Request for Letter of Authorization for the Incidental Taking of Marine Mammals Resulting from Testing and Training Operations in the Eglin Gulf Test and Training Range Eglin Air Force Base, Florida

Submitted to:

Office of Protected Resources National Marine Fisheries Service (NMFS)
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Executive Summary

Eglin Air Force Base (AFB) has prepared this Letter of Authorization (LOA) Request for the incidental taking of marine mammals that may result from military operations proposed to be conducted in the Eglin Gulf Test and Training Range (EGTTR) during the 2023–2030 mission period. The purpose of this LOA Request is to support the consultation process with the National Marine Fisheries Service (NMFS) under the Marine Mammal Protection Act for the proposed EGTTR operations. The proposed operations addressed in this LOA Request represent the Proposed Action that is being analyzed in the *Eglin Gulf Test and Training Range (EGTTR) Range Environmental Assessment*, currently under preparation. Current EGTTR operations are authorized under the LOA issued to Eglin AFB for the previous 5-year mission period from 2018 to 2023.

Under the Proposed Action, the EGTTR would continue to be used during the next mission period based on the maritime testing and training requirements of the various military units that use the EGTTR. The next mission period would span 7 years, from 2023 to 2030. Most operations during this period would be a continuation of the same operations conducted by the same military units during the previous mission period. Most missions would continue to be air-to-surface operations that involve firing live or inert munitions, including missiles, bombs, and gun ammunition, from aircraft at targets on the water surface. The types of targets used vary by mission and primarily include stationary, remotely controlled, and towed boats, inflatable targets, and marker flares. Live munitions used in the EGTTR are set to detonate either in the air a few feet above the water surface (airburst detonation), instantaneously upon contact with the water or target (surface detonation), or approximately 5 to 10 feet below the water surface (subsurface detonation). There would be an increase in the annual quantities of all general categories of munitions (bombs, missiles, and gun ammunition) under the Proposed Action, except for live gun ammunition, which is proposed to be used less over the next mission period. The highest net explosive weight (NEW) of the munitions under the Proposed Action would be 945 pounds, which was also the highest NEW for the previous mission period.

Live missions proposed for the 2023–2030 period would be conducted in the existing Live Impact Area (LIA) within the EGTTR. Certain missions may also be conducted in the proposed East LIA, which would be a new, separate area within the EGTTR where live munitions would be used. Live missions that involve only airburst or aerial target detonations would continue to be conducted in or outside the LIA in any portion of the EGTTR; such detonations have no appreciable effect on marine mammals because there is negligible transmission of pressure or acoustic energy across the air–water interface. Use of inert munitions and live air-to-surface gunnery operations would also continue to occur in or outside the LIA, with new restrictions in certain areas outside the LIA as mitigation to prevent impacts to the Rice's whale.

This LOA Request analyzes the potential impacts of the Proposed Action on the common bottlenose dolphin, Atlantic spotted dolphin, and Rice's whale. Spatial density models developed by the National Oceanic and Atmospheric Administration (2022) were used to predict the densities of these species for the impact analyses. The munitions proposed to be used by each military unit were grouped into mission-day categories so the acoustic impact analysis could be based on the total number of detonations conducted during a given mission instead of each individual detonation. This was done in the previous LOA Request per NMFS's request that the impact analysis account for the accumulated energy from multiple detonations over a 24-hour period. A total of 19 mission-day categories (A through S) were developed for the munitions proposed to be used. Using the dBSea underwater acoustic model and associated analyses, the threshold distances and zones of influence (ZOIs) were estimated for each mission-day category for each marine mammal species. Takes were estimated based on the area of the ZOI, predicted animal density, and annual number of events for each mission-day category. To assess the potential impacts of inert munitions on marine mammals, the proposed inert munitions were categorized into four classes

based on their impact energies, and the threshold distances for each class were modeled and calculated as described for the mission-day categories.

Based on the results of underwater acoustic modeling and associated analyses conducted for this LOA Request, the USAF requests a total of 9 Level A harassment takes and 1,136 Level B harassment takes of the common bottlenose dolphin, and 1 Level A harassment take and 139 Level B harassment takes of the Atlantic spotted dolphin annually for EGTTR operations during the next 7-year mission period. The presented takes are overestimates of actual exposure based on the conservative assumption that all proposed detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets. These take estimates also do not consider the protected species monitoring and mitigation measures implemented for EGTTR operations, which are expected to reduce the overall potential for impacts to dolphins. Based on the low number of injurious takes estimated to result from EGTTR operations and implementation of the established monitoring and mitigation measures, associated impacts to the applicable bottlenose and Atlantic spotted dolphin stocks in the Gulf of Mexico are expected to be negligible.

EGTTR operations under the Proposed Action have the potential to result in non-injurious, Level B harassment of the Rice's whale, estimated as a total of 2 temporary threshold shift (TTS) takes and 4 behavioral disturbance takes annually for all EGTTR missions combined. The requested takes are overestimates because they represent the maximum Level B harassment scenario for all missions and assume that all detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets.

As a mitigation measure to prevent any permanent threshold shift (PTS) impacts to the Rice's whale from detonations during the 2023–2030 mission period, the USAF will restrict the use of live munitions in the western part of each LIA based on the setbacks from the 100-meter isobath presented in this LOA Request. The USAF will also prohibit the use of inert munitions in Rice's whale habitat during the next mission period. Under this new mitigation measure, inert munitions use will be prohibited between the 100-meter and 400-meter isobaths throughout the EGTTR. Lastly, to prevent any PTS impacts to the Rice's whale from Air Force Special Operations Command (AFSOC) gunnery operations, AFSOC gunnery missions will be conducted at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath during the next mission period.

The takes requested for the Rice's whale, although being overestimates of actual takes, avoid injury and would result in insignificant impacts to the Rice's whale population in the Gulf of Mexico. The requested takes have been minimized by the USAF to the greatest extent possible based on the new mitigation measures proposed. By committing to these measures, the USAF is sacrificing a significant amount of testing and training area in the Gulf of Mexico to protect the Rice's whale.

Missions proposed to be conducted during nighttime will be required to be supported by AC-130 aircraft with night-vision instrumentation used for AFSOC gunnery missions or other platforms with comparable nighttime monitoring capabilities. For live nighttime missions, the pre-mission survey area will extend out to, at a minimum, double the dolphin PTS threshold distance for the mission.

Based on the analysis conducted, metals, explosives, and other materials associated with EGTTR operations under the Proposed Action would be released into the marine environment at low concentrations, would be readily diluted, and would have negligible potential to adversely impact water or sediment quality; therefore, no associated impacts to marine mammal habitat are expected from such releases.

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List of Acronyms and Abbreviations

µPa	micropascal(s)
417 FLTS	417th Flight Test Squadron
53 WEG	53rd Weapons Evaluation Group
780 TS	780th Test Squadron
8 SOS	8th Special Operations Squadron
96 OG	96th Operations Group
96 OSS	96th Operational Support Squadron
ADM	American Decoy Missile
AFB	Air Force Base
AFSOC	Air Force Special Operations Command
AGL	above ground level
AGM	Air-to-Ground Missile
AIM	Air Intercept Missile
AMRAAM	Advanced Medium-Range Air-to-Air Missile
ARRW	Air-Launched Rapid Response Weapon
CBU	Cluster Bomb Unit
CCF	Central Control Facility
cm	centimeter(s)
CONEX	Container Express
dB	decibel(s)
dB re 1 µPa	decibel(s) referenced to 1 micropascal
dB re 1 μPa^2-s	decibel(s) referenced to 1 micropascal-squared second
DoD	U.S. Department of Defense
E	Endangered
EGTTR	Eglin Gulf Test and Training Range
EOD	Explosive Ordnance Disposal
ER	Extended Range
ESA	Endangered Species Act
FTS	Flight Termination System
FU	Full Up
GBU	Guided Bomb Unit
GI	gastrointestinal
GIS	geographic information system
GP	General Purpose
GRATV	Gulf Range Armament Test Vessel
GRE	Gulf Range Enhancement
GTV	Guided Test Vehicle
HAAWC	High Altitude Anti-Submarine Warfare Weapon Capability
HACM	Hypersonic Attack Cruise Missile

HE	High Explosive
HOB	height of burst
HSMST	High-Speed Maneuverable Surface Target
Hz	hertz
JAGM	Joint Air-to-Ground Missile
JASSM	Joint Air-to-Surface Standoff Missile
JDAM	Joint Direct Attack Munition
kHz	kilohertz
km^2	square kilometer(s)
LAARS	Large Area Artificial Reef Site
LAICRM	Large Aircraft Infrared Counter Measure
lb	pound(s)
LIA	Live Impact Area
LOA	Letter of Authorization
LSDB	Laser Small-Diameter Bomb
m	meter(s)
MCM	Mine Countermeasures
Mk	Mark
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
msec	millisecond(s)
n/100 km^2	individual(s) per 100 square kilometers
NAVSCOLEOD	Naval School Explosive Ordnance Disposal
NEW	net explosive weight
NEWi	net explosive weight at impact
NLOS	Non-Line-of-Sight
NM	nautical mile(s)
NM^2	square nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OBIS-SEAMAP	Ocean Biodiversity Information System Spatial Ecological Analysis of Megavertebrate Populations
Pa·s	pascal-second(s)
PAM	Passive Acoustic Monitoring
PBR	potential biological removal
PGU	Projectile Gun Unit
PrSM	Precision Strike Missile
psi	pound(s) per square inch
psi-msec	pound(s) per square inch per millisecond
PSP	Precision Strike Package
PSW	Precision Strike Weapon
PTS	permanent threshold shift

REA	Range Environmental Assessment
ROV	remotely operated vehicle
SDB	Small-Diameter Bomb
SEL	sound exposure level
SiAW	Stand-in Attack Weapon
SOPGM	Stand-Off Precision Guided Munitions
SPL	sound pressure level
T	Threatened
TA	Test Area
TM	telemetry
TNT	trinitrotoluene
TNT_{eq}	trinitrotoluene-equivalent
TR	Training Round
TTP	tactics, techniques, and procedures
TTS	temporary threshold shift
UAV	unmanned aerial vehicle
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USCG	U.S. Coast Guard
UXO	unexploded ordnance
WSEP	Weapons System Evaluation Program
ZOI	zone of influence

1. Introduction

1.1 Background

Eglin Air Force Base (AFB) has prepared this Letter of Authorization (LOA) Request for the incidental taking of marine mammals that may result from military operations proposed to be conducted in the Eglin Gulf Test and Training Range (EGTTR) during the 2023–2030 mission period. The EGTTR provides a readily accessible environment for military operations that is supported by maritime and land-based instrumentation and networking assets; these range attributes are not available to the United States (U.S.) military in any other location in the world. EGTTR testing and training operations are critical for achieving military readiness and the overall goals of the National Defense Strategy.

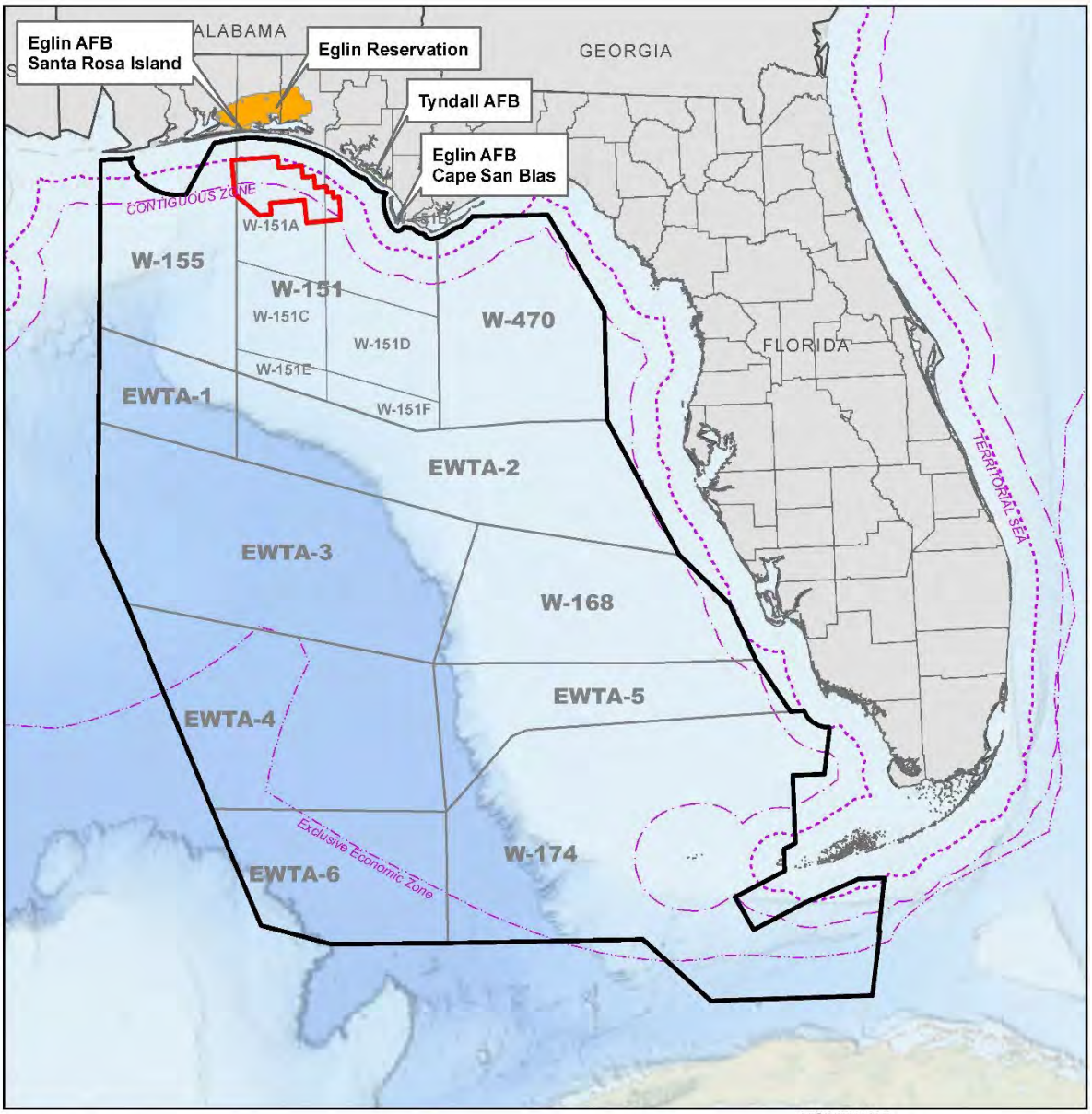
The purpose of this LOA Request is to support the consultation process with the National Marine Fisheries Service (NMFS) under the Marine Mammal Protection Act (MMPA) for the proposed EGTTR operations. The proposed operations addressed in this LOA Request represent the Proposed Action that is being analyzed in the *Eglin Gulf Test and Training Range (EGTTR) Range Environmental Assessment* (REA), currently under preparation (USAF 2021).

Current EGTTR operations are authorized under the 2018 EGTTR LOA (NMFS 2018a) issued to Eglin AFB for the previous 5-year mission period from 2018 to 2023. These authorized operations were analyzed in the 2015 REA (USAF 2015) and associated 2017 LOA Request (USAF 2017b). A Supplemental REA was prepared in 2019 for the expansion of the area within the EGTTR in which live munitions are used, referred to as the existing Live Impact Area (LIA) (USAF 2019a). The USAF is currently preparing the 2021 EGTTR REA for the next mission period, which would span 7 years from 2023 to 2030. This LOA Request has been prepared to support the 2021 EGTTR REA and to request authorization for the incidental taking of marine mammals during the next mission period.

The USAF is consulting separately with NMFS for species protected under the Endangered Species Act (ESA) through preparation of a Biological Assessment for the Proposed Action. Current EGTTR operations are authorized under the 2017 EGTTR Programmatic Biological Opinion (NMFS 2017) issued to Eglin AFB for the previous 5-year mission period from 2018 to 2023.

1.2 Scope of the Proposed Action

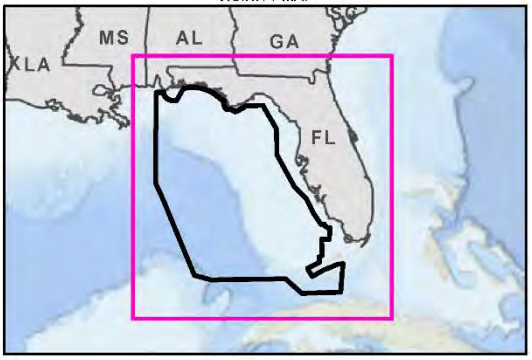
The Eglin Military Complex encompasses approximately 724 square miles of land in the Florida Panhandle and consists of the Eglin Reservation in Santa Rosa, Okaloosa, and Walton Counties and property on Santa Rosa Island and Cape San Blas (Figure 1-1). The EGTTR is the airspace controlled by Eglin AFB over the Gulf of Mexico, beginning 3 nautical miles (NM) from shore, and the underlying Gulf of Mexico waters. The EGTTR extends southward and westward off the coast of Florida and encompasses approximately 102,000 square nautical miles (NM^2). It is subdivided into blocks of airspace that consist of Warning Areas W-155, W-151, W-470, W-168, and W-174 and 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).



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area

VICINITY MAP



Notes:
1. Sources: Marine Bathymetry Map, GEBCO 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

N

Nautical Miles
0 50 100 150 200

FIGURE 1-1
Eglin Gulf Test and Training Range (EGTTR)
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016566\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 1-1 - EGTTR.MXD JO016566 8/11/2021 1:41:46 PM

Although Eglin AFB may use any portion of the EGTTR, the majority of testing and training operations proposed for the 2023–2030 mission period would occur in Warning Area W-151. The nearshore boundary of W-151 parallels much of the coastline of the Florida Panhandle and extends horizontally from 3 NM offshore to approximately 85 to 100 NM offshore, depending on the specific portion of its outer boundary. W-151 encompasses approximately 10,247 NM^2 and includes water depths that range from approximately 5 to 720 meters. The existing LIA, which is the portion of the EGTTR where the use of live munitions is currently authorized, lies mostly within W-151 (Figure 1-1). The existing LIA encompasses approximately 940 NM^2 and includes water depths that range from approximately 30 to 145 meters.

The EGTTR is used by military units at Eglin AFB for various types of testing and training operations. Most missions in the EGTTR are air-to-surface operations that involve firing live or inert munitions, including missiles, bombs, and gun ammunition, from aircraft at designated targets on the water surface. EGTTR missions also include various types of air-to-air, surface-to-air, surface-to-surface, vessel, and in-water operations.

Under the current Proposed Action, the EGTTR would continue to be used during the next mission period based on the maritime testing and training requirements of the various military units that use the EGTTR. The next mission period would span 7 years, from 2023 to 2030. Most operations during this period would be a continuation of the same operations conducted by the same military units during the previous mission period. Operations proposed in the EGTTR during this period would require authorization through the completion of the current REA and the signing of the associated Finding of No Significant Impact, as well as authorization under the MMPA and ESA through issuance of the associated LOA and Biological Opinion, respectively, by NMFS for the proposed operations.

2. Description of the Proposed Action

The Proposed Action is to authorize and implement a new level of activity for testing and training operations conducted in the EGTTR. Operations under the Proposed Action are defined as those that originate, traverse, and/or terminate in the EGTTR. For the purposes of this LOA Request, the Proposed Action refers to Alternative 1 in the 2021 EGTTR REA (USAF 2021). Alternative 1 is the preferred alternative and is analyzed along with the No Action Alternative in the REA. In general, the scope of the Proposed Action (Alternative 1) includes the continued use of the existing LIA, the creation and use of a new LIA within the EGTTR, and the proposed operations of all participating military user groups in the EGTTR during the 2023–2030 mission period.

2.1 Continued Use of Existing Live Impact Area

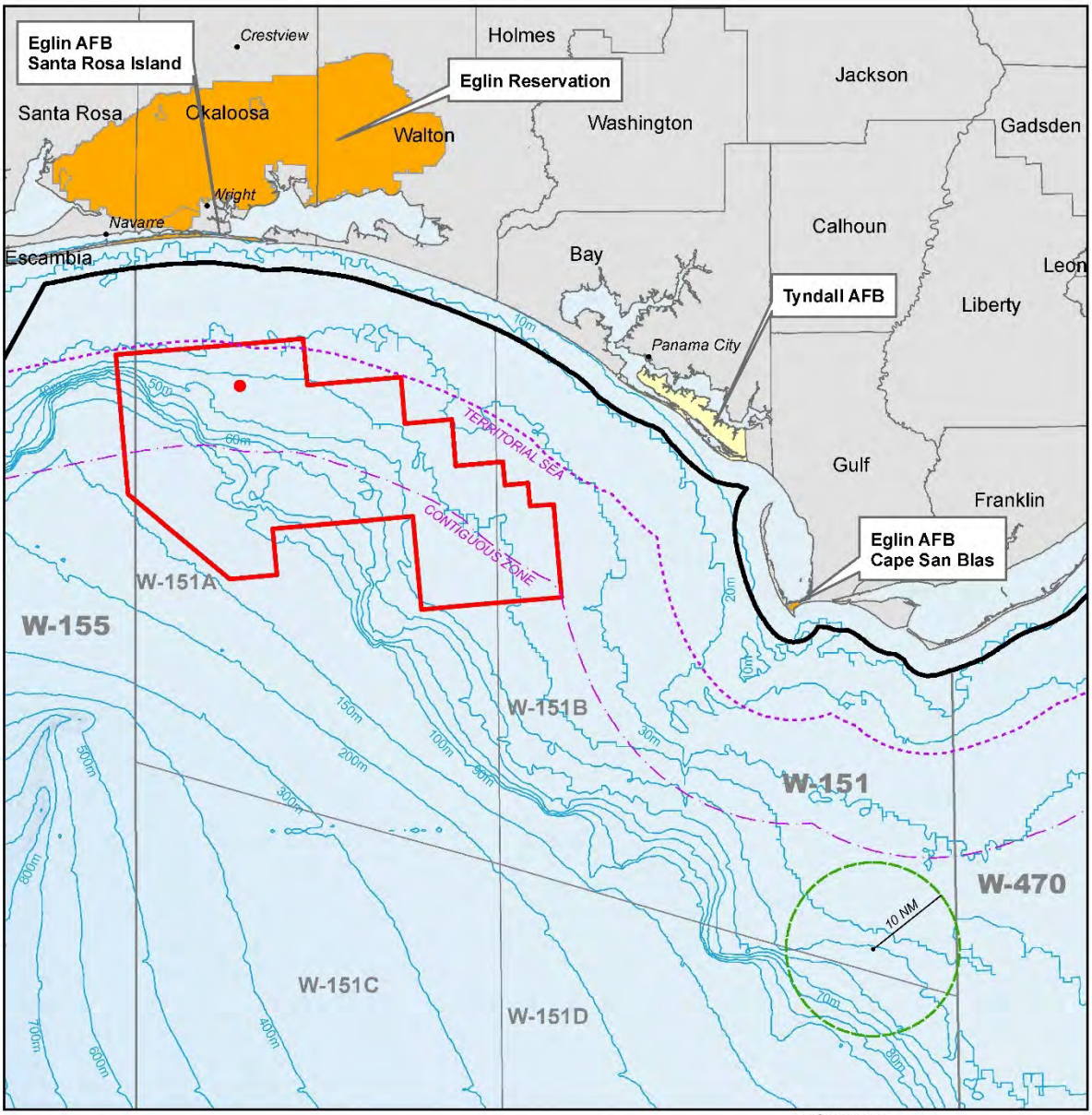
Under the Proposed Action, the existing LIA where live munitions within the EGTTR are used and the Gulf Range Armament Test Vessel (GRATV) is anchored (Figure 2-1) would continue to be used as authorized by the 2019 Supplemental REA (USAF 2019a). The existing LIA encompasses approximately 940 NM^2 and was analyzed in the 2019 Supplemental REA specifically for its suitability to accommodate live missions and anchoring of the GRATV used to support the missions. The GRATV remains anchored at a specific location during a given mission; however, it is mobile and relocated within the LIA based on mission needs.

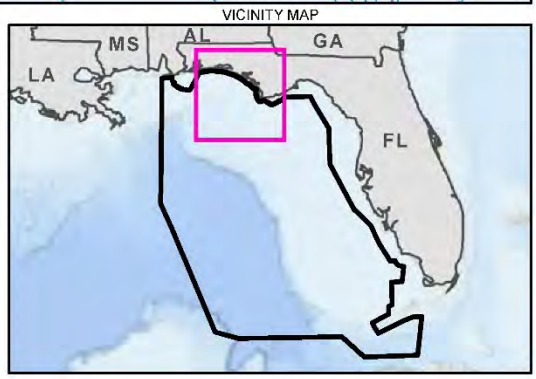
Site selection within the existing LIA for live missions would be made in accordance with the 96th Test Wing's *Memorandum: Policy for Eglin Gulf Test and Training Range (EGTTR) Live Ordnance Employment* (USAF 2018). This policy memorandum outlines the procedures that must be followed by all participating military users to minimize the accumulation of unexploded ordnance (UXO) on the seafloor in the EGTTR and the associated potential for public encounters with UXO. The 2019 Supplemental REA evaluated the preliminary suitability of individual blocks within the LIA based on this policy memorandum and other criteria such as water depth, airspace, and contiguous area requirements; densities of protected marine species; and the presence of known reefs and shipwrecks.

In addition to this initial assessment of suitability, the 2019 Supplemental REA outlined the procedures for evaluating candidate sites within the LIA for live missions and anchoring the GRATV and targets. These procedures include conducting side-scan sonar of the seafloor to verify that no artificial or natural reefs, shipwrecks, or other sensitive resources exist at the site. One or more underwater remotely operated vehicles (ROVs) would be used for visual confirmation and ground-truthing of the sonar scans. These procedures provide field verification of a site's suitability to accommodate live missions and anchoring the GRATV and targets.

2.2 Creation of New Live Impact Area

The Proposed Action provides for the creation of a new, separate area within the EGTTR that would be used for live missions in addition to the existing LIA. This area, herein referred to as the East LIA, would be located approximately 40 NM offshore of Eglin AFB property on Cape San Blas. Cape San Blas is located on St. Joseph Peninsula in Gulf County, Florida, approximately 90 miles southeast of the Eglin Reservation. Eglin AFB facilities on Cape San Blas remotely support EGTTR operations via radar tracking, telemetry, and other functions. The proposed East LIA would be circular-shaped and have a radius of approximately 10 NM and a total area of approximately 314 NM^2. The general location of the proposed East LIA is shown on Figure 2-1.





Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Proposed East LIA (10-NM radius)
- Depth Contour (meters)

Notes:
1. NM = nautical mile
2. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

N

0 10 20 30 40 Nautical Miles

FIGURE 2-1
Existing LIA and Proposed East LIA
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016566\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 2-1 - EXISTING LIA AND EAST LIA.MXD JO016566 8/11/2021 1:43:18 PM

The proposed East LIA would be supported by Test Site D-3 on Cape San Blas and one or more remote land-based instrumentation sites established to support EGTTR operations under the Gulf Range Enhancement (GRE) program, which were analyzed in the 2019 GRE Environmental Assessment (USAF 2019b). Instrumentation in the East LIA would provide wireless connectivity between participating aircraft, targets, and the GRATV in the existing LIA during EGTTR missions. Establishing the East LIA out to 10 NM would allow connections to aircraft and targets either directly or via relay with the GRATV using an unmanned aerial vehicle (UAV). The East LIA would provide a large-footprint weapons test area capable of supporting wireless communication and data transmission via instrumentation located at Test Site D-3 on Cape San Blas and one or more remote GRE sites. Establishment of the East LIA would allow Eglin AFB to maximize the flight range for large-footprint weapons and minimize the distance, time, and cost of deploying support vessels and targets. Based on these factors, the East LIA would allow testing of weapon systems and flight profiles that cannot be conducted within the constraints of the existing LIA. Missions conducted in the East LIA will be required to implement the same established range procedures for public safety and protected species as those implemented in the existing LIA.

2.3 Proposed Operations and Munitions

This section provides descriptions of each user group's proposed EGTTR operations, as well as tables presenting the munitions proposed to be used during the operations, including munition type, category, net explosive weight (NEW), detonation scenario, and annual quantity proposed to be expended in the EGTTR. NEW applies only to live munitions and is the total mass of the explosive substances in a given munition, without packaging, casings, bullets, or other non-explosive components of the munition. The warhead is removed from certain types of munitions proposed to be used in the EGTTR and replaced with a telemetry package that tracks the munition's path and/or Flight Termination System (FTS) that ends the flight of the munition in a controlled manner. The detonation scenario applies only to live munitions, which are set to detonate in one of three ways: (1) in the air a few feet above the water surface, referred to as airburst or height of burst (HOB); (2) instantaneously upon contact with the water or target on the water surface; or (3) after a slight delay, up to 10 milliseconds, after impact, which would correspond to a subsurface detonation at a water depth of approximately 5 to 10 feet. The proposed annual expenditures of munitions are the quantities determined necessary to meet the mission requirements of the user groups and may include a sufficient number of munitions for replicate tests to provide an acceptable confidence level regarding munitions capabilities.

Live missions proposed for the 2023–2030 period would be conducted in the existing LIA and potentially in the proposed East LIA, depending on the mission type and objectives. Live missions that involve only airburst or aerial target detonations would continue to be conducted in or outside the LIA in any portion of the EGTTR; such detonations have no appreciable effect on marine mammals because there is negligible transmission of pressure or acoustic energy across the air–water interface. Use of inert munitions and live air-to-surface gunnery operations would also continue to occur in or outside the LIA, with new restrictions in certain areas outside the LIA as mitigation to prevent impacts to the Rice's whale. These new mitigation measures for the Rice's whale include prohibiting the use of inert munitions between the 100-meter and 400-meter isobaths and conducting gunnery missions at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath during the next mission period. These measures have been developed based on the analyses conducted in Sections 6 and 7, and they are discussed in detail in Section 11.

Range Procedures for Public Safety

Established range clearance procedures are followed during all EGTTR missions for public safety. Prior to each mission, a human safety zone appropriate for the mission is established around the target area. The size of the safety zone varies depending on the munition type and delivery method. A composite safety zone is often developed for missions that involve multiple munition types and delivery methods. A typical composite safety zone is octagon-shaped to make it easier to monitor by mission-support boats and easier

to interpret by the public when it is overlaid on maps with latitude and longitude coordinates. The perimeter of a typical composite safety zone extends out to approximately 15 miles (13 NM) from the center of the zone. Maps of the safety zone with latitude and longitude coordinates are handed out to vessel operators in Destin Pass and made available at marinas in advance of the mission.

The safety zone is continuously monitored by up to 25 mission-support boats to ensure it is free of any non-participating vessels before and during the mission. All non-participating vessels, except for "cargo-carrying or passenger-carrying vessels or tows proceeding on established routes" (33 CFR Part 334.720), are required to be excluded from the safety zone while it is active. Active periods typically last from sunrise to noon. Before munitions are released by mission aircraft, the aircraft often fly over the target area to ensure that it is clear of non-participating vessels. Additional support aircraft may be used to monitor the safety zone during certain missions. The Eglin Safety Office remotely monitors real-time activity of vessels in the area to make clear-to-arm and clear-to-fire calls for the mission. The Eglin Safety Office also requests that the U.S. Coast Guard (USCG) issue a Notice to Mariners in advance of the mission to inform the public about the location and restrictions of the safety zone.

Range clearance procedures for public safety during live air-to-surface gunnery testing and training missions differ in some aspects to those implemented for other live missions. Public safety measures implemented during gunnery missions are discussed in the sections that address AC-130 and CV-22 operations.

Range Procedures for Protected Species

Eglin AFB, in consultation with NMFS, has established measures to minimize the potential for EGTTR operations to impact protected marine species. Prior to each mission, a separate zone for protected species is established around the target area. This zone is based on the distances from the detonation where impacts to marine species would occur, as determined by underwater acoustic modeling and associated analyses. These distances are referred to as threshold distances, and they vary by munition type and species because each species responds differently to the pressure and sound of the detonation. The species protection zone is typically smaller than the human safety zone.

Trained marine species observers survey the species protection zone before each mission and inform mission personnel if marine species or their potential indicators are present in the zone. Missions are conducted only when the zone is confirmed to be free of protected species. Observers monitor for protected species in the field and remotely via live video feed from the Eglin Central Control Facility (CCF). Cameras on the GRATV can also be used to monitor the species protection zone during certain missions. Appropriate sea state conditions must exist for protected species monitoring to be effective. Conditions at the time of the mission must not exceed sea state 4, which is defined as moderate breeze, breaking crests, numerous white caps, wind speed of 11 to 16 knots, and wave height of 3.3 to 6 feet. Missions are delayed or rescheduled if sea state conditions are not suitable for protected species monitoring. Range clearance procedures for protected species during live air-to-surface gunnery training missions differ in some aspects to those implemented for other live missions. The monitoring and mitigation measures implemented by Eglin AFB for the protection of marine species in the EGTTR are discussed in greater detail in Section 11.

Post-Mission Activities

Post-mission activities primarily include removal of UXO and mission-related debris from the target area and post-mission monitoring for protected species. UXO removal is accomplished by USAF Explosive Ordnance Disposal (EOD) personnel, who detonate in place any potential UXO items. Some unexploded bombs, missiles, and other large munitions sink to the seafloor and are not recovered or detonated. After EOD operations are completed, other mission-support personnel remove debris and conduct post-mission protected species surveys. Large, mostly intact, damaged target vessels may be towed, while smaller debris items are netted or lifted aboard vessels and taken to shore for disposal. Post-mission protected species surveys are further discussed in Section 11.

2.3.1 53rd Weapons Evaluation Group

The 53rd Weapons Evaluation Group (53 WEG) conducts the USAF's air-to-ground Weapons System Evaluation Program (WSEP) known as Combat Hammer and the USAF's air-to-air WSEP known as Combat Archer. The 53 WEG proposes to continue conducting maritime WSEP Combat Hammer and Combat Archer missions in the EGTTR during the 2023–2030 period.

2.3.1.1 Combat Hammer

The maritime WSEP known as Combat Hammer involves testing various types of live and inert munitions against small target boats. This testing is conducted to develop tactics, techniques, and procedures (TTP) to be used by USAF aircraft to counter small, maneuvering, hostile vessels. The TTPs are included in Air Force TTP 3-1 and 3-3 series manuals.

Combat Hammer missions proposed in the EGTTR for the 2023–2030 period would involve the use of several types of aircraft, including F-15, F-16, F-18, F-22, F-35, and A-10 fighter aircraft, AC-130 gunships, B-1, B-2, and B-52 bomber aircraft, and MQ-1 and MQ-9 drone aircraft. USAF, Air National Guard, and U.S. Navy units would support these missions. Combat Hammer missions would be conducted in various sea states and weather conditions, up to a wave height of 4 feet. Live munitions would be deployed against static (anchored), remotely controlled, and towed targets. Static and remotely controlled targets would consist of stripped boat hulls with simulated systems and, in some cases, heat sources. Towed targets would be towed by remotely controlled High-Speed Maneuverable Surface Target (HSMST) boats. The 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 from the GRATV. Test data would be collected by instrumentation on the GRATV and through inspections of the damaged targets used during the tests. Support aircraft would provide aerial video of the mission site, including weapon impacts on targets, and assist with range clearance activities. Combat Hammer missions would be controlled from the Eglin CCF. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11.

Swarm exercises may be conducted in association with Combat Hammer missions. During swarm exercises, aircrews employ various targeting and attack techniques against groups of fast moving, manned boats, referred to as swarms. No live or inert munitions are expended during swarm exercises.

Various types of live and inert munitions are used during Combat Hammer missions in the EGTTR, including missiles, bombs, and gun ammunition. Table 2-1 presents information on the munitions proposed for Combat Hammer missions in the EGTTR during the 2023–2030 period. Of the munitions proposed for these missions, the Air-to-Ground Missile (AGM)-158 Joint Air-to-Surface Standoff Missile (JASSM) has the highest NEW, which is 240.26 pounds (lb).

Table 2-1. Proposed Munitions for WSEP Combat Hammer Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
AGR-20	Rocket	9.1	Surface	12
AGM-158D JASSM XR	Missile	240.26	Surface	4
AGM-158B JASSM ER	Missile	240.26	Surface	3
AGM-158A JASSM	Missile	240.26	Surface	3
AGM-65D	Missile	150	Surface	5

Table 2-1. Proposed Munitions for WSEP Combat Hammer Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
AGM-65G2	Missile	145	Surface	5
AGM-65H2	Missile	150	Surface	5
AGM-65K2	Missile	145	Surface	4
AGM-65L	Missile	150	Surface	5
AGM-114 N-6D with TM	Missile	29.1	Surface	4
AGM-114 N-4D with TM	Missile	29.94	Surface	4
AGM-114 R2 with TM (R10)	Missile	27.41	Surface	4
AGM-114 R-9E with TM (R11)	Missile	27.38	Surface	4
AGM-114Q with TM	Missile	20.16	Surface	4
CBU-105D	Bomb	108.6	HOB	8
GBU-53/B (GTV)	Bomb	0.34[a]	HOB/Surface	8
GBU-39 SDB (GTV)	Bomb	0.39[a]	Surface	4
AGM-88C w/FTS	Missile	0.70[a]	Surface	2
AGM-88B w/FTS	Missile	0.70[a]	Surface	2
AGM-88F w/FTS	Missile	0.70[a]	Surface	2
AGM-88G w/FTS	Missile	0.70[a]	Surface	2
AGM-179 JAGM	Missile	27.47	Surface	4
GBU-69	Bomb	6.88	Surface	2
GBU-70	Bomb	6.88	Surface	4
AGM-176	Missile	8.14	Surface	4
GBU-54 KMU-572C/B	Bomb	193	Surface	4
GBU-54 KMU-572B/B	Bomb	193	Surface	4
PGU-43 (105 mm)	Gun Ammunition	4.7	Surface	100
Inert Munitions				
ADM-160B MALD	Missile	N/A	N/A	4
ADM-160C MALD-J	Missile	N/A	N/A	4
ADM-160C-1 MALD-J	Missile	N/A	N/A	4
ADM-160D MALD-J	Missile	N/A	N/A	4
GBU-10	Bomb	N/A	N/A	8

Table 2-1. Proposed Munitions for WSEP Combat Hammer Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
GBU-12	Bomb	N/A	N/A	32
GBU-49	Bomb	N/A	N/A	16
GBU-24/B (84)	Bomb	N/A	N/A	16
GBU-24A/B (109)	Bomb	N/A	N/A	2
GBU-31B(v)1	Bomb	N/A	N/A	4
GBU-31C(v)1	Bomb	N/A	N/A	4
GBU-31B(v)3	Bomb	N/A	N/A	2
GBU-31C(v)3	Bomb	N/A	N/A	2
GBU-32C	Bomb	N/A	N/A	8
GBU-38B	Bomb	N/A	N/A	4
GBU-38C w/BDU-50 (No TM)	Bomb	N/A	N/A	4
GBU-38C	Bomb	N/A	N/A	10
GBU-54 KMU-572C/B	Bomb	N/A	N/A	4
GBU-54 KMU-572B/B	Bomb	N/A	N/A	4
GBU-69	Bomb	N/A	N/A	2
BDU-56A/B	Bomb	N/A	N/A	4
PGU-27 (20 mm)	Gun Ammunition	0.09	N/A	16,000
PGU-15 (30 mm)	Gun Ammunition	N/A	N/A	16,000
PGU-25 (25 mm)	Gun Ammunition	N/A	N/A	16,000
ALE-50	Decoy System	N/A	N/A	6

[a] Warhead replaced by FTS/TM. Identified NEW is for the FTS.

