]Source: Fulling et al., 2003; adjusted for negative bias based on information provided by Barlow (2003; 2006)
* May and October density estimates were not included in the seasonal average calculations due to unacceptably high CV values
** November density estimate was not included in the seasonal average calculation due to an unacceptably high CV value

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4. AFFECTED SPECIES STATUS AND DISTRIBUTION

Information on each marine mammal species, including general descriptions, status, and occurrence, is provided below. Descriptions include Potential Biological Removal (PBR). PBR is defined as the maximum number of animals that may be removed, not including natural mortalities, from a stock while allowing that stock to reach or maintain its optimal sustainable population. Historically, PBR has primarily been used in assessing marine mammal impacts associated with commercial fishing. However, the number is provided in this document as a point of reference. To facilitate management of marine mammals under the MMPA, NMFS has identified various stocks, which are defined as groups of mammals of the same species occurring in the same area, and which interbreed when mature. A stock may be categorized as a *strategic stock*, which is defined as a marine mammal stock considered likely to be listed under the ESA, currently listed under the ESA, currently listed as depleted under the MMPA, or for which the level of non-natural mortality or serious injury (e.g. from commercial fishing) exceeds the PBR level.

Distribution of cetaceans in the Gulf may be influenced by hydrographic and bathymetric features. The dominant hydrographic feature in the Gulf is the Loop Current that, though generally south of the continental slope, can generate anti-cyclonic (clockwise circulating) and cyclonic (counterclockwise) eddies that move onto or influence the slope and shelf regions. Davis et al. (2000) noted during 1997-1998 surveys of the northern Gulf of Mexico that cetaceans were concentrated along the continental slope and in or near cyclonic eddies. Cetaceans may also be associated with seafloor features such as the DeSoto Canyon, Florida Escarpment, Mississippi Canyon, and Mississippi River Delta. These and other bathymetric features are shown on Figure 4-1.

4.1 ATLANTIC BOTTLENOSE DOLPHIN (*TURSIOPS TRUNCATUS*)

Description – Bottlenose dolphins are large and robust, varying in color from light gray to charcoal. The genus *Tursiops* is named for its short, stocky snout that is distinct from the melon (Jefferson et al., 1993). The dorsal fin is tall and falcate. There are regional variations in body size, with adult lengths from 1.9 to 3.8 m (6.2 to 12.5 ft) (Jefferson et al., 1993). Nearshore (coastal) and offshore forms of the bottlenose dolphin are currently recognized, and are distinguished by external and cranial morphology, hematology, diet, and parasite load (Duffield et al., 1983; Hersh and Duffield, 1990; Mead and Potter, 1995; Curry and Smith, 1997). There is also a genetic distinction between nearshore and offshore bottlenose dolphins worldwide (Curry and Smith, 1997; Hoelzel et al., 1998).

Status –In the northern Gulf of Mexico, there is a coastal stocks; a continental shelf stock; an oceanic stock; and 32 bay, sound, and estuary stocks (Waring et al., 2006). Sellas et al. (2005) reported the first evidence that the coastal stock off west central Florida is genetically separated from the adjacent inshore areas. Table 4-1 summarizes information on bottlenose dolphin stocks that occur in the north-central Gulf of Mexico, although not all these stocks have an equal probability of occurrence in the test and training areas. More detailed descriptions follow the table. Descriptions were obtained from stock assessment reports available on the NMFS website.

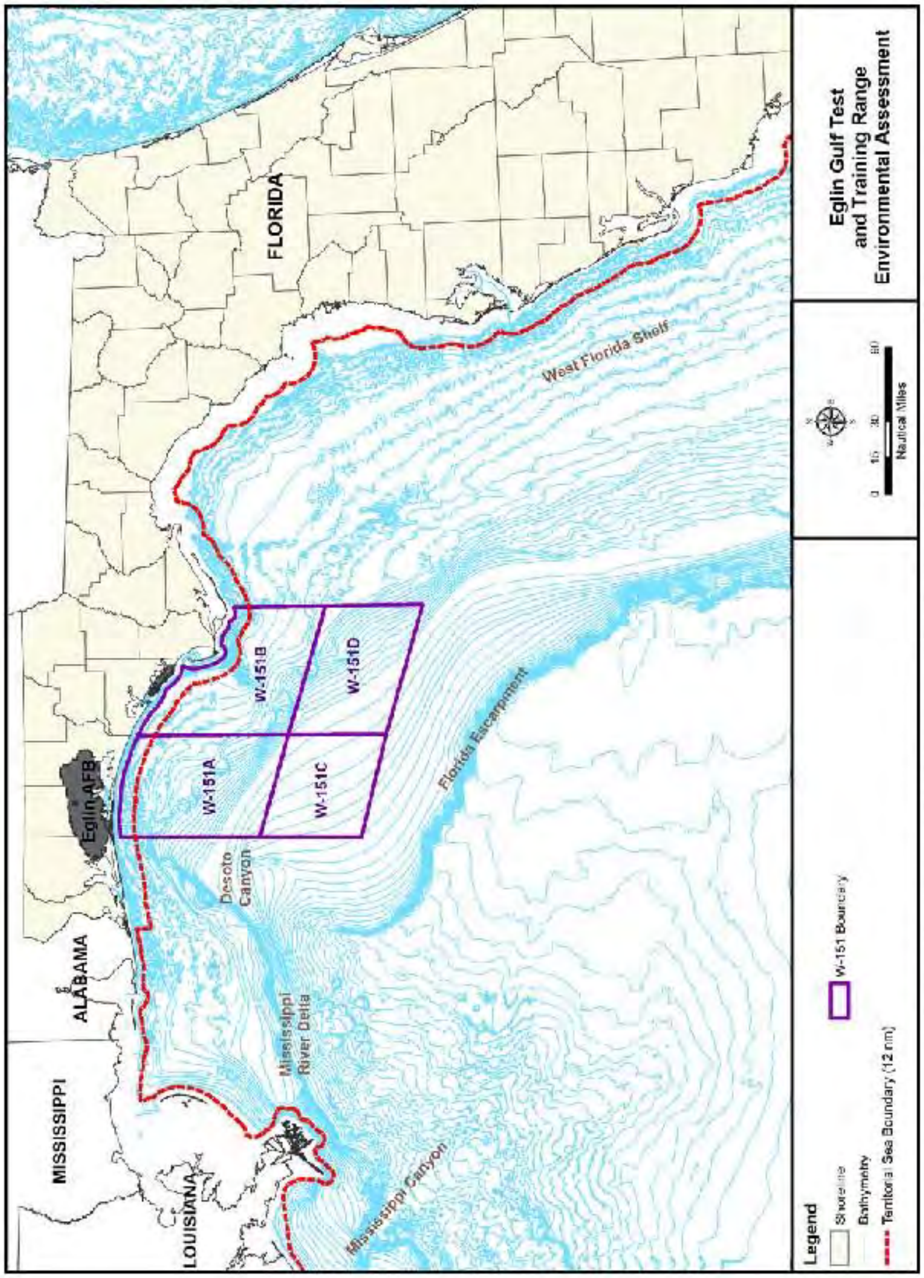

Figure 4-1. Topographical Features of the Gulf of Mexico in Relation to W-151

Affected Species Status and Distribution

Table 4-1. Bottlenose Dolphin Stocks in the North-Central Gulf of Mexico

Stock		Distribution	Strategic Stock	Estimated Abundance	PBR
Bay, Sound, & Estuarine Stocks:	Choctawhatchee Bay	Areas of contiguous, enclosed, or semi-enclosed water bodies	Yes	179 resident, 232 transient	1.7
	Pensacola/East Bay		Yes	33	U
	St. Andrew Bay		Yes	124	U
Gulf of Mexico Northern Coastal		Waters from shore to the 20-meter (66-foot) isobath, from the Mississippi River delta to the Florida Big Bend region	Yes	2,473	20
Northern Gulf of Mexico Continental Shelf		Waters between the 20- and 200-meter (66- and 656-foot) isobaths, from Texas to Key West	No	17,777	U
Northern Gulf of Mexico Oceanic		Waters from the 200-meter (656-foot) isobath to the seaward extent of the U.S. Exclusive Economic Zone	No	5,806	42

PBR = Potential Biological Removal, U = undetermined

Genetic, photo-identification, and tagging data support the concept of relatively discrete bay, sound, and estuary stocks. NMFS has provisionally identified 32 such stocks which inhabit areas of contiguous, enclosed, or semi-enclosed water bodies adjacent to the northern Gulf of Mexico. The stocks are based on a description of dolphin communities in some areas of the Gulf coast. A community is generally defined as resident dolphins that regularly share a large portion of their range; exhibit similar genetic profiles; and interact with each other to a much greater extent than with dolphins in adjacent waters. Although the shoreward boundary of W-151 is beyond these environments, individuals from these stocks could potentially enter the project area. Movement between various communities has been documented (Waring et al., 2009), and Fazioli et al. (2006) reported that dolphins found within bays, sounds, and estuaries on the west central Florida coast move into the nearby Gulf waters used by coastal stocks. Air-to-surface activities will occur directly seaward of the area occupied by the Choctawhatchee Bay stock. The best abundance estimate for this stock, as provided in the Stock Assessment Report, is 179 resident dolphins, with an additional 232 transient dolphins. Stocks immediately to the west and east of Choctawhatchee Bay include Pensacola/East Bay and St. Andrew Bay stocks. PBR for the Choctawhatchee Bay stock is 1.7 individuals. NMFS considers all bay, sound, and estuary stocks to be strategic.

Three coastal stocks have been identified in the northern Gulf of Mexico, occupying waters from the shore to the 20-meter (66-foot) isobath: Eastern Coastal, Northern Coastal, and Western Coastal stocks. The Western Coastal stock inhabits nearshore waters from the Texas/Mexico border to the Mississippi River Delta. The Northern Coastal stock's range is considered to be from the Mississippi River Delta to the Big Bend region of Florida (approximately 84°W). The Eastern Coastal stock is defined from 84°W to Key West, Florida. Of the coastal stocks, the Northern Coastal is geographically associated with the GRATV target location. PBR is 20 individuals. Prior to 2012, this stock was not considered strategic. However, the 2012 Stock Assessment Report identifies an ongoing Unusual Mortality Event of unprecedented size and duration (since February 2012) that has resulted in NMFS' reclassification of this stock as strategic.

Affected Species Status and Distribution

The Northern Gulf of Mexico Continental Shelf stock is defined as bottlenose dolphins inhabiting the waters from the Texas/Mexico border to Key West, Florida, between the 20- and 200-meter (66- and 656-foot) isobaths. The continental shelf stock probably consists of a mixture of coastal and offshore ecotypes. PBR is undetermined, and the stock is not considered strategic.

The Northern Gulf of Mexico Oceanic stock is provisionally defined as bottlenose dolphins inhabiting waters from the 200-meter (656-foot) isobath to the seaward extent of the U.S. Exclusive Economic Zone. This stock is believed to consist of the offshore form of bottlenose dolphins. The continental shelf stock may overlap with the oceanic stock in some areas and may be genetically indistinguishable. PBR is 42 individuals, and the stock is not considered strategic.

Diving Behavior – Dive durations as long as 15 minutes are recorded for trained individuals (Ridgway et al., 1969). Typical dives, however, are more shallow and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths (Mate et al., 1995) and can last longer than 5 minutes during deep offshore dives (Klatsky et al., 2005). Offshore bottlenose dolphins regularly dive to 450 meters (1,476 ft) and possibly as deep as 700 meters (2,297 ft) (Klatsky et al., 2005).

Acoustics and Hearing – Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks and whistles have a dominant frequency range of 110 to 130 kiloHertz (kHz) and a source level of 218 to 228 decibels referenced to one micropascal-meter (dB re 1 µPa-m peak-to-peak) (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 µPa-m peak-to-peak, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Janik et al., 2006). Sound production is influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fishes in some regions (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook et al., 2004). Whistles and clicks may vary geographically in terms of overall vocal activity, group size, and specific context (e.g., feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky et al., 2005; Baron, 2006).

Bottlenose dolphins can hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Temporary threshold shifts (TTS) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses) (Ridgway et al., 1997; Schlundt et al., 2000; Nachtigall et al., 2003; Finneran et al., 2005; Mooney et al., 2005;

Mooney, 2006). Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 µPa-m (Ridgway et al., 1997; Schlundt et al., 2000).

Distribution –Bottlenose dolphins are distributed worldwide in tropical and temperate waters. The species occurs in all three major oceans and many seas. In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig et al., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters over the outer continental shelf and inner slope, as far north as Georges Bank (CETAP, 1982; Kenney, 1990).

Gulf of Mexico

The bottlenose dolphin is the most widespread and common cetacean in coastal waters of the Gulf of Mexico (Würsig et al., 2000). The species is abundant in continental shelf waters throughout the northern Gulf of Mexico (Fulling et al., 2003; Waring et al. (2006), including the outer continental shelf, upper slope, nearshore waters, the DeSoto Canyon region, the West Florida Shelf, and the Florida Escarpment. Mullin and Fulling (2004) noted that in oceanic waters, bottlenose dolphins are encountered primarily in upper continental slope waters (less than 1,000 m [3281 ft] in bottom depth) and that highest densities are in the northeastern Gulf. Significant occurrence is expected near all bays in the northern Gulf.

The results of a recent survey effort of nearshore and continental shelf waters of the eastern Gulf of Mexico (Garrison, 2008) identified four areas where bottlenose dolphins were clustered in winter: nearshore waters off Louisiana, the Florida Panhandle, north of Tampa Bay, and southwestern Florida. Dolphins were also common over the entire shelf. In summer, the number of group sightings was comparatively lower than in winter, and bottlenose dolphins were more evenly distributed throughout coastal and shelf waters.

4.2 ATLANTIC SPOTTED DOLPHIN (*STENELLA FRONTALIS*)

Description – The Atlantic spotted dolphin is similar in appearance to the bottlenose dolphin, with the exception of spots that occur on mature individuals. The body is typically somewhat larger than the inshore bottlenose dolphin ecotype, with a moderately long, thick beak. The dorsal fin is tall and falcate and there is generally a prominent spinal blaze. Adults are up to 2.3 meters (7.5 ft) long and can weigh as much as 143 kilograms (315 pounds) (Jefferson et al., 1993). Atlantic spotted dolphins are born spotless and develop spots as they age (Perrin et al., 1994; Herzing, 1997).

There is marked regional variation in adult body size of the Atlantic spotted dolphin (Perrin et al., 1987). In addition, there are two forms: a robust, heavily spotted form that inhabits the continental shelf, usually found within 250 to 350 km (135 to 189 NM) of the coast, and a smaller, less-spotted form that inhabits offshore waters (Perrin et al., 1994). The largest body size occurs in waters over the continental shelf of North America (East Coast and Gulf of

Mexico) and Central America (Perrin, 2002). The smaller, offshore form is not known to occur in the Gulf of Mexico.

Status – The most recent abundance estimate, as provided in the 2012 Stock Assessment Report, is 37,611 individuals in the northern Gulf of Mexico (outer continental shelf and oceanic waters). The northern Gulf of Mexico population is considered to be genetically distinct from western North Atlantic populations. PBR for this species is undetermined, and the stock is not considered strategic.

Diving Behavior – Information on diving depth for this species is available from a satellite-tagged individual in the Gulf of Mexico (Davis et al., 1996). This individual made short, shallow dives to less than 10 meters (33 ft) and as deep as 60 meters (197 ft), while in waters over the continental shelf.

Acoustics and Hearing – A variety of sounds including whistles, echolocation clicks, squawks, barks, growls, and chirps have been recorded for the Atlantic spotted dolphin. Whistles have dominant frequencies below 20 kHz (range: 7.1 to 14.5 kHz) but multiple harmonics extend above 100 kHz, while burst pulses consist of frequencies above 20 kHz (dominant frequency of approximately 40 kHz) (Lammers et al., 2003). Other sounds typically range in frequency from 0.1 to 8 kHz (Thomson and Richardson, 1995). Recorded echolocation clicks had two dominant frequency ranges at 40 to 50 kHz and 110 to 130 kHz, depending on source level (Au and Herzing, 2003). Echolocation click source levels as high as 210 dB re 1 µPa-m peak-to-peak have been recorded (Au and Herzing, 2003). Spotted dolphins in the Bahamas were frequently recorded during aggressive interactions with bottlenose dolphins (and their own species) to produce squawks (0.2 to 12 kHz broad band burst pulses; males and females), screams (5.8 to 9.4 kHz whistles; males only), barks (0.2 to 20 kHz burst pulses; males only), and synchronized squawks (0.1-15 kHz burst pulses; males only in a coordinated group) (Herzing, 1996).

Hearing ability for the Atlantic spotted dolphin is unknown. However, odontocetes are generally adapted to hear in relatively high frequencies (Ketten, 1997).

Distribution – Atlantic spotted dolphins are distributed in warm-temperate and tropical Atlantic waters from northern New England to Venezuela, including the Gulf of Mexico and the Caribbean Sea (Perrin et al., 1987). Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994). In oceanic waters, this species usually occurs near the shelf break and upper continental slope waters (Davis et al., 1998; Mullin and Hansen, 1999).

Gulf of Mexico

The Atlantic spotted dolphin is the second most abundant cetacean in the nearshore waters of the northern Gulf of Mexico. In the Gulf, Atlantic spotted dolphins are most abundant east of Mobile Bay (Fulling et al., 2003). On the West Florida shelf, spotted dolphins are more common in deeper waters than bottlenose dolphins (Griffin and Griffin, 2003).

5. TAKE AUTHORIZATION REQUESTED

The MMPA established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters under U.S. jurisdiction. The act further regulates "takes" of marine mammals in the high seas by vessels or persons under U.S. jurisdiction. The term *take*, as defined in Section 3 (16 United States Code [USC] 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." *Harassment* was further defined in the 1994 amendments to the MMPA, which provided for two levels: Level A (potential injury) and Level B (potential disturbance).

The National Defense Authorization Act of fiscal year 2004 (Public Law 108-136) amended the definition of harassment for military readiness activities. Military readiness activities, as defined in Public Law 107-314, Section 315(f), includes all training and operations related to combat, and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat. This definition, therefore, includes air-to-surface test and training activities occurring in the EGTTR. The amended definition of harassment for military readiness activities is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild ("Level A harassment"), or
- Disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including but not limited to migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered ("Level B harassment") (16 USC 1362 [18][B][i],[ii]).

Section 101(a)(5) of the MMPA directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing) within a specified geographic region. These incidental takes may be allowed if NMFS determines the taking will have a negligible impact on the species or stock and the taking will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Pursuant to Section 101(a)(5), a LOA for the incidental taking (but not intentional taking) of marine mammals is requested for air-to-surface test and training activities within the EGTTR. The results of acoustic modeling for surface and subsurface detonations indicate the potential for mortality (less than two animals), as well as Level A and Level B (physiological and behavioral) harassment, and take is requested for these levels of impact. However, it is expected that the mitigation measures identified in Section 11 will substantially decrease the number of impacts, and mortality takes are unlikely. The subsequent analyses in this request will identify the applicable types of take.

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6. NUMBERS AND SPECIES TAKEN

Potential marine mammal impacts are considered to occur as a result of pressure and noise generated by detonations at or under the water surface. The potential for ordnance to physically strike marine mammals was evaluated in the 2002 PEA. The analysis concluded the potential for a direct strike was improbable even without taking into consideration that units actively survey and avoid marine species and target specific items and that animals spend most of the time submerged. While the quantity of expended gunnery rounds and inert bombs and missiles would increase somewhat under currently proposed actions, the probability of a direct strike remains remote. In addition, the direct strike calculations provided in the 2002 PEA included all cetacean species potentially present in the northern Gulf of Mexico, whereas only two species are included in this LOA request. Therefore, potential impacts resulting from direct strikes are not considered further.

Dolphins spend their entire lives in the water and are submerged below the surface for much of the time. As a result, dolphins located near an underwater or surface detonation would be exposed to the resulting shock wave and underwater noise effects. Animals located near a detonation may experience tissue damage, eardrum rupture, or other physical impacts that can result in death or injury. As the pressure and sound waves spread away from the detonation point, they lose energy. Therefore, at increasing distances from a detonation, effects may include temporary or permanent hearing threshold shifts or behavioral reactions, such as startle effects or disruption of normal activities. The potential numbers and species taken are assessed in this section. Appendix A includes a detailed description of the acoustic modeling methodology used to estimate exposures. Three sources of information are necessary for estimating potential noise effects on marine mammals: 1) the zone of influence (ZOI), which is the distance from the explosion to which particular levels of impact would extend; 2) the density of animals within the ZOI; and 3) the number of detonations (events). Noise and pressure effects are evaluated only for detonations occurring at and beneath the water surface. In-air detonations are not included in impacts analysis because of the negligible transmission of energy and pressure across the air-water interface.

6.1 ZONE OF INFLUENCE

The ZOI is defined as the area or volume of ocean in which marine mammals could be exposed to various pressure or noise energy levels caused by exploding ordnance. The pressure and energy levels considered to be of concern are defined in terms of metrics, criteria, and thresholds. A *metric* is a technical standard of measurement that describes the noise and pressure at a given location. *Criteria* are the types of possible impact and include mortality, injury, and harassment. A *threshold* is the level of pressure or noise above which the impact criteria are reached. The analysis of potential impacts to marine mammals incorporates criteria and thresholds presented in Finneran and Jenkins (2012), which have been recently adopted by NMFS. The paragraphs below provide a general discussion of the various metrics, criteria, and thresholds used for impulsive noise impact assessment. More detailed information is provided in Appendix A.

Numbers and Species Taken

6.2 METRICS

Standard impulsive and acoustic metrics were used for the analysis of underwater energy and pressure waves in this document. Several different metrics are important for understanding risk assessment analysis of impacts to marine mammals.

