FINAL
ENVIRONMENTAL ASSESSMENT
For
TRAINING OPERATIONS
At
THE PINECASTLE RANGE COMPLEX, FLORIDA

November 2020

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Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Training Operations at Pinecastle Range Complex, Florida
Project Location:	Pinecastle Range Complex, Florida
Lead Agency for the EA:	U.S. Fleet Forces Command and U.S. Navy
Affected Region:	Putnam, Marion, and Volusia Counties, Florida
Action Proponent:	U.S. Fleet Forces Command
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Date:	November 2020

The U.S. Fleet Forces Command, a Command of the U.S. Navy (hereinafter, jointly referred to as the Navy), has prepared this Environmental Assessment in accordance with the National Environmental Policy Act, as implemented by the Council on Environmental Quality Regulations and Navy regulations for implementing the National Environmental Policy Act. The Proposed Action consists of continuing existing military readiness activities and conducting anticipated future military readiness activities, which include both increases and decreases in aircraft use, at the Pinecastle Range Complex, Florida. Existing military readiness activities include aviation and ground activities at Pinecastle Range, Rodman Range, and aviation activities at Lake George Range. Collectively, these three ranges support rotary, fixed-wing, and tilt-rotor aircraft traveling from land military bases and sea-based military platforms. The continuation of military readiness activities also includes periodic closures of access gates along roads near and around the range when certain activities are conducted. Anticipated future range mission requirements at the PRC include the incorporation of mobile electronic warfare equipment, and mission support for the A-29, F/A-18, F-35, T-45, and other aircraft as identified in the 2017 Range Air Installations Compatible Use Zones Study. This Environmental Assessment evaluates the potential environmental impacts associated with the Proposed Action, and the No Action Alternative to the following resource areas: noise, air quality, airspace/range safety, biological resources, water resources, cultural resources, and recreational and socioeconomic resources.

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EXECUTIVE SUMMARY

ES.1 Proposed Action

The Pinecastle Range Complex (PRC) is located in north central Florida, and includes two land ranges (Pinecastle Range and Rodman Range), and one freshwater range (Lake George Range). The Pinecastle Range is in the boundary of the Ocala National Forest, while the Rodman and Lake George Ranges are nearby. Pinecastle Range and a control area that is referred to as the Centroid Facility are located fully within the boundary of the Ocala National Forest; Rodman Range is just north of the Ocala National Forest; Lake George is east of the Ocala National Forest (Figure 1.2-1). In total, Pinecastle Range represents approximately 1.5 percent of the total land within the Ocala National Forest, while the actual cleared target areas represent approximately 0.1 percent of the total land within the Ocala National Forest (Department of the Navy 2017a).

The Proposed Action is to continue existing military readiness activities and conduct anticipated future military readiness activities, which include both increases and decreases in aircraft use, at the PRC. Existing military readiness activities include aviation and ground activities at Pinecastle Range, Rodman Range, and aviation activities at Lake George Range. Collectively, these three ranges support rotary, fixed-wing, and tilt-rotor aircraft traveling from land military bases and sea-based military platforms. The continuation of military readiness activities also includes periodic closures of access gates along roads near and around the Pinecastle Range when certain activities are conducted. Anticipated future range mission requirements at the PRC include the incorporation of mobile electronic warfare equipment, and mission support for the A-29, F/A-18, F-35, T-45, and other aircraft as identified in the 2017 Range Air Installations Compatible Use Zones (RAICUZ) Study.

The continuation of existing operations includes the following:

- Landing operations at Centroid/U.S. Forest Service (USFS) Helibase/Pinecastle Range/Rodman Range by Marine Corps, Army, Air Force, Navy, and Coast Guard rotary-wing aircraft.
- Pinecastle Range:
    - Air-to-ground training, including air-to-ground bombing (non-explosive and high-explosive munitions), lasing, and strafing.
    - Ground operations related to small arms fire.
    - Helicopter operations at landing zones and combat search and rescue training.
    - Aerial lasing operations that are used for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.
    - Approximately four to six major training exercises per year involving multiple events of multiple aircraft in each event from an aircraft carrier in the Jacksonville Operating Area over an extended period of time.
- Lake George Range:
    - Air-to-surface non-explosive ordnance delivery by fixed-wing aircraft.
    - Sea search and rescue training and mine warfare exercises in Lake George.
    - Tactical use of flares.

   - Approximately six electronic warfare training exercises occur each year and generally last for three weeks.
     - During that training period, there may be up to approximately 12 electronic warfare threat training events (72 events/year).
     - Fixed/stationary electronic warfare locations include two sites at the Centroid/R-2910.
   - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft.
- Rodman Range:
   - Helicopter operations at landing zones and combat search and rescue training.
   - Helicopter training operations can include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crew member by winch for search and rescue training.
   - Air-to-ground training, including air-to-ground bombing (non-explosive munitions only).

Anticipated future range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges:
   - Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, Naval Air Station Jacksonville, Naval Station Mayport, and the commercial airfield at Cecil Field.
   - Training events would usually occur over a three-week period consisting of approximately 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
   - Aircraft would be on-range up to 40 minutes at a time.
   - Total training at either range (Pinecastle or Rodman) would consist of approximately 180 events and 720 sorties annually.
   - Mobile emitters siting for electronic warfare training activities.

Approximately four to six major training exercises that currently occur annually at Pinecastle Range involve multiple events of multiple aircraft in each event over an extended period of time from an aircraft carrier in the Jacksonville Operating Area; additional major training exercises could occur as part of the Proposed Action. The number of estimated annual sorties and munitions expenditure associated with additional major training exercises are included within the Proposed Action and evaluated in this EA. All activities associated with the Proposed Action are considered military readiness activities.

In addition to the future ground/airspace training operations, the Proposed Action involves new aircraft as identified in the 2017 RAICUZ Study to be introduced to the PRC. This includes both fixed-wing (e.g., T-45 and F-35) as well as rotary-wing (e.g., UH-1 and H-53) and tilt-rotor aircraft.

The electronic warfare equipment proposed at the PRC would consist of mobile emitters transferred from the Mid-Atlantic Electronic Warfare Range Naval Surface Warfare Center at Marine Corps Air

Station Cherry Point. The mobile emitters would be energized in accordance with the training activity. The emitters may be energized for short periods of time throughout the training activity or continuously throughout the entire time the aircraft is airborne, depending upon the training scenario.

A stationary electronic warfare emitter is located at the Centroid (Figure 2.3-1). Currently, the Centroid has infrastructure in place to support both stationary and mobile electronic warfare emitters. The emitters sit on concrete pads in the upper Centroid locations. Proposed mobile emitter sites are shown in green. Some of the sites shown have concrete pads and power lines to support permanent or stationary emitters, but all sites would easily support mobile emitters. The new mobile emitters would provide maximum electronic warfare training flexibility, and could go anywhere in the Ocala National Forest, aside from protected areas such as wilderness areas or wetlands. Electronic warfare emitters would be parked on established roads and existing roadways, and would not require clearance of any habitat. Mobile emitters leave no footprint after activities are conducted. Frequency and power output management of electronic warfare emitters are managed in accordance with all requirements. The Navy would coordinate with the USFS when siting potential electronic warfare mobile emitter locations in the Ocala National Forest in accordance with the 1988 Master Agreement (see Section 1.7).

Pyrotechnic simulators are used during the electronic warfare threat training for visual cueing. The simulators are composed of a sealed cartridge approximately 1.5 inches in length with a plastic igniter-less cartridge that is consumed in flight with no falling debris. Under the Proposed Action, the number of pyrotechnic simulator rounds expected to be used per year at the PRC is approximately 120-180 (Department of the Navy 2019c).

ES.2 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to achieve, sustain, and maintain fleet training and aviation readiness using the PRC to support and conduct current, emerging, and future training activities. Additionally, this EA will support Navy's request to the USFS for renewal of the Special Use Permit for use of the Pinecastle Range.

The Navy is the action proponent and the lead agency for preparation of this EA. The nature and scope of the Proposed Action involving the use of USFS land requires the participation of, and coordination with, the USFS. The Navy is coordinating with the USFS in support of this EA.

The Proposed Action is needed to maintain and expand Fleet operational readiness to support national defense requirements under Title 10 United States Code (U.S.C.) section 8062. The proximity of the PRC to homeports and air stations along the east coast of the United States is a critical component of naval readiness. Naval forces must be prepared for a broad and changing range of capabilities—from full-scale armed conflict in a variety of different geographic areas to disaster relief efforts—prior to deployment. To learn these capabilities, personnel must train at the PRC with the equipment and systems they require to achieve military objectives. The Navy needs to continue use of the PRC to accomplish Navy and Marine Corps required aviation training, as well as use by other DoD, federal, and state agencies.

ES.3 Alternatives Considered

Alternatives were developed for analysis based upon the following reasonable alternative screening factors:

- Alternatives must preserve and optimize operational readiness and efficiencies for the F-35 Joint Strike Fighter, F/A-18 Super Hornet and other aircraft communities.

- Alternatives must effectively and efficiently use existing infrastructure and airspace.
- Alternatives must provide the capability on the East Coast to accommodate Composite Training Unit Exercises and high-explosive air-to-ground range training for the Navy's Atlantic Fleet.

Based on the considerations detailed above and meeting the purpose and need for the Proposed Action, only one action alternative was identified for analysis within this EA. This document evaluates the No Action Alternative and the Proposed Action Alternative.

ES.4 Summary of Environmental Resources Evaluated in the EA

Council on Environmental Quality regulations, National Environmental Policy Act, and Navy instructions for implementing the National Environmental Policy Act, specify that an Environmental Assessment (EA) should address those resource areas potentially subject to impacts. In addition, the level of analysis should be commensurate with the anticipated level of environmental impact. The study area/region of influence (ROI) for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance the study area for biological and recreational resources may only include the PRC footprint whereas the study area for noise and airspace safety would expand out to include areas that may be impacted by airborne or range noise beyond the PRC boundary.

This EA includes an analysis of potential environmental impacts associated with the action alternative and the No Action Alternative. The environmental resource areas analyzed in this EA include noise, air quality, airspace/range safety, biological resources, water resources, cultural resources, and recreational and socioeconomic resources. Because potential impacts were considered to be negligible or nonexistent, the following resources were not evaluated in detail this EA: geological resources, land use, hazardous materials and waste and toxic substances, and environmental justice.

ES.5 Summary of Potential Environmental Consequences of the Action Alternatives

Table ES-1 provides a tabular summary of the potential impacts to the resources associated with each of the alternative actions analyzed.

ES.6 Public Involvement

The Navy published a Notice of Availability (NOA) of the Draft EA in the *Florida Times-Union* (Jacksonville, FL) on July 26-28, 2020. Publication of the NOA began a public review period, which ended on September 4, 2020. The NOA described the Proposed Action and Purpose and Need, solicited public comments on the Draft EA and provided dates of the public comment period. The Draft EA was available on the U.S. Fleet Forces NEPA website (https://www.nepa.navy.mil/pinecastle). The Draft EA was published and made available for comment by relevant agencies and the interested public and distributed as detailed in Chapter 9. All comments received were reviewed, considered, and addressed appropriately in this Final EA.

Table ES-1. Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Proposed Action Alternative*
Noise	No impacts to Noise	• No noise sensitive points of interest would be impacted. • Noise contours likely to cause annoyance would extend 2.5 miles beyond the Pinecastle Range boundary due to aircraft gunnery, 3 miles beyond the Lake George Range boundary due to aircraft patterns, and 4,000 feet beyond Rodman Range boundary due to aircraft gunnery.
Air Quality	No additional impacts to Air Quality	• Net increases in emissions for each criteria pollutant would not exceed 100 tons per year. • Proposed training activities would not contribute to GHG emissions to any discernible extent (approximate 0.1 percent increase in the ROI).
Airspace/Range Safety	No impacts to Airspace/Range Safety	• No change to existing airspace, RCZs, or range boundaries. • Existing safety measures would continue to be implemented. • No significant impacts to Airspace/Range Safety
Biological Resources	No additional impacts to Biological Resources	• May affect, but is not likely adversely affect the red-cockaded woodpecker, wood stork, West Indian manatee. The U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion concurring with this determination (Appendix D). • May affect, likely to adversely affect the Florida scrub-jay, eastern indigo snake, gopher tortoise, sand skink, Florida bonamia, Lewton's polygala, scrub buckwheat. The USFWS issued a Biological Opinion that the Proposed Action is not likely to jeopardize the continued existence of these species. The Biological Opinion includes mandatory terms and conditions and monitoring and reporting requirements (Appendix D). • No effect to the species' critical habitat. • Wildlife are already habituated to the visual and audible disturbances in the ROI.
Water Resources	No additional impacts to Water Resources	• Ongoing SOPs and best management practices would minimize impacts to surface water and groundwater. • No impacts to floodplains or wetlands. • The Proposed Action is consistent with the CZMA.
Cultural Resources	No additional impacts to Cultural Resources	• No effects to historic properties (archaeological and architectural). • No impacts to traditional cultural properties.
Recreational and Socioeconomic Resources	No additional impacts to Recreational Resources	• Overall access to recreational opportunities would be similar to existing conditions. • Minimal impacts to recreational users due to increasing activities at the PRC occurring within existing training timeframes. • Gate closures within the "safety zone" would cause minor impacts to hunters, OHV trail users and other recreational users. • Lake George Range would have a larger area of noise exposure, lessening the quality of recreational opportunities directly on the lake.

Notes: ROI = Region of Influence; RCZ = Range Compatibility Zone; GHG = Greenhouse Gas; ESA = Endangered Species Act

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Abbreviations and Acronyms

Acronym	Definition
AICUZ	Air Installations Compatible Use Zones
AFB	Air Force Base
Air Force	U.S. Air Force
ARTCC	Air Route Traffic Control Center
BA	Biological Assessment
BNOISE	Blast Noise Prediction
BO	Biological Opinion
CDNL	C-weighted Day-Night Average Sound Level
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
Coast Guard	U.S. Coast Guard
CZMA	Coastal Zone Management Act
dB	Decibel
dBA	A-weighted decibel
dBPk	Single Event Peak Sound Level
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ERC	Energy Release Component
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FACSFACJAX	Fleet Area Control and Surveillance Facility Jacksonville
FGT	Florida Gas Transmission
FL DHR	Florida Department of State, Division of Historical Resources
FNAI	Florida Natural Area Inventory
FONSI	Finding of No Significant Impact
FFWCC	Florida Fish and Wildlife Conservation Commission
FY	Fiscal Year
GHG	greenhouse gas
HAP	hazardous air pollutant
KBDI	Keetch-Byram Drought Index
L_{eq}	Equivalent Sound Level
L_{pk}	Peak Sound Pressure Level
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act

Acronym	Definition
MOA	Military Operations Area
MR_NMAP	Military Operations Area and Range Noise Model
MSAT	Mobile Source Air Toxic
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
Navy	U.S. Navy
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NO_x	Nitrogen oxide
OEIS	Overseas Environmental Impact Statement
OHV	Off-highway vehicle
OPNAVINST	Office of the Chief of Naval Operations Instruction
ORC	Operational Range Clearance
PRC	Pinecastle Range Complex
RAICUZ	Range Air Installations Compatible Use Zones
RCRA	Resource Conservation and Recovery Act
RCZ	Range Compatibility Zone
RFSS	Regional Foresters Sensitive Species List
ROD	Record of Decision
ROI	Region of Influence
SARNAM	Small Arms Range Noise Assessment Model
SEIS	Supplemental Environmental Impact Statement
SESAM	Special Effect Small Arms Marking
SHPO	State Historic Preservation Office(r)
SOP	Standard Operating Procedure
VOC	Volatile organic compound
UAS	Unmanned Aircraft System
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

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1 Purpose of and Need for the Proposed Action

1.1 Introduction

U.S. Fleet Forces Command, a Command of the United States (U.S.) Navy (hereinafter, jointly referred to as the Navy) proposes to continue existing military readiness activities and conduct anticipated future military readiness activities, which include both increases and decreases in aircraft use, at the Pinecastle Range Complex (PRC), Florida.

The Navy has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations and Navy regulations for implementing NEPA.

1.2 Location

The PRC is located in north central Florida and includes two land ranges (Pinecastle Range and Rodman Range), and one freshwater range (Lake George Range). Pinecastle Range and a control area that is referred to as the Centroid Facility are located fully within the Ocala National Forest; Rodman Range is just north of the Ocala National Forest; Lake George is east of the Ocala National Forest (Figure 1.2-1). In total, Pinecastle Range represents approximately 1.5 percent of the total land within the Ocala National Forest, while the actual cleared target areas represent approximately 0.1 percent of the total land within the Ocala National Forest (Department of the Navy 2017a).

1.3 Background

The PRC is an integral part of the Navy's East Coast Tactical Training, which supports naval intermediate and advanced training in preparation for deployment. The PRC's primary mission is to provide an environment for Navy, Marine Corps, and U.S. Air Force (Air Force) personnel to learn the proper maneuvering tactics and techniques required while delivering air-to-ground weapons to targets within a potentially hostile environment, thus enhancing the potential for increased aircrew survivability and weapons delivery accuracy. Pinecastle Range in particular is critical, as it is the Navy's only air-to-ground range on the East Coast that is authorized for the use of high-explosive munitions (Rodman and Lake George are non-explosive-only ranges).

The access to capable range facilities located in the vicinity of homeports and air stations is a critical component of naval readiness. The PRC also accommodates military aircraft training units from Naval Station Mayport, Robbins Air Force Base (AFB), Moody AFB, Homestead AFB, Marine Corps Air Station Beaufort, Naval Air Station (NAS) Jacksonville, several state Air National Guard units, and other military aircraft participating in advanced fleet training exercises off the southeastern coast of the United States. The PRC supports military units by permitting strike warfare training through the delivery of air-to-ground high-explosive (Pinecastle Range only) and non-explosive munitions and air-to-ground gunnery (i.e., strafing at Pinecastle Range only) (Department of the Navy 2017a).

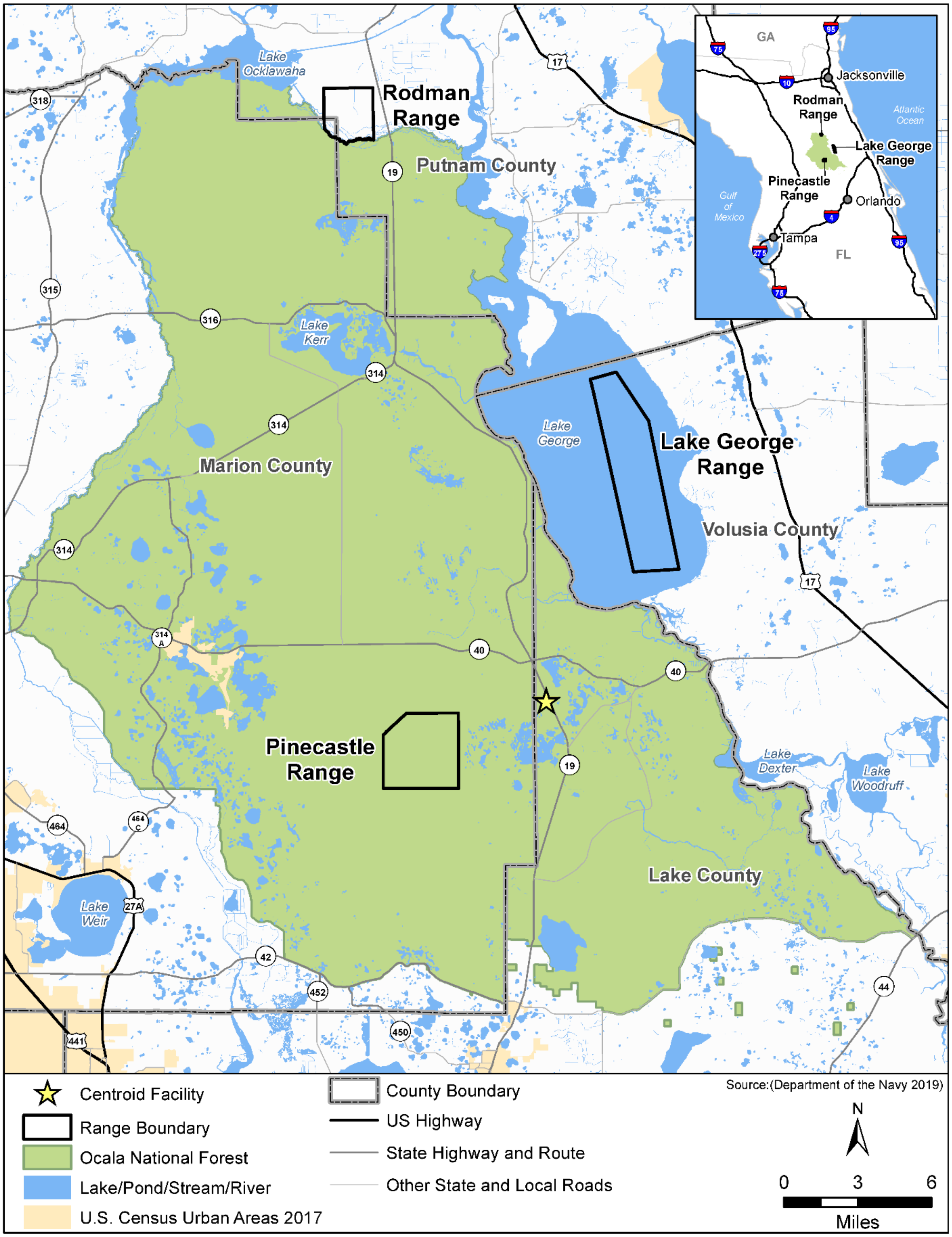

Figure 1.2-1. Pinecastle Range Complex Location Map

Additionally, the PRC is currently utilized for ground-to-ground small arms qualifications and weapons familiarization training. The PRC is also used by the U.S. Coast Guard (Coast Guard), and other federal and state agencies and law enforcement organizations. The PRC regularly supports training for installations located primarily in Florida, Georgia, North Carolina, South Carolina, Virginia and elsewhere (Department of the Navy 2017a). The three ranges in the Complex can be scheduled separately or scheduled jointly for combined training use.

1.3.1 Pinecastle Range Complex Management

The PRC is part of the larger Jacksonville Range Complex, which offers a variety of air, land, and open ocean training venues in support of operating forces and research, development, test, and evaluation in the southeast region. The Fleet Area Control and Surveillance Facility Jacksonville (FACSFACJAX) manages the PRC's day-to-day maintenance and controls access, and schedules all the training activities occurring on the Ranges.

1.3.2 Overview of Training Activities

Training operations at the PRC utilize ground and water ranges, Special Use Airspace, and Military Training Routes. Training activities include air-to-ground high-explosive and non-explosive munitions delivery, lasing, air-to-ground gunnery strafing, and ground-to-ground small arms qualification and weapons familiarization training. Rodman Range, Lake George Range, and Pinecastle Range provide realistic air-to-ground weapons delivery training using a variety of targets for high-explosive and non-explosive munitions (e.g., bombs and rockets). Air-to-ground gunnery strafing at the Pinecastle Range includes helicopter and fixed-wing using munitions. Small arms ground firing occurs at Pinecastle and Rodman Ranges.

1.3.2.1 Rodman Range

Rodman Range (Figure 1.3-1) is an unmanned day/night rocket, non-explosive bomb, and helicopter proficiency training target area approximately 58 miles south of Jacksonville and 40 miles west of the Atlantic coast. The range encompasses about 2,634 acres and supports air-to-ground training using sub-caliber non-explosive practice bombs and rockets (training devices that are typically smaller than operational munitions). No high-explosive munitions or gunnery is authorized. The Navy owns the land that comprises Rodman Range, and after NAS Cecil Field closed in 1999, Rodman Range continued to provide valuable service as a back-up non-explosive munitions bombing target for Pinecastle Range. The Ocklawaha River separates the Rodman Range from the northern border of Ocala National Forest. The range is primarily in Putnam County, situated east of the Rodman Reservoir and west of the St. Johns River; although, a small portion of its southwestern corner is within Marion County. Rodman Range contains a 600-foot-diameter cleared area with a central target equipped with a lighting system to accommodate night ordnance training.

Expended material (i.e., consumed rockets and non-explosive bombs) is recovered in accordance with Navy and Department of Defense (DoD) requirements as defined in the Operational Range Clearance (ORC) Plan for Rodman Range. Range operations also include combat search and rescue operations that train rescue forces personnel in the tasks needed to be performed to affect the recovery of distressed personnel during war or military operations. Rodman Range is a major southeast training site for land-based helicopter search and rescue training.

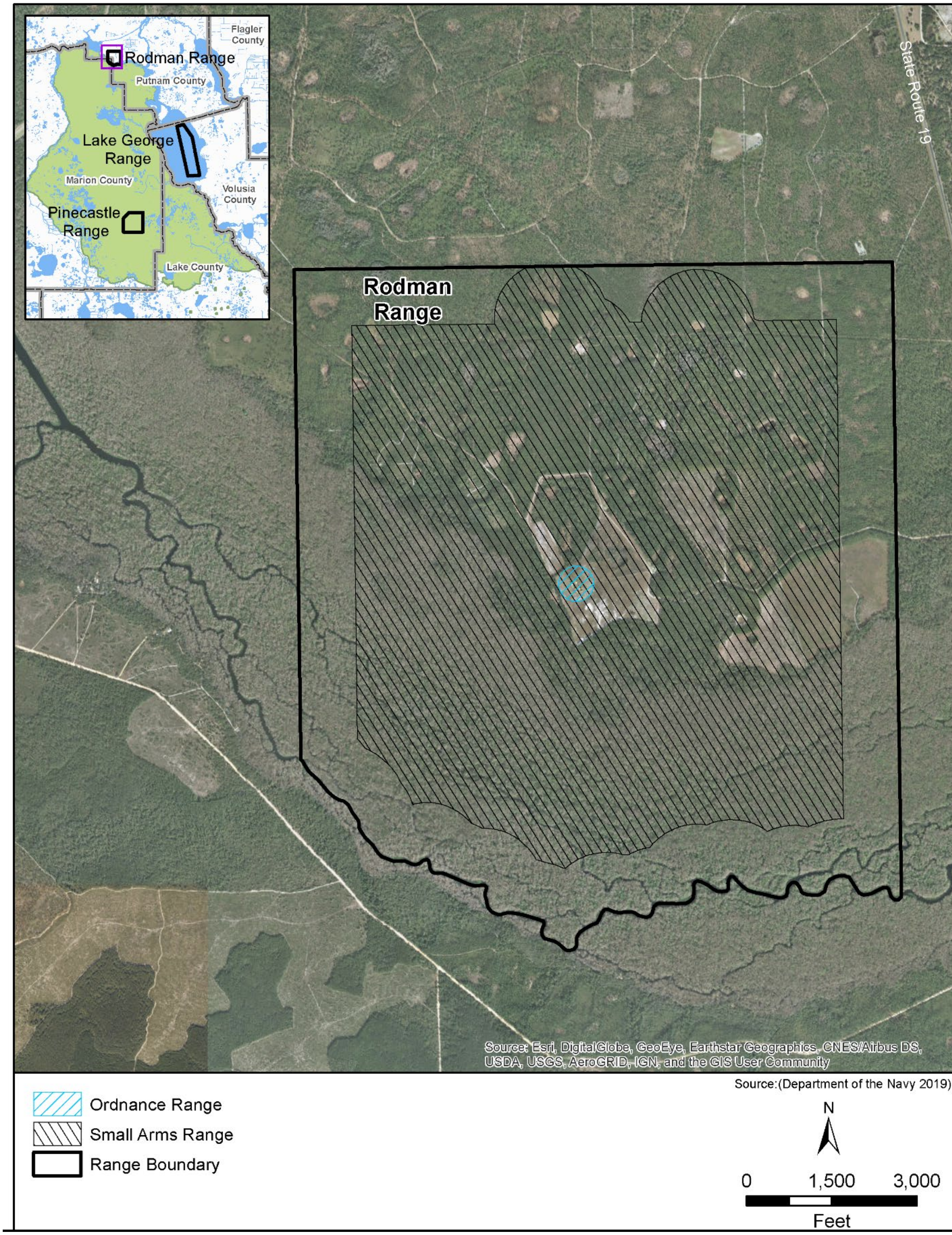

Figure 1.3-1. Rodman Range

1.3.2.2 Lake George Range

Lake George Range (Figure 1.3-2) is a 9,346-acre water range located along the east side of Lake George in Volusia County. The Navy operates the range under a Sovereignty Submerged Land Letter of Consent with the State of Florida, as the State owns the sovereign submerged lands. The Navy began acquiring property interests in the Lake George region in the 1940s for use as a radio beacon site. Range use began in 1952 when the Navy clarified that the range surface danger zone would be well clear of the navigation channel and positioned away from the shoreline.

The types of training missions and operations conducted at Lake George Range have evolved over time, starting with air-to-surface munitions delivery by NAS Jacksonville and Cecil Field-based propeller and jet tactical aircraft using conventional water targets in the early 1950s. In the late 1960s, Lake George became the only electronic warfare range on the East Coast with approved use of flares for electronic countermeasures. In 2009, training use of additional types of flares (missile countermeasure flares, which incorporate the use of an electronic anti-aircraft missile threat simulator) was also approved by the Navy.

Operations include mine warfare and mine laying. Airborne mine laying training uses two types of training operations: mine exercises and mine readiness certification inspections. In the typical mining training profile, mine exercises usually involve a single aircraft sortie planting several non-explosive training mine shapes in the water. The aircrew drops a series of (usually four) training shapes in the water at pre-planned splash points. There are four impact targets on the range, all of which are located on the lake surface. These consist of the North Target, Center Target, and South Target, and the four Mine Exercise Splashdown Points. Lake George Range targets are located in the lake waters.

1.3.2.3 Pinecastle Range

The Pinecastle Range (Figure 1.3-3) lies entirely within the Ocala National Forest in Marion County, approximately 75 miles from NAS Jacksonville. The range is accessible from the north and south by State Road 19, and from the east and west by State Road 40. In the early 1940s, the War Department acquired use of 40,587 acres of the Ocala National Forest for the Lake Bryant Bombing and Gunnery Range used by the U.S. Army Air Forces Command. The site was used for practice bombing, ground gunnery, and rocket missions; and had training facilities for firefighting details. Following World War II, the War Department determined the entire site was no longer required and it was relinquished to the U.S. Department of Agriculture (USDA) by letter of transfer dated May 20, 1947. Several years later, the Navy reacquired the use of a central portion of the original Lake Bryant Bombing and Gunnery Range. The area was renamed the Pinecastle Range and has been in continuous operation by the Navy since August 1951, under various agreements between the Navy and the USDA. The USFS manages the Ocala National Forest, and the Navy operates the Pinecastle Range under a Special Use Permit by the USFS. During times when the range is in use, the USFS assists with potential wildfire management and controlling public access in the vicinity of the Pinecastle Range for some training events.

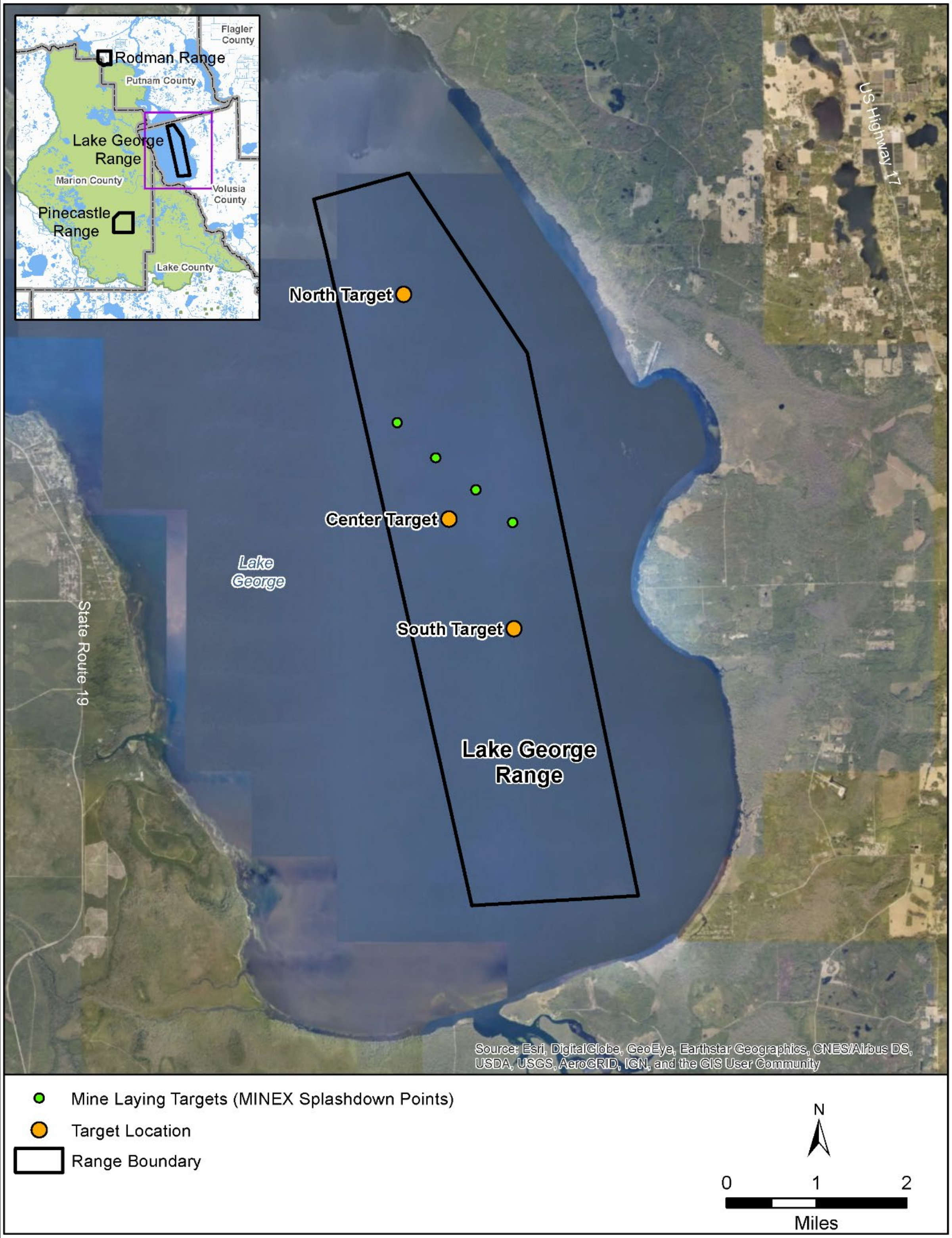

Figure 1.3-2. Lake George Range

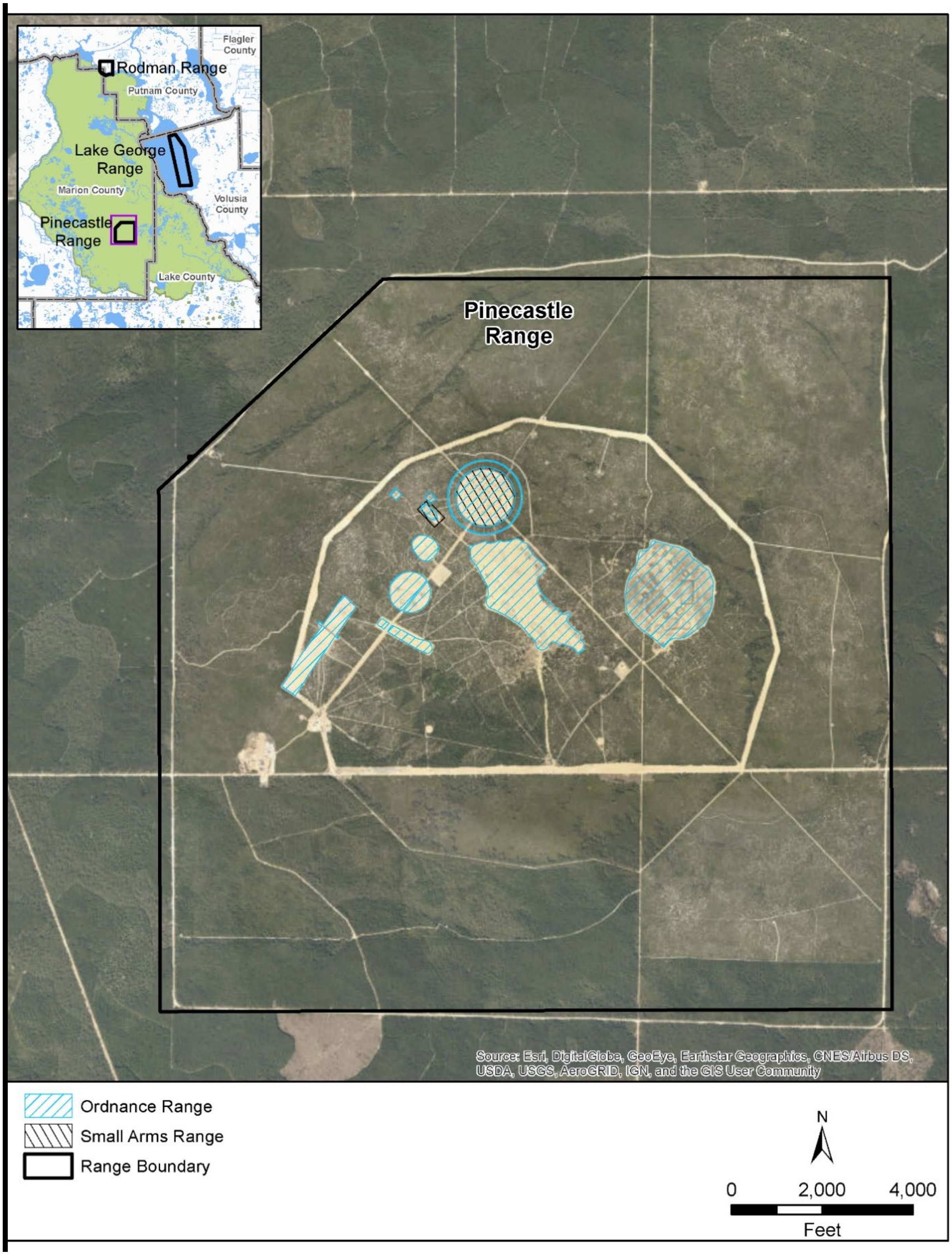

Figure 1.3-3. Pinecastle Range

The Pinecastle Range is comprised of two non-contiguous areas, the target and buffer area and the Centroid. The target and buffer area is 5,698 acres and consists of two high-explosive munitions target areas, eight non-explosive munitions target areas, a strafe pit with three different target areas, and a laser target that can be scored. Of the 5,698 acres, the cleared target areas comprise approximately 400 acres. The size of the cleared target areas can fluctuate within the firebreak area to allow for changes in training. The targets are maintained clear of vegetation to facilitate the monitoring of bombing accuracy, operation range clearance efforts (including the recovery of metal munitions and munition components), and the improvement of fire safety. The remaining approximate 5,300 acres of the target and buffer area are vegetated landscape (predominantly a sand pine-scrub oak vegetative community) designed to isolate the targets and provide a safety buffer for released munitions that miss the target or ricochet away from the target. The Centroid area, located approximately 3 miles northeast of the target and buffer boundary, is 44 acres and houses the control center for the PRC. The Centroid is not an impact area and contains no targets or target arrays.

High-explosive munitions are expended in training activities to achieve the necessary level of proficiency of firing weapons in a high stress and realistic environment, and to exercise the complete chain of aviation strike operations to include the build-up, handling, and delivery of high-explosive air-to-ground munitions. Pinecastle Range is a critical asset to the Navy, ensuring that the Navy's air wing components qualify in strike warfare, command and control, power projection, and air defense missions. Two broad levels of training that differ in complexity and requirements occur at Pinecastle Range: unit level training and major training exercises. The unit level training is considered the primary mode of operation. During training activities, the Range is used to satisfy its primary mission as a range supporting Navy units located in the Jacksonville area and other nearby DoD installations. In general, these training activities involve one to four aircraft launching from an airfield, conducting a mission (which usually involves the release of non-explosive munitions), and then returning to base in a single flight.

The Pinecastle Range is also used to support the major training exercises, which typically involve multiple events of multiple aircraft in each event from an aircraft carrier in the Jacksonville Operating Area over an extended period of time and have a much greater frequency of flights to the Range than do unit level training exercises. Examples of major training exercises are the Composite Training Unit Exercises and Joint Task Force Exercises, each of which involves multiple ships and aircraft. Further, each of these exercises is an integrated exercise and involves aircraft exercises from fleet training operations occurring off the southeast coast of the United States. Approximately four to six major training exercises are currently planned per year at Pinecastle Range, with each exercise occurring over a one to four-week period, involving multiple coordinated air-to-ground operations for approximately five to eight days.