ADM = American Decoy Missile; AGM = Air-to-Ground Missile; ALE = Ammunition Loading Equipment; BDU = Bomb Dummy Unit; CBU = Cluster Bomb Unit; EGTTR = Eglin Gulf Test and Training Range; ER = Extended Range; FTS = Flight Termination System; GBU = Guided Bomb Unit; GTV = Guided Test Vehicle; HOB = height of burst; JAGM = Joint Air-to-Ground Missile; JASSM = Joint Air-to-Surface Standoff Missile; lb = pound(s); MALD = Miniature Air-Launched Decoy; mm = millimeter(s); N/A = not applicable; PGU = Projectile Gun Unit; SDB = Small-Diameter Bomb, TM = telemetry; WSEP = Weapons System Evaluation Program

2.3.1.2 Combat Archer

The maritime WSEP known as Combat Archer involves live air-to-air missile testing in the EGTTR. Combat Archer missions also include firing inert gun ammunition and releasing flares and chaff from aircraft. Air-to-air missile testing during these missions specifically involves firing live AIM-9 Sidewinder and AIM-120 Advanced Medium-Range Air-to-Air Missiles (AMRAAMs) at BQM-167 Subscale Aerial Targets and QF-16 Full-Scale Aerial Targets to evaluate the effectiveness of missile delivery techniques. Combat Archer missions proposed in the EGTTR for the 2023–2030 period would involve the use of several types of

fighter aircraft, including the F-15, F-16, F-18, F-22, F-35, and A-10. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11.

Table 2-2 presents information on the munitions proposed to be used during Combat Archer missions in the EGTTR during the 2023–2030 period. Of the munitions proposed for these missions, the AIM 120C3 missile has the highest NEW, which is 117.94 lb.

Table 2-2. Proposed Munitions for WSEP Combat Archer Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
AIM-120D	Missile	113.05	HOB	24
AIM-120C7	Missile	113.05	HOB	10
AIM-120C5/6	Missile	113.05	HOB	8
AIM-120C3	Missile	102.65	HOB	14
AIM-120C3	Missile	117.94	HOB/Surface	4
AIM-120B	Missile	102.65	HOB	18
AIM-9X Blk I	Missile	60.25	HOB	7
AIM-9X Blk I	Missile	67.9	HOB/Surface	10
AIM-9X Blk II	Missile	60.25	HOB	24
AIM-9M-9	Missile	60.55	HOB	90
Inert Munitions				
AIM-260A JATM	Missile	N/A	N/A	1
PGU-27 (20 mm)	Gun Ammunition	N/A	N/A	80,000
PGU-23 (25 mm)	Gun Ammunition	N/A	N/A	6,000
MJU-7A/B Flare	Flare	N/A	N/A	1,800
R-188 Chaff	Chaff	N/A	N/A	6,000
R-196 (T-1) Chaff	Chaff	N/A	N/A	1,500

AIM = Air Intercept Missile; EGTTR = Eglin Gulf Test and Training Range; HOB = height of burst; JATM = Joint Advanced Tactical Missile; lb = pound(s); MJU = Mobile Jettison Unit; mm = millimeter(s); N/A = not applicable; PGU = Projectile Gun Unit; WSEP = Weapons System Evaluation Program

2.3.2 Air Force Special Operations Command Training

The Air Force Special Operations Command (AFSOC) proposes to continue conducting training missions in the EGTTR during the 2023–2030 period. AFSOC training in the EGTTR primarily involves air-to-surface gunnery, bomb, and missile exercises.

2.3.2.1 AC-130 Gunnery Training

AFSOC gunnery training in the EGTTR involves firing live rounds from AC-130 gunships at targets on the water surface. Gun ammunition used for this training primarily includes 30-millimeter (mm) High Explosive (HE) and 105 mm HE rounds. A standard 105 mm HE round has a NEW of 4.7 lb. The Training Round (TR) variant of the 105 mm HE round, which has a NEW of 0.35 lb, is used by AFSOC for nighttime missions. This TR was developed to have less explosive material to minimize potential impacts to protected marine species, which could not be adequately surveyed at night by earlier aircraft instrumentation. Since the development of the 105 mm HE TR, AC-130s have been equipped with low-light electro-optical and infrared sensor systems that provide excellent night vision. This instrumentation allows aircrews to effectively survey the target area for protected marine species prior to gunnery training. AFSOC has continued to use only the105 mm TRs during nighttime missions as an additional protective measure and proposes to continue this practice during the 2023–2030 period. Nighttime missions during this period would be conducted by AC-130s that have been upgraded recently with MX-25D sensor systems, which provide superior night-vision capabilities relative to earlier sensor systems.

Targets used for AC-130 gunnery training include Mark (Mk)-25 marine markers and inflatable targets. Mk-25 marine markers are floating flares used to mark a location visually on the water surface; these flares have a burn time of approximately 10 to 20 minutes. A typical inflatable target is approximately 20 feet long and pulled by a tugboat using a 2,200-foot cable. These targets continue to float after being struck by munitions and deflating. Any debris produced by the target strikes is retrieved by the tugboat; little to no debris is typically generated during this training.

During each gunnery training mission, gun firing can last up to 90 minutes but typically lasts approximately 30 minutes. Live firing is continuous, with pauses usually lasting well under 1 minute and rarely up to 5 minutes. Firing pauses would exceed 10 minutes only in one of the following situations: (1) a non-participating vessel or protected species causes the mission to relocate; (2) aircraft, gun, or target system malfunction occurs; or (3) more flares need to be deployed. Strike accuracy is high during AC-130 gunnery missions; the Eglin Safety Office has reported that 95 percent of the rounds strike the water within 5 meters of the target (USAF 2015).

Range clearance procedures for public safety and protected species during live air-to-surface gunnery missions differ in some aspects to those implemented for other live missions. For public safety, AC-130 aircrews conduct a search out to 5 NM from each potential target area to ensure it is clear of non-participating vessels prior to gunnery training. The aircrews also search the smaller species protection zone in a similar manner for the presence of any protected marine species; this search is conducted at an altitude of approximately 6,000 feet above ground level (AGL). The searches are accomplished using radar and sensor systems and by visual means. If a non-participating vessel is detected in the 5 NM search area or if a protected species is sighted in the species protection zone, the location is abandoned and an alternative area is evaluated in the same manner. Firing pauses that last longer than 10 minutes will also require reinitiation of protected species surveys by the aircrews.

Other management actions currently implemented during live gunnery operations in the EGTTR for protected species include sea state restrictions; using only the TR variant of the 105 mm HE round for nighttime missions; using ramp-up procedures that begin with the smallest round and proceed to increasingly larger rounds; and conducting all gunnery missions landward of the 200-meter isobath. No known mortality or injury to protected marine species has resulted from AFSOC gunnery missions in the EGTTR. During the 2023–2030 mission period, AFSOC will continue to use the 105 mm HE Full Up (FU) round for daytime missions and the 105 mm HE TR for nighttime missions because of its lower HE material content. As a new mitigation measure to prevent impacts to the Rice's whale, AFSOC gunnery missions during the 2023–2030 period will be conducted at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath (further discussed in Section 11.3).

Table 2-3 presents information on the rounds proposed for AC-130 gunnery training in the EGTTR during the 2023–2030 mission period. AFSOC proposes to conduct 25 daytime gunnery missions and 45 nighttime gunnery missions per year during this period.

Table 2-3. Proposed Rounds for AC-130 Gunnery Training in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Net Explosive Weight (lb)	Detonation Scenario	Number of Missions	Rounds per Mission	Annual Quantity
Daytime Missions					
105 mm HE (FU)	4.7	Surface	25	30	750
30 mm HE	0.1			500	12,500
Nighttime Missions					
105 mm HE (TR)	0.35	Surface	45	30	1,350
30 mm HE	0.1			500	22,500
Total			70		37,100

EGTTR = Eglin Gulf Test and Training Range; FU = Full Up; HE = High Explosive; mm = millimeter(s); lb = pound(s); TR = Training Round

2.3.2.2 CV-22 Training

The 8th Special Operations Squadron (8 SOS) under AFSOC conducts training in the EGTTR using the CV-22 Osprey, which is a tiltrotor aircraft. This training involves firing .50 caliber rounds from CV-22s at floating marker targets on the water surface. The .50 caliber rounds do not contain explosive material and, therefore, do not detonate. Flight procedures for CV-22 training are similar to those described for AC-130 gunnery training, except that CV-22 aircraft typically operate at much lower altitudes (100 to 1,000 feet AGL) than AC-130 gunships (6,000 to 20,000 feet AGL).

Range clearance for public safety during CV-22 training is conducted out to 3 NM from the target area. Species protection zones are monitored by aircrews visually and using sensor systems before, during, and after each mission at a maximum altitude of 1,000 feet AGL. Like AC-130 gunships, CV-22s are equipped with highly sophisticated electro-optical and infrared sensor systems that allow advanced detection capability during day and night. Like AC-130 gunnery missions, all CV-22 training missions are currently conducted landward of the 200-meter isobath. However, as a new mitigation measure to prevent impacts to the Rice's whale, CV-22 gunnery training during the 2023–2030 period, like AC-130 gunnery training, will be conducted at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath (further discussed in Section 11.3). Only .50 caliber rounds are proposed for use during this period; 7.62 mm rounds were used during past CV-22 missions but are no longer proposed for this training.

Table 2-4 presents information on the rounds proposed for CV-22 training in the EGTTR during the 2023–2030 mission period. The 8 SOS proposes to conduct 25 daytime missions and 25 nighttime CV-22 training missions per year during this period.

Table 2-4. Proposed Rounds for CV-22 Training in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Net Explosive Weight (lb)	Detonation Scenario	Number of Missions	Rounds per Mission	Annual Quantity
Daytime Missions					
.50 caliber	N/A	Surface	25	600	15,000
Nighttime Missions					
.50 caliber	N/A	Surface	25	600	15,000
Total			50		30,000

EGTTR = Eglin Gulf Test and Training Range; lb = pound(s); N/A = not applicable

2.3.2.3 Bomb and Missile Training

In addition to AC-130 gunnery and CV-22 training, AFSOC conducts other air-to-surface training in the EGTTR using various types of bombs and missiles. This training is conducted primarily to develop TTPs and train strike aircraft to counter small moving boats. Munitions used for this training primarily include live AGM-176 Griffin missiles, live AGM-114 Hellfire missiles, and various types of live and inert bombs. These munitions are launched from various types of aircraft against small target boats, and they either detonate on impact with the target or at a programmed HOB. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11.

Table 2-5 presents information on the munitions proposed for AFSOC bomb and missile training in the EGTTR during the 2023–2030 mission period. Of the live munitions proposed for these missions, the GBU-12 laser-guided bomb has the highest NEW, which is 298.0 lb.

Table 2-5. Proposed Munitions for AFSOC Bomb and Missile Training in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
AGM-176 Griffin	Missile	4.58	HOB	100
AGM-114R9E/R2 Hellfire	Missile	20.0	HOB	70
2.75-inch Rocket (including APKWS)	Rocket	2.3	Surface	400
GBU-12	Bomb	198.0/298.0	Surface	30
Mk-81 (GP 250 lb)	Bomb	151.0	Surface	30
GBU-39 (SDB I)	Bomb	37.0	HOB	30
GBU-69	Bomb	36.0	HOB	40
Inert Munitions				
GBU-12	Bomb	N/A	N/A	30
MkK-81 (GP 250 lb)	Bomb	N/A	N/A	30

Table 2-5. Proposed Munitions for AFSOC Bomb and Missile Training in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
BDU-50	Bomb	N/A	N/A	30
BDU-33	Bomb	N/A	N/A	50

AFSOC = Air Force Special Operations Command; AGM = Air-to-Ground Missile; APKWS = Advanced Precision Kill Weapon System; BDU = Bomb Dummy Unit; EGTTR = Eglin Gulf Test and Training Range; GBU = Guided Bomb Unit; GP = General Purpose; HOB = height of burst; lb = pound(s); Mk = Mark; N/A = not applicable; SDB = Small-Diameter Bomb

2.3.3 96th Operations Group

Three units under the 96th Operations Group (96 OG) propose to conduct missions in the EGTTR during the 2023–2030 period: the 417th Flight Test Squadron (417 FLTS), 96th Operational Support Squadron (96 OSS), and 780th Test Squadron (780 TS). The 417 FLTS proposes to continue using the EGTTR to test equipment and instrumentation on AC-130 aircraft, including the Precision Strike Package (PSP) and Stand-Off Precision Guided Munitions (SOPGM) systems developed by the U.S. Special Operations Command. The 96 OSS proposes to conduct air-to-surface testing of missiles and precision-guided bombs in the EGTTR in support of the MQ-9 Reaper UAV program. The 780 TS proposes to continue using the EGTTR for air-to-surface, air-to-air, and surface-to-air testing operations. In addition to 417 FLTS, 96 OSS, and 780 TS missions, the 96 OG is expected to continue conducting testing missions involving inert bombs in the EGTTR during the 2023–2030 period. While detailed information on these missions is not available, they would involve only inert munitions.

2.3.3.1 AC-130 Testing

The 417 FLTS proposes to continue conducting AC-130 testing in the EGTTR to evaluate the capabilities of the PSP, SOPGM, and other systems on AC-130 aircraft. AC-130 gunnery testing is generally similar in flight, public safety, protected species, and firing procedures to previously described AFSOC AC-130 gunnery training. Proposed 417 FLTS gunnery testing would involve firing 30 mm HE, 105 mm HE (FU), and 105 mm HE (TR) rounds at floating marker targets on the water surface. As with AFSOC gunnery training missions, all AC-130 gunnery testing missions are currently conducted landward of the 200-meter isobath; however, they will be conducted at least 500 meters landward of the 100-meter isobath during the next mission period to prevent PTS impacts to the Rice's whale. The 417 FLTS does not propose conducting gunnery testing at night during the 2023–2030 mission period.

AC-130 testing also includes SOPGM testing using live AGM-176 Griffin missiles, AGM-114 Hellfire missiles, and GBU-39 SDB precision-guided bombs. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11. Table 2-6 presents information on the munitions proposed for AC-130 testing in the EGTTR during the 2023–2030 mission period. Of the live munitions proposed for these missions, the GBU-39 bomb has the highest NEW, which is 37.0 lb.

Table 2-6. Proposed Munitions for AC-130 Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
AGM-176 Griffin	Missile	4.58	Surface	10
AGM-114 Hellfire	Missile	20.0	Surface	10

Table 2-6. Proposed Munitions for AC-130 Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
GBU-39 (SDB I)	Bomb	37.0	Surface	6
GBU-39 (LSDB)	Bomb	37.0	Surface	10
105 mm HE (FU)	Gun Ammunition	4.7	Surface	60
105 mm HE (TR)	Gun Ammunition	0.35	Surface	60
30 mm HE	Gun Ammunition	0.1	Surface	99

AGM = Air-to-Ground Missile; EGTTR = Eglin Gulf Test and Training Range; FU = Full Up; GBU = Guided Bomb Unit; HE = High Explosive; lb = pound(s); mm = millimeter(s); LSDB = Laser Small-Diameter Bomb; SDB = Small-Diameter Bomb; TR = Training Round

2.3.3.2 MQ-9 Testing

The 96 OSS proposes to conduct air-to-surface testing in the EGTTR using live AIM-9X Sidewinder and AGM-114R Hellfire missiles and live and inert precision-guided bombs to support testing requirements of the MQ-9 Reaper UAV program. The proposed munitions would be tested for MQ-9 integration and would include captive carry and munitions employment tests. During munition employment tests, the proposed munitions would be launched from MQ-9 aircraft at various types of static and moving targets on the water surface. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11. Table 2-7 presents information on the munitions proposed by the 96 OSS for MQ-9 testing in the EGTTR during the 2023–2030 mission period. Of the live munitions proposed for these missions, the GBU-39 bomb has the highest NEW, which is 37.0 lb.

Table 2-7. Proposed Munitions for MQ-9 Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
AGM-114R Hellfire	Missile	20.0	Surface	36
AIM-9X	Missile	7.9	HOB	1
GBU-39B/B LSDB	Bomb	37.0	Surface	2
Inert Munitions				
GBU-39B/B LSDB	Bomb	N/A	N/A	2
GBU-49	Bomb	N/A	N/A	10
GBU-48	Bomb	N/A	N/A	1

AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; EGTTR = Eglin Gulf Test and Training Range; GBU = Guided Bomb Unit; lb = pound(s); LSDB = Laser Small-Diameter Bomb

2.3.3.3 Precision Strike Weapon

The 780 TS, the Air Force Life Cycle Management Center, and the U.S. Navy jointly conduct Precision Strike Weapons (PSW) test missions in the EGTTR. These missions use the AGM-158 JASSM and GBU-39 SDB precision-guided bomb. The JASSM is an air-launched cruise missile with a range of more than 200 NM. During test missions, the JASSM would be launched from aircraft more than 200 NM from the target

location at altitudes greater than 25,000 feet AGL. The JASSM would cruise at altitudes greater than 12,000 feet AGL for most of the flight profile until its terminal descent toward the target. The GBU-39 SDB is a precision-guided glide bomb with a range of more than 50 NM. This bomb would be launched from aircraft more than 50 NM from the target location at altitudes greater than 5,000 feet AGL. The bomb would travel via a non-powered glide to the intended target. Instrumentation in the bomb self-controls the bomb's flight path.

The JASSMs and SDBs would be launched at targets on the water surface within approximately 1,000 feet of the GRATV. Live JASSMs would detonate at a HOB of approximately 5 feet; however, these detonations are assumed to occur at the surface for the impact analysis. The SDBs would detonate either at a HOB of approximately 7 to 14 feet or upon impact with the target (surface). For simultaneous SDB launches, two SDBs would be launched from the same aircraft at approximately the same time to strike the same target. The SDBs would strike the target within approximately 5 seconds or less of each other. Such detonations would be considered a single event, with the associated NEW being doubled for a conservative impact analysis. Chase aircraft such as the F-15, F-16, and/or T-38 would follow the test items during captive carry and free flight but not below a predetermined altitude as directed by Flight Safety. Other support aircraft may include E-9 turboprop aircraft and tanker aircraft such as the KC-10 and KC-135. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11.

Two types of targets are typically used for PSW tests: Container Express (CONEX) targets and hopper barge targets. CONEX targets typically consist of up to five CONEX containers strapped, braced, and welded together to form a single structure. Each CONEX container is 8 feet by 8 feet by 40 feet and filled with approximately 200 sealed 55-gallon steel drums to provide buoyancy. A hopper barge is a common type of barge that cannot move itself; a typical hopper barge measures approximately 30 feet by 12 feet by 125 feet. PSW targets are held in place by a four-point anchoring system using cables. They are anchored at the target location 2 to 3 days prior to the test. Depending on the test schedule, the target may remain anchored for up to 1 month. Surface debris resulting from each target strike is collected by post-test cleanup crews. If the target is severely damaged and determined to be unsafe to retrieve, the target remains may be sunk in coordination with the USCG and U.S. Army Corps of Engineers (USACE).

Other SDB tests in the EGTTR during the 2023–2030 mission period may include operational testing of the GBU-53 (SDB II). These tests may involve live and inert testing of the munition against target boats.

Table 2-8 presents information on the munitions proposed for PSW missions in the EGTTR during the 2023–2030 period. Of the munitions proposed, the AGM-158 JASSM missile has the highest NEW, which is 240.26 lb.

Table 2-8. Proposed Munitions for Precision Strike Weapon Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
AGM-158 (JASSM)	Missile	240.26	Surface	2
GBU-39 (SDB I)	Bomb	37.0	HOB/Surface	2
GBU-39 (SDB I) Simultaneous Launch[a]	Bomb	74.0	HOB/Surface	2
GBU-53 (SDB II)	Bomb	22.84	HOB/Surface	2

Table 2-8. Proposed Munitions for Precision Strike Weapon Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Inert Munitions				
AGM-158 (JASSM)	Missile	N/A	N/A	4
GBU-39 (SDB I)	Bomb	N/A	N/A	4
GBU-39 (SDB I) Simultaneous Launch	Bomb	N/A	N/A	4
GBU-53 (SDB II)	Bomb	N/A	N/A	1

[a] NEW is doubled for simultaneous launch.

AGM = Air-to-Ground Missile; EGTTR = Eglin Gulf Test and Training Range; GBU = Guided Bomb Unit; HOB = height of burst; JASSM = Joint Air-to-Surface Standoff Missile; lb = pound(s); N/A = not applicable; SDB = Small-Diameter Bomb

2.3.3.4 Air-to-Air Missile Testing

The 780 TS, along with the Air Force Life Cycle Management Center and U.S. Navy, propose to jointly conduct air-to-air missile testing in the EGTTR. These missions would involve the use of the AIM-260A Joint Advanced Tactical Missile (JATM), AIM-9X Sidewinder, and AIM-120 AMRAAM missiles; all missiles used in these tests would be inert.

The USAF and U.S. Navy are developing and producing the AIM-260A JATM, which will have increased range and effectiveness over existing air-to-air missiles. The AIM-9X Sidewinder is a short-range, infrared seeking, air-to-air missile. The AIM-120 AMRAAM is the world's most popular beyond-visual-range missile; it is expected to be replaced eventually by the AIM-260 JATM.

Table 2-9 presents information on the munitions proposed for air-to-air missile testing missions in the EGTTR during the 2023–2030 mission period.

Table 2-9. Proposed Munitions for Air-to-Air Missile Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
AIM-260 JATM - Inert	Missile	N/A	N/A	6
AIM-9X - Inert	Missile	N/A	N/A	10
AIM-120 AMRAAM - Inert	Missile	N/A	N/A	15

AIM = Air Intercept Missile; AMRAAM = Advanced Medium-Range Air-to-Air Missile; EGTTR = Eglin Gulf Test and Training Range; lb = pound(s); JATM = Joint Advanced Tactical Missile; N/A = not applicable

2.3.3.5 Longbow and JAGM Missile Testing

The 780 TS proposes to test the ability of the AGM-114L Longbow missile and AGM-179A Joint Air-to-Ground Missile (JAGM) missile to track and impact moving target boats in the EGTTR. These missiles are typically launched from an AH-64D Apache helicopter. The test targets would be remotely controlled boats, including the 25-foot HSMST (foam filled) and 41-foot Coast Guard Utility Boat (metal hull). The missiles would be launched approximately 0.9 to 4.3 NM from the targets. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11.

Up to six live Longbow missiles and eight live JAGM missiles per year are proposed to be tested in the EGTTR during the 2023–2030 mission period (Table 2-10). Each Longbow missile would have a NEW of 35.95 lb and would be set to detonate at a minimum HOB of 1 to 3 meters (3.3 to 9.8 feet) above the surface. Each JAGM missile would have a NEW of 27.47 lb and would either detonate on the surface or be set to detonate at the same HOB as the Longbow missile.

Table 2-10. Proposed Munitions for Longbow and JAGM Missile Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
AGM-114L Longbow	Missile	35.95	HOB	6
AGM-179A JAGM	Missile	27.47	HOB	8

AGM = Air-to-Ground Missile; EGTTR = Eglin Gulf Test and Training Range; HOB = height of burst; JAGM = Joint Air-to-Ground Missile; lb = pound(s)

2.3.3.6 Spike NLOS Missile Testing

The 780 TS proposes to test the Spike Non-Line-of-Sight (NLOS) air-to-surface tactical missile system against static and moving target boats in the EGTTR in support of the U.S. Army's initiative to incorporate the Spike NLOS missile system onto the AH-64E Apache helicopter. These missiles would be launched from an AH-64D Apache helicopter and the test targets would include foam-filled fiberglass boats approximately 25 feet in length that are either anchored or towed by a remotely controlled HSMST. The missiles would be launched approximately 10.8 to 20.5 NM from the targets. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11. Up to three live Spike NLOS missiles per year are proposed to be tested in the EGTTR during the 2023–2030 mission period (Table 2-11). Each missile would have a NEW of 34.08 lb and would detonate on the surface of the target.

Table 2-11. Proposed Munitions for NLOS Spike Missile Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Spike NLOS	Missile	34.08	Surface	3

EGTTR = Eglin Gulf Test and Training Range; lb = pound(s); NLOS = Non-Line-of-Sight

2.3.3.7 Patriot Missile Testing

The 780 TS proposes to conduct surface-to-air testing of Patriot Advanced Capability (PAC)-2 and PAC-3 missiles in the EGTTR. These missiles are expected to be fired from the A-15 launch site on Santa Rosa Island at drones in the EGTTR. Detailed operational data for this testing are not yet available. Standard inventory missiles would be used and up to eight PAC-2 tests and two PAC-3 tests per year are proposed (Table 2-12). For the impact analysis, each missile for these tests is assumed to have a NEW of 145.0 lb. Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11. Public safety and protected species measures for the missile launch site on Santa Rosa Island would be implemented in accordance with measures identified in the Santa Rosa Island REA (USAF 2019c).

Table 2-12. Proposed Munitions for Patriot Missile Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
PAC-2	Missile	145.0[a]	N/A (drone target)	8
PAC-3	Missile	145.0[a]	N/A (drone target)	2

[a] Assumed for impact analysis.

EGTTR = Eglin Gulf Test and Training Range; lb = pound(s); N/A = not applicable; PAC = Patriot Advanced Capability

2.3.3.8 Hypersonic Weapon Testing

Hypersonic weapons are capable of traveling at least five times the speed of sound, referred to as Mach 5. While conventional weapons typically rely on explosive warheads to inflict damage on a target, hypersonic weapons typically rely on kinetic energy from high-velocity impact to inflict damage on targets. For the purpose of assessing impacts, the kinetic energy of a hypersonic weapon may be correlated to energy release in units of feet-lb or trinitrotoluene (TNT) equivalency.

Hypersonic weapon technology is in early development; the U.S. Department of Defense (DoD) is developing hypersonic weapons with support from other agencies. The 780 TS supports several hypersonic weapon programs, including the AGM-183 Air-Launched Rapid Response Weapon (ARRW), Hypersonic Attack Cruise Missile (HACM), and Precision Strike Missile (PrSM) programs. The ARRW, HACM, and PrSM are high-priority rapid-development programs.

The AGM-183 ARRW is a developmental boost-glide hypersonic weapon that is propelled by a rocket booster up to Mach 20 before the glide vehicle containing the warhead detaches and glides unpowered to the target. A captive carry flight test for the ARRW was conducted aboard a B-52 aircraft out of Edwards AFB in June 2019. Successful tests of the ARRW were conducted in May and July 2022. While ARRW testing in the EGTTR is not currently proposed, it is possible that some testing associated with this program may be proposed to be conducted in the EGTTR during the 2023–2030 mission period.

HACM is a developmental air-breathing hypersonic cruise missile that uses scramjet technology for propulsion. This weapon would be smaller than the ARRW and also air-launched. The 780 TS proposes to conduct HACM testing in the EGTTR during the 2023–2030 mission period. HACM testing would involve air launches of the HACM through a north-south corridor within the EGTTR to a target location on the water surface. Test Site D-3 on Cape San Blas could provide land-based telemetry, radar, FTS, and spectrum monitoring to support the terminal phase of the tests. The dimensions and orientation of the test flight corridor within the EGTTR for HACM tests are to be determined; the flight corridor is preliminarily expected to be 300 to 400 NM in total length. Live HACMs would be fired from the southern portion of the EGTTR into either the existing LIA or proposed East LIA. A combination of UAVs and fighter aircraft would provide airborne telemetry, radar, FTS, range clearance, and communications relay. Using the EGTTR to test long-range hypersonic weapons such as the HACM would relieve pressure on Pacific water ranges and help these high-priority programs meet their rapid-development test schedules and goals. Public safety, protected species, and post-mission cleanup procedures for HACM missions in the EGTTR would be conducted as described in Sections 2.3 and 11. Up to two live HACMs per year are proposed to be tested in the EGTTR during the 2023–2030 mission period (Table 2-13).

The PrSM is being developed by the U.S. Army as a surface-to-surface, long-range, precision-strike guided missile to be fired from the M270A1 Multiple Launch Rocket System and the M142 High Mobility Artillery Rocket System. The 780 TS in coordination with the U.S. Army proposes to conduct PrSM testing in the EGTTR during the 2023–2030 mission period. Some PrSM testing is expected to involve surface launches of the PrSM from the A-15 launch site on Santa Rosa Island. The dimensions and orientation of the test flight corridor within the EGTTR for PrSM tests are to be determined; the flight corridor is

preliminarily expected to be 300 to 500 kilometers (162 to 270 NM) in total length. For tests that involve a live warhead on the PrSM, the PrSM would be preset to detonate at a specific height above the water surface (HOB/airburst). Such airburst PrSM tests could occur in any portion of the EGTTR. Inert PrSM tests could occur in any portion of the EGTTR, except between the 100-meter and 400-meter isobaths to prevent impacts to the Rice's whale. As with the proposed HACM tests, a combination of UAVs and fighter aircraft would provide airborne telemetry, radar, FTS, range clearance, and communications relay for the PrSM tests. Public safety, protected species, and post-mission cleanup procedures for PrSM missions in the EGTTR would be conducted as described in Sections 2.3 and 11. Up to two live and two inert PrSMs are proposed to be tested annually in the EGTTR during the 2023–2030 mission period (Table 2-13).

Table 2-13. Proposed Munitions for Hypersonic Weapon Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Live Munitions				
HACM	Hypersonic Weapon	350[a]	Surface	2
PrSM	Hypersonic Weapon	46[a]	HOB	2
Inert Munitions				
PrSM - Inert	Hypersonic Weapon	N/A	N/A	2

[a] Net explosive weight at impact/detonation

EGTTR = Eglin Gulf Test and Training Range; HACM = Hypersonic Attack Cruise Missile; lb = pound(s); N/A = not applicable; PrSM = Precision Strike Missile

2.3.3.9 SINKEX Testing

The 780 TS, in coordination with the Air Force Research Laboratory, proposes to conduct SINKEX testing in the EGTTR. SINKEX exercises would involve the sinking of vessels in the existing LIA. Vessels proposed to be sunk during SINKEX exercises are expected to be approximately 200 to 400 feet in length. The types of munitions that would be used for SINKEX testing is controlled information and, therefore, not identified in this REA. Vessels to be sunk will be prepared and cleaned to remove materials of environmental and safety concern such as fuels, oils, and loose debris. Specific sites within the LIA for SINKEX exercises will be surveyed using side-scan sonar and underwater ROVs as described for anchoring to verify that no hardbottom habitat, shipwrecks, or sunken artificial structures exist at the sites.

Public safety, protected species, and post-mission cleanup procedures for SINKEX missions would be conducted as described in Sections 2.3 and 11. Up to two SINKEX exercises per year are proposed to be conducted in the EGTTR during the 2023–2030 mission period (Table 2-14).

Table 2-14. Proposed SINKEX Exercises in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
SINKEX	Vessel Sinking Exercise	Not Available	Not Available	2

EGTTR = Eglin Gulf Test and Training Range

2.3.3.10 Other 780 TS Testing

The 780 TS plans to lead or support other types of testing in the EGTTR. These missions would primarily include testing live and inert munitions against targets on the water surface, such as boats and barges. Some of these programs are in early planning and development, so detailed descriptions of them are not yet available. Some of the tests would involve munitions with NEWs of up to 945 lb, which is the highest NEW associated with the munitions analyzed in this REA and the munitions analyzed in the 2015 REA (USAF 2015). Public safety, protected species, and post-mission cleanup procedures for these missions would be conducted as described in Sections 2.3 and 11. Table 2-15 presents information on the munitions proposed for other testing expected to be conducted by the 780 TS in the EGTTR during the 2023–2030 mission period.

Table 2-15. Proposed Munitions for Other 780 Test Squadron Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Target Type	Annual Quantity
Live Munitions					
GBU-10, 24, or 31 (QUICKSINK)	Bomb	945	Subsurface	TBD	4 to 8
2,000 lb bomb with JDAM kit	Bomb	945 or less	HOB	TBD	2
Inert GBU-39 (LSDB) with live fuze	Bomb	0.4	HOB/Surface	Small Boat	4
Inert GBU-53 (SDB II) with live fuze	Bomb	0.4	HOB/Surface	Small Boat	4
Inert Munitions					
SiAW AARGM-ER	Missile	N/A	N/A	TBD	7
Multipurpose Booster	Booster	N/A	N/A	TBD	1
JDAM ER	Bomb	N/A	N/A	Water Surface and Barge	3
Navy HAAWC	Torpedo	N/A	N/A	Water Surface	2

AARGM-ER = Advanced Anti-Radiation Guided Missile - Extended Range; EGTTR = Eglin Gulf Test and Training Range; Guided Bomb Unit; HOB = height of burst; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; JDAM = Joint Direct Attack Munition; lb = pound(s); LSDB = Laser Small-Diameter Bomb; N/A = not applicable; SDB = Small-Diameter Bomb; SiAW = Stand-in Attack Weapon; TBD = to be determined

2.3.3.11 Inert Bomb Testing

The 96 OG proposes to continue expending approximately nine inert bombs a year in the EGTTR for testing purposes. The bombs are expected to be up to 2,000 lb in total weight. For the impact analysis, the bombs to be used by the 96 OG in the EGTTR during the 2023–2030 mission period are assumed to be Mk-84 2,000 lb General Purpose (GP) inert bombs (Table 2-16).

Table 2-16. Proposed Munitions for Inert Bomb Testing in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Mk-84 (GP 2,000 lb)[a]	Bomb	N/A	N/A	9

[a] Assumed for impact analysis.

EGTTR = Eglin Gulf Test and Training Range; GP = General Purpose; lb = pound(s); Mk = Mark; N/A = not applicable

2.3.4 Naval School Explosive Ordnance Disposal

Naval School Explosive Ordnance Disposal (NAVSCOLEOD) proposes to conduct training missions in the EGTTR during the 2023–2030 period. NAVSCOLEOD training in the EGTTR would include Mine Countermeasures (MCM) exercises to teach NAVSCOLEOD students techniques for neutralizing mines underwater. Underwater MCM training exercises are regularly conducted by the NAVSCOLEOD in nearshore waters and primarily involve diving and placing small explosive charges adjacent to inert mines by hand; the detonation of such charges disables live mines.

NAVSCOLEOD training is conducted offshore of Santa Rosa Island and in other locations and has not yet extended into the EGTTR. NAVSCOLEOD training proposed for the 2023–2030 mission period would extend approximately 5 NM offshore of Santa Rosa Island, in the EGTTR. Up to eight MCM training missions would be conducted annually in the EGTTR during the 2023–2030 period. Each mission would involve 4 underwater detonations of charges hand placed adjacent to inert mines, for a total of 32 annual detonations. The MCM neutralization charges consist of C-4 explosives, detonation cord, non-electric blasting caps, time fuzes, and fuze igniters; each charge has a NEW of approximately 20 lb. During each mission, a maximum of four charges would detonate with a delay no greater than 20 minutes between shots. After the final detonation, or a delay greater than 20 minutes, a 30-minute environmental observation would be conducted. One large safety vessel and two inflatable boats are the minimum vessel requirements for these missions. All underwater MCM training missions would be conducted during the daytime. In addition to underwater MCM training missions, NAVSCOLEOD proposes to conduct up to 80 floating mine training missions, which would involve detonations of charges on the water surface; these charges would have a NEW of approximately 5 lb. These missions would also be conducted only during the daytime. Public safety, protected species, and post-mission cleanup procedures for NAVSCOLEOD missions in the EGTTR would be conducted as described in Sections 2.3 and 11, with some operation-specific differences. Table 2-17 presents information on the munitions proposed for NAVSCOLEOD missions in the EGTTR during the 2023–2030 period.

Table 2-17. Proposed Munitions for NAVSCOLEOD Training in the EGTTR

LOA for Eglin Gulf Test and Training Range

Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
Underwater Mine Charge	Charge	20[a]	Subsurface	32
Floating Mine Charge	Charge	5[a]	Surface	80

[a] Estimated

EGTTR = Eglin Gulf Test and Training Range; lb = pound(s); NAVSCOLEOD = Naval School Explosive Ordnance Disposal

2.3.5 Summary of Munitions

Table 2-18 presents the munitions proposed to be used in the EGTTR during the 2023–2030 mission period. There would be an increase in the annual quantities of all general categories of munitions (bombs,

missiles, and gun ammunition) under the Proposed Action, except for live gun ammunition, which is proposed to be used less over the next mission period. The highest NEW of the munitions proposed to be used would be 945 lb, which was also the highest NEW for the previous mission period.