SPL (sound pressure level): A ratio of the absolute sound pressure and a reference level. Units are in decibels referenced to 1 micropascal (dB re 1 µPa).

SEL (sound exposure level): SEL is a measure of sound intensity and duration. When analyzing effects on marine animals from multiple moderate-level sounds, it is necessary to have a metric that quantifies cumulative exposures. SEL can be thought of as a composite metric that represents both the intensity of a sound and its duration. SEL is determined by calculating the decibel level of the cumulative sum-of-squared pressures over the duration of a sound, with units of decibels referenced to 1 micropascal-squared seconds (dB re 1 $\mu Pa^2 \cdot s$) for sounds in water.

Positive impulse: This is the time integral of the pressure over the initial positive phase of an arrival. This metric represents a time-averaged pressure disturbance from an explosive source. Units are typically pascal-seconds (Pa·s) or pounds per square inch per millisecond (psi·msec). There is no decibel analog for impulse.

6.3 CRITERIA AND THRESHOLDS

The criteria and thresholds currently endorsed by NMFS for use in marine mammal impacts analysis include mortality, injurious harassment (Level A), and non-injurious harassment (Level B). Each category is discussed below.

6.3.1 Mortality

Whereas a single mortality threshold was previously used in acoustic impacts analysis, species-specific thresholds are currently required. Thresholds are based on the level of impact that would cause extensive lung injury from which 1 percent of exposed animals would not recover (Finneran and Jenkins, 2012). The threshold represents the expected onset of mortality, where 99 percent of exposed animals would be expected to survive. The lethal exposure level of blast noise, associated with the positive impulse pressure of the blast, is expressed as Pa·s and is determined using the Goertner (1982) modified positive impulse equation. This equation incorporates sound propagation, source/animal depths, and the mass of a newborn calf for the affected species. The threshold is conservative because animals of greater mass can withstand greater pressure waves, and newborn calves typically make up a very small percentage of any cetacean group.

For the actions described in this LOA request, two species are expected to occur within the study area: the bottlenose dolphin and the Atlantic spotted dolphin. Finneran and Jenkins (2012) provide known or surrogate masses for newborn calves of several cetacean species. For the bottlenose dolphin, this value is 14 kilograms (kg) (31 pounds). Values are not provided for the Atlantic spotted dolphin and, therefore, a surrogate species, the striped dolphin (*Stenella coeruleoalba*), is used. The mass provided for a newborn striped dolphin calf is 7 kg

Numbers and Species Taken

(15 pounds). Impacts analysis for the unidentified dolphin group (assumed to consist of bottlenose and Atlantic striped dolphins) conservatively used the mass of the smaller spotted dolphin. The Goertner equation, as presented in Finneran and Jenkins (2012) and used in the acoustic model to develop impacts analysis in this LOA request, is as follows:

$$I_M(M,D) = 91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$$

$I_M(M,D)$	mortality threshold, expressed in terms of acoustic impulse (Pa·s)
M	Animal mass (Table D-1)
D	Water depth (m)

6.3.2 Injury (Level A Harassment)

Three categories of blast-related injury (Level A harassment) are currently recognized by NMFS: gastrointestinal (GI) tract injury, slight lung injury, and irrecoverable auditory damage.

Gastrointestinal Tract Injuries

GI tract injuries are correlated with the peak pressure of an underwater detonation. GI tract injury thresholds are based on the results of experiments in the 1970s in which terrestrial mammals were exposed to small charges. The peak pressure of the shock wave was found to be the causal agent in recoverable contusions (bruises) in the GI tract (Richmond et al., 1973, in Finneran and Jenkins, 2012). The experiments found that a peak SPL of 237 dB re 1 µPa predicts the onset of GI tract injuries, regardless of an animal's mass or size. Therefore, the unweighted peak SPL of 237 dB re 1 µPa is used in explosive impacts assessments as the threshold for slight GI tract injury for all marine mammals.

Slight Lung Injury

This threshold is based on a level of lung injury from which all exposed animals are expected to survive (zero mortality). Similar to the mortality determination, the metric is positive impulse and the equation for determination is that of the Goertner injury model (1982), which is defined as:

$$I_S(M,D) = 39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2},$$

where M is the animal mass (kg), D is the animal depth (m), and the units of I_S are Pa·s.

Numbers and Species Taken

Animal mass is considered to be that of a newborn calf. As described in the discussion of the mortality criterion, the striped dolphin is used as a surrogate for Atlantic spotted dolphin and spotted dolphin mass is used for the unidentified dolphin group.

Auditory Damage (Permanent Threshold Shift)

Another type of injury correlated to Level A harassment is permanent threshold shift (PTS), which is auditory damage that does not recover and results in a permanent decrease in hearing sensitivity. There have been no studies to determine the onset of PTS in marine mammals and, therefore, this threshold must be estimated from other available information. Finneran and Jenkins (2012) define separate PTS thresholds for three groups of cetaceans based on hearing sensitivity: low frequency, mid-frequency, and high frequency. Bottlenose and Atlantic spotted dolphins both fall within the mid-frequency hearing category. Dual criteria are provided for PTS thresholds, one based on the SEL and one based on the SPL of an underwater blast. For a given analysis, the more conservative of the two is typically applied to afford the most protection to marine mammals. The mid-frequency cetacean criteria for PTS are:

- SEL (mid-frequency weighted) of 187 dB re 1 $\mu Pa^2 \cdot s$
- Peak SPL (unweighted) of 230 dB re 1 μPa

6.3.3 Non-Injurious Impacts (Level B Harassment)

Two categories of non-injurious Level B harassment are currently recognized: temporary threshold shift (TTS) and behavioral impacts. Although TTS is a physiological impact, it is not considered injury because auditory structures are temporarily fatigued instead of being permanently damaged.

Temporary Threshold Shift (TTS)

Similar to PTS, dual criteria are provided for TTS thresholds, and the more conservative is typically applied in impacts analysis. According to Finneran and Jenkins (2012), the onset thresholds for mid-frequency cetaceans are based on TTS data from a beluga whale exposed to an underwater impulse produced from a seismic watergun. The TTS thresholds consist of the SEL of an underwater blast weighted to the hearing sensitivity of mid-frequency cetaceans and an unweighted peak SPL measure. The dual thresholds for TTS in mid-frequency cetaceans are:

- SEL (mid-frequency weighted) of 172 dB re 1 $\mu Pa^2 \cdot s$
- Peak SPL (unweighted) of 224 dB re 1 μPa

Behavioral Impacts

Behavioral impacts refer to disturbances that may occur at noise levels below those considered to cause TTS in marine mammals, particularly in cases of multiple detonations. Behavioral impacts may include decreased ability to feed, communicate, migrate, or reproduce, among others. Such effects, known as sub-TTS Level B harassment, are based on observations of behavioral reactions in captive dolphins and beluga whales exposed to pure tones, a different type of noise than that produced from an underwater detonation (Finneran and Schlundt, 2004; Schlundt et al.,

2000). The behavioral impacts threshold for mid-frequency cetaceans exposed to multiple, successive detonations is:

- SEL (mid-frequency weighted) of 167 dB re 1 $\mu Pa^2 \cdot s$

6.3.4 Summary of Criteria and Thresholds

Table 6-1 summarizes the thresholds and criteria discussed above and used to estimate potential noise impacts to marine mammals resulting from detonations. All criteria and thresholds are derived from Finneran and Jenkins (2012).

Table 6-1. Criteria and Thresholds Used for Impact Analyses

Mortality[1]	Level A Harassment			Level B Harassment	
	Slight Lung Injury[1]	GI Tract Injury	PTS	TTS	Behavioral
$91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	$39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	Unweighted SPL: 237 dB re 1 µPa	Weighted SEL: 187 dB re 1 $\mu Pa^2 \cdot s$	Weighted SEL: 172 dB re 1 $\mu Pa^2 \cdot s$	Weighted SEL: 167 dB re 1 $\mu Pa^2 \cdot s$
			Unweighted SPL: 230 dB re 1 µPa	Unweighted SPL: 224 dB re 1 µPa (23 psi peak pressure)	

D = water depth (meters); dB re 1 µPa = decibels referenced to 1 micropascal; dB re 1 $\mu Pa^2 \cdot s$ = decibels referenced to 1 micropascal-squared second; *M* = animal mass based on species (kilograms); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift

1. Expressed in terms of acoustic impulse (pascal seconds [Pa·s])

6.4 MARINE MAMMAL DENSITY

Density estimates for marine mammals occurring in the EGTTR are provided in Table 3-1, in Section 3). As discussed in Section 3, densities were provided in documents published by NMFS personnel and were, in some cases, adjusted based on relevant literature. Density is nearly always reported for an area (e.g., animals per square kilometer). Analyses of survey results may include correction factors for negative bias, such as the Garrison (2008) report for bottlenose dolphins. Even though Fulling et al. (2003) did not provide a correction for Atlantic spotted dolphins or unidentified bottlenose/spotted dolphins, Eglin AFB adjusted those densities based on information provided in Barlow (2003 and 2006). Density estimates usually assume that animals are uniformly distributed within the affected area, even though this is likely rarely true. Marine mammals may be clumped in areas of greater importance; for example, animals may be more concentrated in areas offering high prey availability, lower predation, safe calving, etc. However, because there are usually insufficient data to calculate density for small areas, an even distribution is typically assumed.

Although the study area is depicted in preceding figures as only the surface of the water, density actually implicitly includes animals anywhere within the water column under that surface area. Assuming that marine mammals are distributed evenly within the water column does not accurately reflect animal behaviors. Databases of behavioral and physiological parameters obtained through tagging and other technologies have demonstrated that marine animals use the water column in various ways. Some species conduct regular deep dives while others engage in much shallower dives, regardless of bottom depth. Assuming that all species are evenly distributed from surface to bottom is almost never appropriate and can present a distorted view of marine mammal distribution in any region. Therefore, for purposes of this document, a depth

distribution adjustment is applied to marine mammal densities (Table 6-2). By combining marine mammal density with depth distribution information, a three-dimensional density estimate is possible. These estimates allow more accurate modeling of potential exposures from specific noise sources.

Table 6-2. Marine Mammal Depth Distribution

Species	Depth Distribution	Reference
Bottlenose dolphin	Daytime: 96% at <50 m, 4% at >50 m; nighttime: 51% at <50 m, 8% at 50–100 m, 19% at 101–250 m, 13% at 251–450 m, and 9% at >450 m	Klatsky et al. (2007)
Atlantic spotted dolphin	76% at <10 m, 20% at 10–20 m, and 4% at 21–60 m	Davis et al. (1996)

m = meters

6.5 NUMBER OF EVENTS

The number of events generally corresponds to the number of live ordnance items used, which is provided in Table 1-14. Exceptions include 25-, 30-, and 40-mm gunnery rounds and simultaneous SDB launches. In cases of multiple detonations in close proximity occurring over a very short time (from less than a second to a few seconds), pressure and energy impacts may be modeled differently. As discussed in Section 1.5, a simultaneous launch event of two SDBs is modeled as one detonation with double the NEW of a single SDB, although the bombs may detonate a few seconds apart (five seconds or less). This assumption is conservative because, in reality, pressure would only double if 1) the bombs detonated at exactly the same time and point in the water or 2) the pressure waves intersected with each other. The bombs would not detonate at exactly the same time and place and, as discussed in the acoustic modeling description (Appendix A), the probability of multiple pressure waves intersecting at any given point in the ocean is negligible. The assumption is similarly conservative for the positive impulse metric. The 25-, 30-, and 40-mm gunnery rounds are fired in bursts, with between about 6 and 65 rounds fired per second, depending on the munition. The typical number of rounds per burst for each munition is shown in Table 6-3.

Table 6-3. Number of Gunnery Rounds Fired per Burst

Gunnery Round	# Rounds Fired per Burst
25 mm	100
30 mm	20
40 mm	20

mm = millimeter

For gunnery bursts, pressure is not added for each round. The number of animals affected by pressure (peak pressure and positive impulse) is reduced by one per number of rounds per burst. However, energy metrics such as SEL accumulate the integral of the power density of each explosion over the duration of the impulse. Therefore, the energy from each separate explosion in a burst is added. It is assumed that all rounds in a burst affect the same animal population and that the population is refreshed between bursts. Refer to Appendix A for a complete description of the acoustic modeling used for impacts analysis in this LOA request. It is noted that the 7.62-mm and 50-cal rounds do not contain high-explosive material and, therefore, do not

detonate or introduce energy or pressure into the water column. Therefore, these rounds are not included in impacts analysis.

6.6 EXPOSURE ESTIMATES

Based on the acoustic modeling described in Appendix A, Table 6-5 provides the maximum estimated range, or radius, from the detonation point to which the various thresholds extend. As described earlier, only detonations at or below the water surface are included; in-air detonations are not included because energy and pressure transfer across the air-water interface is considered negligible. The larger of the ranges between summer and winter is listed in the table. In all cases, summer ranges are equal to or larger than winter ranges (SEL-based ranges are larger, while other ranges are equal). Both winter and summer ranges were used to calculate the total area of the ZOIs, reflecting an even distribution of testing and training throughout the year. The ranges were then combined with density estimates and the number of events to provide an estimate of the number of marine mammals potentially exposed to the various impact thresholds. For metrics with two criteria (e.g., 187 dB SEL and 230 peak SPL for PTS), the criterion that results in the higher exposure estimate is presented and used for impact calculations. Exposure estimates do not take into account the required mitigation and monitoring measures described in Section 11 of this document.

Table 6-4 indicates the resulting total number of marine mammals potentially exposed and includes the possibility of mortality, injury, and non-injurious harassment (including behavioral harassment) to marine mammals in the absence of mitigation measures. The numbers represent total impacts for all detonations combined. Implementation of the mitigation and monitoring measures outlined in Section 11 is expected to decrease the number of takes estimated in the table.

Table 6-4. Number of Marine Mammals Potentially Affected by Air-to-Surface Testing and Training Missions in the EGTTR

Species	Mortality	Level A Harassment (PTS)	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	1.39	156	8,174	15,332
Atlantic spotted dolphin	0.48	56.3	1,810	2,600
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.08	0.31	1.15	60.2
Total[1]	**1.95**	**213**	**9,985**	**17,992**

PTS = permanent threshold shift; TTS = temporary threshold shift

1 Number of animals impacted by higher thresholds subtracted from less impactive thresholds.

Table 6-5. Threshold Radii (in meters) for EGTTR Air-to-Surface Testing and Training Ordnance

Munition	NEW (lbs)	Detonation Scenario	Mortality	Level A Harassment				Level B Harassment		
			Modified Goertner Model 1	Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
				Modified Goertner Model 2	237 dB SPL	187 dB SEL	230 dB Peak SPL	172 dB SEL	224 dB Peak SPL	167 dB SEL
Bottlenose Dolphin										
GBU-10 or GBU-24	945	Surface	199	350	340	1,128	698	2,547	1,280	3,125
		Subsurface	448	807	343	2,156	698	5,687	1,281	7,580
AGM-158 (JASSM)	300	Surface	132	264	231	848	475	2,072	873	2,602
GBU-12 or GBU-54	192	Surface	111	233	198	781	409	1,879	752	2,547
		Subsurface	273	508	201	1,272	411	4,314	753	5,687
AGM-65 (Maverick)	86	Surface	82	177	150	677	312	1,625	575	2,122
GBU-39 (Double)	74	Surface	77	167	142	621	296	1,619	546	2,084
AIM-9X	68	Surface	75	162	138	616	288	1,617	532	2,076
GBU-39 (SDB I or LSDB)	37	Surface	59	128	112	522	234	1,382	433	1,876
		Subsurface	147	296	116	605	237	3,093	435	4,310
Joint Air-to-Ground Missile	27	Surface	52	113	102	480	211	1,347	392	1,709
GBU-53 (SDB II)	23	Surface	48	105	95	436	199	1,334	368	1,703
		Subsurface	118	245	99	486	202	2,727	370	3,887
AGM-114 (Hellfire)	20	Surface	45	100	92	414	191	1,320	352	1,680
		Subsurface	110	229	95	480	193	2,679	354	3,880
AGM-176 (Griffin)	4.58	Surface	24	53	55	177	116	961	216	1,332
2.75 rockets	10	Surface	34	75	72	295	151	1,129	279	1,600
105-mm FU	4.7	Surface	24	54	56	205	117	962	218	1,333
40-mm burst	0.9	Surface	10	24	33	596	67	1,418	124	2,019
Live fuse	0.4	Surface	7	16	25	46	52	521	95	777
105-mm TR	0.3	Surface	6	15	24	43	49	517	91	769
30-mm burst	0.1	Surface	0	7	16	208	33	965	60	1,334
25-mm burst	0.07	Surface	0	5	14	477	29	1,345	53	1,708

Munition	NEW (lbs)	Detonation Scenario	Mortality	Level A Harassment					Level B Harassment		
			Modified Goertner Model 1	Slight Lung Injury	GI Tract Injury	PTS			TTS		Behavioral
				Modified Goertner Model 2	237 dB SPL	187 dB SEL	230 dB Peak SPL	172 dB SEL	224 dB Peak SPL	167 dB SEL
Atlantic Spotted Dolphin and Unidentified Dolphin[1]										
GBU-10 or GBU-24	945	Surface	237	400	340	1,128	698	2,547	1,280	3,125
		Subsurface	530	946	343	2,156	698	5,687	1,281	7,580
AGM-158 (JASSM)	300	Surface	162	307	231	848	475	2,072	873	2,602
GBU-12 or GBU-54	192	Surface	138	274	198	781	409	1,879	752	2,547
		Subsurface	325	600	201	1,272	411	4,314	753	5,687
AGM-65 (Maverick)	86	Surface	101	216	150	677	312	1,625	575	2,122
GBU-39 (Double)	74	Surface	96	206	142	621	296	1,619	546	2,084
AIM-9X	68	Surface	92	200	138	616	288	1,617	532	2,076
GBU-39 (SDB I or LSDB)	37	Surface	73	158	112	522	234	1,382	433	1,876
		Subsurface	177	355	116	605	237	3,093	435	4,310
Joint Air-to-Ground Missile	27	Surface	64	140	102	480	211	1,347	392	1,709
GBU-53 (SDB II)	23	Surface	60	130	95	436	199	1,334	368	1,703
		Subsurface	144	295	99	486	202	2,727	370	3,887
AGM-114 (Hellfire)	20	Surface	56	124	92	414	191	1,320	352	1,680
		Subsurface	135	277	95	480	193	2,679	354	3,880
AGM-176 (Griffin)	4.58	Surface	30	66	55	177	116	961	216	1,332
2.75 rockets	10	Surface	42	93	72	295	151	1,129	279	1,600
105-mm FU	4.7	Surface	30	67	56	205	117	962	218	1,333
40-mm burst	0.9	Surface	13	30	33	596	67	1,418	124	2,019
Live fuse	0.4	Surface	8	20	25	46	52	521	95	777
105-mm TR	0.3	Surface	8	18	24	43	49	517	91	769
30-mm burst	0.1	Surface	0	9	16	208	33	965	60	1,334
25-mm burst	0.07	Surface	0	7	14	477	29	1,345	53	1,708

AGM = air-to-ground missile; AIM = air intercept missile; cal = caliber; dB = decibels; FU = full up; GBU = Guided Bomb Unit; GI = gastrointestinal; lbs = pounds; LSDB = Laser Small Diameter Bomb; mm = millimeters; NEW = net explosive weight; SDB = small diameter bomb; PTS = permanent threshold shift; TR = training round; TTS = temporary threshold shift

[1]Unidentified dolphin can be either bottlenose or Atlantic spotted dolphin. Mortality and slight lung injury criteria are conservatively based on the mass of a newborn Atlantic spotted dolphin (striped dolphin surrogate)

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7. IMPACTS TO MARINE MAMMAL SPECIES OR STOCKS

Based on acoustic modeling and in the absence of mitigation measures, a total of almost two dolphins could be affected by impulse pressure levels associated with mortality. It is noted that only fractions of an animal are calculated for Atlantic spotted and unidentified dolphins (about half an animal and near zero animals, respectively). Any mortality takes would most likely involve bottlenose dolphins. It is expected that the mitigation measures described in Section 11 will substantially decrease the potential for mortality.

A maximum of up to approximately 213 marine mammals could potentially be exposed to injurious Level A harassment (approximately 156 bottlenose dolphins, 56 Atlantic spotted dolphins, and less than 1 unidentified dolphin). Level A harassment could result from slight lung injury, peak SPL resulting in GI track injury, or one of the two thresholds resulting in the onset of PTS. Since the threshold with the highest exposure estimates was used to determine takes, impacts are associated with the 187 dB SEL threshold, which corresponds to the onset of PTS, or a permanent decrease in hearing sensitivity.

A maximum of approximately 9,985 marine mammals could potentially be exposed to non-injurious (TTS) Level B harassment. TTS results from fatigue or damage to hair cells or supporting structures and may cause disruption in the processing of acoustic cues. However, hearing sensitivity is recovered within a relatively short time. Similar to Level A harassment, the SEL metric (172 dB re 1 $\mu Pa^2 \cdot s$) results in higher exposure estimates compared with the peak SPL metric (224 dB re 1 μPa).

Approximately 17,992 animals could potentially be exposed to noise corresponding to the behavioral threshold of 167 dB SEL during air-to-surface test and training missions. Behavioral harassment occurs at distances beyond the range of structural damage and hearing threshold shift. Possible behavioral responses to a detonation include panic, startle, departure from an area, and disruption of activities such as feeding or breeding.

None of the above estimates take into account the mitigation measures outlined in Section 11, which are expected to reduce the number of exposures.