1.3.3 Special Use Airspace

Special use airspace within the PRC includes Restricted Areas, Military Operations Areas (MOAs), Alert Areas (Figure 1.3-4), Air Traffic Control Assigned Airspace, and Military Training Routes (Figure 1.3-5). The airspace over the PRC comprises three interconnected Restricted Areas corresponding with the three ranges:

- Pinecastle Range, Restricted Area-2910A/B/C/D/E;
- Lake George Range, Restricted Area-2907A/B/C; and

- Rodman Range, Restricted Area-2906.

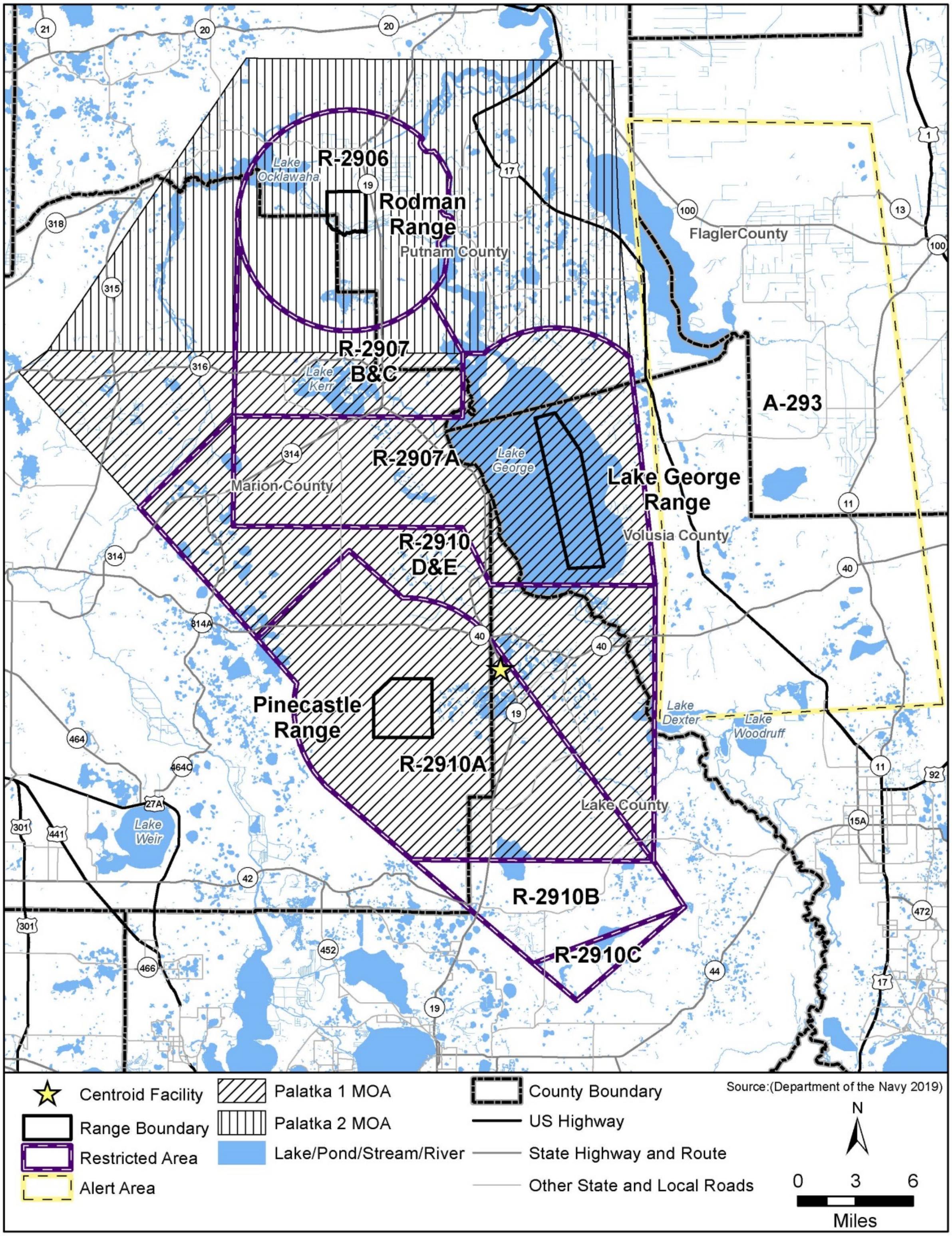

Figure 1.3-4. Military Operations Areas Associated with PRC Special Use Airspace

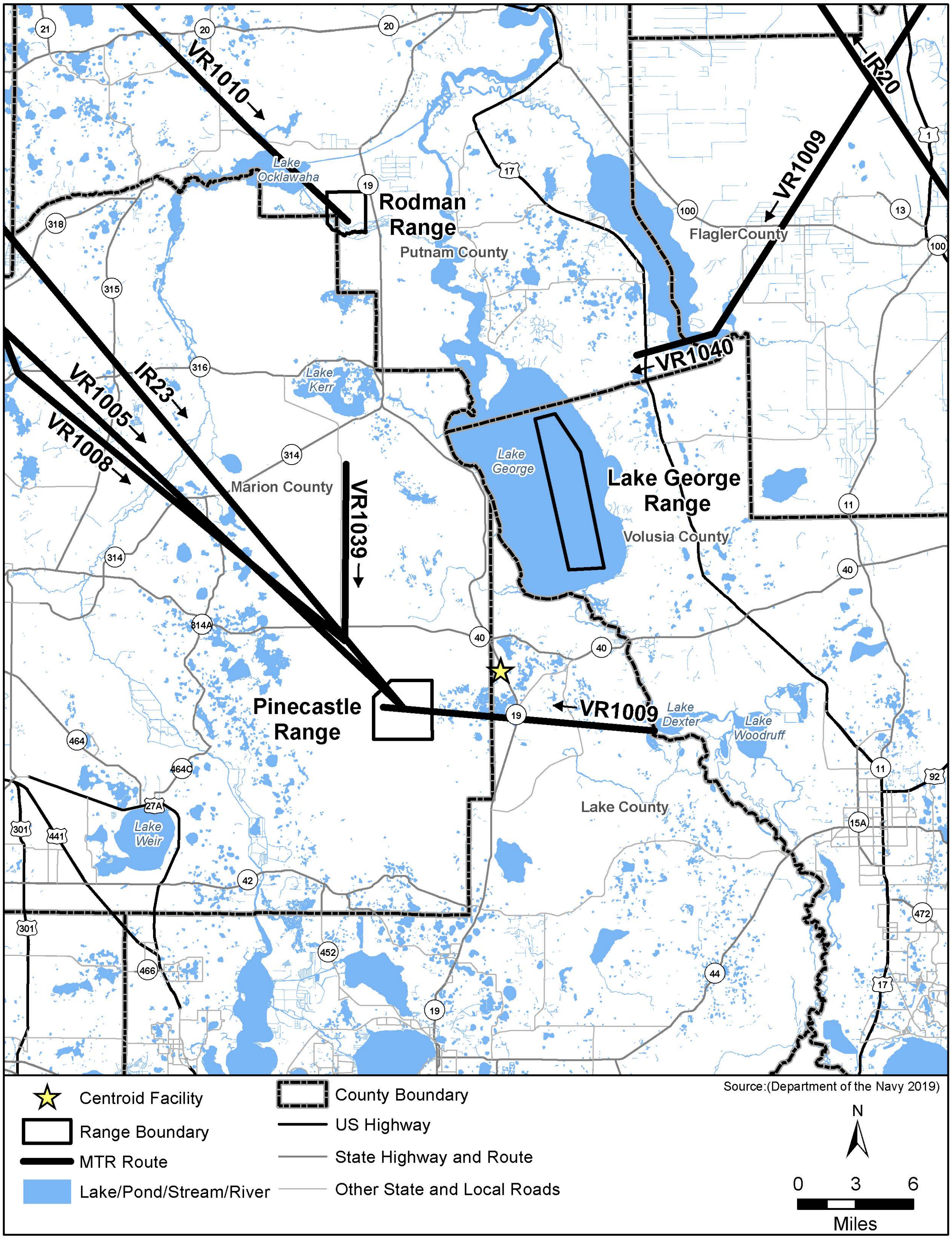

Figure 1.3-5. Military Training Routes Associated with PRC Special Use Airspace

The MOA over the Pinecastle and Rodman Ranges is known as the Palatka MOA. Additionally, the Palatka MOA is divided into two parts, which surround and overlap a majority of the Restricted Area. Other special use airspace associated with the PRC are the Pinecastle Air Traffic Control Assigned Airspace, which overlies the Palatka MOA, and eight Military Training Routes that either originate or terminate within the designated PRC special use airspace (Department of the Navy 2017a).

The eight Military Training Routes include the following:

- VR-1005
- VR-1008
- VR-1009
- VR-1010
- VR-1039
- VR-1040
- VR-1041
- IR-023

1.4 Purpose of and Need for the Proposed Action

The purpose of the Proposed Action is to achieve, sustain, and maintain fleet training and aviation readiness using the PRC to support and conduct current, emerging, and future training activities. Additionally, this EA will support Navy's request to the USFS for renewal of the Special Use Permit for use of the Pinecastle Range.

The Navy is the action proponent and the lead agency for preparation of this EA. The nature and scope of the Proposed Action involving the use of USFS land requires the participation of, and coordination with, the USFS. The Navy is coordinating with the USFS in support of this EA.

> 10 U.S.C. section 8062: "The Navy shall be organized, trained, and equipped primarily for prompt and sustained combat incident to operations at sea. It is responsible for the preparation of naval forces necessary for the effective prosecution of war except as otherwise assigned and, in accordance with integrated joint mobilization plans, for the expansion of the peacetime components of the Navy to meet the needs of war."

The Proposed Action is needed to maintain and expand Fleet operational readiness to support national defense requirements under Title 10 United States Code (U.S.C.) section 8062. The proximity of the PRC to homeports and air stations along the east coast of the United States is a critical component of naval readiness. Naval forces must be prepared for a broad and changing range of capabilities—from full-scale armed conflict in a variety of different geographic areas to disaster relief efforts—prior to deployment. To learn these capabilities, personnel must train at the PRC with the equipment and systems they require to achieve military objectives. The Navy needs to continue use of the PRC to accomplish Navy and Marine Corps required aviation training, as well as use by other DoD, federal, and state agencies.

1.5 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternative and the No Action Alternative. The environmental resource areas analyzed in this EA include noise, air quality, airspace/range safety, biological resources, water resources, cultural resources, and recreational and socioeconomic resources.

The study area/region of influence (ROI) for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance the study area for biological and recreational resources may only include the PRC footprint whereas the study area for noise and airspace safety would expand out to include areas that may be impacted by airborne or range noise beyond the PRC boundary.

1.6 Key Documents

Key documents are sources of information incorporated into this EA. Documents are considered to be key because of similar actions, analyses, or impacts that may apply to this Proposed Action. CEQ guidance encourages incorporating documents by reference. Documents incorporated by reference in part or in whole include:

- The *Final Environmental Impact Statement (EIS) for the Renewal of Authorization to Use Pinecastle Range, Ocala National Forest, Florida,* 2002. The EIS assessed the impacts of renewing the authorization to continue using Pinecastle Range to provide aircrew and support crew training in the handling and delivery of both high-explosive and non-explosive air-to-ground munitions (Department of Navy 2002). This assessment included an analysis of training operations at the Pinecastle Range, but not the Rodman and Lake George Ranges. Under the Proposed Action identified in the EIS, the USFS would issue a Special Use Permit that would authorize the Navy to continue using the PRC for a 20-year period (through 2022). This proposed Special Use Permit would be similar to previous Special Use Permits for the PRC between the Navy and the USFS, and would continue an operating relationship that has been in effect since 1951. The USFS renewed the Special Use Permit on August 1, 2002, authorizing the continued use of the Range for Navy training for a period of 20 years.
- *Jacksonville Range Complex Final EIS/Overseas Environmental Impact Statement (OEIS)*, 2009. The EIS/OEIS evaluated Navy Atlantic Fleet training in the Jacksonville Range Complex over 10 years, from 2009 to 2019. This evaluation included an analysis of training operations at the Rodman and Lake George Ranges (including use of electronic warfare emitters at Lake George), but not the Pinecastle Range. Under the Proposed Action identified in this EIS/OEIS, the Navy would support and conduct current and emerging training and research, development, training and evaluation operations in the Jacksonville Range Complex. The Jacksonville Range Complex study area included the Jacksonville and Charleston operating areas, mean high tide shoreline to three nautical miles offshore, and two inland ranges – Lake George Range and Rodman Range.
- *Final Supplemental EIS (SEIS) to the Final EIS for Renewal of Authorization to use Pinecastle Range, 2010.* This SEIS analyzed information that was not available at the time the 2002 FEIS was completed (Department of the Navy 2010). The SEIS focused on potential environmental consequences associated with new circumstances or information since the 2002 Record of Decision (ROD) was published - circumstances or information that had not changed since issuance of the ROD were not reexamined. This SEIS did not provide new information on the

types and numbers of training operations at Pinecastle Range. Training operations at Rodman Range and Lake George Range were not evaluated. Per the FEIS, the USFS renewed the Special Use Permit on August 1, 2002. Since the 2002 FEIS, the Navy had incorporated SAFE-RANGE, a more technologically advanced modeling system for establishing RCZs, which provides the Navy better fidelity in examining the flight profiles (i.e., air-to-ground munitions delivery scenarios) of a specific training event. The application of the new modeling system to the Navy's operations at the PRC produced more accurate information than was available in the 2002 FEIS. The SEIS describes the Pinecastle Range Operational Risk Management Analysis that characterized risks to persons in the forested areas outside the Range boundary, along with risk control options to reduce or eliminate mishap severity and/or mishap probability.

- *Final EA Addressing the Expansion of the Pinecastle Range Complex Restricted Area* was completed August 2012 and analyzed the potential environmental effects associated with expanding the Restricted Areas inside the existing Palatka 1 and Palatka 2 MOAs, and incorporating the corridors between existing Restricted Areas (Restricted Area-2906, Restricted Area-2907, and Restricted Area-2910). This would result in a larger contiguous Restricted Area to allow for a safer environment for participating and nonparticipating aircraft. The lateral dimensions of the PRC would not change. Portions of the existing Restricted Areas would be expanded vertically to ensure a consistent ceiling altitude of Flight Level 230 across the airspace, except in Restricted Area-2906 where it would remain 14,000 feet above mean sea level and in the southeastern corner of Restricted Area-2910 where it would remain 6,000 feet above mean sea level. Flight level is the altitude of an aircraft in hundreds of feet and is used for altitudes above 18,000 feet (for example, Flight Level 230 corresponds to 23,000 feet above mean sea level).
- *The Range Air Installations Compatible Use Zones (RAICUZ) Study for PRC* was completed September 2017 per Chief of Naval Operations Instruction (OPNAVINST) 3550.1A, which dictates that each Navy and Marine Corps air-to-ground range shall have a RAICUZ Study. The RAICUZ Program is implemented by the Navy to protect public health, safety, and welfare, and to prevent encroachment from the degrading the operational capabilities of air-to-ground ranges. Even though greater than 99 percent of munitions hit within their intended impact area, there is an extremely remote probability of a mechanical or system error resulting in an off-Range impact. To ensure public safety is maintained, in the unlikely and rare event of an off-Range impact, the RAICUZ Program classifies Range and adjacent lands into RCZs and provides various land use recommendations for these areas. Additionally, the RAICUZ Study updated the Pinecastle RCZs from those presented in the *Final SEIS to the Final EIS for Renewal of Authorization to Use Pinecastle Range*.
- *Land and Resource Management Plan for National Forests in Florida* (Forest Plan) was completed in 1999 and provides the framework for land use determinations, management practices, goals, objectives, standards, and guidelines for forest management. The Forest Plan also contains monitoring strategies to provide for an adaptive approach to management where adjustments can be made as the Forest Plan is implemented. Since 1999, the Forest Plan has been amended 12 times, most recently in 2016, to address emerging forest management issues.
- *Integrated Natural Resources Management Plan for NAS Jacksonville Complex* (2014) addresses the PRC and implements ecosystem-based conservation programs that provide for conservation and rehabilitation of natural resources in a manner consistent with the military mission and

surrounding USFS programs, integrates and coordinates all natural resources, provides for sustainable multipurpose uses of natural resources, and provides public access for use of natural resources subject to safety and military security considerations.

1.7 Relevant Laws and Regulations

The Navy has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, including the following:

- NEPA (42 U.S.C. sections 4321–4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] parts 1500–1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Clean Air Act (42 U.S.C. section 7401 et seq.)
- Clean Water Act (33 U.S.C. section 1251 et seq.)
- Coastal Zone Management Act (16 U.S.C. section 1451 et seq.)
- National Historic Preservation Act (54 U.S.C. section 306108 et seq.)
- Archeological and Historic Preservation Act (16 U.S.C. sections 469-469c-2)
- American Indian Religious Freedom Act (42 U.S.C. section 21 et seq.)
- Archaeological Resources Protection Act (16 U.S.C. section 470 et seq.)
- Native American Graves Protection and Repatriation Act (25 U.S.C. ch. 32 section 3001 et seq.)
- Endangered Species Act (16 U.S.C. section 1531 et seq.)
- Migratory Bird Treaty Act (16 U.S.C. sections 703-712)
- Bald and Golden Eagle Protection Act (16 U.S.C. sections 668-668d)
- Marine Mammal Protection Act (16 U.S.C. section 1361 et seq.)
- Comprehensive Environmental Response and Liability Act (42 U.S.C. section 9601 et seq.)
- Emergency Planning and Community Right-to-Know Act (42 U.S.C. sections 11001–11050)
- Energy Independence and Security Act (42 U.S.C. sections 6291, 6293, and 6295, as amended)
- Military Munitions Rule (40 CFR Part 266, Subpart M)
- Resource Conservation and Recovery Act (42 U.S.C. section 6901 et seq.)
- Toxic Substances Control Act (15 U.S.C. sections 2601–2629)
- Master Agreement Between Department of Defense and Department of Agriculture Concerning the Use of the National Forest System Lands for Military Activity (September 1988)
- Executive Order (EO) 11988, Floodplain Management
- EO 11990, Protection of Wetlands

- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13186, Responsibilities of Federal Agencies To Protect Migratory Birds
- EO 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input
- EO 13834, Efficient Federal Operations

A description of the Proposed Action's consistency with these laws, policies, and regulations (as well as the names of regulatory agencies responsible for their implementation) is presented in Chapter 6.

1.8 Public and Agency Participation and Intergovernmental Coordination

Regulations from the CEQ direct agencies to involve the public in preparing and implementing their NEPA procedures. The Navy published a Notice of Availability (NOA) of the Draft EA in the *Florida Times-Union* (Jacksonville, FL) on July 26-28, 2020. Publication of the NOA began a public review period, which ended on September 4, 2020. The NOA described the Proposed Action and Purpose and Need, solicited public comments on the Draft EA, and provided dates of the public comment period. The Draft EA was available on the U.S. Fleet Forces NEPA website (https://www.nepa.navy.mil/pinecastle). The Draft EA was published and made available for comment by relevant agencies and the interested public and distributed as detailed in Chapter 9. All comments received were reviewed, considered, and addressed appropriately in this Final EA.

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2 Proposed Action and Alternatives

2.1 Proposed Action

The Proposed Action is to continue existing military readiness activities and conduct anticipated future military readiness activities, which include both increases and decreases in aircraft use, at the PRC. Existing military readiness activities include aviation and ground activities at Pinecastle Range, Rodman Range, and aviation activities at Lake George Range. Collectively, these three ranges support rotary, fixed-wing, and tilt-rotor aircraft traveling from land military bases and sea-based military platforms. The continuation of military readiness activities also includes periodic closures of access gates along roads near and around the range when certain activities are conducted. Anticipated future range mission requirements at the PRC include the incorporation of mobile electronic warfare equipment, and mission support for the A-29, F/A-18, F-35, T-45 and other aircraft as identified in the 2017 RAICUZ Study.

2.2 Development of the Range of Reasonable Alternatives

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally Proposed Action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis. In developing the proposed range of reasonable alternatives that meet the purpose of and need for the Proposed Action, the Navy carefully reviewed important characteristics of continuing existing operations and conducting anticipated future training missions at the PRC. This review included requirements to achieve, sustain, and maintain fleet training and aviation readiness in light of Title 10 responsibilities, existing training requirements and regulations, and existing Navy range infrastructure and airspace. Based on this review, the following factors were considered when exploring alternatives for the Proposed Action:

- Alternatives must preserve and optimize operational readiness and efficiencies for the F-35 Joint Strike Fighter, F/A-18 Super Hornet and other aircraft communities.
- Alternatives must effectively and efficiently use existing infrastructure and airspace.
- Alternatives must provide the capability on the East Coast to accommodate Composite Training Unit Exercises and high-explosive air-to-ground range training for the Navy's Atlantic Fleet.

2.3 Alternatives Carried Forward for Analysis

Based on the considerations detailed above and meeting the purpose of and need for the Proposed Action, only one action alternative was identified for analysis within this EA. This document evaluates the No Action Alternative and the Proposed Action Alternative.

2.3.1 No Action Alternative

The CEQ regulations (40 CFR 1502.14[d]) require NEPA documents to evaluate a No Action Alternative. The No Action Alternative provides a comparative baseline for analysis that typically enables decision makers to compare the magnitude of potential environmental effects of the Proposed Action with conditions in the affected environment.

Under the No Action Alternative, existing operations at the PRC would continue, but there would be no new additional future training and range missions, and no new aircraft and associated operations would be introduced to the PRC. Mobile electronic warfare equipment and associated training operations would not be incorporated. The No Action Alternative would not meet the purpose of and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA.

Establishing a representative baseline for training operations under the No Action Alternative involves a comparison of available data for annual aircraft sorties and munitions expenditure. A sortie is defined by the DoD as an operational flight by one aircraft. At the PRC, one sortie includes one flight into the Restricted Area airspace, and may include multiple aircraft operations during the event between takeoff and landing.

As with other Navy ranges, the volume of annual sorties at the PRC fluctuates from year-to-year based on several factors such as training needs, national defense missions, humanitarian relief efforts, surge requirements, and construction/repair projects. Because of these year-to-year fluctuations, the peak number of sorties for each aircraft type from 2013 – 2017 was used to represent the baseline and No Action Alternative, from which to compare the potential impacts of the Proposed Action. Selecting the peak number of sorties for each aircraft type provides a realistic scenario of what has recently been and is likely currently occurring at the PRC (Department of the Navy 2018a). The representative baseline munitions expenditure was established similarly, using a peak of data for 2013 to 2017 (Department of the Navy 2018b).

Although the best available data (i.e., the peak number of aircraft sorties and munitions expenditure from 2013 to 2017) was used to represent the baseline/No Action Alternative, it is worth noting that range operations at the PRC during 2013 to 2017 were relatively slow years. This provides context for the increase in operations associated with the Proposed Action. Outside factors, such as the 2013 federal government sequestration and hurricane weather events, contributed to the lower operational tempo at the PRC during this time. As a result, the historic tempo of range operations at the PRC was more robust, and more similar to the Proposed Action.

While the 2002 EIS for the Renewal of Authorization to Use Pinecastle Range*,* and subsequent 2010 SEIS are incorporated into this document for reference, aircraft operation data from the 2002 EIS and 2010 SEIS were not able to be used in a direct comparative manner. The 2002 EIS data are based on multiple “aircraft operations per sortie” rather than individual “sorties” and are not broken out by specific aircraft (multiple operations may be completed during a single sortie). As a result, the 2002 data are not directly comparable to the more recent data sources. More recent data sources provided information using the number of annual sorties and specific types of munitions. As the aircraft operations data from the 2002 EIS uses the number of annual operations which is not readily converted to the number of sorties, these data were not used in developing the representative baseline/No Action Alternative. Similarly, as the number of annual munitions expenditure is grouped into general categories and not listed by type, these data were not used in developing the representative baseline/No Action Alternative. Additionally, the EIS and SEIS only addressed Pinecastle Range and not all ranges that encompass the PRC, thus they did not provide any data for Rodman and Lake George Ranges with which to develop a representative baseline/No Action Alternative.

2.3.2 Proposed Action Alternative

The Proposed Action is the only action alternative that will be analyzed in detail.

The continuation of existing operations includes the following:

- Landing operations at Centroid/USFS Helibase/Pinecastle Range/Rodman Range by Marine Corps, Army, Air Force, Navy, and Coast Guard rotary-wing aircraft.
- Pinecastle Range:
    - Air-to-ground training, including air-to-ground bombing (non-explosive and high-explosive munitions), lasing, and strafing
    - Ground operations related to small arms fire
    - Helicopter operations at landing zones and combat search and rescue training
    - Aerial lasing operations that are used for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.
    - Approximately four to six major training exercises per year involving multiple events of multiple aircraft in each event from an aircraft carrier in the Jacksonville Operating Area over an extended period of time
- Lake George Range:
    - Air-to-surface non-explosive munitions delivery by fixed-wing aircraft
    - Sea search and rescue training and mine warfare exercises in Lake George
    - Tactical use of flares
    - Approximately six electronic warfare training exercises occur each year and generally last for three weeks.
        - During that training period, there may be up to approximately 12 electronic warfare threat training events (72 events/year).
        - Fixed/stationary electronic warfare locations include two sites at the Centroid/R-2910.
    - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft
- Rodman Range
    - Helicopter operations at landing zones and combat search and rescue training
    - Helicopter training operations can include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crew member by winch for search and rescue training.
    - Air-to-ground training, including air-to-ground bombing (non-explosive munitions only)

Anticipated future range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges:

- Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, NAS Jacksonville, Naval Station Mayport, and the commercial airfield at Cecil Field.
- Training events would usually occur over a three-week period consisting of approximately 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
- Aircraft would be on-range up to 40 minutes at a time.
- Total training at either range (Pinecastle or Rodman) would consist of approximately 180 events and 720 sorties annually.
- Mobile emitters siting for electronic warfare training activities.

Approximately four to six major training exercises currently occur annually at Pinecastle Range that involve the multiple events of multiple aircraft in each event from an aircraft carrier in the Jacksonville Operating Area over an extended period of time; additional major training exercises could occur as part of the Proposed Action. The number of estimated annual sorties and munitions expenditure associated with additional major training exercises are included within the Proposed Action and evaluated in this EA. All activities associated with the Proposed Action are considered military readiness activities.

The Proposed Action calls for new aircraft as identified in the 2017 RAICUZ Study to be introduced to the PRC. This includes both fixed-wing (e.g., T-45 and F-35) as well as rotary-wing (e.g., UH-1 and H-53) and tilt-rotor aircraft. The electronic warfare equipment proposed at the PRC would consist of mobile emitters transferred from the Mid-Atlantic Electronic Warfare Range Naval Surface Warfare Center at Marine Corps Air Station Cherry Point. The mobile emitters would be energized in accordance with the training activity. The emitters may be energized for short periods of time throughout the training activity or continuously throughout the entire time the aircraft is airborne, depending upon the training scenario.

A stationary electronic warfare emitter is located at the Centroid (Figure 2.3-1). Currently, the Centroid has infrastructure in place to support both stationary and mobile electronic warfare emitters. The Centroid has facility power and 400 hertz converters that support stationary electronic warfare emitters directly plugged into power infrastructure. The emitters sit on concrete pads in the upper Centroid locations. Proposed mobile emitter sites are shown in green. Some of the sites shown have concrete pads and power lines to support permanent or stationary emitters, but all sites would easily support mobile emitters. The new mobile emitters would provide maximum electronic warfare training flexibility, and could go anywhere in the Ocala National Forest, aside from protected areas such as wilderness areas or wetlands. Electronic warfare emitters would be parked on established roads and existing roadways, and would not require clearance of any habitat. Mobile emitters leave no footprint after activities are conducted. Frequency and power output management of electronic warfare emitters are managed in accordance with all requirements. The Navy would coordinate with the USFS when siting potential electronic warfare mobile emitter locations in the Ocala National Forest in accordance with the 1988 Master Agreement (see Section 1.7).

Pyrotechnic simulators are used during the electronic warfare threat training for visual cueing. The simulators are composed of a sealed cartridge approximately 1.5 inches in length with a plastic igniter-less cartridge that is consumed in flight with no falling debris. Under the Proposed Action, the number of pyrotechnic simulator rounds expected to be used per year at the PRC is approximately 180 (Department of the Navy 2019c).

2.3.2.1 Estimated Sorties and Munitions Expenditure Associated with the Proposed Action

Table 2.3-1 presents a comparison of the estimated number of annual sorties at the PRC for the representative baseline/No Action Alternative and Proposed Action. Overall, the total number of Proposed Action annual sorties would increase by approximately 7,000 sorties when compared to the baseline/No Action Alternative.

Figure 2.3-1. Mobile Electronic Warfare Emitters Locations

Table 2.3-1. Comparison of Estimated Annual Sorties at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Aircraft Type	*Service*	*Representative Baseline/ No Action Alternative(1)*	*Proposed Action(2)*
PINECASTLE			
Cessna	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F-35C	Navy	0	500
F/A-18C/D	Navy	118	0
F/A-18E/F	Navy	473	700
H-60	Navy	253	300
P-3	Navy	11	0
P-8	Navy	0	50
T-45	Navy	0	720
UAS(3)	Navy	12	100
AH-1	Marine Corps	0	150
AV-8	Marine Corps	28	100
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	43	100
H-53	Marine Corps	0	150
KC-130	Marine Corps	0	50
UH-1	Marine Corps	0	150
V-22	Marine Corps	5	50
A-10	Air Force	375	400
A-29	Air Force	0	100
AC-130	Air Force	5	50
F-15	Air Force	166	200
F-16	Air Force	44	100
F-35A	Air Force	0	100
MH-65	Coast Guard	21	50
	Subtotal	1,557	4,320
RODMAN			
E-2	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F-35C	Navy	0	500
F/A-18C/D	Navy	110	0
F/A-18E/F	Navy	441	700
H-60	Navy	132	200
T-45	Navy	0	720
UAS(3)	Navy	12	100
AH-1	Marine Corps	0	50
AV-8	Marine Corps	24	50
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	39	100
H-53	Marine Corps	0	50
KC-130	Marine Corps	0	50

Table 2.3-1. Comparison of Estimated Annual Sorties at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Aircraft Type	*Service*	*Representative Baseline/ No Action Alternative(1)*	*Proposed Action(2)*
UH-1	Marine Corps	0	50
V-22	Marine Corps	5	50
A-10	Air Force	287	400
A-29	Air Force	0	100
AC-130	Air Force	2	50
F-15	Air Force	166	200
F-16	Air Force	29	100
F-35A	Air Force	0	100
	Subtotal	*1,250*	*3,770*
LAKE GEORGE			
Cessna	Navy	1	50
E-2	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F/A-18C/D	Navy	115	0
F/A-18E/F	Navy	458	700
F-35C	Navy	0	500
H-60	Navy	91	200
P-3	Navy	25	50
P-8	Navy	0	100
UAS(3)	Navy	12	100
AV-8	Marine Corps	24	50
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	43	100
KC-130	Marine Corps	0	50
V-22	Marine Corps	5	50
A-10	Air Force	335	400
A-29	Air Force	0	50
AC-130	Air Force	4	50
F-15	Air Force	165	200
F-16	Air Force	44	100
F-35A	Air Force	0	100
	Subtotal	*1,325*	*3,050*
TOTAL		**4,132**	**11,140**

Notes: 1. The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.

2. Aircraft types listed under Proposed Action are representative of those aircraft that typically conduct sorties at the PRC. Other DoD and foreign aircraft may use the PRC and associated airspace; it is anticipated those DoD/foreign aircraft sorties would generally be included in the overall total number of estimated annual sorties listed for the Proposed Action, and therefore, are addressed in the impact analysis in this EA.

3. UAS = Unmanned Aircraft System and includes all UAS, unmanned aerial vehicles and small UAS classes. UASs are remotely piloted or self-piloted (i.e., preprogrammed flight pattern) aircraft that include fixed-wing, rotary-wing, and other vertical takeoff vehicles. They can carry cameras, sensors, communications equipment, or other payloads.

Table 2.3-2 presents a comparison of the estimated annual munitions expenditure at the PRC for the representative baseline/No Action Alternative and Proposed Action. Overall, the total number of Proposed Action munitions expenditure would increase by approximately 484,490 when compared to the baseline/No Action Alternative.

Table 2.3-2. Comparison of Estimated Annual Munitions Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	*Ordnance/Munition Type*(1)	*Representative Baseline/ No Action Alternative*(2)	*Proposed Action*
PINECASTLE			
Large Arms	2.75" Rocket (ne (3)	577	900
	2.75" Rocket (HE)(3)	99	400
	20 mm	42,790	50,000
	25 mm	0	50,000
	30 mm	30,603	40,000
	40 mm	0	600
	105 mm	0	300
	5" Rocket	0	100
	ATM-114B	20	50
	AGM-114B (A-F)	8	50
	AGM-114K/M/N	0	50
	AGM-114P	0	50
	AGM-114Q	0	50
	AGM-175/176	0	50
	BDU-33	796	600
	BDU-45	68	100
	BDU-48/MK-106	0	100
	BDU-50	30	100
	BLU-110	22	200
	BLU-111	241	500
	GBU-10 (HE)	0	200
	GBU-10 (ne)	0	200
	GBU-24 (ne)	0	100
	GBU-31 (ne)	1	500
	GBU-32 (ne)	27	500
	GBU-38 (ne)	0	500
	GBU-44 (ne)	0	100
	GBU-54 (ne)	0	100
	GBU-12 (ne)	78	500
	GBU-12 (HE)	25	100
	GBU-16 (ne)	9	500
	GBU-16 (HE)	2	100
	LGTR	128	500
	MK-76	173	6,060
	MK-81	0	100
	MK-82 (HE)	6	250
	MK-82 (HE)	232	500
	MK-83 (ne)	0	250

Table 2.3-2. Comparison of Estimated Annual Munitions Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	*Ordnance/Munition Type[(1)]*	*Representative Baseline/ No Action Alternative[(2)]*	*Proposed Action*
	MK-83 (HE)	37	500
	MK-84 (HE)	26	250
	Subtotal	*75,998*	*156,010*
Small Arms, Air Gunnery	7.62 mm	77,387	400,000
	7.62 mm (blanks)	0	5,000
	0.50 Cal	18,000	50,000
	Subtotal	*95,387*	*455,000*
Small Arms, Ground	12 Gauge	0	250
	5.56 mm	12,000	15,000
	5.56 mm (blanks)	0	5,000
	SESAM	0	2,000
	7.62 mm	392,410	397,410
	9 mm	1,200	2,000
	0.50 Cal	27,620	30,620
	Subtotal	*433,230*	*452,280*
Other	Countermeasures[(4)]	56	100
	Signaling Device[(5)]	26	100
	Visual Cues[(5)]	72	200
	Subtotal	*154*	*400*
	Pinecastle Total	*604,769*	*1,063,690*
RODMAN			
Large Arms	BDU-33 (ne)	16	100
	MK-76 (ne)	6	5,000
	BDU-45 (ne)	0	100
	BDU-48/MK-106 (ne)	0	100
	BDU-50 (ne)	0	100
	Subtotal	*22*	*5,400*
Small Arms, Aircraft Gunnery	7.62 mm (blanks)	0	5,000
	Subtotal	*0*	*5,000*
Small Arms, Ground	5.56 mm (blanks)	0	10,000
	Special Effect Small Arms Marking System	0	2,000
	Subtotal	*0*	*12,000*
Other	Signaling Device[(5)]	26	100
	Visual Cues[(6)]	72	200
	Subtotal	*98*	*300*
	Rodman Total	*120*	*22,700*

Table 2.3-2. Comparison of Estimated Annual Munitions Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	*Ordnance/Munition Type[(1)]*	*Representative Baseline/ No Action Alternative[(2)]*	*Proposed Action*
LAKE GEORGE			
Large Arms	2.75" Rocket (ne)	0	100
	BDU-33	6	100
	BDU-45	16	100
	BDU-48/MK-106	39	200
	BDU-50	0	100
	MK-62 (ne)	60	250
	MK-63 (ne)	22	100
	MK-82 (ne)	0	100
	5" Rocket (ne)	0	100
	MK-81 (ne)	0	100
	MK-83 (ne)	0	100
	MK-84 (ne)	0	100
	MK-76	15	100
	Subtotal	*158*	*1,550*
Other	Countermeasures[(4)]	1,063	2,500
	Signaling Devices[(5)]	26	100
	Visual Cues[(6)]	72	200
	Subtotal	*1,161*	*2,800*
	Lake George Total	*1,319*	*4,350*
	TOTAL	**606,208**	**1,090,740**

Notes: 1. ne = non-explosive; HE = high-explosive; Non-explosive munitions, such as BDU-33, may contain marking or spotting charges, which provide a puff of smoke for scoring.
2. The representative baseline/No Action Alternative reflects peak data for each munitions type from 2013 to 2017.
3. Some 2.75" rockets at Pinecastle Range would have advanced precision kill weapon system guidance system.
4. Countermeasures includes all countermeasures deployed at the PRC (MJU-27, SM-875, etc.).
5. Signaling Devices includes all devices that are utilized during ground operations (smoke grenade, signaling flare, etc.).
6. Visual Cues includes all the visual cues utilized at the PRC (e.g., Smokey SAMS and OMEGAS).
7. AGM = air-to-ground missile; BDU = bomb dummy unit; BLU = bomb live unit; GBU = glide bomb unit; MK = mark; LGTR = laser guided training round; SESAM = special effect small arms marking.
8. Ordnance/munitions types listed under Proposed Action are representative of those typically delivered at the PRC. Other similar ordnance/munitions may be delivered at the PRC; it is anticipated those similar types of ordnance/munitions would generally be included in the overall total number of estimated ordnance/munitions expenditures listed for the Proposed Action, and therefore, are addressed in the impact analysis in this EA.

2.4 Alternatives Considered but not Carried Forward for Detailed Analysis

The following options were not considered viable alternatives as they either do not support the purpose of and need for the Proposed Action, or meet the considerations in Section 2.2.

- <u>Transition and/or Relocation of Training Conducted at the PRC to Another Range(s)</u>. Transitioning and/or relocating training currently conducted at the PRC to other range(s) would not meet the considerations listed in Section 2.2 because it would require the duplication of existing support and possibly increase travel times for squadrons traveling from homeports and stations to the range to train. This duplication would increase manpower, equipment, and operating costs, and would leave excess capacity and availability at the PRC. It was considered unreasonable to consider locations that would require substantial investment in additional infrastructure and personnel changes, when an existing range designed for this purpose and meeting all needs is already available for use. Additionally, no other Navy training complexes can accommodate the Composite Unit Training Exercise required for readiness training on the East Coast, and Pinecastle Range is the only Navy high-explosive bombing range for the East Coast. As a result, this alternative is not carried forward in this document for detailed analysis.

- Increased Use of Simulators/Fewer Sorties. Simulators are used on a daily basis to satisfy a myriad of flight training requirements. While simulator training complements flight training, it cannot replace the experience provided by flight training with munitions delivery, which is an integral part of the required intermediate and advanced training in preparation for deployment.
- Private Land Use for Electronic Warfare Mobile Emitters. The mobile emitters allow for maximum flexibility, and could be placed in any location, including private lands. This would potentially enhance the real-world training scenarios pilots are seeking when conducting electronic warfare training. The use of private lands was ruled out, however because it conflicts with the 1988 Master Agreement between the DoD and USDA.

As a result, this EA addresses the No Action Alternative and the Proposed Action for continuing existing operations and conducting anticipated future training missions at the PRC.

3 Affected Environment

This chapter presents a description of the environmental resources and baseline conditions that could be affected from implementing any of the alternatives.

All potentially relevant environmental resource areas were initially considered for analysis in this EA. In compliance with NEPA, the CEQ, and Department of Navy guidelines, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact. This section includes noise, air quality, airspace/range safety, biological resources, water resources, cultural resources, and recreational and socioeconomic resources.

The potential impacts to the following resource areas are considered to be negligible or nonexistent so they were not analyzed in detail in this EA:

Geological Resources: Effects to geological resources could result from changes to the bedrock materials, mineral deposits, and fossil remains, terrain, dominant landforms, or other visible features. Effects to soils could occur from erosion. The Proposed Action does not involve large-scale construction or development. Therefore, effects to bedrock materials, mineral deposits and fossil remains, terrain, dominant landforms, or other visible features would not occur. Erosion impacts would be negligible as changes in munitions delivery would be at existing, established range sites with ongoing SOPs/best management practices to minimize erosion. Therefore, there would be no effects to soils from implementation of the Proposed Action.