Table 2-18. Summary of Proposed Munitions for Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

User Group	Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
53 WEG	***Live Munitions***				
	AGR-20	Rocket	9.1	Surface	12
	AGM-158D JASSM XR	Missile	240.26	Surface	4
	AGM-158B JASSM ER	Missile	240.26	Surface	3
	AGM-158A JASSM	Missile	240.26	Surface	3
	AGM-65D	Missile	150	Surface	5
	AGM-65G2	Missile	145	Surface	5
	AGM-65H2	Missile	150	Surface	5
	AGM-65K2	Missile	145	Surface	4
	AGM-65L	Missile	150	Surface	5
	AGM-114 N-6D with TM	Missile	29.1	Surface	4
	AGM-114 N-4D with TM	Missile	29.94	Surface	4
	AGM-114 R2 with TM (R10)	Missile	27.41	Surface	4
	AGM-114 R-9E with TM (R11)	Missile	27.38	Surface	4
	AGM-114Q with TM	Missile	20.16	Surface	4
	CBU-105D	Bomb	108.6	HOB	8
	GBU-53/B (GTV)	Bomb	0.34[a]	HOB/Surface	8
	GBU-39 SDB (GTV)	Bomb	0.39[a]	Surface	4
	AGM-88C w/FTS	Missile	0.70[a]	Surface	2
	AGM-88B w/FTS	Missile	0.70[a]	Surface	2
	AGM-88F w/FTS	Missile	0.70[a]	Surface	2
	AGM-88G w/FTS	Missile	0.70[a]	Surface	2
	AGM-179 JAGM	Missile	27.47	Surface	4
	GBU-69	Bomb	6.88	Surface	2
	GBU-70	Bomb	6.88	Surface	1
	AGM-176	Missile	8.14	Surface	4
	GBU-54 KMU-572C/B	Bomb	193	Surface	1
	GBU-54 KMU-572B/B	Bomb	193	Surface	1
	PGU-43 (105 mm)	Gun Ammunition	4.7	Surface	100
	AIM-120D	Missile	113.05	HOB	24
	AIM-120C7	Missile	113.05	HOB	10
	AIM-120C5/6	Missile	113.05	HOB	8

Table 2-18. Summary of Proposed Munitions for Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

User Group	Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
53 WEG	AIM-120C3	Missile	102.65	HOB	14
	AIM-120C3	Missile	117.94	HOB/Surface	4
	AIM-120B	Missile	102.65	HOB	18
	AIM-9X Blk I	Missile	60.25	HOB	7
	AIM-9X Blk I	Missile	67.9	HOB/Surface	10
	AIM-9X Blk II	Missile	60.25	HOB	24
	AIM-9M-9	Missile	60.55	HOB	90
	Inert Munitions				
	ADM-160B MALD	Missile	N/A	N/A	4
	ADM-160C MALD-J	Missile	N/A	N/A	4
	ADM-160C-1 MALD-J	Missile	N/A	N/A	4
	ADM-160D MALD-J	Missile	N/A	N/A	4
	GBU-10	Bomb	N/A	N/A	8
	GBU-12	Bomb	N/A	N/A	32
	GBU-49	Bomb	N/A	N/A	16
	GBU-24/B (84)	Bomb	N/A	N/A	16
	GBU-24A/B (109)	Bomb	N/A	N/A	2
	GBU-31B(v)1	Bomb	N/A	N/A	16
	GBU-31C(v)1	Bomb	N/A	N/A	16
	GBU-31B(v)3	Bomb	N/A	N/A	2
	GBU-31C(v)3	Bomb	N/A	N/A	2
	GBU-32C	Bomb	N/A	N/A	8
	GBU-38B	Bomb	N/A	N/A	4
	GBU-38C w/BDU-50 (No TM)	Bomb	N/A	N/A	4
	GBU-38C	Bomb	N/A	N/A	10
	GBU-54 KMU-572C/B	Bomb	N/A	N/A	4
	GBU-54 KMU-572B/B	Bomb	N/A	N/A	4
	GBU-69	Bomb	N/A	N/A	2
	BDU-56A/B	Bomb	N/A	N/A	4
	PGU-27 (20 mm)	Gun Ammunition	0.09	N/A	16,000
	PGU-15 (30 mm)	Gun Ammunition	N/A	N/A	16,000
	PGU-25 (25 mm)	Gun Ammunition	N/A	N/A	16,000
	ALE-50	Decoy System	N/A	N/A	6
	AIM-260A JATM	Missile	N/A	N/A	4

Table 2-18. Summary of Proposed Munitions for Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

User Group	Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
53 WEG	PGU-27 (20 mm)	Gun Ammunition	N/A	N/A	80,000
	PGU-23 (25 mm)	Gun Ammunition	N/A	N/A	6,000
	MJU-7A/B Flare	Flare	N/A	N/A	1,800
	R-188 Chaff	Chaff	N/A	N/A	6,000
	R-196 (T-1) Chaff	Chaff	N/A	N/A	1,500
AFSOC	***Live Munitions***				
	105 mm HE (FU)	Gun Ammunition	4.7	Surface	750
	105 mm HE (TR)	Gun Ammunition	0.35	Surface	1,350
	30 mm HE	Gun Ammunition	0.1	Surface	35,000
	AGM-176 Griffin	Missile	4.58	HOB	100
	AGM-114R9E/R2 Hellfire	Missile	20.0	HOB	70
	2.75-inch Rocket (including APKWS)	Rocket	2.3	Surface	400
	GBU-12	Bomb	198.0/298.0	Surface	30
	Mk-81 (GP 250 lb)	Bomb	151.0	Surface	30
	GBU-39 (SDB I)	Bomb	37.0	HOB	30
	GBU-69	Bomb	36.0	HOB	40
	Inert Munitions				
	.50 caliber	Gun Ammunition	N/A	N/A	30,000
	GBU-12	Bomb	N/A	N/A	30
	MkK-81 (GP 250 lb)	Bomb	N/A	N/A	30
	BDU-50	Bomb	N/A	N/A	30
	BDU-33	Bomb	N/A	N/A	50
96 OG	***Live Munitions***				
	AGM-176 Griffin	Missile	4.58	Surface	10
	AGM-114 Hellfire	Missile	20.0	Surface	10
	GBU-39 (SDB I)	Bomb	37.0	Surface	6
	GBU-39 (LSDB)	Bomb	37.0	Surface	10
	105 mm HE (FU)	Gun Ammunition	4.7	Surface	60
	105 mm HE (TR)	Gun Ammunition	0.35	Surface	60
	30 mm HE	Gun Ammunition	0.1	Surface	99
	AGM-114R Hellfire	Missile	20.0	Surface	36
	AIM-9X	Missile	7.9	HOB	1
	GBU-39B/B LSDB	Bomb	37.0	Surface	2
	AGM-158 (JASSM)	Missile	240.26	Surface	2

Table 2-18. Summary of Proposed Munitions for Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

User Group	Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
96 OG	GBU-39 (SDB I)	Bomb	37.0	HOB/Surface	2
	GBU-39 (SDB I) Simultaneous Launch[b]	Bomb	74.0	HOB/Surface	2
	GBU-53 (SDB II)	Bomb	22.84	HOB/Surface	2
	AGM-114L Longbow	Missile	35.95	HOB	6
	AGM-179A JAGM	Missile	27.47	HOB	8
	Spike NLOS	Missile	34.08	Surface	3
	PAC-2	Missile	145.0[c]	N/A (drone target)	8
	PAC-3	Missile	145.0[c]	N/A (drone target)	2
	HACM	Hypersonic Weapon	350[e]	Surface	2
	PrSM	Hypersonic Weapon	46[e]	HOB	2
	SINKEX	Vessel Sinking Exercise	Not Available	Not Available	2
	GBU-10, 24, or 31 (QUICKSINK)	Bomb	945	Subsurface	4 to 8
	2,000 lb bomb with JDAM kit	Bomb	945 or less	HOB	2
	Inert GBU-39 (LSDB) with live fuze	Bomb	0.4	HOB/Surface	4
	Inert GBU-53 (SDB II) with live fuze	Bomb	0.4	HOB/Surface	4
	Inert Munitions				
	GBU-39B/B LSDB	Bomb	N/A	N/A	2
	GBU-49	Bomb	N/A	N/A	10
	GBU-48	Bomb	N/A	N/A	1
	AGM-158 (JASSM)	Missile	N/A	N/A	4
	GBU-39 (SDB I)	Bomb	N/A	N/A	4
	GBU-39 (SDB I) Simultaneous Launch	Bomb	N/A	N/A	4
	GBU-53 (SDB II)	Bomb	N/A	N/A	1
	AIM-260 JATM - Inert	Missile	N/A	N/A	6
	AIM-9X - Inert	Missile	N/A	N/A	10
	AIM-120 AMRAAM - Inert	Missile	N/A	N/A	15
	PrSM - Inert	Hypersonic Weapon	N/A	N/A	2
	SiAW AARGM-ER	Missile	N/A	N/A	7
	Multipurpose Booster	Booster	N/A	N/A	1

Table 2-18. Summary of Proposed Munitions for Missions in the EGTTR

LOA for Eglin Gulf Test and Training Range

User Group	Type	Category	Net Explosive Weight (lb)	Detonation Scenario	Annual Quantity
96 OG	JDAM ER	Bomb	N/A	N/A	3
	Navy HAAWC	Torpedo	N/A	N/A	2
	Mk-84 (GP 2,000 lb)[c]	Bomb	N/A	N/A	9
NAVSCOLEOD	Underwater Mine Charge	Charge	20[d]	Subsurface	32
	Floating Mine Charge	Charge	5[d]	Surface	80

[a] Warhead replaced by FTS/TM. Identified NEW is for the FTS.
[b] NEW is doubled for simultaneous launch.
[c] Assumed for impact analysis.
[d] Estimated.
[e] NEW at impact/detonation

53 WEG = 53rd Weapons Evaluation Group; 780 TS = 780th Test Squadron; 96 OG = 96th Operations Group; AARGM-ER = Advanced Anti-Radiation Guided Missile - Extended Range; ABMS = Advanced Battle Management System; ADM = American Decoy Missile; AFSOC = Air Force Special Operations Command; AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; ALE = Ammunition Loading Equipment; AMRAAM = Advanced Medium-Range Air-to-Air Missile; APKWS = Advanced Precision Kill Weapon System; BDU = Bomb Dummy Unit; C-RAM = Counter, Rocket, Artillery, and Mortar; CBU = Cluster Bomb Unit; EGTTR = Eglin Gulf Test and Training Range; ER = Extended Range; FTS = Flight Termination System; FU = Full Up; GBU = Guided Bomb Unit; GP = General Purpose; GTV = Guided Test Vehicle; HAAWC = High Altitude Anti-Submarine Warfare Weapon Capability; HACM = Hypersonic Attack Cruise Missile; HE = High Explosive; HOB = height of burst; JDAM = Joint Direct Attack Munition; JAGM = Joint Air-to-Ground Missile; JASSM = Joint Air-to-Surface Standoff Missile; JATM = Joint Advanced Tactical Missile; LAICRM = Large Aircraft Infrared Counter Measure; lb = pound(s); LSDB = Laser Small-Diameter Bomb; MALD = Miniature Air-Launched Decoy; MJU = Mobile Jettison Unit; Mk = Mark; mm = millimeter(s); N/A = not applicable; NLOS = Non-Line-of-Sight; NAVSCOLEOD = Naval School Explosive Ordnance Disposal; PAC = Patriot Advanced Capability; PGU = Projectile Gun Unit; SDB = Small-Diameter Bomb; SiAW = Stand-in Attack Weapon; SRI = Santa Rosa Island; TA = Test Area; TBD = to be determined; TM = telemetry; TR = Training Round

3. Species and Numbers of Marine Mammals

Marine mammals that have potential to occur in the northeastern Gulf of Mexico include several species of cetaceans (whales and dolphins) and the Florida manatee (*Trichechus manatus latirostris*). The Florida manatee inhabits coastal and inland waters and is rarely sighted offshore. Therefore, the manatee is unlikely to occur in the EGTTR, especially in the existing LIA, which begins at approximately 12 NM offshore or in the East LIA, which begins at approximately 25 NM offshore. Based on the manatee's low potential to occur where most EGTTR operations would be conducted, the USAF has determined that the Proposed Action would have no effect on the Florida manatee; therefore, this species is not analyzed further in this LOA Request.

Whales and dolphins in the northern Gulf of Mexico may be generally categorized into those species that occur over the continental shelf, which is typically considered to extend from shore to the 200-meter isobath, and those species that occur beyond the continental shelf break in waters deeper than 200 meters. Water depths range from approximately 30 to 145 meters in the existing LIA and from approximately 35 to 95 meters in the proposed new East LIA; therefore, the vast majority of EGTTR operations under the Proposed Action would occur in waters over the continental shelf. Live munitions used outside the LIA beyond the 200-meter isobath are set to detonate above the water surface; such airburst detonations are not considered to affect marine mammals because there is little transmission of pressure or sound energy across the air–water interface. For these reasons, only cetacean species that predominantly occur landward of the 200-meter isobath are analyzed in this LOA Request.

There are a total of 21 cetacean species that regularly inhabit the northern Gulf of Mexico; the continental shelf cetacean community consists of the common bottlenose dolphin (*Tursiops truncatus*) and Atlantic spotted dolphin (*Stenella frontalis*) and the oceanic cetacean community consists of the other 19 cetacean species (Maze-Foley and Mullin 2006). Based on the occurrence of the bottlenose and Atlantic spotted dolphin in continental shelf waters in the EGTTR, the potential impacts of the Proposed Action on these two dolphin species are analyzed in detail in this LOA Request. These dolphin species are not federally listed under the ESA but are protected under the MMPA (Table 3-1). The Rice's whale (*Balaenoptera ricei*), which is proposed to be classified as a new species of Bryde's-like whale, occurs near the continental shelf break in the northeastern Gulf of Mexico. Bryde's whales that occur in the northern Gulf of Mexico historically have been assumed to be a subpopulation of the broadly distributed *Balaenoptera edeni* species; however, recent genetic and morphological studies indicate that the northern Gulf population is evolutionarily distinct from all other whales within the Bryde's whale complex (Rosel and Wilcox 2014; Rosel et al. 2021). Rosel and others (2021) reported that based on a compilation of sighting and stranding data from 1992 to 2019, the primary habitat of the Rice's whale is the northeastern Gulf of Mexico, particularly the De Soto Canyon area, at water depths of 150 to 410 meters. Habitat for the Rice's whale is currently considered by NMFS to be within the depth range of 100 to 400 meters in this part of the Gulf of Mexico (NMFS 2016, 2020a). Rice's whale habitat exists in the western part of the existing LIA and is near the proposed East LIA; therefore, the potential impacts of the Proposed Action on the Rice's whale are analyzed in detail in this LOA Request. The Rice's whale is protected under the ESA and MMPA (Table 3-1).

Table 3-1. Marine Mammal Species Known to Occur in the EGTTR Landward of the 200-Meter Isobath
LOA for Eglin Gulf Test and Training Range

Common Name	Scientific Name	Federal Legal Status
Atlantic spotted dolphin	*Stenella frontalis*	MMPA
Common bottlenose dolphin	*Tursiops truncatus*	MMPA
Rice's whale	*Balaenoptera ricei*	E

Source: NMFS, 2021a

E = Endangered: species in danger of extinction throughout all or a significant portion of its range; MMPA = Marine Mammal Protection Act; T = Threatened: species likely to become endangered within the foreseeable future throughout all or a significant portion of its range

As recommended by NMFS during review of this LOA Request, densities of the common bottlenose dolphin, Atlantic spotted dolphin, and Rice's whale in the study area are based on the spatial density model developed by the National Oceanic and Atmospheric Administration (NOAA) Southeast Fisheries Science Center for the species in the Gulf of Mexico (NOAA 2022). The density model, herein referred to as the NOAA model, integrated visual observations from aerial and shipboard surveys conducted in the Gulf of Mexico from 2003 to 2019. The model results are available online at https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.nodc:0256800.

For this LOA Request, the NOAA model was used to predict the average density of the common bottlenose dolphin and Atlantic spotted dolphin in the existing LIA and proposed East LIA. The model generates densities for hexagon-shaped raster grids that are 40 square kilometers (km^2). The average annual density of each dolphin species in the existing LIA and proposed East LIA was computed in a geographic information system (GIS) based on the densities of the raster grids within the boundaries of each LIA. To account for portions of the grids outside of the LIA, the species density value of each grid was area-weighted based on the respective area of the grid within the LIA. For example, the density of a grid that is 70 percent within the LIA would be weighted to reflect only the 70 percent grid area, which contributes to the average density of the entire LIA. The density of the 30 percent grid area outside the LIA does not contribute to the average LIA density, so it is not included in the estimation. The resulting area-weighted densities of all the grids were summed to determine the average annual density of each dolphin species within each LIA. The densities of dolphins estimated in each LIA for this LOA Request are presented in Table 3-2. For comparison, Table 3-2 also presents the densities of each dolphin species estimated in the 2017 EGTTR LOA Request (USAF 2017b). The 2017 EGTTR LOA Request estimated dolphin densities for the entire W-151 area landward of the 150-meter isobath, referred to as a large-scale density estimate, and for the portion of the LIA where the GRATV was anchored at the time, referred to as a fine-scale density estimate. Lastly, Table 3-2 presents the dolphin densities estimated in the 2019 Supplemental REA (USAF 2019a) for the existing LIA using the same model.

Table 3-2. Predicted Dolphin Densities in the Study Area

LOA for Eglin Gulf Test and Training Range

Species	Density Estimate (animals per km^2)				
	2017 LOA Request[a]		2019 Supplemental REA[b]	Current LOA Request[e]	
	Large-Scale[c]	Fine-Scale[d]	Existing LIA	Existing LIA	Proposed East LIA
Atlantic spotted dolphin	0.160	0.148	0.144	0.032	0.038
Common bottlenose dolphin	0.276	0.433	0.286	0.261	0.317

[a] Source: USAF, 2017b

[b] Source: USAF, 2019a

[c] Estimated density for the entire W-151 area landward of the 150-meter isobath

[d] Estimated density centered on the location of the Gulf Range Armament Test Vessel at the time

[e] Estimated average density within LIA based on spatial density model developed by NOAA (2022)

km^2 = square kilometer(s); LIA = Live Impact Area; LOA = Letter of Authorization; N/A = not applicable; REA = Range Environmental Assessment

As indicated in Table 3-2, the common bottlenose dolphin density in the existing LIA, estimated by this LOA Request based on the NOAA model, is comparable to the densities estimated by the 2019 Supplemental REA and 2017 LOA Request. However, the NOAA model indicates that the density of the Atlantic spotted dolphin in the existing LIA is considerably lower than the densities estimated by the previous studies. The NOAA model results indicate an equally low density for the Atlantic spotted dolphin in the proposed East LIA.

The NOAA model was used to determine Rice's whale density in the exposure analysis conducted for the Rice's whale in this LOA Request. Areas of Rice's whale exposure to pressure and impulsive noise from munitions use, predicted by underwater acoustic modeling and quantified by GIS analysis, were coupled with the associated modeled grid densities from the NOAA model to estimate abundance of affected animals. The use of the NOAA model to estimate Rice's whale abundance and associated exposure from EGTTR operations is discussed further in Section 6.7.2.

4. Affected Species Status and Distribution

4.1 Common Bottlenose Dolphin

The common bottlenose dolphin occurs worldwide and is the most common cetacean species in the coastal waters of the Gulf of Mexico. It is abundant in the northeastern Gulf from inshore to upper continental slope waters less than 1,000 meters deep (Mullin and Fulling 2004). Genetically distinct coastal and offshore ecotypes of the bottlenose dolphin occur in the Gulf of Mexico and in other locations (Hoelzel et al. 1998).

A total of 36 common bottlenose dolphin stocks have been designated in the northern Gulf of Mexico; these include coastal, continental shelf, and oceanic stocks as well as 31 bay, sound, and estuarine stocks (Waring et al. 2016). Stocks within and in the vicinity of the EGTTR include the northern Gulf of Mexico coastal, continental shelf, and oceanic stocks, and the three inshore stocks designated in the northeastern Gulf, which include the Choctawhatchee Bay, Pensacola/East Bay, and St. Andrew Bay stocks (Table 4-1). The estimated abundance of each stock presented in Table 4-1 is based on the population sizes identified in Marine Mammal Stock Assessment Reports prepared by NMFS for the stocks (Waring et al. 2016; NMFS 2019, 2020).

Table 4-1. Bottlenose Dolphin Stocks in the Northern Gulf of Mexico

LOA for Eglin Gulf Test and Training Range

Stock		Distribution	Strategic Stock?	Estimated Abundance
Bay, sound, and estuarine stocks[a]	Choctawhatchee Bay	Areas of contiguous, enclosed, or semi-enclosed water bodies	Yes	179[b]
	Pensacola/East Bay		Yes	33[b]
	St. Andrew Bay		No	199[c]
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)	No	7,185[b]
Northern Gulf of Mexico Continental Shelf		Waters between the 20- and 200-meter (66- and 656-foot) isobaths, from Texas to Key West	No	51,192[b]
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	7,462[d]

[a] Identified bay, sound, and estuarine stocks occur in the northeastern Gulf of Mexico.

[b] Source: Waring et al., 2016

[c] Source: NMFS, 2019

[d] Source: NMFS, 2020

As indicated in Table 4-1, two of the identified inshore stocks (Choctawhatchee Bay and Pensacola/East Bay) are designated as being strategic, whereas the coastal, continental shelf, and oceanic stocks are designated as not being strategic. A strategic marine mammal stock is a stock for which the level of direct human-caused mortality exceeds the potential biological removal (PBR) level; which is declining and likely to be listed under the ESA within the foreseeable future; or which is listed as threatened or endangered under the ESA. The PBR level is the maximum number of individuals, not including natural mortalities, that

could be removed from a stock while still allowing the stock to reach or maintain its optimum sustainable population. Individuals from different stocks may occasionally overlap; however, the degree of overlap is unknown, and substantial mixing or interbreeding between stocks is not expected to occur (Waring et al. 2016). Genetic studies indicate that if there is spatial overlap, there may be factors that reduce interbreeding among the stocks.

The designated inshore stock areas are landward of the EGTTR boundary; therefore, individuals from these stocks would have low potential to be exposed to EGTTR operations. The Gulf of Mexico Northern Coastal Stock inhabits waters from shore to the 20-meter isobath and, therefore, has potential to occur within the EGTTR, which starts at 3 NM offshore, where water depths can be 20 meters or slightly less. The Northern Gulf of Mexico Continental Shelf Stock inhabits waters that are 20 to 200 meters deep and, therefore, is expected to be the primary bottlenose dolphin stock that occurs in the existing LIA, where water depths range from approximately 30 to 145 meters, and in the proposed East LIA, where water depths range from approximately 35 to 85 meters. This stock is not strategic and is estimated to consist of 51,192 individuals (Waring et al. 2016). The PBR level for this stock is 469 individuals. The Northern Gulf of Mexico Oceanic Stock inhabits waters deeper than 200 meters and, therefore, is expected to have low potential under typical conditions to occur in either LIA.

The bottlenose dolphin reaches a length ranging from about 6 to 13 feet and a weight ranging from about 300 to 1,400 lb. The diet of bottlenose dolphins consists primarily of fish, squid, and crustaceans. They hunt for prey using a variety of techniques individually and cooperatively. For example, they may work as a group to herd and trap fish as well as use high-frequency echolocation, which is a form of sonar, to catch prey. Bottlenose dolphins can hear within a broad frequency range from approximately 0.075 to more than 150 kilohertz (kHz), which is well beyond the normal range of human hearing (0.02 to 20 kHz). *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (Version 2.0) (NMFS 2018b), referred to herein as the 2018 NMFS Technical Guidance, and *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (DoN 2017), referred to herein as the 2017 Navy Phase III Guidance, categorize the bottlenose dolphin in the mid-frequency functional hearing group, which consists of cetaceans with a hearing frequency range of 150 hertz (Hz) to 160 kHz (NMFS 2018b). Using a different categorization scheme, Southall and others (2019) referred to the hearing sensitivity of the bottlenose dolphin as being high frequency.

4.2 Atlantic Spotted Dolphin

The Atlantic spotted dolphin occurs throughout the Atlantic Ocean and the Gulf of Mexico. In the Gulf, it occurs primarily from continental shelf waters to slope waters less than 500 meters deep (Maze-Foley and Mullin 2006). There is only one stock of the Atlantic spotted dolphin in U.S. Gulf waters, referred to as the Northern Gulf of Mexico Stock; this stock is not considered strategic under the MMPA. The most recent abundance estimate for this stock is 37,611 individuals; this is the combined estimate of abundance for outer continental shelf waters based on 2000–2001 fall surveys and oceanic waters based on 2003–2004 spring/summer surveys (Waring et al. 2016). Based on the age of these survey data, the current population size for the Atlantic spotted dolphin in the northern Gulf of Mexico is unknown (Waring et al. 2016). The PBR level for this stock is currently undetermined.

Atlantic spotted dolphins are about 5 to 7.5 feet long and weigh about 220 to 315 lb. Their diet consists primarily of small fish, invertebrates, and cephalopods, which they catch using a variety of techniques including echolocation. Atlantic spotted dolphins are social animals and form groups of up to 200 individuals. Most groups consist of fewer than 50 individuals, and in coastal waters groups typically consist of 5 to 15 individuals (NMFS 2021b). Little is known about the hearing ability of the Atlantic spotted dolphin. Its hearing range may be comparable to that of a bottlenose dolphin given other similarities between these species. The 2018 NMFS Technical Guidance and 2017 Navy Phase III Guidance include the Atlantic spotted dolphin in the mid-frequency functional hearing group, like the bottlenose dolphin (NMFS 2018b; DoN 2017).

4.3 Rice's Whale

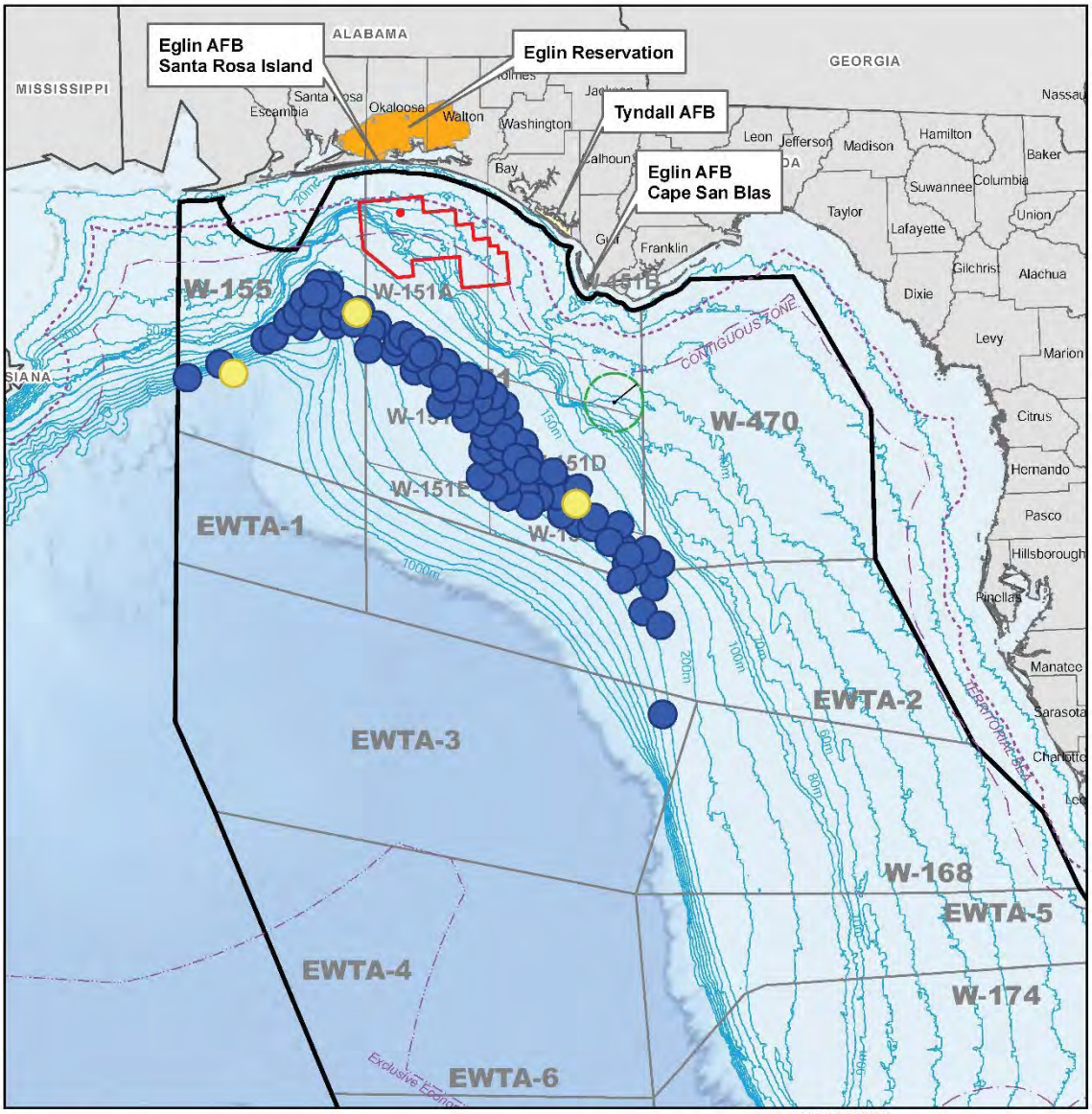
The Gulf of Mexico Bryde's whale was listed as endangered throughout its entire range on April 15, 2019, under the ESA. Based on genetic analyses and new morphological information, scientists have proposed that the Gulf of Mexico Bryde's whale be recognized as a distinct species (*Balaenoptera ricei*) with the new name of Rice's whale. This proposed new species classification is currently under review.

Rosel and Wilcox (2014) identified a new, evolutionarily distinct lineage of whale in the Gulf of Mexico. Genetic analysis of whales sampled in the northeastern Gulf of Mexico revealed that this population is evolutionarily distinct from all other whales within the Bryde's whale complex and all other known balaenopterid species (Rosel and Wilcox 2014). Rosel and others (2021) published the first morphological examination of a complete skull from this species, identifying diagnostic characteristics distinguishing it from other closely related baleen whales. Together, the genetic and morphological data provide strong support for a new species (Rosel et al. 2021).

The Rice's whale is a medium-sized baleen whale. To date, the largest verified Rice's whale to strand was a lactating female about 1,265 centimeters (cm) long; the largest male was 1,126 cm (Rosel et al. 2021). Rice's whales are uniformly dark gray on top, including the upper and lower jaws, and pale to pinkish on the underside. They have a falcate dorsal fin approximately two-thirds of the way back from the snout. Similar to whales in the Bryde's whale complex, the Rice's whale has three longitudinal ridges on the rostrum (Rosel et al. 2021).

The Rice's whale is the only year-round resident baleen whale species in the Gulf of Mexico. Rosel and others (2021) reported that based on a compilation of sighting and stranding data from 1992 to 2019, the primary habitat of the Rice's whale is the northeastern Gulf of Mexico, particularly the De Soto Canyon area, at water depths of 150 to 410 meters. Habitat for the Rice's whale is currently considered by NMFS to be within the depth range of 100 to 400 meters in this part of the Gulf of Mexico (NMFS 2016, 2020a). Figure 4-1 shows all visual survey sightings of whales suspected to be the Rice's whale recorded during NMFS vessel and aerial surveys from 1992 to 2019.The majority of these visual observations were seaward of the 150-meter isobath, and all were outside both the existing LIA and proposed East LIA.

The Rice's whale population was first discovered in the early 1990s with the beginning of systematic surveys of the shelf break region and oceanic waters (Hansen et al. 1995). Most sightings of Bryde's-like whales in the Gulf of Mexico are from shipboard and aerial line-transect surveys conducted by NMFS (Waring et al. 2013). These surveys were conducted at various times throughout all seasons and covered waters from the 20-meter isobath to the seaward extent of the U.S. Exclusive Economic Zone (Fulling et al. 2003; Maze-Foley and Mullin 2006; Waring et al. 2013). During these past surveys, sightings of Bryde's-like whales were restricted to the northeastern Gulf in waters along and seaward of the 200-meter isobath. The deepest location where a Rice's whale was sighted was 408 meters (Rosel et al. 2021). The majority of sightings are confined to the northeastern Gulf of Mexico; however, it is possible the species had a broader distribution. Historical whaling records from the 1800s suggest Bryde's-like whales may have been more common in the waters of the north central Gulf, south of the Mississippi River delta and in the southern Gulf on the Campeche Bank (Reeves et al. 2011). Recently, there was a confirmed Rice's whale sighting in the western Gulf of Mexico off the central Texas coast at a 225-meter water depth (NMFS 2018c), and two Bryde's-like whales were sighted during a NMFS survey in the western Gulf in the early 1990s.



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Proposed East LIA (10-NM radius)
- Depth Contour (meters)
- Visual Survey Sightings
- Seismic Vessels

Notes:
1. NM = nautical mile
2. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; Bryde's Whale Observations, Rosel et al., 2021; County Borders, State Borders, ESRI 2021.

N

0 40 80 120 160 Nautical Miles

FIGURE 4-1
Rice's Whale Observations
LOA for Eglin Gulf Test and Training Range

FES0610211511TPA

Little is known about the life history of the Rice's whale. Basic information about the species is incomplete because of inadequate sample sizes. Total length measurements of stranded whales have ranged from 470 to 1,265 cm (Rosel et al. 2021). Stranding and genetic data indicate that both sexes are present in the Gulf of Mexico. Several smaller Rice's whales, including a stranded calf, are cited in stranding records, indicating that the whales are breeding in the isolated region. Two Rice's whales were sighted together in the northeastern Gulf of Mexico during a 2016 NMFS survey, and one was half the size of the other and had the physical characteristics of a calf. A dead lactating female was also found in Tampa Bay in 2009.

The diet of the Rice's whale is poorly understood. Soldevilla and others (2017) tagged a Rice's whale in the northeastern Gulf of Mexico. The tag remained attached for 3 days and revealed a diel dive pattern that indicates that the whales forage near the seafloor during the day and remain near the surface of the water (within 15 meters) during the night. It is unknown what type of prey the whales target during daytime dives. This tagging study provides the first and only data on Rice's whale diving behavior.

The 2018 NMFS Technical Guidance (NMFS 2018b), 2017 Navy Phase III Guidance (DoN 2017), and Southall and others (2019) include the Rice's whale in the low-frequency hearing group, which consists of cetaceans with a hearing frequency range of 7 Hz to 35 kHz.

Estimates of abundance for Rice's whales are under 100 individuals. Data from aerial and vessel-based line-transect surveys conducted in the northern Gulf of Mexico have been used to estimate cetacean abundance. Abundance estimates made between 1991 and 2009 range between 0 and 44 individuals (Rosel et al. 2016). The current best estimate of abundance for the Rice's whale is 51 individuals (NMFS 2020).

Potential threats to Rice's whales include vessel collisions, marine debris, anthropogenic noise, energy exploration and development, oil spills and response, and the potential for fisheries-related entanglement (Rosel et al. 2016, 2021; Soldevilla et al. 2017; NOAA 2021).

5. Take Authorization Requested

The MMPA established a moratorium on the taking of marine mammals in U.S. waters, with limited exceptions. Take, as defined under the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 *United States Code* 1362). The MMPA allows exceptions to the moratorium for commercial fishing, scientific research, public display, photography, and limited authorized incidental taking of marine mammals. 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 within a specified geographic region. For requested incidental takes to be authorized, NMFS must determine that the total taking will have a negligible impact on the species or stock.

Pursuant to Section 101(a)(5) of the MMPA, Eglin AFB is requesting an LOA for the incidental, but not intentional, taking of marine mammals resulting from EGTTR operations proposed to be conducted during the next mission period, which spans 7 years from 2023 to 2030. On August 13, 2018, the 2019 National Defense Authorization Act (Pub. L. 115–232) amended the MMPA to allow incidental take regulations for military readiness activities to be issued for up to 7 years. Based on the acoustic modeling and associated analyses conducted for this LOA Request, Eglin AFB has estimated incidental takes for all established criteria and thresholds, from mortality to behavioral disturbance, for each marine mammal species potentially affected by the Proposed Action. Eglin AFB is requesting authorization for these estimated takes. Eglin AFB believes that the well-established monitoring and mitigation measures that it has been implementing for years will continue to reduce the potential for dolphin takes at all threshold levels, and that the new mitigation measures developed in this LOA Request will result in insignificant Level B harassment takes of the Rice's whale.

6. Take Estimates for Marine Mammals

Potential impacts to marine mammals from EGTTR operations under the Proposed Action would primarily result from detonations of live munitions at or near the water surface. Based on the dispersed distribution of marine mammals in the open ocean, the relatively short amount of time they spend at the water surface compared with the time they spend underwater, and the annual quantities of munitions proposed to be expended, it is highly improbable that a marine mammal would be directly struck by a munition during EGTTR operations. This conclusion was also reached in the previous EGTTR LOA Request (USAF 2017b) and associated 2015 REA (USAF 2015). Therefore, direct munition strikes on marine mammals are not analyzed further in this LOA Request.

The pressure and impulsive noise from munition detonations have the potential to cause mortality, injury, hearing impairment, or behavioral responses in marine mammals, depending on the explosive energy released by the munition and the distance of the animal from the detonation. The most potentially severe effects would occur close to the detonation point, including tissue damage, barotrauma, or even death. Pressure and sound waves lose energy as they spread away from the detonation point; therefore, adverse effects on animals decrease with distance from the explosion. Animals farther from the detonation may experience temporary hearing impairment or disturbance that may evoke a behavioral response and interrupt normal activities.

Three sources of information are necessary for estimating the effects of detonations on marine mammals: (1) the zone of influence (ZOI), which is the area around the explosion within which the various levels of impact would occur; (2) the density of animals within the ZOI; and (3) the number of detonations. Pressure and impulsive noise impacts are analyzed only for surface and subsurface detonations; HOB (airburst) and aerial target detonations are not included in the impact analysis because of the negligible transmission of pressure and sound energy across the air–water interface.

This section presents the results of underwater acoustic modeling and other analyses conducted to assess how munitions use under the Proposed Action would potentially affect marine mammals. Additional information on the methodology and assumptions used for the acoustic modeling and associated analyses is provided in Appendix A.