Atlantic spotted dolphins potentially affected by air-to-surface activities conducted in the EGTTR are part of the northern Gulf of Mexico stock, which is considered to occur over the continental shelf from 10 to 200 meters depth and onto the continental slope. This stock is not considered strategic. Four bottlenose dolphin stocks occur in the north-central Gulf of Mexico and could potentially be affected by test activities. The Choctawhatchee Bay stock occurs north of the EGTTR boundary and is considered strategic. It is not probable that large numbers of dolphins from this stock would be affected, given that most activities will occur at least 17 miles seaward of Choctawhatchee Bay. However, individuals may move into deeper water at times and, therefore, there is some potential for occurrence. In addition, individuals from other adjacent bay, sound, and estuarine stocks (primarily Pensacola/East Bay and St. Andrew Bay), which are also considered strategic, could potentially transit the areas. Bottlenose dolphins affected by activities are most likely to be associated with the northern coastal stock (shoreline to

20 meter depth; considered strategic) and northern Gulf of Mexico continental shelf stock (20- to 200-meter depth; not considered strategic). Individuals from the oceanic stock, which is not strategic, are unlikely to be affected because of their distribution beyond the 200-meter isobath.

8. IMPACT ON SUBSISTENCE USE

Potential impacts resulting from the proposed activities will be limited to individuals of bottlenose dolphin and Atlantic spotted dolphin stocks located in nearshore waters of the northeastern Gulf of Mexico. These species have no subsistence requirements. Therefore, no impacts on the availability of species or stocks for subsistence use are considered.

Impact on Subsistence Use

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9. IMPACTS TO MARINE MAMMAL HABITAT AND THE LIKELIHOOD OF RESTORATION

The primary sources of marine mammal habitat impact are noise and pressure waves resulting from live weapon detonations. However, neither the noise nor overpressure constitutes a long-term physical alteration of the water column or ocean floor. Further, these effects are not expected to substantially affect prey availability, are of limited duration, and are intermittent. Surface vessels associated with the missions are present in limited duration and are intermittent as well. Therefore, it is not anticipated that marine mammals will stop utilizing the waters of W-151 or any other portion of the Gulf of Mexico, either temporarily or permanently, as a result of mission activities.

Other factors related to air-to-surface activities that could potentially affect marine mammal habitat include the introduction of metals, explosives and explosion by-products, other chemical materials, and debris into the water column and substrate due to the use of munitions and target vessels. The effects of each were analyzed under National Environmental Policy Act documentation (*Eglin Gulf Test and Training Range Environmental Assessment*; in preparation) and were determined to not be significant. The analysis in the REA is provided in the following paragraphs.

Metals

Various metals would be introduced into the water column through expended munitions. The casings, fins, or other parts of large munitions such as bombs and missiles are typically composed primarily of steel but usually also contain small amounts of lead, manganese, phosphorus, sulfur, copper, nickel, and several other metals (U.S. Navy, 2013). Many smaller caliber rounds contain aluminum, copper, and zinc. Aluminum is also present in some explosive materials such as tritonal and PBXN-109. Lead is present in batteries typically used in vessels such as the remotely controlled target boats. Many metals occur naturally in seawater at varying concentrations and some, such as aluminum, would not necessarily be detrimental to the substrate or water column. However, at high concentrations, a number of metals (e.g., lead) may be toxic to microbial communities in the substrate.

Munitions and other metal items would sink to the seafloor and would typically undergo one of three processes: 1) enter the sediment where there is reduced oxygen content, 2) remain exposed on the ocean floor and begin to react with seawater, or 3) remain exposed on the ocean floor and become encrusted with marine organisms. The rate of deterioration would therefore depend on the specific composition of an item and its position relative to the seafloor/water column. Munitions located deep in the sediment would typically undergo slow deterioration. Some portion of the metal ions would become bound to sediment particles. Metal materials exposed to seawater would begin to slowly corrode. This process typically creates a layer of corroded material between the seawater and metal, which slows the movement of the metal ions into the adjacent sediment and water column. Therefore, elevated levels of metals in sediment would be restricted to a small zone around the munitions, and releases to the overlying water column would be diluted. A similar process would occur with munitions that become covered by marine growth. Direct exposure to seawater would be reduced, thereby decreasing the rate of corrosion.

Impacts to Marine Mammal Habitat and the Likelihood of Restoration

Munitions that come to rest on the seafloor would slowly corrode and would release small amounts of metals to adjacent sediment and the water column. Metal particles that migrate into the water column would be diluted by diffusion and water movement. Elevated concentrations would be localized and would not be expected to significantly affect overall local or regional water quality. This expectation is supported by the results of two U.S. Navy studies related to munitions use and water quality, as summarized in U.S. Navy (2013). In one study, water quality sampling for lead, manganese, nickel, vanadium, and zinc was conducted at a shallow bombing range in Pamlico Sound off North Carolina immediately following a bomb training event with inert practice munitions. With the exception of nickel, all water quality parameters tested were within the state limits. The nickel concentration was significantly higher than the state criterion, although the concentration did not differ significantly from a control site located outside the bombing range. This suggests that bombing activities may not have been responsible for the elevated nickel concentration. The second study, conducted by the U.S. Marine Corps, included sediment and water quality sampling for 26 munitions constituents at several water training ranges. Metals included lead and magnesium. No levels were detected above screening values used at the water ranges.

Explosives and Explosion Byproducts

Chemical materials with potential to affect substrates and the water column include explosives, explosion by-products, and fuel, oil, and other fluids (including battery acid) associated with vessel operations and the use of remotely controlled target boats. Explosives are complex chemical mixtures that may affect water or sediment quality through the by-products of their detonation and the distribution of unconsumed explosives. Some of the more common types of explosive materials used in air-to-surface activities include tritonal and research department explosive (RDX). Tritonal is primarily composed of 2,4,6-trinitrotoluene (TNT). Therefore, discussion in the remainder of this section will consider TNT and RDX to be representative of all explosives. During detonation, energetic compounds may undergo high-order (complete) detonation or low-order (incomplete) detonation, or they may fail to detonate altogether. High-order detonations consume almost all of the explosive material, with the remainder released into the environment as discrete particles. Analysis of live-fire detonations on terrestrial ranges have indicated that over 99.9 percent of TNT and RDX explosive material is typically consumed during a high-order detonation (USACE, 2003). Pennington et al. (2006) reported a median value of 0.006 percent and 0.02 percent for TNT and RDX residue, respectively, remaining after detonation. The annual total NEW for all combined munitions is 30,488 pounds. Using the more conservative (higher) value of 0.02 percent for residual material, a total of about 6.1 pounds of explosive material could be deposited into the EGTTR annually. For purposes of analysis, it may be conservatively assumed that all residual materials are deposited simultaneously and remain within W-151A and within the top 10 ft of the water column (10 ft is the maximum detonation scenario for any munition). In this case, the resulting concentration of explosive material would be about 8×10^{-8} milligrams/liter (mg/L). In reality, the materials would be dispersed throughout a larger surface area and water volume by currents, waves, and wind (for in-air detonations). Although there are no regulatory standards specifically for explosive materials in marine waters, this value may be compared with the Department of Defense Range and Munitions Use Working Group marine screening value for the amount of C-4 (another type of explosive composed of mostly RDX) remaining after detonation (as provided

Impacts to Marine Mammal Habitat and the Likelihood of Restoration

in U.S. Navy, 2013). The screening value is 5 mg/L, which is many orders of magnitude greater than the concentration calculated above.

Various by-products are produced during and immediately after detonation of TNT and RDX. During the brief time that a detonation is in progress, intermediate products may include carbon ions, nitrogen ions, oxygen ions, water, hydrogen cyanide, carbon monoxide, nitrogen gas, nitrous oxide, cyanic acid, and carbon dioxide (Becker, 1995). However, reactions quickly occur between the intermediates, and the final products consist mainly of carbon (i.e., soot), carbon dioxide (CO_2), water, carbon monoxide (CO), and nitrogen gas (Swisdak, 1975). These substances are natural components of seawater. Other products, occurring at substantially lower concentrations, include hydrogen, ammonia, methane, and hydrogen cyanide, among others.

After detonation, the residual explosive materials and detonation by-products would be dispersed throughout the northern Gulf of Mexico by diffusion and by the action of wind, waves, and currents. A portion of the carbon compounds, such as CO and CO_2, would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds would be metabolized or assimilated by phytoplankton and bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be released to the atmosphere. In addition, many of the detonations would occur in the air or at the water surface. In these cases, some portion of the by-products could be widely distributed by wind. Given that the residual concentration of explosive material would be small, that most of the explosion by-products would be harmless or natural seawater constituents, and that by-products would dissipate or be quickly diluted, impacts resulting from high-order detonations would be negligible.

Low-order detonations consume a lower percentage of the explosive and, therefore, a portion of the material is available for release into the environment. If the ordnance fails to detonate, the entire amount of energetic compound remains largely intact and is released to the environment over time as the munition casing corrodes. The likelihood of incomplete detonations is not quantified; however, the portion of munitions that could fail to detonate (i.e., duds) has been estimated at between about 3 and 5 percent (USACE, 2007; Rand Corporation, 2005). Due to the potential dud rate, number of live munitions included in the 2015 REA, and NEW in each munition, an un-estimable but small amount of explosive material (TNT and RDX, among others) could enter the EGTTR annually through unexploded munitions. However, most of this material would not be available to the marine environment immediately. Explosive material would diffuse into the water through screw threads, cracks, or pinholes in the munition casings. Therefore, movement of explosive material into the water column would likely be a slow process, potentially ranging from months to decades.

After leaving the munition casing, explosive material would enter the sediment or water column. Similar to the discussion of explosive by-products above, chemical materials in the water column would be dispersed by currents and would eventually become uniformly distributed throughout the northern Gulf of Mexico. Explosive materials in the water column would also be subject to biotic (biological) and abiotic (physical and chemical) transformation and degradation, including hydrolysis, ultraviolet radiation exposure, and biodegradation. The results of a recent investigation suggest that TNT is rapidly degraded in marine environments by biological and photochemical processes (Walker et al., 2006). Marine ecosystems are generally nitrogen

limited compared with freshwater systems, and marine microbes such as bacteria may therefore readily use TNT metabolites (e.g., ammonia and ammonium). TNT that is not biodegraded may sorb (bind to by absorption or adsorption) onto particulates, break down into dissolved organic matter, or dissolve into the water column. TNT is also subject to photochemical degradation, known as photolysis, whereby the ultraviolet component of sunlight degrades the compound into products similar to those produced by biodegradation. Photolysis is more effective in waters of shallower depth and/or with greater clarity. Uptake and metabolism of TNT has also been noted in phytoplankton. It is assumed that similar processes could affect other explosives such as RDX.

The results of studies of UXO in marine environments generally suggest that there is little overall impact to water quality resulting from the leaching of explosive material. Various researchers have studied an area in Halifax Harbor, Nova Scotia, where UXO was deposited in 1945. Rodacy et al. (2000) reported that explosives signatures were detectable in 58 percent of water samples, but that marine growth was observed on most of the exposed ordnance. TNT metabolites, suspected to result from biological decomposition, were also detected. In an earlier study (Darrach et al. 1998), sediment collected near unexploded (but broken) ordnance did not indicate the presence of TNT, whereas samples near intact ordnance showed trace explosives in the range of low parts per billion or high parts per trillion. The authors concluded that, after 50 years, the contents of broken munitions had dissolved, reacted, biodegraded, or photodegraded and that intact munitions appear to be slowly releasing their contents through corrosion pinholes or screw threads.

Hoffsommer et al. (1972) analyzed seawater (as well as sediment and ocean floor fauna) at known munitions dumping sites off Washington State and South Carolina for the presence of TNT, RDX, tetryl, and ammonium perchlorate. None of these materials were found in any of the samples. Walker et al. (2006) sampled seawater and sediment at two offshore sites where underwater demolition was conducted using 10-pound charges of TNT and RDX. Residual TNT and RDX were below the detection limit in seawater, including samples collected in the plume within five minutes of detonation.

Other Chemical Materials

Additional materials produced during air-to-surface activities would include petroleum products (primarily fuel and oil in target boats), battery acid, and plastics. Increased use of remotely controlled target boats and mission support vessels would increase the potential for fuel, oil, and battery acid to be deposited in the water (primarily through destruction of target boats). When hydrocarbons enter the ocean, the lighter-weight components evaporate, degrade by sunlight, and undergo chemical degradation. Many constituents are also consumed by microbes. Higher-weight molecular compounds are more resistant to degradation and tend to persist after these processes have occurred. Microbial breakdown of PCBs has been documented in estuarine and marine sediments (Agency for Toxic Substances and Disease, 2000). In addition, currents would disperse any hydrocarbons produced during test and training activities. It is anticipated that potential impacts to water quality due to petroleum-based products would be insignificant. Similarly, battery acid, while possibly having a temporary and local effect on the water column, would be quickly dispersed and diluted by water currents.

Impacts to Marine Mammal Habitat and the Likelihood of Restoration

Missions that involve target boat destruction could result in generation of plastic or fiberglass debris. Because of their buoyancy and resistance to degradation, many types of plastic float and may travel long distances in the ocean (U.S. Commission on Ocean Policy, 2004). Plastics may serve as vehicles for transport of various pollutants, whether by binding them from seawater or from the constituents of the plastics themselves. However, it is anticipated that plastic items would eventually break down into smaller particles due to photolysis and mechanical wear (Law et al., 2010). Plastics may also wash ashore over time. In addition, for some missions involving target boat destruction, the Air Force would perform debris cleanup at the water surface.

Debris

Debris deposited on the seafloor would include spent munitions fragments and possibly pieces of targets (fiberglass, plywood, etc.). Debris would not appreciably affect the sandy seafloor. Debris moved by water currents could scour the bottom, but sediments would quickly refill any affected areas, and overall effects to benthic communities would be minor. Large pieces of debris would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Target boats have foam-filled hulls and most of the pieces are designed to float in order to facilitate collection for a damage assessment. Overall, the quantity of material deposited on the seafloor would be small compared with other sources of debris in the Gulf of Mexico. Hardbottom habitats and artificial reefs would be avoided when possible through location of target sites and training missions and would not be likely to be affected by debris. There is a potential for some debris to be carried by currents and interact with the substrate, but damage to natural or artificial reefs is not expected and the impacts would not be significant.

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10. IMPACTS TO MARINE MAMMALS FROM LOSS OR MODIFICATION OF HABITAT

Based on the discussions in Section 9, marine mammal habitat will not be lost or significantly modified.

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11. MEANS OF AFFECTING THE LEAST PRACTICABLE ADVERSE IMPACTS

The potential takes discussed in Section 6 represent the maximum expected number of animals that could be exposed to particular noise and pressure thresholds. The impact estimates do not take into account measures that will be employed to minimize impacts to marine species. Eglin proponents have a range of options available to support mitigation and monitoring efforts based on the types of assets (aircraft, surface vessels, etc.) available for specific test or training missions. Section 11.1 summarizes each of these measures, Section 11.2 describes monitoring options available for air-to-surface missions, and Section 11.3 outlines the implementation plan for executing them based on mission criteria.

11.1 GENERAL REQUIREMENTS FOR ALL AIR-TO-SURFACE ACTIVITIES

All air-to-surface testing and training missions in the EGTTR involving live ordnance will incorporate required monitoring and mitigation measures. These measures will include trained observers, pre- and post-mission monitoring from various platforms, and sea state restrictions. These measures are summarized below and will be implemented as described in Section 11.2.

11.1.1 Trained Observers

All monitoring will be conducted by personnel who have completed Eglin's Marine Species Observer Training Course, which was developed in cooperation with the National Marine Fisheries Service. This training includes a summary of environmental laws, consequences of non-compliance, description of an observer's role, pictures and descriptions of protected species and protected species indicators, survey methods, monitoring requirements, and reporting procedures. The training will be provided to user groups either electronically or in person by an Eglin Natural Resources representative. Any person acting as an observer for a particular mission must have completed the training within the year prior to the mission. Names of personnel who have completed the training will be submitted to Eglin Natural Resources along with the date of completion. In cases where multiple survey platforms are required to cover large survey areas, a Lead Biologist will be designated to lead all monitoring efforts and coordinate sighting information with the Test Director or Safety Officer (see Section 11.2.2).

11.1.2 Pre- and Post-Mission Monitoring

For each live mission, at a minimum, pre- and post-mission monitoring will be required. Monitoring will be conducted from a given platform depending on the specific mission. The purposes of pre-mission monitoring are to 1) evaluate the mission site for environmental suitability and 2) verify that the ZOI is free of visually detectable marine mammals and potential marine mammal indicators. The duration of pre-mission surveys will depend on the area required to be surveyed, survey platforms (vessels versus aircraft), and any potential lapse in time between the end of the surveys to the beginning of the mission. This lapse would typically occur when survey vessels are required to vacate the human safety zone prior to the aircraft releasing the munitions. All marine mammal sightings including the species (if possible), number, location, and behavior of the animals will be documented on report forms that will be

submitted to Eglin Natural Resources after each mission. Missions may be postponed, relocated, or cancelled based on the presence of protected species within the survey areas.

Post-mission monitoring is designed to determine the effectiveness of pre-mission mitigation by reporting sightings of any dead or injured marine mammals. The duration of post-mission surveys will vary based on survey platform and any potential time lapse between the last detonation of the mission and when the post-mission surveys can begin. This lapse typically occurs when survey vessels are stationed on the perimeter of the human safety zone and are required to wait until the range has been declared clear. Similar to pre-mission surveys, all sightings would be properly documented on report forms and submitted to Eglin Natural Resources.

If any marine mammals are killed or injured as a result of the mission, Eglin Natural Resources would be contacted immediately. Observers would document the species or description of the animal, location, and behavior and, if practicable, take pictures and maintain visual contact with the animal. Eglin Natural Resources would then contact the local Marine Mammal Stranding Coordinator and either await further instructions or the arrival of a response team on-site, if feasible. Last known GPS points would be provided to the Stranding Coordinator.

11.1.3 Sea State Conditions

Weather conducive to marine mammal monitoring is required to effectively conduct the pre- and post-mission surveys. Wind speed and the resulting surface conditions are critical factors affecting observation effectiveness. Higher winds typically increase wave height and create "whitecap" conditions, both of which limit an observer's ability to locate marine species at or near the surface. Air-to-surface missions will be delayed or rescheduled if the sea state is greater than number 4, as listed on Table 11-1, at the time of the mission. Protected species observers or the Lead Biologist will make the final determination of whether or not conditions are conducive to sighting protected species. In addition, the missions will occur no earlier than two hours after sunrise and no later than two hours prior to sunset to ensure adequate daylight for pre- and post-mission monitoring, with the exception of AFSOC and the 413 FLTS gunnery missions. In those cases, aircrews will utilize aircraft instrumentation and sensors to monitor the area.

Table 11-1. Sea State Scale for EGTTR Pre-Mission Surveys

Sea State Number	Sea Conditions
0	Flat, calm, no waves or ripples
1	Light air, winds 1–2 knots; wave height to 1 foot; ripples without crests
2	Light breeze, winds 3–6 knots; wave height 1–2 feet; small wavelets, crests not breaking
3	Gentle breeze, winds 7–10 knots; wave height 2–3.5 feet; large wavelets, scattered whitecaps
4	Moderate breeze, winds 11–16 knots; wave height 3.5–6 feet; breaking crests, numerous whitecaps

Visibility is also a critical factor for flight safety issues when aerial surveys are being conducted. Therefore, a minimum ceiling of 305 m (1,000 ft) and visibility of 5.6 km (3 NM) is required to support monitoring efforts and flight safety concerns.

11.1.4 Determination of Survey Areas

Each threshold range listed in Table 6-5 in Section 6.6 represents a radius of impact for a given threshold of each munition/detonation scenario. These ranges will be used for determining the size of the area required to be monitored during pre-mission surveys for each activity. For any mission involving live munitions other than gunnery rounds, an area extending out to the Atlantic spotted dolphin Level A PTS harassment range for the largest munition being released will be completely cleared of marine mammals prior to release of the first live ordnance. Depending on the mission, the corresponding radius could be between 46 m for a live fuse surface detonation with 0.4 lbs NEW up to 2,156 m for a GBU-10 subsurface detonation with 945 lbs NEW. This would help ensure that no marine mammals will be within any of the Level A harassment or mortality zones during a live detonation event. As described in Section 2, some missions will be delayed to allow survey platforms to evacuate the human safety zone after pre-missions surveys are completed. For these delayed missions, Eglin proposes to include a buffer around the survey area that would extend to the Level B TTS harassment zone for the largest munition being released during that mission. In all cases, this would more than double the survey area from that of the Level A PTS zone, increasing the survey area from 126 to 461 percent. This buffer will mitigate the potential for an animal outside the area during pre-mission surveys swimming into the Level A harassment or mortality zones during a mission.

However, missions that consist solely of gunnery testing and training operations will actually survey larger areas based on previously established safety profiles and the ability to conduct aerial surveys of large areas from mission aircraft. These ranges are shown in Table 11-2. Monitoring procedures for gunships are described in Section 11.2.2. Comparing the monitoring area below with threshold radii provided in Table 6-5 shows that more than double the Level B behavioral harassment threshold range for gunnery rounds (105 mm, 40 mm, 30 mm, and 25 mm) will be covered by this monitoring procedure.

Table 11-2. Monitoring Area Radii for Gunnery Missions

Aircraft	Gunnery Round	Monitoring Area	Monitoring Altitude	Operational Altitude
AC-130 gunship	25 mm, 30 mm, 40 mm, 105 mm (FU and TR)	5 NM (9,260 m)	6,000 ft	15,000 – 20,000 ft
CV-22 Osprey	.50 cal, 7.62 mm	3 NM (5,556 m)	1,000 ft	1,000 ft

cal = caliber; ft = feet; FU = full up; m = meters; mm = millimeter; NM = nautical miles; TR = Training Round

11.2 DESCRIPTION OF MONITORING ACTIVITIES

The following monitoring options have been developed to support various types of air-to-surface mission activities that may be conducted in the EGTTR. Eglin users covered by this LOA request must meet specific test or training objectives and safety requirements and have different assets available to execute the pre- and post-mission surveys. The monitoring options and mitigation measures described in the subsections below balance all mission-essential parameters with measures that will provide adequate protection to marine mammals.