Land Use: Effects to land use could result from changes in how land is developed and used, typically in terms of the types of activities allowed. Land use categories can include residential, commercial, manufacturing, transportation/communication/utilities, recreation, institutional, industrial, public, conservation, mixed-use, etc. Compatibility of land use within airfield noise and safety zones affects land use patterns both within and in the vicinity of ranges. The Proposed Action would not cause changes to existing land use or result in incompatibility with surrounding land uses. Therefore, there would be no effects to land use from implementation of the Proposed Action.

Hazardous Materials and Wastes and Toxic Substances: The PRC is classified under the Resource, Conservation, and Recovery Act (RCRA) as a Very Small Quantity Generator (USEPA ID FL0001021617) of hazardous waste (100 kilograms or less of hazardous waste generated per month) that processes paint waste, oily rags, waste fuel, aerosols, damaged lead acid batteries, and universal waste in the form of batteries and fluorescent bulbs. Used oil, used anti-freeze, and used oil filters are captured for recycling (J. Croci 2020). The PRC also reports fugitive and non-point air emissions of lead and aluminum (fume or dust) from exploded munitions to the Toxic Release Inventory as part of the Emergency Planning and Community Right-To-Know- Act.

As discussed in the 2002 Pinecastle Range Complex FEIS (Department of Navy 2002) and 2010 Pinecastle Range Complex SEIS (Department of the Navy 2010), several types of munitions are used at the PRC and the constituents of the munitions used are the same.

The Navy maintains an Operational Range Clearance (ORC) program to ensure ordnance is managed in compliance with the USEPA's Military Munitions Rule and DoD Manual 4715.26, *DoD Military Munitions Rule Implementation Procedures*. Under the Military Munitions Rule, military munitions destroyed on range as part of operational range clearance, or subjected to material recovery activities (e.g. recycling) are not considered “solid waste” under RCRA and therefore are not waste military munitions. They are therefore not subject to federal, State, interstate, or local waste military munitions management requirements. Ordnance/military munitions management would not change under the Proposed Action and groundwater monitoring would continue. As a result, the Proposed Action would have negligible effects on the environment.

Additionally, the PRC would continue its adherence to RCRA in managing hazardous wastes (e.g. used fluids and batteries), based on monthly quantities of hazardous waste generated, currently as Very Small Quantity Generator, which would ensure the Proposed Action would have only negligible effects with regard to hazardous materials and wastes.

Environmental Justice and Protection of Children: Consistent with EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations*, the Navy’s policy is to identify and address any disproportionate high and adverse human health or environmental effects of its actions on minority and low-income populations. EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal agencies to “make it a high priority to identify and assess environmental health and safety risks that may disproportionately affect children and shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.” The Proposed Action does not involve military construction, short or long-term job creation, new or additional housing, nor an increase in personnel to the PRC. No military personnel or civilians live on or in proximity to the PRC. No schools or childcare facilities are located near the PRC. Adjacent land uses are largely undeveloped or forested. Effects from noise are primarily in and adjacent to the range complex and airspace boundary and would not disproportionately affect minority or low-income communities, as there are also populations not considered minority or low-income present experiencing the same minor noise environment. Minority and low-income populations would not experience disproportionately high and adverse noise or safety effects under the Proposed Action. The Navy has determined that there are no environmental health and safety risks associated with the Proposed Action that would disproportionately affect children. Therefore, there would be no effects to environmental justice from implementation of the Proposed Action.

3.1 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors/points of interest in the human environment. Noise in relation to biological resources and wildlife species is discussed in the Biological Resources section.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency – the number of cycles per second the air vibrates, in Hertz
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance (see Appendix A, Noise Effects). The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output and are given special attention in this EA given the Proposed Action. In depth background information on noise, including its effect on many facets of the environment is provided in Appendix A, Noise Effects.

3.1.1 Basics of Sound and A-Weighted Sound Level

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second or Hertz. To mimic the human ear’s non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an “A-weighted” scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the “A” to the measurement unit in order to identify that the measurement has been made with this filtering process, the A-weighted decibel (dBA). In this document, the dB unit refers to A-weighted sound levels. Table 3.1-1 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table 3.1-1. Subjective Responses to Changes in A-Weighted Decibels

Change	***Change in Perceived Loudness***
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Figure 3.1-1 provides a chart of A-weighted sound levels from typical noise sources (Cowan 1994). Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Noise levels from aircraft operations that exceed background noise levels at an airfield typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contributions drop to lower levels, often becoming indistinguishable from the background noise.

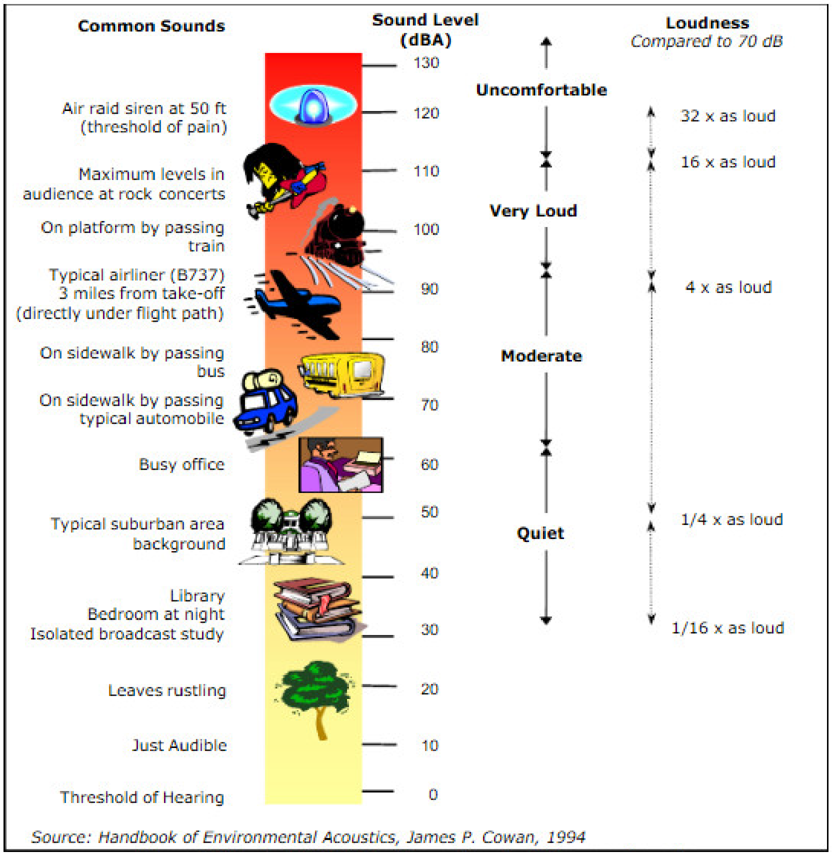

Figure 3.1-1. A-Weighted Sound Levels from Typical Sources

3.1.2 Noise Metrics

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The noise metrics used in this EA are described in summary format below and in a more detailed manner in Appendix A. While the Day-Night Average Sound Level (DNL) noise metric is the most commonly used tool for analyzing noise generated at an airfield, the DoD has been developing additional metrics (and analysis techniques). These supplemental metrics and analysis tools provide more detailed noise exposure information for the decision process and improve the discussion regarding noise exposure. The DoD Noise Working Group product, *Improving Aviation Noise Planning, Analysis and Public Communication with Supplemental Metrics* was used to determine the appropriate metrics and analysis tools for this EA (DoD Noise Working Group 2009).

3.1.2.1 Day-Night Average Sound Level

The DNL metric is the energy-averaged sound level measured over a 24-hour period, with a 10-dB penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). DNL values are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The DNL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. DNL is the standard noise metric used by the U.S.

Department of Housing and Urban Development, Federal Aviation Administration (FAA), U.S. Environmental Protection Agency (USEPA), and DoD. Studies of community annoyance in response to numerous types of environmental noise show that DNL correlates well with impact assessments; there is a consistent relationship between DNL and the level of annoyance (refer to Appendix A, Noise Effects). Most people are exposed to sound levels of 50 to 55 dB DNL or higher on a daily basis.

Research has indicated that about 87 percent of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise 1980). Therefore, the 65 dB DNL noise contour is used to help determine compatibility of military aircraft operations with local land use, particularly for land use associated with airfields.

3.1.2.2 C-weighted Day-Night Average Sound Level

Impulsive sound sources, such as artillery fire, detonation of air-to-ground or ground-to-ground high-explosive ammunition, gun fire, surface blasting, and rockets, contain significantly higher energy created at low frequencies than aircraft engine noise. The report by the Committee on Hearing, Bioacoustics, and Biomechanics Working Group 84 recommends using the C-weighted Day-Night Average Sound Level (CDNL) cumulative metric to define high-energy impulsive sounds (ANSI S12.9 1996).

3.1.2.3 Peak Sound Pressure Level

Peak Sound Pressure Level (L_{pk}) is the highest instantaneous level for a noise event. The L_{pk} is typically measured using a 20 microseconds or faster sampling rate, and is commonly based on un-weighted or linear response of the meter. The L_{pk} can be used to determine impacts to animals in the areas surrounding impulsive events like the training rounds and the strafe fire. Because L_{pk} sound levels are the maximum sound pressure level for an event, the reported peak levels only exist for a fraction of a second, which can be as short as a few microseconds. The short duration of these events could make them much less noticeable than longer duration events at similar sound pressure levels.

3.1.2.4 Single Event Peak Sound Level

The Single Event Peak Sound Level (dBPk) is a metric used in addition to cumulative noise metrics to provide more information on the effects of noise from ordnance activity. The dBPk metric is the calculated peak noise level, without frequency weighting, expected to be exceeded by 15 percent of all modeled events. It allows assessment of the risk of noise complaints from large caliber impulsive noise resulting from armor, artillery, mortars and demolition activities, as well as from small arms ranges.

3.1.3 Noise Modeling

Computer modeling provides a tool to assess potential noise impacts. DNL noise contours are generated by a computer model that draws from a library of aircraft noise measurements. Noise contours produced by the model allow a comparison of existing conditions and proposed changes or alternative actions, even when the aircraft studied are not currently operating from the installation. For these reasons, on-site noise monitoring is seldom used at military air installations, especially when the aircraft mix and operational tempo are not uniform.

The noise environment for this EA was modeled with the DoD computer-based programs for analysis of aircraft, ordnance, and small arms weapon fire noise exposure and compatible land uses: Military Operating Area and Range Noise Model (MR_NMAP), Blast Noise Prediction (BNOISE), and Small Arms Range Noise Assessment Model (SARNAM 2) and NOISEMAP Version 7.3.

3.1.3.1 MR_NMAP

When the aircraft flight tracks are not well defined, but are distributed over a wide area, such as in MOAs, Range/Restricted Areas, and Military Training Routes with wide corridors, noise is often more appropriately assessed using the MR_NMAP program. MR_NMAP is a distributed flight track and area model that allows for entry of airspace information, the distribution of operations, flight profiles (average power settings, altitude distributions, and speeds), and numbers of sorties. From the grid of points, lines of equal contours of 65 dBA through 85 dBA (if applicable), in 5 dBA increments, were plotted.

3.1.3.2 NOISEMAP

NOISEMAP analyzes all the operational data (types of aircraft, number of operations, flight tracks, altitude, speed of aircraft, engine power settings, and engine maintenance run-ups), environmental data (average humidity and temperature), and surface hardness and terrain. The result of the modeling is noise contours; which are lines connecting points of equal value (e.g., 65 dB DNL and 70 dB DNL).

3.1.3.3 BNOISE

Noise from ordnance delivery (blast noise) is impulsive in nature and of short duration. Blast noise can consist of two components, the firing of the projectile from the weapon and the detonation of the projectile if it contains a high-explosive charge. When a projectile or bomb is released from an aircraft, and the projectile contains high-explosive material, only the noise resulting from the detonation of the projectile is calculated. The same process is applied to a projectile that is ground-delivered. If the projectile is non-explosive, only the noise resulting from the firing of the projectile is calculated. Vibrations of buildings and structures induced by blast noise may result in increased annoyance and risk of noise complaints or damage.

Blast noise contours are developed using the DoD's BNOISE program. BNOISE is a suite of computer programs, which together can produce CDNL contours for blasting activities or military operations resulting from impulsive noise. Similar to NOISEMAP, the BNOISE computer program processes the above files to generate a grid file, which is simply an array of noise levels at equally spaced points within a rectangular area. BNOISE can compute CDNL, which is typically used for land use compatibility assessments. From the grid of points, lines of equal contours of 57, 62, and 70 dB CDNL were plotted.

3.1.3.4 SARNAM

For small arms range complexes, SARNAM Version 2 calculates and plots noise contours for a variety of noise management tasks, such as assessing long-term community noise impact, examining noise levels resulting from single firing events, or planning range operations. SARNAM is capable of analyzing small arms rounds up to 20mm in diameter. It includes consideration of weapon and ammunition type, spectrum and directivity for both muzzle blast and projectile bow shock, number of rounds fired, time at which rounds are fired, range attributes, frequency weighting, propagation conditions, noise metrics, noise assessment penalties, and long-term assessment period and procedure. Effects of terrain on sound propagation are not considered in the program (a flat terrain assumption).

3.1.4 Regulatory Setting

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 dBA over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed is 115 dBA and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

The joint instruction, OPNAVINST 11010.36C and Marine Corps Order 11010.16, *Air Installations Compatible Use Zones (AICUZ) Program,* provides guidance administering the AICUZ program, which recommends land uses that are compatible with aircraft noise levels. OPNAVINST 3550.1A and Marine Corps Order 3550.11 provide guidance for a similar program, RAICUZ. This program includes range safety and noise analyses, and provides land use recommendations which will be compatible with Range Compatibility Zones and noise levels associated with military range operations. Per OPNAVINST 11010.36C, NOISEMAP is to be used for developing noise contours for military aircraft.

3.1.5 Affected Environment

Many operational components may generate noise and warrant analysis as contributors to the total noise impact. Within the study area (i.e., the special use airspace, depicted in Figure 1.3-4, and Military Training Routes depicted in Figure 1.3-5), the predominant noise sources consist of aircraft operations, aircraft gunnery, and small arms ground fire. Other components such as ground support equipment for maintenance purposes, and vehicle traffic produce noise, but such noise generally represents a transitory and negligible contribution to the average noise level environment. The analysis of existing noise levels are provided in the subsections that follow for Pinecastle Range (Section 3.1.7.1), Lake George Range (Section 3.1.7.2), and Rodman Range (Section 3.1.7.3).

Response to noise varies, depending on the type and characteristics of the noise, distance between the noise source and whoever hears it (the receptor), receptor sensitivity, and time of day. A noise sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Sensitive points of interest may also include noise sensitive cultural practices, some domestic animals, or certain wildlife species. Table 3.1-2 identifies seven representative points of interest within the Region of Influence (ROI) of the PRC. The locations of these points of interest are included in the figures introduced later in this section (Figures 3.1-2, 3.1-3, and 3.1-4).

Table 3.1-2. Representative Points of Interest in the PRC

Vicinity	*Name*	*Type*	*Approximate Location*
Pinecastle Range	Summit Ponds	Residential	3 miles southeast of Pinecastle Range
Pinecastle Range	Big Steep Pond	Residential	5 miles west of Pinecastle Range
Lake George Range	Pine Island Resort	Commercial	2 miles east of Lake George Range
Lake George Range	Drayton Island	Residential	2 miles north of Lake George Range
Lake George Range	West Shore	Residential	3 miles west of Lake George Range
Rodman Range	Buckskin Prairie	Residential	3 miles south of Rodman Range
Rodman Range	Rodeheaver Boy's Ranch	Recreational	2 miles northeast of Rodman Range

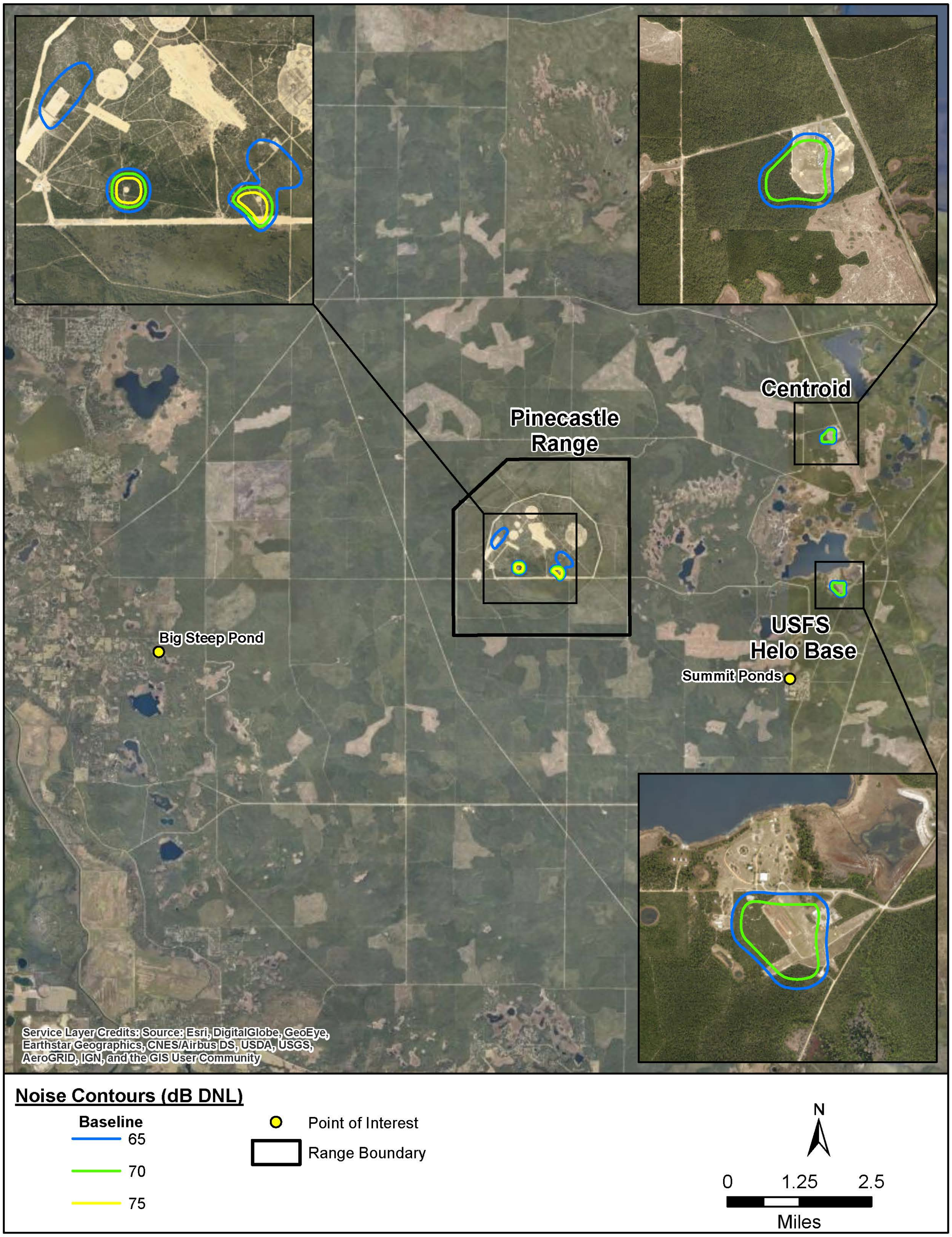

Figure 3.1-2. Baseline Aircraft Noise with Points of Interest at Pinecastle Range

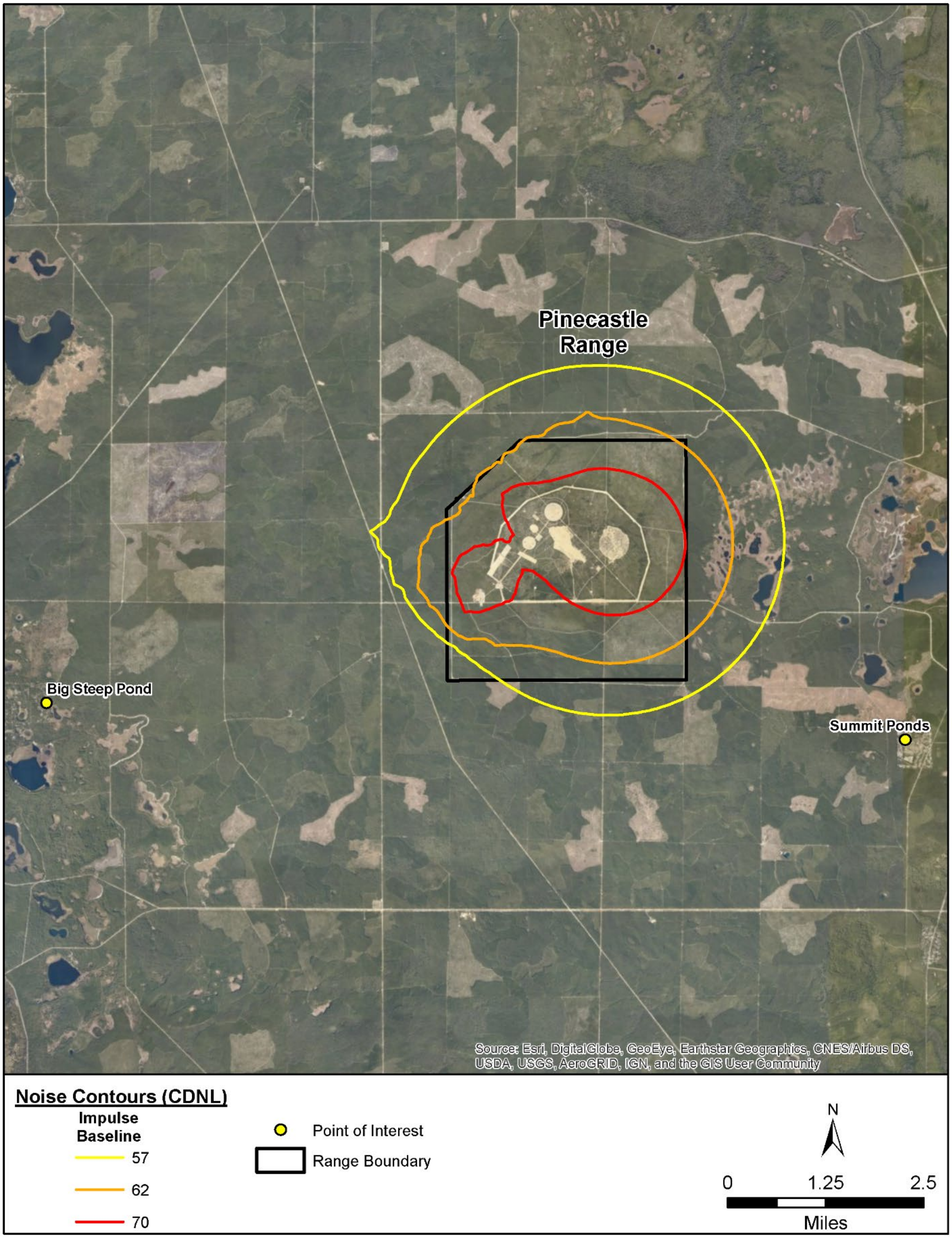

Figure 3.1-3. Baseline Impulsive Noise with Points of Interest at Pinecastle Range

Figure 3.1-4. Baseline Small Arms Noise with Points of Interest at Pinecastle Range

3.1.5.1 Pinecastle Range

Training within the Pinecastle Range is comprised of aircraft flights occurring in R-2910 A/B/C and Palatka 1 MOA. Aircraft activity can be categorized along the following categories:

- **Ingress/Egress:** Flight routes into and out of the Pinecastle Range from surrounding areas, including the Centroid and USFS Helicopter Base landing zones;
- **Strafe Patterns**: Rectangular flight track with varying dive angles directed towards a ground target for gun fire practice;
- **Tactical Runway Area Strafe Patterns**: Similar to strafe patterns but focused on Tactical Runway Area;
- **Bomb Delivery Patterns:** Utilize the Live Impact Area for various high-explosive bomb drop training missions and other targets on the range for non-explosive bomb drop training;
- **Orbit Patterns:** Circular flight paths flown by AC-130 and KC-130J at 9,000 feet above ground level; and
- **Rotary-Wing Air Gunnery Patterns:** Various patterns flown by rotary-wing aircraft for gun training at ground targets.

Total estimated annual average sorties are 1,557, which includes 12 Unmanned Aircraft System (UAS) sorties. However, cumulative noise generated by UAS is considered negligible when compared to the noise levels generated by the other aircraft because cumulative noise generated by proposed UAS operations do not contribute to cumulative noise generated by other aircraft. Therefore, the 12 annual UAS sorties have no potential to contribute to the overall cumulative noise environment at Pinecastle Range. As a result, for noise modeling purposes, 1,545 sorties are used. Representative aircraft of the predominant types are used for modeling smaller, quieter, similar aircraft. The Navy Hornets (F/A-18C/D/E/F) comprise the largest portion of activity with 38 percent of annual sorties followed by the A-10 at 24 percent. The EA-6B and Cessna do not include ground target or landing type missions so specific flight tracks do not apply. Additional modeling details are included in the PRC Noise Study (Appendix B) (Department of the Navy 2019a).

Estimated current annual munitions expenditures at Pinecastle Range is 604,761, as listed in Table 2.3-2. Pinecastle Range contains multiple small arms ranges and areas. The majority of munitions expended (433,230) is due to small arms ground fire of both blank and explosive-fire rounds within tactical training areas. The remaining ordnance includes small arms air gunnery from aircraft and both high-explosive and non-explosive large arms dropped or fired from aircraft. The advanced precision kill weapon system guidance system used on 2.75" rockets is included in the noise modeling at Pinecastle Range.

Baseline Noise Exposure at Pinecastle Range

Noise from aircraft was determined through a combination of the modeling software NOISEMAP and MR_NMAP. The resulting estimated aircraft noise exposure is presented in annual average DNL contours from 65 to 80 dB, in 5 dB increments, as depicted in Figure 3.1-2. Aircraft activity is not great enough to generate 80 or 85 dB DNL. The greatest noise is focused at the helicopter landing zone (shown in the top call-out box in Figure 3.1-2), and the strafe target to the west, and the tactical runway to the east inside the Pinecastle Range due to the relatively low aircraft altitudes in these areas. The 65 dB DNL and greater is contained within the Pinecastle Range boundary.

Several of the air gunnery operations conducted within the Pinecastle Range involve high explosives (i.e., explosive Hellfire missiles). This impulsive noise is modeled with both the air gunnery operations and ground explosions, as discussed in Section 3.1.5. The results from the two models were combined to provide the overall estimated CDNL exposure within the Pinecastle Range, as shown in Figure 3.1-3. The 62 dB CDNL contour is mostly contained within the Pinecastle Range extending approximately 2,000 feet to the west and north and less than 4,000 feet to the east. The 62 dB CDNL represents the level of moderate potential for annoyance to noise sensitive points of interest and the level at which some land uses are considered incompatible with noise. The area surrounding the Pinecastle Range is undeveloped and the nearest noise sensitive points of interest is the residential area at Summit Pond over 2.5 miles to the east, outside the Figure 3.1-3 map extent.

Because the Pinecastle Range small arms ground fire is assessed with the dBPk metric, the loudest weapon drives the size of the noise contours. In this case, the 0.50 Cal blank round generates the greatest single event sound levels. The distance from the weapon firing location to the point where the dBPk would reach 87 was calculated with SARNAM and found to be 6,440 feet. The distance to the 104 dBPk was calculated in the same manner and found to be 1,774 feet. Firing locations were buffered by these distances resulting in the contours depicted in Figure 3.1-4. The 87 dBPk currently extends roughly two miles to the north beyond the Pinecastle Range boundary over undeveloped land while the 104 dBPk is contained within the boundary. Neither contour reaches either of the residential points of interest.

3.1.5.2 Lake George Range

Lake George Range is a water range located along the east side of Lake George in Volusia County overlain by Restricted Area R-2907A, as shown in Figure 1.3-4, and used for sea search and rescue training and mine warfare exercises. Total estimated annual average sorties are 1,325, which includes 12 UAS sorties. However, cumulative noise generated by UAS is considered negligible when compared to the noise levels generated by the other aircraft because cumulative noise generated by proposed UAS operations do not contribute to cumulative noise generated by other aircraft. Therefore, the 12 annual UAS sorties have no potential to contribute to the overall cumulative noise environment at Lake George Range. As a result, for noise modeling purposes, 1,313 sorties are used. Also, representative aircraft of the predominant types are used for modeling smaller, quieter, similar aircraft (approximately 30 percent of sorties). Approximately 44 percent of sorties are flown by Navy Hornets and Super Hornets (F/A-18C/D/E/F) with Air Force A-10 accounting for 26 percent. Fighter aircraft conduct mine warfare exercise training at the four Mine Exercise targets while rotary-wing aircraft (H-60 and V-22) utilize the center target. The remaining aircraft do not perform target-focused missions, so they are modeled distributed throughout the R-2907A area. Additional modeling details are included in the PRC Noise Study (Appendix B) (Department of the Navy 2019a).

Baseline Noise Exposure at Lake George Range

Noise from aircraft was determined through a combination of NoiseMap and MRNMap, as described in Section 3.1.5. The resulting aircraft noise exposure for the Lake George Range, as depicted in Figure 3.1-5, shows that aircraft activity is not great enough to generate 65 dB DNL or greater. Similarly, noise exposure from munitions delivery at the Lake George Range is not great enough to generate 57 dB CDNL or greater.

3.1.5.3 Rodman Range

Rodman Range is overlain by Restricted Area R-2906 and is used for strike warfare as well as helicopter training and combat search and rescue. Rodman Range includes eight landing zones used by rotary-wing aircraft. Total estimated annual average sorties are 1,250, which includes 12 UAS sorties. However, cumulative noise generated by UAS is considered negligible when compared to the noise levels generated by the other aircraft because cumulative noise generated by proposed UAS operations do not contribute to cumulative noise generated by other aircraft. Therefore, the 12 annual UAS sorties have no potential to contribute to the overall cumulative noise environment at Rodman Range. As a result, for noise modeling purposes, 1,238 sorties are used. Also, representative aircraft of the predominant types are used for modeling smaller, quieter, similar aircraft. Navy F/A-19C/D/E/F Hornets and Super Hornets comprise the largest portion of annual sorties at 45 percent followed by Air Force A-10s at 23 percent.

Baseline Noise Exposure at Rodman Range

Noise from aircraft was determined through a combination of NOISEMAP and MR_NMAP, as described in Section 3.1.5. The resulting estimated aircraft noise exposure is presented in annual average DNL contours from 65 to 70 dB, in 5 dB increments, as depicted in Figure 3.1-6. Aircraft activity is not great enough to generate 70 dB DNL or greater. The 65 dB DNL contours enclose four of the landing zones due to the low altitude of rotary-wing aircraft in these areas and the relatively small volume of space where aircraft are concentrated during training. Noise exposure from munitions delivery at Rodman Range is not great enough to generate 87 dBPk or greater.

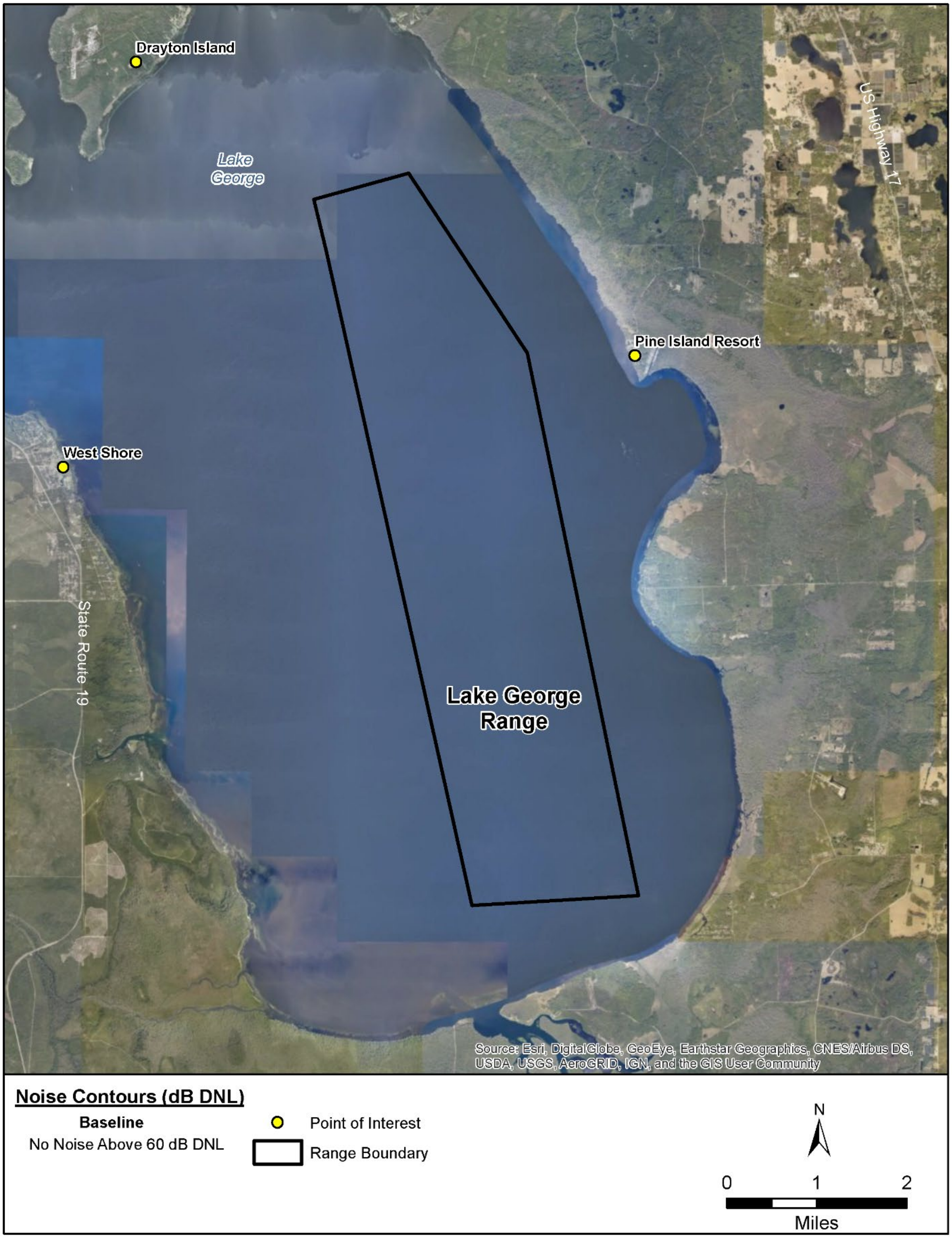

Figure 3.1-5. Baseline Aircraft Noise with Points of Interest at Lake George Range

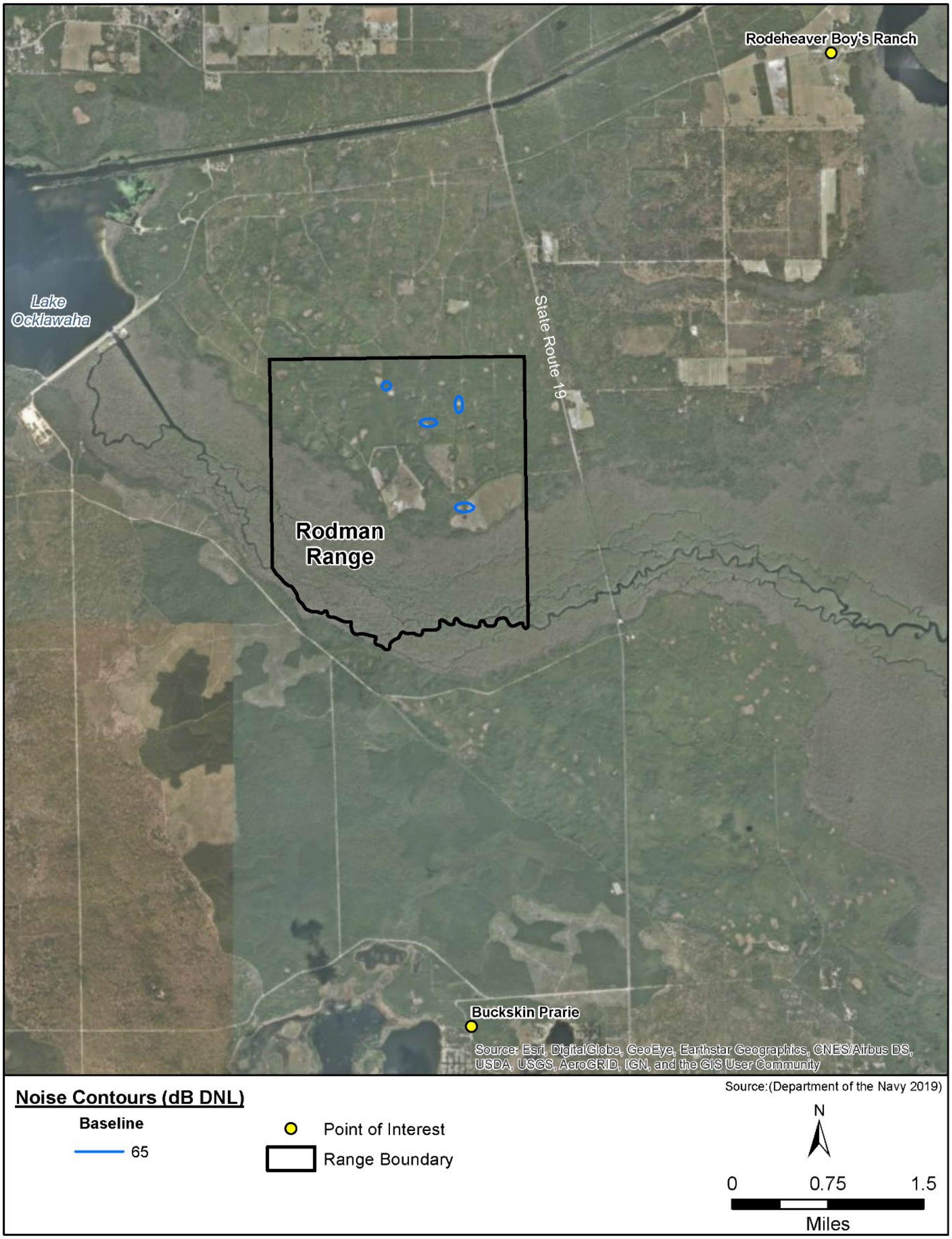

Figure 3.1-6. Baseline Aircraft Noise with Points of Interest at Rodman Range

3.2 Air Quality

The study area for air quality is where the majority of the emissions generated activity associated with PRC operations occur: Volusia, Putnam, and Marion counties in Florida.

3.2.1 Regulatory Setting

3.2.1.1 Criteria Pollutants and National Ambient Air Quality Standards

The principal pollutants defining the air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). CO, SO_2, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. Ozone, NO_2, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the Clean Air Act, the USEPA has established National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for these pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

3.2.1.2 Mobile Sources

Hazardous Air Pollutants (HAPs) emitted from mobile sources are called Mobile Source Air Toxics (MSATs). MSATs are compounds emitted from vehicles, aircraft and non-road equipment that are known or suspected to cause cancer or other serious health and environmental effects.

MSATs to be emitted under the Proposed Action would be primarily during aircraft flight and weapon firing operations. According to findings from *Select Source Materials and Annotated Bibliography on the Topic of Hazardous Air Pollutants (HAPs) Associated with Aircraft, Airports, and Aviation*, the FAA concluded that neither aircraft nor airports meet the definitions of the source types that are regulated under Clean Air Act Section 112, "Hazardous Air Pollutants" (FAA 2003). Therefore, for this EA, aircraft associated HAPs were not evaluated further in the document. This is justified because aircraft emissions of HAPs are unlikely to reach levels considered adverse below the 3,000 feet mixing height and would not create health risks to humans living underneath airspace in which these aircraft operate. Similarly, HAPs with potential to be emitted during weapon launch and/or explosives detonation are not anticipated to result in any human health risks. Therefore, the HAPs impacts from weapon firing do not warrant a further evaluation.

3.2.1.3 General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. However, the Proposed Action would occur in Volusia, Putnam, and Marion counties in Florida, all attainment areas, thus the General Conformity Rule applicability analysis is not required.

3.2.1.4 Greenhouse Gases

Greenhouse gases (GHGs) are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

Federal agencies are required to address GHG emissions with emission-reduction planning. EO 13834, *Efficient Federal Operations,* directs federal agencies to manage their buildings, vehicles, and overall operations to optimize energy and environmental performance, reduce waste, and cut costs in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment.