6.1 Criteria and Thresholds

The criteria and thresholds used for the analysis of detonation impacts on marine mammals in this LOA Request are discussed in this section. The criteria are the types of potential impact, which range from mortality to non-injurious harassment, and the thresholds are the established levels of pressure or noise required to cause the impact. The following standard metrics are used to assess underwater pressure and impulsive noise impacts on marine mammals:

- *Sound pressure level (SPL)* is the ratio of the absolute sound pressure and a reference level. In water, the units are in decibels (dB) referenced to 1 micropascal (µPa) (dB re 1 µPa).
- *Sound exposure level (SEL)* accounts for both sound intensity and duration. This metric provides a measure of cumulative exposure from multiple detonations over a 24-hour period. In water, the units are in dB referenced to 1 µPa-squared second (dB re 1 $\mu Pa^2 \cdot s$).
- *Positive impulse* is the time integral of the initial positive phase of the pressure impulse. This metric provides a measure of energy in the form of time-integrated pressure. Units are typically pascal-seconds (Pa·s) or pounds per square inch (psi) per millisecond (msec) (psi·msec).

6.1.1 Mortality

Primary blast injuries result from the compression of a body exposed to the pressure wave of an explosion and are usually observed as barotrauma of gas-containing organs, such as the lung and gut, and structural

damage to the auditory system. Barotrauma refers to injuries caused when large pressure changes occur across tissue interfaces, normally at the boundaries of air-filled tissues such as the lungs. Primary blast injuries to the respiratory system may be fatal depending on their severity.

Thresholds established for marine mammal mortality are species-specific and based on the level of impact predicted to cause the onset of unrecoverable lung injury. The mortality threshold is derived based on the positive impulse pressure of the blast. It is calculated using the onset mortality equation presented in the 2017 Navy Phase III Guidance (DoN 2017) and is expressed as Pa·s. This equation incorporates source/animal depths and the mass of a newborn calf for the affected species. The thresholds established for mortality are conservative because animals of greater mass can withstand greater pressure, and newborn calves typically account for a small percentage of the number of individuals in any cetacean population. The 2017 Navy Phase III Guidance provide mass values for newborn calves of various marine mammal species. The mass provided for a Bryde's whale calf (680 kg) is used for the Rice's whale in this LOA Request. A mass value is provided for the bottlenose dolphin (14 kg) but not for the Atlantic spotted dolphin; therefore, the mass value provided for the striped dolphin (*Stenella coeruleoalba*) (7 kg) was used as a surrogate for the Atlantic spotted dolphin in this LOA Request.

6.1.2 Injury (Level A Harassment)

Non-lethal injuries are referred to as Level A harassment and include slight lung injury, gastrointestinal (GI) tract damage, and permanent threshold shift (PTS).

The slight lung injury threshold, like the mortality threshold, is calculated using the onset slight lung injury equation presented in the 2017 Navy Phase III Guidance (DoN 2017) and is expressed as Pa·s. The calf masses previously identified for the Rice's whale and dolphin species used for the mortality threshold are also used for the slight lung injury threshold in this LOA Request.

Slight GI tract injuries are correlated to the peak pressure of the blast and have been found to be independent of the animal's size (Goertner 1982). An unweighted SPL of 237 dB re 1 µPa is used as the GI tract threshold for all marine mammals. An unweighted SPL indicates absolute pressures without adjustments for species- or organ-specific sensitivities.

PTS refers to auditory damage that does not fully heal and results in a permanent decrease in hearing sensitivity. Two thresholds are used for PTS, one based on cumulative SEL and one based on peak SPL of an underwater blast. For analyses in this LOA Request, the more conservative of the two thresholds is applied to afford the most protection to marine mammals. The PTS thresholds for the species analyzed are based on those presented in the 2017 Navy Phase III Guidance (DoN 2017) for mid-frequency (dolphins) and low-frequency (Rice's whale) cetaceans.

6.1.3 Non-Injurious Impacts (Level B Harassment)

Non-injurious impacts are referred to as Level B harassment and include temporary threshold shift (TTS) and behavioral impacts. TTS is a recoverable loss of hearing sensitivity; it is not considered to be an injury because auditory structures are temporarily fatigued and not permanently damaged. Two thresholds are used for TTS, one based on cumulative SEL and one based on peak SPL of an underwater blast. For analyses in this LOA Request, the more conservative of the two thresholds is applied to afford the most protection to marine mammals. The TTS thresholds for the species analyzed are based on those presented in the 2017 Navy Phase III Guidance (DoN 2017) for cetaceans with mid-frequency hearing (dolphins) and low-frequency hearing (Rice's whale).

Behavioral impacts are disturbances that may result from sound levels lower than those that would cause TTS in marine animals. Such disturbance, referred to as sub-TTS Level B harassment, may include a startle response followed by other behavioral responses such as swimming away from the perceived source of disturbance. Such disturbances may interrupt important biological functions such as feeding and cause the affected animal to expend energy to dive or swim away from the disturbance. For multiple, successive detonations occurring within a 24-hour period, the threshold for behavioral disturbance for the dolphins

and Rice's whale is set 5 dB below the respective SEL-based TTS thresholds for each species, as recommended by Finneran and Jenkins (2012). This derivation is based on observed onsets of behavioral response by captive dolphins and beluga whales during TTS tests (Finneran and Schlundt 2004; Schlundt et al. 2000).

6.1.4 Criteria and Thresholds for Species Analyzed

The criteria and thresholds used to analyze detonation impacts for the dolphins and Rice's whale in this LOA Request are presented in Tables 6-1 and 6-2, respectively.

Table 6-1. Criteria and Thresholds for the Bottlenose Dolphin and Atlantic Spotted Dolphin

LOA for Eglin Gulf Test and Training Range

Mortality	Level A Harassment			Level B Harassment	
	Slight Lung Injury	GI Tract Injury	PTS	TTS	Behavioral
$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Positive Impulse: B: 248.4 Pa·s AS: 197.1 Pa·s	$47.5M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Positive Impulse: B: 114.5 Pa·s AS: 90.9 Pa·s	Unweighted SPL: 237 dB re 1 µPa	Weighted SEL: 185 dB re 1 µPa²·s Unweighted SPL: 230 dB re 1 µPa	Weighted SEL: 170 dB re 1 µPa²·s Unweighted SPL: 224 dB re 1 µPa	Weighted SEL: 165 dB re 1 µPa²·s

AS = Atlantic spotted dolphin; B = bottlenose dolphin; *D* = water depth (meters); dB re 1 µPa = decibel(s) referenced to 1 micropascal; dB re 1 µPa²·s = decibel(s) referenced to 1 micropascal-squared second; GI = gastrointestinal; *M* = animal mass based on species (kilograms); Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift

Table 6-2. Criteria and Thresholds for the Rice's Whale

LOA for Eglin Gulf Test and Training Range

Mortality	Level A Harassment			Level B Harassment	
	Slight Lung Injury	GI Tract Injury	PTS	TTS	Behavioral
$103M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Positive Impulse: 906.2 Pa·s	$47.5M^{1/3}\left(1+\frac{D}{10.1}\right)^{1/6}$ Positive Impulse: 417.9 Pa·s	Unweighted SPL: 237 dB re 1 µPa	Weighted SEL: 183 dB re 1 µPa²·s Unweighted SPL: 219 dB re 1 µPa	Weighted SEL: 168 dB re 1 µPa²·s Unweighted SPL: 213 dB re 1 µPa	Weighted SEL: 163 dB re 1 µPa²·s

D = water depth (meters); dB re 1 µPa = decibel(s) referenced to 1 micropascal; dB re 1 µPa²·s = decibel(s) referenced to 1 micropascal-squared second; GI = gastrointestinal; *M* = animal mass based on species (kilograms); Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift

6.2 Munition Impact and Detonation Characteristics

When an air-to-surface munition impacts the water, some of the kinetic energy displaces water in the formation of an impact "crater" in the water, some of the kinetic energy is transmitted from the impact point as underwater acoustic energy in a pressure impulse, and the remaining kinetic energy is retained by the munition continuing to move through the water.

Following impact, the warhead of a live munition detonates at or slightly below the water surface. The warhead detonation converts explosive material into gas, further displacing water through the rapid creation of a gas bubble in the water and creates a much larger pressure wave than the pressure wave created by the impact. These impulse pressure waves radiate from the impact point at the speed of sound in water, roughly 1,500 meters per second.

If the detonation is sufficiently deep, the gas bubble goes through a series of expansions and contractions with each cycle being of successively lower energy. When detonations occur below but near the water surface, the initial gas bubble reaches the surface causing venting, which also dissipates energy through the ejection of water and release of detonation gases into the atmosphere. When a detonation occurs below the water surface after the impact crater has fully or partially closed, water can be violently ejected upward by the pressure impulse and through venting of the gas bubble formed by the detonation.

When detonations occur at the water surface, a large portion of the energy and gases that would otherwise form a detonation bubble are reflected upward from the water. Likewise, when a shallow detonation occurs below the water surface but prior to the impact crater closing, considerable energy is reflected upward from the water.

The impulsive pressure waves generated by munition impact and warhead detonation radiate spherically and are reflected between the water surface and the sea bottom. There is generally some attenuation of the pressure waves by the sea bottom but relatively little attenuation of the pressure waves by the water surface.

The NEW of a munition at impact can be directly correlated with the energy in the impulsive pressure wave generated by the warhead detonation. The NEWs of munitions addressed in this LOA Request range from 0.1 lb for small projectiles to 945 lb for the largest bombs. The explosive materials used in the proposed munitions also vary considerably in their composition with different formulations created to produce different intended effects. For this LOA Request, the primary detonation metrics considered are the peak impulse pressure and duration of the impulse. An integration of the pressure of an impulse over the duration (time) of an impulse provides a measure of the energy in an impulse.

Some of the NEW of certain types of munitions, such as missiles, is associated with the solid rocket motor propellant used for the flight of the munition. This propellant NEW is unrelated to the NEW of the warhead, which is the primary source of explosive energy in most munitions. The propellant of a missile fuels the flight phase and is mostly consumed prior to impact. Missile propellant typically has a lower flame speed than warhead explosives and is relatively insensitive to detonation from impacts but burns readily. A warhead detonation provides a high-pressure flame front that may cause burning propellant to detonate; therefore, this LOA Request assumes that the unconsumed residual propellant that remains at impact contributes to the detonation-induced pressure impulse in the water. Only propellant in solid rocket motors contributes to the detonation energy; liquid-fueled turbo jet engines, which are used in certain missiles such as the AGM-158 JASSM, do not contribute to the detonation energy, primarily due to the lack of integrated oxidizer in the liquid fuel. The impact analysis assumes that 20 percent of the solid rocket motor propellant remains unconsumed in missiles at impact; this assumption is based on input from user groups and is considered a reasonable estimate for the purpose of analysis. The NEW associated with this unconsumed propellant is added to the NEW of the warhead to derive the total energy released by the detonation. Absent a warhead detonation, it is assumed that continued burning or deflagration of unconsumed residual propellant does not contribute to the pressure impulse in the water; this applies to inert missiles that lack a warhead but contain propellant for flight.

In addition to the energy associated with the detonation, energy is also released by the physical impact of the munition with the water. This kinetic energy has been calculated and incorporated into the estimations of munitions energy for both live and inert munitions in this LOA Request. The kinetic energy of the munition at impact is calculated as one half the mass of the munition times the square of the velocity of the munition. The initial impact event contributing to the pressure impulse in water is assumed to be 1 millisecond in duration. To calculate the velocity (and kinetic energy) immediately after impact, the deceleration contributing to the pressure impulse in the water is assumed for all munitions to be 1,500 g-forces or 48,300 feet per square second over 1 millisecond. A substantial portion of the change in kinetic energy at impact is dissipated as a pressure impulse in the water, with the remainder being dissipated through structural deformation of the munition, heat, displacement of water, and other smaller energy categories. Even with 1,500 g-forces of deceleration, the change in velocity over this short time period is small and is proportional to the impact velocity and munition mass. The impact energies of the proposed live munitions were calculated and included in their total energy estimations. The impact energies of the inert munitions proposed to be used were also calculated.

For this LOA Request, the NEW associated with the physical impact of each munition and the unconsumed propellant in certain munitions is added to the NEW of the warhead to derive the NEW at impact (NEWi) for each live munition. The NEWi of each munition was then used to calculate the peak pressure and pressure decay for each munition. This results in a more accurate estimate of the actual energy released by each detonation. Extensive research since the 1940s has shown that each explosive formulation produces unique correlations to explosive performance metrics. The peak pressure and pressure decay constant depend on the NEW, explosive formulation, and distance from the detonation. The peak pressure and duration of the impulse for each munition can be calculated empirically with similitude equations, with constants used in these equations determined from experimental data (NSWC 2017). The explosive-specific similitude constants and munition-specific NEWi were used for calculating the peak pressure and pressure decay for each munition analyzed in this LOA Request. The peak pressure and pressure decay at various radii were then used to determine the distance to effect for mortality, slight lung injury, peak pressure PTS, and peak pressure TTS for each species. The munition-specific peak pressures and decays for all munitions were also used as a time-series input in the underwater acoustic model to determine the distance to effect for cumulative SEL-based (24-hour) PTS, TTS, and behavioral effects for each species.

6.3 Zone of Influence

The ZOI is the area or volume of ocean in which marine mammals could be exposed to various pressure and impulsive noise levels generated by a surface or subsurface detonation. For this LOA Request, the ZOIs for the detonations under the Proposed Action were estimated using Version 2.3 of the dBSea model for cumulative SEL and using explicit similitude equations for SPL and positive impulse. As discussed in Section 6.2, the various threshold metrics used to estimate the ZOIs are derived from the NEWi estimated for the munitions proposed to be used. The dBSea model is a commercially available model for evaluating underwater acoustic transmission. For this LOA Request, the dBSea model was used with the ray-tracing option for calculating the underwater transmission of impulsive noise represented in a time series. Details on the parameters and other inputs used for the model are provided in Appendix A. The characteristics of the impulse noise at the source were calculated based on munition-specific data including munition mass at impact, munition velocity at impact, NEW of warheads, explosive-specific similitude data, and propellant data for missiles.

The ZOI is based on multiple parameters including the acoustic characteristics of the detonation and sound propagation loss in the marine environment, which is influenced by a number of environmental factors including water depth and seafloor properties. Based on integration of these parameters, the dBSea model predicts the distances at which each marine mammal species is estimated to experience the onset of PTS, TTS, and behavioral disturbance related to cumulative SEL. As previously discussed, the thresholds for the onset of TTS and PTS used in the model and pressure calculations are based on those presented in the 2017 Navy Phase III Guidance (DoN 2017) for cetaceans with mid-frequency hearing

(dolphins) and low-frequency hearing (Rice's whale). Behavioral thresholds are set 5 dB below the SEL-based TTS threshold, as recommended by Finneran and Jenkins (2012).

6.4 Marine Mammal Density

The spatial density model developed by NOAA (2022) for the common bottlenose dolphin, Atlantic spotted dolphin, and Rice's whale was used to estimate the densities of these species for the exposure analyses in this LOA Request. The model and associated analyses conducted to estimate marine mammal densities are described in Section 3. The densities of dolphins estimated in each LIA for this LOA Request are presented in Table 3-2. Bottlenose dolphin densities are greater than Atlantic spotted dolphin densities in both LIAs.

Estimates of abundance for Rice's whales are under 100 individuals, with the current best estimate of abundance considered to be 51 individuals (NMFS 2020). The modeled grid densities from the NOAA model were used to estimate Rice's whale abundance in areas of exposure to pressure and impulsive noise from munitions use, predicted by underwater acoustic modeling and quantified in GIS. The use of the NOAA model to estimate Rice's whale abundance and associated exposure from EGTTR operations is discussed further in Section 6.7.2.

6.5 Number of Events

For the previous LOA Request, NMFS requested that the acoustic impact analysis be based on the total number of detonations conducted during a given mission instead of each individual detonation to account for the accumulated energy from multiple detonations over a 24-hour period. In response to this request, the USAF developed mission-day categories for each user group for the munitions proposed to be used in the previous LOA Request. In accordance with this approach, mission-day categories for each user group were also developed for this current LOA Request (Table 6-3). For each category, each mission day represents a separate event that includes the munitions assigned to the category. Like in the previous LOA Request, munitions were categorized to provide mission-day scenarios of varying intensities with respect to total energy released.

The number of mission days assigned to each category was based on historical numbers and projections provided by certain user groups. Although the mission-day categories developed for this LOA Request may not represent the exact manner in which munitions would be used, they provide a conservative range of mission scenarios to account for accumulated energy from multiple detonations. It is important to note that only acoustic energy metrics (SEL) are affected by the accumulation of energy over a 24-hour period. Pressure metrics (e.g., peak SPL and positive impulse) do not accumulate and are based on the highest impulse pressure value within the 24-hour period. As indicated in Table 6-3, a total of 19 mission-day categories (A through S) were developed for the Proposed Action analyzed in this LOA Request. Based on the categories developed, the total NEWi per mission day would range from 2,413.6 to 30.4 lb. The highest detonation energy of any single munition used under the Proposed Action would be 945 lb NEW, which was also the highest NEW for a single munition in the previous LOA Request. The munitions having this NEW include the GBU-10, GBU-24, and GBU-31.

As previously discussed, the types of munitions that would be used for SINKEX testing are controlled information and, therefore, not identified in this LOA Request. For the purpose of analysis, SINKEX exercises are assigned to mission-day category J, which represents a single subsurface detonation of 945 lb NEW. SINKEX exercises would not exceed this NEW. The two annual SINKEX exercises are added to the other eight annual missions involving subsurface detonations of these bombs, resulting in 10 total annual missions under mission-day category J (Table 6-3).

Table 6-3. Mission-Day Categories for Acoustic Impact Analysis

LOA for Eglin Gulf Test and Training Range

User Group	Mission-Day Category	Munition Type	Category	Warhead NEW (lb)	NEWi (lb)	Detonation Scenario	Munitions per Day	Mission Days per Year	Annual Quantity	NEWi per Mission Day (lb)
53 WEG	A	AGM-158D JASSM XR	Missile	240.26	241.36	Surface	4	1	4	2,413.6
		AGM-158B JASSM ER	Missile	240.26	241.36	Surface	3	1	3	
		AGM-158A JASSM	Missile	240.26	241.36	Surface	3	1	3	
	B	GBU-54 KMU-572C/B	Bomb (Mk-82)	192	192.3	Surface	4	1	4	2,029.9
		GBU-54 KMU-572B/B	Bomb (Mk-82)	192	192.3	Surface	4	1	4	
		AGM-65D	Missile	85	98.3	Surface	5	1	5	
	C	AGM-65H2	Missile	85	98.3	Surface	5	1	5	1,376.2
		AGM-65G2	Missile	85	98.3	Surface	5	1	5	
		AGM-65K2	Missile	85	98.3	Surface	4	1	4	
	D	AGM-65L	Missile	85	98.3	Surface	5	1	5	836.22
		AIM-120C3	Missile	15	36.18	Surface	4	1	4	
		AIM-9X Blk I	Missile	7.7	20	Surface	10	1	10	
	E	AGM-114 N-4D with TM	Missile	9	13.08	Surface	4	1	4	997.62
		AGM-114 N-6D with TM	Missile	9	13.08	Surface	4	1	4	
		AGM-179 JAGM	Missile	9	13.08	Surface	4	1	4	
		AGM-114 R2 with TM (R10)	Missile	9	13.08	Surface	4	1	4	
		AGM-114 R-9E with TM (R11)	Missile	9	13.08	Surface	4	1	4	
		AGM-114Q with TM	Missile	9	13.08	Surface	4	1	4	
		AGR-20 (APKWS)	Rocket	2.3	3.8	Surface	12	1	12	
		AGM-176	Missile	9	13.08	Surface	4	1	4	
		PGU-43 (105 mm)	Gun Ammunition	4.7	4.72	Surface	100	1	100	
		GBU-69	Bomb	36	36.1	Surface	2	1	2	
		GBU-70	Bomb	36	36.1	Surface	1	1	4	
		AGM-88C w/FTS	Missile	0.70[a]	0	Surface	2	1	2	
		AGM-88B w/FTS	Missile	0.70[a]	0	Surface	2	1	2	
		AGM-88F w/FTS	Missile	0.70[a]	0	Surface	2	1	2	
		AGM-88G w/FTS	Missile	0.70[a]	0	Surface	2	1	2	
		GBU-39 SDB (GTV)	Bomb	0.39[a]	0.49	Surface	4	1	4	
		GBU-53/B (GTV)	Bomb	0.34[a]	0.44	Surface	8	1	8	
AFSOC	F	GBU-12	Bomb (Mk-82)	192	192.3	Surface	2	15	30	584.6
		Mk-81 (GP 250 lb)	Bomb	100	100	Surface	2	15	30	

Table 6-3. Mission-Day Categories for Acoustic Impact Analysis

LOA for Eglin Gulf Test and Training Range

User Group	Mission-Day Category	Munition Type	Category	Warhead NEW (lb)	NEWi (lb)	Detonation Scenario	Munitions per Day	Mission Days per Year	Annual Quantity	NEWi per Mission Day (lb)
AFSOC	G	105 mm HE (FU)	Gun Ammunition	4.7	4.72	Surface	30	25 (daytime)	750	191.6
		30 mm HE	Gun Ammunition	0.1	0.1	Surface	500		12,500	
	H	105 mm HE (TR)	Gun Ammunition	0.35	0.37	Surface	30	45 (nighttime)	1,350	61.1
		30 mm HE	Gun Ammunition	0.1	0.1	Surface	500		22,500	
	I	2.75-inch Rocket (including APKWS)	Rocket	2.3	3.8	Surface	8	50	400	30.4
96 OG	J	GBU-10, 24, or 31 (QUICKSINK)	Bomb (Mk-84)	945	946.8	Subsurface	1	10[b]	10[b]	946.8
	K	HACM	Hypersonic Weapon	Not available	350	Surface	1	2	2	350
	L	AGM-158 (JASSM)	Missile	240.26	241.36	Surface	2	1	2	627.12
		GBU-39 (SDB I) Simultaneous Launch[c]	Bomb	72	72.2	Surface	2	1	2	
	M	GBU-39 (SDB I)	Bomb	36	36.1	Surface	4	2	8	324.9
		GBU-39 (LSDB)	Bomb	36	36.1	Surface	5	2	10	
	N	GBU-39B/B LSDB	Bomb	36	36.1	Surface	2	1	2	238.08
		Spike NLOS	Missile	34.08	40	Surface	3	1	3	
		GBU-53 (SDB II)	Bomb	22.84	22.94	Surface	2	1	2	
	O	AGM-114R Hellfire	Missile	9	13.08	Surface	8	4	36	104.64
	P	AGM-114 Hellfire	Missile	9	13.08	Surface	5	2	10	130.8
		AGM-176 Griffin	Missile	9	13.08	Surface	5	2	10	
	Q	105 mm HE (FU)	Gun Ammunition	4.7	4.72	Surface	20	3	60	94.4
	R	Inert GBU-39 (LSDB) with live fuze	Bomb	0.39	0.49	Surface	4	1	4	35.82
		Inert GBU-53 (SDB II) with live fuze	Bomb	0.34	0.44	Surface	4	1	4	
		105 mm HE (TR)	Gun Ammunition	0.35	0.37	Surface	60	1	60	
		30 mm HE	Gun Ammunition	0.1	0.1	Surface	99	1	99	
NAVSCOLEOD	S	Underwater Mine Charge	Charge	20[d]	20	Subsurface	4	8	32	130
		Floating Mine Charge	Charge	5[d]	5	Surface	10	8	80	

[a] Warhead replaced by FTS/TM. Identified NEW is for the FTS.

[b] Includes 2 SINKEX exercises.

[c] NEW is doubled for simultaneous launch.

[d] Estimated

53 WEG = 53rd Weapons Evaluation Group; 96 OG = 96th Operations Group; AFSOC = Air Force Special Operations Command; AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; APKWS = Advanced Precision Kill Weapon System; ER = Extended Range; FTS = Flight Termination System; FU = Full Up; GBU = Guided Bomb Unit; GP = General Purpose; GTV = Guided Test Vehicle; HACM = Hypersonic Attack Cruise Missile; HE = High Explosive; JAGM = Joint Air-to-Ground Missile; JASSM = Joint Air-to-Surface Standoff Missile; lb = pound(s); LSDB = Laser Small-Diameter Bomb; Mk = Mark; mm = millimeter(s); NEW = net explosive weight; NEWi = net explosive weight at impact; NLOS = Non-Line-of-Sight; NAVSCOLEOD = Naval School Explosive Ordnance Disposal; PGU = Projectile Gun Unit; SDB = Small-Diameter Bomb; TM = telemetry; TR = Training Round

6.6 Exposure Estimates

6.6.1 Live Munitions

The distances from the detonation point that correspond to the various effect thresholds are referred to as threshold distances. Using the dBSea model and associated analyses, threshold distances were calculated for each mission-day category for each marine mammal species. The model was run assuming that the detonation point is at the center of the existing LIA, the SEL threshold distances are the same for the proposed East LIA, and all missions are conducted in either the existing LIA or proposed East LIA. Model outputs for the two LIAs are statistically the same as a result of similarities in water depths, sea bottom profiles, water temperatures, and other environmental characteristics. Tables 6-4 and 6-5 present the threshold distances estimated for the dolphins and Rice's whale, respectively, for live missions in the existing LIA.

The threshold distances were used to calculate the ZOI for each effect threshold for each species. The ZOI is the circular area around the detonation point within which the various established thresholds for pressure and impulsive noise are experienced by the animal. The thresholds resemble concentric circles within the ZOI, with the most severe (mortality) being closest to the center (detonation point) and the least severe (behavioral disturbance) being farthest from the center. The areas encompassed by the concentric thresholds are the impact areas associated with the applicable criteria. To prevent double counting of animals, areas associated with higher-impact criteria (e.g., mortality) were subtracted from areas associated with lower-impact criteria (e.g., Level A harassment). To estimate the number of animals potentially exposed to the various thresholds within the ZOI, the adjusted impact area was multiplied by the predicted animal density and the annual number of events for each mission-day category. These calculations typically resulted in decimal values, suggesting that a fraction of an animal would be exposed. Therefore, the results were rounded at the annual mission-day level and then summed for each criterion to estimate the total annual take numbers for each species. For impulse and SPL metrics, a take is considered to occur if the received level is equal to or above the associated threshold. For SEL metrics, a take is considered to occur if the received level is equal to or above the associated threshold within the appropriate frequency band of the sound received, adjusted for the appropriate weighting function value of that frequency band. For impact categories with multiple criteria (e.g., slight lung injury, GI tract damage, and PTS for Level A harassment) and criteria with two thresholds (e.g., SEL and SPL for PTS), the criterion and/or threshold that yielded the higher exposure estimate was used.

Table 6-4. Dolphin Threshold Distances (in kilometers) for Live Missions in the Existing Live Impact Area

LOA for Eglin Gulf Test and Training Range

Mission-Day Category	Mortality	Level A Harassment				Level B Harassment		
		Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
	Positive Impulse B: 248.4 Pa·s AS: 197.1 Pa·s	Positive Impulse B: 114.5 Pa·s AS: 90.9 Pa·s	Peak SPL 237 dB	Weighted SEL 185 dB	Peak SPL 230 dB	Weighted SEL 170 dB	Peak SPL 224 dB	Weighted SEL 165 dB
Bottlenose Dolphin								
A	0.139	0.276	0.194	0.562	0.389	5.59	0.706	9.538
B	0.128	0.254	0.180	0.581	0.361	5.215	0.655	8.937
C	0.100	0.199	0.144	0.543	0.289	4.459	0.524	7.568
D	0.100	0.199	0.144	0.471	0.289	3.251	0.524	5.664
E	0.068	0.136	0.103	0.479	0.207	3.272	0.377	5.88
F	0.128	0.254	0.180	0.352	0.362	2.338	0.655	4.596
G	0.027	0.054	0.048	0.274	0.093	1.095	0.165	2.488
H	0.010	0.019	0.021	0.225	0.040	0.809	0.071	1.409
I	0.025	0.049	0.045	0.136	0.087	0.536	0.154	0.918
J	0.228	0.449	0.306	0.678	0.615	3.458	1.115	6.193
K	0.158	0.313	0.222	0.258	0.445	1.263	0.808	2.663
L	0.139	0.276	0.194	0.347	0.389	2.35	0.706	4.656
M	0.068	0.136	0.103	0.286	0.207	1.446	0.377	3.508
N	0.073	0.145	0.113	0.25	0.225	1.432	0.404	2.935
O	0.046	0.092	0.078	0.185	0.155	0.795	0.278	1.878
P	0.046	0.092	0.078	0.204	0.155	0.907	0.278	2.172
Q	0.027	0.054	0.048	0.247	0.093	0.931	0.165	1.563
R	0.012	0.024	0.026	0.139	0.052	0.537	0.093	0.91
S	0.053	0.104	0.084	0.429	0.164	1.699	0.294	2.872

Table 6-4. Dolphin Threshold Distances (in kilometers) for Live Missions in the Existing Live Impact Area

LOA for Eglin Gulf Test and Training Range

Mission-Day Category	Mortality	Level A Harassment				Level B Harassment		
		Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
	Positive Impulse B: 248.4 Pa·s AS: 197.1 Pa·s	Positive Impulse B: 114.5 Pa·s AS: 90.9 Pa·s	Peak SPL 237 dB	Weighted SEL 185 dB	Peak SPL 230 dB	Weighted SEL 170 dB	Peak SPL 224 dB	Weighted SEL 165 dB
Atlantic Spotted Dolphin								
A	0.171	0.338	0.194	0.562	0.389	5.59	0.706	9.538
B	0.157	0.311	0.180	0.581	0.361	5.215	0.655	8.937
C	0.123	0.244	0.144	0.543	0.289	4.459	0.524	7.568
D	0.123	0.244	0.144	0.471	0.289	3.251	0.524	5.664
E	0.084	0.168	0.103	0.479	0.207	3.272	0.377	5.88
F	0.157	0.312	0.180	0.352	0.362	2.338	0.655	4.596
G	0.033	0.066	0.048	0.274	0.093	1.095	0.165	2.488
H	0.012	0.023	0.021	0.225	0.040	0.809	0.071	1.409
I	0.030	0.060	0.045	0.136	0.087	0.536	0.154	0.918
J	0.279	0.550	0.306	0.678	0.615	3.458	1.115	6.193
K	0.194	0.384	0.222	0.258	0.445	1.263	0.808	2.663
L	0.171	0.338	0.194	0.347	0.389	2.35	0.706	4.656
M	0.084	0.168	0.103	0.286	0.207	1.446	0.377	3.508
N	0.090	0.179	0.113	0.25	0.225	1.432	0.404	2.935
O	0.057	0.113	0.078	0.185	0.155	0.795	0.278	1.878
P	0.057	0.113	0.078	0.204	0.155	0.907	0.278	2.172
Q	0.033	0.066	0.048	0.247	0.093	0.931	0.165	1.563
R	0.015	0.030	0.026	0.139	0.052	0.537	0.093	0.91
S	0.065	0.128	0.084	0.429	0.164	1.699	0.294	2.872

AS = Atlantic spotted dolphin; B = bottlenose dolphin; dB = decibel(s); GI = gastrointestinal; Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift

Table 6-5. Rice's Whale Threshold Distances (in kilometers) for Live Missions in the Existing Live Impact Area

LOA for Eglin Gulf Test and Training Range

Mission-Day Category	Mortality	Level A Harassment				Level B Harassment		
		Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
	Positive Impulse 906.2 Pa·s	Positive Impulse 417.9 Pa·s	Peak SPL 237 dB	Weighted SEL 183 dB	Peak SPL 219 dB	Weighted SEL 168 dB	Peak SPL 213 dB	Weighted SEL 163 dB
A	0.044	0.088	0.194	5.695	1.170	21.435	2.120	27.923
B	0.041	0.81	0.180	5.253	1.076	20.641	1.955	26.845
C	0.031	0.063	0.144	4.332	0.861	18.772	1.562	24.526
D	0.031	0.063	0.144	2.979	0.861	16.419	1.562	21.579
E	0.021	0.043	0.103	2.323	0.617	15.814	1.121	21.22
F	0.041	0.081	0.180	2.208	1.076	14.403	1.955	19.439
G	0.009	0.017	0.048	0.494	0.266	7.532	0.470	12.92
H	0.003	0.006	0.021	0.401	0.114	3.624	0.201	7.065
I	0.008	0.016	0.045	0.305	0.247	2.95	0.437	6.059
J	0.073	0.145	0.306	4.487	1.830	13.216	3.323	16.88
K	0.050	0.100	0.222	0.831	1.320	7.723	2.393	11.809
L	0.044	0.088	0.194	2.325	1.170	15.216	2.120	20.319
M	0.021	0.043	0.103	1.304	0.617	11.582	1.121	16.688
N	0.023	0.046	0.113	1.026	0.658	9.904	1.183	14.859
O	0.015	0.029	0.078	0.611	0.460	6.926	0.832	11.159
P	0.014	0.029	0.078	0.671	0.460	7.841	0.832	12.307
Q	0.009	0.017	0.048	0.549	0.266	6.299	0.470	10.393
R	0.004	0.008	0.026	0.283	0.152	2.383	0.273	5.06
S	0.017	0.034	0.084	0.938	0.473	8.676	0.843	12.874

dB = decibel(s); GI = gastrointestinal; Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TTS = temporary threshold shift

6.6.2 Inert Munitions

As discussed in Section 6.2, a portion of the kinetic energy released by an inert munition at impact is transmitted as underwater acoustic energy in a pressure impulse. To assess the potential impacts of inert munitions on marine mammals, the proposed inert munitions were categorized into four classes based on their impact energies, and the threshold distances for each class were modeled and calculated as described for the mission-day categories. Table 6-6 presents the impact energy classes developed for the

proposed inert munitions. The four impact energy classes represent the entire suite of inert munitions proposed to be used in the EGTTR during the next mission period (Table 2-18). The impact energy is the portion of the kinetic energy at impact that is transmitted as an underwater pressure impulse, expressed in units of TNT-equivalent (TNT_{eq}).

Table 6-6. Impact Energy Classes for Proposed Inert Munitions

LOA for Eglin Gulf Test and Training Range

Impact Energy Class ($lb\ TNT_{eq}$)	Representative Munitions	Approximate Weight (lb)	Approximate Velocity (Mach)
2	Mk-84, GBU-10, and GBU-31	2,000	1.1
1	AGM-158 JASSM	2,250	0.9
0.5	GBU-54 and AIM-120	250 to 650	Variable
0.15	AIM-9, GBU-39, and PGU-15	1 to 285	Variable

AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; GBU = Guided Bomb Unit; JASSM = Joint Air-to-Surface Standoff Missile; lb = pound(s); Mk = Mark; PGU = Projectile Gun Unit; TNT_{eq} = trinitrotoluene-equivalent

The kinetic energy of the munition at impact is calculated as one half the mass times the velocity squared. The initial impact event contributing to the pressure impulse in water is assumed to be 1 millisecond in duration. To calculate the velocity (and kinetic energy) immediately after impact, the deceleration contributing to the pressure impulse in the water is assumed for all munitions to be 1,500 g-forces or 48,300 feet per square second over 1 millisecond.

The four impact energy classes developed for the proposed inert munitions range from 0.15 to 2 lb TNT_{eq}; these values correspond closely to the actual or average impact energy values of the munitions and are rounded for the purpose of analysis. The 2 lb class represents the largest inert bomb, which includes the Mk-84 GP, GBU-10, and GBU-31 bombs, whereas the 1 lb class represents the largest inert missile, which is the AGM-158 JASSM. As indicated in Table 6-6, the JASSM has greater mass but lower impact energy than the GBU-31; this is due to the JASSM's lower velocity at impact and associated change in velocity over the deceleration period contributing to the pressure impulse. The 0.5 lb and 0.15 lb impact energy classes each represent the approximate average impact energy of multiple munitions, with the 0.5 lb class representing a mid-level energy category, and the 0.15 lb class representing the munitions with the lowest energies. Tables 6-7 and 6-8 present the threshold distances estimated for the dolphins and Rice's whale, respectively, for inert munitions in the existing LIA.