Means of Affecting the Least Practicable Adverse Impacts

11.2.1 Vessel-based Monitoring

Pre-mission surveys conducted from surface vessels will typically begin at sunrise. Trained observers will be aboard designated vessels to conduct protected species surveys before and after each mission. These vessels will be dedicated solely to monitoring for protected marine species and species indicators during the pre-mission surveys. For missions that require multiple vessels to conduct surveys based on the size of the survey area, a Lead Biologist will be designated to coordinate all survey efforts, compile sighting information from the other vessels, function as the point of contact between the survey vessels and Tower Control, and provide final recommendations to the Safety Officer/Test Director on the suitability of the mission site based on environmental conditions and survey results.

Survey vessels will run pre-determined line transects, or survey routes, that will provide sufficient coverage of the survey area. Monitoring activities will be conducted from the highest point feasible on the vessels (Figure 11-1). There will be at least two dedicated observers on each vessel, and they will utilize optical equipment with sufficient magnification to allow observation of surfaced animals.

Figure 11-1. Marine Species Observer

Roles and Responsibilities

All sighting information from pre-mission surveys will be communicated to the Lead Biologist on a pre-determined radio channel to reduce overall radio chatter and potential confusion. After compiling all the sighting information from the other survey vessels, the Lead Biologist will inform Tower Control on whether the area is clear of protected species or not. If the range is not clear, the Lead Biologist will provide recommendations on whether the mission should be delayed or cancelled. For example, a mission delay would be recommended if a small number of protected species are in the ZOI but appear to be on a heading away from the mission area. The delay would continue until the Lead Biologist has confirmed that the animals are no longer in the

ZOI and traveling away from the mission site. On the other hand, a mission cancellation could be recommended if one or more protected species in the ZOI are found and there is no indication that they would leave the area on their own within a reasonable timeframe. Tower Control will relay the Lead Biologist's recommendation to the Safety Officer. The Safety Officer and Test Director will collaborate regarding range conditions based on the information provided by the Lead Biologist and the status of range clearing vessels. Ultimately, the Safety Officer will have final authority on decisions regarding delays and cancellations of missions.

Human Safety Zone Enforcement

For missions that occur relatively close to shore and, therefore, have the potential to endanger civilian boat traffic, a large number of range clearing boats (approximately 20 to 25) will be stationed around the mission site to prevent non-participating vessels from entering the human safety zone. Based on a composite footprint from previous similar missions, range clearing boats would be located approximately 24 kilometers (15 miles) from the detonation point (Figure 11-2). Actual distance will vary based on the type of munition being deployed and its release parameters. These range clearing boats are typically at their guard stations (as shown in the figure below) by sunrise before commercial and recreational boaters have an opportunity to enter the safety zone. Two range clearing boats are stationed in the East Pass to distribute flyers and maps to civilian boaters as they exit the pass and enter the Gulf of Mexico, informing them of the area closures.

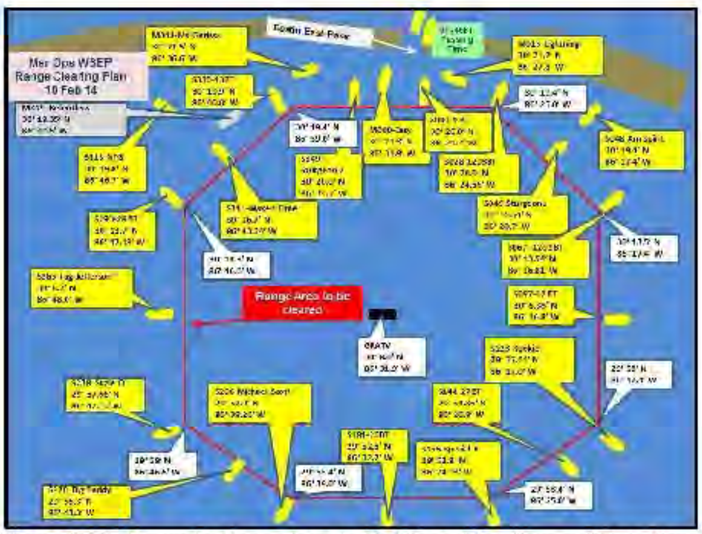

Figure 11-2. Example Range Area to Be Cleared for Human Safety Zone

Survey vessels are also required to abide by the human safety zone enforcement. When feasible, they typically aim to complete the pre-mission surveys at least 30 minutes prior to mission start to transit from the end point of their survey routes to the safety zone periphery. Observers will continue monitoring for marine mammals from outside the safety zone during the mission, but effectiveness will be limited because each vessel will remain at a designated station to assist with

range clearing activities. Additional measures are taken to address this time lapse, which may include surveying an additional buffer area or employing supplemental monitoring as described later in this section.

Air Force Support Vessels

Air Force support vessels will consist of a combination of Air Force and civil service/civilian personnel responsible for mission site/target setup and range clearing activities. Air Force personnel will be within the mission area (on boats and the GRATV) for each mission well in advance of weapon deployment, typically near sunrise. They will perform a variety of tasks including target preparation, equipment checks, etc., and will observe for marine mammals and indicators as feasible throughout test preparation. However, such observations are considered incidental and would only occur as time and schedule permits. Any sightings would be relayed to the Lead Biologist.

The Eglin Safety Officer, in cooperation with the Santa Rosa Island Tower Control at Test Site A-13B and CCF, will coordinate and manage all range clearing efforts and be in direct communication with the survey vessel team, typically through the Lead Biologist. All support vessels will be in radio contact with one another and with Tower Control on the government VHF channel 81a or 82a. The Safety Officer will monitor all radio communications, but Tower Control will relay messages between the vessels and the Safety Officer. The Safety Officer and Tower Control will also be in continual contact with the Test Director throughout the mission and will convey information regarding range clearing progress and protected species survey status. Final decisions regarding mission execution, including possible mission delay or cancellation based on protected species sightings or civilian boat traffic interference, will be the responsibility of the Safety Officer, with concurrence from the Test Director.

11.2.2 Aerial-based Monitoring

Aircraft typically provide an excellent viewing platform for detection of marine mammals at or near the surface. Depending on the mission, the aerial survey team will either consist of Eglin Natural Resources personnel or their designees aboard a non-mission aircraft or the aircrew conducting the mission. A description of each follows.

Non-Mission Aircraft

For non-mission aircraft, the pilot will be instructed in protected marine species survey techniques and will be familiar with marine species expected to occur in the area. One person in the aircraft will act as data recorder and is responsible for relaying the location, species (if possible), direction of movement, and number of animals sighted to the Lead Biologist. The aerial team will also identify protected species indicators such as large schools of fish and large, active groups of birds. Pilots will fly the aircraft in such a manner that the entire ZOI (and a buffer, if required) is monitored. Marine mammal sightings from the aerial survey team will be compiled by the Lead Biologist and communicated to the Test Director or Safety Officer. Similar to survey vessel requirements, all non-mission personnel will be required to exit the human safety zone before the mission can commence. As a result, the ZOI may not be monitored up to immediate deployment of live weapons. Due to this fact, the aerial team may be required to

survey an additional buffer zone (as described in Section 11.1.4), unless other monitoring assets, such as live video monitoring, can be employed.

Mission Aircraft

Some mission aircraft have the capability to conduct aerial surveys immediately prior to releasing munitions. In those instances, aircrews that have completed the marine species observer training will make several passes over the target area to ensure the area is clear of all protected species. For mission aircraft in this category, aircrews will operate at reasonable and safe altitudes (dependent on the aircraft) appropriate to either visually scan the sea surface or utilize available instrumentation and sensors to detect protected species. Typical missions in this category are air-to-surface gunnery operations from AC-130 and CV-22 gunships. In some cases, other aerial platforms may be available to supplement monitoring activities for pre-mission surveys and during the missions.

AC-130 and CV-22 Gunship Procedures

After arriving at the mission site and prior to initiating firing events, gunships will conduct at least two complete orbits around the survey area at a minimum safe airspeed around the mission site at the appropriate monitoring altitude. Provided that marine mammals (and other protected species or indicators) are not detected, the aircraft will then begin the ascent to operational altitude, continuing to orbit the target area as it climbs. The initial orbits occur over a timeframe of approximately 10 to 15 minutes. Monitoring for marine mammals, vessels, and other objects will continue throughout the mission. If a towed target is used, mission personnel will ensure that the target remains in the center portion of the survey area to ensure gunnery impacts do not extend past the ZOI.

During the low-altitude orbits and climb, the aircrew will visually scan the sea surface within the aircraft's orbit circle for the presence of marine mammals. The surface scan will primarily be conducted by the flight crew in the cockpit and personnel stationed in the tail observer bubble and starboard viewing window. During nighttime missions, crews will use night vision goggles during observation. In addition to visual surveys, aircraft optical and electronic sensors will also be used for site clearance. AC-130 gunships are equipped with low-light TV cameras and AN/AAQ-26 infrared detection sets (IDSs). The TV cameras operate in a range of visible and near-visible light. Infrared systems are capable of detecting differences in temperature from thermal energy (heat) radiated from living bodies or from reflected and scattered thermal energy. In contrast to typical night-vision devices, visible light is not necessary for object detection. Infrared systems are equally effective during day or night use. The IDS is capable of detecting very small thermal differences. See the Notice of IHA (73 FR 246, December 22, 2008) for a further description of AC-130 sensor capabilities. CV-22 aircraft have similar visual scanners and operable sensors, however, they operate at a much lower altitudes than the AC-130 gunships, and no HE rounds will be fired from these aircraft.

If any marine mammals are detected during pre-mission surveys or during the mission, activities will be immediately halted until the ZOI area is clear of all marine mammals, or the mission will be relocated to another target area. If the mission is relocated, the pre-mission survey procedures

will be repeated. In addition, if multiple firing missions are conducted within the same flight, clearance procedures will precede each mission.

Gunship crews will conduct a post-mission survey beginning at the operational altitude and proceeding through a spiraling descent to the designated monitoring altitude. It is anticipated that the descent will occur over a three- to five-minute time period. During this time, aircrews will use similar equipment and instrumentation to scan the water surface for animals that may have been impacted during the gunnery exercise. During daytime missions, visual scans will be used as well.

Other Mission Aircraft

For missions other than gunnery activities, at least two ordnance delivery aircraft will typically participate in each live weapon release. Prior to the release, Air Force pilots aboard mission aircraft may make a dry run over the target area to ensure it is clear of non-participating vessels before ordnance is deployed. Observation effectiveness may vary among aircraft types. Jets will fly at a minimum speed of 300 knots indicated air speed (approximately 345 miles per hour, depending on atmospheric conditions) and at a minimum altitude of 1,000 ft (305 meters). Due to the limited flyover duration and potentially high speed and altitude, observation for marine species would probably be marginally effective at best and, therefore, pilots will not participate in species surveys.

11.2.3 Video-based Monitoring

Video-based monitoring may be accomplished via live high-definition video feed transmitted to CCF. Video monitoring typically facilitates data collection for the mission but can also allow remote viewing of the area for determination of environmental conditions and the presence of marine species up to the release time of live munitions. There are multiple sources of video that can be streamed to multiple monitors within CCF. When authorized for specific missions (e.g., Maritime WSEP), a trained marine species observer from Eglin Natural Resources will monitor all live video feed transmitted to CFF and will report any marine mammal sightings to the Safety Officer, who will also be at CCF. Employing this measure typically resolves any lapse between the time survey vessels or aircraft leave the safety zone after completing pre-mission surveys but before the mission actually begins.

The primary platform for video monitoring would be through the GRATV. Four video cameras are typically positioned on the GRATV (anchored on-site) to allow for real-time monitoring and data collection during the mission. The cameras will also be used to monitor for the presence of protected species. All cameras have a zoom capability of up to at least a 300-mm equivalent. At this setting, when targets are at a distance of 2 NM from the GRATV, the field of view would be 195 ft by 146 ft. Video observers can detect an item with a minimum size of 1 square foot up to 4,000 meters away. The Air Force is in the process of acquiring cameras with even greater zoom capability (up to a 1,200-mm zoom lens) to support future missions. The GRATV will typically be located about 183 meters (600 ft) from the target area; this range is well within the zooming capability of the video cameras. Representative screen shots from three different cameras are shown in Figure 11-3 through Figure 11-5.

Figure 11-3. Representative Screen Shot Camera 1

Figure 11-4. Representative Screen Shot Camera 2

Figure 11-5. Representative Screen Shot Camera 3

Supplemental video monitoring can also be accomplished through the employment of additional aerial assets. Eglin's aerostat balloon provides aerial imagery of weapon impacts and instrumentation relay. When utilized, it is tethered to a boat anchored near the GRATV but outside weapon impact areas. The balloon can be deployed to an altitude up to 2,000 ft above sea level. It is equipped with a high-definition camera system that is remotely controlled to pivot and focus on a specific target or location within the mission site. The video feed from the camera system is transmitted to CCF. Eglin may also employ other assets such as intelligence, surveillance, and reconnaissance aircraft to provide real-time imagery or relay targeting pod videos from mission aircraft. Unmanned aerial vehicles may also be employed to provide aerial video surveillance. While each of these platforms may not be available for all missions, they typically can be used in combination with each other and with the GRATV cameras to supplement marine mammal monitoring efforts.

Even with a variety of platforms potentially available to supply video feeds to CCF, the entire zone of influence may not be visible for the entire duration of the mission. However, the targets

and immediately surrounding areas will typically be in the field of view of the GRATV cameras and the observer will be able to identify any protected species that may enter the target area before weapon releases. In addition, the observer will be able to determine if any animals were injured immediately following the detonations. Should a protected marine species be detected on the live video, the weapon release can be stopped almost immediately because the video camera observer is in direct contact with Test Director and Safety Officer at CCF.

The protected species survey vessels and the video camera observer will have open lines of communication to facilitate real-time reporting of marine mammals and other relevant information, such as safety concerns and presence of non-participating vessels in the human safety zone. Direct radio communication between all surface vessels, GRATV personnel, and the Tower Control will be maintained throughout the mission. The Range Safety Officer will monitor all radio communications from CCF, and information between the Safety Officer and the support vessels will be relayed via Tower Control.

11.3 OPERATIONAL MITIGATION MEASURES FOR GUNNERY ACTIONS

Eglin AFB has identified and required implementation of three operational mitigation measures for gunnery missions, including development of the 105-mm TR, use of ramp-up procedures, and eliminating missions conducted over waters beyond the continental shelf. The largest type of ammunition used during gunnery missions is a 105-mm round, which contains 4.7 pounds of high explosive (HE). This is several times more HE than that found in the next largest round (40 mm). As a mitigation technique, the Air Force developed a 105-mm TR that contains only 0.35 pounds of HE. The training round was developed to substantially reduce the risk of harassment during nighttime operations, when visual surveying for marine mammals is of limited effectiveness (however, monitoring by use of the AC-130's instrumentation, as described in Section 11.2.2 above, is effective at night).

Ramp-up procedures refer to the process of beginning with the least impactive action and proceeding to more impactive actions. In the case of A/S gunnery activities, ramp-up procedures entail beginning a mission with the lowest caliber munition and proceeding to the highest, which means the munitions would be fired in the order of 25 mm, 40 mm, and 105 mm. The rationale for the procedure is that this process may allow marine species to perceive steadily increasing noise levels and to react, if necessary, before the noise reaches a threshold of significance.

The AC-130 gunship weapons are used in two phases. First, the guns are checked for functionality and calibrated. This step requires an abbreviated period of live fire. After the guns are determined ready for use, the aircraft deploys a flare onto the surface of the water as a target, and the mission proceeds under various test and training scenarios. This second phase involves a more extended period of live fire and can incorporate use of one or any combination of the munitions available (25-mm, 40-mm, and 105-mm rounds).

The ramp-up procedure will be required for the initial calibration phase and, after this phase, the guns may be fired in any order. Eglin AFB believes this process will allow marine species the opportunity to respond to increasing noise levels. If an animal leaves the area during ramp-up, it is unlikely to return during the live-fire mission. This protocol provides a more realistic training experience for aircrews. In combat situations, gunship crews would not necessarily fire the

complete ammunition load of a given caliber gun before proceeding to another gun. Rather, a combination of guns might be used as required by real-time situations. An additional benefit of this protocol is that mechanical or ammunition problems with an individual gun can be resolved while live fire continues with functioning weapons. This diminishes the possibility of a lengthy pause in live fire which, if greater than 10 minutes, would necessitate reinitiation of protected species surveys.

Many marine mammal species found in the Gulf of Mexico, including the federally listed sperm whale, occur with greater regularity in waters over and beyond the continental shelf break. As a conservation measure to avoid impacts to the sperm whale, AFSOC has agreed to conduct all gunnery missions within (shoreward of) the 200-meter isobath, which is considered to be the shelf break for purposes of this document. This measure will incidentally provide greater protection to several other species as well. The 200-meter depth contour is shown on Figure 1-7 (in Section 1).

11.4 COORDINATION WITH EGLIN NATURAL RESOURCES OFFICE FOR IMPLEMENTATION OF MONITORING REQUIREMENTS

Prior to conducting live missions, proponents will coordinate with Eglin Natural Resources to be briefed on their mitigation and monitoring requirements. Throughout coordination efforts, mission assets available for monitoring will be identified and an implementation plan will be developed. Based on the assets, survey routes will be designed to incorporate the size of the monitoring area and determine whether a buffer will be required. Training and reporting requirements will also be communicated to the proponents.

A following section is an example mitigation plan that would generally be applicable to air-to-surface missions incorporating vessel-based pre-mission surveys and video monitoring. While most or all of the described elements could be implemented for many missions, there may be instances where specific actions are not feasible. However, the detailed plan is provided here to illustrate the types of actions that would typically be employed. All mitigation activities will be regulated by Air Force safety parameters. Any mission may be delayed or cancelled due to technical issues or range clearing issues. Should a delay occur during pre-mission surveys, all mitigation procedures will continue either for the duration of the delay or until the mission is cancelled.

11.4.1 Example Mitigation Plan

To ensure the safety of survey personnel, the team will depart the mission area approximately 30 minutes before live ordnance delivery is scheduled to begin. Stepwise mitigation procedures are outlined below.

(a) Sunrise or Two Hours Prior to Mission

Air Force range clearing vessels and protected species survey vessels will be on-site at least two hours prior to the mission. The Lead Biologist onboard one survey vessel will assess the overall suitability of the mission site based on environmental conditions (sea state) and presence or

absence of marine mammal indicators. This information will be communicated to Tower Control and relayed to the Safety Officer in CCF.

(b) One and One-Half Hours Prior to Mission – Commence Pre-Mission Surveys

Vessel-based surveys will begin approximately one and one-half hours prior to live weapon deployment. Surface vessel observers will survey the ZOI and relay all marine species and indicator sightings, including the time of sighting, GPS location, and direction of travel, if known, to the Lead Biologist. The Lead Biologist will document all sighting information on report forms to be submitted to Eglin Natural Resources after each mission. Surveys will continue for approximately one hour or until the entire ZOI has been adequately surveyed, whichever comes first. During this time, Air Force personnel in the mission area will also observe for marine species as feasible. If marine mammals or indicators are observed within the ZOI, the range will be declared "fouled," a term that signifies to mission personnel that conditions are such that a live ordnance drop cannot occur (e.g., protected species or civilian vessels are in the mission area). If no marine mammals or indicators are observed, the range will be declared clear of protected species.

(c) One-Half Hour Prior to Mission

At approximately 30 minutes to 1 hour prior to live weapon deployment, marine species observers will be instructed to leave the mission site and remain outside the safety zone, which on average will be 15 miles from the detonation point. The actual size is determined by weapon NEW and method of delivery. The survey team will continue to monitor for protected species while leaving the area. As the survey vessels leave the area, marine species monitoring of the immediate target areas will continue at CCF through the live video feed received from the high definition cameras on the GRATV. Once the survey vessels have arrived at the perimeter of the safety zone (approximately 30 minutes after being instructed to leave, depending on actual travel time) the range will be declared "green" and mission will be allowed to proceed, assuming all non-participating vessels have left the safety zone as well.

(d) Execution of Mission

Immediately prior to live weapon drop, the Test Director and Safety Officer will communicate to confirm the results of marine mammal surveys and the appropriateness of proceeding with the mission. The Safety Officer will have final authority to proceed with, postpone, or cancel the mission. The mission would be postponed if:

1. Any marine mammal is visually detected within the ZOI. Postponement would continue until the animal(s) that caused the postponement is either:
    a. Confirmed to be outside of the ZOI on a heading away from the targets.
    b. Not seen again for 30 minutes and presumed to be outside the Level A PTS ZOI due to the animal swimming out of the range.

2. Large schools of fish or large flocks of birds feeding at the surface are observed within the ZOI. Postponement would continue until these potential indicators are confirmed to be outside the ZOI.
3. Any technical or mechanical issues related to the aircraft or target boats.
4. Non-participating vessels enter the human safety zone prior to weapon release.

In the event of a postponement, protected species monitoring would continue from CCF through the live video feed.

(e) Completion of the Mission – Commence Post-Mission Surveys

Post-detonation monitoring surveys will commence once the mission has ended or, if required, as soon as EOD personnel declare the mission area safe. Vessels will move into the survey area from outside the safety zone and monitor for at least 30 minutes, concentrating on the area downcurrent of the test site. If boat targets have been struck by weapons, this area is easily identifiable because of the floating debris in the water from the impacted targets. Up to 10 Air Force support vessels will clean debris and collect damaged targets from this area, thus spending many hours in the area once the mission is completed. All vessels will be instructed to report any dead or injured marine mammals to the Lead Biologist.