In an effort to reduce energy consumption, reduce GHGs, reduce dependence on petroleum, and increase the use of renewable energy resources the Navy has implemented a number of renewable energy projects. The Navy has established Fiscal Year (FY) 2020 GHG emissions reduction targets of 34 percent from a FY 2008 baseline for direct GHG emissions and 13.5 percent for indirect emissions.

3.2.2 Affected Environment

The air quality ROI is Volusia, Putnam, and Marion counties in Florida. Volusia County is within the Central Florida Intrastate Air Quality Region, while Putnam and Marion counties are in the Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region. The Florida Department of Environmental Protection is responsible for implementing and enforcing state and federal air quality regulations in Florida. Volusia, Putnam, and Marion counties are classified by the USEPA as unclassified/attainment for all criteria pollutants. Therefore, a General Conformity evaluation is not required for federal actions in these counties. The most recent emissions inventory for each of the three affected counties is shown as tons per year in Table 3.2-1. Volatile organic compound (VOC) and nitrogen oxide (NO_x) emissions are used to represent ozone generation because they are precursors of ozone.

Table 3.2-1. Affected County Air Emissions Inventory (2014)

Location	*NO_x*	*VOC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
Marion County	10,088	66,966	77,612	367	33,110	4,172	2,853,274
Putnam County	6,187	32,706	29,638	13,794	12,541	1,698	594,277
Volusia County	14,043	48,148	97,803	664	17,135	2,817	3,802,995

Source: USEPA 2014; Note: Emissions are shown as tons per year.

Existing training operations consist of aviation, weapon, and ground operations at the PRC. Although air pollutant emissions occur during all phases of aircraft operation, only those emissions emitted in the lower atmosphere's mixing layer have the potential to result in ground level ambient air quality impacts. The mixing layer is the air layer extending from ground level up to the point at which the vertical mixing of pollutants decreases significantly. The USEPA recommends that a default mixing layer of 3,000 feet be used in aircraft emission calculations (USEPA 1992). Consistent with this recommendation, aircraft emissions released above 3,000 feet were not included in the estimate.

Range training-related aircraft emissions were estimated based on the time in mode of each aircraft cruising within each range and the available aircraft emission factors applicable to range mission operations provided primarily by the Navy Aircraft Environmental Support Office Representative aircraft were also conservatively considered in estimating emissions from those aircraft at a similar or smaller scale without cruise emission factors.

Air emissions are also potentially released during each weapon firing round. Potential emission releases occur during the launching of a projectile, from the propellant charge at the firing position, and from the detonation explosion of the projectile in the target vicinity. The USEPA has published draft emission factors for ordnance in the AP-42 handbook (USEPA 2008-2009) and also documented net explosive weight-based emission factors in *Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation* (USEPA 1998). These available emission factors for weapons firing and explosive detonation were used to predict munitions emissions within each range area. The munition emission factors for each applicable weapon expenditure were multiplied by the number of rounds anticipated during firing to predict munitions emissions. Detailed emissions estimates can be found in Appendix C, Air Quality. Minimal emissions are released during the limited electronic warfare exercises that occur at the PRC. All emissions are managed by Naval Special Warfare Center Corona Division in California.

Recent annual criteria pollutants emissions and GHG emissions in terms of carbon dioxide (CO_2) emissions from existing training operations were estimated in tons per year and are shown in Table 3.2-2.

Table 3.2-2. Baseline Range Activity Estimated Air Emissions Inventory

Range	*NOx*	*VOC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
Pinecastle	43.6	0.3	5.1	0.0	11.8	6.8	5,468.4
Rodman	43.1	0.2	1.3	0.0	5.9	5.9	4,856.1
Lake George	62.8	0.3	1.7	0.0	8.6	8.6	7,008.3

Note: Emissions are shown as tons per year.

3.3 Airspace/Range Safety

This discussion of airspace includes current uses and control of the airspace. The FAA manages all airspace within the United States and the U.S. territories. Airspace, which is defined in vertical and horizontal dimensions and also by time/scheduling, is considered to be a finite resource that must be managed for the benefit of all aviation sectors including commercial, general, and military aviation. Ranges support military training to maintain proficiency weapon systems by permitting strike warfare training in the delivery of air-to-ground high-explosive munitions and non-explosive practice munitions, plus air-to-ground gunnery for both helicopters and fixed-wing aircraft.

Operations at the PRC are supported by established associated special use airspace. Special use airspace is airspace of defined dimensions wherein activities must be confined because of their nature, or wherein limitations may be imposed upon aircraft operations that are not a part of those activities (FAA 2017). Designated special use airspace alerts nonparticipating aircraft to the possible presence of military activity, and to provide segregation of participating and nonparticipating aircraft.

Military Training Routes provide special corridors for high-speed, low altitude training flights that are designed to provide realistic low altitude training conditions. The PRC is a point of terminus or destination for training in low altitude approaches to the simulated battlefields/range targets.

Military Operations Area. A MOA is a type of special use airspace where military flight operations (training and practice combat) are conducted. MOAs are established to separate or segregate certain nonhazardous military activities from instrumental flight rule traffic and to identify for visual flight rule traffic where these activities are conducted (FAA 2017). An active MOA may be transited by visual flight rule traffic, but special vigilance is recommended to ensure sufficient separation from military activities. When a MOA becomes inactive, the airspace is returned to the controlling agency.

Restricted Area. Within a Restricted Area special use airspace, aircraft flight is not prohibited, but is subject to restriction. Most Restricted Areas are designated joint use and instrument flight rule/visual flight rule operations in the area may be authorized by the controlling facility when it is not being used by the using agency (FAA 2017). Flight within the Restricted Area is controlled by the using agency, except when the area has been released to the controlling agency. During such periods, the controlling agency may permit nonparticipating aircraft operations in the Restricted Area. Restricted Areas denote the existence of unusual, often invisible, hazards to aircraft (e.g., artillery firing, aerial gunnery, or guided missiles). Flight through an active Restricted Area without authorization from the controlling agency can be extremely hazardous to nonparticipating aircraft and its occupants due to the presence of these hazards.

3.3.1 Regulatory Setting

Specific aviation and airspace management procedures and policies to be used by the Navy are provided by OPNAVINST 3710.7, *Naval Aviation Training and Operating Procedure Standardization*. Other applicable regulations regarding special use airspace management include specific FAA Orders.

Special Use Airspace identified for military and other governmental activities is charted and published by the National Aeronautical Charting Office in accordance with FAA Order JO 7400.8Y (issued February 5, 2016) and other applicable regulations and orders.

3.3.2 Affected Environment

3.3.2.1 Airspace Safety

R-2906 and Rodman Range. R-2906 and Rodman Range are used for helicopter operations and search and rescue training (see Figure 1.3-4). The range consists mainly of a 600-foot-diameter cleared area with a central target. Only non-explosive munitions are used at Rodman Range. Rodman Range is also certified for aerial lasing operations; the operations are directed only at certified laser targets on the ground. The controlling agency for R-2906 is FAA, Jacksonville Terminal Radar Approach Control and the using agency is FACSFACJAX (Department of the Navy 2012).

R-2907 and Lake George Range. R-2907 and Lake George Range are used for sea search and rescue training and mine warfare exercises in Lake George. Lake George is the only electronic warfare range on the East Coast with approved use of flares for small missile simulation. The controlling agency for R-2907 is FAA, Jacksonville Air Route Traffic Control Center (ARTCC) and the using agency is FACSFACJAX (Department of the Navy 2012).

R-2910 and Pinecastle Range. R-2910 and Pinecastle Range are used for high-explosive munitions training (including air-to-ground bombing), lasing, and strafing. Pinecastle Range consists of eight targets, including the Live Impact Area (only target where high-explosive munitions can be used), and seven targets for non-explosive munitions. R-2910 can be used alone, but normally all the Restricted Areas are used together when the aircraft are training. In addition, the USFS Helicopter Base is within Pinecastle Range, and used by both the USFS and the Navy. As noted in the Navy-USFS Operating Plan, when air-delivered munitions training is scheduled, an air support helicopter is on standby to suppress any wildfires as needed. The controlling agency for R-2910 is FAA, Jacksonville ARTCC and the using agency is FACSFACJAX (Department of the Navy 2012).

Aerial lasing operations occur at the Pinecastle Range and are directed only at certified laser targets on the ground. Laser exercises generally (i.e., excepting some helicopter exercises) require aircraft to be at high altitudes, approximately 12 nautical miles away from the target, and directed down to the certified laser targets. Lasing can occur in combination with bombing operations or alone (Department of the Navy 2012). Lasing operations are conducted under strict safety controls, including compliance with existing SOPs, monitoring by Airport Surveillance Radar-9 radar, use of the Navy's Identification, Friend or Foe system, and presence of the Laser System Safety Officer. Both air traffic control and the Laser System Safety Officer are in direct communication with personnel in the aircraft cockpit, who can then turn the laser system off should any unauthorized aircraft approach the vicinity of the laser operation. Direct communication is also established and maintained between the pilots who are lasing, FACSFACJAX, PRC personnel, and a Range Safety Observer (Department of the Navy 2012).

Palatka 1 and Palatka 2 MOAs. The Palatka 1 MOA is activated at the same time as R-2907 and R-2910 and the Palatka 2 MOA is activated at the same time as Restricted Areas R-2907, R2907 B/C, R-2910 and R-2910 D/E (Department of the Navy 2012). R-2906 is within the Palatka 2 MOA. All other existing PRC Restricted Areas are within the Palatka 1 MOA, except for portions of R-2910B and R-2910C, which are not within a MOA (see Figure 1.3-4). The MOAs are accessed when military aircraft need to move between the Restricted Areas during training. The controlling agency for Palatka MOAs is FAA, Jacksonville ARTCC and the using agency is FACSFACJAX.

Since the PRC includes high volumes of military aircraft, instrument flight rule traffic is not normally cleared though the Palatka MOAs when the Restricted Areas are active. The airspace directly south and east of the Palatka 1 and Palatka 2 MOAs is frequently used by commercial aircraft operating under instrument flight rules, including standard arrival and departure routes to Orlando International Airport (approximately 28 miles southeast of R-2910). Nonparticipating instrument flight rule aircraft (e.g., commercial airliners) may be cleared through a MOA if instrument flight rule separation can be provided by air traffic control. Otherwise, air traffic control will reroute or restrict the aircraft. Therefore, Jacksonville ARTCC currently has procedures that reroute traffic to and from Orlando International Airport when the MOAs are active. For example, when R-2910 and the Palatka MOAs are active, Orlando International Airport traffic is shifted from the northwestern departure route that overlaps R-2910 to another established departure route to the east, thereby avoiding the special use airspace. There is also a heavily used arrival corridor to Orlando International Airport just east of the Palatka MOAs that is not affected by the activity status of the PRC.

Visual flight rule aircraft may transit the MOAs when they are active. However, per FAA procedures visual flight rule aircraft are encouraged to use extreme caution. When the Palatka MOAs and the existing Restricted Areas are active, there are two narrow corridors between R-2906 and R-2907 and between R-2907 and R-2910 through which aircraft operating under visual flight rule can fly. Most visual flight rule traffic consists of local, general aviation aircraft, which operate at less than 12,000 feet above mean sea level. PRC air traffic control personnel estimate that a small number of nonparticipating general aviation visual flight rule aircraft transit the corridors. Coordination between the military services over shared use of military airspace and other training assets is an ongoing activity (Department of the Navy 2012).

Laser Safety. The purpose of range laser safety is to prevent exposure of both military personnel and the general public to laser radiation and to ensure that only intended target areas are engaged by the laser without placing unnecessary restrictions on laser system use. Different control measures are required depending on the class of the laser, the operational environment, and the level of personnel training. Most control measures fall into the category of common-sense practices aimed at limiting the laser exposure. Unauthorized personnel are not permitted in areas where laser training is conducted, and laser eye protection is required for personnel who may potentially engage in intrabeam viewing within this area. DoD handbook MIL-HDBK-828B, *Range Laser Safety* provides uniform guidance for the safe use of military lasers and laser systems on DoD ranges, and directs each military service to establish a range laser safety program as part of their overall range safety program. Accordingly, Navy instruction OPNAVINST 5100.27B, *Navy Laser Hazards Control Program*, prescribes the Navy and Marine Corps policy and guidance in the identification and control of laser radiation hazards. This instruction includes, but is not limited to: controls over laser design and operation; protection of personnel and equipment, including training requirements; and specific information on various laser safety subjects. There is no safety risk to the public when complying with existing access restrictions.

3.3.2.2 Range Safety

With respect to range safety, the Navy is responsible for minimizing potential safety hazards from air-to-ground and ground-to-ground training, to the extent practicable, without affecting operational and training capabilities. The Navy works with federal, state, and local planning officials to implement the objectives of the RAICUZ Study for the PRC (see Section 1.6). The RAICUZ Study presents RCZs associated with the various live-fire training operations at the PRC. Range safety includes the various policies, plans, and procedures in place at the ranges that are designed to mitigate the potential safety hazards related to the use of ordnance, ammunition, demolition, and explosives. Range safety programs are established for all training ranges in accordance with OPNAVINST 3550.1A/Marine Corps Order 3550.11 to ensure the highest degree of safety is applied. The various programs outline specific safety policies and responsibilities to protect civilian and military populations who live and work near live-fire operational ranges. The programs also minimize, to the extent practical, the potential safety hazards. The Navy personnel stationed at the PRC monitor range activities and ensure that training occurs in accordance with approved safety procedures (Department of the Navy 2017a).

Electromagnetic Radiation. The phrase “electromagnetic radiation” has been used to describe the electronic warfare emitters’ output. In this case, “radiation” is simply electronic energy. Electromagnetic energy is composed of two components: an electric wave and a magnetic wave. These two waves are in phase and move at 90 degrees to each other. The electromagnetic waves create electromagnetic radiation and can be drawn as an oscillating wave of electric and magnetic fields**.** All electromagnetic waves (from television waves to radio waves) have different wavelengths; however, all wavelengths must fall within certain parameters of the electronic spectrum (Department of the Navy 2014). The mobile emitters send signals that are similar to some satellite communications, Wi-Fi devices, cordless phones, Bluetooth devices and weather radar systems (Department of the Navy 2019b).

Effective electronic warfare training requires that the military learn how to deny an enemy the advantage of, and ensure unimpeded access to, the electromagnetic spectrum—the range of all possible frequencies of electromagnetic radiation (i.e., electromagnetic energy) for use in such applications as communication systems, navigation systems, and defense-related systems and components (Joint Chiefs of Staff 2012). The use of the emitter systems listed in the Proposed Action provides the Navy with the ability to simulate modern electronic warfare threats in an open-air environment to train the operators of these systems effectively and efficiently (Joint Chiefs of Staff 2012). The mobile emitter systems transmit electromagnetic radiation within an identifiable and recognizable energy wave within the electromagnetic spectrum. Mobile emitters transmit radio frequency energy directed at training aircraft. The radio frequency energy used at all locations is regulated and approved by the Federal Communications Commission. The frequency band that the mobile emitters are capable of transmitting within is 4 to 8 gigahertz (GHz). Mobile emitter vehicles are similar to television news satellite trucks in that they broadcast a signal skyward, but rather than broadcasting to a satellite, these will be aimed at the participating training aircraft.

DoD Instruction 3200.16, *Operational Range Clearance* policy, and OPNAVINST 3571.4, *Operational Range Clearance Policy for Navy Ranges,* establish the policies and requirements for performing ORC on Navy ranges in accordance with DoD 4715.11.The ORC policy applies to all operational land-based ranges exclusive of water ranges (Lake George) and small arms ranges. Thus at the PRC, the ORC policy applies only to Pinecastle and Rodman Ranges. The policy requires an ORC Plan for each operational range programmed for continued use. OPNAVINST 3571.4 identifies policy objectives specific to responsibilities for performing ORC on Navy operational testing and training ranges. The Navy has a responsibility to sustain the highest levels of readiness to meet its mission requirements while operating in an environmentally responsible manner that is protective of the public. The Navy has implemented the *ORC Plan for the Pinecastle Range and Rodman Bomb Target, Pinecastle Range Complex, Florida*. The purpose of the ORC Plan is to ensure the safety of aircrews, range operations, maintenance personnel, range clearance personnel, and the public. Major elements of the ORC Plan include the following:

- Range clearance schedule (annual and 5-year expanded clearance);
- Hazard assessment prior to range clearance operations;
- Procedures for range clearance activities, including a Quality Assurance Surveillance Plan;
- Procedures for removal and disposal or recycling of range scrap and debris (e.g., munitions, munitions residue, and target residue);
- Permanent record of the locations of past, current, and future range clearances;
- Outreach program; and
- Safety program.

3.4 Biological Resources

Within this EA, biological resources are divided into four major categories: (1) terrestrial vegetation, (2) terrestrial wildlife, (3) marine vegetation, and (4) marine wildlife. Although Lake George is a freshwater lake, it is recognized as the upper limit of tidal waters for the St. John's River system. Therefore, biological resources associated with Lake George are largely analyzed as marine resources in this EA. Threatened, endangered, and other special-status species are discussed in their respective categories.

3.4.1 Regulatory Settings

Special-status species, for the purposes of this EA, are those species listed as threatened or endangered under the Endangered Species Act (ESA) and species afforded federal protection under the Marine Mammal Protection Act (MMPA) or the Migratory Bird Treaty Act (MBTA). The ESA provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife. All marine mammals are protected under the provisions of the MMPA. The MMPA prohibits any person or vessel from "taking" marine mammals in the United States or the high seas without authorization. The MMPA defines "take" to mean "to harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal."

Birds, both migratory and most native-resident bird species, are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186, *Migratory Bird Conservation*. Under the MBTA it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess migratory birds or their nests or eggs at any time, unless permitted by regulation. Military readiness activities are exempt from the take prohibitions of the MBTA, provided they would not result in a significant adverse effect on a population of migratory bird species. Bald and golden eagles are protected by the Bald and Golden Eagle Protection Act. This Act prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald eagles, including their parts, nests, or eggs. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

The Magnuson-Stevens Fishery Conservation and Management Act provides for the conservation and management of the fisheries. Under the Act, essential fish habitat consists of the waters and substrate needed by fish to spawn, breed, feed, or grow to maturity.

Additionally, this EA analyzes impacts to species on the USFS Regional Foresters Sensitive Species (RFSS) list that have the potential to be affected by activities at Pinecastle Range (Table 3.4-1). The complete list can be found in Appendix G.

3.4.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under biological resources occurring within the ROI. The ROI for the purpose of this analysis includes the Pinecastle Range, Rodman Range, Lake George Range, and associated special use airspace (as applicable). A composite list of threatened and endangered species applicable to the Proposed Action is provided in Table 3.4-1. Potential species occurrence is based on a USFWS Information for Planning and Consultation search of the three ranges in the ROI (USFWS 2019a); past USFWS consultations; existing documents, including the NAS Jacksonville Complex Integrated Natural Resources Management Plan (INRMP) (Department of the Navy 2014a), the Supplemental Environmental Impact Statement for

Renewal of Authorization to Use Pinecastle Range (Department of the Navy 2010b), and the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Department of the Navy 2009); and Florida Natural Areas Inventory (FNAI) data searches for the three ranges in the ROI (FNAI 2019).

Table 3.4-1. Special-Status Species Known to Occur or Potentially Occurring in or Adjacent to the ROI

Common Name	Scientific Name	Federal Listing Status	State Listing Status	Potential to Occur[1]			Critical Habitat Present?
				Pinecastle Range	Lake George Range	Rodman Range	
Federally Listed/Protected Species							
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	E	E	-	-	-	no
Shortnose sturgeon	*Acipenser brevirostrum*	E	E	-	Known (Rare)	-	no
Bald eagle	*Haliaeetus leucocephalus*	BGEPA	None	-	-	Likely	no
Florida scrub-jay	*Aphelocoma coerulescens*	T	T	Known	Likely[2]	Likely	no
Red-cockaded woodpecker	*Picoides borealis*	E	E	Potential	Likely[2]	Potential	no
Wood stork	*Mycteria americana*	T	T	Known	Likely	Known	no
American alligator	*Alligator mississippiensis*	T	SSC	-	Known	Known	no
Eastern indigo snake	*Drymarchon couperi*	T	T	Known	Likely[2]	Likely	no
Gopher tortoise	*Gopherus polyphemus*	C	T	Known	Likely[2]	Known	no
Sand skink	*Plestiodon reynoldsi*	T	T	Known	Likely[2]	Potential	no
West Indian manatee	*Trichechus manatus*	E	E	-	Potential	Potential	All of Lake George
Britton's beargrass	*Nolina brittoniana*	E	None	Potential	-	-	no
Clasping warea	*Warea amplexifolia*	E	None	-	-	Potential	no
Florida bonamia	*Bonamia grandiflora*	T	E	Known	-	-	no
Lewton's polygala	*Polygala lewtonii*	E	E	Known	-	Potential	no
Scrub buckwheat	*Eriogonum longifolium* var. *gnaphalifolium*	T	E	Known	-	Potential	no
Scrub pigeon-wing	*Clitoria fragrans*	T	E	Potential	-	Potential	no
State Listed/Protected Species							

Table 3.4-1. Special-Status Species Known to Occur or Potentially Occurring in or Adjacent to the ROI

Common Name	Scientific Name	Federal Listing Status	State Listing Status	Potential to Occur[1]			Critical Habitat Present?
				Pinecastle Range	Lake George Range	Rodman Range	
Bluenose shiner	*Pteronotropis welaka*	None	SSC	-	Potential	Potential	NA
Tessellated darter	*Etheostoma olmstedi*	None	SSC	-	-	Potential	NA
Florida burrowing owl	*Athene cunicularia floridana*	None	SSC	Potential	-	Potential	NA
Florida sandhill crane	*Grus canadensis pratensis*	None	T	Potential	Potential	Potential	NA
Least tern	*Sternula antillarum*	None	T	-	-	-	NA
Little blue heron	*Egretta caerulea*	None	SSC	-	-	Known	NA
Snowy egret	*Egretta thula*	None	SSC	-	-	Known	NA
Southeastern American kestrel	*Falco sparverius*	None	T	-	Likely	-	NA
Tricolored heron	*Egretta tricolor*	None	SSC	-	-	-	NA
White ibis	*Eudocimus albus*	None	SSC	-	-	Known[2]	NA
Florida pine snake	*Pituophis melanoleucus mugitus*	None	SSC	Potential	-	Potential	NA
Gopher frog[3]	*Lithobates capito*	None	SSC	Potential	Potential	Likely	NA
Short-tailed snake	*Lampropeltis extenuata*	None	T	Potential	Potential	Potential	NA
Florida black bear	*Ursus americanus floridanus*	None	T	Likely	-	Likely	NA
Sherman's fox squirrel[3]	*Sciurus niger shermani*	None	SSC	Known	NA	NA	NA
Pondspice	*Litsea aestivalis*	None	E	Potential	Potential	Known	NA
Sand butterfly pea[3]	*Centrosema arenicola*	None	E	Potential	NA	NA	NA
Scrub stylisma[3]	*Stylisma abdita*	None	E	Potential	NA	NA	NA
Regional Foresters Sensitive Species (Pinecastle Range Only)							
Florida mouse	*Podomys floridanus*	None	None	Potential	NA	NA	NA
Rafineque's big-eared bat	*Corynorhinus rafinesquii*	None	None	Potential	NA	NA	NA
Bachman's sparrow	*Aimophila aestivalis*	None	None	Potential	NA	NA	NA
Florida scrub lizard	*Sceloporus woodi*	None	None	Potential	NA	NA	NA
Southern hognose snake	*Heterodon simus*	None	None	Potential	NA	NA	NA
Eastern diamondback rattlesnake	*Crotalus adamanteus*	None	None	Potential	NA	NA	NA

Table 3.4-1. Special-Status Species Known to Occur or Potentially Occurring in or Adjacent to the ROI

Common Name	Scientific Name	Federal Listing Status	State Listing Status	Potential to Occur[1]			Critical Habitat Present?
				Pinecastle Range	Lake George Range	Rodman Range	
Striped newt	*Notophthalmus perstriatus*	None	None	Potential	NA	NA	NA
Ocala deepdigger scarab beetle	*Peltotrupes youngi*	None	None	Potential	NA	NA	NA
Ocala clawcerus grasshopper	*Melanopus nanciae*	None	None	Potential	NA	NA	NA
Monarch butterfly	*Danaus plexippus*	None	None	Potential	NA	NA	NA
Purple skimmer	*Libellula jesseana*	None	None	Potential	NA	NA	NA
Wakulla Springs vari-colored microcaddisfly	*Hydroptila wakulla*	None	None	Potential	NA	NA	NA

Note: [1]Species potential to occur is based on the system used by the Florida Natural Area Inventory (FNAI). An FNAI Biodiversity Matrix Query Result (Unofficial Report) was performed on May 14, 2019. Known = There is a documented occurrence in the FNAI database of the species within one or more of the Matrix Units. Likely = The species is known to occur in this vicinity, and is considered likely within one or more the Matrix Units. Potential = One or more of the Matrix Units lies within the known or predicted range of the species based on expert knowledge and environmental variables. A dash (-) means that no database record for the species occurs in the FNAI in the vicinity of the project area; it does not imply that the species could not occur there.

[2]Species likely occurs in the terrestrial habitats surrounding Lake George, but is not likely to occur within the Lake George Range (open water habitat).

[3]Species is also an RFSS (Pinecastle Range Only).

Legend: Selections for Listing Status Column include: BGEPA = Bald and Golden Eagle Protection Act; C = candidate species for listing, E = endangered, T = threatened, SSC = Species of Special Concern (State designation), NA = Not Applicable.

The American alligator is known to occur in or near the Rodman Range and Lake George Range and is listed as "threatened due to similarity of appearance" to other listed crocodilians. The purpose of the listing is to regulate the intentional taking of alligators and to prevent the taking of other crocodilian species. The alligator is not biologically threatened in Florida, and ESA section 7 consultation requirements do not apply to this species. Therefore, the American alligator is not analyzed as a special-status species in this EA.

The Ocala National Forest contains a small group of Britton's beargrass individuals only in the western section of the forest boundary (USFS 2016). There is potential habitat at the Pinecastle Range, but there are no known occurrences in the Rodman or Pinecastle ranges. Likewise, although potential habitat for clasping warea occurs at the Rodman Range (FNAI 2019), the species is not known to occur there (Navy 2014a). It is reasonable to conclude that no effects to these species would occur from the Proposed Action, and Britton's beargrass and clasping warea are not addressed further.

3.4.2.1 Terrestrial Vegetation

Vegetation includes terrestrial plants as well as freshwater aquatic communities and constituent plant species. Threatened and endangered plant species, and species on the RFSS list occurring or having the potential to occur in the ROI are presented in Table 3.4-1.

Pinecastle Range

Vegetation in the Ocala National Forest is largely dependent upon fire frequency, hydrology, soils, and geologic history. The vegetation of Ocala National Forest is diverse, consisting of communities in aquatic environments, wet prairies, hydrophytic hardwoods, mesic hardwoods, flatwoods, and xerophytic sandhills. However, the Pinecastle Range does not contain aquatic or wetland habitats. The Ocala National Forest and Pinecastle Range are dominated by scrub habitat. The scrub ecosystem is characterized by sand pine (*Pinus clausa*), evergreen oaks, and dense shrubs. Scrub is found on excessively well-drained sandy soil associated with the Central Florida ridge. Scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire (Department of the Navy 2010b).

Additionally, RFSS-listed plants that are associated with sand pine scrub, and could potentially occur on Pinecastle Range include Florida cacalia (*Arnoglossum floridanum)*, Curtiss' milkweed (*Asclepias curtissii*), Ashe's calamint (*Calamintha ashei*), sand butterfly pea (*Centrosema arenicola*), liverwort (*Frullania donnellii*), nodding pinweed (*Lechea cernua*), silk bay (*Persea humilis*), Florida feathershank (*Schoenocaulon dubium*), tough bully (*Sideroxylon tenax*), jeweled blue-eyed grass (*Sisyrinchium xerophyllum*), and showy dawnflower (*Stylisma abdita*).

Lake George Range

No land areas or terrestrial vegetation occurs on the Lake George Range. Lands surrounding Lake George are largely undeveloped and the vegetation primarily consists of forested uplands and wetlands. Aquatic vegetation in the Lake George Range is described in Section 3.4.2.3.

Rodman Range

The majority of the Rodman Range is undeveloped and consists of forested uplands and wetlands. Approximately 52 percent (1,390 acres) of the range consists of natural vegetation communities including approximately 1,200 acres of floodplain swamp and bottomland forest along the Ocklawaha River in the southern part of the property (Department of the Navy 2009). Flatwoods located on the north part of the range are composed of mostly mature slash pine plantations with a heavy saw palmetto understory.

Numerous small depression marshes and dome swamps are interspersed throughout the flatwood plantations. Rodman Range has a main target area of about 100 acres, which is maintained by routine mowing and occasional plowing to meet operational and safety requirements. Vegetation in the target area consists of grasses and other herbaceous plants (Department of the Navy 2009).

Vegetation at the range is managed in accordance with the INRMP to support the mission and to provide for sustained, multiple uses (Department of the Navy 2014a). Prescribed fire is used as a management tool throughout the range and silvicultural practices are used in the pine plantations. Lands surrounding Rodman Range are undeveloped and primarily forested. The Ocala National Forest borders the range to the south and west.

Federally Listed Plant Species

Florida Bonamia

Florida bonamia is a perennial, trailing vine endemic to scrub and scrub edge that typically occurs in open, sunny areas. It can grow in the filtered light of closed canopy areas when the shrub canopy is open, but flowering is not prolific (Navy 2002). The species has evolved in fire-maintained xeric communities, including oak-dominated scrub and sandhills (USFWS 2007c).

The population of Florida bonamia throughout the Ocala National Forest, including the Pinecastle Range, is large. Surveys in 1993, 1997, and 2001 recorded numerous individual plants at a variety of sites in accessible areas along roadsides near the Pinecastle Range (Navy 2002). The number of sites increased from six (with a total of 210 plants) in 1993 to 19 (more than 200 plants) in 2001. The 2001 survey showed that large populations were being supported in areas that had been harvested since 1995 and burned since 1988 and in an adjacent area maintained as open sand (Navy 2002). The species was last formally monitored in 2007 (Jenkins et al. 2007), when observers described the presence of Florida Bonamia in survey areas as "widespread and numerous" in suitable habitat. The species is frequently seen flowering within a year of timber harvest by Ocala National Forest personnel. An analysis of land cover in the vicinity of the Pinecastle Range identified large areas of potential habitat for the Florida bonamia in the area. Monitoring results at the Ocala National Forest suggest that the local population follows "boom and decline" responses to management, (e.g., prescribed burning) (USFWS 2007c).

Florida bonamia is not known to occur at the Rodman Range (Department of the Navy 2019b), and the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Florida bonamia at the Rodman and Lake George ranges are not addressed in further detail.

Lewton's Polygala

Lewton's polygala is found in a variety of habitats, including transitional habitats between high pine and turkey barrens, oak scrub, and high pine communities (USFWS 1999). There is a significant population of the species in and around Pinecastle Range, making the area important for the conservation of the species. It includes a significant number of the known locality records, the second largest population overall, and the largest scrub population in the Ocala National Forest (Navy 2002). Surveys in 1993, 1997, and 2001 identified up to 17 sites consisting of 37 to 76 individual plants as well as small clumps (Navy 2002).

Lewton's polygala potential habitat occurs in the general vicinity of Rodman Range; therefore, the FNAI Biodiversity Matrix lists Lewton's polygala as potentially occurring at Rodman Range (FNAI 2019). However, it is not known to occur at Rodman Range, and training operations at Rodman Range would not affect vegetation outside the range boundaries. During a rare, threatened, and endangered plant survey conducted in 2017, no occurrence of Lewton's polygala was observed within the Rodman Range (LG2 Environmental Solutions, Inc. 2018). In addition, the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Lewton's polygala at the Rodman and Lake George ranges are not addressed in further detail.

Scrub Buckwheat

Scrub buckwheat occurs in oak-hickory scrub, sandhills, and turkey barrens communities (USFWS 2008). This species occurs within Ocala National Forest, which is considered the northern limits of its range. The FNAI Biodiversity Matrix listed scrub buckwheat as know to occur in the area of Pinecastle Range, but this species was not found in Pinecastle Range in surveys conducted in 1993, 1997, and 2001, although suitable habitat is found on the site (Navy 2002). The current management practices prescribing frequent disturbances are conducive to establishing scrub habitat for scrub buckwheat. As such, there is the potential for this species to occur in the Pinecastle Range.

Scrub buckwheat potential habitat occurs in the general vicinity of Rodman Range; therefore, the FNAI Biodiversity Matrix listed scrub buckwheat as potentially occurring at Rodman Range (FNAI 2019). However, the species has never been observed at Rodman Range, and training operations at Rodman

Range would not affect vegetation outside the range boundaries. The Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to scrub buckwheat at the Rodman and Lake George ranges are not addressed in further detail.

3.4.2.2 Terrestrial Wildlife

Wildlife includes all animal species (i.e., insects and other invertebrates, freshwater fish, amphibians, reptiles, birds, and mammals). Threatened, endangered, other special-status wildlife species, and RFSS species occurring or having the potential to occur in the ROI are presented in Table 3.4-1.

Pinecastle Range

A variety of wildlife species occur at or in the vicinity of the Pinecastle Range. The large expanses of scrub habitat are home to mammal species, including the white-tailed deer (*Odocoileus virginianus*), eastern cottontail (*Sylvilagus floridanus*), gray fox (*Urocyon cinereoargenteus*), gray squirrel (*Sciurus carolinensis*), bobcat (*Lynx rufus*), and raccoon (*Procyon lotor*) (Department of the Navy 2010a). Additionally, RFSS-listed mammals that could occur on the range include Florida mouse (*Podomys floridanus),* Sherman's fox squirrel *(Sciurus niger shermani), eastern pipistrelle (Perimyotis subflavus),* southeastern bat (*Myotis austroriparius*) and Rafineque's big-eared bat *(Corynorhinus rafinesquii).*

Non-imperiled reptiles and amphibians that occur include eastern coachwhips (*Masticophis flagellum flagellum*), scarlet snakes (*Coluber guttatus*), racers (*Coluber* spp.), southern toads (*Bufo terrestris*), southern fence lizards (*Sceloporus undulatus undulatus*), and tree frogs (*Hyla spp.*). Additionally, RFSS-listed reptiles and amphibians that could occur on the range include Florida scrub lizard (*Sceloporus woodi),* southern hognose snake (*Heterodon simus),* eastern diamondback rattlesnake *(Crotalus adamanteus),* gopher tortoise *(Gopherus Polyphemus),* gopher frog *(Lithobates capito),* and striped newt *(Notophthalmus perstriatus).* Insects on the RFSS that could occur on the range include the Ocala deepdigger scarab beetle (*Peltotrupes youngi*), Ocala claw-cercus grasshopper (*Melanopus nanciae*), Wakulla Springs vari-colored microcaddisfly (*Hydroptila wakulla*), purple skimmer (*Libellula jesseana*), and the monarch butterfly *(Danaus plexippus*).

Many migratory and non-migratory species of bird may be found at or in the vicinity of the Pinecastle Range, including Carolina wrens (*Thryothorus ludovicianus*), bobwhite quail (*Colinus virginianus*), nighthawks (*Chordeiles minor*), rufous-sided towhees (*Pipilo erythrophthalmus*), loggerhead shrikes (*Lanius ludovicianus*), great crested flycatchers (*Myiarchus crinitus*), brown thrashers (*Toxostoma rufum*), and wild turkey (*Meleagris gallopavo*), among others (Department of the Navy 2010a).

Additionally, RFSS-listed birds that could occur on the range include Bachman's sparrow (*Aimophila aestivalis*) and Florida sandhill crane (*Grus canadensis pratensis*).

Lake George Range

The mixed hardwood swamp and pine flatwoods in the vicinity of the Lake George Range support populations of bobcat, Florida black bear, alligator, a variety of hawks, several representatives of the heron family, river otters, owls, osprey, and white-tailed deer. However, no terrestrial habitats occur within the Lake George Range (Department of the Navy 2009). Aquatic wildlife occurring at the Lake George Range are described in Section 3.4.2.3.

Rodman Range

The vegetation at the Rodman Range provides a variety of habitats for wildlife. Approximately 50 percent of the range is covered by natural swamps or marsh communities. Amphibians and reptiles, such as frogs, salamanders, turtles, and snakes commonly occur and forage in swamps and marshes. Common species are the marbled salamander (*Ambystoma opacum*), tree frogs, and mud snakes (*Farancia abacura*) (Department of the Navy 2009).

Birds are among the most abundant wildlife in the swamps and marshes of the Rodman Range. The changing water levels, vegetation canopy, tree cavities, and abundance of invertebrates provide habitat for waterfowl, wading birds, songbirds, woodpeckers, and occasionally wild turkeys. Wood ducks (*Aix sponsa*) can be found in the open waters of swamps and marshes. Several species of heron (*Ardea* spp.), egrets (*Egretta* spp.), limpkins (*Aramus guarauna*), rails (*Rallus* spp.), various waterfowl, and Florida sandhill crane (*Grus canadensis pratensis*) commonly wade in the shallow waters in search of benthic invertebrates and fish. Warblers (*Limnothlypis* and *Protonotaria* spp.) and at least three species of woodpeckers can be found in the canopy (Department of the Navy 2009). Bird surveys conducted at Rodman Range from 1997 through 2000 documented 46 species of birds including flycatchers, sparrows, owls, woodpeckers, herons, warblers, vireos, hawks, and game birds such as wild turkey, mourning dove, wood duck, and bobwhite quail (Department of the Navy 2009).

Mammals common to the swamps and marshes of the Rodman Range are not necessarily confined to wetland habitats. The most common species include white-tailed deer, wild hogs, rabbit, gray and fox squirrel, raccoon, opossum, and fox (Department of the Navy 2009). The largest species associated with swamps at the Rodman Range is the Florida black bear (*Ursus americanus floridanus*), which is common in this portion of the state. In addition, bat species, such as Rafinesque's big-eared bat and the southeastern myotis , are known to occur at and in the vicinity of the Rodman Range (Department of the Navy 2014a).

Federally Listed Terrestrial Wildlife Species

Florida Scrub-Jay

The Florida scrub-jay is endemic to Florida's sand scrub habitats. Florida scrub-jays are extremely habitat-specific, non-migratory, and not highly mobile. They reside in scrub habitat that typically contains sand live oak (*Quercus geminata*), myrtle oak (*Quercus myrtifolia*), inopine oak (*Quercus inopina*), Chapman oak (*Quercus chapmanii*), saw palmetto (*Sereno repens*), scrub palmetto (*Sabal etonia*), young sand pines, and rosemary (*Ceratiola ericoides*).

Florida scrub-jays maintain a social structure that involves cooperative breeding (Woolfenden and Fitzpatrick 1984). Florida scrub-jays live in groups ranging from two (a single mated pair) up to large, extended families of eight adults and one to four juveniles. Fledgling scrub-jays remain with the breeding pair in their natal territory as "helpers," forming a closely knit, cooperative family group. There is only one breeding pair within a group and the non-breeding individuals help rear the young (Woolfenden and Fitzpatrick 1984).

Habitat is the greatest limiting factor for this species. The ecology of the scrub habitat is driven by disturbance, mainly fire. The USFS manages scrub-jay habitat in the Ocala National Forest through management practices such as prescribed fire and clear-cutting. Approximately 200,000 acres of sand pine scrub are within the Ocala National Forest and the land is managed in such a way that 40,000 acres at any given time are available scrub-jay habitat.

While there are 21 metapopulations of Florida scrub-jay in Florida, only three are large enough to contain sufficient numbers to ensure long-term viability (USFWS 2015). One of these three large populations is within the Ocala National Forest. Surveys for Florida scrub-jays on the Ocala National Forest conducted in 2012-2014 yielded estimates of 1,100-1,250 groups, which translates into approximately 2,530-2,875 individuals if an average observed group size of 2.3 birds per group is extrapolated to the entire population (Miller et al. 2015). The Florida scrub-jay population on the Ocala National Forest has not been as thoroughly surveyed as the other two major populations due to the vast amount of potential habitat present and the infeasibility of conducting statistically robust surveys.