Table 6-7. Dolphin Threshold Distances (in kilometers) for Inert Munitions in the Existing Live Impact Area

LOA for Eglin Gulf Test and Training Range

Inert Impact Class (lb TNT_{eq})	Mortality	Level A Harassment				Level B Harassment		
		Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
	Positive Impulse B: 248.4 Pa·s AS: 197.1 Pa·s	Positive Impulse B: 114.5 Pa·s AS: 90.9 Pa·s	Peak SPL 237 dB	Weighted SEL 185 dB	Peak SPL 230 dB	Weighted SEL 170 dB	Peak SPL 224 dB	Weighted SEL 165 dB
Bottlenose Dolphin								
2	0.020	0.041	0.040	0.030	0.080	0.205	0.145	0.327
1	0.015	0.031	0.032	0.025	0.063	0.134	0.114	0.250
0.5	0.012	0.023	0.025	0.015	0.050	0.119	0.091	0.198
0.15	0.008	0.015	0.017	0.009	0.034	0.061	0.061	0.119
Atlantic Spotted Dolphin								
2	0.025	0.051	0.040	0.030	0.080	0.205	0.145	0.327
1	0.019	0.038	0.032	0.025	0.063	0.134	0.114	0.250
0.5	0.014	0.029	0.025	0.015	0.050	0.119	0.091	0.198
0.15	0.009	0.018	0.017	0.009	0.034	0.061	0.061	0.119

AS = Atlantic spotted dolphin; B = bottlenose dolphin; dB = decibel(s); GI = gastrointestinal; lb = pound(s); Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TNT_{eq} = trinitrotoluene-equivalent; TTS = temporary threshold shift

Table 6-8. Rice's Whale Threshold Distances (in kilometers) for Inert Munitions in the Existing Live Impact Area

LOA for Eglin Gulf Test and Training Range

Inert Impact Class ($lb\ TNT_{eq}$)	Mortality	Level A Harassment				Level B Harassment		
		Slight Lung Injury	GI Tract Injury	PTS		TTS		Behavioral
	Positive Impulse 906.2 Pa·s	Positive Impulse 417.9 Pa·s	Peak SPL 237 dB	Weighted SEL 183 dB	Peak SPL 219 dB	Weighted SEL 168 dB	Peak SPL 213 dB	Weighted SEL 163 dB
2	0.006	0.013	0.040	0.151	0.238	0.474	0.430	0.884
1	0.005	0.010	0.032	0.110	0.188	0.327	0.340	0.542
0.5	0.004	0.007	0.025	0.055	0.149	0.261	0.270	0.521
0.15	0.002	0.005	0.017	0.026	0.100	0.154	0.181	0.284

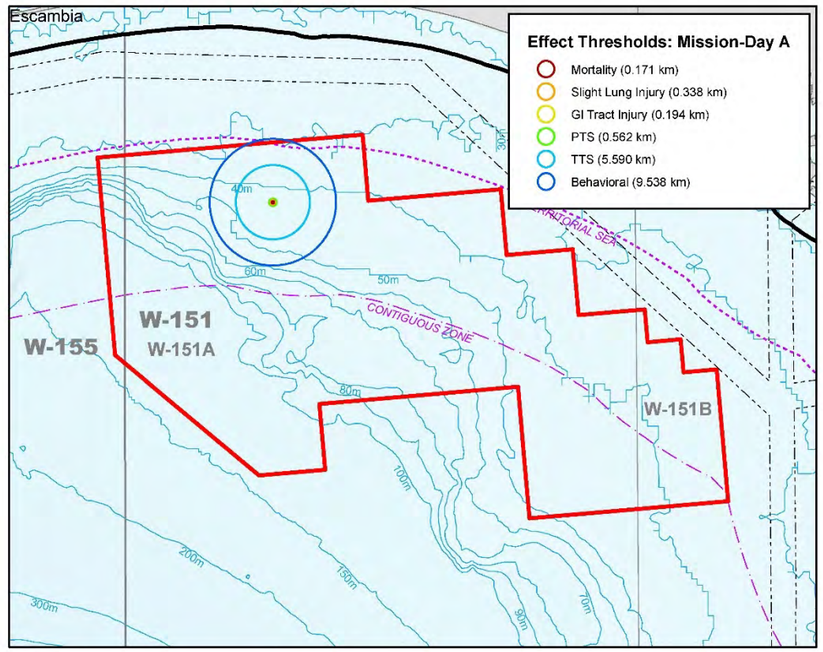
dB = decibel(s); GI = gastrointestinal; lb = pound(s); Pa·s = pascal-second(s); PTS = permanent threshold shift; SEL = sound exposure level; SPL = sound pressure level; TNT_{eq} = trinitrotoluene-equivalent; TTS = temporary threshold shift

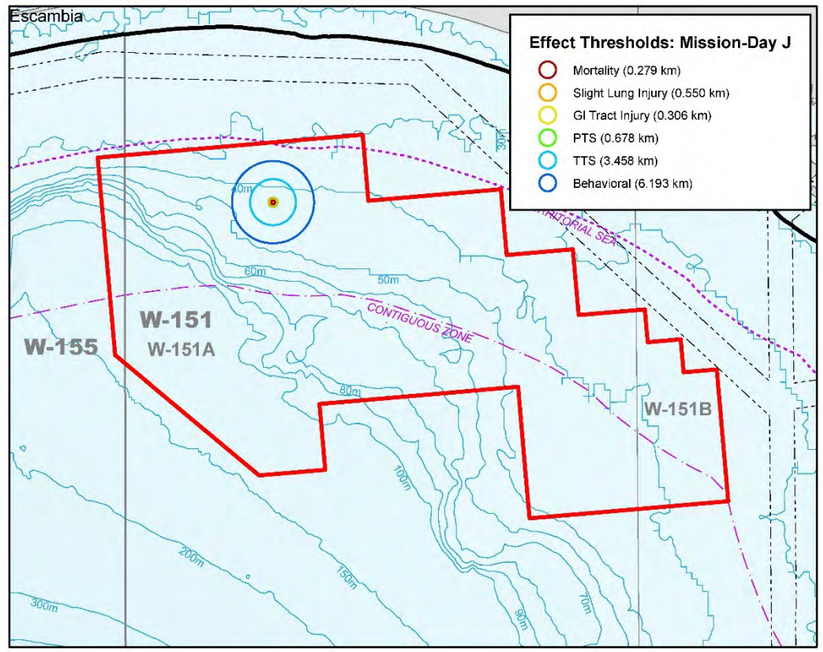
6.7 Take Estimations

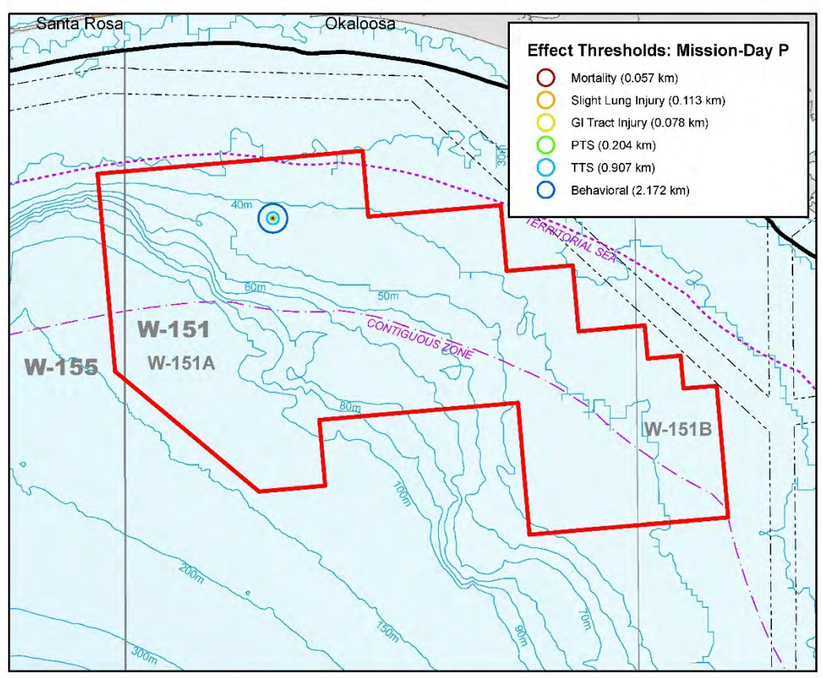
6.7.1 Dolphins

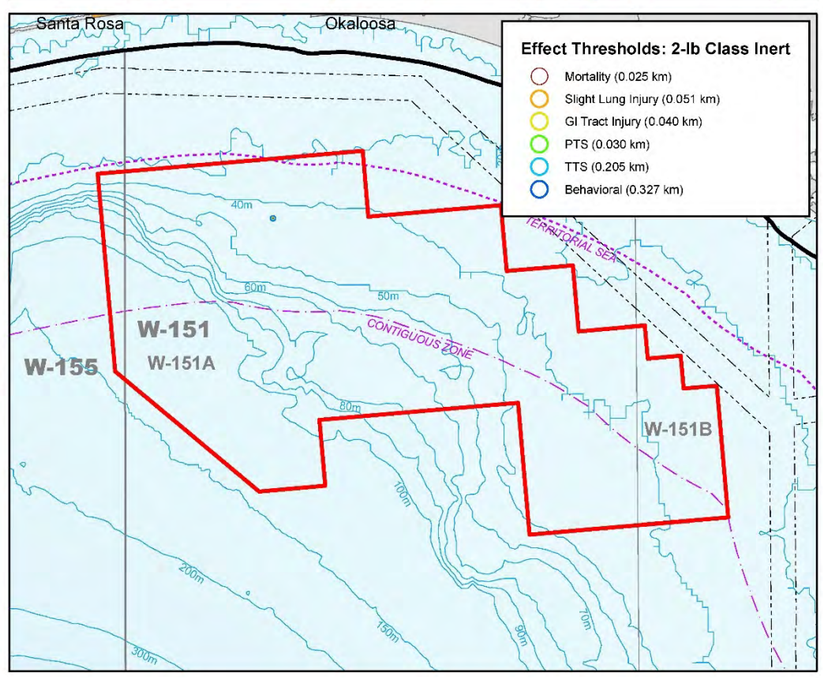
Figure 6-1 shows the estimated dolphin threshold distances and associated ZOIs for mission-day category A, J, and P and use of a 2 lb class inert munition at the location where the GRATV is typically anchored in the existing LIA. The threshold distances shown for mortality and slight lung injury are for the Atlantic spotted dolphin; the remaining threshold distances apply to both dolphin species. Mission-day category A has the largest total cumulative energy of all the mission-day categories. Mission-day category J represents the most powerful single detonation proposed, which would be a subsurface detonation of a bomb with a NEW of 945 lb. Mission-day category P represents a mission with relatively low cumulative energy, and the 2 lb class inert munition is the largest inert munition in terms of kinetic energy at impact and is represented by a 2,000 lb inert bomb (Table 6-3).

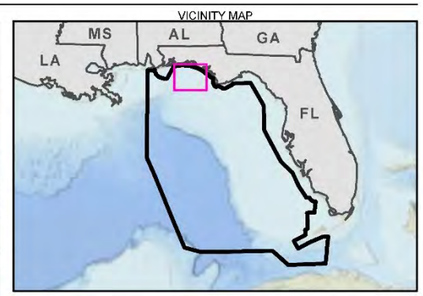
Takes of dolphins were estimated based on the area of the ZOI, predicted dolphin density, and annual number of events for each mission-day category. As previously discussed, take estimates for dolphins are based on the average density of each dolphin species in each LIA, estimated using the spatial density model developed by NOAA (2022). To estimate the takes of each dolphin species in both LIAs collectively, the take estimates for each LIA were weighted based on the expected usage of each LIA over the 7-year mission period, which was determined based on input provided by the user groups. Of the total number of missions proposed, 90 percent are expected to be conducted in the existing LIA and 10 percent are expected to be conducted in the proposed East LIA. Therefore, the collective takes are the sum of 90 percent of the takes in the existing LIA and 10 percent of the takes in the proposed East LIA. The usage ratio may change over time as mission needs change. If the usage ratio changes substantially in the future, Eglin AFB would re-evaluate the exposure estimates and reinitiate consultation with NMFS to determine whether the take estimations need to be adjusted.











Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV)
- Shipping Lanes
- Depth Contour (meters)

Notes:
1. Threshold distances shown for mortality and slight lung injury are for the Atlantic spotted dolphin; the remaining threshold distances apply to both the bottlenose and Atlantic spotted dolphin.
2. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

Kilometers
0 10 20 30 40
N

FIGURE 6-1
Dolphin ZOI for Various Missions – Current GRATV Site
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016586\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-1 DOLPHIN ZOIS VARIOUS MDS LIA GRATV.MXD JO016586 4/12/2022 1:14:53 PM

The annual takes of dolphins requested under the Proposed Action are presented in Table 6-9. As indicated, a total of 9 Level A harassment takes and 1,136 Level B harassment takes of the common bottlenose dolphin, and 1 Level A harassment take and 139 Level B harassment takes of the Atlantic spotted dolphin are requested annually for EGTTR operations during the next 7-year mission period. The presented takes are overestimates of actual exposure based on the conservative assumption that all proposed detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets. The take estimates also do not consider the monitoring and mitigation measures implemented during EGTTR operations for the protection of dolphins. As indicated in Table 6-9, the mortality takes calculated for the bottlenose dolphin (0.75) and Atlantic spotted dolphin (0.14) are both less than 1 animal; therefore, no mortality takes are requested for either dolphin species. The injury takes are calculated to be 2.18 and 0.40 for the bottlenose dolphin and Atlantic spotted dolphin, respectively. These and the take estimates for the other effect thresholds are the sum of the respective takes for all 19 mission-day categories. Each individual mission-day category results in a fraction of a single injury take. Adding up all the fractional takes in this manner results in a highly conservative estimate of take. As discussed previously, the calculated takes are also overestimates of actual exposure based on the conservative assumption that all proposed detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets. Based on the conservative assumptions applied to the impact analysis and the pre-mission surveys conducted for dolphins, which extend out to, at a minimum, double the PTS threshold distance that applies to both dolphin species (185 dB SEL), no injury takes are expected to result from EGTTR operations and none are requested for the bottlenose dolphin. As indicated in Table 6-9, the requested PTS, TTS, and behavioral disturbance takes for both dolphin species are based on the respective calculated takes, rounded to the nearest whole number.

Table 6-9. Annual Takes of Dolphins under the Proposed Action

LOA for Eglin Gulf Test and Training Range

Mission	Mortality	Level A Harassment		Level B Harassment	
		Injury[a]	PTS	TTS	Behavioral
Bottlenose Dolphin					
Missions at Existing LIA	0.74	2.14	9.25	312.7	799.7
Missions at East LIA	0.89	2.6	11.24	379.79	971.29
90 Percent of Existing LIA Missions	0.66	1.92	8.33	281.43	719.73
10 Percent of East LIA Missions	0.09	0.26	1.12	37.98	97.13
Total	0.75	2.18	9.45	319.41	816.86
Total Takes Requested	0	0	9	319	817
Atlantic Spotted Dolphin					
Missions at Existing LIA	0.14	0.39	0.96	38.34	98.05
Missions at East LIA	0.16	0.47	1.14	45.53	116.43
90 Percent of Existing LIA Missions	0.12	0.36	0.86	34.50	88.24
10 Percent of East LIA Missions	0.02	0.05	0.11	4.55	11.64
Total	0.14	0.4	0.98	39.06	99.89
Total Takes Requested	0	0	1	39	100

[a] Slight lung and/or gastrointestinal tract injury

LIA = Live Impact Area; PTS = permanent threshold shift; TTS = temporary threshold shift

The dolphin threshold distances predicted for the mission-day categories, presented in Table 6-4, will be used to determine the size of the pre-mission survey areas during the 2023–2030 period covered by this LOA Request. For any live mission other than gunnery missions, the pre-mission survey area will extend out to, at a minimum, double the Level A PTS threshold distance that applies to both dolphin species (185 dB SEL). Depending on the mission-day category that best corresponds to the actual mission, the distance from the detonation point to be monitored could vary between approximately 1,356 meters for mission-day category J and 272 meters for mission-day category I (Table 6-4). Surveying twice the dolphin PTS threshold distance provides a buffer when there is a lapse between the time when the survey ends and the time when the species observers reach the perimeter of the human safety zone before the start of the mission. Surveying this additional buffer area ensures that dolphins are not within the PTS zone at the start of the mission. Missions involving air-to-surface gunnery operations will survey even larger areas based on previously established safety profiles and the ability to conduct aerial surveys of large areas from the types of aircraft used for these missions. Monitoring and mitigation measures for dolphins are further discussed in Section 11.

6.7.2 Rice's Whale

Figure 6-2 shows the estimated Rice's whale threshold distances and associated ZOIs for mission-day category A, J, and P and use of a 2 lb class inert munition at the location where the GRATV is typically anchored in the existing LIA. As indicated on Figure 6-2, portions of the ZOIs of mission-day categories A and J extend into Rice's whale habitat, whereas the ZOIs for mission-day category P and the largest inert munition are entirely outside Rice's whale habitat. As previously discussed, the spatial density model developed by NOAA (2022) for the Rice's whale was used in this LOA Request to predict Rice's whale density for the purpose of estimating takes. The NOAA model generates densities for hexagon-shaped raster grids that are 40 km^2. The specific areas of the raster grids within each ZOI were computed in GIS and coupled with their respective modeled densities to estimate the number of animals that would be exposed. Figure 6-3 shows the ZOIs of mission-day category A at the current GRATV anchoring site. As shown, portions of the TTS and behavioral disturbance ZOIs are within grids of modeled density greater than zero individuals per 40 km^2 (n/40 km^2). However, the modeled densities in these areas are small and reflect higher occurrence probability for the Rice's whale farther to the southwest, outside the LIA. To estimate annual takes, the number of animals in all model grids within each ZOI for all mission-day categories, except gunnery missions (G and H), were computed using the densities from the NOAA model and the impact areas calculated in GIS. The modeled densities and the associated areas were multiplied together to estimate abundance within each ZOI. The resulting abundance estimates were summed together and then multiplied by the number of annual missions proposed to estimate annual takes. These calculations resulted in a total of 0.04 annual TTS take and 0.10 annual behavioral disturbance take, which indicates that all missions conducted at the current GRATV site combined would not result in a single Level B harassment take of the Rice's whale. For comparison, Figure 6-4 shows the ZOIs of mission-day category A at the center of the proposed East LIA. As shown, a small portion of the behavioral disturbance ZOI encompasses a grid of low modeled density, with grids of higher density being farther to the southwest.

Certain missions could have a PTS impact if they were to be conducted farther to the southwest within the LIAs closer to Rice's whale habitat, as defined by the 100-meter isobath. The modeled threshold distances were used to determine the locations in the existing LIA and proposed East LIA where each mission-day category would cause the onset of PTS, measured as a setback from the 100-meter isobath. At this setback location, the mission would avoid PTS and result only in non-injury Level B harassment, if one or more Rice's whales were in the affected habitat. The setback distances are based on the longest distance predicted by the dBSea model for a cumulative SEL of 168 dB within the ZOI; the predicted average cumulative SEL is used as the basis of effect for estimating takes. The setback distances determined for the

mission-day categories are presented in Table 6-10 and are shown for the existing LIA and proposed East LIA on Figures 6-5 and 6-6, respectively.

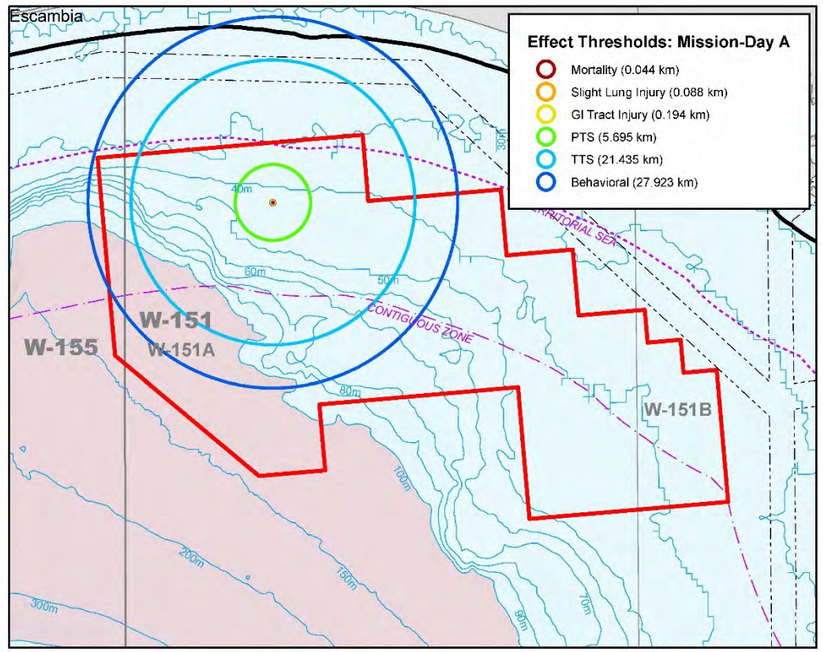
Locating a given mission in the LIA at its respective setback distance would represent the maximum Level B harassment scenario for the mission. If all the missions were conducted at their respective setbacks, the resulting takes would represent the maximum Level B harassment takes that would result for all mission-day categories except for gunnery missions. This is not a realistic scenario; however, it is analyzed to provide a worst-case estimate of takes. The takes under this scenario were calculated using the NOAA model as described for the GRATV location scenario. Figure 6-7 shows mission-day category A conducted at its maximum Level B setback location. Under this scenario, the TTS and behavioral disturbance ZOIs extend farther into Rice's whale habitat; however, the modeled densities within affected areas are still relatively small. PTS impacts are avoided. The PTS ZOI is slightly offset from the 100-meter isobath because the setback is based on the longest distance predicted by the dBSea model, whereas the ZOIs shown are based on the average distance predicted by the model. The take calculations for the maximum Level B harassment scenario resulted in a total of 0.49 annual TTS take and 1.19 annual behavioral disturbance takes (Table 6-11). These are the maximum number of takes estimated to potentially result from detonations in the existing LIA. These takes are overestimates because a considerable portion of all missions in the LIA are expected to continue to be conducted at or near the currently used GRATV anchoring site. These takes would not be exceeded because all missions will be conducted behind their identified setbacks as a new mitigation measure to prevent injury to the Rice's whale. Take calculations for the maximum Level B harassment scenario in the East LIA resulted in 0.63 annual TTS take and 2.33 annual behavioral disturbance takes (Table 6-11).

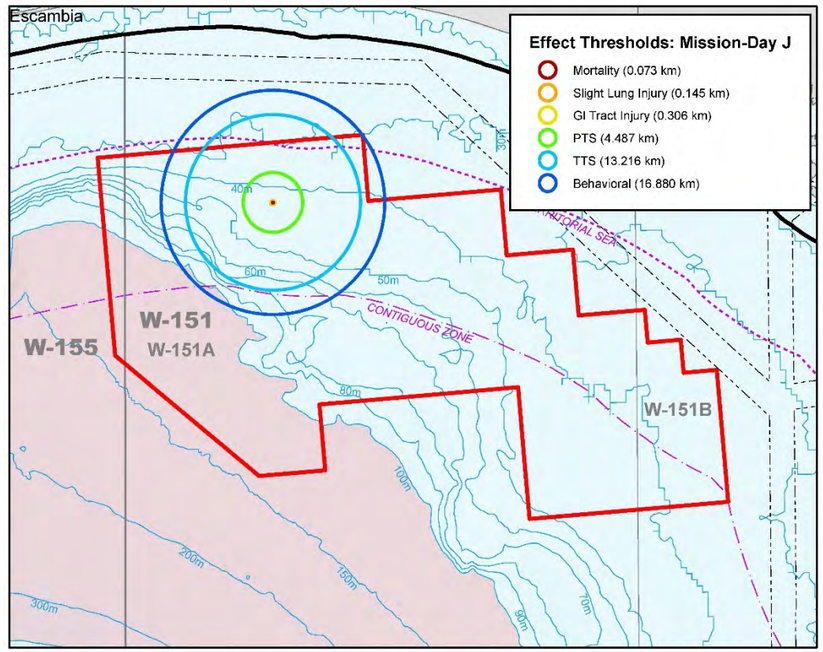
Table 6-10. Setbacks to Prevent Permanent Threshold Shift Impacts to the Rice's Whale

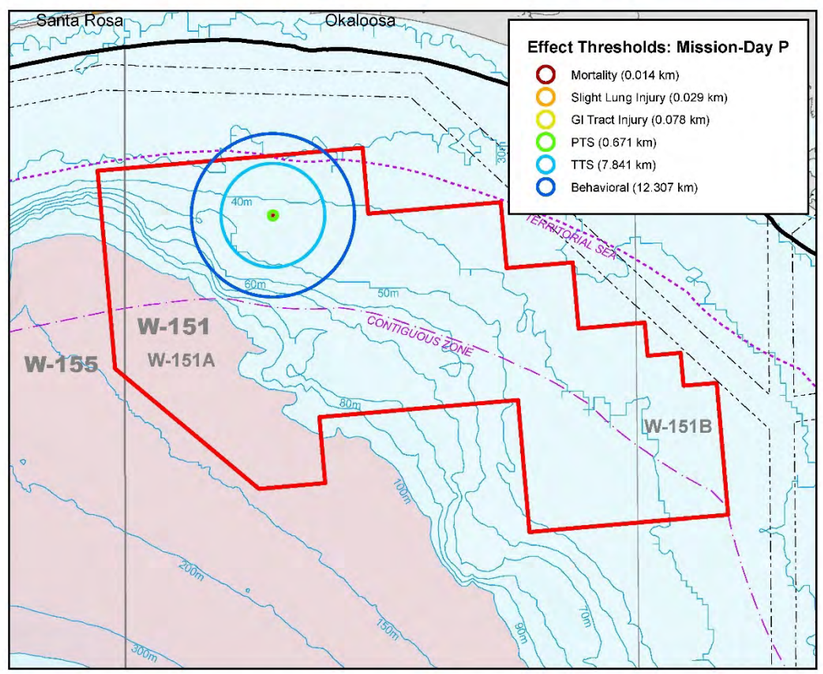
LOA for Eglin Gulf Test and Training Range

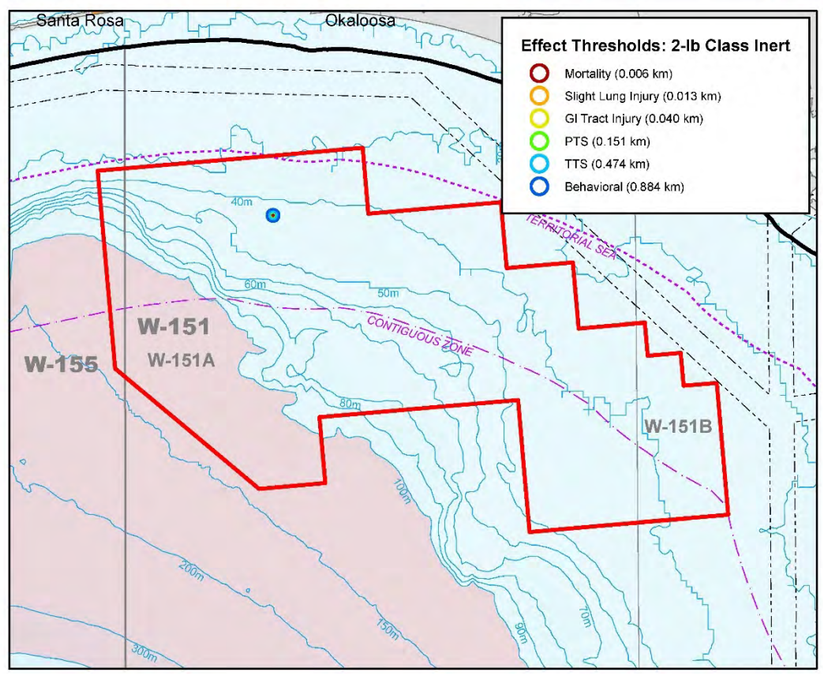
User Group	Mission-Day Category	NEWi (lb)	Setback from 100-Meter Isobath (km)
53 WEG	A	2,413.6	7.323
	B	2,029.9	6.659
	C	1,376.2	5.277
	D	836.22	3.557
	E	934.9	3.192
AFSOC	F	584.6	3.169
	I	29.6	0.394
96 OG	J	946.8	5.188
	K	350	1.338
	L	627.1	3.315
	M	324.9	2.017
	N	238.1	1.815
	O	104.6	0.734
	P	130.8	0.787
	Q	94.4	0.667
	R	37.1	0.368
NAVSCOLEOD	S	130	1.042

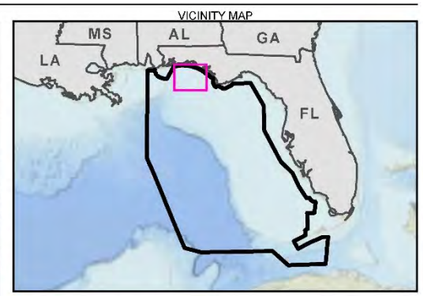
53 WEG = 53rd Weapons Evaluation Group; 96 OG = 96th Operations Group; AFSOC = Air Force Special Operations Command; km = kilometer(s); lb = pound(s); NAVSCOLEOD = Naval School Explosive Ordnance Disposal; NEW = net explosive weight; NEWi = net explosive weight at impact











Legend

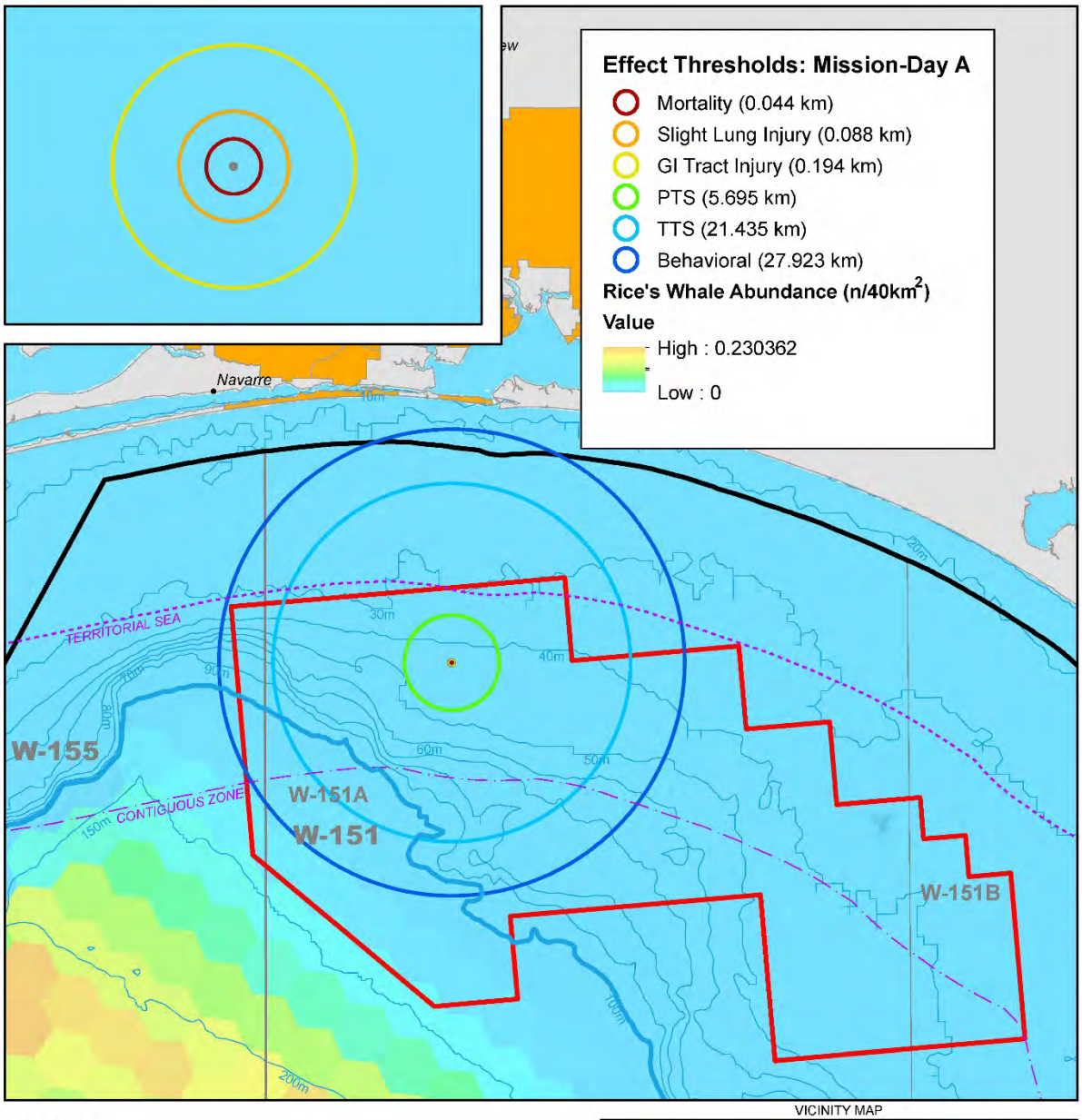
- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV)
- Rice's Whale Core Habitat
- Shipping Lanes
- Depth Contour (meters)

Notes:
1. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

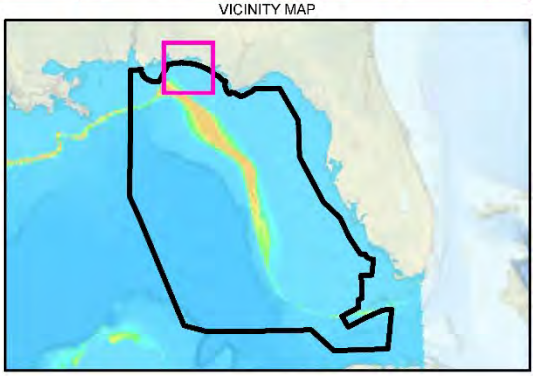
Kilometers
0 10 20 30 40
N

FIGURE 6-2
Rice's Whale ZOI for Various Missions
Current GRATV Site
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016566\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 4-1 RICES WHALE ZOIS VARIOUS MDS EXISTING GRATV.MXD JO016566 3/17/2022 11:39:44 AM



VICINITY MAP



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Depth Contour (meters)

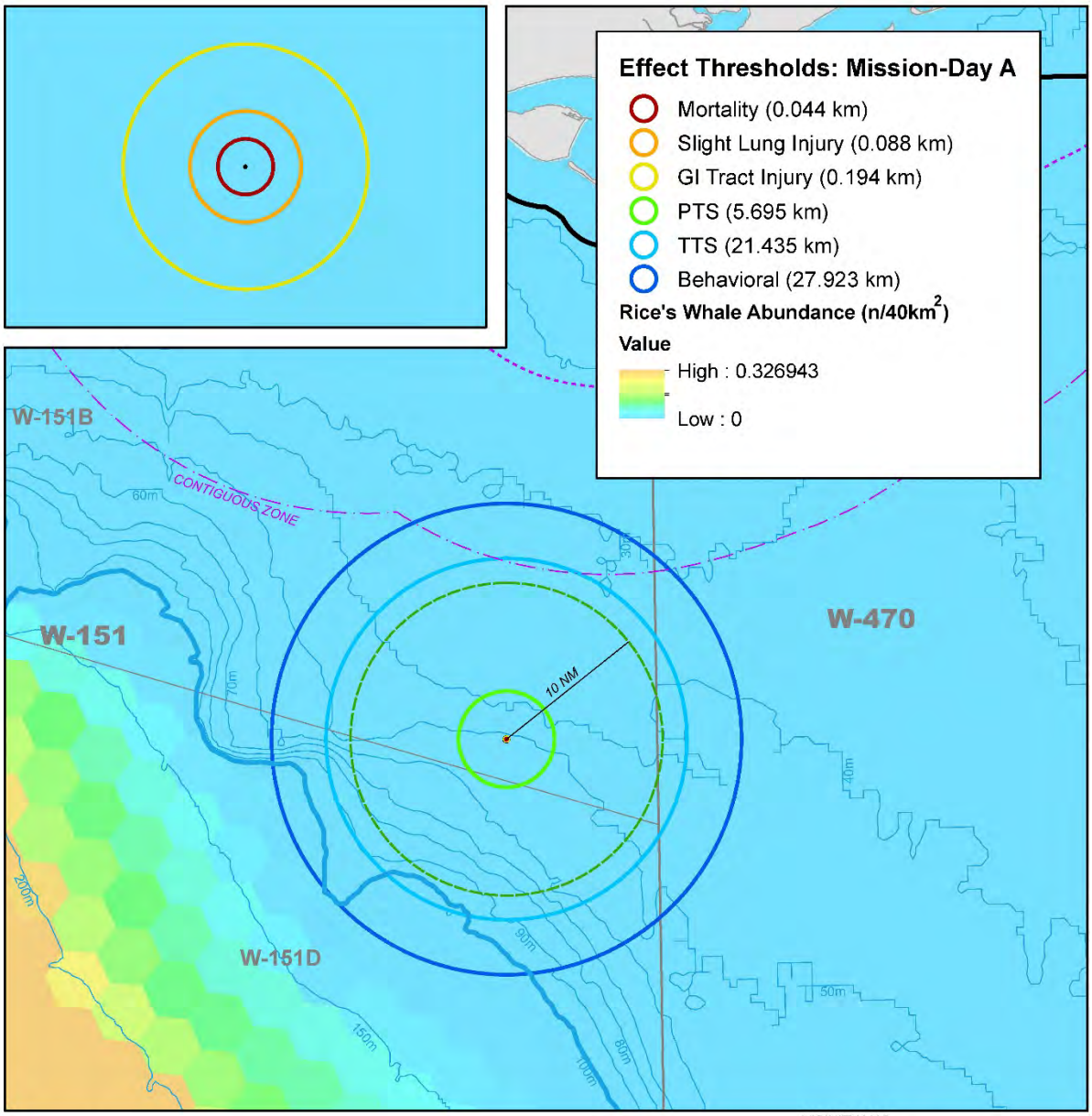
Notes:
1. The map scale is applicable only to the main map.
2. Rice's whale abundance based on spatial density model developed by NOAA (2022)
3. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

0 10 20 30 40 Kilometers

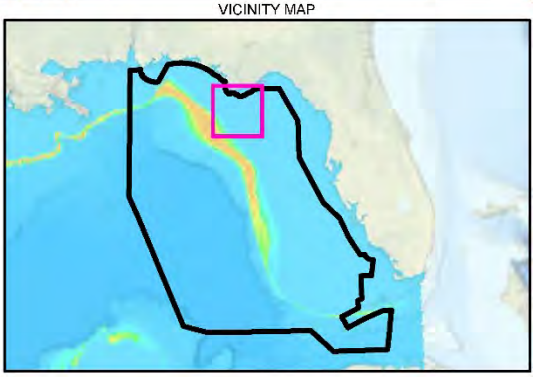
N

FIGURE 6-3
Rice's Whale ZOI for Mission Day A
Current GRATV Site
LOA for Eglin Gulf Test and Training Range

UNK \\DC1VS01\GISPROJ\U\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-3 RICES WHALE ZOI FOR MD-A GRATV_V3.MXD RENDONE 10/7/2022 2:47:15 PM



VICINITY MAP



Legend

- EGTTR
- EGTTR Air Space
- Proposed East LIA (10-NM radius)
- Proposed East LIA Center
- Depth Contour (meters)