11.5 MITIGATION EFFECTIVENESS

The effectiveness of the mitigation and monitoring measures described above depends largely on the ability to visually locate marine mammals at or near the water surface (visual observation is the primary measure used) and the elapsed time between the completion of surveys and the actual detonation(s). Aerial surveys are used during some missions but are not feasible for all missions due to airspace and mission complexity. In these instances, observation will occur primarily from vessels and video cameras, when available. Eglin AFB has implemented all monitoring options described in Section 11.2 for previous Air Force actions in the EGTTR. The following qualitative analysis for mitigation effectiveness is largely based on the success of all Eglin air-to-surface mission activity in the EGTTR over the last five years.

Since 2010, Eglin AFB has conducted 37 gunnery missions (as of July 2015) in the EGTTR. Each year, Eglin Natural Resources submits an Annual Report to NMFS summarizing these activities and survey results. Monitoring procedures that have been employed are the same as those described in Section 11.2.2, under *AC-130 and CV-22 Gunship Procedures.* To date, no marine mammals have been impacted from gunnery operations. Instrumentation on the AC-130 and CV-22 has been proven effective in clearing a potential mission site of protected species prior to commencement of firing live gunnery rounds. Figure 11-6 depicts an unclassified image of three sharks captured from an AC-130 conducting a 3-mile (5-km) orbit at a 15,000-ft altitude using the Raytheon Multispectral Targeting System (MTS™)-A electro-optical/infrared sensor. Monitoring altitudes during pre-mission surveys for both the AC-130 and CV-22 are much lower than 15,000 ft (see Table 11-2), and employing an infrared system for monitoring should make it easier to identify warm-blooded marine mammals.

Figure 11-6. Image of Sharks Captured on AC-130 Gunship Using Raytheon MTS-A Sensors at 15,000-foot Altitude

Since 2012, 13 live ordnance missions have been conducted under either the Maritime Strike Operations or Maritime WSEP Operational Testing activities. NMFS issued Eglin AFB an IHA on August 13, 2013, for Maritime Strike Operations missions and an IHA for Maritime WSEP Operation Testing missions on February 5, 2015. These two programs were similar in that they both involved the release of varying live munitions against small, fast-moving boat targets in the EGTTR. Monitoring procedures incorporated a combination of vessel-based surveys and live video monitoring from CCF. Due to changing acoustic criteria and thresholds for marine mammals in between these actions, the approach used to determine survey areas for these missions were not the same. Even though Maritime Strike had more and larger weapons than Maritime WSEP, Eglin AFB was required to survey a larger area for Maritime WSEP based on discussions revolving around accumulated energy impacts from multiple detonations. For both sets of missions, Eglin conducted monitoring activities based on the descriptions in Sections 11.2.1 and 11.2.3. While marine mammals were observed during pre-mission surveys on multiple mission days, proper measures were taken (delay of missions while waiting on marine mammals to clear the area) to ensure no marine mammals were in the area during the mission. As a result, no marine mammal takes occurred during any of the Maritime Strike and Maritime WSEP missions. The increase in survey area for Maritime WSEP missions did not appear to provide an added benefit to marine mammals over what was accomplished during Maritime Strike; observers detected no more marine mammals among the search areas, respectively. The overall effectiveness of these measures in reducing take levels has not been quantified; however, the high numbers of documented sightings during the pre-mission surveys indicate a significant level of success in executing the survey plans and identifying protected species in the area. Furthermore, there were no observed impacts to any protected species during post-mission surveys, and none were identified in the days immediately following the end of all Maritime Strike and Maritime WSEP missions. Therefore, Eglin believes the proposed mitigations will provide protection to marine mammals from potential acoustic impacts while enabling the military mission to proceed.

11.6 MONITORING OPTIONS AVAILABLE TO KNOWN PROPONENTS AND MISSIONS

The following table lists known proponents (based on mission descriptions provided in Section 2) and the monitoring platforms that may be employed for marine mammal monitoring before, during, and after live air-to-surface missions. As stated above, coordination with proponents before live missions will ensure these options are still available, as well as any changes to assets or mission capabilities for new proponents that would fall under this authorization. Eglin Natural Resources will ensure all practical measures will be implemented to the maximum extent possible to comply with the mitigation and monitoring requirements while meeting mission objectives.

Table 11-3. Monitoring Options Available for Live Air-to-Surface Mission Proponents Operating in the EGTTR

Mission[1]	Monitoring Platform		
	Vessel	Aerial	Video
86 FWS Maritime Weapons System Evaluation Program (WSEP)	▪		▪
Air Force Special Operations Command (AFSOC) Training			
Air-to-Surface Gunnery		▪	
Small Diameter Bomb/Griffin Missile Training		▪	
CV-22 Training		▪	
413th Flight Test Squadron (FLTS)			
AC-130J Precision Strike Package Testing		▪	
AC-130J Stand-Off Precision Guided Munitions Testing		▪	
780th Test Squadron			
Precision Strike Weapon	▪	▪	
Longbow Littoral Testing	▪		

86 FWS = 86th Fighter Weapons Squadron
1 See Section 2 for a complete description.

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12. MINIMIZATION OF ADVERSE EFFECTS ON SUBSISTENCE USE

Based on the discussion provided in Section 8, there will be no impacts on the availability of species or stocks for subsistence use.

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13. MONITORING AND REPORTING MEASURES

For air-to-surface missions using live ordnance, prospective mission sites will be monitored for marine mammal presence prior to commencement of activities. Pre-mission monitoring will be conducted from one or a combination of vessels, video cameras, and aircraft, depending on the mission type. In some cases, after survey vessels (when applicable) have exited the safety footprint, a trained marine species observer located in the CCF will continue to monitor the immediate target area through live video feed for the duration of the mission. Post-mission surveys will also be carried out in most cases. If any marine mammals are detected during pre-mission surveys or the live video feed, activities will be immediately halted until the area is clear of all marine mammals. Refer to Section 11 for a more detailed explanation of monitoring requirements for each type of mission.

In addition to monitoring for marine species before and (in most cases) after missions, the following monitoring and reporting measures will be required.

- Within a year before the planned missions, all protected species observers will receive the Marine Species Observer Training Course developed by Eglin in cooperation with NMFS.
- Eglin Natural Resources will track use of the EGTTR and protected species observation results through the use of protected species observer report forms.
- A summary annual report of marine mammal observations and mission activities will be submitted to the NMFS Southeast Regional Office and the NMFS Office of Protected Resources. This annual report must include the following information:
  - Date and time of each exercise
  - A complete description of the pre-exercise and post-exercise activities related to mitigating and monitoring the effects of mission activities on marine mammal populations
  - Results of the monitoring program, including numbers by species/stock of any marine mammals noted injured or killed as a result of the missions, and number of marine mammals (by species if possible) that may have been harassed due to presence within the activity zone
- If any dead or injured marine mammals are observed or detected prior to mission activities, or injured or killed during mission activities, a report must be made to NMFS by the following business day.
- Any dead or injured marine mammals must be immediately reported to the respective stranding network representative.

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14. RESEARCH

Although Eglin AFB does not currently conduct independent marine mammal research, Eglin Natural Resources participates in marine animal tagging and monitoring programs lead by other agencies. Additionally, Eglin Natural Resources has also supported participation with NMFS in annual surveys of marine mammals in the Gulf of Mexico. From 1999 to 2002, Eglin participated in summer cetacean monitoring and research efforts through a contractor. The contractor participated in visual surveys for cetaceans in 1999 in the Gulf of Mexico, as a visual observer during the 2000 Sperm Whale Pilot Study, and as member of the behavioral team for the 2001 and 2002 Sperm Whale Seismic Study (SWSS) research cruises. In addition, Eglin Natural Resources has obtained Department of Defense funding for two marine mammal habitat modeling projects. The most recent project (Garrison, 2008) included funding for and extensive involvement of NMFS personnel so that recent aerial survey data could be utilized for habitat modeling and protected species density estimates in the northeastern Gulf of Mexico, including portions of the EGTTR.

Eglin conducts other research efforts that utilize marine mammal stranding information as a potential means of detecting the effectiveness of mitigation techniques. Stranding data are collected and maintained for the Florida panhandle area as well as for the entire Gulf of Mexico. This task is undertaken through the establishment and maintenance of contacts with local, state, and regional stranding networks. Eglin AFB assists with stranding data collection by maintaining its own team of permitted stranding personnel. In addition to simply collecting stranding data, various analyses are performed. Stranding events are tracked by year, season, and NMFS statistical zone, both in the Gulf of Mexico and on the coastline in proximity to Eglin AFB. Stranding data may be analyzed in relation to records of EGTTR mission activity in each water range and possible correlations examined. In addition to being used as a possible measure of the effectiveness of mitigations, stranding data can yield insight into the species composition of cetaceans in the region.

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APPENDIX A

ACOUSTIC MODELING METHODOLOGY

Eglin Air Force Base

Eglin Gulf Test and Training Range (EGTTR) MMPA and ESA Acoustic Impact Modeling: Modeling Appendix

Submitted by:

Leidos

To:

Eglin Natural Resources
96 CEG/CEIEA
Eglin Air Force Base, FL

In response to tasking associated with:

Task Order 2 under Contract W91278-14-D-0009

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Submittal date: July 2015

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APPENDIX A
MMPA AND ESA ACOUSTIC IMPACT MODELING

A.1 BACKGROUND AND OVERVIEW

A.1.1 Federal Regulations Affecting Marine Animals

All marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

The Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of their ecosystems. A "species" is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. Some marine mammals, already protected under MMPA, are also listed as either endangered or threatened under ESA, and are afforded special protections. In addition, all sea turtles are protected under the ESA.

Actions involving sound in the water may have the potential to harass marine animals in the surrounding waters. Demonstration of compliance with the MMPA and ESA, using best available science, has been assessed using criteria and thresholds accepted or negotiated, and described here.

Sections of the MMPA (16 USC 1361 et seq.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity, other than commercial fishing, within a specified geographical region. Through a specific process, if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted if National Marine Fisheries Service (NMFS) finds that the taking will have no more than a negligible impact on the species or stock(s), will not have an immitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and that the permissible methods of taking, and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth.

NMFS has defined negligible impact in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

Subsection 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. The National Defense Authorization Act of 2004 (NDAA) (Public Law

108-136) removed the small numbers limitation and amended the definition of "harassment" as it applies to a military readiness activity to read as follows:

> (i) *any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or*
>
> (ii) *any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].*

The primary potential impact to marine mammals from underwater acoustics is Level A and Level B harassment, as defined by the MMPA from noise. Potential impacts to sea turtles from underwater acoustic exposure are primarily behavioral responses and impairment, with some potential for injury, and a very small potential for mortality.

A.1.2 Development of Animal Impact Criteria

A.1.2.1 Marine Mammals

For explosions of ordnance planned for use in the Eglin Gulf Test and Training Range (EGTTR) Study Area, in the absence of any mitigation or monitoring measures, there is a small chance that a marine mammal could be injured or killed when exposed to the energy generated from an explosive force. Analysis of noise impacts is based on criteria and thresholds initially presented in U.S. Navy Environmental Impact Statements for ship shock trials of the Seawolf submarine and the Winston Churchill (DDG 81), and subsequently adopted by NMFS.

Lethal impact determinations currently incorporate species-specific thresholds that are based on the level of impact that would cause extensive lung injury from which one percent of exposed animals would not recover (Finneran and Jenkins, 2012). The threshold represents the expected onset of mortality, where 99 percent of exposed animals would be expected to survive. The lethal exposure level of blast noise, associated with the positive impulse pressure of the blast, is expressed as Pascal-seconds (Pa·s) and is determined using the Goertner (1982) modified positive impulse equation. This equation incorporates sound propagation, source/animal depths, and the mass of a newborn calf of the affected species. The Goertner equation used in the acoustic model to develop mortality impact analysis, is as follows:

$$I_M(M,D) = 91.4 M^{1/3} \left(1 + \frac{D}{10.1}\right)^{1/6}$$

$I_M(M,D)$	mortality threshold, expressed in terms of acoustic impulse (Pa·s)
M	Animal mass (Table D-1)
D	Water depth (m)

Non-lethal injurious impacts (Level A Harassment) are defined in those documents as permanent (auditory) threshold shift (PTS), gastro-intestinal (GI) tract damage, and the onset of slight lung injury. Two thresholds are used for PTS, one based on sound exposure level (SEL) and the other on the sound pressure level (SPL) of an underwater blast. Thresholds follow the approach of Southall et al. (2007). The threshold producing either the largest Zone of Influence (ZOI) or higher exposure levels is then used as the more protective of the dual thresholds. In most cases, the weighted total EFD is more conservative that the largest EFD in any single 1/3-octave band used in earlier models. Type II weighting functions are for each functional hearing group. The threshold for the Type II weighted EFD is 187 decibels referenced to 1 microPascal-squared – seconds (dB re 1 μPa^2-s); the threshold for peak pressure is 46 pounds per square inch (psi) or 230 dB re 1 μPa.

The criteria for slight injury to the GI tract was found to be a limit on peak pressure and independent of the animal's size (Goertner, 1982). A threshold of 103 psi (237 dB re 1 μPa) is used for all marine mammals. This level at which slight contusions to the GI tract were reported from small charge tests (Richmond *et al.*, 1973).

The criteria for onset of slight lung injury were established using partial impulse because the impulse of an underwater blast wave was the parameter that governed damage during a study using mammals, not peak pressure or energy (Yelverton, 1981). Goertner (1982) determined a way to calculate impulse values for injury at greater depths, known as the Goertner "modified" impulse pressure. Those values are valid only near the surface because as hydrostatic pressure increases with depth, organs like the lung, filled with air, compress. Therefore the "modified" impulse pressure thresholds vary from the shallow depth starting point as a function of depth.

The shallow depth starting points for calculation of the "modified" impulse pressures are mass-dependent values derived from empirical data for underwater blast injury (Yelverton, 1981). During the calculations, the lowest impulse and body mass for which slight, and then extensive, lung injury found during a previous study (Yelverton et al, 1973) were used to determine the positive impulse that may cause lung injury. The Goertner model is sensitive to mammal weight such that smaller masses have lower thresholds for positive impulse so injury and harassment will be predicted at greater distances from the source for them. The equation used for determination of slight lung injury is:

$$I_s(M,D) = 39.1M^{1/3}\left(1 - \frac{D}{10.1}\right)^{1/2},$$

where M is animal mass (kg), D is animal depth (m), and the units of I_s are Pa-s.

Level B (non-injurious) Harassment includes temporary (auditory) threshold shift (TTS), a slight, recoverable loss of hearing sensitivity. One criterion used for TTS, the total Type II weighted energy flux density of the signal, is a threshold of 172 dB re 1 μPa^2-s for toothed whales (e.g., dolphins). A second criterion, a maximum allowable peak pressure of 23 psi (224 dB re 1 μPa), has recently been established by NMFS to provide a more conservative range

for TTS when the explosive or animal approaches the sea surface, in which case explosive energy is reduced, but the peak pressure is not. NMFS applies the more conservative of these two.

For multiple successive explosions, the acoustic criterion for non-TTS behavioral disturbance is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The threshold for behavioral disturbance is set 5 dB below the Type II weighted total EFD-based TTS threshold, or 167 dB re 1 μPa^2-s. This is based on observations of behavioral reactions in captive dolphins and belugas occurring at exposure levels approximately 5 dB below those causing TTS after exposure to pure tones (Schlundt et al., 2000).

Table A-1 summarizes the current threshold levels for marine mammals used to analyze explosives identified for use in the EGTTR study area.

Table A-1. Explosives Threshold Levels for Marine Mammals

Mortality*	Level A Harassment			Level B Harassment	
	Slight Lung Injury*	GI Tract Injury	PTS	TTS	Behavioral
$91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	$39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	Unweighted SPL: 237 dB re 1 µPa	Weighted SEL: 187 dB re 1 $\mu Pa^2 \cdot s$	Weighted SEL: 172 dB re 1 $\mu Pa^2 \cdot s$	Weighted SEL: 167 dB re 1 $\mu Pa^2 \cdot s$
			Unweighted SPL: 230 dB re 1 µPa	Unweighted SPL: 224 dB re 1 µPa (23 psi peak pressure)	

M = Animal mass based on species (kilograms); *D* = Water depth (meters); dB re 1 µPa = decibels referenced to 1 microPascal; dB re 1 $\mu Pa^2 \cdot s$ = decibels reference to 1 microPascal-squared – seconds; GI = gastrointestinal; PTS = permanent threshold shift; SEL = sound exposure level; ; TTS = temporary threshold shift; SPL = sound pressure level
*Expressed in terms of acoustic impulse (Pascal – seconds [Pa·s])

A.1.2.2 Sea Turtles

The sound sources will be located in an area that is inhabited by species listed as threatened or endangered under the ESA (16 USC §§ 1531-1543), including sea turtles. Operation of the sound sources, that is, transmission of acoustic signals in the water column, could potentially cause harm or harassment to listed species.

"Harm" defined under ESA regulations is "…an act which actually kills or injures…" (50 CFR 222.102) listed species. "Harassment" is an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

If a federal agency determines that its proposed action "may affect" a listed species, it is required under Section 7 of the ESA to consult, either formally or informally, with the appropriate regulator. Such consultations would likely be concluded favorably, subject to requirements that the activity will not appreciably reduce the likelihood of the species' survival and recovery and impacts are minimized and mitigated. If appropriate, the Air Force would initiate formal interagency consultation by submitting a Biological Assessment to NMFS, detailing the proposed action's potential effects on listed species and their designated critical habitats. Consultation would conclude with NMFS' issuance of a Biological Opinion (BO) that addresses the issues of whether the project can be expected to jeopardize the continued existence of listed

species or result in the destruction or adverse modification of critical habitat. Within the BO, an Incidental Take Statement is included and identifies the anticipated number of incidental "takes" that are authorized.

Until recently, there were no acoustic energy or pressure impact thresholds defined specifically for ESA-listed sea turtles, and in the absence of such information the thresholds used for marine mammal analysis were typically applied. However, NMFS has recently undertaken a more detailed investigation of the effects of underwater detonations on turtles and provided the following summary of potential behavioral responses at various peak dB levels (Table A-2).

Table A-2. Range of Sea Turtle Behavioral Responses at Multiple Underwater Noise Levels

dB Level (Peak) Range	Response Category	Number of Animals Potentially Affected
110 – 160	Discountable effects; minor response possible, but within the range of normal behaviors.	Very few
>160 – 200	Some swimming and diving response, becoming stronger and more frequent at higher dB levels.	Few at 160 dB; most at 200 dB
>200 – 220	Strong avoidance response.	Some to all at 220 dB
>220	Intolerable.	All individuals

dB = decibel

NMFS has also recently developed five criteria and threshold levels for sea turtle impacts from underwater detonations. The criteria are defined as follows:

- *Mortality*: mortal injury, cracked shell, or lung/intestinal/organ damage.
- *Injury*: potentially lethal physical injuries, prolonged immobilization by stunning, or auditory trauma.
- *Impairment*: temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization).
- *Disturbance*: habitat displacement, increased swimming speed, or increased heart rate.
- *Onset of Behavioral Response*: brief response to a single explosion, startle responses including diving and swimming.

Based on this information and other research examining the effects of underwater detonations and airgun operation on turtles and other vertebrates (e.g., Richmond et al., 1973; DeRuiter and Doukara, 2012; Finneran and Jenkins, 2012), NMFS has defined the impact threshold levels shown in Table A-3. Thresholds are defined in terms of both the peak noise level (in dB) and pressure in pounds per square inch (psi). Although there has been recent effort to address turtle-specific thresholds, there are currently no experimental or modeling data sufficient to support development of physiological thresholds. Therefore, mortality, primary blast injury, and auditory effects continue to be based on marine mammal thresholds (low frequency functional group where applicable). Mortality and blast injury thresholds are based on the GI tract injury threshold used for marine mammals; TTS and PTS thresholds are based on those used for low frequency functional hearing group cetaceans. However, turtle-specific behavioral responses to impulsive sounds (airguns) have been documented in the literature (e.g., McCauley et al., 2000) and have been incorporated by NMFS into behavioral categories. The disturbance threshold is considered to approximate a sub-TTS, high level behavioral response.

Table A-3. Sea Turtle Exposure Thresholds for Single Underwater Detonation Events

Mortality	Injury	Impairment	Disturbance	Onset of Behavioral Response
>237 dB (peak)	>229 dB (peak)	>224 dB (peak)	>218 dB (peak)	>180 dB (peak)
102 psi	40 psi	23 psi	12 psi	0.14 psi

dB = decibel; psi = pounds per square inch

Work is ongoing in the scientific community to refine the threshold criteria in response to new information about marine animal biology. The new modeling described here uses more conservative thresholds than were used in previous studies. Models were implemented in a way that allows the threshold criteria to be varied (over a realistic range of values). New results can be generated if the current criteria change.

A.2 EXPLOSIVE ACOUSTIC SOURCES

A.2.1 Acoustic Characteristics of Explosive Sources

The acoustic sources employed at the EGTTR study area are categorized as broadband explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). Detailed descriptions of the sources in the EGTTR study area are provided in this subsection.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive weight (or NEW) accounts for the first two parameters. The NEW of an explosive is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

A.2.2 Animal Harassment Effects of Explosive Sources

The harassments expected to result from these sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following. Let A represent the impact area (that is, the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are

spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N explosives is merely NA regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of detonations spaced closely in time, while the energy metrics increase at a rate of $N^{1/2}$ (under spherical spreading loss only) or less.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. As with detonations, if bursts are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N bursts is merely NA, where A is the impact area of a single burst, regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis. A more detailed description of pressure and energy considerations resulting from munition bursts is provided in Section A.2.3 below.