The Pinecastle Range, with the exception of the target areas, is actively managed for scrub habitat. Approximately 1,517 acres of scrub-jay habitat occurs within the Pinecastle Range. The density of scrub-jay groups has been found to be one group per 40 acres within the Pinecastle Range, a higher density than other parts of the Ocala National Forest, because of the prescribed burning conducted on the Range by the USFS in cooperation with the Navy (Navy 2002). Surveys conducted at the Pinecastle Range in 2011 observed 53 groups of scrub-jays (127 individuals), while 2012 surveys observed 38 groups of scrub-jays (101 individuals). The survey report noted that scrub-jays were absent from stands that had recently burned, and that this typically takes 5-10 years for scrub habitat to become optimal for scrub-jays following a burn (Department of the Navy 2012).

The FNAI Biodiversity Matrix lists the Florida scrub-jay as likely to occur in the database area that includes Rodman Range. However, the Florida scrub-jay was not observed during FNAI (1997) surveys at Rodman Range and suitable habitat is not present (Department of the Navy 2019b). Mapping provided by the Florida Fish and Wildlife Conservation Commission (FFWCC) showed several occurrence records for this species south of the range in the Ocala National Forest, but none within the range boundaries. The Florida scrub-jay is not expected to occur at Rodman Range based on the lack of sightings and lack of suitable habitat.

The Florida scrub jay is not expected to use the open water habitats within the Lake George Range, but is considered likely to occur in scrub habitat in lands surrounding Lake George.

Red-Cockaded Woodpecker

The red-cockaded woodpecker is a small woodpecker that, like the Florida scrub-jay, engages in a cooperative breeding system. They live in groups containing a single breeding pair, while others help incubate eggs, feed nestlings and fledglings, and defend territories (USFWS 2019b).

Red-cockaded woodpeckers inhabit open, mature pine woodlands. Optimal habitat is characterized as a broad savanna with a scattered overstory of large pines and a dense groundcover containing a diversity of grass, forb, and shrub species. This habitat is characterized by low intensity fire, which historically occurred during the growing season at intervals of about 1-10 years. Therefore, fire suppression can have a detrimental impact on red-cockaded woodpecker populations. Landscape features, such as fragmentation of foraging habitat, total area of foraging habitat, percentage of pinewood or hardwood cover, contiguity of the canopy and forest cover, and habitat patch size and shape may affect the habitat quality (NatureServe 2019).

Short-term rotation timber management has eliminated the majority of dead or dying pines (i.e., snags) that are used for roosting, nesting, and foraging; fire suppression has allowed invasion of pine stands by hardwoods. However, recent management innovations have alleviated threats and resulted in population increases in some areas (NatureServe 2019). Management goals for the species include maintaining old-growth pine forests and establishing an effective prescribed burning program. Burns conducted in spring and summer are most effective in controlling hardwood encroachment.

In the Ocala National Forest, the red-cockaded woodpecker typically nests in mature longleaf pine. The FNAI Biodiversity Matrix (FNAI 2019) indicates that this species has the potential to occur in the general vicinities of the Rodman and Pinecastle Ranges, but does not contain records for documented occurrences at either range. No suitable habitat for red-cockaded woodpecker exists at the Pinecastle Range. The red-cockaded woodpecker has not been observed at Rodman Range and the range generally lacks suitable open, mature pine woodland habitat for this species. Most of the pine forest habitats at the Rodman Range are composed of mature slash pine plantations with a heavy saw palmetto understory (Navy 2005). The red-cockaded woodpecker is not expected to occur at the Pinecastle or Rodman Range based on lack of sightings and lack of suitable habitat.

The red-cockaded woodpecker is not expected to use the open water habitats within Lake George Range, but mapping provided by FFWCC shows several occurrence records for this species west of Lake George in the Ocala National Forest (FFWCC 2020a).

Wood Stork

Wood storks are large wading birds that inhabit freshwater marshes, swamps, lagoons, ponds, and flooded fields. The wood stork can also occur in brackish wetlands. Wood storks nest mostly in upper parts of cypress trees, mangroves, or dead hardwoods situated over water, on islands along streams, or adjacent to shallow lakes. Nesting is tied to receding water levels and concentration of food sources, regardless of the time of year. Colonies are made up of a few to thousands of nesting pairs (NatureServe 2019).

Wood storks feed predominantly in the areas in which they nest. The wood stork eats mainly small fish, though it will also eat other miscellaneous small animals detected with its touch-sensitive bill. They forage mainly in shallow water and flooded fields. Areas with falling water levels attract these birds as they have more highly concentrated food sources (NatureServe 2019).

The current population of adult birds is difficult to estimate, since not all nest each year. Presently, the wood stork breeding population is estimated to be greater than 8,000 nesting pairs (16,000 breeding adults) (USFWS 2013).

The FNAI Biodiversity Matrix indicates that wood storks are known to occur in the area that includes Pinecastle Range (FNAI 2019). There are no known wood stork rookeries in the Ocala National Forest, and no nesting or foraging habitat is located on the Pinecastle Range. Shallow water and emergent wetlands containing foraging areas for wood storks are located within two miles of the Pinecastle Range, and the area is not a major feeding site as indicated by the low number of wood storks seen within this area. The USFWS determined that operations at the Pinecastle Range would have no effect on wood storks (Navy 2002). No known wood stork colonies or their core foraging areas are located in or near the Pinecastle Range based on mapping produced by the USFWS (2019c).

The wood stork has been documented at Rodman Range; however, nesting has not been documented at the range. The FNAI Biodiversity Matrix also indicates that wood storks have been documented in the vicinity of Rodman Range (FNAI 2019). Wood storks are expected to occasionally use Rodman Range for foraging, but nesting is not expected. No known wood stork colonies or their core foraging areas are located in or near the Rodman Range based on mapping produced by the USFWS (2019c). A majority of foraging activity is expected to occur in the floodplain swamp community in the southern part of the Rodman Range along the Ocklawaha River.

The wood stork is not expected to use the open water habitats within Lake George Range. The FNAI Biodiversity Matrix indicated that wood storks are known to occur in the area that includes Lake George Range. However, the FNAI contains no records of documented, likely, or potential occurrence of wood storks in the Lake George Range (FNAI 2019). No known wood stork colonies or their core foraging areas are located in the Lake George Range based on mapping produced by the USFWS (2019c). Despite the lack of documented occurrences, it is expected that wood storks would occasionally forage or travel through the Lake George Range.

Eastern Indigo Snake

The eastern indigo snake is a large, black, non-venomous snake found in the southeastern U.S. It uses a variety of habitats that include pine flatwoods, scrubby flatwoods, high pine, dry prairie, hardwood hammocks, and edges of freshwater wetlands, agricultural land, coastal dunes, and disturbed areas (Navy 2002). A study in the Gulf Hammock Wildlife Management Area to the west of the Ocala National Forest found that eastern indigo snakes have home ranges of approximately 158 to 390 acres and were found in association with ponds and wetlands 25 percent to 68 percent of the time (Navy 2002).

Eastern indigo snakes are often associated with the burrows of the gopher tortoise, where they seek shelter from thermal stress and lay eggs (Navy 2002). A study in Georgia found that 77 percent of indigo snake dens were in tortoise burrows. In areas lacking tortoise burrows, decayed stumps and logs are important habitat features for cover. Indigo snakes eat a variety of small mammals and herpetofauna, including gopher tortoise hatchlings (Navy 2002).

There has been no detailed survey work on the Ocala National Forest over the last ten years and there are no references in the literature regarding empirically derived estimates of the eastern indigo snake population on the Ocala National Forest. Individuals are known to occur in the Forest based on confirmed sightings from Ocala National Forest personnel and cooperators (Enge et al. 2013). Based on the presence of the range of preferred habitat types and a gopher tortoise population present in the xeric habitats, eastern indigo snake occurrence within suitable habitats on the Ocala National Forest can be assumed. The USFWS has estimated that there are nearly 363,500 acres of potential indigo snake habitat in the Ocala National Forest. While the eastern indigo snake has been recorded in a variety of scrub, sandhills, and flatwoods habitats in the Ocala National Forest, surveys in 1993, 1997, and 2001 did not confirm its presence in the Pinecastle Range (Navy 2002). However, due to availability of suitable habitat, the eastern indigo snake is likely to occur in the Pinecastle Range. The Pinecastle Range and the surrounding area support a substantial population of gopher tortoises, further enhancing the available habitat for eastern indigo snakes in this area (Navy 2002).

Suitable eastern indigo snake habitat likely exists at Rodman Range based on the interspersion of xeric uplands with gopher tortoise burrows and wetlands. The FNAI (2004) conducted eastern indigo snake surveys at Rodman Range in 2003 – 2004 by searching gopher tortoise burrows with a burrow camera. No eastern indigo snakes or signs of the snakes were found during the surveys. While these surveys indicate that eastern indigo snakes were not using the burrows surveyed at Rodman Range, they are not considered definitive in determining the absence of this species at Rodman Range. Additional herpetofauna surveys were conducted at the Rodman Range in 2017, where no eastern indigo snakes were discovered; however, suitable habitat was determined to exist within the Rodman Range (LG2 Environmental Solutions, Inc. 2018).

The eastern indigo snake is not expected to use the open water habitats within the Lake George Range. The FNAI Biodiversity Matrix indicates that eastern indigo snake are likely to occur in the area that includes Lake George Range. However, the FNAI contains no records of documented, likely, or potential occurrence of eastern indigo snakes in the Lake George Range (FNAI 2019). However, eastern indigo snakes are known to use edges of freshwater wetlands and have the potential to occur in lands surrounding Lake George.

Gopher Tortoise

Gopher tortoises usually live in relatively well-drained, sandy soils that are often associated with longleaf pine and dry oak sandhills. They also live in scrub, dry hammock, pine flatwoods, dry prairie, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of habitats that have been disturbed or altered by man, such as power line rights-of-way, and along roadsides (USFWS 2019d). Gopher tortoises are most active in warmer months, but spend most of their lives underground in their burrows. As a result, gopher tortoises do not seem to be heavily impacted by noise (Bowles et al. 1999). Additionally, individuals will dig and use many burrows throughout the active season. The burrows can vary from 3 to 52 feet long and 9 to 23 feet deep (USFWS 2019d). Their burrows provide important refuge and protection for a variety of species including the eastern indigo snake.

Threats to the gopher tortoise include habitat destruction, fragmentation, and degradation; predation; inadequacy of regulatory mechanisms; and incompatible use of herbicides in forest management and some silvicultural activities (USFWS 2019d). Gopher tortoises need large parcels of undeveloped land not fragmented by roads, buildings, parking lots, and other structures. Such barriers in natural habitat limit food availability and burrow space for tortoises plus expose them to closer contact with humans and their vehicles. Roadkill is one of the major causes of death for adult tortoises (USFWS 2019d).

The Pinecastle Range and the surrounding area support a substantial population of gopher tortoises, and the species is known to occur throughout the Range (Navy 2010). Gopher tortoise burrows are abundant in disturbed areas of the Pinecastle Range, and are typically concentrated along openings such as roads and trails in old stands of sand pine at the Range.

Counts of gopher tortoise burrows at the Rodman Range between 2009 and 2011 included 23 active burrows and 22 inactive burrows (Department of the Navy 2019b). Survey results from 1996 to 1997 found the densities of gopher tortoises at the Rodman Range to be 4.4/hectare in scrub habitat and 0.5/hectare in scrubby flatwoods habitat (Department of the Navy 2019b). More recently, surveys in 2017 of all suitable habitat at the Rodman Range found 73 active, 11 potentially occupied, and 4 abandoned gopher tortoise burrows (LG^2 Environmental Solutions, Inc. 2018). At the time of the 2017 survey, it was noted that all suitable habitat at the Rodman Range was occupied and that it should be allowed to naturally reach carrying capacity with existing populations (LG^2 Environmental Solutions, Inc. 2018). Gopher tortoises are managed and protected at the Rodman Range in accordance with the INRMP (Department of the Navy 2019b) and Gopher Tortoise Management Plan (NAS Jacksonville 2006), which were developed cooperatively with the USFWS and FFWCC.

The gopher tortoise does not occur in the open water habitats within Lake George Range. However, they are likely occur in land surrounding Lake George in scrub, dry hammock, pine flatwoods, dry prairie, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of habitats that have been disturbed or altered by man (USFWS 2019d).

Sand Skink

The sand skink is a fossorial lizard (i.e., adapted to digging and living underground) with vestigial legs, allowing it to move in a snake-like fashion through loose sand and requiring loose sand for locomotion and foraging (Navy 2002). The sand skink is active throughout the year, eating a variety of insects that are available a few inches below the ground surface.

Sand skinks prefer moist soil, exhibiting a narrow tolerance for soil moisture in the range of 20 to 27 percent for efficient burrowing in loose sand under laboratory conditions (Navy 2002). They are found from surface debris to 18 inches deep, depending on the length of time since recent rainfall, and probably do not penetrate more than a few inches below the surface in tightly packed soil. Sand skinks prefer areas with low soil compaction, which allows them to move more freely through surficial sediment layers, and their presence is also linked with larger particle size and low soil temperature (USFWS 2007a). While logs and woody debris on the surface are important cover, pocket gopher mounds are also important microhabitat for sand skinks (Navy 2002).

The sand skink is one of the USFS Land and Resource Management Plan indicator species for the scrub community, inhabiting a variety of scrub habitat types (USFS 1999). In the sand pine scrub, sand skinks appear to be restricted to the youngest or most open stands, while in sandhills the species appears to be restricted to areas with a low density of longleaf pines and wiregrass (Navy 2002). The sand skink's primary habitat has been identified in areas south of the Ocala National Forest in the Lake Wales Ridge area (USFS 2005).

Based on vegetation and soil criteria, the USFS (2005) estimated approximately 224,750 acres of potential sand skink habitat in the Ocala National Forest and approximately 5,308 acres in the Pinecastle Range. Using cover boards and mark-recapture techniques, surveys have found densities in the Ocala National Forest between 36 and 275 individuals per hectare (Navy 2002). Cover board surveys resulted in three site records in 1997 and eight additional site records in 2001 in the Pinecastle Range, all on open sand sites. This indicates that the sand skink may be restricted in scrub habitat to open sand areas or that the species is difficult to observe elsewhere.

The sand skink was not observed at the Rodman Range during surveys conducted by the FNAI in 1997 (FNAI 1997). The FNAI Biodiversity Matrix does not have records of documented occurrences for this species in the general vicinity but indicates they can potentially occur in the general area (FNAI 2019). If present, the area of suitable habitat would be limited because about 70 percent of the Rodman Range consists of wetlands. The Rodman Range target area is not expected to provide suitable habitat for the sand skink because it is maintained through mowing and occasional plowing. The sand skink is not expected to occur at Rodman Range based on available survey data and the limited potential for suitable habitat to be present. A survey conducted in 2009 observed no presence of sand skinks within their potential habitat in the Rodman Range (Gulf South Research Corporation 2009). An additional herpetofauna survey conducted in 2017 determined that there were no sand skink individuals, nor potential habitat observed within the Rodman Range (LG2 Environmental Solutions, Inc. 2018). However, the sand skink may occur outside the Rodman Range boundaries, within areas of scrub.

The sand skink is not expected to use the open water habitats within the Lake George Range. However, they are likely to occur in land surrounding Lake George in scrub habitat.

3.4.2.3 Marine Species

Marine Vegetation

Marine vegetation includes plants occurring in marine or estuarine waters. These may include mangroves, algae, and various grasses.

The St. Johns River system, including Lake George, has a diverse set of plant communities, with submerged, emergent, and floating vegetation (Department of the Navy 2009). While comprehensive submerged aquatic vegetation mapping has not been completed for Lake George, mapping conducted in nearby areas on the St. Johns River shows that vegetation is limited to the littoral (nearshore) zone (Dobberfuhl and Trahan 2003). The benthic environment in the Lake George Range is relatively uniform, composed of soft-bottom substrate, and generally lacks hard substrates (Porter 2020). Submerged aquatic vegetation is not expected to grow in areas of Lake George that are deeper than about five feet (Department of the Navy 2009). The Lake George Range is in waters ranging from 8 to 11 feet deep.

The range is located 0.6 to 1.9 miles off the lake's eastern shoreline and 2.4 to 4.7 miles off the western shoreline. Therefore, submerged aquatic vegetation is not expected to occur within the Lake George Range boundaries.

Marine Mammals

Jurisdiction over marine mammals is maintained by National Oceanic and Atmospheric Administration (NOAA) Fisheries and the U.S. Fish and Wildlife Service (USFWS). NOAA Fisheries maintains jurisdiction over whales, dolphins, porpoises, seals, and sea lions. The USFWS maintains jurisdiction for certain other marine mammal species, including walruses, polar bears, dugongs, sea otters, and manatees.

Critical habitat for the West Indian manatee was designated under 41 FR 41914 in 1976 with an augmentation and correction in 1977 (USFWS 1976). The habitat extends in the state of Florida and encompasses the St. Johns River, including Lake George.

West Indian manatees can be found throughout the Upper St. Johns River system in summer, but during the winter months (generally December through February) animals are found in or near warm-water refuge sites (Volusia County Government 2001; Bengtson 1981). A network of primary and secondary warm-water refuge sites exist in the Upper St. Johns River region. Primary warm-water refuge sites have a consistent water temperature range sufficient to maintain manatees over a cold winter and/or support consistent or dependent use by 50 or more manatees. Secondary refuge sites can have variable thermal plume temperatures, sporadic manatees use, and/or are used predictably by manatees, but not consistently. Blue Spring, located approximately 22 miles upstream (south) of Lake George, is the only primary refuge site in the Upper St. Johns River region. Silver Glen Springs and Salt Springs, which discharge flow into Lake George along the western shoreline, are secondary warm-water refuge sites (USFWS 2007b).

West Indian manatee data are limited for the St. Johns River system in comparison to some waters of the state. Overhanging vegetation and dark waters, which obscure visibility, limit the usefulness of aerial surveys (Volusia County Government 2001). Demographic indicators summarized by USFWS (2007b) indicate a minimum population size of 112 for the Upper St. Johns River Management Unit and a population growth rate of 6.2 percent per year from 1990 through 1999. This is the highest population growth rate for any management unit.

The FNAI Biodiversity Matrix indicates that West Indian manatee can potentially occur in the area that includes Lake George Range. It is likely that West Indian manatees commonly travel through and forage in Lake George during warmer months. Manatees probably occur in Lake George in winter; at least sporadically. Manatees using Silver Glen Spring and Salt Spring as a warm-water refuge during the winter must travel through Lake George to access the springs. Manatees using these springs in the winter could also move in and out of Lake George to forage. Patterns may vary from year to year based on weather conditions. Manatees likely use the springs as stop over points when traveling to and from Blue Spring during cold weather, indicating that manatees also move through Lake George during the winter (Navy 2009).

The FFWCC West Indian manatee Mortality Database is another source of information regarding manatee occurrence in Lake George. The database has one record of manatee mortality (cold stress) in Lake George for the period of January 2018 through January 2020 (FFWCC 2020b). The spatial distribution of West Indian manatees in Lake George is expected to vary seasonally and may be largely driven by food availability and the presence of warm-water refuge sites on the western shoreline. Manatee foraging would be limited to littoral areas where submerged aquatic vegetation grows. Traveling manatees could occur throughout the lake, especially during warmer months, but most travel routes are expected to be relatively close to shore (Bengtson 1981). The Lake George Range is located approximately 0.6 to 1.9 miles from the eastern shoreline and 2.4 to 4.7 miles from the western shoreline. The Lake George Range target area lacks submerged aquatic vegetation and warm-water refuge sites do not exist within the target area. While manatees probably travel through the target area occasionally, they are not expected to spend extended periods of time in the target area based on available data. Sufficient data do not exist to calculate density estimates.

West Indian manatees may potentially occur in the Ocklawaha River along the southern boundary of the Rodman Range. No training operations take place in or near the river. Therefore, the Proposed Action at the Rodman Range would have no effect on the manatee and manatees are not analyzed in further detail for the Rodman Range.

Fish

Fish are vital components of the marine ecosystem. They have great ecological and economic aspects. To protect this resource, NOAA Fisheries works with the regional fishery management councils to identify the essential habitat for every life stage of each federally managed species using the best available scientific information. Essential fish habitat has been described for approximately 1,000 managed species to date. Essential fish habitat includes all types of aquatic habitat including wetlands, coral reefs, seagrasses, and rivers; all locations where fish spawn, breed, feed, or grow to maturity.

Threatened, endangered, and other special-status fish species occurring or having the potential to occur in the ROI are presented in Table 3.4-1.

The shortnose sturgeon is a semi-anadromous species. Habitat use by the shortnose sturgeon varies seasonally and ranges from upriver to estuaries, with rare occurrences in coastal waters migrating between river systems. Shortnose sturgeon spend most of their time in estuaries feeding and resting, and then move upstream in the spring to spawn (NOAA Fisheries 2019). The FNAI Biodiversity Matrix indicates a known, but rare, presence of shortnose sturgeon in the St. Johns River. Shortnose sturgeon used to be considered extinct in the St. Johns River, but a single specimen was found in the river by the FFWCC during extensive sampling of the river in 2002 and 2003 (NOAA Fisheries 2019). A Navy-sponsored survey of the St. Johns River conducted in 2014 and 2015 detected no shortnose sturgeon in the river system, using both net and acoustic array sampling (Fox et al. 2018). Although the species' southern population can potentially inhabit the St. Johns River (NOAA Fisheries 2019), no breeding habitat is known to occur in the St. Johns River system, including Lake George. Therefore, the likelihood of an individual shortnose sturgeon occurring as a transient in the Lake George Range is extremely minimal.

The St. Johns River constitutes the southern limit of the South Atlantic distinct population segment of Atlantic sturgeon, but no known spawning occurs in the St. Johns River. Although historical data confirm the presence of Atlantic sturgeon in the St. Johns River, no recent evidence of a viable population exists for that river system, including Lake George. A Navy-sponsored survey of the St. Johns River conducted in 2014 and 2015 captured one Atlantic sturgeon (genetically assigned to the Altamaha population) during 150 net sets, totaling 174 hours of soak time (Fox et al. 2018). Acoustic array surveys in the St. Johns River detected eight Atlantic sturgeon, which had all been tagged in other river systems (Fox et al. 2018). In addition, Atlantic sturgeon are not known to occur in Lake George, and NMFS reports no documented occurrences of Atlantic sturgeon upriver of Palatka, Florida (pers. comm. 2020). Therefore, Atlantic sturgeon are not expected to occur in the Proposed Action Area.

Since Atlantic sturgeon are not known to occur in Lake George and the likelihood of individual shortnose sturgeon occurring in the Lake George Range is extremely small, the Proposed Action would have no effect on either species, and they are not further analyzed in this EA.

Common freshwater fish in Lake George include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), and crappie (*Pomoxis* spp.) (Department of the Navy 2009). In addition, some saltwater species occur in the lake. The gray snapper (*Lutjanus griseus*) and the red drum (*Sciaenops ocellatus*) are frequently found in Lake George. The bonnethead shark (*Sphyrna tiburo*) and sheepshead (*Archosargus probatocephalus*) are infrequently found in Lake George (Department of the Navy 2009).

Essential fish habitat for summer flounder (*Paralichthys dentatus*) and white shrimp (*Penaeus setiferus*) occur within Lake George. Essential fish habitat for white shrimp in Lake George includes the tidal freshwater wetlands that surround the lake. However, the Lake George Range is located entirely within the waters of Lake George, with a buffer zone between the shoreline and the range. Since all exercise activities occur within the boundaries of the range, wetlands, and other shoreline habitats are not impacted by training activities at the range (Department of the Navy 2009).

Essential fish habitat for summer flounder includes inshore estuaries where larvae, juveniles, and adults can occur. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf in colder months (Packer et al. 1999).

3.5 Water Resources

This discussion of water resources includes surface water, groundwater, wetlands, and floodplains. This section also discusses the physical characteristics of wetlands.

Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. A Total Maximum Daily Load is the maximum amount of a pollutant that can be assimilated by a water body without causing impairment. A water body can be deemed impaired if water quality analyses conclude that exceedances of water quality standards occur.

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater is used for water consumption, agricultural irrigation, and industrial applications. Groundwater properties are often described in terms of depth to aquifer, aquifer or well capacity, water quality, and surrounding geologic composition. Sole source aquifer designation provides limited protection of groundwater resources which serve as drinking water supplies.

Wetlands are jointly defined by USEPA and U.S. Army Corps of Engineers as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include "swamps, marshes, bogs and similar areas."

Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. Floodplain delineation maps are produced by the Federal Emergency Management Agency and provide a basis for comparing the locale of the Proposed Action to the floodplains.

3.5.1 Regulatory Setting

Wetlands are currently regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act as a subset of all "Waters of the United States." Waters of the United States are defined as (1) territorial seas susceptible to use in interstate or foreign commerce, (2) tributaries, (3) lakes and ponds and (4) adjacent wetlands under Section 404 of the Clean Water Act, as amended, and are regulated by USEPA and the U.S. Army Corps of Engineers. The Clean Water Act requires that Florida establish a Section 303(d) list to identify impaired waters and establish Total Maximum Daily Loads for the sources causing the impairment. Section 404 of the Clean Water Act authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredge or fill into wetlands and other Waters of the United States. Any discharge of dredge or fill into Waters of the United States requires a permit from the U.S. Army Corps of Engineers.

The Coastal Zone Management Act (CZMA) of 1972 provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones. Actions occurring within the coastal zone commonly have several resource areas that may be relevant to the CZMA.

EO 11990, *Protection of Wetlands,* requires that federal agencies adopt a policy to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction and modification of wetlands and to avoid the direct and indirect support of new construction in wetlands whenever there is a practicable alternative.

EO 11988, *Floodplain Management*, requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative.

Flood potential of a site is usually determined by the 100-year floodplain, which is defined as the area that has a one percent chance of inundation by a flood event in a given year.

3.5.2 Affected Environment

3.5.2.1 Surface Water

The climate in the vicinity of the project area is humid and subtropical, with mild weather during winters and hot weather during summers. Afternoon thunderstorms are common during normal summers. Rainfall averages approximately 50 inches per year, with the wettest months being June through September.

The St. Johns River and its tributaries are the main sources of surface water in the region. Several characteristics of the St. Johns River limit its assimilation capabilities, contributing to high pollution rates. These characteristics include the relatively flat drainage basin, the high number of associated draining water bodies, and the slow flow rate of the river. The St. Johns River, its tributaries, and lakes within the basin are designated as Class III, which is intended for recreational use and the propagation of fish and wildlife (Department of the Navy 2019).

Pinecastle Range

There are no surface waters bodies, wetlands, or springs within the Pinecastle Range. Pinecastle Range comprises a small area within a much larger area of high recharge. The nearest significant surface water in the area or the range is Farles Lake and the associated wetlands of Farles Prairie, which are located approximately 1 mile to the east of the range boundary (Department of the Navy 2002). Specifically, the Pinecastle Range accounts for only approximately 0.1 percent of the 4.7 million acres of the St. Johns River Water Management District.

Lake George Range

The Lake George Range is a water range on the east side of Lake George.

Rodman Range

The southern boundary of Rodman Range borders approximately 2.6 miles of the Ocklawaha River 2 miles downstream of the Rodman Reservoir Dam. The St. John's River is approximately 4 miles farther downstream to the east. A few small streams drain from the Rodman Range into the river (Department of the Navy 2014a).

3.5.2.2 Groundwater

The Floridan Aquifer System is one of the most productive aquifers in the world and is the major source of potable water in northeast Florida. This aquifer system underlies an area of approximately 100,000 square miles in southern Alabama, southeast Georgia, southern South Carolina, and all of Florida. The Floridan Aquifer is a multiple-use aquifer system and approximately 10 million people rely on the Floridan Aquifer to satisfy their drinking water requirements (USGS 2020).

Pinecastle Range

Three primary hydrogeologic units, a surficial aquifer, an intermediate confining unit, and the Floridan Aquifer System, are present at the Pinecastle Range. Recharge of the surficial aquifer occurs by direct infiltration of precipitation. Locally, groundwater from the surficial aquifer may migrate laterally downgradient, or in the absence of an underlying aquitard, it may migrate downward to recharge the

Upper Floridan Aquifer. Groundwater from the surficial aquifer is not a primary drinking-water source in the region but is frequently utilized for non-potable purposes (Department of the Navy 2013).

The entire Pinecastle Range is located within the Floridan Aquifer recharge area. The Floridan Aquifer underlies the Pinecastle Range at a depth of approximately 50 to 150 feet below land surface (Department of the Navy 2013). Community and public water supplies normally draw from the Floridan Aquifer. Shallow or Floridan Aquifer groundwater flow, in general, appears to be to the east and northeast toward Lake George (Knowles 1997).

Pinecastle Range has two operational drinking water wells: one serves the Centroid area and one provides water for firefighting purposes at the target and buffer. The well near the towers at the center of the range is used occasionally for service vehicles and other small uses. Operation of the wells does not have a noticeable impact on groundwater levels due to the high capacity of the Floridan Aquifer (Department of the Navy 2010b). Additionally, the Navy maintains a series of groundwater monitoring wells on Pinecastle Range. These wells have presented no evidence of off-range migration of munitions constituents. Wells are monitored in accordance with the groundwater monitoring plan.

Public and private potable water wells are down gradient from Pinecastle Range. A publicly used potable water well is located at the Juniper Springs Campground approximately 3 miles (4.8 km) north of the Range, which is approximately 4.3 miles (6.9 km) north of the Live Impact Area. The Farles Prairie Recreation Area has a publicly used potable water well approximately 1 mile due east of the range's east gate (USDA 2020).

Lake George Range

The Lake George Range is a water range on the east side of Lake George. To the northeast of Lake George, the closest privately used potable wells are those of residences along the southwest shoreline of Lake George, approximately 5.3 miles from the range boundary.

Rodman Range

A test well at the St. Johns River east of the Rodman Range penetrated the following formations from surface to 700 feet down: Hawthorn Formation, Williston Formation, Inglis Formation, Avon Park Limestone, and Lake City Limestone. In some places in this region, the Hawthorn Formation supplies artesian wells, as it is confined by clays and marls in its upper strata. The lower depths of the Hawthorn comprise the Floridan Aquifer, which is the primary source of water supply. The Hawthorn is overlain by upper Miocene or Pliocene deposits, which also yield water. Recharge to the Floridan Aquifer from the Rodman Range is generally low (Department of the Navy 2014a).

3.5.2.3 Floodplains

Pinecastle Range

There are no floodplains within the Pinecastle Range (FEMA 2008).

Lake George Range

Lake George and surrounding areas are located within the floodplains classified as Zone A and Zone AE, or land that would be inundated by a flood having a 1 percent chance of occurring in any given year (commonly known as the 100-year floodplain) (FEMA 2014).

Rodman Range

Portions of the Rodman Range are located within the floodplain wetlands classified as Zone A, or land that would be inundated by a flood having a 1 percent chance of occurring in any given year (commonly known as the 100-year floodplain) (FEMA 2012).

3.5.2.4 Wetlands

Pinecastle Range

There are no wetlands within the Pinecastle Range (USFWS 2020).

Lake George Range

Lake George is considered lacustrine habitat and lands surrounding Lake George include emergent/forested/shrub palustrine wetlands and riverine habitat (USFWS 2020).

Rodman Range

The Rodman Range contains 1,905 acres of USACE jurisdictional wetlands that include depression marsh, baygall, dome swamp, bottomland forest, and floodplain swamp (Department of the Navy 2014) that are considered emergent/forested/shrub palustrine wetlands (USFWS 2020). The Ocklawaha River along the southern boundary of Rodman Bomb Target is considered riverine habitat (USFWS 2020).

3.6 Cultural Resources

3.6.1 Affected Environment

Cultural resources listed in the National Register of Historic Places (NRHP) or eligible for listing in the NRHP are "historic properties" as defined by the National Historic Preservation Act. The list was established under the NHPA and is administered by the National Park Service on behalf of the Secretary of the Interior. The NRHP includes properties on public and private land. Properties can be determined eligible for listing in the NRHP by the Secretary of the Interior or by a federal agency official with concurrence from the applicable State Historic Preservation Office (SHPO). An NRHP-eligible property has the same protections as a property listed in the NRHP. Historic properties include archaeological and architectural resources.

The area of potential effects for cultural resources is the geographic area or areas within which an undertaking (project, activity, program or practice) may cause changes in the character or use of any historic properties present. The area of potential effects is influenced by the scale and nature of the undertaking and may be different for various kinds of effects caused by the undertaking. For this Proposed Action, the Navy determined that the area of potential effects includes the areas underlying modeled noise contours, where noise from operations under the Proposed Action may affect historic properties (refer to Figures 4.1-1 through 4.1-6 in Section 4.1.2). For archaeological resources, the area of potential effects also includes the areas where ground disturbance would occur. Due to the chance that ordnance aimed at target areas may malfunction and land in the safety zone the area of potential effects encompasses the entirety of the Pinecastle, Rodman, and Lake George Ranges. The Navy has previously conducted NHPA Section 106 consultation for this area of potential effects as part of the documents incorporated by reference in Section 1.6; specifically: the Final EIS for the Renewal of Authorization to Use Pinecastle Range (Department of the Navy 2002), Jacksonville Range Complex Final EIS/OEIS (Department of the Navy 2009), and Final SEIS to the Final EIS for Renewal of Authorization to use Pinecastle Range (Department of the Navy 2010a). The Draft EA was provided to the Florida SHPO for review and comment through the Florida State Clearinghouse review process.

3.6.1.1 Archaeological Resources

Pinecastle Range

An intensive archaeological reconnaissance survey was performed at the Pinecastle Range in 1999. Prior to field investigations, a predictive model specific to Pinecastle Range was prepared by reviewing data on previously identified archaeological sites within a 625 square-mile area that included the Pinecastle Range. Following preparation of the predictive model, a pedestrian and all-terrain vehicle reconnaissance survey was performed. The survey resulted in the identification of one prehistoric archaeological site (8MR2717) that consisted of a surface scatter of Pre-Contact period ceramic sherds. The site was recommended not eligible for listing in the NRHP and no additional archaeological investigation was recommended. The survey report also found that, due to the results of the predictive model and the large area examined during the survey, it is unlikely that NRHP-eligible archaeological resources are located at the Pinecastle Range (Johnson 1999). The Florida Department of State, Division of Historical Resources (FL DHR) concurred with the findings of the survey (FL DHR 1999).

Rodman Range

Archaeological surveys were performed between 1996 and 1999 on the entire Rodman Range, and the results were analyzed in a report completed in 2015. The original surveys identified 12 sites and one archaeological occurrence within the boundaries of Rodman Range. The 2015 report recommended that four sites are eligible for listing in the NRHP (8PU1223, 8PU1225, 8PU1226, and 8PU1229) and eight sites lack integrity or research potential and are not eligible for listing (8PU1224, 8PU1227, 8PU1228, and 8PU1230-8PU1234). The FL DHR concurred with the findings of the 2015 report (Austin and Hendryx 2015; FL DHR 2015).

The Davenport Landing Site (8PU0814) was identified during a reconnaissance survey in 1993. The site consists of a historic-period boat landing along the southern boundary of the Rodman Range on the banks of the Ocklawaha River. No survey report was submitted to the FL DHR and it is unclear if the site is located within the boundaries of the Rodman Range or if it is eligible for listing in the NRHP (Department of the Navy 2010b).

Lake George Range

In 2009, a technical memorandum was prepared to identify known cultural resources within three Potential Bottom Impact Areas located in the Jacksonville Range Complex Operating Area, including the Lake George Range. The analysis used several Geographic Information System sources, including the National Oceanic and Atmospheric Administration Automated Wreck and Obstruction Information System, the U.S. Coast Guard Hazards to Navigation database, and the Florida State Master File, as well as several additional secondary sources. The memorandum also applied a predictive model to the water ranges to analyze the potential for unidentified cultural resources (Krivor 2009).

The analysis of Geographic Information System and secondary sources indicated that the majority of the listings within the Lake George Range are not associated with cultural resources. Although 12 archaeological sites have been identified within .5 miles of Lake George, there are no known terrestrial archaeological sites located within the Lake George Range. During a 2009 field study, a submerged Paleoindian site (8PU1470) and the shipwreck the Isis were identified in Lake George, but they are located outside of the limits of the range and thus the area of potential effects (Thulman 2009). The Krivor memorandum concludes by stating that the application of an archaeological predictive model indicates that there is a low probability for cultural resources being located in the Lake George Range (Krivor 2009).

3.6.1.2 Architectural Resources

Pinecastle Range

The Pinecastle Range includes 40 buildings/structures located within boundaries of the target and buffer area: All of the facilities at Pinecastle Range have been used in support of the larger training mission of the Navy and other DoD service branches since their respective construction dates. Facilities 147 (Emergency Generator Switch Building; built 1968); 149 (Range Operations Center; built 1968); 155 (110-foot Antenna Tower; built 1968), 157 (50-foot Antenna Tower; built 1968), 158 (150-foot Antenna Tower; built 1968); 221 (Tower 2-1, Impact; built 1960), 222 (Tower 2-2 Impact; built 1960); and X22A (Ready Service Magazine; built 1968) exceed 50 years of age. However, given the training function of the range, the Navy has determined in consultation with the Florida Division of Historical Resources that none of these facilities possess those qualities of significance necessary for inclusion in the NRHP.

Rodman Range

According to Geographic Information System data for Rodman Range, there are eight architectural resources within the range: Facilities 5QA (Observation Tower Center; built in 1961); 300 (Repeater Building; built in 2007); 301 (200-foot Antenna Tower; built in 2007); 302 (Unmanned Tower; built in 1961); 303 (Range Breakroom; built in 1985); 304 (Target Lightning Receiver Building; built in 1961); 305 (Manned Tower; built in 1961); and 306 (Non-potable Water Pumphouse; built post-1970). None of these facilities have been evaluated for the NRHP, but some were constructed more than 50 years ago (Department of the Navy 2010b). However, given the training function of the range, the Navy has determined in consultation with the Florida Division of Historical Resources that none of these facilities possess those qualities of significance necessary for inclusion in the NRHP.

Lake George Range

Lake George Range includes four buildings/structures within the range. Two architectural resources associated with the Lake George Range exceed 50 years of age, Facility 18 (9 Mile Point Tower; built 1968) and Facility 19UC (Pine Island Tower; built 1968). However, given the training function of the range, the Navy has determined in consultation with the Florida Division of Historical Resources that none of these facilities possess those qualities of significance necessary for inclusion in the NRHP. A transformer building (Facility 18C), is located on the east shore of the lake. This building, however, is located outside of the area of potential effects for the Proposed Action according to Geographic Information System data.

3.6.1.3 Traditional Cultural Properties

The PRC has not been the subject of a traditional cultural properties study and no such properties have been identified at the PRC. The following federally recognized American Indian tribes that have historically occupied and/or used PRC lands include: Coushatta Tribe of Louisiana, Miccosukee Tribe of Indians of Florida, and Muscogee (Creek) Nation of Oklahoma (U.S. Department of Housing and Urban Development 2019). Three federally recognized American Indian tribes that have historically occupied and/or used the Rodman Bombing Range lands include: Seminole Nation of Oklahoma, Seminole Tribe of Florida, and Miccosukee Tribe of Florida (Department of the Navy 2010b). The Navy's prior analysis of cultural resources in the area of potential effects, incorporated by reference (see Section 1.6), have included analysis of traditional cultural properties.

3.7 Recreational and Socioeconomic Resources

3.7.1 Affected Environment

Recreation

Recreational activities in and around the PRC are primarily associated with the Ocala National Forest. The USFS administers recreation for the Ocala National Forest and Pinecastle Range as outlined in the Forest Plan. The Forest Plan outlines the goals, objectives, and management actions for Ocala National Forest. Public access to Pinecastle Range is controlled, both for security reasons and to safeguard against potential hazards associated with military activities. Public access control is conducted through the use of road guards, gates, and posted signs. The USFS Special Use Permit for the Pinecastle Range includes public access restrictions to the range for public safety (Department of the Navy 2017).

Activities at the Ocala National Forest include boating, fishing, hiking, hunting, nature studying, primitive camping, visiting interpretive and heritage resource sites, driving for pleasure and cycling, horseback riding, all-terrain vehicles, off highway vehicles (OHVs), and motorcycle riding. The USFS currently does not limit types of permittees that may use the area surrounding the PRC; however a major use of the area is associated with OHVs, as this area of the Ocala National Forest contains some of the most used OHV trails (H. Ellison 2019a).

The forest has 12 developed camping areas, including one with electrical, water, and sewer hook-ups; two dispersed/primitive camping areas; and five group camping areas that can accommodate all desired types of camping from very primitive with only a fire pit to other fully developed campgrounds providing grills, potable water, bathrooms with showers, play areas, picnic tables, garbage cans, electrical hookups, and other amenities. Additionally, two cabins, the Lake Dorr and Sweetwater Cabins, are available to rent.