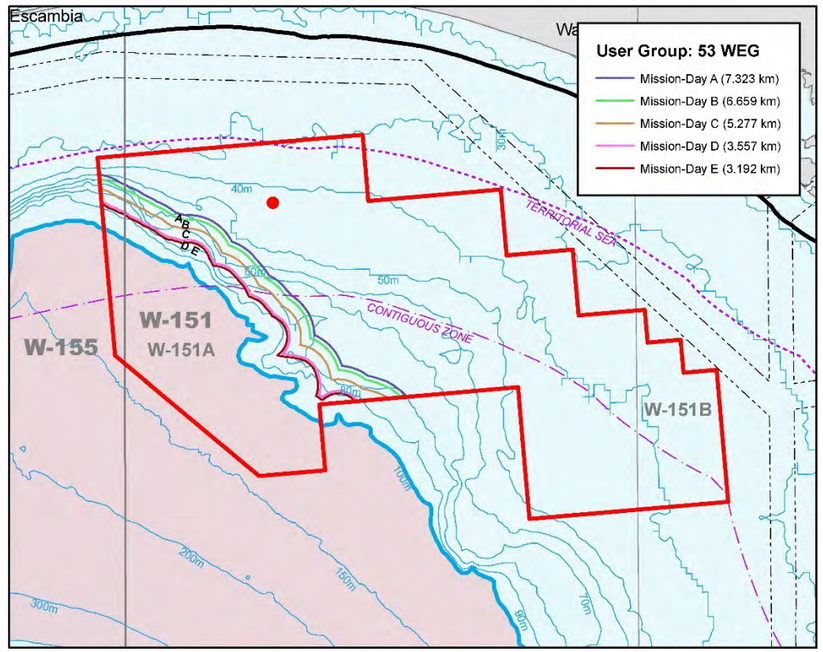
Notes:
1. The map scale is applicable only to the main map.
2. Rice's whale abundance based on spatial density model developed by NOAA (2022)
3. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

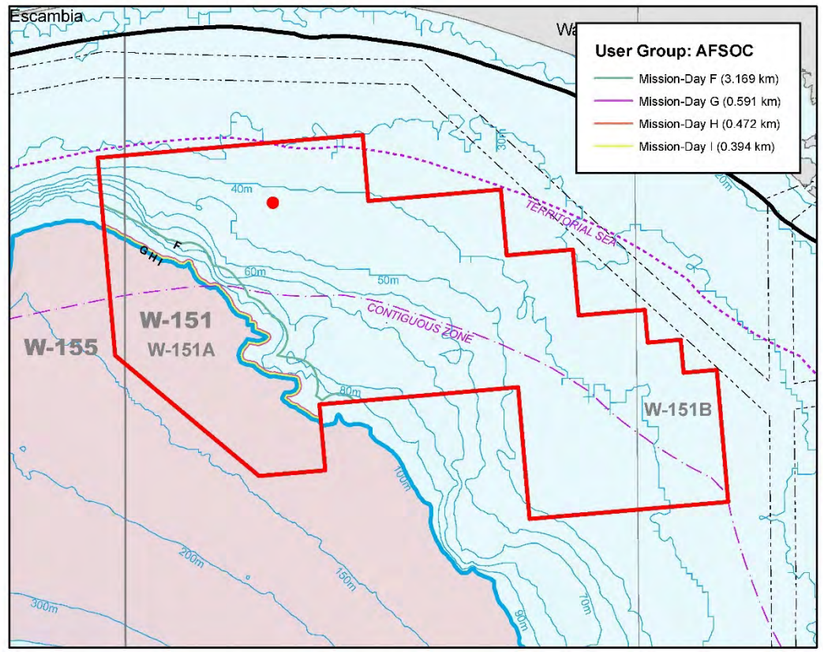
0 10 20 30 40 Kilometers

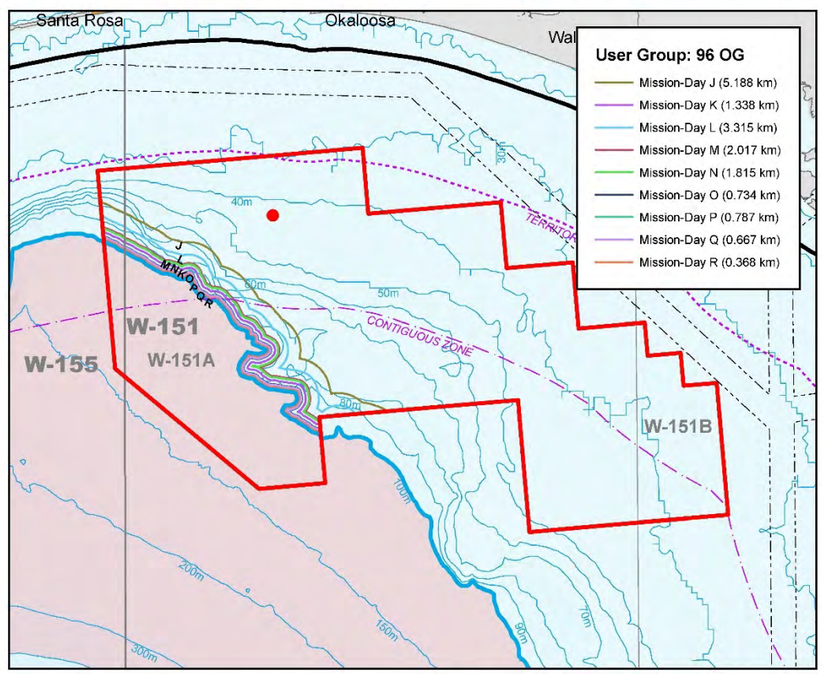
N

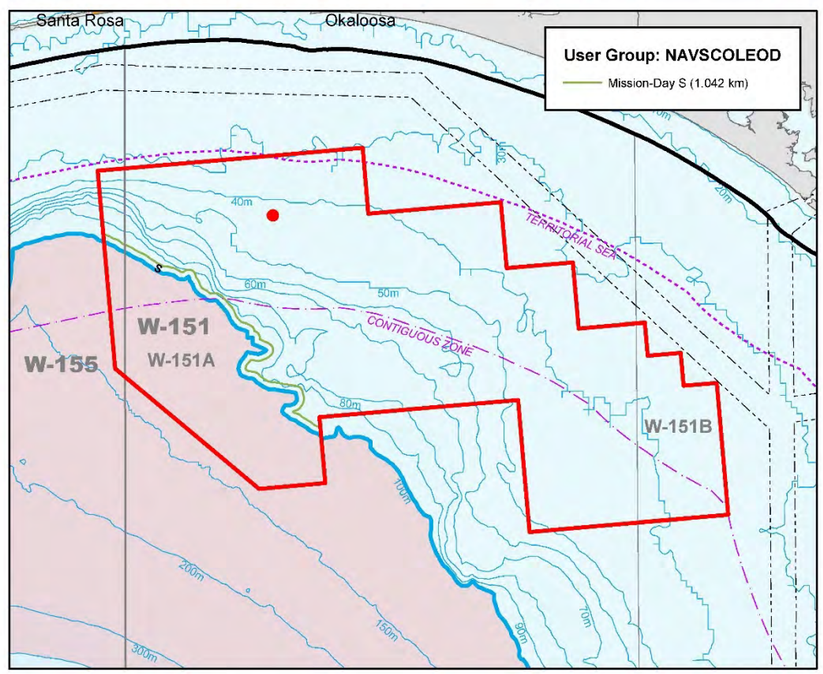
FIGURE 6-4
Rice's Whale ZOI for Mission Day A
East LIA Center
LOA for Eglin Gulf Test and Training Range

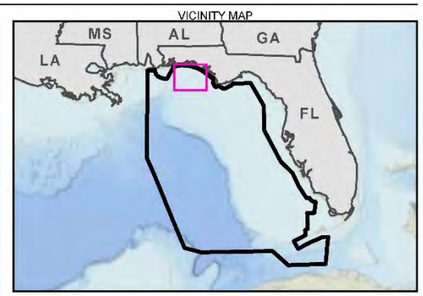
UNK \\DC1VS01\GISPROJ\U\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-4 RICES WHALE ZOI FOR MD-A EAST LIA CENTER_V3.MXD RENDONE 10/7/2022 2:47:29 PM











Legend

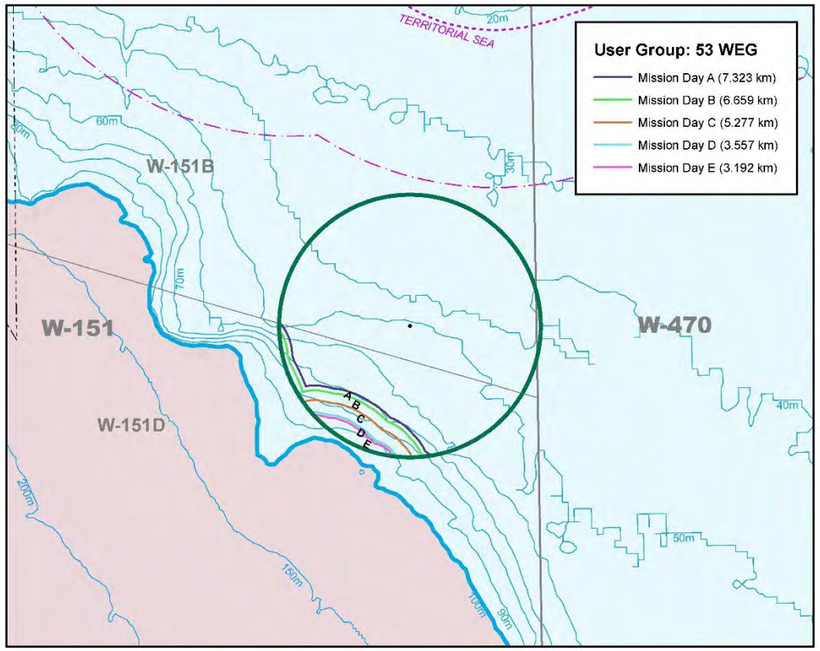
- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV)
- Rice's Whale Core Habitat
- Shipping Lanes
- Depth Contour (meters)

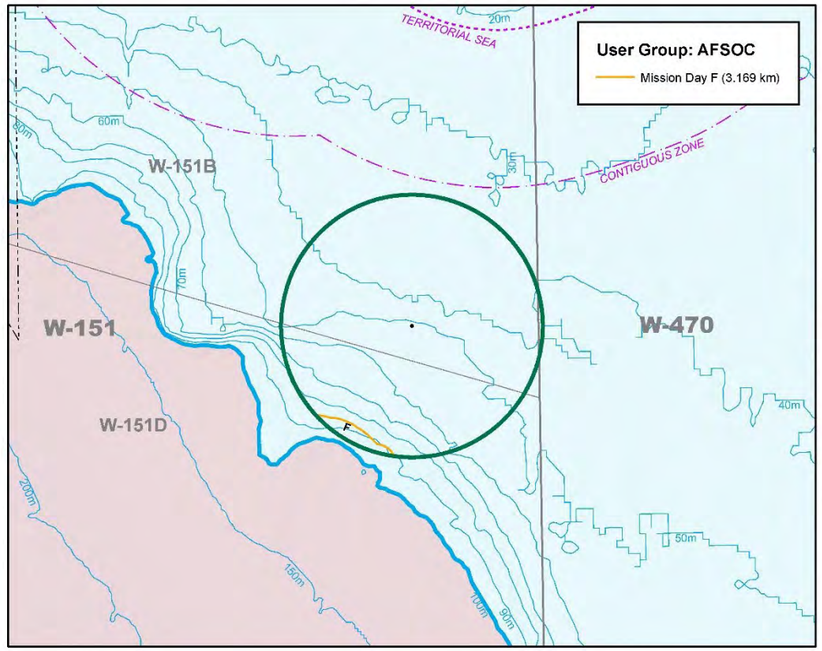
Notes:
1. Setback distances shown for Rice's Whale behavioral disturbance and TTS are from the 100 meter depth contour.
2. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

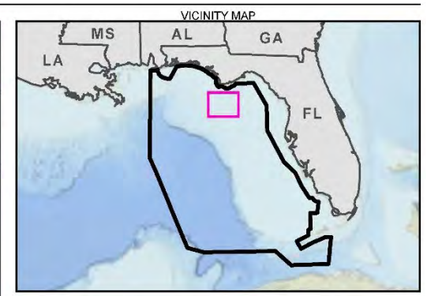
Kilometers
0 10 20 30 40
N

FIGURE 6-5
Rice's Whale Setbacks – Existing LIA
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016586\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 4-4 RICES WHALE SETBACKS EXISTING LIA 100M.MXD JO016586 4/12/2022 2:02:04 PM

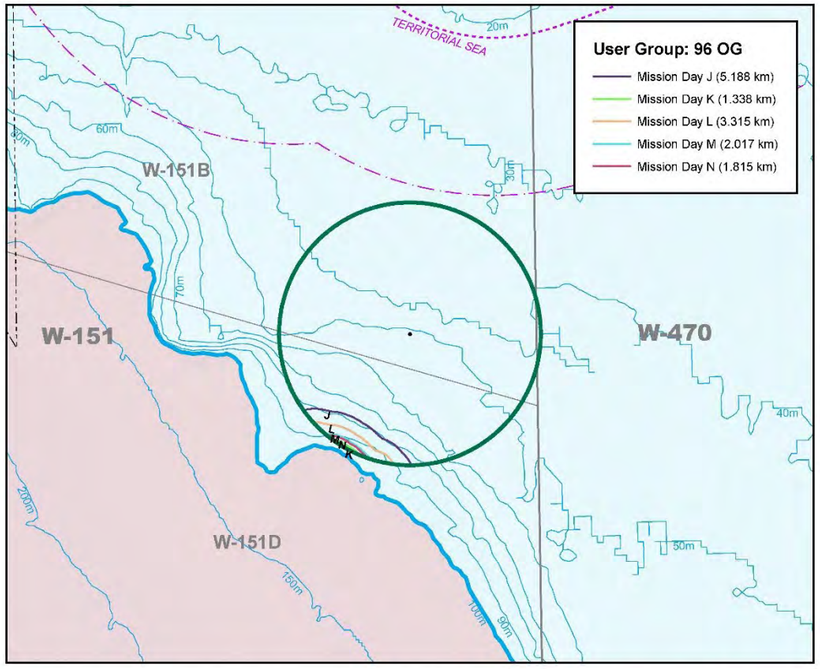


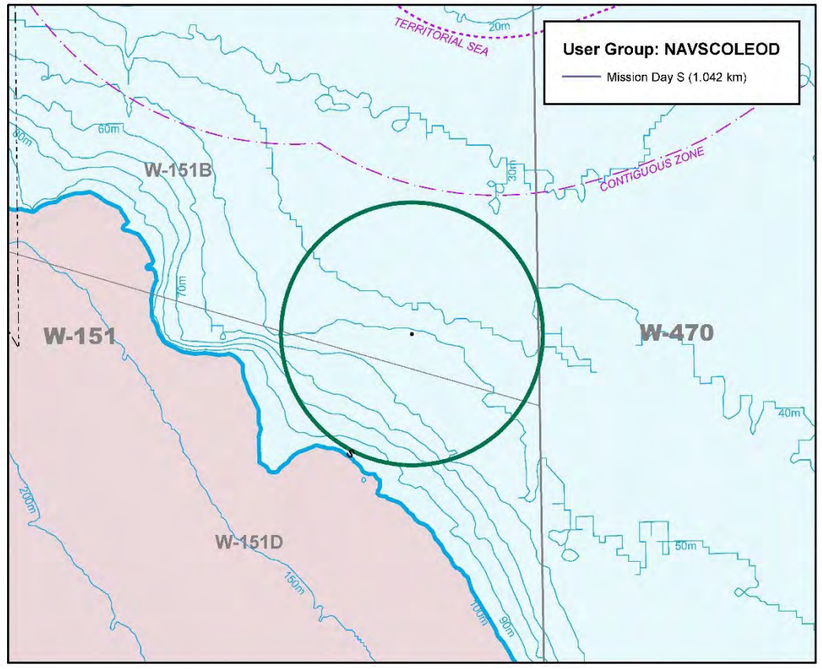




Legend

- EGTTR
- EGTTR Air Space
- Proposed East LIA
- Rice's Whale Core Habitat
- Shipping Lanes
- Depth Contour (meters)





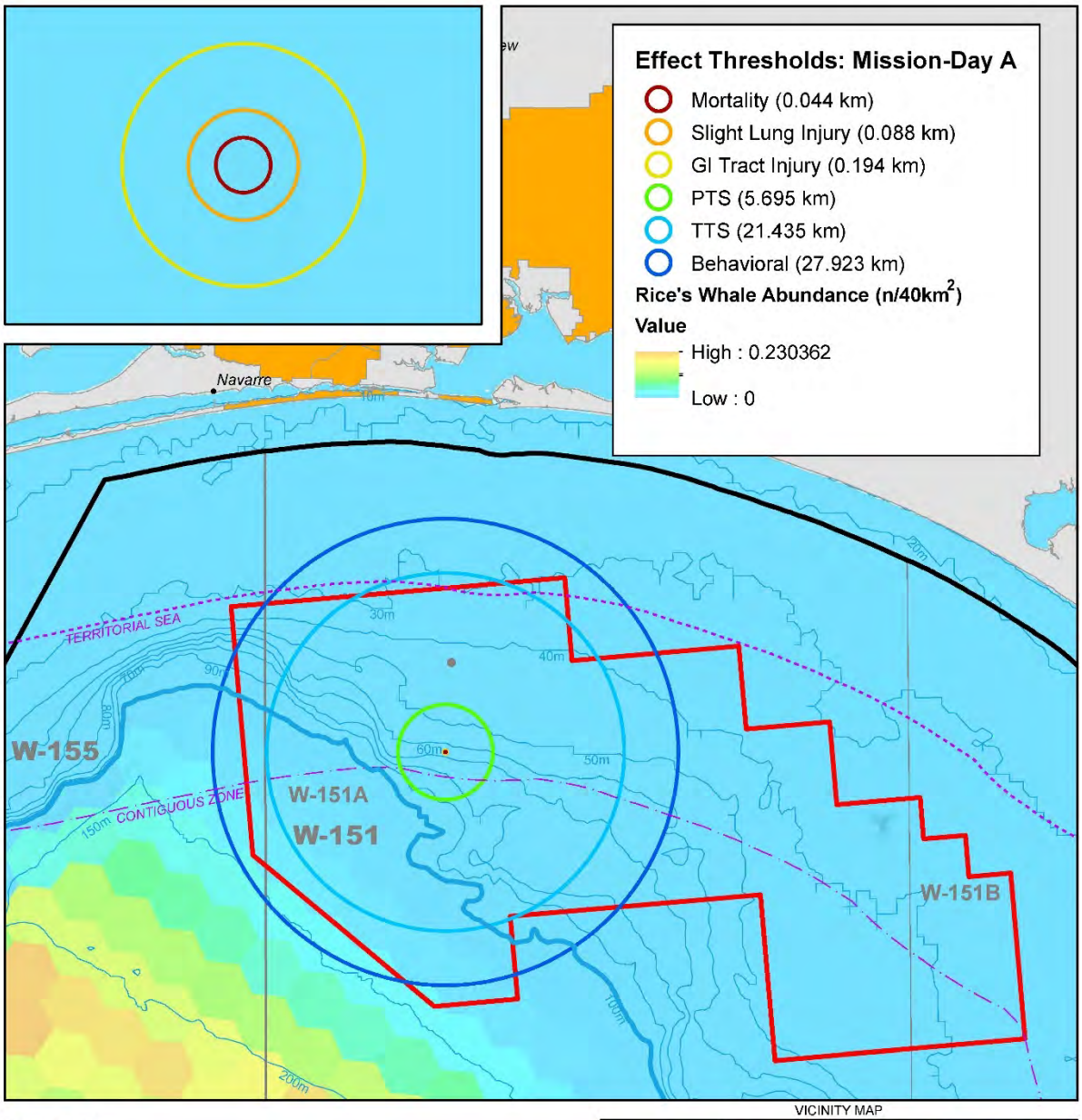
Notes:
1. Setback distances shown for Rice's Whale behavioral disturbance and TTS are from the 100 meter depth contour.
2. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

0 10 20 30 40 Kilometers

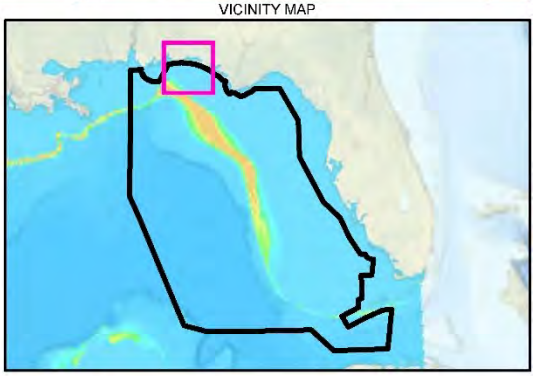
N

FIGURE 6-6
Rice's Whale Setbacks – Proposed East LIA
LOA for Eglin Gulf Test and Training Range

UNK C:\USERS\JO016566\DOCUMENTS\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 4-5 RICES WHALE SETBACKS EAST LIA 100M.MXD JO016566 4/12/2022 2:44:25 PM



VICINITY MAP



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Depth Contour (meters)

Notes:
1. The map scale is applicable only to the main map.
2. Rice's whale abundance based on spatial density model developed by NOAA (2022)
3. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

N

0 10 20 30 40 Kilometers

FIGURE 6-7
Rice's Whale ZOI for Mission Day A
Maximum Level B Harassment
LOA for Eglin Gulf Test and Training Range

UNK \\DC1VS01\GISPROJ\U\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-7 RICES WHALE ZOI FOR MD-A EXLIA MAX LEVEL B HARASSMENT_V3.MXD RENDONE 10/7/2022 11:00:28 AM

As a mitigation measure to prevent any PTS impacts to the Rice's whale during the next mission period, the USAF will restrict live munitions use in the LIAs in accordance with the identified setback distances. For example, the subsurface detonation of a GBU-10, GBU-24, or GBU-31, which each have a NEW of 945 lb, would represent the most powerful single detonation that would be conducted under the Proposed Action; such a detonation would correspond to mission-day category J. To prevent any PTS impacts to the Rice's whale, a mission that would involve such a single subsurface detonation would be conducted in a portion of the LIA that is behind the setback identified for mission-day category J. Likewise, a mission that would involve multiple detonations that have a total cumulative NEWi comparable to that of mission-day category A would be conducted behind the setback identified for mission-day category A. Each user group will use the mission-day categories and corresponding setback distances to determine the setback distance that is appropriate for their actual mission. The user group will estimate the NEWi of the actual mission to identify which mission-day category and associated setback to use. The energy of the actual mission will be less than the energy of the mission-day category in terms of total NEWi and largest single-munition NEWi to ensure that the energy and effects of the actual mission will not exceed the energy and effects estimated for the corresponding mission-day category. The setbacks that correspond to the mission-day categories for each group are shown separately on the figures to make it easier for each user group to identify the setbacks that will apply to their missions.

As indicated in Table 6-8, the threshold distances estimated for the proposed inert munitions are considerably smaller than those of live munitions, even when compared with a mission-day category of relatively low cumulative energy such as mission-day category P (Figure 6-2). To minimize impacts to the Rice's whale from inert munitions both inside and outside the LIAs, the USAF will prohibit the use of inert munitions in Rice's whale habitat during the next mission period. Under this new mitigation measure, inert munitions use will be prohibited between the 100-meter and 400-meter isobaths throughout the EGTTR.

As a mitigation measure to prevent impacts to cetacean species known to occur in deeper portions of the Gulf of Mexico, such as the federally endangered sperm whale, AFSOC has historically conducted all gunnery missions landward of the 200-meter isobath, which is generally considered to be the shelf break in the Gulf of Mexico. Although implementing this measure would prevent impacts to most marine mammal species in the Gulf, it may not provide full protection to the Rice's whale, which has been documented to occur in waters as shallow as 117 meters, although the majority of sightings have occurred in waters deeper than 200 meters. AFSOC gunnery missions are represented by mission-day categories G (daytime missions) and H (nighttime missions). Daytime missions involve firing thirty 105 mm FU rounds and five hundred 30 mm rounds, and nighttime missions involve firing the same number of rounds but use 105 mm TRs instead of the 105 mm FU rounds (Table 6-3). The modeled distances for behavioral disturbance for gunnery daytime and nighttime missions are 12.9 km and 7.1 km, respectively. The pre-mission aerial surveys conducted by AFSOC gunnery aircrews extend out 5 NM, or approximately 9.2 km, from the mission site. Therefore, the aircrews are able to survey all of the behavioral disturbance ZOI for a nighttime gunnery mission but not for a daytime gunnery mission.

All gunnery missions during the 2023–2030 period will be conducted at least 500 meters landward of the 100-meter isobath to prevent any PTS impacts to the Rice's whale. This setback distance from the 100-meter isobath is based on the modeled PTS threshold distance for daytime gunnery missions (mission-day G) of 494 meters (Table 6-5). At this setback distance, potential PTS effects from daytime gunnery missions would not extend into Rice's whale habitat, as defined by the 100-meter isobath. Figures 6-8 and 6-9 show the ZOIs for daytime and nighttime gunnery missions, respectively, conducted at a location within the existing LIA that is precisely 500 meters landward of the 100-meter isobath. Gunnery missions may be conducted inside or outside the LIA, and they have been historically conducted landward of the 200-meter isobath, with most missions over the last 5 years having occurred in waters shallower than 100 meters. As indicated on Figure 6-8, the PTS ZOI of a daytime gunnery mission conducted precisely 500 meters landward of the 100-meter isobath does not extend into Rice's whale habitat. The PTS ZOI of a nighttime gunnery mission, which is 401 meters in radius, is contained farther landward of the habitat boundary (Figure 6-9).

Conducting a given gunnery mission 500 meters landward of the 100-meter isobath would approximately represent the maximum Level B harassment scenario for the mission. If all gunnery missions were conducted at this 500-meter setback from the habitat boundary, the resulting takes would represent the maximum Level B harassment takes that would result for all gunnery missions. This is not a realistic scenario; however, it is analyzed for gunnery missions as it is for detonations in this LOA Request to provide a worst-case estimate of takes.

The location shown on Figures 6-8 and 6-9 is used in this LOA Request as a representative location to estimate the maximum Level B harassment takes for daytime and nighttime gunnery missions. As indicated on Figures 6-8 and 6-9, the modeled Rice's whale densities in the TTS and behavioral disturbance ZOIs are small, and reflect a higher occurrence probability for the Rice's whale farther to the southwest. The take calculations were performed using the NOAA model and GIS in the same manner described for the other missions. The take calculations estimated 0.003 TTS take and 0.012 behavioral disturbance take per daytime gunnery mission and 0.0006 TTS take and 0.002 behavioral disturbance take per nighttime gunnery mission. The resulting annual takes for all 25 proposed daytime gunnery missions are 0.08 TTS take and 0.30 behavioral disturbance take, and the resulting annual takes for all 45 proposed nighttime gunnery missions are 0.03 TTS take and 0.09 behavioral disturbance take (Table 6-11). This is a conservative estimation of Level B harassment takes because all gunnery missions would not be conducted precisely 500 meters landward of the 100-meter isobath as assumed under this worst-case take scenario. Based on a review of gunnery mission locations, most gunnery missions during the last 5 years have occurred in waters shallower than 100 meters. Under the proposed new mitigation measure, all gunnery missions would be conducted at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath, and a considerable number of actual missions are expected to continue to be conducted in waters considerably shallower than 100 meters.

The annual maximum Level B harassment takes estimated for daytime gunnery missions (mission-day G) and nighttime gunnery missions (mission-day category H) are combined with the annual maximum Level B harassment takes estimated for the other mission-day categories to determine the total takes of the Rice's whale from all EGTTR operations during the next mission period. To estimate takes of the Rice's whale in both LIAs collectively, the take estimates for each LIA were weighted based on the expected usage as discussed for the dolphins. The annual takes of the Rice's whale under the Proposed Action are presented in Table 6-11. As indicated, the total annual takes of the Rice's whale under the Proposed Action are calculated as 0.61 TTS take and 1.69 behavioral takes. Per NMFS guidance, the annual requested takes are derived by rounding the calculated takes to the nearest whole number and multiplying by two based on an average group size of two animals, resulting in 2 TTS takes and 4 behavioral takes requested annually. The requested takes are overestimates because they represent the maximum Level B harassment scenario for all missions. These takes are also overestimates of actual exposure based on the conservative assumption that all proposed detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets.

Table 6-11. Annual Takes of the Rice's Whale under the Proposed Action

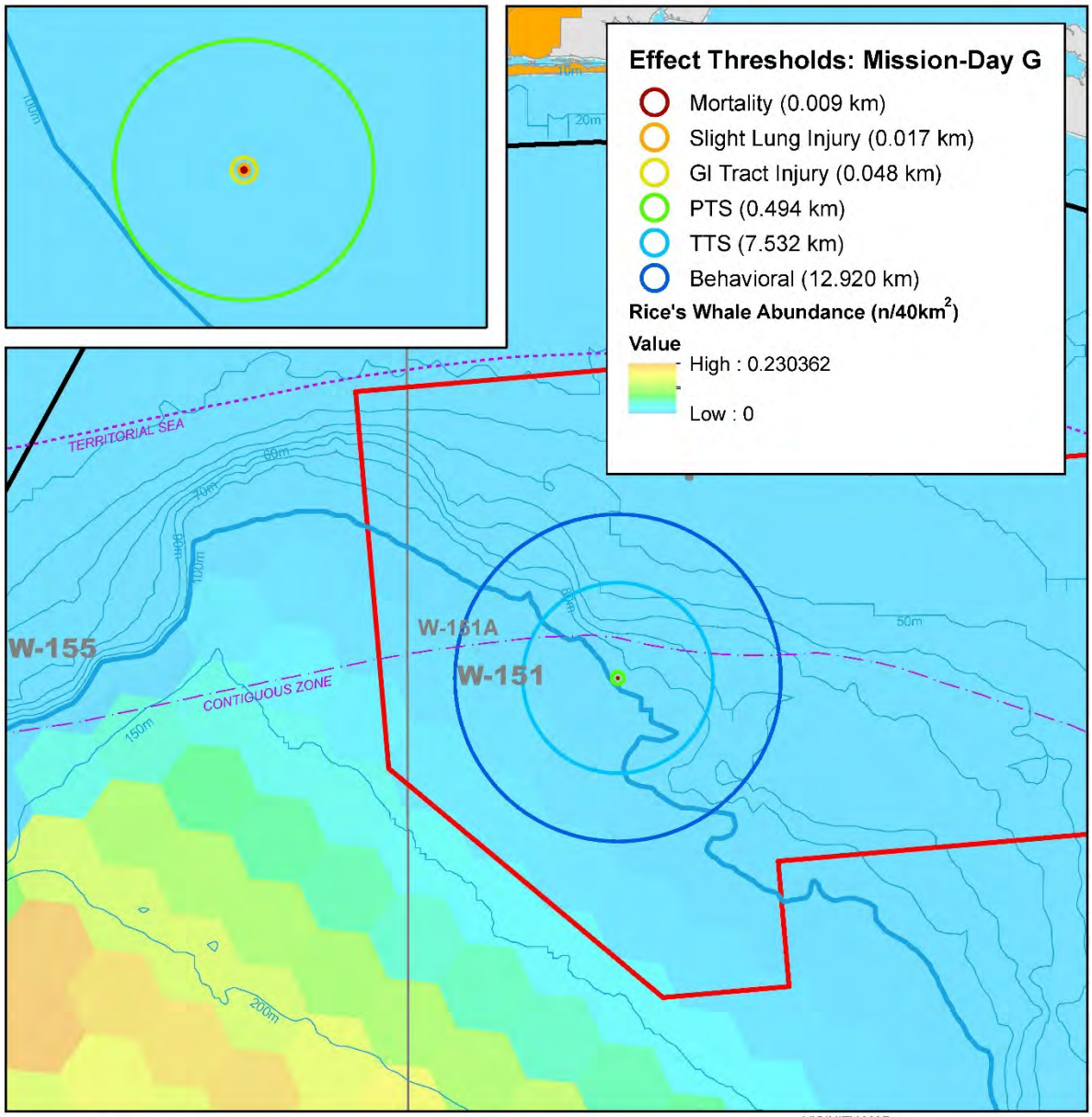
LOA for Eglin Gulf Test and Training Range

Mission	Mortality	Level A Harassment		Level B Harassment	
		Injury[a]	PTS	TTS	Behavioral
Missions at Existing LIA	0	0	0	0.49	1.19
Missions at East LIA	0	0	0	0.63	2.33
90 Percent of Existing LIA Missions	0	0	0	0.441	1.071
10 Percent of East LIA Missions	0	0	0	0.063	0.233
Daytime Gunnery Missions	0	0	0	0.08	0.30
Nighttime Gunnery Missions	0	0	0	0.03	0.09
Total	0	0	0	0.61	1.69
Total Takes Requested	0	0	0	2[b]	4[b]

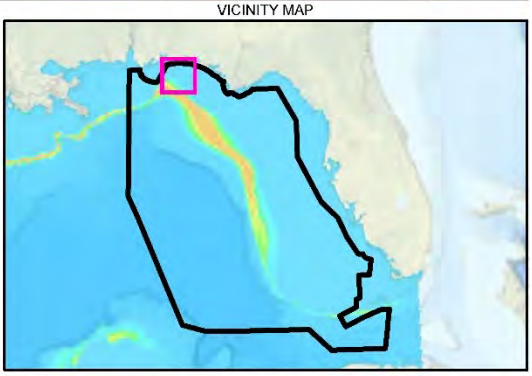
[a] Slight lung and/or gastrointestinal tract injury

[b] Estimated takes rounded to nearest whole number and then doubled based on an average group size of two animals

LIA = Live Impact Area; PTS = permanent threshold shift; TTS = temporary threshold shift



VICINITY MAP



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Depth Contour (meters)

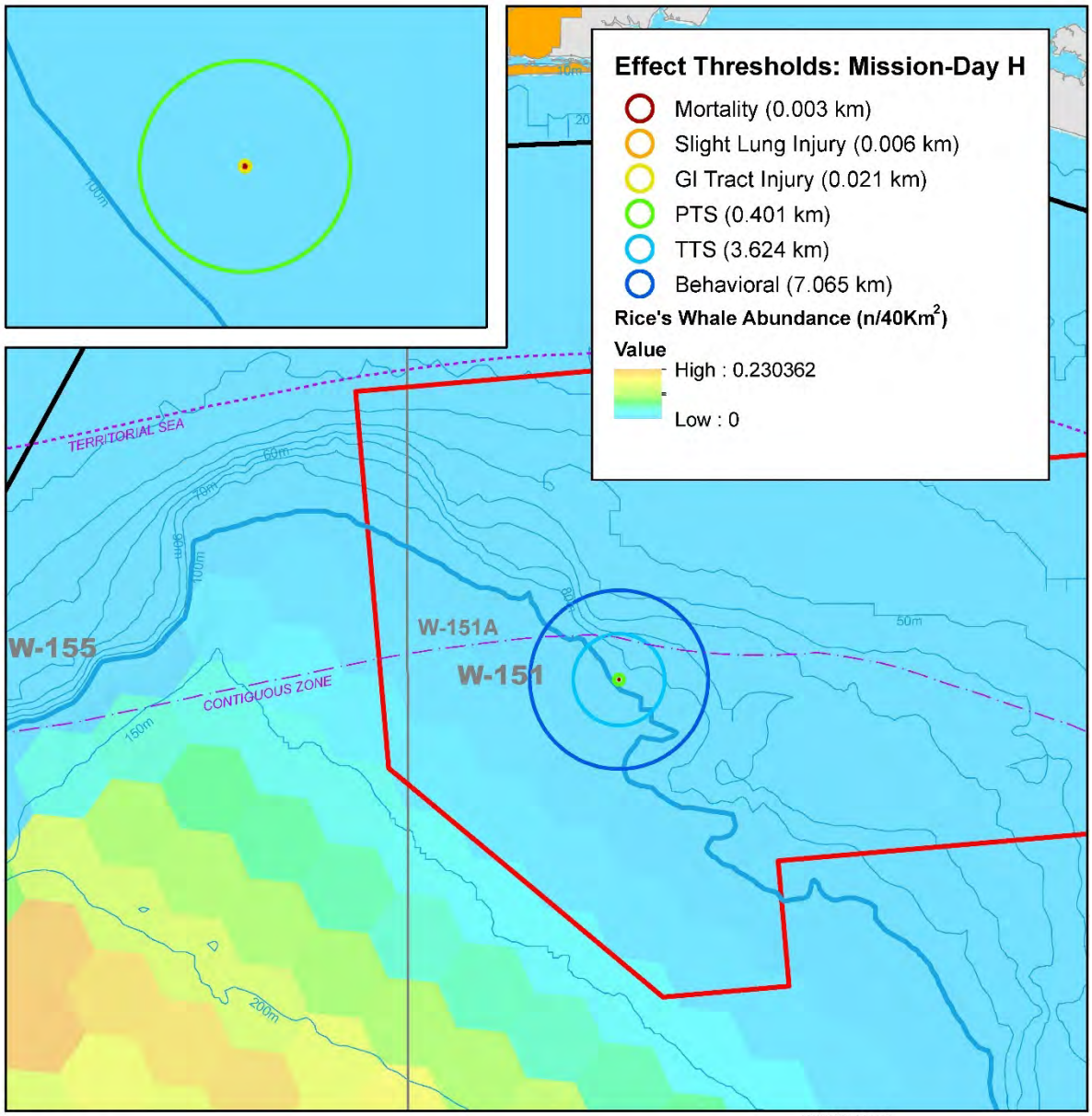
Notes:
1. The map scale is applicable only to the main map.
2. Rice's whale abundance based on spatial density model developed by NOAA (2022)
3. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

N

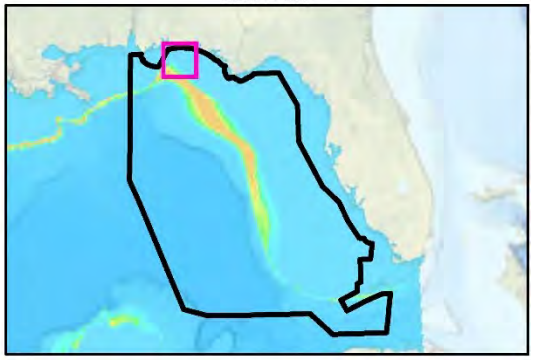
0 7.5 15 22.5 30 Kilometers

FIGURE 6-8
Rice's Whale ZOI for Mission Day G
500 Meters Landward of the 100-Meter Isobath
LOA for Eglin Gulf Test and Training Range

UNK \\DC1VS01\GISPROJ\U\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-8 RICES WHALE ZOI FOR MD-G 500M LW OF 100M ISOBATH_V3.MXD RENDONE 10/7/2022 2:50:10 PM



VICINITY MAP



Legend

- EGTTR
- EGTTR Air Space
- Existing Live Impact Area (LIA)
- Gulf Range Armament Test Vessel (GRATV) Barge (Mobile Position)
- Depth Contour (meters)

Notes:
1. The map scale is applicable only to the main map.
2. Rice's whale abundance based on spatial density model developed by NOAA (2022)
3. Sources: Marine Bathymetry Map, GEBCO 2021; Bathymetric Contours, USCD STRM30+ 2021; US Maritime Boundaries, US Coast Guard; County Borders, State Borders, ESRI 2021.