Explosives are modeled as detonating at depths ranging from the water surface to 10 ft below the surface, as provided by Government-Furnished Information. Impacts from above surface detonations were considered negligible and not modeled.

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breach the surface with some of the acoustic energy escaping the water column. We model surface detonations as occurring 1' below the water surface. The source levels have not been adjusted for possible venting nor does the subsequent analysis attempt to take this into account.

A.2.3 Zone of Influence: Per-Detonation Versus Net Explosive Weight Combination

It may be considered why and when it is appropriate to treat rounds within a burst as separate events, rather than combining the NEW of all rounds and treating it as a single, larger event. The basic information necessary to address this issue is provided below.

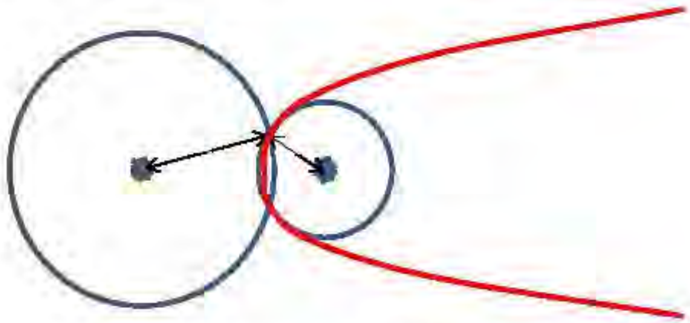
Peak Pressure and Positive Impulse

Peak pressures add if two (or more) impulses reach the same point at the same time. Since explosive rounds go off at different times and locations, this will only be true for a small set of points. This problem is mathematically the same as the passive sonar problem of localizing a sound source based on the time difference of arrival (TDOA) of a signal reaching two receivers. The red curve in the figure (half of a hyperbola) represents the set of all point where

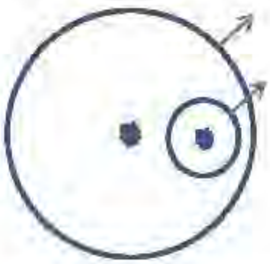
$R1 - R2 = c*(T2 - T1)$, for

c = the speed of sound in water, and

T1 and T2 being the detonation times of the two rounds :



Such a curve can only be drawn when c*(T2-T1) is less than the distance between the two explosions. If, for instance, 30 rounds/second are fired (and the difference in impact time is assumed to be roughly the distance in firing time), then the peak impact pressure from the first round will have traveled 1,500 m/s * 1/30 sec = 50 m. If the second round hits less than 50 m from the first round, the impact wave from the second round will never catch the impact wave from the first.



In the first case (loose grouping), the pressures will only add along a curve with very narrow width and negligible volume. The pressure on this curve less than twice the pressure of the closest round, as it will be the pressure at R2 and at (R2+c*dT). In the second case (tight grouping), the pressures will never add.

If this logic is extended to a many-shot burst, the logic becomes even more persuasive. For the impulse peak from a third shot to interact with the peaks from the first two using the 30 round/sec assumption, it would have to impact the water more than 100 m away from the impact of the first round and more than 50 m away from the impact of the second round. Even in that case, there would be at most two places in the ocean where the curve from the 1^{st} and 3^{rd} impacts would meet the curve from 2^{nd} and 3^{rd} explosions (and the travel distances would have to be 50 m longer for one and 100 m longer for the other). In summary:

- There would be 0 to 4 directions where a curve (a hyperbola approaches an asymptotic line far from the source) of negligible thickness, and volume would have less than two times the pressure from the closest source

- There would be 0 to 2 very small points with no extent in range or bearing where one would see less than three times the pressure from the closest source
- In every other part of the zone of influence (ZOI), the impulse from each round would be received separately by any animal present

For the 4th round and any subsequent round, another curve could be added, if it was far enough away from the previous shots so that their peak had not already passed the impact point. However, this new curve would intersect with the previous 2 curves at a different location than where the first two curves intersected. No matter how many rounds are fired, there would not be any point in the ocean where more than 3 peaks arrive at the same time. These points would have almost no volumetric extent and required range increases from the closest source of N*dt*c, where N is the difference in shot number and dt is the time between shots.

If the rate of fire is increased, there is a decrease in the additional required separation in order to have any coherent increase in pressure or positive impulse. However, the end result is that almost all of the ocean experiences only one pressure peak at a time.

If the rounds are far enough apart in space and close enough in time, there will be curves where sequential rounds add coherently; however,

- They will not occupy any significant volume, and
- They will be less than a factor of 2 above the pressure or positive impulse of the nearest source.

Contrast this with the alternative assumption that pressures from separate rounds be added. This models the event as if all rounds went of exactly at the same place and exactly at the same time. That is the only way that travelling pressure peaks from separate rounds would go through space together and add pressures at all points. This is not realistic and would over-estimate pressure and positive impulse metrics by a factor equal to the number of rounds in the burst, which could be 10 or 20 dB in pressure levels.

Energy Metrics

Energy metrics accumulate the integral of the power density of each explosion over the duration of the impulse. Thus, even though the peaks from separate explosions arrive at different times, the energy from all of their arrivals will be added. If you fire N_{burst} rounds close together in a burst, the energy from all of the rounds will add and the sound exposure level will be $10*\log10(N_{burst})$ higher than if a single shot had been fired. The area affected, A_{burst}, would be larger than the area, A_1 affected by a single shot, because additional transmission loss would be needed to reduce the larger energy level to a given threshold.

The alternative assumption is that each round sees a fresh population and the area affected by N single bullets is $N*A_1$.

The single-shot assumption is more conservative as long as $A_{burst} < N*A_1$. This is true as long as the power density falls off faster than $1/R^2$. Simple modeling generally limits the pressure to a maximum decrease of $1/R^2$, for spherical spreading, and a minimum decrease of 1/R, for

cylindrical spreading (where the sound wave has already reached the bottom so the pressure is assumed to spread only in range and not in depth). Since power density is proportional to the square of the pressure, these limits correspond to power drop off of $1/R^4$ and $1/R^2$ respectively. Thus, the single shot assumption is the most conservative and creates the largest total impact area for a given number of bullets.

A.3 ENVIRONMENTAL CHARACTERIZATION

A.3.1 Important Environmental Parameters for Estimating Animal Harassment

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular source activity. In turn, propagation loss as a function of range depends on a number of environmental parameters including:

- Water depth;
- Sound speed variability throughout the water column;
- Bottom geo-acoustic properties; and
- Surface roughness, as determined by wind speed.

Due to the importance that propagation loss plays in Anti-Submarine Warfare, the Navy has, over the last four to five decades, invested heavily in measuring and modeling these environmental parameters. The result of this effort is the following collection of global databases containing these environmental parameters, which are accepted as standards for Navy modeling efforts. Table A-4 contains the version of the databases used in the modeling for this report.

Table A-4. Navy Standard Databases Used in Modeling

Parameter	Database	Version
Water Depth	Digital Bathymetry Data Base Variable Resolution	DBDBV 6.0
Ocean Sediment	Re-packed Bottom Sediment Type	BST 2.0
Wind Speed	Surface Marine Gridded Climatology Database	SMGC 2.0
Temperature/Salinity Profiles	Generalized Digital Environment Model	GDEM 3.0

The sound speed profile directs the sound propagation in the water column. The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. If the sound speed minimum occurs within the water column, more sound energy can travel further without suffering as much loss (ducted propagation). But if the sound speed minimum occurs at the surface or bottom, the propagating sound interacts more with these boundaries and may become attenuated more quickly. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled to demonstrate the extent of the difference.

Losses of propagating sound energy occur at the boundaries. The water-sediment boundary defined by the bathymetry can vary by a large amount. In a deep water environment, the interaction with the bottom may matter very little. In a shallow water environment the opposite

is true and the properties of the sediment become very important. The sound propagates through the sediment, as well as being reflected by the interface. Soft (low density) sediment behaves more like water for lower frequencies and the sound has relatively more transmission and relatively less reflection than a hard (high density) bottom or thin sediment.

The roughness of the boundary at the water surface depends on the wind speed. Average wind speed can vary seasonally, but could also be the result of local weather. A rough surface scatters the sound energy and increases the transmission loss. Boundary losses affect higher frequency sound energy much more than lower frequencies.

A.3.2 Characterizing the Acoustic Marine Environment

The environment for modeling impact value is characterized by a frequency-dependent bottom definition, range-dependent bathymetry and sound velocity profiles (SVP), and seasonally varying wind speeds and SVPs. The bathymetry database is on a grid of variable resolution.

The sound velocity profile database has a fixed spatial resolution storing temperature and salinity as a function of time and location. The low frequency bottom loss is characterized by standard definition of geo-acoustic parameters for then given sediment type of sand. The high frequency bottom loss class is fixed to match expected loss for the sediment type. The area of interest can be characterized by the appropriate sound speed profiles, set of low frequency bottom loss parameters, high frequency bottom loss class, and HFEVA very-high frequency sediment type for modeled frequencies in excess of 10 kHz.

Generally seasonal variation is sampled by looking at summer and winter cases. Ordnance usage was assumed to be spread equally between summer and winter environments.

Impact volumes in the operating area are then computed using propagation loss estimates and the explosives model derived for the representative environment.

A.3.3 Description of the Eglin Gulf Test and Training Range Area Environment

The EGTTR Study Area is located off the coast of Florida in the Gulf of Mexico. It is an area that slopes from shallow waters near the coast to deeper waters offshore. The bottom is characterized as sandy sediment according to the Bottom Sediments Type Database. Environmental values were extracted from unclassified Navy standard databases in a radius of 50 km around the center point at

N 30° 08.5' W 86° 28'

The Navy standard database for bathymetry has a resolution of 0.05 minutes in the Gulf of Mexico; see Figure A-1. Mean and median depths from DBDBV in the extracted area are 47 and 112 meters, respectively.

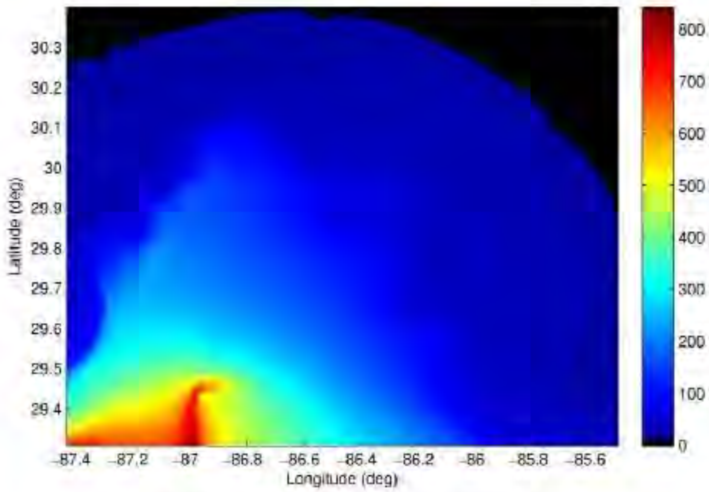


Figure A-1. Bathymetry (in meters) for the EGTTR Study Area Representative Environment

The seasonal variability in wind speed was modeled as 8.6 knots in the summer and 13.02 knots in the winter.

Example input of range-dependent bathymetry is depicted in Figure A-2 for the due-north bearing.

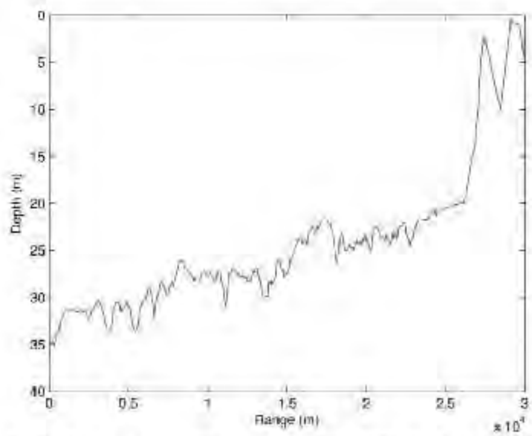


Figure A-2. Bathymetry due-North of the EGTTR Study Area Center Point

A.4 MODELING IMPACT ON MARINE ANIMALS

Many underwater actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

Estimating the number of animals that may be injured or otherwise harassed in a particular environment entails the following steps.

- For the relevant environmental acoustic parameters, transmission loss (TL) estimates are computed, sampling the water column over the appropriate depth and range intervals. TL calculations are also made over disjoint one-third octave bands for a wide range of frequencies with dependence in range, depth, and azimuth for bathymetry and sound speed. TL computations were sampled with 40 degree spacing in azimuth.
- The Type II weighted total accumulated energy within the waters where the source detonates is sampled over a volumetric grid. At each grid point, the received energy from each source emission is modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate metric is similarly modeled for each emission. The maximum value of that metric over all frequencies and emissions, is stored at each grid point.
- The impact volume for a given threshold is estimated by summing the incremental volumes represented by each grid point sampled in range and depth for which the appropriate metric exceeds that threshold, and accumulated over all modeled bearings. Histograms representing impact volumes as a function of (possibly depth-dependent) thresholds, are stored in a spreadsheet for dynamic changes of thresholds.
- Finally, the number of harassments is estimated as the inner-product of the animal density depth profile and the impact volume and scaled by user-specifiable surface animal densities.

This section describes in detail the process of computing impact volumes.

A.4.1 Calculating Transmission Loss

Transmission loss (TL) was pre-computed for both seasons for thirty non-overlapping frequency bands. The 30 bands had one-third octave spacing around center frequencies from 50 Hz to approximately 40.637 kHz. In the previous report, TL was computed at only seven frequencies. The broadband nature of the sources has been well covered in this report. The TL was modeled using the Navy Standard GRAB V3 propagation loss model (Keenan, 2000) with CASS v4.3

The transmission loss results were interpolated onto a variable range grid with logarithmic spacing. The increased spatial resolution near the source provided greater fidelity for estimates.

The transmission loss was calculated from the source depth to an array of output depths. The output depths were the mid-points of depth intervals matching GDEM's depth sampling. For

water depths from surface to 10 m depth, the depth interval was 2 m. Between 10 m and 100 m water depth, the depth interval was 5 m. For waters greater than 100 m, the depth interval was 10 m. For the EGTTR study area environment, there were thirty depths (1, 3, 5, 7, 9, 12.5, 17.5, 22.5, 27.5, 32.5, 37.5, 42.5, 47.5, 52.5, 57.5, 62.5, 67.5, 72.5, 77.5, 82.5, 87.5, 92.5, 97.5, 105, 115, 125, 135, 145, 155, 160, all in meters) representing depth-interval midpoints. The output depths represent possible locations of the animals and are used with the animal depth distribution to better estimate animal impact. The depth grid is used to make the surface image interference correction and to capture the depth-dependence of the positive impulse threshold.

An important propagation consideration at low frequencies is the effect of surface-image interference. As either source or target approach the surface, pairs of paths that differ by a single surface reflection set up an interference pattern that ultimately causes the two paths to cancel each other when the source or target is at the surface. A fully coherent summation of the eigenrays produces such a result but also introduces extreme fluctuations that would have to be highly sampled in range and depth, and then smoothed to give meaningful results, and would be inappropriate in representing a broad one-third octave band of the spectrum. An alternative approach is to implement what is sometimes called a semi-coherent summation. A semi-coherent sum attempts to capture significant effects of surface-image interference (namely the reduction of the field due to destructive interference of reflected paths as the source or target approach the surface) without having to deal with the more rapid fluctuations associated with a fully coherent sum. The semi-coherent sum is formed by a random phase addition of paths that have already been multiplied by the expression:

$$\sin^2\left(\frac{4\pi f z_s z_a}{c^2 t}\right)$$

where f is the frequency, z_s is the source depth, z_a is the animal depth, c is the sound speed and t is the travel time from source to animal along the propagation path. For small arguments of the sine function this expression varies directly as the frequency and the two depths. It is this relationship that causes the propagation field to go to zero as the depths approach the surface or the frequency approaches zero.

A.4.2 Computing Impact Volumes

This section and the next provide a detailed description of the approach taken to compute impact volumes for explosives. The impact volume associated with a particular activity is defined as the volume of water in which some acoustic metric exceeds a specified threshold. The product of this impact volume with a volumetric animal density yields the expected value of the number of animals exposed to that acoustic metric at a level that exceeds the threshold. The acoustic metric can either be an energy term (weighted or un-weighted energy flux density, either in a limited frequency band or across the full band) or a pressure term (such as peak pressure or positive impulse). The thresholds associated with each of these metrics define the levels at which half of the animals exposed will experience some degree of harassment (ranging from behavioral change to mortality).

Impact volume is particularly relevant when trying to estimate the effect of repeated source emissions separated in either time or space. Impact range, which is defined as the maximum range at which a particular threshold is exceeded for a single source emission, defines the range to which marine mammal activity is monitored in order to meet mitigation requirements.

The effective energy source level is modeled directly for the sources to be used at the BT-9 target area. The energy source level is comparable to the model used for other explosives (Arons (1954), Weston (1960), McGrath (1971), Urick (1983), Christian and Gaspin (1974)). The energy source level over a one-third octave band with a center frequency of *f* for a source with a net explosive weight of *w* pounds is given by:

$$ESL = 10\log_{10}(0.26 f) + 10\log_{10}(2 p_{max}^2 / [1/\theta^2 + 4\pi^2 f^2]) + 197 \text{ dB}$$

where the peak pressure for the shock wave at 1 meter is defined as

$$p_{max} = 21600\,(w^{1/3} / 3.28)^{1.13} \text{ psi} \qquad \text{(B-1)}$$

and the time constant is defined as:

$$\theta = [(0.058)\,(w^{1/3})\,(3.28 / w^{1/3})^{0.22}] / 1000 \text{ sec} \qquad \text{(B-2)}$$

For each season and explosive source, the amount of energy in the water column is calculated. The propagation loss for each frequency, expressed as a pressure term, modulates the sound energy found at each point on the grid of depth (uniform spacing) and range (logarithmic spacing). If a threshold is exceeded at a point, the impact volume at an annular sector is added to the total impact volume. The impact volume at a point is calculated exactly using the depth interval, the range interval of the point, and the slice of a sphere centered where the range is zero.

A.4.3 Effects of Metrics on Impact Volumes

The impact of explosive sources on marine wildlife is measured by three different metrics, each with its own thresholds. The energy metric, the peak pressure metric, and the "modified" positive impulse metric are discussed in this section. The energy metric, using the Type II weighted total energy, is accumulated after the explosive detonation. The other two metrics, peak pressure and positive impulse, are not accumulated but rather the maximum levels are taken.

Energy Metric

The energy flux density is sampled at several frequencies in one-third-octave bands. The total weighted energy flux at each range/depth combination is obtained by summing the product of the Type II frequency weighting function, $W_{II}(f)$, and the energy flux density at each frequency. The type II weighting function in dB is given by:

$$\boldsymbol{W_{II}(f) = maximum\big(G_1(f), G_{12}(f)\big)}, \text{ where}$$

$$\boldsymbol{G_1(f) = K_1 + 20log_{10}\left[\frac{b_1^1 f^1}{(a_1^1+f^1)(b_1^1+f^1)}\right]}, \text{ and}$$

$$G_2(f) = K_2 + 20log_{10}\left[\frac{b_2^2 f^2}{(a_2^2+f^2)(b_2^2+f^2)}\right].$$

The component lower cutoff frequencies, a1, upper cutoff frequencies, b, and gain, K, are a function of the functional hearing group. Parameters used for cetaceans are given in Table A-5.

Table A-5. Parameters used for Cetaceans

Functional Hearing Group	K_1(dB)	a_1(Hz)	b_1(Hz)	K_2(dB)	a_2(Hz)	b_2(Hz)
LF cetaceans	-16.5	7	22,000	0.9	674	12,130
MF cetaceans	-16.5	150	160,000	1.4	7,829	95,520
HF cetaceans	-19.4	200	180,000	1.4	9,480	108,820

Note that because the weightings are in dB, we will actually weight each frequency's EFD by $10^{(W_{H}(f)/10)}$, sum the EFDs over frequency and then convert the weighted total energy to back to dB, with level = 10 $\log_{10}$(total weighted EFD).

Peak Pressure Metric

The peak pressure metric is a simple, straightforward calculation at each range/animal depth combination. First, the transmission pressure ratio, modified by the source level in a one-third-octave band, is summed across frequency. This averaged transmission ratio is normalized by the total broadband source level. Peak pressure at that range/animal depth combination is then simply the product of:

- The square root of the normalized transmission ratio of the peak arrival,
- The peak pressure at a range of 1 meter (given by equation B-1), and
- The similitude correction (given by $r^{-0.13}$, where r is the slant range).

If the peak pressure for a given grid point is greater than the specified threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

"Modified" Positive Impulse Metric

The modeling of positive impulse follows the work of Goertner (Goertner, 1982). The Goertner model defines a "partial" impulse as

$$\int_{0}^{T_{min}} p(t)\, dt$$

where $p(t)$ is the pressure wave from the explosive as a function of time t, defined so that $p(t) = 0$ for $t < 0$. This similitude pressure wave is modeled as

$$p(t) = p_{max}\, e^{-t/\theta}$$

where p_{max} is the peak pressure at 1 meter (see, equation B-1), and θ is the time constant defined in equation A-2.

The upper limit of the "partial" impulse integral is

$$T_{min} = \min\ \{T_{cut}, T_{osc}\}$$

where T_{cut} is the time to cutoff and T_{osc} is a function of the animal lung oscillation period. When the upper limit is T_{cut}, the integral is the definition of positive impulse. When the upper limit is defined by T_{osc}, the integral is smaller than the positive impulse and thus is just a "partial" impulse. Switching the integral limit from T_{cut} to T_{osc} accounts for the diminished impact of the positive impulse upon the animals lungs that compress with increasing depth and leads to what is sometimes call a "modified" positive impulse metric.