The developed campgrounds include the following:

- Alexander Springs
- Big Bass
- Big Scrub
- Clearwater Lake
- Fore Lake
- Hopkins Prairie
- Juniper Springs
- Lake Eaton
- Salt Springs
- Shanty Pond
- Lake Delancy East
- Lake Delancy West

The primitive campgrounds include the following:

- Davenport Landing
- 52 Landing

The group use campgrounds include the following:

- Mill Dam
- Doe Lake
- Lake Shore
- River Forest
- Buck Lake

Canoe rentals are available at Alexander Springs and Juniper Springs. Excellent canoeing opportunities exist on these spring runs, the Ocklawaha River, and various lakes and ponds throughout the Ocala National Forest. Boat launches are available at several recreation areas. Portions of Ocala National Forest are also open to hunting to include small game and deer (USDA 2019a). The Ocala National Forest provides equestrian access to the Ocala One-Hundred Mile Horse Trail, which is divided into three sections: Flatwoods Trail (40 miles), Prairie Trail (40 miles), and Baptist Lake Trail (20 miles). Hiking is one of the more popular activities in the forest. The Florida National Scenic Trail, better known as the Florida Trail and managed by the USFS, is a federally designated, non-motorized recreation trail that meanders approximately 1,300 miles across the state from the western panhandle to the Everglades in southern Florida. A 66-mile segment of the Florida Trail traverses Ocala National Forest, providing day hiking and backpacking opportunities. Interpretive trails are also available at several developed recreation sites including Alexander Springs, Juniper Springs, and Clearwater Lake Recreation Area (USDA 2019b). Ocala National Forest recreational opportunities surrounding the PRC are shown in Figures 3.6-1, 3.6-2, and 3.6-3.

Hunting and fishing at the Ocala National Forest is managed by the FFWCC (USDA 2019a). As shown in the figures, much of the PRC underlies various wildlife management areas. Hunting is permitted in many wildlife management areas but the FFWCC should be consulted for all permitted activities to include hunting within each individual management area.

Demand for outdoor recreation was most recently examined in the 2016-2017 Participation Study as part of the 2019 *Florida's Statewide Comprehensive Outdoor Recreation Plan* (now referred to as Recreation Plan) (Florida Department of Environmental Protection 2019). With regard to outdoor recreation development recommendations, the most popular suggestion for development is more hiking and walking trails. This item emerged as the top suggestion in each of the eight regions identified in the study, of which the PRC is within the Central Region. The top three requested items by residents on a statewide level all relate to having more trails for hiking, biking, and nature viewing.

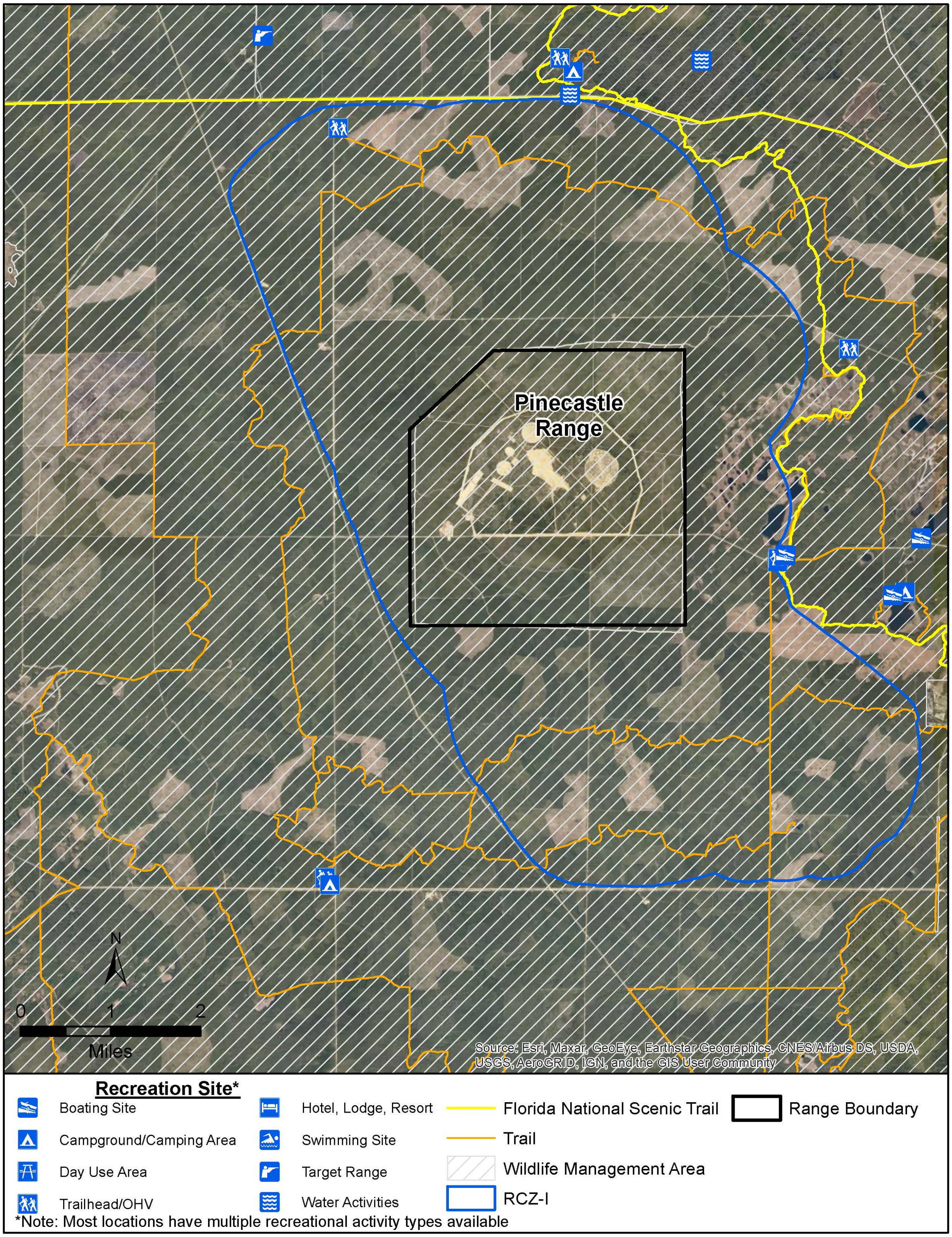

Figure 3.7-1. Recreational Activities Surrounding Pinecastle Range

Figure 3.7-2. Recreational Activities Surrounding Lake George Range

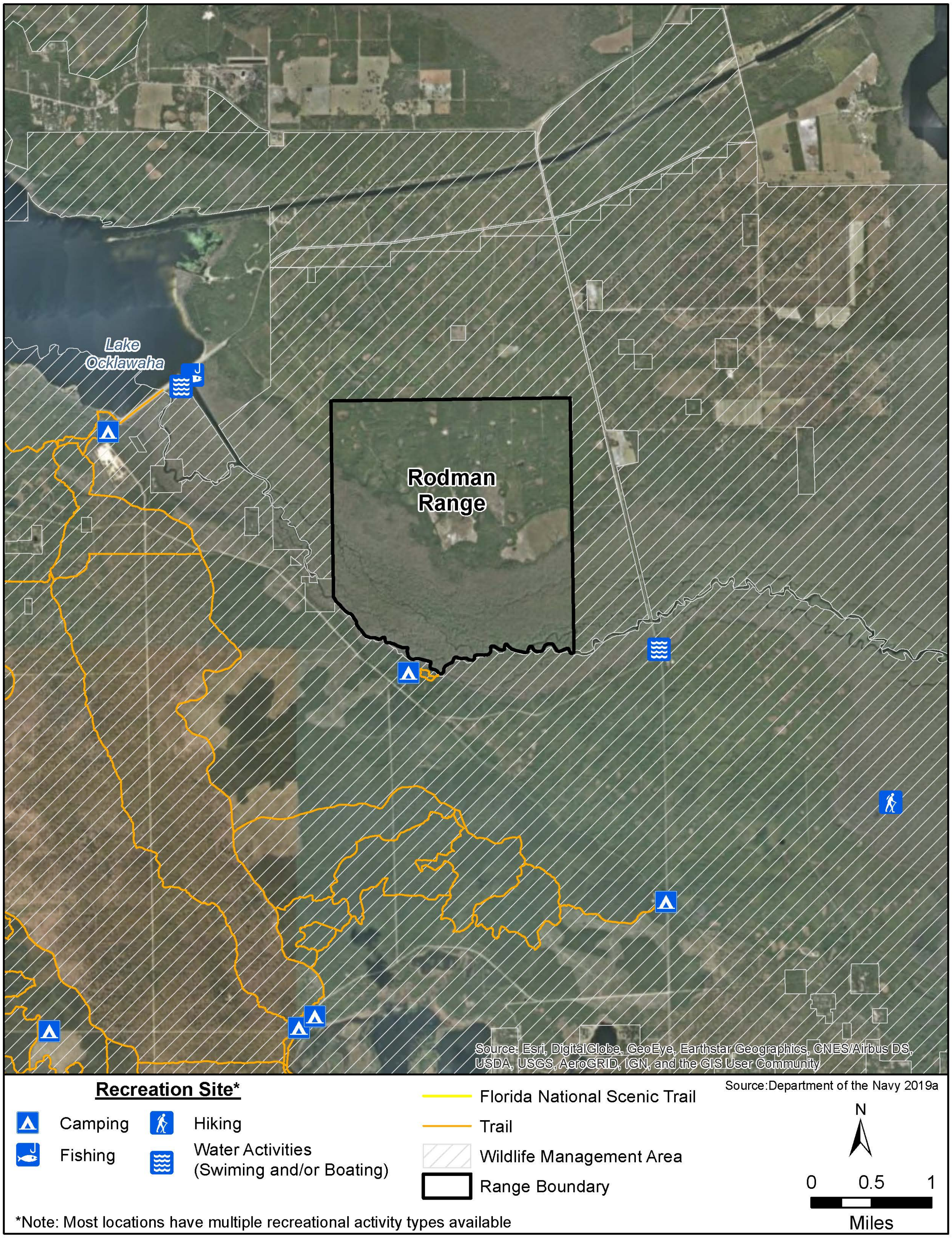

Figure 3.7-3. Recreational Activities Surrounding Rodman Range

Planning regions with the densest populations, such as the Central region, tend to have the greatest needs for recreational access and supply, a trend that will likely continue for the foreseeable future. Overall demand was identified and predicted in the Recreation Plan Participation Study. With respect to some of the recreational activities provided at the Ocala National Forest, the following information was noted.

- Overall participation in nature viewing by Florida residents and tourists in 2016 was 20.4 million individuals. The projected number of participants in 2025 is 26.6 million.
- The number of off-road cyclists (trail bike riding) in Florida in 2025 is projected to be nearly 10 million. Additional off-road trails (and associated campsites) will be needed in all eight regions to accommodate future demand.
- There were 37 million hikers in Florida during 2016. The number of hikers in Florida in 2025 is estimated to be 48.3 million.
- An estimated 8.4 million people participated in horseback riding in Florida in 2016, with that number predicted to climb to 11 million by 2025.
- Participation in tent camping in 2016 was up by 4.4 million compared to 2011. The projected number of tent campers in Florida for 2025 is 17.8 million.
- Florida has one of the largest wildlife management area systems in the nation, with nearly 6 million acres, and the total number of hunting acres open to the public increased by 1.8 million acres (33 percent) since 2011. According to the FWC, white-tailed deer is the most popular game species in Florida, and is hunted in the Ocala National Forest.

Socioeconomic Factors Associated with the PRC

Many of the recreational activities occurring within the Ocala National Forest and adjacent to the PRC have a socioeconomic impact to the area. A commercial use or activity on USFS land occurs when (a) an applicant intends to charge an entry or participation fee, or (b) the primary purpose is the sale of a good or service, regardless of the intent to produce a profit. Money collected may cover expense categories, such as food, transportation, prizes, advertising, purchase replacement of equipment, or compensation for the leader of the activity (USDA 2020b). Each permittee who conducts recreational business and/or activity on the Ocala National Forest is required to develop an individual Operation and Maintenance Plan that outlines how they intend to manage the permitted activity, which is to include: non-native species, vegetation management, cultural resource requirements, hydrologic issues and management, along with any other concerns that the USFS specialists feel warrant attention. The permittee is responsible for all costs associated with the required maintenance activities, such as vegetation trimming, utilities upgrades etc. (H. Ellison 2019b). The general types of permitted uses, events, and associated costs that have occurred or may occur within the vicinity of the PRC on the Ocala National Forest include the following:

- Group small mammal hunts (e.g., raccoon)
    - Generally does not require a permit from the USFS
    - FWC notifies USFS of activities occurring on the Pipeline area
    - No cost associated with events

    - Occurs during small mammal hunting season

- Outfitter and Guiding services (Optucorp dba Extreme Tours, OHV Guided Tours, Sierra Club, Fit Packing)
    - OHVs on the Centennial Trail systems in the Ocala National Forest
        - Typically offered daily, but average 4-5 days a week.
        - Up to 2 trail ride tours per day at about $100-150/person with between 2 to 18 participants per tour.
        - Estimated total revenue per day: $400 to $5,400
    - Backpacking the Florida Trail
        - Occurs 1-3 times per year.
        - Costs vary widely based on season and demand.
    - An Operating and Maintenance Plan for outfitters and guide companies is required to be included with the application submittal. The USFS requires use of the FS-2700-3f form “Special Use Application and Temporary Permit for Outfitting and Guiding” to be submitted prior to companies operating in the Ocala National Forest.
- Recreation Events
    - Example events include the following: Central Florida Dog Hunters, East Coast Dog Hunters, Finders Fest, Bike Ocala, Huracan 300 (bike race), High Intensity Interval Training, Sea to Sea, and Adventure Races.
    - A basic Operating Plan for recreation events is required to be included with the application submittal. The USFS requires use of the FS-2700-3c form “Special Use Application and Permit for Recreation Events” to be submitted prior to events occurring in the Ocala National Forest.
    - Hunting Dog Trials for deer, fox and other small mammals
        - These events occur approximately 6 times per year between October 4 and the end of hunting season.
        - Events charge $15 to $25 per person with around 50 participants on average.
    - Geocaching events
        - These events occur about twice a year throughout the Ocala National Forest wherever geocaches are located.
        - Costs are unknown/event run from Organized Camp.
    - Running and/or cycling events as well as group OHV riding events are also available, however they have not occurred at areas around the PRC in the last three years.
- Filming Requests

- While rare, the USFS occasionally receives filming applications and fees to film in the Ocala National Forest. These requests are usually associated with marketing for the various outfitter and guide companies in the area (H. Ellison 2019b).

The RCZ-I associated with the Pinecastle Range and established by the 2017 PRC RAICUZ (see Figure 3.7-1), is not activated for the entire exercise period during these events, but only implemented (off-limits to the USFS and general public) for specified time periods. Access is controlled through a network of gates that are closed when RCZ-I is activated. RCZs define areas based on a level of protection to public health, safety, and welfare and to recommend compatible land uses to prevent encroachment from degrading the operational capability of the air to ground ranges. RCZ-I defines the area of the greatest potential safety hazard and designates the minimum range surface area needed to contain all munitions delivered at air-to-ground ranges. RCZ's are not predictors of safety hazards but depict areas where mishaps are likely to occur if they occur.

4 Environmental Consequences

This chapter presents an analysis of the potential direct and indirect effects of each alternative on the affected environment. The following discussion elaborates on the nature of the characteristics that might relate to resources.

4.1 Noise

Noise Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative: Noise contours likely to cause annoyance would extend 2.5 miles beyond the Pinecastle Range boundary due to aircraft gunnery, 3 miles beyond the Lake George Range boundary due to aircraft patterns, and 4,000 feet beyond Rodman Range boundary due to ordnance. However, no noise sensitive points of interest would be affected in these areas.

Analysis of potential noise impacts includes estimating likely noise levels from the Proposed Action and determining potential effects to sensitive receptor sites.

4.1.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented and there would be no change to existing noise levels at the PRC.

4.1.2 Proposed Action Alternative

The Proposed Action would result in an overall increase in military readiness activities. As mentioned in Section 2.3.2, estimated total sorties for the PRC would increase from 4,132 under baseline conditions to 11,290 under Proposed Action. However, most activities would occur under the regular training schedule and operating hours of the designated range. This change would include the following new estimated aircraft operations:

- T-45: 1,440 annual sorties
- F-35A/B/C: 2,100 annual sorties
- AH-1, UH-1, H-53: 600 annual sorties
- A-29: 250 annual sorties
- KC-130: 150 annual sorties
- P-8: 150 annual sorties
- EA-18G: 150 annual sorties

In addition, the Proposed Action would increase estimated operations for the following aircraft already operating at the PRC:

- F/A-18E/F: 728 additional annual sorties
- A-10: 203 additional annual sorties
- H-60: 224 additional annual sorties
- Other existing aircraft 899 additional annual sorties

The additional operations would be dispersed across Pinecastle Range, Lake George Range, and Rodman Range. The increase in aircraft operations would also increase estimated munitions expenditures from 606,220 to 1,090,740. New small arms ground fire totaling an estimated 12,000 expenditures annually would be added to Rodman Range as part of the Proposed Action. Details of estimated munitions expenditures are presented in Table 2.3-2.

Table 4.1-1 lists the estimated proposed 4,220 sorties that would occur at Pinecastle Range, an increase of 2,625 sorties. The T-45 would represent the largest contributor of the new activity.

Most of the additional estimated munitions expenditures, nearly 360,000, would occur at Pinecastle Range in the form of small arms air gunnery (i.e., 7.62 mm and 0.50 Cal).

Table 4.1-1. Pinecastle Proposed Estimated Annual Aircraft Sorties

Aircraft Type	*Service*	*No Action*	*Proposed*	*Change*
F/A-18C/D	Navy	118	0	-118
F/A-18E/F	Navy	473	700	+227
P-3	Navy	11	0	-11
P-8	Navy	0	50	+50
EA-6B	Navy	2	0	-2
EA-18G	Navy	0	50	+50
Cessna	Navy	1	50	+49
T-45	Navy	0	720	+720
H-60	Navy	253	300	+47
F-35C	Navy	0	500	+500
F/A-18C/D	Marine Corps	43	100	+57
AV-8	Marine Corps	28	100	+72
V-22	Marine Corps	5	50	+45
AH-1	Marine Corps	0	150	+150
UH-1	Marine Corps	0	150	+150
H-53	Marine Corps	0	150	+150
KC-130	Marine Corps	0	50	+50
F-35B	Marine Corps	0	100	+100
F-16	Air Force	44	100	+56
F-15	Air Force	166	200	+34
A-10	Air Force	375	400	+25
AC-130	Air Force	5	50	+45
A-29	Air Force	0	100	+100
F-35A	Air Force	0	100	+100
MH-65	Coast Guard	21	50	+29
TOTAL		**1,545**	**4,220**	**+2,625**

Table 4.1-2 lists the estimated proposed 2,950 sorties that would occur at Lake George, an increase of 1,637 sorties. The F-35 aircraft would represent the largest contributor of the new activity generating 700 new sorties.

Estimated munitions expenditures at Lake George would increase from 158 to 1,550 due to the Proposed Action. The additional expenditures would vary from practice non-explosive to high-explosive munitions.

Table 4.1-2. Lake George Range Proposed Estimated Annual Aircraft Sorties

Aircraft Type	*Service*	*No Action*	*Proposed*	*Change*
F/A-18C/D	Navy	115	0	-115
F/A-18E/F	Navy	458	700	+242
P-3	Navy	25	50	+25
P-8	Navy	0	100	+100
EA-6B	Navy	2	0	-2
EA-18G	Navy	0	50	+50
E-2	Navy	1	50	+49
H-60	Navy	91	200	+109
Cessna	Navy	1	50	+49
F-35C	Navy	0	500	+500
F/A-18C/D	Marine Corps	43	100	+57
AV-8	Marine Corps	24	50	+26
V-22	Marine Corps	5	50	+45
KC-130	Marine Corps	0	50	+50
F-35B	Marine Corps	0	100	+100
F-16	Air Force	44	100	+56
F-15	Air Force	165	200	+35
A-10	Air Force	335	400	+65
AC-130	Air Force	4	50	+46
A-29	Air Force	0	50	+50
F-35A	Air Force	0	100	+100
TOTAL		**1,313**	**2,950**	**+1,637**

Table 4.1-3 lists the estimated proposed 3,670 sorties that would occur at Rodman Range, an increase of 2,432 sorties. Similar to Lake George the F-35A, B, and C would generate 700 new sorties but the T-45 would account for the largest proportion at 720 annual sorties.

Estimated munitions expenditures at Rodman Range would increase from 98 to 22,700 due to the Proposed Action. Roughly three quarters of the increase would be small arms air gunnery and small arms ground fire weapons (i.e., 7.62 mm and 5.56 mm). The remainder would primarily be the MK-76 practice bomb with spotting charge. The Proposed Action would add small arms ground fire from 5.56 mm blank rounds and sub-caliber Special Effect Small Arms Marking system (SESAM) simulated munitions.

Table 4.1-3. Rodman Range Proposed Estimated Annual Aircraft Sorties

Aircraft Type	*Service*	*No Action*	*Proposed*	*Change*
F/A-18C/D	Navy	110	0	-110
F/A-18E/F	Navy	441	700	+259
EA-6B	Navy	2	0	-2
EA-18G	Navy	0	50	+50
E-2	Navy	1	50	+49
H-60	Navy	132	200	+68
T-45	Navy	0	720	+720
F-35C	Navy	0	500	+500
F/A-18C/D	Marine Corps	39	100	+61
AV-8	Marine Corps	24	50	+26
V-22	Marine Corps	5	50	+45
AH-1	Marine Corps	0	50	+50
UH-1	Marine Corps	0	50	+50
H-53	Marine Corps	0	50	+50
KC-130	Marine Corps	0	50	+50
F-35B	Marine Corps	0	100	+100
F-16	Air Force	29	100	+71
F-15	Air Force	166	200	+34
A-10	Air Force	287	400	+113
AC-130	Air Force	2	50	+48
A-29	Air Force	0	100	+100
F-35A	Air Force	0	100	+100
TOTAL		**1,238**	**3,670**	**+2,432**

4.1.2.1 Pinecastle Range

The estimated change in aircraft noise exposure is presented in annual average DNL contours from 65 to 85 dB, in 5 dB increments, as depicted in Figure 4.1-1. The greatest noise would be focused at the helicopter landing zone due to the relatively low aircraft altitudes in this area. Although the size of the 65 dB DNL contour would increase to cover most of on the ground targets, the noise contour would be contained within the Pinecastle Range boundary and not affect noise sensitive points of interest, which are at least 2.5 miles from the boundary.

The estimated change in noise due to aircraft gunnery and large arms presented in CDNL is shown in Figure 4.1-2 for Pinecastle Range. The 62 dB CDNL would extend beyond the Pinecastle Range boundary on all sides and up to 2.5 miles to the north; however, this area is part of the Ocala National Forest and uninhabited. The residential area at Summit Pond would be exposed to CDNL between 57 and 62 dB, which corresponds to a low risk for noise complaints.

The noise contours for small arms ground fire are based upon dBPk, which presents the peak level for the loudest weapon. Because the 0.50 caliber would remain the loudest munition under the Proposed Action, the dBPk contours presented in Figure 3.1-4, Baseline Small Arms Noise with Points of Interest at Pinecastle Range, would not change.

4.1.2.2 Lake George Range

The estimated change in aircraft noise exposure is presented in annual average DNL contours from 65 to 70 dB, in 5 dB increments, as depicted in Figure 4.1-3. Aircraft activity would not generate noise exposure levels of 75 dB DNL or greater. The 65 dB DNL contour would follow the Mine Exercise flight patterns, which approach from the northwest while descending towards the target, then turn left while climbing back to the pattern altitude. The 65 dB DNL contour would extend 3 miles to the northwest to the shore of Drayton Island and 1.5 miles to the east of the range boundary but remain over Lake George. Residences on Drayton Island and the Pine Island Resort represent the closest noise sensitive receptors, neither of which would be impacted by the Proposed Action because DNL would remain below 65 dB at these noise sensitive locations.

The estimated noise due to aircraft large arms presented in CDNL is shown in Figure 4.1-4 for Lake George Range (baseline levels of large arms use did not generate a 57 dB CDNL+ contour at Lake George). The 57 dB CDNL would be contained within the range boundary. The 62 dB CDNL would be contained within the Lake George Range boundary and would not impact the noise sensitive points of interest on either Drayton Island or Pine Island Resort.

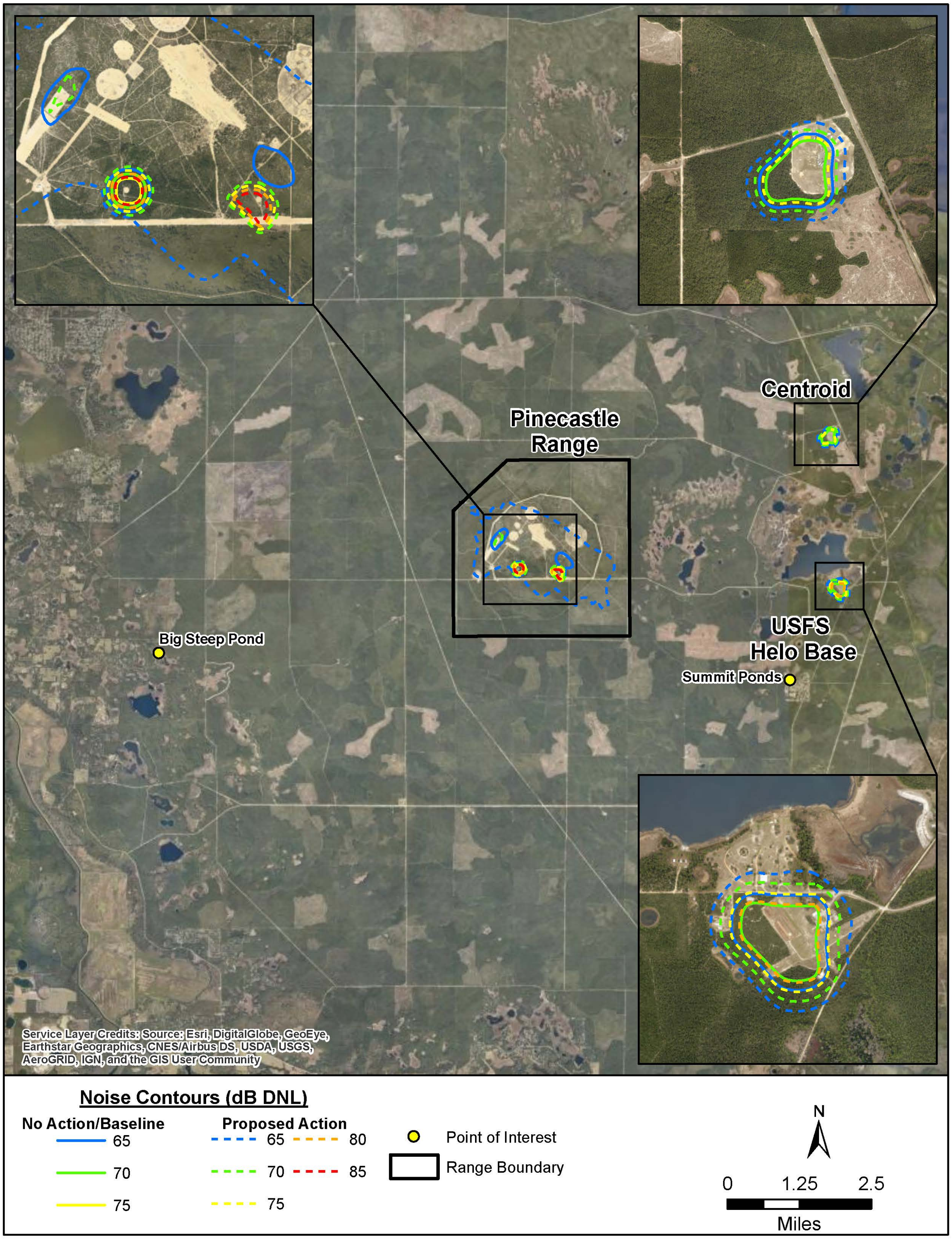

Figure 4.1-1. Proposed Aircraft Noise Exposure at Pinecastle Range

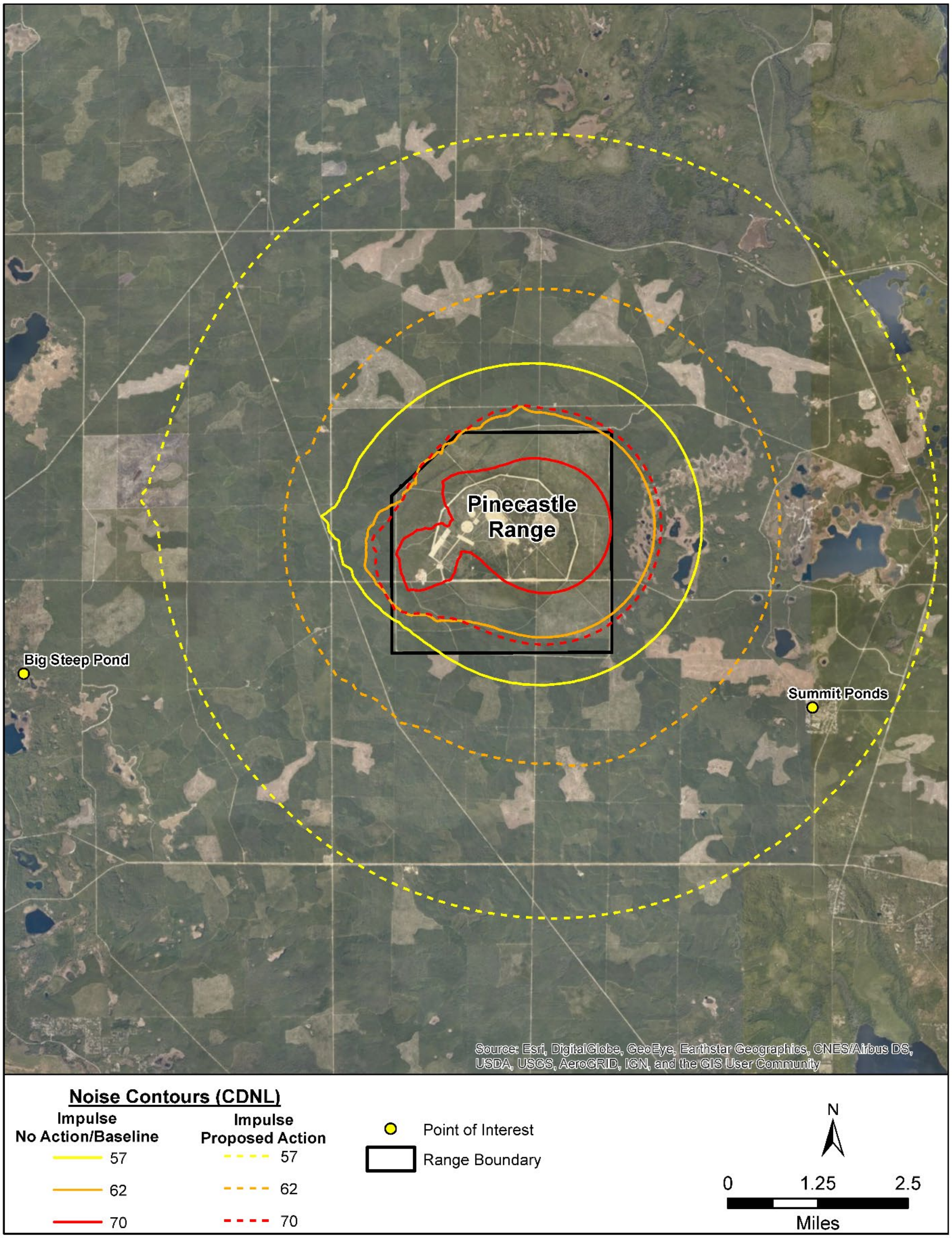

Figure 4.1-2. Proposed Impulsive Noise Exposure at Pinecastle Range

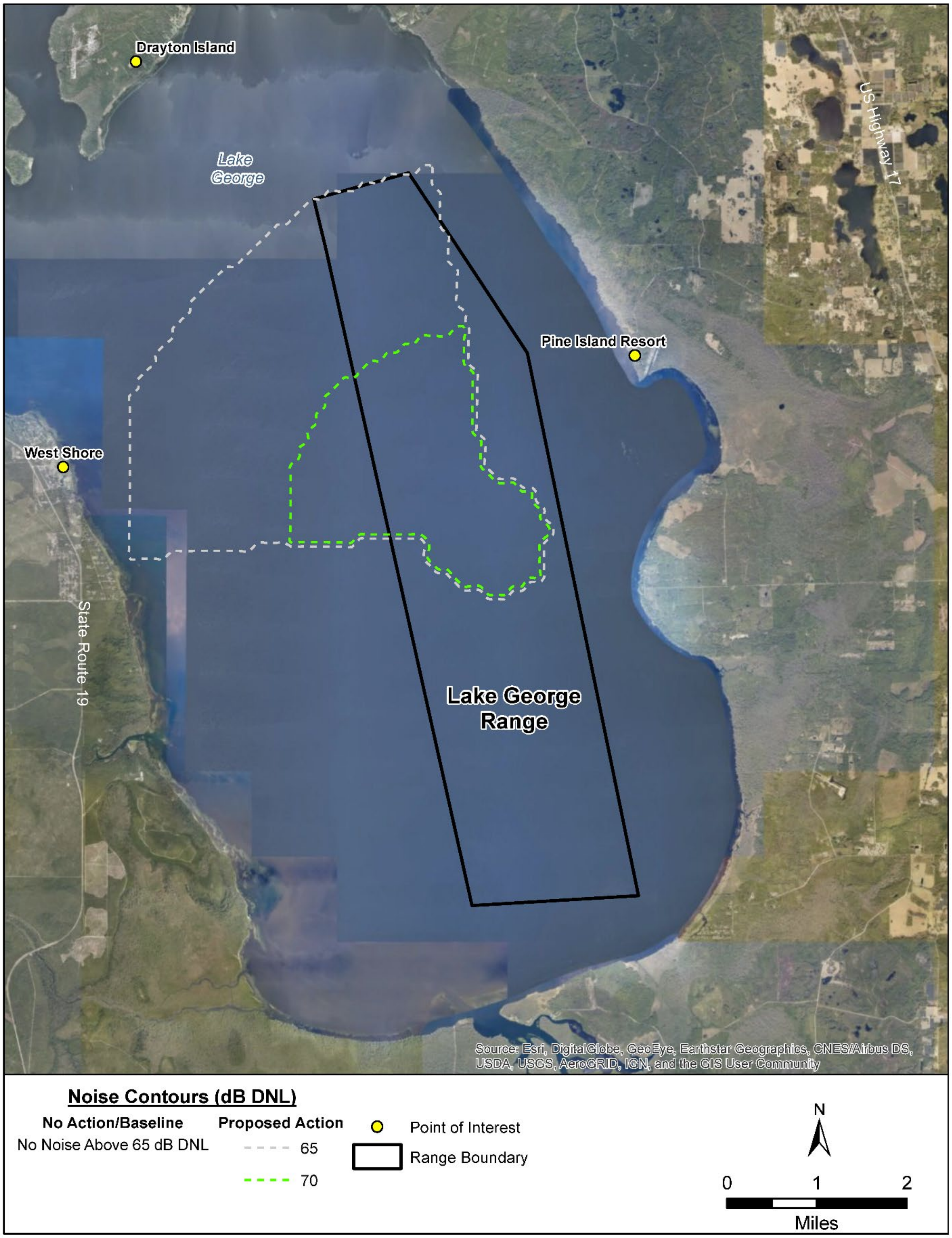

Figure 4.1-3. Proposed Aircraft Noise Exposure at Lake George Range

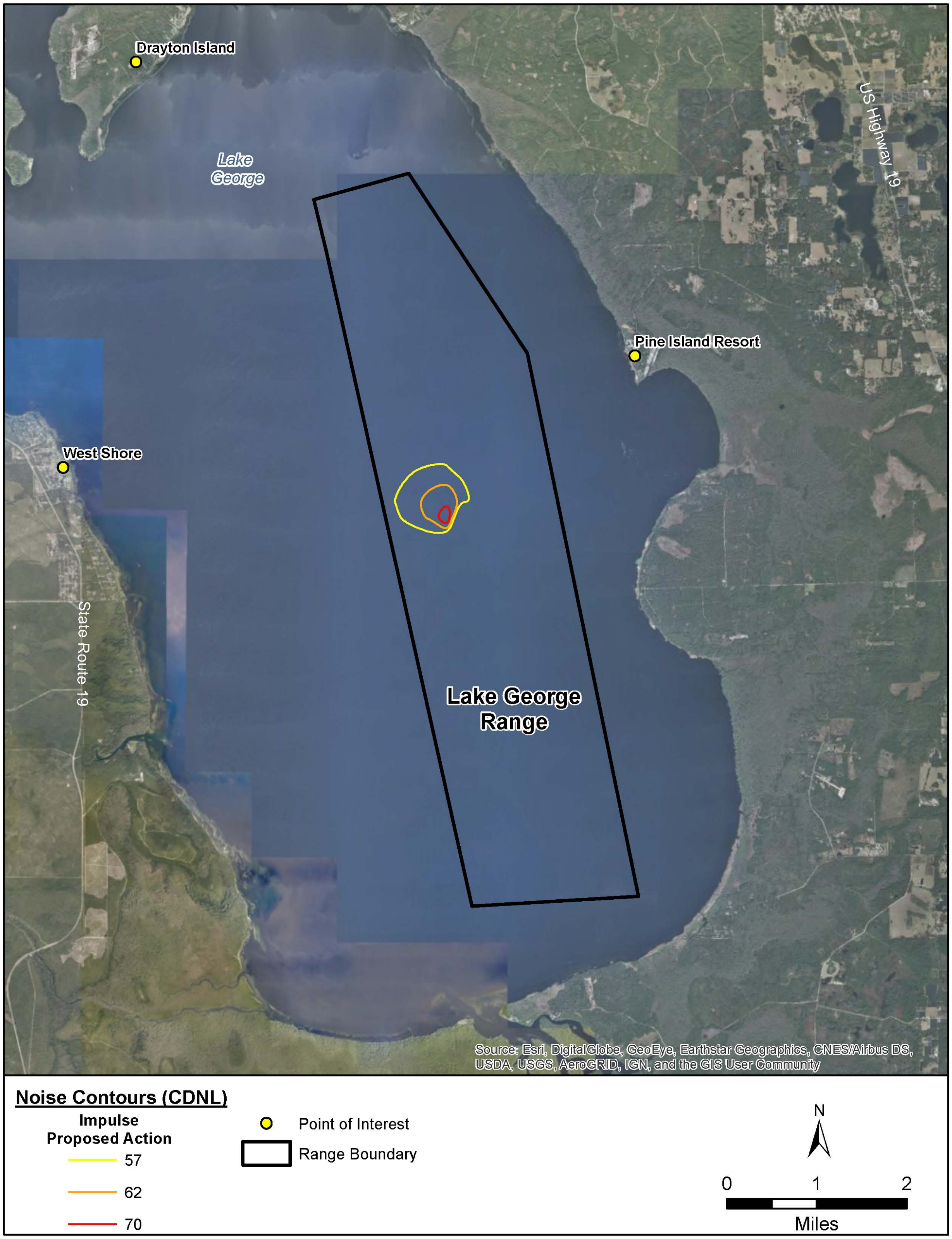

Figure 4.1-4. Proposed Impulsive Noise Exposure at Lake George Range

4.1.2.3 Rodman Range

The estimated change in aircraft noise exposure at Rodman Range is presented in annual average DNL contours from 65 to 85 dB, in 5 dB increments, as depicted in Figure 4.1-5. Noise would continue to be focused at the eight landing zones due to the low altitude of rotary-wing aircraft in these areas and the relatively small volume of space where aircraft are concentrated during training. DNL would increase 15 to 20 dB but remain within the range boundary and not impact noise sensitive points of interest.

Noise levels from small arms firing within Rodman Range would only occur under the Proposed Action due to new operations involving aircraft gunnery and ground firing. The estimated noise due to the air gunnery operations is presented in dBPk as shown in Figure 4.1-6 for Rodman Range. These dBPk contours extend outside of the range boundary, but do not impact noise sensitive points of interest.