N

0 7.5 15 22.5 30 Kilometers

FIGURE 6-9
Rice's Whale ZOI for Mission Day H
500 Meters Landward of the 100-Meter Isobath
LOA for Eglin Gulf Test and Training Range

UNK \\DC1VS01\GISPROJ\U\USACE\EGLIN\EGTTR EA\GIS\MXD\FIGURE 6-9 RICES WHALE ZOI FOR MD-H 500M LW OF 100M ISOBATH_V3.MXD RENDONE 10/7/2022 2:50:04 PM

7. Anticipated Impact of the Activity

7.1 Dolphins

Based on the results of underwater acoustic modeling and associated analyses conducted for this LOA Request, the USAF requests a total of 9 Level A harassment takes for the common bottlenose dolphin and a total of 1 Level A harassment take for the Atlantic spotted dolphin annually for EGTTR operations during the 2023–2030 mission period. All Level A harassment takes would be in the form of PTS; no lung or GI tract injury takes are expected to result from EGTTR operations. In addition, the USAF requests a total of 1,136 and 139 Level B harassment takes, in the form of TTS and/or behavioral disturbance, annually for the bottlenose dolphin and Atlantic spotted dolphin, respectively. TTS is a temporary loss of hearing sensitivity due to fatigue of auditory structures; the loss of hearing sensitivity is recovered in a relatively short time. As with PTS, the SEL metric for TTS results in higher exposure compared with the peak SPL metric; therefore, it was used to calculate takes. Potential behavioral disturbance in response to a detonation may include a startle response, swimming away from the perceived source of disturbance, or disruption of activities such as feeding.

The presented takes are overestimates of actual exposure based on the conservative assumption that all proposed detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets. A substantial portion of the bombs, missiles, and other munitions used during EGTTR operations strike targets and, therefore, transmit only minor amounts of pressure and noise energy across the air–water interface. This conservative assumption results in the overestimation of the cumulative energy assigned to the mission-day categories used to estimate exposure and takes. The take estimations also do not consider the monitoring and mitigation measures that are implemented during EGTTR operations for the protection of marine mammals. These measures have been established in coordination with NMFS and have been implemented as part of EGTTR missions for years. It should be noted that no evidence of any adverse impact to any marine mammal has been found during monitoring of past EGTTR operations by trained marine species observers. Although monitoring is limited to observable impacts within and in the vicinity of the mission area, the lack of any past evidence of such impacts is an indication that there is low overall potential for mortality and injury impacts to marine mammals from EGTTR operations under such monitoring and mitigation requirements. For any live mission other than gunnery missions, the pre-mission survey area will extend out to, at a minimum, double the Level A PTS threshold distance that applies to both dolphin species (185 dB SEL), which is estimated to range from 1,356 meters to 272 meters for the identified mission-day categories (Table 6-4). Surveying twice the dolphin PTS threshold distance provides a buffer when there is a lapse between the time when the survey ends and the time when the species observers reach the perimeter of the human safety zone before the start of the mission. Surveying this additional buffer area ensures that dolphins are not within the PTS zone at the start of the mission. Monitoring and mitigation measures for dolphins are further discussed in Section 11.

There is only one stock of the Atlantic spotted dolphin in U.S. Gulf waters, referred to as the Northern Gulf of Mexico Stock; this stock is not considered strategic under the MMPA. The most recent abundance estimate for this stock is 37,611 individuals (Waring et al. 2016). Based on the low number of Level A harassment takes (1 PTS) estimated to result from EGTTR operations and implementation of the established monitoring and mitigation measures, associated impacts to this stock are expected to be minor.

A total of 36 bottlenose dolphin stocks have been designated in the northern Gulf of Mexico (Waring et al. 2016). Stocks within and in the vicinity of the EGTTR include the northern Gulf of Mexico coastal, continental shelf, and oceanic stocks and the three inshore stocks designated in the northeastern Gulf, which include the Choctawhatchee Bay, Pensacola/East Bay, and St. Andrew Bay stocks (Table 3-2). As indicated in Table 3-2, two of the identified inshore stocks (Choctawhatchee Bay and Pensacola/East Bay) are designated as being strategic, whereas the coastal, continental shelf, and oceanic stocks are

designated as not being strategic. The designated inshore stock areas are landward of the EGTTR boundary; therefore, the identified inshore stocks are not expected to be affected by EGTTR operations. The Gulf of Mexico Northern Coastal Stock inhabits waters from shore to the 20-meter isobath and, therefore, has potential to occur within the EGTTR, which starts at 3 NM offshore, where water depths can be 20 meters or slightly less. However, given that most EGTTR operations would occur in either the existing LIA, where water depths range from approximately 30 to 145 meters, and in the proposed East LIA, where water depths range from approximately 35 to 85 meters, EGTTR operations are expected to have no appreciable effect on this stock. The Northern Gulf of Mexico Oceanic Stock inhabits waters deeper than 200 meters and, therefore, is also expected to have low potential to be impacted by EGTTR operations. The Northern Gulf of Mexico Continental Shelf Stock inhabits waters that are 20 to 200 meters deep and, therefore, is expected to be the primary bottlenose dolphin stock that occurs in the LIAs. The USAF assumes that all the takes estimated for the bottlenose dolphin in this LOA Request apply to this stock. This stock is not strategic and is estimated to consist of 51,192 individuals (Waring et al. 2016). The PBR level for this stock is 469 individuals. The PBR level is the maximum number of individuals, not including natural mortalities, that could be removed from a stock while still allowing the stock to reach or maintain its optimum sustainable population. The estimated number of Level A harassment takes (9 PTS) that would result from EGTTR operations is well under the PBR, and with monitoring and mitigation measures, potential impacts to this stock under the Proposed Action are expected to be minor.

7.2 Rice's Whale

EGTTR operations under the Proposed Action have the potential to result in non-injurious, Level B harassment of the Rice's whale, estimated as a total of 2 TTS takes and 4 behavioral disturbance takes annually for all EGTTR missions combined. The requested takes are overestimates because they represent the maximum Level B harassment scenario for all missions and assume that all detonations would occur at or just below the water surface instead of a portion occurring upon impact with targets.

As a mitigation measure to prevent any PTS impacts to the Rice's whale during the 2023–2030 mission period, the USAF will restrict the use of live munitions in the western part of each LIA based on the setbacks from the 100-meter isobath presented in this LOA Request. The USAF will also prohibit the use of inert munitions in Rice's whale habitat during the next mission period. Under this new mitigation measure, inert munitions use will be prohibited between the 100-meter and 400-meter isobaths throughout the EGTTR. All gunnery missions during the 2023–2030 period will be conducted at least 500 meters landward of the 100-meter isobath to prevent any PTS impacts to the Rice's whale. The takes requested for the Rice's whale, although being overestimates of actual takes, avoid injury and would result in insignificant impacts to the Rice's whale population in the Gulf of Mexico. The requested takes have been minimized by the USAF to the greatest extent possible based on the new mitigation measures proposed. By committing to these measures, the USAF is sacrificing a significant amount of testing and training area in the Gulf of Mexico to protect the Rice's whale. Any further measures would severely impact Eglin AFB's mission.

8. Anticipated Impacts on Subsistence Uses

Potential impacts on subsistence uses do not apply to the Proposed Action. This issue applies only in Alaska.

9. Anticipated Impacts on Habitat

9.1 Detonations

Pressure and noise from munitions detonations dissipate quickly and have no permanent effects on the marine environment. Based on the analysis conducted in the current EGTTR REA, the gas bubble produced by a subsurface detonation of the munition with the highest NEW (945 lb) is estimated to extend to a maximum depth of approximately 11.4 meters. Given that water depths range from approximately 30 to 145 meters in the existing LIA and from approximately 35 to 95 meters in the proposed new East LIA, overpressures from detonations under the Proposed Action would have no potential to impact the seafloor or associated benthic habitat.

Surface and subsurface munition detonations do have the potential to impact fish that occur in the upper layers of the ocean, depending on the exposure level. The overall probability of detonations occurring near dense schools of fish is relatively low because of their patchy distribution in the open ocean. Based on the amount of detonations that would be conducted on an annual basis and the low probability of impacting large numbers of fish during detonations, munitions detonations are not expected to adversely affect the growth or reproduction of any fish population that may serve as prey for the marine mammals analyzed.

9.2 Mission Debris

Most of the mission-related debris from EGTTR operations consists of intact munitions (inert and UXO) and the casing fragments of detonated munitions, all of which are mostly metal and readily sink to the seafloor. The overall amount of target-related debris that may float or remain suspended in the water column is comparatively small. Post-mission cleanup procedures minimize the amount of mission-related debris that remains on the water surface and in the water column. Debris that may float or remain suspended in the water column would primarily include fragments of damaged targets, which typically consist of wood, fiberglass, and foam hull material. Post-mission cleanup crews recover as much target-related debris as possible from the water surface by hand and by using dip nets; typical post-cleanup operations involve the use of several boats for up to 2 to 3 hours. Target-related debris that is not recovered by cleanup crews is dispersed by ocean currents, and much of it is expected to eventually settle on the seafloor. Based on the amount of target-related debris that would be deposited into the marine environment, post-mission cleanup of the debris, and dispersion of the unrecoverable debris by ocean currents, any associated impacts on marine mammal habitat would be negligible.

After being deposited on the seafloor, debris items may become partially or entirely buried in sediments over time, depending on the item's size, shape, and density, and environmental factors such as sediment characteristics, water depth, and the occurrence of strong storms that may move sediments. Munitions that become buried deep in sediments may experience less corrosion because of low oxygen levels and may remain intact for longer periods of time. Inert munitions and UXO that settle on the seafloor would displace the habitat provided by the affected sediments to benthic epifauna and infauna but would also provide substrate that could be used as habitat by marine organisms, like other sunken artificial structures. The overall level of disturbance to marine sediments in the EGTTR from mission-related debris under the Proposed Action is expected to be negligible based on the quantity of debris that would be deposited on the seafloor and the expected behavior of the debris in the marine environment over time.

9.3 Water and Sediment Quality

Based on the analysis conducted in the current EGTTR REA, metals, explosives, and other materials associated with EGTTR operations under the Proposed Action would have negligible potential to adversely impact water or sediment quality; therefore, no associated impacts to marine mammal habitat are

expected from such releases. The analyses of these potential impacts are discussed in detail in the current EGTTR REA and are summarized in the subsections that follow.

9.3.1 Metals

Metals are the dominant constituent by weight of bombs, missiles, gun ammunition, and other munitions, including inert munitions, used during EGTTR testing and training operations. Bomb casings and fins are typically constructed of steel, whereas missiles are typically constructed of aluminum and its alloys. Bombs and missiles may contain many other metals including chromium, copper, tungsten, lead, magnesium, titanium, and others. Gun ammunition is composed of steel, copper, tungsten, and other metals. Some targets used during EGTTR missions also contain metals, including CONEX and hopper barge targets used for PSW tests and certain components of remotely controlled target boats.

Aluminum and steel, which is composed mostly of iron, compose the bulk of the metal that enters the marine environment from EGTTR operations. Iron and aluminum are relatively benign metals in terms of toxicity. Chromium, lead, and copper, which make up a relatively small percentage of the overall metal input into the marine environment from EGTTR operations, have higher toxicity effects.

Metals contained in casing fragments of detonated munitions, intact inert munitions, UXO, and other mission-related debris will corrode from exposure to seawater. The rate of corrosion depends on the metal type and the extent to which the item is directly exposed to seawater, which can be influenced by existing corrosion on the item and the degree to which the item may be encrusted by marine organisms and/or buried in sediments. Through its lifetime in the marine environment, a portion of the overall metal content would dissolve; the solubility of metals in seawater is controlled by various factors including pH, temperature, salinity, and the nature of the specific anions involved. Dissolved metals would readily undergo mixing and dilution and would have no appreciable effect on water quality or marine life within the water column. Metals in particulate form would be released into sediments through the corrosion process. Elevated levels of undissolved metals in sediments would be restricted to a relatively small area around the metal-containing item. Encrustation of the item by marine life would reduce the rate of corrosion and the extent of direct exposure to seawater, sediments, and marine organisms.

Several studies conducted at maritime military ranges and munitions disposal sites provide supporting evidence that expended or disposed military munitions on the seafloor do not result in excessive accumulation of metals in sediments or significant degradation of sediment quality by metals. A U.S. Marine Corps study that sampled 26 munitions constituents, including lead and magnesium, in sediments near bombing sites in Pamlico Sound concluded that the munitions constituents did not exceed background levels and did not migrate off-range (U.S. Department of the Navy 2010). Pait and others (2010) reported low concentrations of metals in sediments in former Navy training areas off the coast of Vieques, Puerto Rico, that have experienced extensive munitions use for more than 45 years. This study found that the average concentrations of all metals, except copper, in sediments were below both the threshold and probable effects levels established for sediments; the average copper concentration was above the threshold effect level but below the probable effect level. A study conducted at the Potomac River Test Range, where bombs, rockets, mortars, mines, torpedoes, gun ammunition, and other munitions have been used for almost 100 years, reported that the concentrations of metals in sediments at the range were orders of magnitude lower than in other portions of the Potomac River where metals are introduced from non-military sources (U.S. Department of the Navy 2013). Studies conducted at World War II munitions disposal sites in Hawaii reported that metal concentrations in sediments adjacent to munitions were not substantially higher than metal concentrations at control sites and that no associated adverse impacts to the marine ecology were evident compared with the control sites (Briggs et al. 2016). Lastly, long-term studies at a military training area in the Mariana Islands found no evidence that algae, corals, benthic invertebrates, sharks, rays, bony fish, or sea turtles have been adversely impacted by munitions used in the area since 1971 (Smith and Marx 2016). Overall, the cited studies indicate that excessive metals accumulation in sediments, degradation of water or sediment quality by metals, or associated

impacts on marine life have not occurred at maritime sites where substantial numbers of munitions have been expended or disposed, in some cases over many decades.

9.3.2 Explosives

Munitions used for EGTTR testing and training operations contain a wide variety of explosives including TNT, RDX, HMX, Composition B, Tritonal, AFX-757, PBXN, and others. During live missions in the EGTTR, explosives can enter the marine environment via high-order detonations, which occur when the munition functions as intended and the vast majority of explosives are consumed; low-order detonations, which occur when the munition partially functions and only a portion of the explosives are consumed; and unexploded munitions, which fail to detonate with no explosives consumed. During high-order detonations, a residual amount of the explosive material, typically less than 1 percent, would be unconsumed and released into the environment (Walsh et al. 2011). During low-order detonations, some residual amount of explosives associated with the detonation along with the remaining unconsumed portion of the explosive fill would enter the marine environment. If the munition does not explode, it becomes UXO. In this case, all the explosive material would remain within the munition casing and enter the marine environment. Explosives in UXO may be released into the marine environment if the casing corrodes or ruptures.

The majority of live munitions used during EGTTR operations are successfully detonated as intended. Given that high-order detonations consume the vast majority of explosive material in the munition, successful detonations are considered to be a negligible source of explosives released into the marine environment. Failure rates for munitions vary by munition type and the manner in which the munition is used during the mission. Failure rates are not available for all munitions that would be used under the Proposed Action; however, a failure rate of 5 percent is considered a reasonable estimate for general munition failure. Low-order detonations are much less common than munition failures and, therefore, are considered to contribute negligible explosives into the marine environment. Based on these factors, approximately 5 percent of the munitions that would be used under the Proposed Action are expected to be potential sources of explosives material released into the EGTTR.

Various factors influence how explosives behave in the marine environment, including their solubility in seawater, their capacity for adsorbing onto other materials in the water, and the extent to which they degrade and lose their energetic properties. Several studies have shown that explosives such as TNT, RDX, and others undergo degradation in the marine environment by microbes in the water column and sediments (Walker et al. 2006; Juhasz and Naidu 2007; Singh et al. 2009). Studies conducted at World War II munitions disposal sites in Hawaii reported that there were no confirmed detections of explosives in any sediment samples collected from the sites (Briggs et al. 2016) and that there was no bioaccumulation of munitions-related chemicals in organisms that colonized intact munitions (either UXO or inert) at the sites (Koide et al. 2016). A study conducted at the Potomac River Test Range, where bombs, rockets, mortars, mines, torpedoes, gun ammunition, and other munitions have been used for almost 100 years, reported that the concentrations of explosives and explosives by-products in sediments at the range were lower than in other portions of the Potomac River that receive inputs from non-military sources (U.S. Department of the Navy 2013). Lastly, Pait and others (2010) reported that explosives were not detected in sediment samples collected off the coast of Vieques, Puerto Rico, following the cessation of Navy training activities on the island, which were conducted for more than 45 years. Collectively, these studies indicate that explosives and explosives by-products that are released into the marine environment can be removed via biodegradation and that expended or disposed military munitions on the seafloor do not result in excessive accumulation of explosives in sediments or significant degradation of sediment quality by explosives.

9.3.3 Other Materials

In addition to metals and explosives, other materials associated with EGTTR operations that may be released into the marine environment include fuel, oil, and other fluids contained in remotely controlled

target boats. These materials would be released in relatively small quantities and would be readily mixed and diluted in the ocean with no appreciable impacts on water quality. Target boats may ignite and burn for hours following a munition strike. Target boats consist mostly of fiberglass and wood and contain polyurethane or polyisocyanurate foam in their hulls. The prolonged burning of fiberglass and foams in target boats would release fumes or smoke that contain toxic chemicals. Such released chemicals could eventually precipitate in air and enter the water column. Based on the vast area that such fumes would mix in air, the concentrations of any chemicals that may deposit on the ocean are expected to be low, and subsequent dilution with ocean water would further reduce any potential adverse impacts on water quality.

Flares and chaff are the primary aerial countermeasure munitions released by aircraft to prevent attack by enemy defense systems. Flares used for aerial countermeasures are commonly referred to as decoy flares and are typically composed of magnesium pellets that burn at high temperatures. The heat produced by decoy flares is intended to attract heat-seeking missiles toward the flares and away from the aircraft. Chaff serves as a radar countermeasure and consists of aluminum-coated glass fibers. When released from aircraft, clouds of chaff fibers are designed to confuse radar-guided missiles and prevent them from attacking the aircraft. The 53 WEG proposes to use a total of 1,800 flares and 7,500 bundles of chaff annually for Combat Archer missions in the EGTTR during the 2023–2030 period (Table 2-2). These quantities of flares and chaff are substantially lower than the quantities proposed to be used in the EGTTR annually during the previous mission period, which were 202,747 flares and 434,275 bundles of chaff.

Toxicity is of low concern during use of decoy flares based on the low toxicity of magnesium and the unlikelihood of ingestion of flare material by humans or animals (USAF 1997). Combat Archer missions would use the MJU-7A/B decoy flare, which is widely used throughout the DoD. This flare consists of a rectangular case that measures 1 by 2 by 8 inches and contains magnesium pellets. The pellets and case are designed to burn completely; the only components of the expended flare that are not consumed by burning are the plastic end cap and remains of the piston. Flare ash is a by-product of the combustion process and is widely dispersed by winds. Magnesium deposition into the marine environment would occur only when expended flares fail to function and the magnesium pellets in the flare do not burn. The MJU-7A/B flare has improved reliability relative to earlier versions. The reliability of the MJU-7A/B flare is estimated to be approximately 99 percent (GlobalSecurity.org 2011). Based on a 1 percent failure rate, 18 dud flares would be potentially deposited into the marine environment annually as a result of EGTTR operations under the Proposed Action. The unconsumed magnesium in these dud flares may ultimately leach into the water column; however, there would be no appreciable impact on water or sediment quality, or marine biota based on the low toxicity of magnesium, dilution in seawater, and low probability of ingestion by marine organisms. The end caps and pistons would be dispersed by ocean currents, eventually sink, and pose no appreciable risk to marine biota. For these reasons, the proposed annual expenditures of flares under the Proposed Action are expected to have no appreciable effect on water or sediment quality, or marine biota.

Combat Archer missions would primarily use R-188 chaff, which is a commonly used type of chaff. R-188 chaff consists of a rectangular cartridge that measures 1 by 1 by 8 inches and contains 5.46 million aluminum-coated glass fibers (dipoles) that are each approximately the thickness of a strand of fine human hair. The primary chemical constituents of this chaff type are aluminum, silica (silicon dioxide), and stearic acid, which is used in the anti-clumping coating applied to the fibers. When chaff is expended, the cartridge remains in the aircraft, and only the chaff fibers, a plastic piston, a felt spacer, and a plastic end cap are ejected from the aircraft. Chaff fibers are considered to not be toxic at the concentrations that are deposited during military training. When released from aircraft, chaff can be dispersed over long distances by wind before eventually depositing onto land or water bodies (Arfsten et al. 2002; USAF 1997). Based on a review of available literature, chaff releases during military training exercises would have no significantly adverse impacts on the marine environment based on the low toxicity of chaff constituents, the amount of chaff that can be realistically deposited in any given area, and dispersion of deposited chaff fibers by ocean currents (Farrell and Siciliano 2004; Hullar et al. 1999; USAF 1997). The associated chaff pistons, spacers, and end caps would be dispersed by ocean currents, eventually sink, and pose no

appreciable risk to marine organisms. For these reasons, the proposed annual expenditures of chaff under the Proposed Action are expected to have no appreciable effect on water or sediment quality, or marine biota. Missiles, which make up a substantial portion of the munitions that would be used under the Proposed Action, are propelled by solid rocket motors. The solid-propellant mixture of solid rocket motors typically consists of ammonium perchlorate as the oxidizer, aluminum powder as the fuel, iron oxide (catalyst), a polymer that serves as binder for holding the mixture together and acting as a secondary fuel, and an epoxy curing agent. Ammonium perchlorate as the oxidizing agent accounts for most of the propellant by weight. Studies have shown that all but trace amounts of ammonium perchlorate are consumed by solid rocket motors in missiles and rockets (Jenkins et al. 2008). Ammonium perchlorate is highly soluble in water; therefore, any ammonium perchlorate that may be released into the marine environment (for example, from a failed missile test) is expected to be readily diluted and have no appreciable effect on water quality.

9.3.4 Summary

Based on the analysis conducted, metals, explosives, and other materials associated with EGTTR operations under the Proposed Action would be released into the marine environment at low concentrations, would be readily diluted, and would have negligible potential to adversely impact water or sediment quality; therefore, no associated impacts to marine mammal habitat are expected from such releases. This finding is supported by several studies that indicate that excessive accumulation of munitions constituents such as metals and explosives has not occurred in sediments, water and sediment quality have not been degraded by such substances, and there have been no associated adverse impacts on marine life at maritime sites where substantial numbers of munitions have been expended or disposed of, in some cases over many decades (Pait et al. 2010; U.S. Department of the Navy 2010; U.S. Department of the Navy 2013; Briggs et al. 2016; Koide et al. 2016; Smith and Marx 2016).

10. Anticipated Effects of Habitat Impacts on Marine Mammals

Based on the analysis conducted in Section 9, munitions detonations, mission-related debris, and release of metals, explosives, and other materials associated with EGTTR operations under the Proposed Action would not result in loss or degradation of marine mammal habitat. Therefore, there would be no associated impacts to any of the marine mammals analyzed.

11. Mitigation Measures to Protect Marine Mammals

The takes presented in this LOA Request for the common bottlenose dolphin, Atlantic spotted dolphin, and Rice's whale are overestimates based on the conservative assumptions applied to the impact analyses conducted for the Proposed Action, as discussed in Sections 6 and 7. The take estimates also do not consider the monitoring and mitigation measures that are implemented for the protection of marine mammals during EGTTR operations. These measures have been developed in consultation with NMFS for past incidental take requests and have been integrated into the planning and execution of EGTTR missions for years. These measures will continue to be implemented along with new measures for the Rice's whale during the 2023–2030 mission period. Descriptions of the established monitoring and mitigation measures in this section are carried over from the previous LOA Request (USAF 2017b), except where noted otherwise.

11.1 General Information

Monitoring and mitigation measures for protected species are implemented for all EGTTR missions that involve the use of live munitions. These measures broadly include trained marine species observers, pre- and post-mission monitoring from various platforms, and sea state restrictions.

11.1.1 Trained Observers

All personnel who conduct protected species monitoring are required to complete Eglin's Marine Species Observer Training Course, which was developed in consultation with NMFS. This training covers applicable environmental laws and regulations, consequences of non-compliance, observer roles and responsibilities, photographs and descriptions of protected species and indicators, survey methods, monitoring requirements, and reporting procedures. Personnel from Eglin Natural Resources provide the training and maintain the training records. Any person who will serve as a protected species observer for a particular mission must have completed the training within a year prior to the mission. For missions that require multiple survey platforms to cover a large area, a Lead Biologist is designated to lead the monitoring and coordinate sighting information with the Test Director or Safety Officer.

11.1.2 Pre- and Post-Mission Monitoring

Pre- and post-mission monitoring for protected species is conducted for every live mission. The purpose of pre-mission monitoring is 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 depends on the area required to be surveyed, the type of survey platforms used (vessels versus aircraft), and any potential lapse in time between the end of the surveys and the beginning of the mission. This lapse would typically occur when survey vessels are required to relocate to the perimeter of the human safety zone prior to the release of munitions. To address this lapse in time, Eglin AFB has been surveying twice the dolphin PTS threshold distance of the mission-day category. Surveying this additional buffer area ensures that dolphins are not within the PTS zone at the start of the mission. Observers document all marine mammal sightings, including the species (if possible), number, location, and behavior of the observed animals on report forms that are submitted to Eglin Natural Resources after each mission. Missions may be postponed, relocated, or canceled based on the presence of protected species within the survey areas. If one or more sperm or Rice's whales are detected during pre-mission monitoring, mission activities will be suspended for the remainder of the day.

During post-mission monitoring, observers survey the mission site for any dead or injured marine mammals. The duration of post-mission surveys is based on the survey platforms used and any potential time lapse between the last detonation and the beginning of the post-mission survey. This lapse typically occurs when survey vessels stationed on the perimeter of the human safety zone are required to wait until the range has been declared clear before they can begin the survey. All marine mammal sightings during

post-mission surveys are documented on report forms that are submitted to Eglin Natural Resources after the mission.

Any observations of dead or injured marine mammals would be reported immediately to Eglin Natural Resources. Observers would identify the species and location, collect information on the animal's appearance, condition, and behavior, and, if practicable, take photographs and maintain visual contact with the animal. Once notified by the observer, Eglin Natural Resources would contact the local Marine Mammal Stranding Coordinator and provide available information on the animal. The GPS coordinates of the last known location of the animal would be provided to the Stranding Coordinator, who would potentially send a response team to the site.

11.1.3 Sea State Conditions

Appropriate sea state conditions must exist for protected species monitoring to be effective. Wind speed and the associated roughness of the sea surface are key factors that influence the effectiveness of observer monitoring. Strong winds increase wave height and create whitecaps, both of which limit an observer's ability to visually detect marine species at or near the surface. The sea state scale used for EGTTR pre-mission protected species surveys is presented in Table 11-1. Missions will be delayed or rescheduled if conditions exceed sea state 4, which is defined as moderate breeze, breaking crests, numerous white caps, wind speed of 11 to 16 knots, and wave height of 3.3 to 6 feet. Marine species observers or the Lead Biologist will determine whether sea conditions are suitable for protective species monitoring.

In addition to sea state restrictions, daylight and visibility restrictions are also implemented to ensure the effectiveness of protected species monitoring. All live missions except for AFSOC gunnery and hypersonic weapon missions will occur no earlier than 2 hours after sunrise and no later than 2 hours before sunset to ensure adequate daylight for pre- and post-mission monitoring. Protected species monitoring for AFSOC gunnery missions is conducted by the aircrews using radar and sensor systems and by visual means. When aerial monitoring is conducted by aircraft, a minimum ceiling of 305 meters (1,000 feet) and visibility of 5.6 kilometers (3 NM) are required for effective monitoring efforts and flight safety.

Table 11-1. Sea State Scale Used for EGTTR Pre-Mission Protected Species Surveys
LOA for Eglin Gulf Test and Training Range

Sea State Number	Sea Conditions
0	Flat, calm, no waves or ripples
1	Light air, winds 1 to 2 knots; wave height to 1 foot; ripples without crests
2	Light breeze, winds 3 to 6 knots; wave height 1 to 2 feet; small wavelets, crests not breaking
3	Gentle breeze, winds 7 to 10 knots; wave height 2 to 3.5 feet; large wavelets, scattered whitecaps
4	Moderate breeze, winds 11 to 16 knots; wave height 3.5 to 6 feet; breaking crests, numerous whitecaps
5	Strong breeze, winds 17 to 21 knots; wave height 6 to 10 feet; large waves, spray possible

11.1.4 Determination of Survey Areas

The dolphin threshold distances predicted for the mission-day categories, presented in Table 6-4, will be used to determine the size of the pre-mission survey areas during the 2023–2030 period covered by this LOA Request. Each user group will identify the mission-day category that best corresponds to its actual mission based on the energy that would be released. The user group will estimate the NEWi of the actual mission to identify which mission-day category to use. The energy of the actual mission will be less than the energy of the mission-day category in terms of total NEWi and largest single munition NEWi to ensure

that the energy and effects of the actual mission will not exceed the energy and effects estimated for the corresponding mission-day category.

For any live mission other than gunnery missions, the pre-mission survey area will extend out to, at a minimum, double the Level A PTS threshold distance that applies to both dolphin species (185 dB SEL). Depending on the mission-day category that best corresponds to the actual mission, the distance from the detonation point to be monitored could vary between approximately 1,356 meters for mission-day category J and 272 meters for mission-day category I (Table 6-4). Surveying twice the dolphin PTS threshold distance provides a buffer when there is a lapse between the time when the survey ends and the time when the species observers reach the perimeter of the human safety zone before the start of the mission. Surveying this additional buffer area ensures that dolphins are not within the PTS zone at the start of the mission.

Missions involving air-to-surface gunnery operations will survey even larger areas based on previously established safety profiles and the ability to conduct aerial surveys of large areas from the types of aircraft used for these missions. The monitoring areas and altitudes for gunnery missions are identified in Table 11-2. Monitoring procedures for gunnery missions are discussed in Section 11.2.

Table 11-2. Monitoring Areas and Altitudes for Gunnery Missions

LOA for Eglin Gulf Test and Training Range

Aircraft	Gunnery Round	Monitoring Area	Monitoring Altitude	Operational Altitude
AC-30 Gunship	30 mm; 105 mm (FU and TR)	5 NM (9,260 m)	6,000 feet	15,000 to 20,000 feet
CV-22 Osprey	.50 caliber	3 NM (5,556 m)	1,000 feet	1,000 feet

FU = Full Up; m = meter(s); mm = millimeter(s); NM = nautical mile(s); TR = Training Round

11.2 Description of Monitoring Activities

11.2.1 Vessel-Based Monitoring

Pre-mission surveys conducted from vessels will typically begin at sunrise. Trained marine species observers will use dedicated vessels to monitor for protected marine species and potential indicators during the pre-mission surveys. For missions that require multiple vessels to cover a large survey area, a Lead Biologist will be designated to coordinate all survey efforts, compile sighting information from the other vessels, serve 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 predetermined line transects, or survey routes, that will provide sufficient coverage of the survey area. Monitoring will be conducted from the highest point feasible on the vessels (Figure 11-1). There will be at least two observers on each vessel, and they will each use professional-grade binoculars.

Figure 11-1. Marine Species Observer

11.2.1.1 Roles and Responsibilities

All sighting information from pre-mission surveys will be communicated to the Lead Biologist on a predetermined 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 if the survey area is clear or not clear of protected species. If the area is not clear, the Lead Biologist will provide recommendations on whether the mission should be delayed or canceled. For example, a mission delay would be recommended if a small number of protected species are in the ZOI but appear to be 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 are swimming away from the range. A mission cancellation could be recommended if one or more protected species are sighted in the ZOI and there is no indication that they would leave the area within a reasonable time frame. 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. Ultimately, the Safety Officer will have final authority on decisions regarding delays and cancellations of missions.

11.2.1.2 Human Safety Zone Enforcement

The size of the human safety zone varies depending on the munition type and delivery method. A composite safety zone is often developed for missions that involve multiple munition types and delivery methods. A typical composite safety zone is octagon-shaped to make it easier to monitor by range-clearing boats and easier to interpret by the public when it is overlaid on maps with latitude and longitude coordinates (Figure 11-2). The perimeter of a composite safety zone may extend out to approximately 15 miles (13 NM) from the center of the zone and may be monitored by up to 25 range-clearing boats to ensure it is free of any non-participating vessels before and during the mission. The range-clearing boats are typically at their guard stations by sunrise before commercial and recreational boaters have an opportunity to enter the safety zone. Maps of the safety zone with latitude and longitude coordinates are handed out to vessel operators in Destin Pass and made available at marinas in advance of the mission. Two range-clearing boats are stationed in Destin 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. The Eglin Safety Office remotely monitors real-time activity of vessels in the area to make clear-to-arm and clear-to-fire

calls for the mission. The Eglin Safety Office also requests that the USCG issue a Notice to Mariners in advance of the mission to inform the public about the location and restrictions of the safety zone.

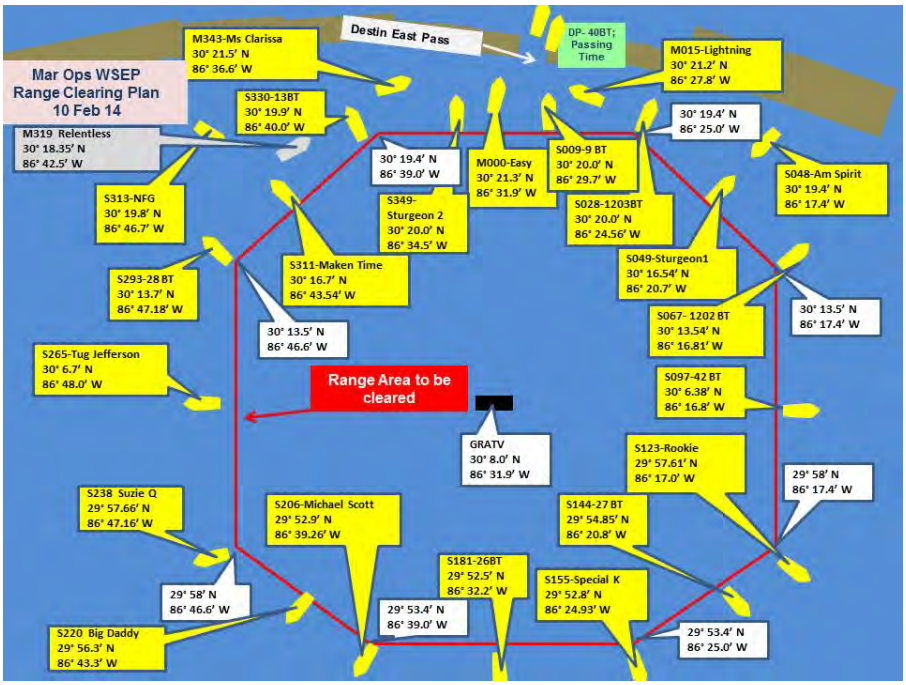


Figure 11-2. Example Human Safety Zone to Be Cleared

Marine species observers typically aim to complete the pre-mission surveys at least 30 minutes prior to the mission start time 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; however, the effectiveness of the monitoring will be limited because each vessel will remain at a designated station to maintain range clearance. Additional measures are implemented to address this time lapse, which may include surveying an additional buffer area or supplemental monitoring.

11.2.1.3 Air Force Support Vessels

Air Force support vessels will be operated by a combination of USAF and civil service/civilian personnel responsible for mission site/target setup and range-clearing activities. For each mission, USAF personnel will be within the mission area (on boats and the GRATV) well in advance of initial munitions use, typically around sunrise. While in the mission area, they will perform a variety of tasks, such as target preparation and equipment checks, and will also observe for marine mammals and indicators when possible. Such observations are considered incidental and would occur only as time and schedule permit. Any sightings would be relayed to the Lead Biologist.

The Eglin Safety Officer, in cooperation with the CCF and Tower Control at Test Site A-13B on Santa Rosa Island, will coordinate and manage all range-clearing efforts and will be in direct communication with the survey vessel team, typically through the Lead Biologist. All support vessels will be in radio contact with each other and with Tower Control. The Safety Officer will monitor all radio communications, and Tower Control will relay messages between the vessels and the Safety Officer. The Safety Officer and Tower Control will also be in constant contact with the Test Director throughout the mission to convey information on range clearance and marine species surveys. Final decisions regarding mission execution, including possible mission delay or cancellation based on marine species sightings or civilian boat traffic, will be the responsibility of the Safety Officer, with concurrence from the Test Director.

11.2.2 Aerial-Based Monitoring

Aircraft provide an excellent viewing platform for detecting marine mammals at or near the sea surface. Depending on the mission, the aerial survey team will consist of Eglin Natural Resources personnel or their designees aboard a non-mission aircraft or the mission aircrew who have completed the Marine Species Observer Training.