The time to cutoff is modeled as the difference in travel time between the direct path and the surface-reflected path in an isovelocity environment. At a range of r, the time to cutoff for a source depth z_s and an animal depth z_a is

$$T_{cut} = 1/c\ \{ [r^2 + (z_a + z_s)^2]^{1/2} - [r^2 + (z_a - z_s)^2]^{1/2} \}$$

where c is the speed of sound.

The animal lung oscillation period is a function of animal mass M and depth z_a and is modeled as

$$T_{osc} = 1.17\ M^{1/3}\ (1 + z_a/33)^{-5/6}$$

where M is the animal mass (in kg) and z_a is the animal depth (in feet).

The modified positive impulse threshold is unique among the various injury and harassment metrics in that it is a function of depth and the animal weight. So instead of the user specifying the threshold, it is computed as $K\,(M)^{1/3}\ (1 + z_a/33)^{1/2}$. The coefficient K depends upon the level of exposure. For the onset of slight lung injury, K is 39.1; for the onset of extensive lung hemorrhaging (1% mortality), K is 91.4.

Although the thresholds are a function of depth and animal weight, sometimes they are summarized as their value at the sea surface for a typical dolphin calf (with an average mass of 12.2 kg). For the onset of slight lung injury, the threshold at the surface is approximately 13 psi-msec; for the onset of extensive lung hemorrhaging (1% mortality), the threshold at the surface is approximately 31 psi-msec.

As with peak pressure, the "modified" positive impulse at each grid point is compared to the derived threshold. If the impulse is greater than that threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

A.5 ESTIMATING ANIMAL HARASSMENT

A.5.1 Distribution of Animals in the Environment

Species densities are usually reported by marine biologists as animals per square kilometer. This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector specifies the volume of water ensonified above the specified threshold in each depth interval. A

corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth.

The following bottlenose dolphin (summer profile) example demonstrates the method used to account for three-dimensional analysis by merging the depth distributions with user-specifiable surface densities. Bottlenose dolphins are distributed with:

- 19.2% in 0-10 m,
- 76.8% in 10-50 m,
- 1.7% in 50-100 m, and
- 2.3% in 100-165 m.

The impact volume vector is sampled at 30 depths over the maximally 165 meter water column. Since this is a finer resolution than the depth distribution, densities are apportioned uniformly over depth intervals. For example, 19.2% of bottlenose dolphins are in the 0-10 meter interval, so approximately

- 3.84% are in 0-2 meters,
- 3.84% are in 2-4 meters,
- 3.84% are in 4-6 meters,
- 3.84% are in 6-8 meters, and
- 3.84% are in 8-10 meters.

Similarly, 76.8% are in the 10-50 m interval, so approximately

- 9.60% are in 10 - 15 meters,
- 9.60% are in 15 - 20 meters,
- 9.60% are in 20 - 25 meters,
- etc.

A.5.2 Harassment Estimates

Impact volumes for all depth intervals are scaled by their respective depth densities, divided by their depth interval widths, summed over the entire water column and finally converted to square kilometers to create impact areas. The spreadsheet allows a user-specifiable surface density in animals per square kilometer, so the product of these quantities yields expected number of animals in ensonified water where they could experience harassment.

Since the impact volume vector is the volume of water at or above a given threshold per unit operation (e.g. per detonation, or clusters of munitions explosions), the final harassment count for each animal is the unit operation harassment count multiplied by the number of units deployed.

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

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APPENDIX D

MMPA AND ESA ACOUSTIC IMPACT MODELING

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MMPA AND ESA ACOUSTIC IMPACT MODELING

D.1 BACKGROUND AND OVERVIEW

D.1.1 Federal Regulations Affecting Marine Animals

All marine mammals are protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

The Endangered Species Act of 1973 (ESA) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of their ecosystems. A "species" is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future. Some marine mammals, already protected under MMPA, are also listed as either endangered or threatened under ESA, and are afforded special protections. In addition, all sea turtles are protected under the ESA.

Actions involving sound in the water may have the potential to harass marine animals in the surrounding waters. Demonstration of compliance with the MMPA and ESA, using best available science, has been assessed using criteria and thresholds accepted or negotiated, and described here.

Sections of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity, other than commercial fishing, within a specified geographical region. Through a specific process, if certain findings are made and regulations are issued or, if the taking is limited to harassment, notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings may be granted if National Marine Fisheries Service (NMFS) finds that the taking will have no more than a negligible impact on the species or stock(s), will not have an immitigable adverse impact on the availability of the species or stock(s) for subsistence uses, and that the permissible methods of taking, and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth.

NMFS has defined negligible impact in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to adversely affect the species or stock through effects on annual rates of recruitment or survival.

Subsection 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the United States can apply for an authorization to incidentally take small numbers of marine mammals by harassment. The National Defense Authorization Act of 2004 (NDAA) (Public Law 108-136) removed the small numbers limitation and amended the definition of "harassment" as it applies to a military readiness activity to read as follows:

> (i) *any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or*
> (ii) *any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered [Level B Harassment].*

The primary potential impact to marine mammals from underwater acoustics is Level A and Level B harassment, as defined by the MMPA from noise. Potential impacts to sea turtles from underwater acoustic exposure are primarily behavioral responses and impairment, with some potential for injury, and a very small potential for mortality.

D.1.2 Development of Animal Impact Criteria

D.1.2.1 Marine Mammals

For explosions of ordnance planned for use in the Eglin Gulf Test and Training Range (EGTTR) Study Area, in the absence of any mitigation or monitoring measures, there is a small chance that a marine mammal could be injured or killed when exposed to the energy generated from an explosive force. Analysis of noise impacts is based on criteria and thresholds initially presented in U.S. Navy Environmental Impact Statements for ship shock trials of the Seawolf submarine and the Winston Churchill (DDG 81), and subsequently adopted by NMFS.

Lethal impact determinations currently incorporate species-specific thresholds that are based on the level of impact that would cause extensive lung injury from which one percent of exposed animals would not recover (Finneran and Jenkins, 2012). The threshold represents the expected onset of mortality, where 99 percent of exposed animals would be expected to survive. The lethal exposure level of blast noise, associated with the positive impulse pressure of the blast, is expressed as Pascal-seconds (Pa·s) and is determined using the Goertner (1982) modified positive impulse equation. This equation incorporates sound propagation, source/animal depths, and the mass of a newborn calf of the affected species. The Goertner equation used in the acoustic model to develop mortality impact analysis is as follows:

$$I_M(M,D) = 91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$$

$I_M(M,D)$	mortality threshold, expressed in terms of acoustic impulse (Pa·s)
M	Animal mass (Table D-1)
D	Water depth (m)

Non-lethal injurious impacts (Level A Harassment) are defined in those documents as permanent (auditory) threshold shift (PTS), gastro-intestinal (GI) tract damage, and the onset of slight lung injury. Two thresholds are used for PTS, one based on sound exposure level (SEL) and the other on the sound pressure level (SPL) of an underwater blast. Thresholds follow the approach of Southall et al. (2007). The threshold producing either the largest Zone of Influence (ZOI) or higher exposure levels is then used as the more protective of the dual thresholds. In most cases, the weighted total EFD is more conservative that the largest EFD in any single 1/3-octave band used in earlier models. Type II weighting functions are for each functional hearing group. The threshold for the Type II weighted EFD is 187 decibels referenced to 1 microPascal-squared – seconds (dB re 1 μPa^2-s); the threshold for peak pressure is 46 pounds per square inch (psi) or 230 dB re 1 μPa.

The criteria for slight injury to the GI tract was found to be a limit on peak pressure and independent of the animal's size (Goertner, 1982). A threshold of 103 psi (237 dB re 1 μPa) is used for all marine mammals. This level at which slight contusions to the GI tract were reported from small charge tests (Richmond *et al.,* 1973).

The criteria for onset of slight lung injury were established using partial impulse because the impulse of an underwater blast wave was the parameter that governed damage during a study using mammals, not peak pressure or energy (Yelverton, 1981). Goertner (1982) determined a way to calculate impulse values for injury at greater depths, known as the Goertner "modified" impulse pressure. Those values are valid only near the surface because as hydrostatic pressure increases with depth, organs like the lung, filled with air, compress. Therefore the "modified" impulse pressure thresholds vary from the shallow depth starting point as a function of depth.

The shallow depth starting points for calculation of the "modified" impulse pressures are mass-dependent values derived from empirical data for underwater blast injury (Yelverton, 1981). During the calculations, the lowest impulse and body mass for which slight, and then extensive, lung injury found during a previous study (Yelverton et al, 1973) were used to determine the positive impulse that may cause lung injury. The Goertner model is sensitive to mammal weight such that smaller masses have lower thresholds for positive impulse so injury and harassment will be predicted at greater distances from the source for them. The equation used for determination of slight lung injury is:

$$I_S(M,D) = 39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2},$$

where M is animal mass (kg), D is animal depth (m), and the units of I_s are Pa-s.

Level B (non-injurious) Harassment includes temporary (auditory) threshold shift (TTS), a slight, recoverable loss of hearing sensitivity. One criterion used for TTS, the total Type II weighted energy flux density of the signal, is a threshold of 172 dB re 1 µPa^2-s for toothed whales (e.g., dolphins). A second criterion, a maximum allowable peak pressure of 23 psi (224 dB re 1 µPa), has recently been established by NMFS to provide a more conservative range for TTS when the explosive or animal approaches the sea surface, in which case explosive energy is reduced, but the peak pressure is not. NMFS applies the more conservative of these two.

For multiple successive explosions, the acoustic criterion for non-TTS behavioral disturbance is used to account for behavioral effects significant enough to be judged as harassment, but occurring at lower sound energy levels than those that may cause TTS. The threshold for behavioral disturbance is set 5 dB below the Type II weighted total EFD-based TTS threshold, or 167 dB re 1 µPa^2-s. This is based on observations of behavioral reactions in captive dolphins and belugas occurring at exposure levels ~ 5 dB below those causing TTS after exposure to pure tones (Finneran and Schlundt, 2004; Schlundt et al., 2000).

Table D-1 summarizes the current threshold levels for marine mammals used to analyze explosives identified for use in the EGTTR study area.

Table D-1. Explosives Threshold Levels for Marine Mammals

Mortality*	Level A Harassment			Level B Harassment	
	Slight Lung Injury*	GI Tract Injury	PTS	TTS	Behavioral
$91.4M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	$39.1M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/2}$	Unweighted SPL: 237 dB re 1 µPa	Weighted SEL: 187 dB re 1 µPa^2·s	Weighted SEL: 172 dB re 1 µPa^2·s	Weighted SEL: 167 dB re 1 µPa^2·s
			Unweighted SPL: 230 dB re 1 µPa	Unweighted SPL: 224 dB re 1 µPa (23 psi peak pressure)	

*Expressed in terms of acoustic impulse (Pacsal – seconds [Pa·s]); M = Animal mass based on species (kilograms); D = Water depth (meters); PTS = permanent threshold shift; TTS = temporary threshold shift; SPL = sound pressure level; SEL = sound exposure level; dB re 1 µPa = decibels referenced to 1 microPascal; dB re 1 µPa^2·s = decibels reference to 1 microPascal-squared – seconds.

D.1.2.2 Sea Turtles

The sound sources will be located in an area that is inhabited by species listed as threatened or endangered under the ESA (16 USC §§ 1531-1543), including sea turtles. Operation of the sound sources, that is, transmission of acoustic signals in the water column, could potentially cause harm or harassment to listed species.

"Harm" defined under ESA regulations is "…an act which actually kills or injures…" (50 CFR 222.102) listed species. "Harassment" is an "intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

If a federal agency determines that its proposed action "may affect" a listed species, it is required under Section 7 of the ESA to consult, either formally or informally, with the appropriate regulator. Such consultations would likely be concluded favorably, subject to requirements that the activity will not appreciably reduce the likelihood of the species' survival and recovery and impacts are minimized and mitigated. If appropriate, the Air Force would initiate formal interagency consultation by submitting a Biological Assessment to NMFS, detailing the proposed action's potential effects on listed species and their designated critical habitats. Consultation would conclude with NMFS' issuance of a Biological Opinion (BO) that addresses the issues of whether the project can be expected to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. Within the BO, an Incidental Take Statement is included and identifies the anticipated number of incidental "takes" that are authorized.

Until recently, there were no acoustic energy or pressure impact thresholds defined specifically for ESA-listed sea turtles, and in the absence of such information the thresholds used for marine mammal analysis were typically applied. However, the NMFS has recently undertaken a more detailed investigation of the effects of underwater detonations on turtles and provided the following summary of potential behavioral responses at various peak dB levels (Table D-2).

Table D-2. Range of Sea Turtle Behavioral Responses at Multiple Underwater Noise Levels

dB Level (Peak) Range	Response Category	Number of Animals Potentially Affected
110 – 160	Discountable effects; minor response possible, but within the range of normal behaviors.	Very few
>160 – 200	Some swimming and diving response, becoming stronger and more frequent at higher dB levels.	Few at 160 dB; most at 200 dB
>200 – 220	Strong avoidance response.	Some to all at 220 dB
>220	Intolerable.	All individuals

dB = decibel

NMFS has also recently developed five criteria and threshold levels for sea turtle impacts from underwater detonations. The criteria are defined as follows:

- *Mortality*: mortal injury, cracked shell, or lung/intestinal/organ damage.
- *Injury*: potentially lethal physical injuries, prolonged immobilization by stunning, or auditory trauma.
- *Impairment*: temporary hearing loss, stunning (disorientation, erratic flipper movements, or brief immobilization).
- *Disturbance*: habitat displacement, increased swimming speed, or increased heart rate.

- *Onset of Behavioral Response*: brief response to a single explosion, startle responses including diving and swimming.

Based on this information and other research examining the effects of underwater detonations and airgun operation on turtles and other vertebrates (e.g., Richmond et al., 1973; DeRuiter and Doukara, 2012; Finneran and Jenkins, 2012), NMFS has defined the impact threshold levels shown in Table D-3. Thresholds are defined in terms of both the peak noise level (in dB) and pressure in pounds per square inch (psi). Although there has been recent effort to address turtle-specific thresholds, there are currently no experimental or modeling data sufficient to support development of physiological thresholds. Therefore, mortality, primary blast injury, and auditory effects continue to be based on marine mammal thresholds (low frequency functional group where applicable). Mortality and blast injury thresholds are based on the GI tract injury threshold used for marine mammals; TTS and PTS thresholds are based on those used for low frequency functional hearing group cetaceans. However, turtle-specific behavioral responses to impulsive sounds (airguns) have been documented in the literature (e.g., McCauley et al., 2000) and have been incorporated by NMFS into behavioral categories. The disturbance threshold is considered to approximate a sub-TTS, high level behavioral response.

Table D-3. Sea Turtle Exposure Thresholds for Single Underwater Detonation Events

Mortality	Injury	Impairment	Disturbance	Onset of Behavioral Response
>237 dB (peak)	>229 dB (peak)	>224 dB (peak)	>218 dB (peak)	>180 dB (peak)
102 psi	40 psi	23 psi	12 psi	0.14 psi

dB = decibel; psi = pounds per square inch

Work is ongoing in the scientific community to refine the threshold criteria in response to new information about marine animal biology. The new modeling described here uses more conservative thresholds than were used in previous studies. Models were implemented in a way that allows the threshold criteria to be varied (over a realistic range of values). New results can be generated if the current criteria change.

D.2 EXPLOSIVE ACOUSTIC SOURCES

D.2.1 Acoustic Characteristics of Explosive Sources

The acoustic sources employed at the EGTTR study area are categorized as broadband explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). Detailed descriptions of the sources in the EGTTR study area are provided in this subsection.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive

weight (or NEW) accounts for the first two parameters. The NEW of an explosive is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

D.2.2 Animal Harassment Effects of Explosive Sources

The harassments expected to result from these sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following. Let A represent the impact area (that is, the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N explosives is merely NA regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of detonations spaced closely in time, while the energy metrics increase at a rate of $N^{1/2}$ (under spherical spreading loss only) or less.

The firing sequence for some of the munitions consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. As with detonations, if bursts are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, the cumulative impact area of N bursts is merely NA, where A is the impact area of a single burst, regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis. A more detailed description of pressure and energy considerations resulting from munition bursts is provided in Section B.2.3 below.

Explosives are modeled as detonating at depths ranging from the water surface to 10 feet below the surface, as provided by Government-Furnished Information. Impacts from above surface detonations were considered negligible and not modeled.

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breach the surface with some of the acoustic energy escaping the water column. Leidos modeled

surface detonations as occurring 1' below the water surface. The source levels have not been adjusted for possible venting nor does the subsequent analysis attempt to take this into account.

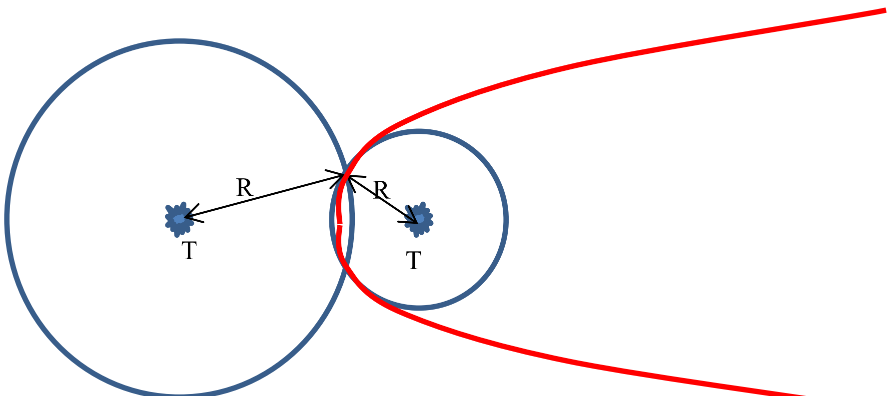
D.2.3 Zone of Influence: Per-Detonation Versus Net Explosive Weight Combination

It may be considered why and when it is appropriate to treat rounds within a burst as separate events, rather than combining the NEW of all rounds and treating it as a single, larger, event. The basic information necessary to address this issue is provided below.

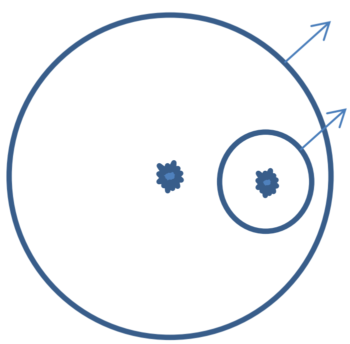
Peak Pressure and Positive Impulse

Peak pressures add if two (or more) impulses reach the same point at the same time. Since explosive rounds go off at different times and locations, this will only be true for a small set of points. This problem is mathematically the same as the passive sonar problem of localizing a sound source based on the time difference of arrival (TDOA) of a signal reaching two receivers. The red curve in the figure (half of a hyperbola) represents the set of all point where

R1 – R2 = c*(T2 – T1), for
c = the speed of sound in water, and
T1 and T2 being the detonation times of the two rounds :



Such a curve can only be drawn when c*(T2-T1) is less than the distance between the two explosions. If, for instance, 30 rounds/second are fired (and the difference in impact time is assumed to be roughly the distance in firing time), then the peak impact pressure from the first round will have traveled 1,500 m/s * 1/30 sec = 50 m. If the second round hits less than 50 m



from the first round, the impact wave from the second round will never catch the impact wave from the first.

In the first case (loose grouping), the pressures will only add along a curve with very narrow width and negligible volume. The pressure on this curve less than twice the pressure of the closest round, as it will be the pressure at R2 and at (R2+c*dT). In the second case (tight grouping), the pressures will never add.

If this logic is extended to a many-shot burst, the logic becomes even more persuasive. For the impulse peak from a third shot to interact with the peaks from the first two using the 30 round/sec assumption, it would have to impact the water more than 100 m away from the impact of the first round and more than 50 m away from the impact of the second round. Even in that case, there would be at most two places in the ocean where the curve from the 1st and 3rd impacts would meet the curve from 2nd and 3rd explosions (and the travel distances would have to be 50 m longer for one and 100 m longer for the other). In summary:

- There would be 0 to 4 directions where a curve (a hyperbola approaches an asymptotic line far from the source) of negligible thickness, and volume would have less than two times the pressure from the closest source
- There would be 0 to 2 very small points with no extent in range or bearing where one would see less than three times the pressure from the closest source
- In every other part of the zone of influence (ZOI), the impulse from each round would be received separately by any animal present

For the 4th round and any subsequent round, another curve could be added, if it was far enough away from the previous shots so that their peak had not already passed the impact point. However, this new curve would intersect with the previous 2 curves at a different location than where the first two curves intersected. No matter how many rounds are fired, there would not be any point in the ocean where more than 3 peaks arrive at the same time. These points would have almost no volumetric extent and required range increases from the closest source of N*dt*c, where N is the difference in shot number and dt is the time between shots.

If the rate of fire is increased, there is a decrease in the additional required separation in order to have any coherent increase in pressure or positive impulse. However, the end result is that almost all of the ocean experiences only one pressure peak at a time.

If the rounds are far enough apart in space and close enough in time, there will be curves where sequential rounds add coherently; however,

- They will not occupy any significant volume, and
- They will be less than a factor of 2 above the pressure or positive impulse of the nearest source.

Contrast this with the alternative assumption that pressures from separate rounds be added. This models the event as if all rounds went of exactly at the same place and exactly at the same time. That is the only way that travelling pressure peaks from separate rounds would go through space

together and add pressures at all points. This is not realistic and would over-estimate pressure and positive impulse metrics by a factor equal to the number of rounds in the burst, which could be 10 or 20 dB in pressure levels.