The estimated dBPk noise contours for the ground firing were determined for Rodman Range using the same methodology as described in Section 3.1.7 for Pinecastle Range except the 5.56 mm and SESAMs rounds were used for distance buffering. As shown in Figure 4.1-6, both the 87 and 104 dBPk would remain within the range boundary except for the 87 dBPk to the north. These areas result from firing operation near two landing zones. The closest noise sensitive receptors are residences approximately 3 miles south of the Rodman Range boundary at Buckskin Prairie, outside the Figure 4.1-6 map extent.

Noise Exposure Conclusion

Although the noise contours at Pinecastle Range, Lake George, and Rodman would extend beyond their range boundaries, no noise sensitive points of interest would be impacted in these areas. These increases would likely be noticeable, but the areas are currently exposed to noise from aircraft operations and munitions expenditure. These changes to DNL and single event levels would not constitute a dramatic change to the intensity of noise in the local environment.

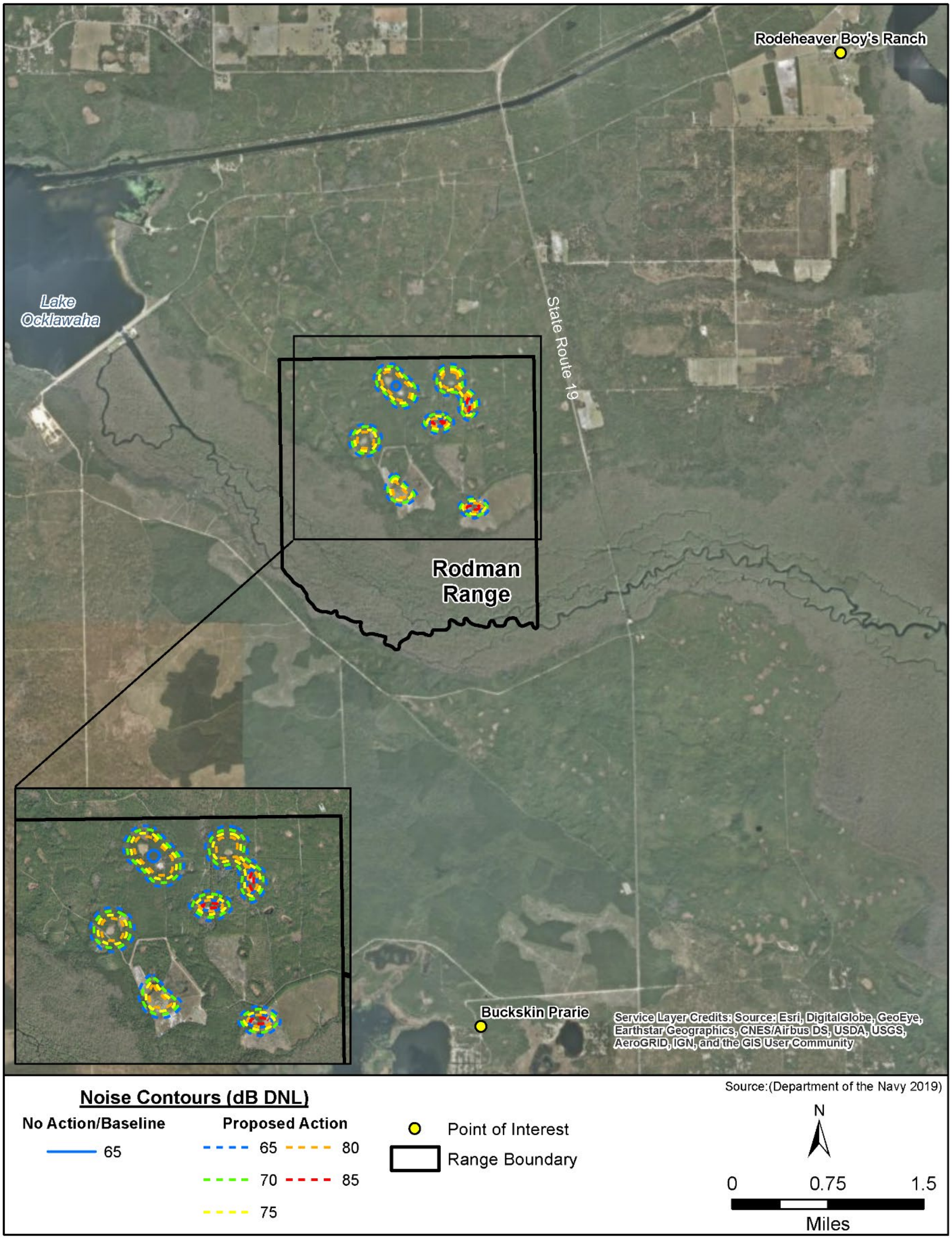

Figure 4.1-5. Proposed Aircraft Noise Exposure at Rodman Range

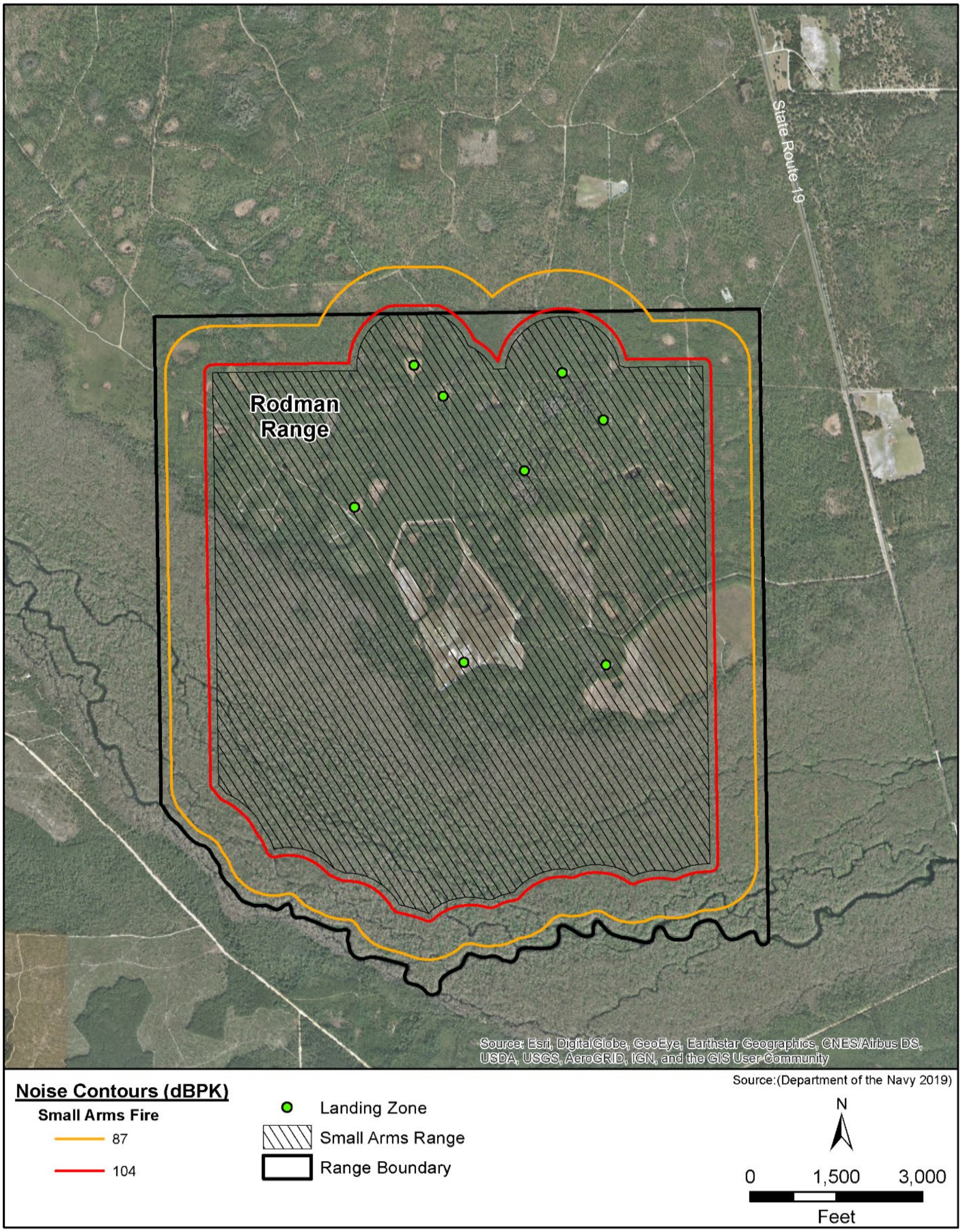

Figure 4.1-6. Proposed Peak Sound Level for Aircraft Gunnery Fire at Rodman Range

4.2 Air Quality

> Air Quality Potential Impacts:
>
> - No Action: Same as existing conditions.
> - Proposed Action Alternative:
>   - Net increases in emissions for each criteria pollutant would not exceed the 100 tons per year.
>   - Proposed training activities would not contribute to global warming to any discernible extent.

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The ROI for assessing air quality impacts is the counties in which the project is located, the counties of Volusia, Putnam, and Marion, Florida.

Since Volusia, Putnam, and Marion counties are in attainment for all criteria pollutants and have no designated maintenance areas, the General Conformity Rule does not apply; however, for the purposes of this analysis, 100 tons per year per pollutant was used as an indicator to trigger further evaluation of potential air quality impacts. Indicators do not trigger a regulatory requirement; however, they provide an indication or a warning that the action is potentially approaching a threshold that would trigger a regulatory requirement. Used in this way, indicators provide relevant evidence of the potential impacts to air quality. The 100 tons per year per pollutant indicator is based on the *de minimis* thresholds that apply under the General Conformity Regulations.

No similar regulatory indicator is available for mobile source emissions, which are the primary sources for operation activities under this proposal. Lacking any regulatory mobile source emissions thresholds, the 100 ton per year per pollutant indicator was used to equitably assess mobile source emissions associated with the Proposed Action.

4.2.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented and there would be no change to baseline air quality conditions in Volusia, Putnam, and Marion counties in Florida.

4.2.2 Proposed Action Alternative

Under the Proposed Action Alternative, existing training missions would be expanded to meet future range mission requirements at the PRC with an increase in both aircraft flight operations and ordnance at each range.

4.2.2.1 Potential Impacts

The air quality analysis evaluates the change in air pollutant emissions as a result of the Proposed Action as compared to the No Action Alternative by using the methodologies described previously. Table 4.2-1 contains the estimated annual emissions within each range area associated with the changes proposed for both aircraft flight operations and increases in munitions expenditures. Table 4.2-2 presents the total combined air emissions predicted over the three range areas for both baseline/No Action Alternative and Proposed Action Alternative conditions. As shown in Table 4.2-2, the net increases in emissions for each criteria pollutant would not exceed the 100 tons per year comparative impact threshold. Under the Proposed Action, emissions would not create a major regional source of air pollutants or affect the current attainment status at the PRC in Florida, and would comply with all applicable state and regional air agency rules and regulations.

Table 4.2-1. Proposed Action Alternative Range Activity Estimated Air Emissions Inventory

Range	*NOx*	*VOC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
Pinecastle	68.6	0.7	15.4	0.2	39.2	11.2	8,523.7
Rodman	60.6	0.4	3.4	0.0	8.9	8.9	6,968.5
Lake George	85.2	0.4	3.3	0.1	12.4	12.4	10,018.7

Table 4.2-2. Average Total Combined Annual Operation Estimated Air Emissions

Scenario	*NOx*	*VOC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2)*
Baseline/ No Action Alternative	149.4	0.7	8.2	0.0	26.3	21.2	17,332.8
Proposed Action Alternative	214.4	1.5	22.2	0.4	60.5	32.5	25,511.0
Net Change from Baseline/No Action Alternative	64.9	0.8	14.0	0.4	34.2	11.3	8,178.1
Comparative Threshold	100	100	100	100	100	100	NA
Exceed Comparative Threshold	No	No	No	No	No	No	NA

Greenhouse Gases

Implementation of the Preferred Alternative would contribute directly to emissions of GHGs in terms of CO_2 emissions from the combustion of fossil fuels. Aircraft and weapon operational activities would generate approximately 8,178 tons (7,419 metric tons) of CO_2 emissions if the proposed activities occurred at the three ranges. This limited amount of emissions would represent approximately 0.1 percent increase of the existing GHGs inventory over the three counties in the ROI to be affected by the proposed training activities and would not contribute to global warming to any discernible extent.

4.3 Airspace/Range Safety

Airspace/Range Safety Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative: No change to existing airspace, RCZs, or range boundaries. Existing safety measures would continue to be implemented.

The analysis of airspace management and use involves consideration of many factors including the types, locations, and frequency of aerial operations, the presence or absence of already designated (controlled) airspace, and the amount of air traffic using or transiting through a given area.

4.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented, and the affected environment would remain unchanged. There would be no change to aircraft type or number of training operations at the PRC. Airspace and range safety would continue to be managed as described in Section 3.3.2.

4.3.2 Proposed Action Alternative

Under the Proposed Action Alternative, existing training missions would be expanded to meet future range mission requirements at the PRC with an increase in both aircraft flight operations and munitions at each range, as well as introduction of new aircraft for training operations. The ROI includes the existing special use airspace and the three ranges associated with the PRC.

4.3.2.1 Airspace Safety

Under the Proposed Action, all training operations would be conducted within the existing boundaries of the three ranges, and within airspace currently utilized by the PRC, using all existing SOPs, *Naval Aviation Training and Operating Procedure Standardization* (OPNAVINST 3710.7), instructor supervision, and specific FAA regulations. The new aircraft are similar in function to existing aircraft and would not result in a change to predominant flight paths. Flight patterns, altitudes, and airspeeds for training operations would remain similar to those currently conducted under existing conditions. The proposed increase in air operations would result in a greater number of flight hours flown in the PRC and possibly an increase in local mishap potential that is not necessarily proportional or quantifiable in a defensible manner.

The USFS Helicopter Base, within Pinecastle Range, would continue to be managed under current procedures. Similar to current conditions, under the Proposed Action nonparticipating traffic would not be able to transition through the Palatka MOAs or the Restricted Areas when they are active, and would be need to rerouted. No impacts on nonparticipating instrument flight rule aircraft would occur under the implementation of the Proposed Action. As discussed in Section 3.3.2, air traffic control procedures are already in place at Orlando International Airport to reroute nonparticipating instrument flight rule aircraft when the Palatka MOAs and current Restricted Areas are active. Under the Proposed Action, the proposed increase in operations and addition of aircraft would not impact the current procedures at Orlando International Airport. Consequently, no impacts on air traffic into Orlando International Airport would occur.

Lasing operations at the PRC would continue to be conducted under strict safety controls, to include SOPs, monitoring by Airport Surveillance Radar-9 radar, use of the Navy's Identification, Friend or Foe system, and presence of the Laser System Safety Officer. Both air traffic control and the Laser System Safety Officer are in direct communication with personnel in the aircraft cockpit, who can then turn the laser system off should any unauthorized aircraft approach the vicinity of the laser operation. Direct communication is also established and maintained between the pilots who are lasing, FACSFACJAX, PRC personnel, and a Range Safety Observer.

4.3.2.2 Range Safety

The Proposed Action Alternative would have no effect on the existing RCZs at the PRC; the two high-explosive munitions target areas, eight non-explosive munitions target areas, strafe pit with three different target areas, and laser target at Pinecastle Range; the four impact targets on the Lake George Range; or the cleared area with a central target and lighting system at Rodman Range. The existing ranges would continue to adhere to the parameters set out in the RAICUZ Study, existing SOPs and the ORC Plan; and the PRC would not require the orientation of any range be reconfigured to retain optimal safety and efficiency. The proposed increased munitions expenditures have the potential for increased risk of mishap that is not necessarily proportional or quantifiable in a defensible manner.

Gates are located at various access points adjacent to and outside of the approved 2017 RAICUZ Study RCZ-I boundary. Figure 4.3-1 depicts the location of RCZ-I as well as the current locations of access control gates. The area between the RCZ-I boundary and the gates is referred to as the “safety zone” or “safety zone buffer” in the 2017 RAICUZ study as well as on signage and kiosks around the area. The terms “safety zone” and “safety zone buffer” are not defined in the Navy’s RAICUZ program. The “safety zone” or “safety zone buffer” was not a modeled area under the RAICUZ program for increased risk of flight or weapons mishap. The “safety zone” is an area approximately 81 square miles surrounding the RCZ-I analyzed in the 2017 PRC RAICUZ Study (see Figure 4.3-1). Pinecastle Range is fully within the “safety zone”. During certain training exercises, the gates are closed for public safety. The gates have been placed to maximize efficiencies in securing access to the RCZ-I during applicable military readiness activities. The gate locations may change over time and additional gates may be added as future public safety needs dictate.

While the siting of the electronic warfare equipment proposed at the PRC would potentially consist of new locations, the sites would be locations historically used for electronic warfare equipment, and existing safety procedures with respect to electronic warfare equipment would be implemented. Physical reactions to electromagnetic radiation are subject to the power and energy of the emitted electromagnetic wave. Mobile emitters are capable of generating an electromagnetic wave at frequencies ranging from 4 to 8 GHz. Emitters would only produce electromagnetic signals in frequency bands in accordance with approvals that are attained through the Navy Marine Spectrum Office and reviewed by the Federal Communications Commission, the FAA, and the National Telecommunications and Information Administration. The safety of electromagnetic radiation is largely a function of the locations of the emitters relative to people, the power and frequency output of the emitters, the amount of time an individual is exposed to the electromagnetic energy, and the Navy’s management practices related to operation of the emitters (Department of the Navy 2014).

The Navy implements a wide range of rules and practices for safe military use of training systems such as electronic warfare emitters. The Navy would continue to follow OPNAVINST 5100.23G, *Navy Safety and Occupational Health Program Manual,* for its radiation protection requirements and safety guidelines. OPNAVINST 5100.23G defines the exposure limits to personnel based on the controlled environment and to the general public based on the action level environment and the averaging time of exposure. Controlled environments are defined as areas where exposure may be incurred by people who are aware of the potential for electromagnetic radiation exposures as a result of employment or duties, exposure of individuals who knowingly enter areas where higher radiation levels can reasonably be anticipated to exist, and incidental exposure that may occur due to transient passage through such area. Typically, for military sites, controlled areas include all operational and work areas. Action level environments are defined as public areas where individuals have no knowledge or control of their exposure. Such areas include living quarters, workplaces, or public areas where there are no expectations that higher radiation levels should exist. If a public safety issue is present (e.g., active hunting, camping, or hiking in the area) during the operation of the mobile emitter, the mobile emitter would be de-energized and relocated, as necessary. Controlled and action level environments at the mobile sites would be monitored by Navy personnel. The Proposed Action Alternative would not result in impacts to airspace and range safety.

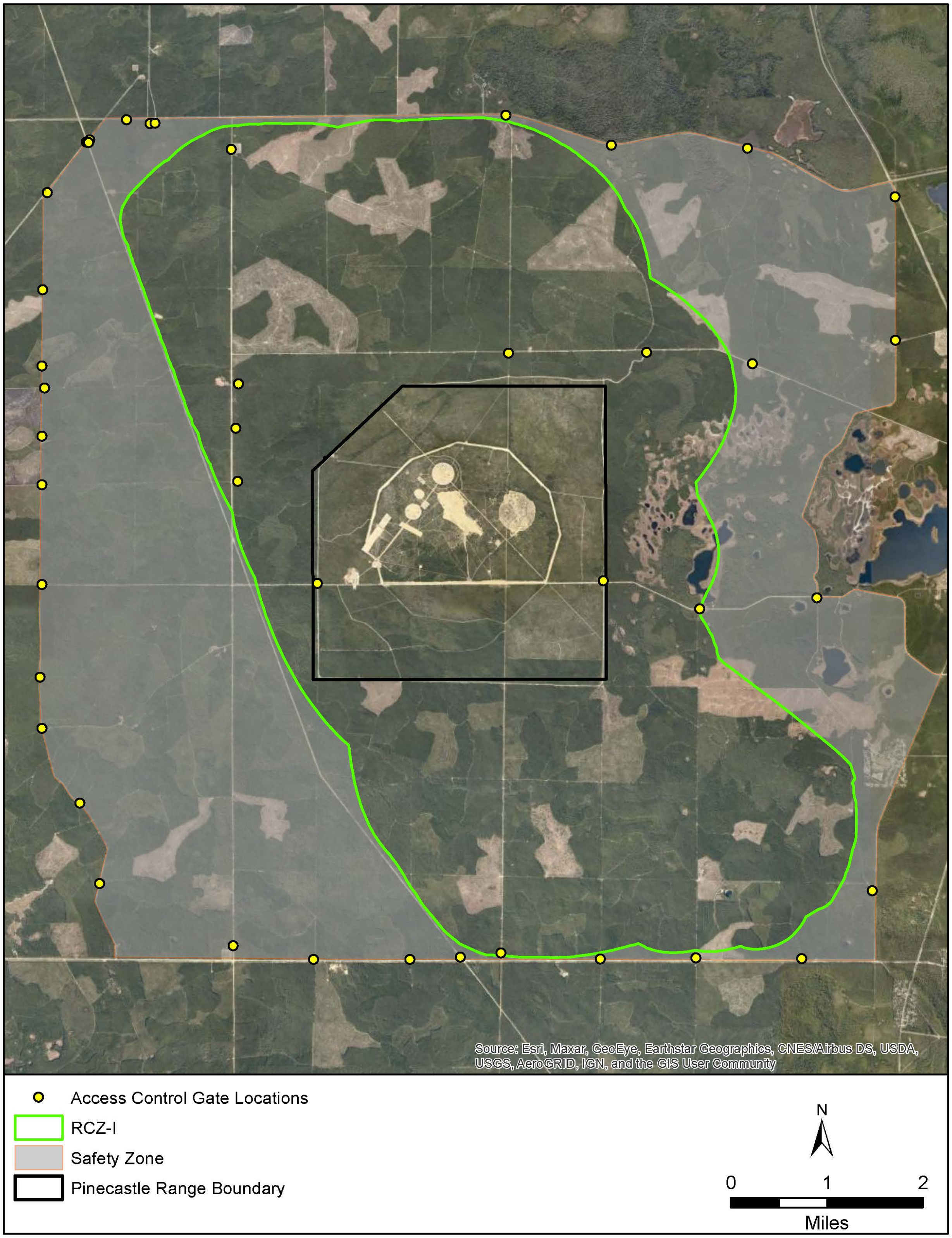

Figure 4.3-1. RCZ-I and Gate Locations Surrounding Pinecastle Range

4.4 Biological Resources

This analysis focuses on wildlife or vegetation types that are important to the function of the ecosystem or are protected under federal or state law or statute.

Biological Resources Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative:
  - May affect the listed species.
  - No effect to the species' critical habitat.
  - Wildlife are already habituated to the visual and audible disturbances in the ROI.

4.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented, and the affected environment would remain unchanged. There would be no change to aircraft type or number of training operations at the PRC, and thus there would be no change to baseline biological resource conditions.

4.4.2 Proposed Action Alternative

The ROI for the analysis of effects to biological resources associated with the Proposed Action Alternative includes the Pinecastle Range, Rodman Range, Lake George Range, and associated special use airspace.

4.4.2.1 Potential Impacts

Potential impacts to biological resources from the Proposed Action would occur from the continuation of existing operations and the anticipated future training range missions at the PRC. Existing operations at the PRC have been largely addressed in previous NEPA documents (Department of the Navy 2009; 2010b). The analysis of potential impacts to biological resources focuses largely on the impacts that future training operations would have beyond baseline conditions.

Terrestrial Vegetation

Pinecastle Range

Under the Proposed Action, there is a high probability of a fire igniting in the unlikely event of a high-explosive munitions exceeding the Pinecastle Range target boundaries. In the unlikely event high-explosive munitions exceed the Range boundaries, vegetation damage could occur from the impact and subsequent removal of the munitions.

In addition, munitions could potentially ignite fires, resulting in the loss of vegetation, causing an immediate change in the habitat. While this would initially be an adverse effect, positive effects would result over time, because scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire (Menges and Kohfeldt 1995). Per the Annual Operating Plan, the use of air-delivered munitions, to include both explosive and non-explosive, would be prohibited with the following Energy Release Component (ERC) and the Keetch-Byram Drought Index (KBDI):

- ERC 60 or less: No prohibitions providing the KBDI is less than 400.
- ERC 61+: No air-delivered munitions with KBDI over 400, unless approved by the USFS.

The KBDI is a way of assessing fire potential using a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in deep duff and upper soil layers. It is a continuous index, relating to the flammability of organic material in the ground. The index is a closed system ranging from 0 to 800 units and represents a moisture regime from 0 to 8 inches of water through the soil layer. At 8 inches of water, the KBDI assumes saturation. Zero is the point of no moisture deficiency and 800 is the maximum drought that is possible. At any point along the scale, the KBDI number indicates the amount of net rainfall that is required to reduce the index to zero, or saturation (USFS 2020).

Regional Forester's Sensitive Species.

There are two sensitive plant species listed on the RFSS that have the potential to be found on Pinecastle Range: sand butterfly pea and scrub stylisma. The plant species are associated with sand pine scrub habitat and are herbaceous/ground cover or shade-intolerant understory plants that require open habitat conditions (e.g., lack of a canopy, bare patches of sand). Fire presents some risk of direct impact to these species, but most of them possess a hardy bulb or other underground root structure that allow the plants to re-sprout after disturbance. Fires of moderate intensity would create a flush of nutrients for plants and would likely increase germination and stimulate re-sprouting and growth. The low potential for fire presents only a limited amount of risk of direct impacts to individual plants, and a much lower risk to the greater localized populations of these sensitive species. There are limited activities as part of the Proposed Action that may have an indirect effect on sensitive plant species, therefore any indirect impact would be negligible. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Lake George Range

No terrestrial vegetation occurs within the Lake George Range; therefore, no impact to terrestrial vegetation would occur under the Proposed Action at the Lake George Range.

Rodman Range

Under the Proposed Action, non-explosive practice munitions could impact the ground surface within the target area at the Rodman Range, resulting in localized disturbance to vegetation and surface soils. Vegetation in the target area consists of grasses and other herbaceous species, which is routinely maintained by mowing and occasional plowing. Impacts to vegetation would be localized and no natural communities would be affected.

Terrestrial Wildlife

Pinecastle Range

Under the Proposed Action, aircraft movement and ordnance use could result in wildlife injury/mortality and loss of habitat. Wildlife may be affected if a fire were to occur, which is a possibility due to use of high-explosive munitions. Adverse effects include temporary or long-term loss of habitat as well as the potential for mortality. In particular, slower or less mobile wildlife species, and those seeking refuge in burrows, may not be able to evade a fire. However, the chances of a fire occurring are low, due to protective measures implemented by the Navy in cooperation with the USFS, such as various firebreaks which are maintained throughout the Range to prevent the spread of wildfires (Department of the Navy 2010a). Additionally, many wildlife species found within the scrub community of the Pinecastle Range live in or use fire-dependent communities. Conversely, scrub communities typically require fire regimes in order to maintain healthy ecosystems, and therefore a fire could be beneficial to the community that these wildlife species depend upon (Department of the Navy 2010a).

Under the Proposed Action, there would be an increase in fixed-, rotary-, and tilt-wing aircraft operations (Table 2.3-1). While the Proposed Action represents an increase in the tempo of aircraft overflights, the potential for bird/bat-aircraft strikes would remain very low. Bats would be less likely to strike aircraft, as the majority of aircraft operations would occur during daytime hours. Fixed-wing aircraft would typically operate higher than 1,500 feet above ground level and do not take off or land at the ranges. While rotary-wing aircraft operate at lower altitudes, they also fly at relatively low airspeeds during training exercises (Navy 2009). This increases the likelihood that wildlife could hear or see an oncoming rotary-wing aircraft, flee the immediate area, and avoid being struck. Lower airspeeds also provide pilots an opportunity to identify safety concerns and to avoid a strike by maneuvering the helicopter. Therefore, an incremental increase to existing aircraft operations would not result in a significant increase in low-level rotary-wing and tilt-rotor aircraft strikes on bird/bat species.

Use of aircraft, particularly low-level flights and landings/takeoffs would cause noise and visual disturbance to wildlife. Impacts to wildlife from aircraft noise and visual stressors can include: a startle reflex that induces running or flight, increased expenditure of energy, decreased time and energy spent on life functions such as feeding and mating, increased likelihood of predation, and interruption of breeding or nursing behavior (Larkin 1996; Efroymson et al. 2000). Effects related to rotor wash and noise from rotary-wing and tilt-rotor aircraft would diminish with distance from the source, and exposure to elevated noise levels would generally be localized around landings, takeoffs, and low-level hovering but diminish with distance.

Noises that are close, loud, sudden, and combined with a visual stimulus produce the most intense reactions in animals (Bowles et al. 1999). Rotary-wing and tilt-rotor aircraft generally induce the startle effect more frequently than fixed-wing aircraft (Frid 2003). As the Proposed Action would allow continued aircraft and ordnance training, it is assumed that wildlife in the ROI are already partially habituated to such visual and aural disturbance.

A considerable number of bird species that utilize resources at or near the Pinecastle Range do so during migration or as passing vagrants, and are not permanent residents. Most bird species known to regularly utilize the project area are considered fairly common and widespread. Training activities under the Proposed Action may eliminate visitation by certain bird species or reduce the amount of time they spend in the ROI. However, displacement of these species during training exercises would not be considered substantial.

Wildlife exposed to low altitude aircraft overflights and ordnance noise could exhibit short-term behavioral and/or physiological responses, but not to the extent where the general health of individuals or populations would be compromised. These impacts are not expected to result in chronic stress based on the short duration and infrequency of exposure. In addition, the proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. Some bird and mammal species have shown to habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Krausman et al. 1996; Conomy et al. 1998). Additionally, bird species in the vicinity of airports have been shown to habituate to aircraft noise and show little to no increase in physiological stress (Wolfenden 2017). The Proposed Action at the Pinecastle Range would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. Military readiness activities are exempt from the take prohibitions of the MBTA, provided they would not result in a significant adverse effect on a population of migratory bird species. Bald eagles are not present at Pinecastle; therefore, the Proposed Action at the Pinecastle Range would not result in take of bald eagles or to disturb bald eagles as defined by the Bald and Golden Eagle Protection Act.

As training activities already occur at the Pinecastle Range, and with implementation of impact avoidance and minimization measures, impacts to wildlife under the Proposed Action, including those listed in the RFSS, would be minor and occasional at the Pinecastle Range. In addition to the effects discussed above, analysis specific to species on the RFSS list is included below.

Regional Forester's Sensitive Species.

Florida Mouse

Fire would be unlikely to directly impact Florida mice inhabiting stands post-harvest since they could escape to tortoise burrows or areas left undisturbed, but some chance exists that individuals could be harmed by the described actions. Fire indirectly benefit the Florida mouse by creating an open canopy and sustaining oak species within an age range that provides mast. Gopher tortoises would also benefit from these treatments, and the Florida mouse shares a close association with this species' burrows (Layne 1992).

Sherman's fox squirrel

There is little information in the literature on the use of scrub habitat by Sherman's fox squirrels. Based on local observation, their use of the scrub appears to be limited to ecotones between sandhills and scrub. There would little to no use of burned habitat by fox squirrels, except for foraging of burned mast on the edges of the fire. Fire may directly impact young squirrels if mature sand pine trees with nests are burned. Fire would indirectly benefit squirrels by providing additional mast sources when oaks re-sprout and begin producing mast (approx. three years post-fire). The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Rafinesque's big-eared bat

This species is considered rare throughout its entire range. Individuals have been documented in pine flatwoods and hardwood hammocks in Florida and have been observed roosting in large, hollow old-growth trees in bottomland hardwood forests. Though the action area contains few potential roost sites, a fire could destroy roost trees. Based on the scarcity of potential roosting sites and the Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Bachman's sparrow

The Bachman's sparrow is strongly associated with open pine woodlands. Fledged individuals could avoid fire, but nests and eggs would be susceptible to mortality. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Florida scrub lizard

Scrub lizards are quick enough to evade fire or could also use gopher tortoise burrows for protection therefore direct impact would not be expected. Some risk of egg destruction exists, but the indirect benefits of fire outweigh potential egg loss by increasing habitat quality (e.g., areas of bare sand for basking and feeding) immediately after fire. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Southern hognose snake

Southern hognose snakes are assumed to be active burrowers and thus likely spend time underground in gopher tortoise burrows or other refuges such as stump holes or root holes. This behavior would protect them from the direct effects of fire. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Eastern diamondback rattlesnake

The eastern diamondback rattlesnake occupies sandhills, flatwoods, prairie, and scrub habitats. As with many other species, eastern diamondback rattlesnakes use gopher tortoise burrows as a resource for cover, which would aid them in avoiding the direct effects of fire. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Gopher frog

Gopher frogs could occupy ponded areas within or adjacent to the action area and they co-inhabit gopher tortoise burrows. Fire would indirectly benefit the gopher frog by increasing habitat suitability for the gopher tortoise. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Ocala deepdigger scarab beetle

The Ocala deepdigger scarab beetle is a large black beetle with green iridescence that occurs in sandhill and scrub habitats. The species makes deep vertical burrows that may reach up to five meters in length and houses the larval young. Adult beetles emerge from their burrows starting in November and are active aboveground until April. Their burrows would provide refuge from fire, and Kalisz and Stone (1984) found increases in beetle mound densities in a scrub site after a wildfire. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Ocala Clawcercus Grasshopper

This grasshopper species is known to occur only on the Ocala National Forest. Little is known of its natural history, but it has been found only in “clearcut forest following harvest of pines” (Capinera 1999) or in “oak scrub with open patches and occasional areas of bare sand” (Deyrup 1994). Individuals could fly away from most disturbances, but could be killed by fire. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Monarch butterfly

The monarch butterfly fees exclusively on milkweed. Fire would not be expected to cause direct mortality to monarch butterflies, as they could easily avoid impacted areas, and the effects would benefit habitat where milkweed grows. The Proposed Action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability.

Lake George Range

Under the Proposed Action, terrestrial wildlife would be impacted in much the same manner as described above for the Pinecastle Range, except that, as the Lake George Range is a water range, terrestrial wildlife would be impacted to a lesser degree. Additionally, no high-explosive munitions impacts would occur at the Lake George Range. Birds and bats that forage or fly over the Lake George Range would be susceptible to the same aircraft training impacts as described for the Pinecastle Range. Land-based mammals, reptiles, and amphibians would experience the same aircraft training impacts as described for the Pinecastle Range, but to a lesser extent as the exposure to impacts would be more peripheral.

The Proposed Action at the Lake George Range would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. Furthermore, bald eagles are not present at the Lake George Range; therefore, the Proposed Action at the Lake George Range would not result in take of bald eagles or to disturb bald eagles as defined by the Bald and Golden Eagle Protection Act.

Rodman Range

Under the Proposed Action, terrestrial wildlife would be impacted in much the same manner as described above for the Pinecastle Range, except that, no explosive munitions impacts would occur at the Rodman Range. Wildlife would be susceptible to the same aircraft training impacts as described for the Pinecastle Range and is not expected to experience chronic stress based on the short duration and infrequency of exposure. The Proposed Action at the Rodman Range would not have a significant adverse effect on migratory bird populations as defined by MBTA regulations applicable to military readiness activities. Furthermore, the Proposed Action at the Rodman Range is not expected to result in take of bald eagles or to disturb bald eagles as defined by the Bald and Golden Eagle Protection Act.

Marine Species

As described in Section 3.4.2.3, the Lake George Range is located 0.6 to 1.9 miles off the lake's eastern shoreline and 2.4 to 4.7 miles off the western shoreline. Therefore, submerged aquatic vegetation is not expected to grow within the Lake George Range boundaries. The Proposed Action would have no impact on marine or other aquatic vegetation.

Under the Proposed Action, non-explosive munitions would impact the water surface within the target area at the Lake George Range, resulting in short-term and localized disturbance to the water column. Localized disturbances to benthic habitat would be expected based on the relatively shallow depth of Lake George (8 to 11 feet in the target area). Impact with the lake bottom could create small craters and bottom sediments would be temporarily resuspended, resulting in increased water turbidity. The effects would be short-term and localized. Turbidity levels would return to normal shortly after an event and benthic habitat would recover through natural sedimentation processes.

As the munitions accumulate over time, they would create structure on the lake bottom, which could attract and provide cover for certain species of fish. It is likely that some fish would be in the target area at the time of ordnance delivery because some species are attracted by the structure and cover provided by the expended munitions on the bottom. The number of fish that might be affected by direct strikes cannot be quantified, but is expected to be minimal because the benthic environment in the Lake George Range does not provide the types of structure or vegetation to support dense populations of fish. Therefore, the Proposed Action would have only a minor and occasional impact on fish species.

Threatened and Endangered Species

The Department of the Navy submitted a Biological Assessment (BA) on April 16, 2020 to support formal ESA section 7 consultation with the USFWS regarding impacts to federally listed species from the Proposed Action (Department of the Navy 2020; Appendix D). The BA contains complete analyses regarding potential impacts to federally listed species from implementation of the Proposed Action, as well as conservation measures that would be implemented to reduce potential impacts. The USFWS concurred with analyses presented in the BA in a Biological Opinion (BO) dated November 10, 2020 (USFWS 2020; Appendix D). A BO is the document that states the findings of the USFWS, required under section 7 of the ESA, as to whether a federal action is likely to jeopardize the continued existence of species listed as endangered or threatened; or result in the destruction or adverse modification of designated critical habitat. The BO includes mandatory terms and conditions, which carry out reasonable and prudent measures to minimize the impacts. These terms and conditions, including monitoring and reporting requirements, are provided in Section 4.4.2.2 and in Appendix D.

General effects and brief species' impact assessments are provided below. Refer to Appendix D for detailed effect determinations and the USFWS's BO for federally listed species.

General Effects to Federally Listed Species

Under the Proposed Action, there would be no anticipated ground impacts outside of the Pinecastle or Rodman target boundaries. Non-explosive munitions can create soil disturbance and damage vegetation. Statistically, the chances of an individual listed species being hit by non-explosive munitions are unlikely. High-explosive munitions (only at the Pinecastle Range) can create a larger area of soil/vegetation disturbance. Mortality from explosions could occur; however, this is difficult to quantify. In the unlikely event that non-explosive munitions exceed target boundaries, vegetation damage could occur from the impact and subsequent removal of the munitions. There may also be effects to the habitat due to the removal of pine trees at the Pinecastle Range. Trees that obscure the camera scoring system's line-of-sight are removed every four to five years on a rotational basis. The trees can be up to 70 feet tall, are cut using either equipment or by hand, and once cut, are left in place.

Under the Proposed Action, non-explosive munitions would impact the water surface within the target area at the Lake George Range, resulting in short-term and localized disturbance to the water column. Localized disturbances to benthic habitat would be expected based on the relatively shallow depth of Lake George (8 to 11 feet in the target area). Impact with the lake bottom could create small craters and bottom sediments would be temporarily re-suspended, resulting in increased water turbidity. The effects would be short-term and localized. Turbidity levels would return to normal shortly after an event and benthic habitat would recover through natural sedimentation processes. No terrestrial habitat/vegetation occurs in the Lake George Range, and the Proposed Action would have no effect on terrestrial habitats in the vicinity of the range.

Noise would also potentially affect federally listed species. Munitions impact creates a loud noise that lasts for a short duration but can be audible for miles. Aircraft noise also has been found to be disruptive to wildlife. Use of aircraft, particularly low-level flights and landings/takeoffs would cause noise and visual disturbance to wildlife. Impacts to wildlife from aircraft noise and visual stressors can include: a startle reflex that induces running or flight, increased expenditure of energy, decreased time and energy spent on life functions such as feeding and mating, increased likelihood of predation, and interruption of breeding or nursing behavior (Larkin 1996; Efroymson et al. 2000). Effects related to rotor wash and noise from rotary-wing and tilt-rotor aircraft would diminish with distance from the source, and exposure to elevated noise levels would generally be localized around landings, takeoffs, and low-level hovering but diminish with distance.

Noises that are close, loud, sudden, and combined with a visual stimulus produce the most intense reactions in animals (Bowles et al. 1999). Rotary-wing and tilt-rotor aircraft generally induce the startle effect more frequently than fixed-wing aircraft (Frid 2003). Some bird and mammal species habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Conomy et al. 1998; Krausman et al. 1996). Wildlife exposed to low altitude aircraft overflights and ordnance noise could exhibit short-term behavioral and/or physiological responses, but not to the extent where the general health of individuals or populations would be compromised. These impacts are not expected to result in chronic stress based on the short duration and infrequency of exposure. As indicated in Section number 4.1 Noise*,* there would be no significant change in noise contours associated with the proposed increase in operations as compared with baseline conditions and ambient noise levels would not noticeably increase.