11.2.2.1 Non-Mission Aircraft

For non-mission aircraft, the pilot will be instructed on marine species survey techniques and will be familiar with the protected species expected to occur in the area. One trained observer in the aircraft will record data and relay information on species sightings, including the species (if possible), location, direction of movement, and number of animals, to the Lead Biologist. The aerial team will also look for potential indicators of protected species presence, such as large schools of fish and large, active groups of birds. Pilots will fly the aircraft so that the entire ZOI (and a buffer, if required) is monitored. Marine species sightings from the aerial survey team will be compiled by the Lead Biologist and communicated to the Test Director or Safety Officer. As with vessel-based surveys, all non-mission personnel will be required to exit the human safety zone before the mission begins. Depending on the time lapse between the pre-mission survey and commencement of munitions use, the aerial team may be required to survey an additional buffer zone, as previously described, unless other monitoring assets, such as live video monitoring, can be conducted. Monitoring by non-mission aircraft would be conducted only for certain missions, when the use of such aircraft is practicable based on other mission-related factors.

11.2.2.2 Mission Aircraft

Some mission aircraft have the capability to conduct aerial surveys for marine species immediately prior to releasing munitions. Mission aircraft used to conduct aerial surveys will be operated at reasonable and safe altitudes appropriate for visually scanning the sea surface and/or using onboard instrumentation to detect protected species. The primary mission aircraft that conduct aerial surveys for marine species are the AC-130 gunship and CV-22 Osprey used for gunnery operations. For some missions, other aerial platforms may be available to provide supplemental monitoring before and/or during the mission.

AC-130 and CV-22 Procedures

AC-130 gunships and CV-22 tiltrotor aircraft are used to conduct gunnery operations in the EGTTR. AFSOC AC-130 gunnery training involves the use of 30 mm and 105 mm FU rounds during daytime and 30 mm and 105 mm TRs during nighttime. The TR variant (0.35 lb NEW) of the 105 mm HE round has less explosive material than the FU round (4.7 lb NEW). AC-130s are equipped with low-light electro-optical and infrared sensor systems that provide excellent night vision. AFSOC uses the 105 mm TRs during nighttime missions as an additional mitigation measure for protected marine species.

After arriving at the mission site and before initiating gun firing, the aircraft will fly at least two complete orbits around the target area out to the applicable ZOI at a minimum safe airspeed and appropriate monitoring altitude. If no protected species or indicators are detected, the aircraft will then ascend to an operational altitude while continuing to orbit the target area as it climbs. The initial orbits typically last approximately 10 to 15 minutes. Monitoring for marine species and non-participating vessels continues throughout the mission. If a towed target is used, mission personnel will maintain the target in the center portion of the survey area to ensure gunnery impacts do not extend past the predetermined ZOI.

During the low-altitude orbits and climb, the aircrew will visually scan the sea surface for the presence of protected marine species. The visual survey will 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 for these visual surveys. In addition to the visual surveys, the low-light electro-optical and infrared sensor systems on board the aircraft will also be used for protected species monitoring. Infrared sensors are capable of detecting differences in temperature from thermal energy (heat) radiating from living bodies or from reflected and scattered thermal energy. Infrared systems are

equally effective during day or night. Nighttime missions during the 2023–2030 period would be conducted by AC-130s that have been upgraded recently with MX-25D sensor systems, which provide superior night-vision capabilities relative to earlier sensor systems. CV-22 training involves the use of only .50 caliber rounds, which do not contain explosive material and, therefore, do not detonate. Protected species monitoring procedures for CV-22 training are similar to those described for AC-130 gunnery training, except that CV-22 aircraft typically operate at much lower altitudes than AC-130 gunships (Table 11-2). CV-22s have comparable electro-optical and infrared sensor systems that allow advanced detection capability during day and night.

If protected marine species are detected during pre-mission surveys or during the mission, operations will be immediately halted until the ZOI is clear of all animals, or the mission will be relocated to another target area. If the mission is relocated, the pre-mission survey procedures will be repeated in the new area. In addition, if multiple gunnery missions are conducted during the same flight, marine species monitoring will be conducted separately for each mission. Following each mission, aircrews will conduct a post-mission survey beginning at the operational altitude and continuing through an orbiting descent to the designated monitoring altitude. The descent will typically last approximately 3 to 5 minutes. Aircrews will conduct visual and instrumentation-based scans during the post-mission survey as described for the pre-mission survey.

11.2.3 Video-Based Monitoring

Video-based monitoring is conducted via transmission of live, high-definition video feeds from the GRATV at the mission site to the CCF. These video feeds can be used to remotely view the mission site to evaluate environmental conditions and monitor for marine species up to the time munitions are used. There are multiple sources of video that can be streamed to multiple monitors within the CCF. When authorized for specific missions, a trained marine species observer from Eglin Natural Resources will monitor the live video feeds transmitted to the CCF and will report any protected marine species sightings to the Safety Officer, who will also be at the CCF. Video monitoring can mitigate the lapse in time between the end of the pre-mission survey and the beginning of the mission.

Four video cameras are typically operated on the GRATV for real-time monitoring and data collection during the mission. 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 by 146 feet. The cameras allow video observers to detect an item as small as 1 square foot up to 4,000 meters away. The USAF 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 is typically located approximately 600 feet (183 meters) from the target area. Representative screenshots from three different cameras are shown on Figures 11-3 through 11-5.

Figure 11-3. Representative Screenshot from Camera 1

Figure 11-4. Representative Screenshot from Camera 2

Figure 11-5. Representative Screenshot from Camera 3

Supplemental video monitoring can also be conducted via additional aerial assets, when available. Eglin's aerostat balloon provides aerial imagery of weapon impacts and instrumentation relay. When used, it is tethered to a boat anchored near the GRATV. The balloon can be deployed to an altitude of up to 2,000 feet. 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 the 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. UAVs 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 overall monitoring efforts. Even with a variety of platforms potentially available to supply video feeds to the CCF, the entire ZOI may not be visible for the entire duration of the mission. However, the targets and immediate surrounding areas will typically be in the field of view of the GRATV cameras, which will allow the observer to detect any protected species that may enter the target area before weapon releases. The cameras also allow the observer to readily inspect the target area for any signs that animals were injured. If a protected marine species is 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 the CCF.

The video camera observer will have open lines of communication with the observers on vessels to facilitate real-time reporting of marine species sightings and other relevant information, such as the presence of non-participating vessels near the human safety zone. Direct radio communication will be maintained between vessels, GRATV personnel, and Tower Control throughout the mission. The Safety Officer will monitor all radio communications from the CCF, and information between the Safety Officer and support vessels will be relayed via Tower Control.

11.3 Operational Mitigation Measures for Gunnery Missions

In addition to the mitigation measures associated with the pre-mission surveys, other operational mitigation measures that have been historically implemented for gunnery missions include using only the 105 mm TR for nighttime missions; using ramp-up procedures that begin with the smallest round and proceed to increasingly larger rounds; and conducting all gunnery missions landward of the 200-meter isobath. The aircrews also reinitiate the protected species surveys if gunnery firing pauses last longer than 10 minutes. There has been no evidence to date of any cases in which mortality or injury to protected marine species resulted from gunnery missions in the EGTTR.

A standard 105 mm HE round has a NEW of 4.7 lb. The TR variant of the 105 mm HE round, which has a NEW of 0.35 lb, is used by AFSOC for nighttime missions. This TR was developed to have less explosive material to minimize potential impacts to protected marine species, which could not be adequately surveyed at night by earlier aircraft instrumentation. Since the development of the 105 mm TR, AC-130s have been equipped with low-light electro-optical and infrared sensor systems that provide excellent night vision. AFSOC has continued to use only the 105 mm TRs during nighttime missions as an additional protective measure and proposes to continue this practice during the 2023–2030 period.

Guns on the AC-130 are first checked for functionality and are calibrated, which 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 training scenarios. Gun firing during the initial calibration phase will begin with the smallest round and proceed to increasingly larger rounds. This process is referred to as ramp-up procedures, and its purpose is to expose the environment to steadily increasing noise levels with the intent that marine animals will move away from the area before noise levels increase. Ramp-up procedures will continue to be used during the 2023–2030 mission period.

As a mitigation measure to prevent impacts to cetacean species known to occur in deeper portions of the Gulf of Mexico, such as the federally endangered sperm whale, AFSOC has historically conducted all gunnery missions landward of the 200-meter isobath, which is generally considered to be the shelf break in the Gulf of Mexico. While implementing this measure would prevent impacts to most marine mammal species in the Gulf, it may not provide full protection to the Rice's whale, which has been documented to occur in waters as shallow as 117 meters, although the majority of sightings have occurred in waters deeper than 200 meters. To prevent any PTS impacts to the Rice's whale from gunnery operations, all gunnery missions during the 2023–2030 period will be conducted at least 500 meters landward of the 100-meter isobath instead of landward of the 200-meter isobath.

11.4 Other Mitigation Measures

As a mitigation measure to prevent any PTS impacts to the Rice's whale during the 2023–2030 mission period, the USAF will restrict the use of live munitions in the western part of the existing LIA and proposed East LIA based on the setbacks from the 100-meter isobath presented in this LOA Request. Each user group will use the mission-day categories and corresponding setback distances to determine the setback distance that is appropriate for their actual mission. The setback distances determined for the mission-day categories are presented in Table 6-10 and are shown for the existing LIA and proposed East LIA on Figures 6-5 and 6-6, respectively.

To minimize impacts to the Rice's whale from inert munitions both inside and outside the LIAs, the USAF will prohibit the use of inert munitions in Rice's whale habitat during the next mission period. Under this

new mitigation measure, inert munitions use will be prohibited between the 100-meter and 400-meter isobaths throughout the EGTTR.

Missions proposed to be conducted during nighttime would require pre-mission monitoring comparable to the monitoring conducted by AC-130 aircrews for AFSOC gunnery missions. Other than AFSOC gunnery training, HACM tests are the only other EGTTR missions currently proposed to be conducted at nighttime during the 2023–2030 period. HACM tests and any other missions that are actually conducted at nighttime during the mission period will be required to be supported by AC-130 aircraft with night-vision instrumentation or other platforms with comparable nighttime monitoring capabilities. Live HACMs would be fired into the existing LIA or East LIA. Like other inert munitions, inert HACMs could be fired into portions of the EGTTR outside the LIAs but would need to be outside the area between the 100-meter and 400-meter isobaths. For live HACM missions, the pre-mission survey area will extend out to, at a minimum, double the Level A PTS threshold distance that applies to both dolphin species (185 dB SEL) for a HACM test. A HACM test would correspond to mission-day category K, which is estimated to have a PTS threshold distance of 0.26 km. Therefore, the pre-mission survey for a HACM test would extend out to 0.52 km, at a minimum.

11.5 Coordination with Eglin Natural Resources Office for Implementation of Monitoring Requirements

Prior to live missions, user groups will coordinate with Eglin Natural Resources on their mitigation and monitoring requirements. Mission assets available for monitoring will be identified, and an implementation plan will be developed. Training and reporting requirements will also be communicated to the user groups.

An example mitigation plan that would generally apply to air-to-surface missions incorporating vessel-based pre-mission surveys and video monitoring is presented in the subsection that follows. Most or all the identified elements could be implemented for many missions; however, there may be instances when specific actions are not feasible.

11.5.1 Example Mitigation Plan

To ensure the safety of survey personnel, the team will depart from the mission area approximately 30 minutes before live ordnance delivery is scheduled to begin. Stepwise mitigation procedures are as follows:

a) Sunrise or 2 Hours prior to Mission:

USAF range-clearing vessels and protected species survey vessels will be onsite at least 2 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 or absence of marine mammal indicators. This information will be communicated to Tower Control and relayed to the Safety Officer in the CCF. If weather and/or sea conditions preclude adequate pre-mission monitoring for detecting protected marine species, the mission will be delayed until adequate conditions exist for monitoring to be conducted.

b) 1 1/2 Hours prior to Mission – Commence Pre-Mission Surveys:

Vessel-based surveys will begin approximately 1 1/2 hours prior to live weapon deployment. Vessel observers will survey the ZOI and relay all sightings of marine species and indicators, 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 1 hour or until the entire ZOI has been adequately surveyed, whichever comes first. If marine mammals or indicators are observed within the ZOI, the range will be declared to be “fouled,” which signifies to

mission personnel that conditions are not suitable to proceed with the mission. If no marine mammals or indicators are sighted, the range will be declared to be clear of protected species.

c) 1/2 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 will be on average approximately 15 miles (13 NM) from the detonation point. The actual size of the safety zone is determined by the weapon NEW and method of delivery. Observers will continue to monitor for protected species while transiting to the safety zone perimeter. As the survey vessels leave the mission area, marine species monitoring of the immediate target areas will continue at the CCF via 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 the mission will be allowed to proceed, assuming no other non-participating vessels are in the mission area.

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 will be postponed if the following events occur:

1) Any marine mammal is visually detected within the ZOI. Postponement would continue until one of the following criteria are met for the animals that caused the postponement:
    a) The animals are confirmed to be outside of the ZOI on a heading away from the targets.
    b) The animals are not seen again for 30 minutes and are presumed to be outside the Level A PTS ZOI due to the animals 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.
5) If one or more sperm or Rice's whales are detected during pre-mission monitoring, mission activities will be suspended for the remainder of the day.

In the event of a postponement, protected species monitoring would continue from the CCF via 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 as soon as EOD personnel declare the mission area to be safe, if required. 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. In addition, up to 10 USAF support vessels will spend several hours in this area collecting debris from damaged targets. All vessels will be instructed to report any dead or injured marine mammals to the Lead Biologist.

11.6 Mitigation Effectiveness

The effectiveness of the monitoring and mitigation measures implemented for EGTTR operations depends largely on the ability to visually detect marine mammals at or near the water surface and the elapsed time between the completion of pre-mission surveys and munitions use. Eglin AFB implements sea state, daylight, and visibility restrictions to maximize the ability of observers to visually detect protected species during surveys. To address the lapse in time between the end of the survey and the start of the mission, Eglin AFB has been surveying twice the dolphin PTS threshold distance of the mission-day category. Surveying this additional area provides a buffer that ensures that dolphins are not within the PTS zone at the start of the mission. This buffer area and the use of live video monitoring of the target area during the mission minimize the potential for animals to enter the ZOI during the time when vessel-based monitoring cannot be conducted. Eglin AFB will continue to implement these mitigation measures during the 2023–2030 mission period to the extent practicable.

Each year, Eglin Natural Resources submits an annual report to NMFS that summarizes the results of protected species surveys conducted for EGTTR missions. From 2010 to 2021, Eglin AFB conducted 67 gunnery missions in the EGTTR. The monitoring procedures followed for these missions are described in Section 11.2.2. To date, there has been no evidence that marine mammals have been impacted from gunnery operations conducted in the EGTTR. Instrumentation on the AC-130 and CV-22 has proven effective in pre-mission surveys conducted to ensure the mission site is clear of protected species prior to gun firing. An unclassified image of three sharks, which was taken by an AC-130 at an approximate altitude of 15,000 feet using an electro-optical/infrared sensor, is provided as Figure 11-6. Monitoring altitudes during pre-mission surveys for both the AC-130 and CV-22 are much lower than 15,000 feet (Table 11-2); therefore, the instrumentation on these aircraft would be even more effective at detecting marine species than indicated by the photograph.

Figure 11-6. Image of Sharks from an AC-130 at an Approximate Altitude of 15,000 Feet above Sea Level

From 2013 to 2020, Eglin AFB conducted 25 live missions collectively under the Maritime Strike Operations and Maritime WSEP Operational Testing programs in the EGTTR, and from 2016 to 2021, Eglin AFB conducted 16 live PSW missions in the EGTTR. Maritime WSEP and PSW missions are proposed to continue over the 2023–2030 period (Sections 2.3.1 and 2.3.3). Protected species monitoring for these past missions was conducted using a combination of vessel-based surveys and live video monitoring from the CCF, as described in Section 11.2. Pre-mission survey areas for Maritime WSEP and PSW missions were based on mission-day categories developed per NMFS's request to account for the accumulated energy

from multiple detonations. Surveys conducted for the earlier Maritime Strike missions were based on thresholds determined for single detonations; however, these missions involved detonations of larger munitions. There has been no evidence of mortality, injury, or any other detectable adverse impact to any marine mammal from the Maritime Strike, Maritime WSEP, or PSW missions conducted to date. Dolphins were sighted within the ZOI prior to ordnance delivery during some of these past missions. In these cases, the mission was postponed until the animals were confirmed to be outside the ZOI. Although monitoring during and following munitions use is limited to observable impacts within and in the vicinity of the mission area, the lack of any past evidence of any associated impacts on marine mammals is an indication that the monitoring and mitigation measures implemented for EGTTR operations are effective.

12. Mitigation Measures to Protect Subsistence Uses

Potential impacts on subsistence uses do not apply to the Proposed Action. This issue applies only in Alaska.

13. Monitoring and Reporting

The monitoring conducted by Eglin AFB for the protection of marine mammals in the EGTTR is described in detail in Section 11. The following training and reporting requirements are associated with the marine species monitoring conducted by Eglin AFB in the EGTTR:

- Within a year before the planned missions, all personnel who will serve as observers will take the Marine Species Observer Training Course developed by Eglin AFB in cooperation with NMFS.
- Eglin Natural Resources will track use of the EGTTR and protected species monitoring results using protected species observer report forms.
- An annual report that summarizes the results of marine mammal surveys conducted for EGTTR missions will be submitted to the NMFS Southeast Regional Office and NMFS Office of Protected Resources. This annual report must include the following information:
  - Date, time, and description of each mission
  - Description of the monitoring and mitigation measures implemented during each mission
  - Results of the monitoring program, including relevant observations and any information on observed or expected takes
- If any dead or injured marine mammals are observed or detected prior to mission activities, or injured or killed during mission activities, a report documenting the incident must be submitted to NMFS by the following business day.

14. Suggested Means of Coordination

Eglin AFB does not currently conduct independent marine mammal research; however, Eglin Natural Resources participates in marine animal tagging and monitoring programs led by other agencies. In addition, Eglin Natural Resources has participated in marine mammal surveys led by NMFS in the Gulf of Mexico. From 1999 to 2002, Eglin participated in summer cetacean monitoring and research through a contractor, who served as a visual observer for cetacean surveys in 1999 and the Sperm Whale Pilot Study in 2001, and as member of the behavioral team for the Sperm Whale Seismic Study research cruises in 2001 and 2002. Eglin Natural Resources also obtained DoD funding for the development of two marine mammal density models by NMFS, including the habitat-based density models developed by Garrison (2008) for cetaceans and sea turtles in the Gulf of Mexico.

Eglin AFB collects, analyzes, and maintains marine mammal stranding data to increase its understanding of cetacean populations in the northeastern Gulf and how they may be potentially impacted by EGTTR operations. Eglin AFB coordinates with local, state, and regional marine mammal stranding networks and maintains its own team of permitted stranding personnel. Stranding events are tracked by year, season, and NMFS statistical zone, both in the Gulf of Mexico and on the coastline around Eglin AFB.

In July 2019, Eglin AFB received funding from the Air Force Civil Engineer Center to conduct a passive acoustic monitoring study that would involve in situ acoustic measurements of in-air and underwater detonations. To date, Eglin AFB has conducted in situ acoustic measurements during two missions involving live ordnance. Eglin AFB is coordinating with NMFS on the preliminary findings of these studies. The exposure and take estimates and associated mitigation measures presented in this LOA Request are based on the use of the dBSea Model, spatial density models developed by NMFS, established energy thresholds and equations, and the most recent scientific data available on marine mammal populations in the Gulf of Mexico. Eglin AFB will continue to coordinate with NMFS regarding the acoustic modeling and associated analyses conducted for EGTTR operations, including how in situ acoustic measurements can be potentially used to further our understanding of detonation acoustics and the associated impacts on marine mammals.

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Appendix A
Underwater Acoustic Impact Modeling and Analysis

Appendix A. Underwater Acoustic Impact Modeling and Analysis

Potential impacts to marine mammals and sea turtles from Eglin Gulf Test and Training Range (EGTTR) operations would primarily result from detonations of live munitions at or near the water surface. The pressure and impulsive noise from munition detonations have the potential to cause mortality, injury, hearing impairment, or behavioral responses in marine animals, depending on the impulsive energy released to the water by the munition and the distance of the animal from the source of the impulse. Impulsive sound waves lose energy as they spread from the detonation point; therefore, adverse effects on animals decrease exponentially with distance from the explosion. Animals farther from the detonation may experience temporary hearing impairment or disturbance that may evoke a behavioral response and interrupt normal activities. This appendix supplements information presented in Section 6 of this Letter of Authorization (LOA) Request regarding the modeling and analysis of underwater acoustic impacts to the Rice's whale and four sea turtle species as a result of EGTTR operations.

1.1 Munition Impact and Detonation Characteristics

Munitions traveling through air to an impact point have a kinetic energy equal to one half of the munition mass times the square of the munition velocity. When an air-to-surface munition impacts the water, some of the kinetic energy displaces water in the formation of an impact "crater" in the water, some of the kinetic energy is transmitted from the impact point as underwater acoustic energy in a pressure impulse, and the remaining kinetic energy is retained by the munition continuing to move through the water.

Following impact, the warhead of a live munition detonates at or slightly below the water surface. The warhead detonation converts explosive material into gas, further displacing water through the rapid creation of a gas bubble in the water, and creates a much larger pressure wave than the pressure wave created by the impact. These impulse pressure waves radiate from the impact point at the speed of sound in water, roughly 1,500 meters per second.

If the detonation is sufficiently deep, the gas bubble goes through a series of expansions and contractions, with each cycle being of successively lower energy. When detonations occur below but near the water surface, the initial gas bubble reaches the surface and causes venting, which also dissipates energy through the ejection of water and release of detonation gases into the atmosphere. When a detonation occurs below the water surface after the impact crater has fully or partially closed, water can be violently ejected upward by the pressure impulse and through venting of the gas bubble formed by the detonation. With radii of up to 15 meters, the gas bubbles that would be generated by EGTTR munition detonations would be larger than the depth of detonation but much smaller than the water depth, so all munitions analyzed are considered to fully vent to the surface without forming underwater bubble expansion and contraction cycles.

When detonations occur at the water surface, a large portion of the energy and gases that would otherwise form a detonation bubble are reflected upward from the water. Likewise, when a shallow detonation occurs below the water surface but prior to the impact crater closing, considerable energy is reflected upward from the water. As a conservative assumption, no energy losses from surface effects are included.

The impulsive pressure waves generated by munition impact and warhead detonation radiate spherically and are reflected between the water surface and the sea bottom. There is generally some attenuation of the pressure waves by the sea bottom but relatively little attenuation of the pressure waves by the water surface. As a conservative assumption, the water surface is assumed to be flat (no waves) to allow for maximum reflectivity.

The net explosive weight (NEW) of a munition at impact can be directly correlated with the energy in the impulsive pressure wave generated by the warhead detonation. The NEWs of munitions addressed range from 0.1 pound (lb) for small projectiles to 945 lb for the largest bombs. The explosive materials used in these munitions also vary considerably with different formulations used to produce different intended effects. The primary detonation metrics directly considered and used for modeling analysis are the peak

impulse pressure and duration of the impulse. An integration of the pressure of an impulse over the duration (time) of an impulse provides a measure of the energy in an impulse.

Some of the NEW of certain types of munitions, such as missiles, is associated with the propellant used for the flight of the munition. This propellant NEW is unrelated to the NEW of the warhead, which is the primary source of explosive energy in most munitions. The propellant of a missile fuels the flight phase and is mostly consumed prior to impact. Missile propellant typically has a lower flame speed than warhead explosives and is relatively insensitive to detonation from impacts but burns readily. A warhead detonation provides a high-pressure, high-velocity flame front that may cause burning propellant to detonate; therefore, this analysis assumes that the unconsumed residual propellant that remains at impact contributes to the detonation-induced pressure impulse in the water. The impact analysis assumes that 20 percent of the propellant remains unconsumed in missiles at impact; this assumption is based on input from user groups and is considered a reasonable estimate for the purpose of analysis. The NEW associated with this unconsumed propellant is added to the NEW of the warhead to derive the total energy released by the detonation. Absent a warhead detonation, it is assumed that continued burning or deflagration of unconsumed residual propellant does not contribute to the pressure impulse in the water; this applies to inert missiles that lack a warhead but contain propellant for flight.

In addition to the energy associated with the detonation, energy is also released by the physical impact of the munition with the water. This kinetic energy has been calculated and incorporated into the estimations of munitions energy for both live and inert munitions in this LOA Request. The kinetic energy of the munition at impact is calculated as one half of the munition mass times the square of the munition velocity. The initial impact event contributing to the pressure impulse in water is assumed to be 1 millisecond in duration. To calculate the velocity (and kinetic energy) immediately after impact, the deceleration contributing to the pressure impulse in the water is assumed for all munitions to be 1,500 g-forces, or 48,300 feet per square second over 1 millisecond. A substantial portion of the change in kinetic energy at impact is dissipated as a pressure impulse in the water, with the remainder being dissipated through structural deformation of the munition, heat, displacement of water, and other smaller energy categories. Even with 1,500 g-forces of deceleration, the change in velocity over this short time period is small and is proportional to the impact velocity and munition mass. The impact energy is the portion of the kinetic energy at impact that is transmitted as an underwater pressure impulse, expressed in units of trinitrotoluene-equivalent (TNT_{eq}). The impact energies of the proposed live munitions were calculated and included in their total energy estimations.

The impact energies of the inert munitions proposed to be used were also calculated. To assess the potential impacts of inert munitions on marine animals, the inert munitions were categorized based on their impact energies into the following four classes of 2 lb, 1 lb, 0.5 lb, and 0.15 lb TNT_{eq}; these values correspond closely to the actual or average impact energy values of the munitions and are rounded for the purpose of analysis. The 2 lb class represents the largest inert bomb, which includes the Mark (Mk)-84 General Purpose (GP), Guided Bomb Unit (GBU)-10, and GBU-31 bombs, whereas the 1 lb class represents the largest inert missile, which is the Air-to-Ground Missile (AGM)-158 Joint Air-to-Surface Standoff Missile (JASSM). The JASSM has greater mass but lower impact energy than the GBU-31; this is because of the JASSM's lower velocity at impact and associated change in velocity over the deceleration period, which contributes to the pressure impulse. The 0.5 lb and 0.15 lb impact energy classes each represent the approximate average impact energy of multiple munitions, with the 0.5 lb class representing munitions with mid-level energies, and the 0.15 lb class representing munitions with the lowest energies.

For this analysis, the NEW associated with the physical impact of each munition and the unconsumed propellant in certain munitions is added to the NEW of the warhead to derive the NEW at impact (NEWi) for each live munition. The NEWi of each munition was then used to calculate the peak pressure and pressure decay for each munition. This results in a more accurate estimate of the actual energy released by each detonation. Extensive research since the 1940s has shown that each explosive formulation produces unique correlations to explosive performance metrics. The peak pressure and pressure decay constant depend on the NEW, explosive formulation, and distance from the detonation. The peak pressure and

duration of the impulse for each munition can be calculated empirically using similitude equations, with constants used in these equations determined from experimental data (NSWC 2017).

Similitude Equations

$$\text{Pmax} = k_p \left(\frac{W^{1/3}}{3.28r} \right)^{\alpha_p}$$

$$\theta = k_\theta W^{1/3} \left(\frac{W^{1/3}}{3.28r} \right)^{\alpha_\theta}$$

where:

Pmax = shock wave peak pressure, pounds per square inch (psi)
θ = shock wave time constant, milliseconds (msec)
W = net explosive weight (NEW) or net explosive weight at impact (NEWi), lb
r = radial distance from detonation, meters
k_p = explosive-specific peak pressure similitude coefficient
α_p = explosive-specific peak pressure similitude exponent
k_θ = explosive-specific θ similitude coefficient
α_θ = explosive-specific θ similitude exponent

The explosive-specific similitude constants and munition-specific NEWi were used for calculating the peak pressure and pressure decay for each munition analyzed. It should be noted that this analysis assumes that all detonations occur in the water and none of the detonations occur above the water surface when a munition impacts a target. This exceptionally conservative assumption implies that all munition energy is imparted to the water rather than the intended targets.

1.2 Analysis Metrics

The following standard metrics are used to assess underwater pressure and impulsive noise impacts on marine animals:

- *Sound pressure level (SPL)* is the ratio of the absolute sound pressure and a reference level. In water, the units are in decibels (dB) referenced to 1 micropascal (µPa) (dB re 1 µPa). The SPL for a given munition can be explicitly calculated at a radial distance using the similitude equations.
- *Sound exposure level (SEL)* accounts for both sound intensity and duration. This metric provides a measure of cumulative exposure from multiple detonations over a 24-hour period. In water, the units are in dB referenced to 1 µPa-squared second (dB re 1 $\mu Pa^2 \cdot s$). A commercially available software package, dBSea (version 2.3), was used to calculate the SEL for each mission day.
- *Positive impulse* is the time integral of the initial positive phase of the pressure impulse. This metric provides a measure of energy in the form of time-integrated pressure. Units are typically pascal-seconds (Pa·s) or pounds per square inch (psi) per millisecond (msec) (psi·msec). The positive impulse for a given munition can be explicitly calculated at a given distance using the similitude equations and integrating the pressure over the initial positive phase of the pressure impulse.

The munition-specific peak pressure and pressure decay at various radii were used to determine the species-specific distance to effect for mortality, slight lung injury, peak pressure–induced permanent threshold shift (PTS) in hearing and peak pressure–induced temporary threshold shift (TTS) in hearing for each species. The munition-specific peak pressures and decays for all munitions in each mission-day category were used as a time-series input in the dBSea underwater acoustic model to determine the

distance to effect for cumulative SEL-based (24-hour) PTS, TTS, and behavioral effects for each species for each mission day.

1.3 Analysis Methodology

The zone of influence (ZOI) is the area or volume of ocean in which marine animals could be exposed to various pressure and impulsive noise levels generated by a surface or subsurface detonation. For this LOA Request, the ZOIs for the detonations under the Proposed Action were estimated using Version 2.3 of the dBSea model for cumulative SEL and using explicit similitude equations for SPL and positive impulse. The dBSea model is a commercially available model for evaluating underwater acoustic transmission. The characteristics of the impulse noise at the source were calculated based on munition-specific data including munition mass at impact, munition velocity at impact, NEW of warheads, explosive-specific similitude data, and propellant data for missiles. Table A-1 presents the source-level SPLs (at r = 1 meter) calculated for the munitions addressed in this LOA Request.

Table A-1. Calculated Source SPLs for Munitions

				Peak Pressure and Decay Values		
Type	**Warhead NEW (lbm)**	**Modeled Explosive**	**Model NEWi (lbm)**	**Pmax @ 1 m (psi)**	**SPL @ 1 m dB re 1 mPa**	**θ msec**
AGM-158 JASSM All Variants	240.26	Tritonal	241.36	45961.4858	290.0	0.320
GBU-54 KMU-572C/B, B/B	192	Tritonal	192.3	42101.8577	289.3	0.302
AGM-65 (all variants)	85	Comp B	98.3	37835.4932	288.3	0.200
AIM-120C3	15	PBXN-110	36.18	24704.864	284.6	0.167
AIM-9X Blk I	7.7	PBXN-110	20	19617.2833	282.6	0.143
AGM-114 (All ex R2 with TM(R10))	9	PBXN-110	13.08	16630.2435	281.2	0.128
AGM-179 JAGM	9	PBXN-110	13.08	16630.2435	281.2	0.128
AGM-114 R2 with TM (R10)	8	PBXN-9	13.08	17240.2131	281.5	0.124
AGR-20 (APKWS)	2.3	Comp B	3.8	10187.8419	276.9	0.090
PGU-43 (105 mm)	4.7	Comp B	4.72	11118.8384	277.7	0.095
GBU-69	36	Tritonal	36.1	22074.1015	283.7	0.198
GBU-70	36	Tritonal	36.1	22074.1015	283.7	0.198
GBU-39 SDB (GTV)	0.39	PBXN-9	0.49	4757.6146	270.3	0.054
GBU-53/B (GTV)	0.34	PBXN-9	0.44	4561.06062	270.0	0.053
GBU-12	192	Tritonal	192.3	42101.8577	289.3	0.302
Mk-81 (GP 250 lb)	100	H-6	100	38017.3815	288.4	0.237

105 mm HE (FU)	4.7	Comp B	4.7	11099.8118	277.7	0.095
30 mm HE	0.1	Comp B	0.1	2349.10708	264.2	0.037
105 mm HE (TR)	0.35	Comp B	0.37	3981.78228	268.8	0.051
GBU-10, GBU-24, or GBU-31	945	Tritonal	946.8	77897.0371	294.6	0.452
HACM	n/a	TNT	350	54468.3436	291.5	0.306
GBU-39 (SDB I)	36	Tritonal	36.1	22074.1015	283.7	0.198
Spike NLOS	34.08	PBXN-9	40	26720.2127	285.3	0.164
GBU-53 (SDB II)	22.84	PBXN-109	22.94	19365.0753	282.5	0.154
Inert GBU-39 (LSDB) with live fuze	0.39	PBXN-9	0.49	4757.6146	270.3	0.054
Inert GBU-53 (SDB II) with live fuze	0.34	PBXN-9	0.44	4561.06062	270.0	0.053
Underwater Mine Charge	20	C-4	20	20527.4244	283.0	0.140
Floating Mine Charge	5	C-4	5	11811.7218	278.2	0.100

θ = shock wave time constant; AGM = Air-to-Ground Missile; AIM = Air Intercept Missile; APKWS = Advanced Precision Kill Weapon System; dB re 1 µPa = decibel(s) referenced to 1 micropascal; FU = Full Up; GBU = Guided Bomb Unit; GP = General Purpose; GTV = Guided Test Vehicle; HACM = Hypersonic Attack Cruise Missile; HE = High Explosive; JASSM = Joint Air-to-Surface Standoff Missile; lb = pound(s); lbm = pound-mass; LSDB = Laser Small-Diameter Bomb; m = meter(s); Mk = Mark; mm = millimeter(s); msec = millisecond(s); NEW = net explosive weight; NEWi = net explosive weight at impact; NLOS = Non-Line-of-Sight; PGU = Projectile Gun Unit; Pmax = shock wave peak pressure; psi = pound(s) per square inch; SDB = Small-Diameter Bomb; SPL = sound pressure level; TM = telemetry

For SEL analysis, the dBSea model was used with the ray-tracing option for calculating the underwater transmission of impulsive noise sources represented in a time series (1,000,000 samples per second) as calculated using similitude equations (r = 1 meter) for each munition for each mission day. All surface detonations are assumed to occur at a depth of 1 meter, and all subsurface detonations, which would include the GBU-10, GBU-24, GBU-31, and subsurface mines, are assumed to occur at a depth of 3 meters. The model used bathymetry for the Live Impact Area (LIA) with detonations occurring at the center of the LIA with a water depth of 70 meters. The seafloor of the LIA is generally sandy, so sandy bottom characteristics for reflectivity and attenuation were used in the dBSea model. The model was used to calculate impulsive acoustic noise transmission on one-third octaves from 31.5 hertz to 32 kilohertz. Maximum SELs from all depths projected to the surface were used for the analyses.

The cumulative SEL is based on multiple parameters including the acoustic characteristics of the detonation and sound propagation loss in the marine environment, which is influenced by a number of environmental factors including water depth and seafloor properties. Based on integration of these parameters, the dBSea model predicts the distances at which each marine animal species is estimated to experience SELs associated with the onset of PTS, TTS, and behavioral disturbance. The thresholds for the onset of TTS and PTS used in the model and pressure calculations are based on those presented in *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)* (DoN 2017) for cetaceans with mid- to high-frequency hearing (dolphins) and low-frequency hearing (Rice's whale). Behavioral

thresholds are set 5 dB below the SEL-based TTS threshold, as recommended by Finneran and Jenkins (2012).

1.4 Number of Events

Following issuance of the 2017 Programmatic Biological Opinion, the National Marine Fisheries Service requested that the acoustic impact analysis be based on the total number of detonations conducted during a given mission instead of each individual detonation to account for the accumulated energy from multiple detonations over a 24-hour period. In accordance with this approach, mission-day categories for each user group were developed (Table 4-2) and used for modeling and analysis in this LOA Request. Each mission-day category represents one or more events that includes the munitions assigned to the category. Munitions were categorized to provide mission-day scenarios of varying intensities with respect to total energy released. The number of mission days assigned to each category was based on historical numbers and projections provided by certain user groups. Although the mission-day categories developed for this LOA Request may not represent the exact manner in which munitions would be used, they provide a conservative range of mission scenarios to account for accumulated energy from multiple detonations. It is important to note that only acoustic energy metrics (SEL) are affected by the accumulation of energy over a 24-hour period. Pressure metrics (e.g., peak SPL and positive impulse) do not accumulate and are based on the highest impulse pressure value within the 24-hour period. As indicated in Table 4-2, a total of 19 mission-day categories (A through S) were developed for this LOA Request. Table A-2 presents the source-level SPL and SEL (at r = 1 meter) for each mission-day category. Based on the categories developed, the total NEWi per mission day would range from 2,413.6 to 30.4 lb. The highest detonation energy of any single munition used under the Proposed Action would be 945 lb NEW; the munitions having this NEW include the GBU-10, GBU-24, and GBU-31. This was also the highest NEW for a single munition in the previous LOA Request.

Table A-2. Calculated Source SPLs and SELs for Mission-Day Categories

Mission Day	Total Warhead NEW, lbm	Modeled NEWi, lbm	Source Cumulative SEL, dB	Source Peak SPL, dB
A	2402.6	2413.6	262.1	290
B	1961	2029.9	261.4	289.3
C	1145	1376.2	259.8	288.3
D	562	836.22	257.6	288.3
E	817.88	997.62	257.1	281.5
F	584	584.6	256.2	289.3
G	191	191.6	250.4	277.7
H	60.5	61.1	245.2	268.8
I	18.4	30.4	242.5	276.9
J	945	946.8	258.1	294.6
K	Not available	350	253.4	291.5
L	624.52	627.12	256.2	290
M	324	324.9	253.2	283.6
N	219.92	238.08	252	285.3

O	72	104.64	248.3	281.2
P	90	130.8	249.3	281.2
Q	94	94.4	247.5	277.7
R	35.12	35.82	241.7	270.3
S	130	130	249.4	283

lbm = pound-mass; NEW = net explosive weight; NEWi = net explosive weight at impact; SEL = sound exposure level; SPL = sound pressure level