Energy Metrics

Energy metrics accumulate the integral of the power density of each explosion over the duration of the impulse. Thus, even though the peaks from separate explosions arrive at different times, the energy from all of their arrivals will be added. If you fire N_{burst} rounds close together in a burst, the energy from all of the rounds will add and the sound exposure level will be $10*log10(N_{burst})$ higher than if a single shot had been fired. The area affected, A_{burst}, would be larger than the area, A_1 affected by a single shot, because additional transmission loss would be needed to reduce the larger energy level to a given threshold.

The alternative assumption is that each round sees a fresh population and the area affected by N single bullets is $N*A_1$.

The single-shot assumption is more conservative as long as $A_{burst} < N*A_1$. This is true as long as the power density falls off faster than $1/R^2$. Simple modeling generally limits the pressure to a maximum decrease of $1/R^2$, for spherical spreading, and a minimum decrease of 1/R, for cylindrical spreading (where the sound wave has already reached the bottom so the pressure is assumed to spread only in range and not in depth). Since power density is proportional to the square of the pressure, these limits correspond to power drop off of $1/R^4$ and $1/R^2$ respectively. Thus, the single shot assumption is the most conservative and creates the largest total impact area for a given number of bullets.

D.3 ENVIRONMENTAL CHARACTERIZATION

D.3.1 Important Environmental Parameters for Estimating Animal Harassment

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular source activity. In turn, propagation loss as a function of range depends on a number of environmental parameters including:

- water depth
- sound speed variability throughout the water column
- bottom geo-acoustic properties, and
- surface roughness, as determined by wind speed

Due to the importance that propagation loss plays in Anti-Submarine Warfare, the Navy has, over the last four to five decades, invested heavily in measuring and modeling these environmental parameters. The result of this effort is the following collection of global databases containing these environmental parameters, which are accepted as standards for Navy modeling efforts. Table D-4 contains the version of the databases used in the modeling for this report.

Table D-4. Navy Standard Databases Used in Modeling

Parameter	Database	Version
Water Depth	Digital Bathymetry Data Base Variable Resolution	DBDBV 6.0
Ocean Sediment	Re-packed Bottom Sediment Type	BST 2.0
Wind Speed	Surface Marine Gridded Climatology Database	SMGC 2.0
Temperature/Salinity Profiles	Generalized Digital Environment Model	GDEM 3.0

The sound speed profile directs the sound propagation in the water column. The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. If the sound speed minimum occurs within the water column, more sound energy can travel further without suffering as much loss (ducted propagation). But if the sound speed minimum occurs at the surface or bottom, the propagating sound interacts more with these boundaries and may become attenuated more quickly. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled to demonstrate the extent of the difference.

Losses of propagating sound energy occur at the boundaries. The water-sediment boundary defined by the bathymetry can vary by a large amount. In a deep water environment, the interaction with the bottom may matter very little. In a shallow water environment the opposite is true and the properties of the sediment become very important. The sound propagates through the sediment, as well as being reflected by the interface. Soft (low density) sediment behaves more like water for lower frequencies and the sound has relatively more transmission and relatively less reflection than a hard (high density) bottom or thin sediment.

The roughness of the boundary at the water surface depends on the wind speed. Average wind speed can vary seasonally, but could also be the result of local weather. A rough surface scatters the sound energy and increases the transmission loss. Boundary losses affect higher frequency sound energy much more than lower frequencies.

D.3.2 Characterizing the Acoustic Marine Environment

The environment for modeling impact value is characterized by a frequency-dependent bottom definition, range-dependent bathymetry and sound velocity profiles (SVP), and seasonally varying wind speeds and SVPs. The bathymetry database is on a grid of variable resolution.

The sound velocity profile database has a fixed spatial resolution storing temperature and salinity as a function of time and location. The low frequency bottom loss is characterized by standard definition of geo-acoustic parameters for then given sediment type of sand. The high frequency bottom loss class is fixed to match expected loss for the sediment type. The area of interest can be characterized by the appropriate sound speed profiles, set of low frequency bottom loss parameters, high frequency bottom loss class, and HFEVA very-high frequency sediment type for modeled frequencies in excess of 10 kHz.

Generally seasonal variation is sampled by looking at summer and winter cases. Ordnance usage was assumed to be spread equally between summer and winter environments.

Impact volumes in the operating area are then computed using propagation loss estimates and the explosives model derived for the representative environment.

D.3.3 Description of the Eglin Gulf Test and Training Range Area Environment

The EGTTR Study Area is located off the coast of Florida in the Gulf of Mexico. It is an area that slopes from shallow waters near the coast to deeper waters offshore. The bottom is characterized as sandy sediment according to the Bottom Sediments Type Database. Environmental values were extracted from unclassified Navy standard databases in a radius of 50 km around the center point at

N 30° 08.5' W 86° 28'

The Navy standard database for bathymetry has a resolution of 0.05 minutes in the Gulf of Mexico; see Figure D-1. Mean and median depths from DBDBV in the extracted area are 47 and 112 meters, respectively.

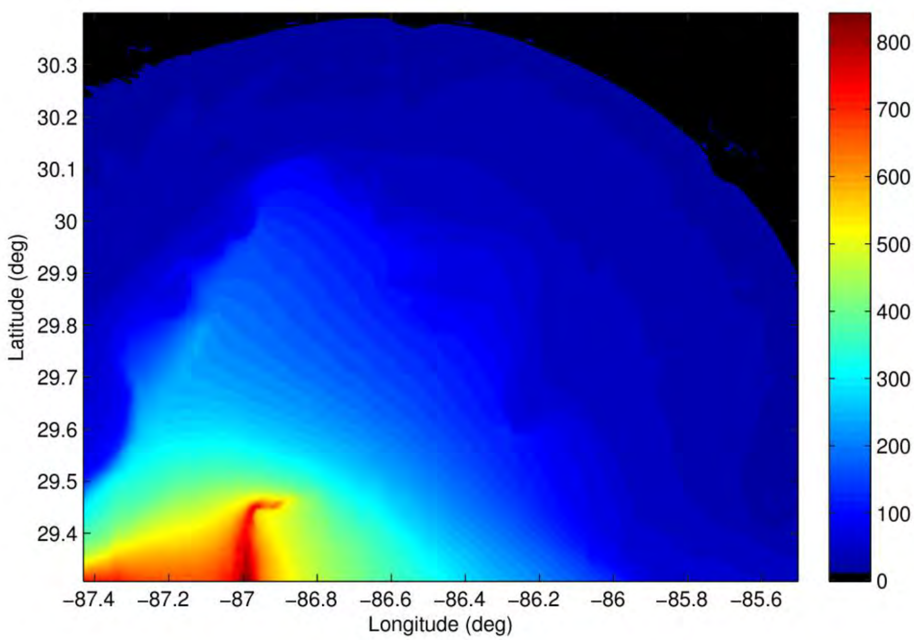


Figure D-1. Bathymetry (in meters) for the EGTTR Study Area Representative Environment

The seasonal variability in wind speed was modeled as 8.6 knots in the summer and 13.02 knots in the winter.

Example input of range-dependent bathymetry is depicted in Figure D-2 for the due-north bearing.

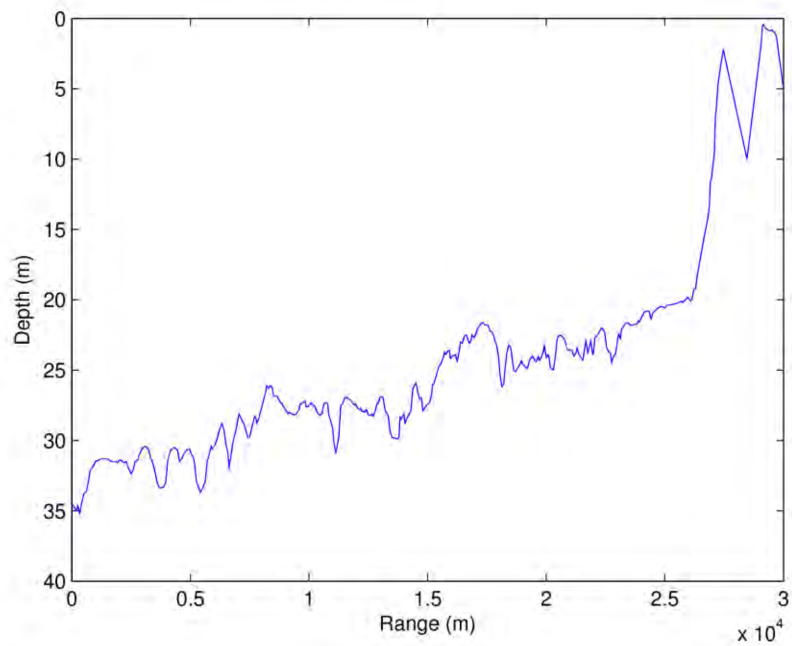


Figure D-2. Bathymetry Due North of the EGTTR Study Area Center Point

D.4 MODELING IMPACT ON MARINE ANIMALS

Many underwater actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

Estimating the number of animals that may be injured or otherwise harassed in a particular environment entails the following steps.

For the relevant environmental acoustic parameters, transmission loss (TL) estimates are computed, sampling the water column over the appropriate depth and range intervals. TL calculations are also made over disjoint one-third octave bands for a wide range of frequencies with dependence in range, depth, and azimuth for bathymetry and sound speed. TL computations were sampled with 40 degree spacing in azimuth.

The Type II weighted total accumulated energy within the waters where the source detonates is sampled over a volumetric grid. At each grid point, the received energy from each source emission is modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate metric is similarly modeled for each emission. The maximum value of that metric over all frequencies and emissions, is stored at each grid point.

The impact volume for a given threshold is estimated by summing the incremental volumes represented by each grid point sampled in range and depth for which the appropriate metric exceeds that threshold, and accumulated over all modeled bearings. Histograms representing impact volumes as a function of (possibly depth-dependent) thresholds, are stored in a spreadsheet for dynamic changes of thresholds.

Finally, the number of harassments is estimated as the inner-product of the animal density depth profile and the impact volume and scaled by user-specifiable surface animal densities.

This section describes in detail the process of computing impact volumes.

D.4.1 Calculating Transmission Loss

Transmission loss (TL) was pre-computed for both seasons for thirty non-overlapping frequency bands. The 30 bands had one-third octave spacing around center frequencies from 50 Hz to approximately 40.637 kHz. In the previous report, TL was computed at only seven frequencies. The broadband nature of the sources has been well covered in this report. The TL was modeled using the Navy Standard GRAB V3 propagation loss model (Keenan, 2000) with CASS v4.3

The transmission loss results were interpolated onto a variable range grid with logarithmic spacing. The increased spatial resolution near the source provided greater fidelity for estimates.

The transmission loss was calculated from the source depth to an array of output depths. The output depths were the mid-points of depth intervals matching GDEM's depth sampling. For water depths from surface to 10 m depth, the depth interval was 2 m. Between 10 m and 100 m water depth, the depth interval was 5 m. For waters greater than 100 m, the depth interval was 10 m. For the EGTTR study area environment, there were thirty depths (1, 3, 5, 7, 9, 12.5, 17.5, 22.5, 27.5, 32.5, 37.5, 42.5, 47.5, 52.5, 57.5, 62.5, 67.5, 72.5, 77.5, 82.5, 87.5, 92.5, 97.5, 105, 115, 125, 135, 145, 155, 160, all in meters) representing depth-interval midpoints. The output depths represent possible locations of the animals and are used with the animal depth distribution to better estimate animal impact. The depth grid is used to make the surface image interference correction and to capture the depth-dependence of the positive impulse threshold.

An important propagation consideration at low frequencies is the effect of surface-image interference. As either source or target approach the surface, pairs of paths that differ by a single surface reflection set up an interference pattern that ultimately causes the two paths to cancel each other when the source or target is at the surface. A fully coherent summation of the eigenrays produces such a result but also introduces extreme fluctuations that would have to be highly sampled in range and depth, and then smoothed to give meaningful results, and would be inappropriate in representing a broad one-third octave band of the spectrum. An alternative approach is to implement what is sometimes called a semi-coherent summation. A semi-coherent sum attempts to capture significant effects of surface-image interference (namely the reduction of the field due to destructive interference of reflected paths as the source or target approach the surface) without having to deal with the more rapid fluctuations associated with a fully coherent sum. The semi-coherent sum is formed by a random phase addition of paths that have already been multiplied by the expression:

$$\sin^2\left(\frac{4\pi f z_s z_a}{c^2 t}\right)$$

where f is the frequency, z_s is the source depth, z_a is the animal depth, c is the sound speed and t is the travel time from source to animal along the propagation path. For small arguments of the sine function this expression varies directly as the frequency and the two depths. It is this relationship that causes the propagation field to go to zero as the depths approach the surface or the frequency approaches zero.

D.4.2 Computing Impact Volumes

This section and the next provide a detailed description of the approach taken to compute impact volumes for explosives. The impact volume associated with a particular activity is defined as the volume of water in which some acoustic metric exceeds a specified threshold. The product of this impact volume with a volumetric animal density yields the expected value of the number of animals exposed to that acoustic metric at a level that exceeds the threshold. The acoustic metric can either be an energy term (weighted or un-weighted energy flux density, either in a limited frequency band or across the full band) or a pressure term (such as peak pressure or positive impulse). The thresholds associated with each of these metrics define the levels at which half of the animals exposed will experience some degree of harassment (ranging from behavioral change to mortality).

Impact volume is particularly relevant when trying to estimate the effect of repeated source emissions separated in either time or space. Impact range, which is defined as the maximum range at which a particular threshold is exceeded for a single source emission, defines the range to which marine mammal activity is monitored in order to meet mitigation requirements.

The effective energy source level is modeled directly for the sources to be used at the BT-9 target area. The energy source level is comparable to the model used for other explosives (Arons (1954), Weston (1960), McGrath (1971), Urick (1983), Christian and Gaspin (1974)). The energy source level over a one-third octave band with a center frequency of f for a source with a net explosive weight of w pounds is given by:

$$\mathrm{ESL} = 10 \log_{10} (0.26 f) + 10 \log_{10} (2\, p_{max}^2 / [1/\theta^2 + 4 \pi^2 f^2]) + 197 \;\; \mathrm{dB}$$

where the peak pressure for the shock wave at one meter is defined as

$$p_{max} = 21600 \, (w^{1/3} / 3.28)^{1.13} \;\; \mathrm{psi} \qquad \text{(B-1)}$$

and the time constant is defined as:

$$\theta = [(0.058)\,(w^{1/3})\,(3.28 / w^{1/3})^{0.22}] / 1000 \;\; \mathrm{sec} \qquad \text{(B-2)}$$

For each season and explosive source, the amount of energy in the water column is calculated. The propagation loss for each frequency, expressed as a pressure term, modulates the sound

energy found at each point on the grid of depth (uniform spacing) and range (logarithmic spacing). If a threshold is exceeded at a point, the impact volume at an annular sector is added to the total impact volume. The impact volume at a point is calculated exactly using the depth interval, the range interval of the point, and the slice of a sphere centered where the range is zero.

D.4.3 Effects of Metrics on Impact Volumes

The impact of explosive sources on marine wildlife is measured by three different metrics, each with its own thresholds. The energy metric, the peak pressure metric, and the "modified" positive impulse metric are discussed in this section. The energy metric, using the Type II weighted total energy, is accumulated after the explosive detonation. The other two metrics, peak pressure and positive impulse, are not accumulated but rather the maximum levels are taken.

Energy Metric

The energy flux density is sampled at several frequencies in one-third-octave bands. The total weighted energy flux at each range/depth combination is obtained by summing the product of the Type II frequency weighting function, $W_{II}(f)$, and the energy flux density at each frequency. The type II weighting function in dB is given by:

$$W_{II}(f) = maximum\big(G_1(f), G_{12}(f)\big), \text{ where}$$

$$G_1(f) = K_1 + 20log_{10}\left[\frac{b_1^2 f^2}{(a_1^2+f^2)(b_1^2+f^2)}\right], \text{ and}$$

$$G_2(f) = K_2 + 20log_{10}\left[\frac{b_2^2 f^2}{(a_2^2+f^2)(b_2^2+f^2)}\right].$$

The component lower cutoff frequencies, a1, upper cutoff frequencies, b, and gain, K, are a function of the functional hearing group. Parameters used for cetaceans are given in Table D-5.

Table D-5. Parameters used for Cetaceans

Functional Hearing Group	K_1(dB)	a_1(Hz)	b_1(Hz)	K_2(dB)	a_2(Hz)	b_2(Hz)
LF cetaceans	-16.5	7	22,000	0.9	674	12,130
MF cetaceans	-16.5	150	160,000	1.4	7,829	95,520
HF cetaceans	-19.4	200	180,000	1.4	9,480	108,820

Note that because the weightings are in dB, Leidos weights each frequency's EFD by $10^{(W_{II}(f)/10)}$, sums the EFDs over frequency and then converts the weighted total energy to back to dB, with level = 10 $\log_{10}$(total weighted EFD).

Peak Pressure Metric

The peak pressure metric is a simple, straightforward calculation at each range/animal depth combination. First, the transmission pressure ratio, modified by the source level in a one-third-

octave band, is summed across frequency. This averaged transmission ratio is normalized by the total broadband source level. Peak pressure at that range/animal depth combination is then simply the product of:

the square root of the normalized transmission ratio of the peak arrival,

the peak pressure at a range of one meter (given by equation B-1), and

the similitude correction (given by $r^{-0.13}$, where r is the slant range).

If the peak pressure for a given grid point is greater than the specified threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

"Modified" Positive Impulse Metric

The modeling of positive impulse follows the work of Goertner (Goertner, 1982). The Goertner model defines a "partial" impulse as

$$\int_0^{T_{min}} p(t)\,\mathrm{d}t$$

where $p(t)$ is the pressure wave from the explosive as a function of time t, defined so that $p(t) = 0$ for $t < 0$. This similitude pressure wave is modeled as

$$p(t) = p_{max}\, e^{-t/\theta}$$

where p_{max} is the peak pressure at one meter (see, equation B-1), and θ is the time constant defined in equation A-2.

The upper limit of the "partial" impulse integral is

$$T_{min} = \min\,\{T_{cut}, T_{osc}\}$$

where T_{cut} is the time to cutoff and T_{osc} is a function of the animal lung oscillation period. When the upper limit is T_{cut}, the integral is the definition of positive impulse. When the upper limit is defined by T_{osc}, the integral is smaller than the positive impulse and thus is just a "partial" impulse. Switching the integral limit from T_{cut} to T_{osc} accounts for the diminished impact of the positive impulse upon the animals lungs that compress with increasing depth and leads to what is sometimes call a "modified" positive impulse metric.

The time to cutoff is modeled as the difference in travel time between the direct path and the surface-reflected path in an isovelocity environment. At a range of r, the time to cutoff for a source depth z_s and an animal depth z_a is

$$T_{cut} = 1/c\ \{\ [r^2 + (z_a + z_s)^2]^{1/2} - [r^2 + (z_a - z_s)^2]^{1/2}\ \}$$

where c is the speed of sound.

The animal lung oscillation period is a function of animal mass *M* and depth z_a and is modeled as

$$T_{osc} = 1.17\, M^{1/3}\, (1 + z_a/33)^{-5/6}$$

where *M* is the animal mass (in kg) and z_a is the animal depth (in feet).

The modified positive impulse threshold is unique among the various injury and harassment metrics in that it is a function of depth and the animal weight. So instead of the user specifying the threshold, it is computed as $K\,(M)^{1/3}\,(1 + z_a/33)^{1/2}$. The coefficient *K* depends upon the level of exposure. For the onset of slight lung injury, *K* is 39.1; for the onset of extensive lung hemorrhaging (1% mortality), *K* is 91.4.

Although the thresholds are a function of depth and animal weight, sometimes they are summarized as their value at the sea surface for a typical dolphin calf (with an average mass of 12.2 kg). For the onset of slight lung injury, the threshold at the surface is approximately 13 psi-msec; for the onset of extensive lung hemorrhaging (1% mortality), the threshold at the surface is approximately 31 psi-msec.

As with peak pressure, the “modified” positive impulse at each grid point is compared to the derived threshold. If the impulse is greater than that threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

D.5 ESTIMATING ANIMAL HARASSMENT

D.5.1 Distribution of Animals in the Environment

Species densities are usually reported by marine biologists as animals per square kilometer. This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector specifies the volume of water ensonified above the specified threshold in each depth interval. A corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth.

The following bottlenose dolphin (summer profile) example demonstrates the method used to account for three-dimensional analysis by merging the depth distributions with user-specifiable surface densities. Bottlenose dolphins are distributed with:

- 19.2% in 0-10 m,
- 76.8% in 10-50 m,
- 1.7% in 50-100 m, and
- 2.3% in 100-165 m.

The impact volume vector is sampled at 30 depths over the maximally 165 meter water column. Since this is a finer resolution than the depth distribution, densities are apportioned uniformly

over depth intervals. For example, 19.2% of bottlenose dolphins are in the 0-10 meter interval, so approximately

- 3.84% are in 0-2 meters,
- 3.84% are in 2-4 meters,
- 3.84% are in 4-6 meters,
- 3.84% are in 6-8 meters, and
- 3.84% are in 8-10 meters.

Similarly, 76.8% are in the 10-50 m interval, so approximately

- 9.60% are in 10 - 15 meters,
- 9.60% are in 15 - 20 meters,
- 9.60% are in 20 - 25 meters,
- etc.

D.5.2 Harassment Estimates

Impact volumes for all depth intervals are scaled by their respective depth densities, divided by their depth interval widths, summed over the entire water column and finally converted to square kilometers to create impact areas. The spreadsheet allows a user-specifiable surface density in animals per square kilometer, so the product of these quantities yields expected number of animals in ensonified water where they could experience harassment.

Since the impact volume vector is the volume of water at or above a given threshold per unit operation (e.g. per detonation, or clusters of munitions explosions), the final harassment count for each animal is the unit operation harassment count multiplied by the number of units deployed.

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

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