Wildlife/aircraft strikes could cause harm to federally listed bird species. While the Proposed Action represents an increase in the tempo of aircraft overflights, the potential for aircraft strikes on federally listed birds would remain very low. Fixed-wing aircraft would typically operate higher than 1,500 feet above ground level and do not take off or land at the ranges. While rotary-wing aircraft operate at lower altitudes, they also fly at relatively low airspeeds during training exercises (Navy 2009). This increases the likelihood that wildlife could hear or see an oncoming rotary-wing aircraft, flee the immediate area, and avoid being struck. Lower airspeeds also provide pilots an opportunity to identify safety concerns and to avoid a strike by maneuvering the helicopter.

An indirect effect associated with use of high-explosive munitions at the Pinecastle Range is habitat alteration that may occur due to fire. There is a high probability of a fire igniting in the unlikely event of high-explosive munitions exceeding the Pinecastle Range target boundaries. A fire could result in the loss of some individuals and cause an immediate change in the habitat. Adverse effects on plant species' populations would result immediately from the fire; however, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire (Menges and Kohfeldt 1995; Breininger et al. 2017). The Florida scrub-jay, sand skink, eastern indigo snake, gopher tortoise, Florida bonamia, scrub buckwheat, and Lewton's polygala are all associated with early-successional scrub habitat. In addition, they are all adapted to living in fire-dependent ecosystems. The recovery of any burned area after a fire would be suitable habitat for these species and it is anticipated that they would re-colonize the area.

Florida Bonamia, Lewton's Polygala, and Scrub Buckwheat

In the BA, the Navy has determined that the Proposed Action may affect, and is likely to adversely affect, Florida bonamia, Lewton's polygala, and scrub buckwheat. Populations of the species may benefit in habitats recovering from fire induced by high-explosive munitions exceeding the Pinecastle Range target boundaries. However, fire would potentially kill individuals in the near term. The potential for direct harm to individuals within the ROI is unlikely. If any individuals are lost due to fire, it would not result in impacts at population levels. Therefore, the Proposed Action would have less than significant impacts on these plant species. The USFWS issued a BO that the Proposed Action is not likely to jeopardize the continued existence of the Florida bonamia, Lewton's polygala, and scrub buckwheat.

Florida Scrub-Jay

In the BA, the Navy has determined that the Proposed Action may affect, and is likely to adversely affect, the Florida scrub-jay due to the potential for fire caused by high-explosive munitions, mortality from explosions, and increased exposure to aircraft overflights (Appendix D). It is expected that a relatively low but unquantifiable number of Florida scrub-jays may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the

ROI is unlikely. Therefore, the Proposed Action would have less than significant impacts on the species. The USFWS issued a BO that the Proposed Action is not likely to jeopardize the continued existence of the Florida scrub-jay.

Red-Cockaded Woodpecker

In the BA, the Navy has determined that the Proposed Action may affect, but is not likely to adversely affect, the red-cockaded woodpecker due to the low likelihood of impacts to individuals associated with increased exposure to aircraft overflights (Appendix D). There would be no impact to the species' habitat. Therefore, the Proposed Action would have less than significant impacts on the species. The USFWS concurred with this determination in the BO.

Wood Stork

In the BA, the Navy has determined that the Proposed Action may affect, but is not likely to adversely affect, the wood stork due to the low likelihood of impacts to individuals associated with increased exposure to aircraft overflights, and the low likelihood of an aircraft striking an individual in the Lake George Range or in lands underneath the special use airspace (Appendix D). There would be no impact to the species' habitat. Therefore, the Proposed Action would have less than significant impacts on the species. The USFWS concurred with this determination in the BO.

Eastern Indigo Snake

In the BA, the Navy has determined that the Proposed Action may affect, and is likely to adversely affect, the eastern indigo snake due to the potential for fire caused by high-explosive munitions, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights (Appendix D). It is expected that a relatively low but unquantifiable number of eastern indigo snakes may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the ROI is unlikely. Therefore, the Proposed Action would have less than significant impacts on the species. The USFWS issued a BO that the Proposed Action is not likely to jeopardize the continued existence of the eastern indigo snake.

Gopher Tortoise

In the BA, the Navy has determined that the Proposed Action may affect, and is likely to adversely affect, the gopher tortoise due to the potential for fire caused by high-explosive munitions, mortality from explosions, and increased exposure to aircraft overflights (Appendix D). It is expected that a relatively low but unquantifiable number of gopher tortoises may be affected by the Proposed Action, representing a small fraction of the population. In addition, continuation of gopher tortoise conservation measures (refer to Section 2.3 of the BA in Appendix D) would impart beneficial impacts on the species. The potential for direct harm to individuals within the ROI is unlikely. Therefore, the Proposed Action would have less than significant impacts on the species. In the BO, the USFWS noted that the gopher tortoise is not currently a protected species under the ESA, but currently the species is considered an at-risk species under federal purview. Gopher tortoises are a state-listed threatened species and the USFWS encouraged the Navy to coordinate with the FFWCC and the USFS regarding this species. The BO noted that if the species is listed in the future, re-initiation of this consultation will be warranted to provide coverage for the species.

Sand Skink

In the BA, the Navy has determined that the Proposed Action may affect, and is likely to adversely affect, the sand skink due to the potential for fire caused by high-explosive munitions, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights (Appendix D). It is expected that a relatively low but unquantifiable number of sand skinks may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the ROI is unlikely. Therefore, the Proposed Action would have less than significant impacts on the species. The USFWS issued a BO that the Proposed Action is not likely to jeopardize the continued existence of the sand skink.

West Indian Manatee

In the BA, the Navy has determined that the Proposed Action may affect, but is not likely to adversely affect, the West Indian manatee due to training activities in and over the Lake George Range (Appendix D). However, based on the low likelihood of manatees occurring in the Lake George Range during training activities, the potential for impacts to individuals is minimal. In addition, continuation of manatee conservation measures (refer to Section 2.3 of the BA in Appendix D) would reduce the potential for impacts on the species and its critical habitat. Therefore, the Proposed Action would have less than significant impacts on the species and its critical habitat. The USFWS concurred with this determination in the BO.

Impacts to other special status species would be consistent with the potential impacts discussed above for vegetation and wildlife, and no species would be significantly impacted by the Proposed Action. Therefore, the Proposed Action would have no significant impacts to biological resources.

4.4.2.2 Consistency with the USFWS BO

In the BO issued by the USFWS on November 10, 2020, terms and conditions were identified to ensure consistency with the parameters of the species impacts as identified in Section 4.4.2.1. All terms and conditions of the BO (Appendix D) will be applied under the Proposed Action.

The Proposed Action meets the regulatory definition of a “mixed programmatic action” for purposes of an incidental take statement, which is a federal action that’s an approved action(s) that are not subject to further ESA section 7 consultation; and approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and are subject to further section 7 consultation. For a mixed programmatic action, an incidental take statement is required at the programmatic level only for those activities that are reasonably certain to cause take and are not subject to further section 7 consultation. In order to monitor the impact of incidental take, the Navy will report the progress of the Proposed Action and its impact on the species to the USFWS as specified in the incidental take statement in the BO.

The following terms and conditions were identified in the BO, and the Navy will require any permittee, contractor, or grantee to implement these terms and conditions through enforceable terms that the Navy includes in the permit, contract, or grant document.

1. Continue to monitor and manage threatened and endangered species (i.e., both animal and plant) populations at a level that enables the Navy to contribute to quantifying the amount of take from military and natural resource management activities. Additionally, due to live-fire mission of Pinecastle Range, monitoring on the Ocala National Forest immediately surrounding Pinecastle Range. This

includes identifying important areas that threatened and endangered species are using for feeding, breeding, and sheltering.

2. The Navy shall incorporate the Standard Protective Measures [listed in the BO] for the eastern indigo snake.

3. Relocation of all gopher tortoises within an impact footprint shall be in accordance with FFWCC *Gopher Tortoise Permitting Guidelines*.

4. Disposition of dead or injured specimens (salvage). Care must be taken in handling any dead specimens found in the project area to preserve the specimen or its remains in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the Act. Unauthorized take of Florida scrub-jays, eastern indigo snakes, or sand skinks associated with the Proposed Action should be immediately reported by notifying the Jacksonville Ecological Services Field Office. If dead Florida scrub-jay or eastern indigo snake are found in the project area, the specimens should be thoroughly soaked in water and frozen for later analysis of cause of death. Any eastern indigo snakes that are found injured within the Proposed Action area shall be placed within a secure container with ample ventilation and notification shall be made to the District Ranger and USFWS immediately. If the USFWS is unable to be reached, the Navy shall notify the FFWCC Wildlife Alert Hotline at 1-888-404-3922, and follow up notification to the USFWS shall be made the next business day.

The BO also identified mandatory monitoring and reporting requirements, including procedures for handling and disposing of any individuals of a species actually killed or injured. As necessary and appropriate to fulfill this responsibility, the Navy must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that the Navy includes in the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the Navy and the USFWS if the amount or extent of incidental take specified in the BO's incidental take statement is exceeded during implementation of the Proposed Action.

The Navy shall submit an annual report documenting all known incidental take of species covered in the BO or the acreage of the surrogate habitat impacted that occurred during the missions carried out at the PRC for each calendar year.

4.5 Water Resources

The analysis of water resources looks at the potential impacts on surface water, groundwater, wetlands, and floodplains. The analysis of surface water quality considers the potential for impacts that may change the water quality, including both improvements and degradation of current water quality. Groundwater analysis focuses on the potential for impacts to the quality, quantity, and accessibility of the water. The impact assessment of wetlands considers the potential for impacts that may change the local hydrology, soils, or vegetation that support a wetland. The analysis of floodplains considers if any new construction is proposed within a floodplain or may impede the functions of floodplains in conveying floodwaters.

Water Resources Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative:
  - Ongoing SOPs and best management practices would minimize impacts to surface water and groundwater.
  - No impacts to floodplains or wetlands.
  - The Proposed Action is consistent with the CZMA.

4.5.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented, and the affected environment would remain unchanged. There would be no change to aircraft type or number of training operations at the PRC, and thus there would be no change to baseline water resource conditions.

4.5.2 Proposed Action Alternative

Proposed increases in munitions expenditures would occur at existing, established range sites conducting similar training, and these ranges have ongoing SOPs and best management practices to minimize impacts to water resources. Additional actions taken by the Navy subsequent to the initial Range Condition Assessment for the Pinecastle Range include the completion of an Operational Range Clearance Plan and an SEIS (see Section 1.6). Range condition assessments are required at least once every five years per the Navy’s Range Sustainability Environmental Program Assessment Policy.

Groundwater quality monitoring is conducted in accordance with the groundwater monitoring plan within the Pinecastle Range as a condition of the Special Use Permit. The results of groundwater monitoring since 2005 indicate that no off-range releases of munitions constituents have been observed.

Proposed training operations would not be expected to significantly increase compared with previous operations. As a result, the impacts of munitions constituents entering the natural environment under the Proposed Action would be minimal and consistent with prior environmental impacts.

No new activities are proposed for the off-range area encompassed by the gates used to secure the safety zone. Munitions would only be dropped during Navy training within the Pinecastle Range as is done under existing conditions. Consistent with current practices, in the unlikely event that a munition lands off-range, the Navy would immediately notify the USFS, initiate emergency response procedures to mitigate the hazard, and remove it from areas of public access. The Navy would coordinate with the USFS to ensure actions are conducted in as environmentally sound a manner as possible. Should a munition impact wetlands off-range, an interdisciplinary team of USFS and Navy subject matter experts would conduct an assessment to determine the best course of action to mitigate impacts.

It is anticipated that signal cartridges (visual cues) expended over Lake George Range would be consumed in the air and no material would be deposited in the water.

The Proposed Action Alternative does not involve construction or development in floodplains or wetlands. As a result, the Proposed Action would comply with EO 11988, *Floodplain Management*, which requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative. Also, the Proposed Action Alternative would comply with EO 11990, *Protection of Wetlands,* which requires federal agencies' policies to avoid, to the extent possible, long- and short-term adverse impacts associated with destruction and modification of wetlands and to avoid the direct and indirect support of new construction in wetlands whenever there is a practicable alternative.

In accordance with the CZMA, the Proposed Action has been evaluated for consistency with the enforceable policies of the Florida Coastal Management Act (see Appendix F), and the Navy sought concurrence with this consistency determination from the Florida State Clearinghouse in an email dated July 29, 2019. The Florida State Clearinghouse concurred with the Navy's determination in a response dated 26 September 2019. Copies of the correspondence are included in Appendix F.

Therefore, the Proposed Action Alternative would have no significant impacts to water resources.

4.6 Cultural Resources

Cultural Resources Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative:
  - No effects to archaeological resources
  - No impacts to historic architectural resources
  - No impacts to traditional cultural properties

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment that contribute to the importance of the resource, introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting), or neglecting the resource to the extent that it deteriorates or is destroyed. Indirect impacts primarily result from the effects that are farther removed from the immediate project area including visual, audible (noise), or atmospheric changes due to the project implementation.

4.6.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented, and the affected environment would remain unchanged. Existing Navy operations would continue throughout the area of potential effects along with established protocols to avoid, minimize, or reduce impacts to cultural resources. Prior evaluations and consultations for these undertakings, which are incorporated by reference, concluded that with implementation of SOPs for protection of cultural resources, there would be no adverse effect to historic properties. Therefore, there would be no adverse impacts to cultural resources at the PRC under the No Action Alternative.

4.6.2 Proposed Action Alternative

4.6.2.1 Archaeological Resources

Throughout much of the area of potential effects, the Navy has determined through survey and analysis that there is a low potential for occurrence of archaeological sites that are eligible for listing in the NRHP. Although there are four archaeological sites eligible for listing on the NRHP on Rodman Range, these sites are located outside of the existing target areas. While the number of operations would increase under the Proposed Action Alternative, no changes are planned for the target areas at the Rodman Range. Existing SOPs for protection of cultural resource sites within the area of potential effects would continue. If previously unidentified sites are discovered during training activities, *SOP 5*, *Inadvertent Discoveries*, in the NAS Jacksonville and Rodman Bombing Range ICRMP will be followed. If an inadvertent discovery is found, training activities will stop immediately, and the Natural and Cultural Resources Manger will be notified. A professional archaeologist who meets the Secretary of Interior Standards will be contracted to evaluate the resource and develop treatment measures that may be warranted in for consultation with the Florida SHPO (Department of the Navy 2010b). Additionally, in all cases within Ocala National Forest where there may be inadvertent discoveries, or damage to historic resources, the Forest Archaeologist would be informed, and all information gathered from investigations by contractors would be shared with the Forest Archaeologist.

Overall, implementation of the Proposed Action Alternative would result in no effects on archaeological resources under the NHPA. The Navy initiated NHPA Section 106 consultation with the Florida SHPO in a letter dated February 26, 2020 requesting concurrence with the finding of “no historic properties affected” with respect to both architectural and archaeological resources (Appendix E). The SHPO concurred in a letter dated June 17, 2020. Under NEPA, implementation of the Proposed Action Alternative would not result in impacts to archaeological resources.

4.6.2.2 Architectural Resources

None of the five architectural resources within the affected environment at Pinecastle Range have been evaluated for the NRHP. However, the levels of noise exposure associated with the Proposed Action will not negatively affect the physical integrity of the structures. Under the Proposed Action Alternative, these buildings would be exposed to slightly higher aviation noise levels (65 dB DNL under the Proposed Action as compared to <65 dB DNL the No Action Alternative) and similar levels of noise exposure from air-to-ground bombing (70 CDNL under both the Proposed Action and No Action Alternative).

At Rodman Range, none of the five architectural resources within the affected environment have been evaluated for the NRHP. However, similar to the Pinecastle Range, the levels of noise exposure associated with the Proposed Action will not negatively affect the physical integrity of the structures. The level of noise exposure to these buildings under the Proposed Action Alternative would be similar to noise levels under the No Action Alternative (65 dB DNL for aircraft noise, 57 CDNL for impact noise). Although the small arms fire at Rodman Range would introduce a new noise exposure (estimated at 104 dBPk), such noise would not be expected to affect the potential eligibility of the range buildings, as they have been exposed to noise from the other types of training that have been occurring at Rodman Range.

At Lake George Range, there are no architectural resources within the affected environment.

Overall, implementation of the Proposed Action Alternative would result in no adverse effects on historic architectural resources under the NHPA. The Navy initiated NHPA Section 106 consultation with the Florida SHPO in a letter dated February 26, 2020 requesting concurrence with the finding of “no historic properties affected" with respect to both architectural and archaeological resources (Appendix E). The SHPO concurred in a letter dated June 17, 2020. Under NEPA, implementation of the Proposed Action Alternative would not result in impacts to historic architectural resources.

4.6.2.3 Traditional Cultural Properties

There are no known traditional cultural properties at the PRC. The Navy consulted with the following federally recognized tribes: Miccosukee Tribe of Indians of Florida, Seminole Nation of Oklahoma, and Seminole Tribe of Florida in letters dated February 26, 2020 requesting concurrence with the Navy's finding of "no historic properties affected" and any comments or questions on the Proposed Action. The Seminole Nation of Oklahoma replied they had no objection to the Proposed Action and concurred with the Navy's finding in a letter dated March 11, 2020. Additionally, the Seminole Tribe of Florida responded they did not object in an email dated April 15, 2020. Tribal consultation documentation can be found in Appendix E. Therefore, the Proposed Action would have no impacts on traditional cultural properties in terms of both NHPA and NEPA.

4.7 Recreational and Socioeconomic Resources

Impacts to recreation are assessed in terms of anticipated levels of disruption or improvement of current levels of access to recreational areas. Impacts may arise from physical restriction of recreational areas and, as a result, stressors that would likely impact recreational interests are increases in aircraft operations and their associated increases in training operations and expended material, and thus, increases in military use of restricted areas for exclusive use of military training.

Recreational and Socioeconomic Resources Use Potential Impacts:

- No Action: Same as existing conditions.
- Proposed Action Alternative:
  - Lake George Range would have a larger area of noise exposure, lessening the quality of recreational opportunities on the lake.
  - Access to recreational opportunities would be similar to existing conditions.
  - Recreational companies using the Ocala National Forest would experience minimal change to current use of forest lands.

4.7.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not be implemented and there would be no change in access to existing recreational areas, or ability for outfitters and guiding companies to use the Ocala National Forest. The USFS would continue to manage the Ocala National Forest, and assist with controlling public access in the vicinity of the Pinecastle Range for some training events consistent with existing conditions (e.g., notifications on informational kiosks adjacent to trailheads noting the restricted areas).

4.7.2 Proposed Action Alternative

The PRC and adjacent lands define the study area for recreational and socioeconomic resources analyses. As discussed earlier, the Ocala National Forest is a highly utilized recreational resource, particularly for activities such as hiking, hunting, camping, accessing the Florida Trail, or OHV and guiding companies conducting trips in the forest. However, there are no specific user estimates for sections of the Florida Trail adjacent to the ranges. Additionally, there are no specific estimates for hunters using the area of the Ocala National Forest surrounding the Pinecastle Range; however, it is known to be heavily utilized for hunting activities and special group hunting events, specifically during the first two weeks of general gun season (November 14 to January 10). Currently, use of the Ocala National Forest by recreational companies is also not quantifiable. For context, it is important to note that the Pinecastle Range is the only portion of the PRC within the Ocala National Forest and comprises only 1.5 percent of the forest land. Thus, the vast majority of the Ocala National Forest recreational opportunities are currently not at all impacted by activities at the PRC. There would be no change to those restrictions and the remaining portions of the Ocala National Forest will continue to be available for recreational opportunities without impact from Navy training activities.

Under the Proposed Action Alternative, there would be an increase in aircraft operations and annual munitions expenditure; however, in general, training activities and use of the PRC would occur under the regular training schedule and operating hours of when the designated range is already open, and access is already restricted. Under existing permit conditions, recreational companies in the area are aware that the USFS periodically alerts them to gate closures of restricted areas during training activities at the Pinecastle Range, and thus events are to be cancelled within that timeframe. The Navy takes active measures to notify the USFS in advance of a closure. Gates are located at various access points adjacent to and outside of the approved 2017 RAICUZ Study RCZ-I boundary (see Figure 4.3-1). A set of inner and outer gates allows for partial access depending on the requirements of the military activity at the Pinecastle Range. While the inner gates are typically closed more often due to their closer proximity to the Pinecastle Range, recreational activities do not generally occur in that area to the extent the increased gate closures would be noticeable.

Hunters could potentially notice increased restricted access; however, hunting is not currently authorized on the Pinecastle Range, and signs are posted noting the restriction along the range boundary. OHV trail users would potentially notice minor increased restrictions to use from the larger "safety zone" activation (see Section 4.3.2); however, impacts are minimized through informational kiosks posted in the area that provide maps for OHV trail users of alternate OHV trail locations within 20 minutes of the Ocala National Forest. The nature of the guiding work requires extensive pre-planning to account for weather, logistics, skill levels etc., and potential access restrictions are part of the pre-planning process. Given that the increased activities at the range would be occurring within the existing training schedule, the impact to recreational companies would be minimal.

Effects to recreational experiences at the Ocala National Forest due to training range noise would remain at levels similar to existing conditions (see Section 3.1.6). Recreational users of Lake George would experience a larger area of exposure of 65 DNL as compared to baseline conditions (Figure 4.1-3). Noise exposure at both Pinecastle and Rodman Ranges is limited within the range boundaries. Although increased training operations could diminish the recreation experience for some users, existing users of the public recreational amenities in this area would be already acclimated to the noise and visual disturbance generated by overflying aircraft. Likewise, the in-air noise would be temporary, short in duration, and dissipate quickly once the training operation is completed.

4.8 Summary of Potential Impacts to Resources

A summary of the potential impacts associated with the Proposed Action and the No Action Alternative is presented in Table 4.8-1.

Table 4.8-1. Summary of Potential Impacts to Resource Areas

Resource Area	***No Action Alternative***	***Proposed Action Alternative***
Noise	No additional impacts to Noise	• No noise sensitive points of interest would be impacted. • Noise contours likely to cause annoyance would extend 2.5 miles beyond the Pinecastle Range boundary due to aircraft gunnery, 3 miles beyond the Lake George Range boundary due to aircraft patterns, and 4,000 feet beyond Rodman Range boundary due to ordnance.
Air Quality	No additional impacts to Air Quality	• Net increases in emissions for each criteria pollutant would not exceed 100 tons per year. • Proposed training activities would not contribute to GHG emissions to any discernible extent (approximate 0.1 percent increase in the ROI).
Airspace/Range Safety	No additional impacts to Airspace/Range Safety	• No change to existing airspace, RCZs, or range boundaries. • Existing safety measures would continue to be implemented.
Biological Resources	No additional impacts to Biological Resources	• May affect, but is not likely adversely affect the red-cockaded woodpecker, wood stork, West Indian manatee. USFWS issued a BO concurring with this determination. • May affect, likely to adversely affect the Florida scrub-jay, eastern indigo snake, gopher tortoise, sand skink, Florida bonamia, Lewton's polygala, scrub buckwheat. The USFWS issued a BO that the Proposed Action is not likely to jeopardize the continued existence of these species. The BO includes mandatory terms and conditions and monitoring and reporting requirements (Appendix D). • No effect to the species' critical habitat. • Wildlife are already habituated to the visual and audible disturbances in the ROI.
Water Resources	No additional impacts to Water Resources	• Ongoing SOPs and best management practices would minimize impacts to surface water and groundwater. • No impacts to floodplains or wetlands. • The Proposed Action is consistent with the CZMA.
Cultural Resources	No additional impacts to Cultural Resources	• No effects to historic properties (archaeological and architectural). • No impacts to traditional cultural properties.
Recreational and Socioeconomic Resources	No additional impacts to Recreational and Socioeconomic Resources	• Overall access to recreational opportunities would be similar to existing conditions. • Minimal impacts to recreational companies due to increasing activities at the PRC occurring within existing training timeframes. • Gate closures within the "safety zone" would cause minor impacts to hunters, OHV trail users, and other recreational users. • Lake George Range would have a larger area of noise exposure, lessening the quality of recreational opportunities directly on the lake.

Notes: ROI = Region of Influence; RCZ = Range Compatibility Zone; GHG = Greenhouse Gas; ESA = Endangered Species Act

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5 Cumulative Impacts

This section (1) defines cumulative impacts, (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts, (3) analyzes the incremental interaction the Proposed Action may have with other actions, and (4) evaluates cumulative impacts potentially resulting from these interactions.

5.1 Definition of Cumulative Impacts

The approach taken in the analysis of cumulative impacts follows the objectives of NEPA, CEQ regulations, and CEQ guidance. Cumulative impacts are defined in 40 CFR section 1508.7 as "the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

To determine the scope of environmental impact analyses, agencies shall consider cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact analysis document.

In addition, CEQ and USEPA have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ 2005) and Consideration of Cumulative Impacts in EPA Review of NEPA Documents (USEPA 1999). CEQ guidance entitled *Considering Cumulative Impacts Under NEPA* (1997) states that cumulative impact analyses should

"…determine the magnitude and significance of the environmental consequences of the Proposed Action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a Proposed Action and other actions expected to occur in a similar location or during a similar time period. Actions overlapping with or in close proximity to the Proposed Action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions.

- Does a relationship exist such that affected resource areas of the Proposed Action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the Proposed Action and another action could be expected to interact, would the Proposed Action affect or be affected by impacts of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the Proposed Action is considered alone?

5.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area will include those ROIs previously identified in Chapter 4 for the respective resource areas. The time frame for cumulative impacts centers on the timing of the Proposed Action.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the Proposed Action, the analysis employs the measure of “reasonably foreseeable” to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions include notices of intent for EISs and EAs, management plans, land use plans, and other planning related studies.

5.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects at and near the Proposed Action locale. In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable action. Specifically, using the first fundamental question included in Section 5.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action (included in this EA) might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ 2005), these actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making. Projects included in this cumulative impacts analysis are listed in Table 5.3-1 and briefly described in the following subsections.

Table 5.3-1. Cumulative Action Evaluation

Action	*Level of NEPA Analysis Completed*
Past Actions Incorporated by Reference (see Section 1.6)	
Renewal of Authorization to use Pinecastle Range, Ocala National Forest	EIS
Jacksonville Range Complex Training Operations	EIS/OEIS
Supplemental - Renewal of Authorization to use Pinecastle Range	SEIS
Addressing the Expansion of PRC Restricted Area	EA
Land and Resource Management Plan for National Forests in Florida (1999), as amended	EIS
Integrated Natural Resources Management Plan for NAS Jacksonville Complex	EA
Other Past Actions	
Beddown of 59 F-35 Aircraft at Eglin AFB, Florida	EIS/SEIS
Modernization and Expansion of Townsend Bombing Range, Georgia	EIS
Present and Reasonably Foreseeable Future Actions	
Ocala International Airport Operations	NA
Florida Gas Transmission Pipeline	NA

Table 5.3-1. Cumulative Action Evaluation

Action	Level of NEPA Analysis Completed
Florida Trail Improvements at the Ocala National Forest	DM
Land and Resource Management Plan for National Forests in Florida Update	EIS
Recreational Use of Ocala National Forest	NA
Ocala National Forest Timber Sales	NA
Biological Evaluation for the Central Scrub Project	NA

Legend: NA = Not Applicable; DM = Decision Memo

5.3.1 Past Actions

Prior NEPA analysis and other resource management planning for the ROI was incorporated by reference into this EA in Section 1.6. These past actions are formative and thus frequently referenced in the description of the affected environment (Chapter 3) and provide context for the resource impact analysis throughout the analysis of environmental consequences (Chapter 4).

Beddown of 59 F-35 Aircraft at Eglin AFB, Florida. A ROD was signed in February 2009, following the completion of an EIS. The ROD authorized the beddown and operations of up to 59 F-35 aircraft at Eglin AFB at the western end of the Florida panhandle. That ROD imposed minor limitations on operations at Eglin's North/South runway until an SEIS was completed to address further details. In addition to the main Eglin AFB, additional flight operations would be conducted at Duke and Choctaw auxiliary fields. The proposal supported the recommendation of the 2005 Base Realignment and Closure Commission to establish the F-35 Initial Joint Training Center at the installation. The SEIS addressed where the F-35 aircraft might ultimately beddown on the Eglin AFB installation, how they might be operated, and the degree to which other mitigation measures are possible. The ROD for the SEIS was signed June 26, 2014 (Department of the Air Force 2014). This action is relevant and considered ongoing in that Eglin AFB-based aircraft occasionally use the PRC for training.

Modernization and Expansion of Townsend Bombing Range, Georgia. An EIS was prepared for the modernization and expansion of the Townsend Bombing Range in McIntosh County, Georgia. The proposal called for the accommodation of non-explosive precision-guided munitions training with its associated larger land requirements for East Coast aviation units (to include F/A-18 and F-35 aircraft) to be able to train with precision-guided munitions, especially those based at Marine Corps Air Station Beaufort. To accomplish this, the Marine Corps proposed to acquire lands in the vicinity of Townsend Bombing Range to create new impact and target areas that allow for a greater variety of training activities. The ROD was signed January 31, 2014 and the actual expansion and land acquisition is currently underway (Department of the Navy 2014b). This action is relevant because the change in capabilities at Townsend Bombing Range has a regional impact on DoD range types and availability of training resources for all DoD users in the southeast.

5.3.2 Present and Reasonably Foreseeable Actions

Ocala International Airport Operations. Ocala International Airport primarily support general aviation activity. Annual operations are approximately 35 percent business related, 30 percent flight training, and 25 percent visiting aircraft. The remainder is commercial aviation as transient military operations by both helicopter and fixed-wing aircraft. The Airport Master Plan was last updated in 2014 (Ocala International Airport 2014). Since then, construction projects have begun at the Ocala International

Airport to include the new General Aviation Terminal and rehabilitation of Taxiway Alpha. The new 17,500 square foot General Aviation Terminal will include office space for the Airport's Fixed Base Operator Sheltair Aviation, Airport Administration, a restaurant, meeting space, car rental companies, as well as additional office space for future tenants. Construction on the new terminal is in progress and expected to open in summer 2019. The rehabilitation of Taxiway Alpha is expected to begin the end of 2019 and be completed sometime in 2020 (City of Ocala 2019). The 2014 Airport Master Plan Update for Ocala International Airport forecasts an average annual growth rate of 1.02 percent in airfield operations. It is anticipated that by 2032, the airport would be witnessing approximately 64,000 annual aircraft operations (Ocala International Airport 2014). This project is relevant because of geographic proximity to the ROI in terms of construction impacts to resources and operational impacts to airspace, noise, and air quality.

Florida Gas Transmission Pipeline. The Florida Gas Transmission (FGT) pipeline is an approximately 5,500-milelong pipeline that transports natural gas from Texas to Florida. The pipeline bisects the Ocala National Forest and its north-south portion is adjacent to Pinecastle Range's southwestern edge. The FGT pipeline extends from the town of Pittman northwest along the western boundary of Pinecastle Range and continues along NFS 09, passing to the west of Lake Kerr, and out of Marion County. FGT is owned by Florida Gas Transmission Company, LLC. The company transports natural gas to cogeneration facilities, electric utilities, municipal generators, independent power producers, and local distribution companies. Its principal supply sources are in Louisiana, Mississippi, and Texas. The FGT pipeline is the largest interstate natural gas pipeline system supplying the state, delivering more than 60 percent of the natural gas consumed in Florida. Of the 5,500 miles of pipeline, 3,700 are located in Florida (Department of the Navy 2017). The continued operation and maintenance of the FGT is relevant due to presence within the ROI, compatibility constraint for range operations, and emergency preparedness and response in the event of a breach in the pipeline system.

Florida Trail Improvements at the Ocala National Forest. The USFS proposed improvements to an 11-mile segment of the Florida Trail on the western side of the forest north of State Road 40 around Lake Charles in partnership with the Florida Trail Association. The purpose of this project is to manage this section of the Florida Trail consistently with direction from the National Trails System Act "to provide for the maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which such trails may pass" (16 U.S.C. 1242(a) (2)). Additionally, this project will serve the public by expanding recreational opportunities and increasing visitor safety on the Ocala National Forest consistent with the goals and objectives of the Forest Plan. The Western Corridor of the Florida National Trail runs through the wettest part of the Ocala National Forest. The 3,200 feet of puncheon (simple boardwalk) that allows hikers to follow the trail between State Route 40 and County Road 314 in Marion County was installed approximately 20 years ago and is in a state of disrepair that makes it unsafe and, in some locations, unusable by trail users. Hurricanes and other storm damage, and general exposure to the elements, have resulted in rotten and broken wood in most locations. All 17 of the existing puncheons need complete replacement. A Decision Memo authorizing the proposed improvements was signed December 11, 2018 (USDA 2018). As of April 2019, improvements to this segment of the Florida National Trail are ongoing. This action is relevant as it is within the ROI and has potential impacts to multiple resources.

Land and Resource Management Plan for National Forests in Florida Update. The Land and Resource Management Plan for National Forests in Florida, known as the Forest Plan, provides guidance for the overall management of the National Forests in Florida for 10 - 15 years. The Forest Plan is a framework for decision-making, not a list of specific projects. Land use determinations, management practices, goals, objectives, standards, and guidelines are elements of the Forest Plan's management directions. The Forest Plan also contains monitoring strategies to provide for an adaptive approach to management where adjustments can be made as we learn from implementing the Plan's direction. Forest Plans are designed to be modified when needed. Changes may be identified from a variety of sources such as annual monitoring and evaluation, changed environmental conditions, or social issues. When a potential change to the Land and Resource Management Plan is identified, it is analyzed to determine the potential effects on forest resources and public use (USDA 1999a). The Forest Plan was last comprehensively overhauled in 1999, and has since been amended 12 times, most recently in 2016. It is currently being updated by the USFS (USDA 2019). This action is relevant to multiple resources within the ROI as it potentially impacts future land use, resource management, and recreation/public/multiple use for Ocala National Forest.

Recreational Use of Ocala National Forest. Section 3.6 addresses recreational use within the ROI and trends/expectations regarding future use. Recreational use has the potential for additive/interactive impacts to for other resource areas in terms of sensitive noise receptors and recreation use impacts to natural resources.

Ocala National Forest Timber Sales. Timber harvest and silviculture operations are rotated around the Forest. In FY 2020 and 2021 cutting of timber occurred just west of the Pinecastle Range, so 1-5 years after the sale harvesting of these stands and prepping them to be reseeded occurs. Other actions like burning might occur more often. Once an area is harvested, the area will not be used for timber harvest or silviculture operations for 6 to 8 years. Impacts from training at the Pinecastle Range would be limited to just a few days and previously have been negligible (J. Nobles 2019).

Biological Evaluation for the Central Scrub Project. This Biological Evaluation considers the potential effects of the Central Scrub Project on sensitive wildlife species. The Biological Evaluation serves to ensure that USFS actions do not contribute to loss of viability or a trend towards Federal listing for any Sensitive species and provide a process and standard by which to ensure that sensitive species receive full consideration in the decision making process. The best available science on sensitive wildlife species was used to document this consideration of potential effects, including recent scientific literature, correspondence with knowledgeable individuals in scientific/land management professions, field surveys, and personal observation.

5.4 Cumulative Impact Analysis

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available, and a qualitative analysis was undertaken. In addition, where an analysis of potential environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA where possible. The analytical methodology presented in Chapter 4, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

5.4.1 Noise

5.4.1.1 Description of Geographic Study Area

The ROI for or the analysis of cumulative impacts to noise associated with the Proposed Action is the area underlying modeled noise contours ≥65 dB DNL from air operations and munitions expenditure at the PRC.

5.4.1.2 Relevant Past, Present, and Future Actions

The past actions listed in Table 5.3-1, as well as the Florida Trail Improvements at Ocala National Forest, FGT Pipeline, the Ocala International Airport operation, the Forest Plan Update as it relates to noise-generating actions (e.g., timber harvest) and noise sensitive use (e.g., recreational sites), and recreational use of Ocala National Forest present and future actions have been identified as having potential cumulative impacts to noise.

5.4.1.3 Cumulative Impact Analysis

The cumulative impact of past actions on noise are largely that noise levels within the ROI have included Navy training and operations for many years and frame the baseline for existing conditions and context for the analysis of potential impacts for the Proposed Action. Present cumulative actions that produce ground-based noise are widely dispersed and intermittent throughout the ROI. These include vehicle/equipment operation associated with recreation (including noise at recreational firing ranges), timber harvest, and resource management activities at Ocala National Forest as well as maintenance activities for the FGT Pipeline and Florida Trail improvement. Noise exposure associated with the Ocala International Airport airfield operations is localized to the airfield environment with the 65+ DNL noise contours extending a couple of miles north and south of the runway and approximately 0.5-mile east and west of the runway (Ocala International Airport 2014). Construction-related noise from airport improvement projects would be short-term and localized. Noise from PRC operations is predominant in terms of average annual noise levels and sound level exposure during noise-generating aircraft operations, aircraft gunnery, and small arms ground fire activities.

Although increases in recreational use levels could change the number and types of people exposed to noise levels associated with the Proposed Action, the projected noise contours at Pinecastle Range and Lake George would extend beyond their range boundaries, no noise sensitive points of interest would be impacted in these areas. Additionally, the areas are currently exposed to noise from aircraft operations and munitions expenditure and the changes to DNL and single event levels associated with the Proposed Action would not constitute a dramatic change to the intensity of noise in the local environment.

Overall, the incremental impact of additive/interactive noise impacts from other past, present, and future actions within the ROI would be transitory and an overall negligible contribution to the average noise level environment within the ROI.

5.4.2 Air Quality

5.4.2.1 Description of Geographic Study Area

The ROI consists of the Mobile (Alabama)-Pensacola-Panama City (Florida)-Southern Mississippi Interstate Air Quality Control Region.

5.4.2.2 Relevant Past, Present, and Future Actions

All actions listed in Table 5.3-1 have the potential to generate air emissions within the ROI and are, therefore, relevant for the analysis of potential cumulative impacts to air quality.

5.4.2.3 Cumulative Impact Analysis

Air emissions associated with most of the past, present, and reasonably foreseeable actions are generally minor mobile sources with some minor stationary uses. The one exception is air emissions from prescribed burns. Fire has far more effect on air quality than any other phenomenon that is apt to occur on the national forests in Florida. Prescribed fire is a means for both forestry management and to reduce smoke-related visibility and other non-air quality related hazards. Prescribed burns result in smoke emissions to be spread out on a planned basis rather than the potentially higher emissions producing wildland fire events. Fires primarily result in particulate matter and carbon monoxide emissions. The USFS estimates that statewide, for most years, prescribed burning would result in 6,000-9,000 tons of PM_{10} and 45,000-65,000 tons of CO emissions per year and would not cause violation of any current Federal air quality standard (USDA 1999b).

Overall, the cumulative air quality impact in terms of aircraft or munition emissions in combination with the past, present, and future actions within the affected counties would be a minor incremental increase above existing air emission levels. Existing operational protocols deconflict prescribed burning with military training operations and reduce the potential that emissions from both activities would be occurring at high levels on a concurrent basis. The degree of additive impact resulting from the Proposed Action is considered to be low and would not appreciably impact the trend in the air quality within the ROI over time.

5.4.3 Airspace/Range Safety

5.4.3.1 Description of Geographic Study Area

For the purposes of cumulative impacts analysis, the ROI for airspace/range safety encompasses the PRC boundary and associated airspace.

5.4.3.2 Relevant Past, Present, and Future Actions

All of the past, present, and future actions listed in Table 5.3-1 have the potential for cumulative impacts to airspace and/or range safety as all are relevant to ongoing Navy efforts to minimize existing, emerging, and potential land and airspace use management and compatibility/constraints for operational and training capabilities.

5.4.3.3 Cumulative Impact Analysis

Ocala International Airport is the nearest international airport to the ROI, but there are about 75 private and public airports and heliports within 30 nautical miles from the edge of the ROI. All of these airports have aircraft flying through the ROI; although they might not fly through the MOA. Some of these flights are with general aviation aircraft; some are with commercial aircraft, and some with military aircraft. Short-term, localized impacts include ongoing aircraft flights in the ROI using the same airspace-control procedures as are currently implemented. The projected increase in operations at Ocala International Airport would have negligible additive impacts. The increase in air operations associated with the Proposed Action has the potential long-term cumulative impacts with the respect for an increased demand on airspace, a finite resource. Participating and commercial aircraft operations would not change as a result of the implementation of the Proposed Action.

The Forest Plan Update has the potential for beneficial, long-term interactive and countervailing impacts as the USFS ensures that planning for ongoing and co-use of the Ocala National Forest is further coordinated with the Navy. This is expected to include continued management of public and agency concerns regarding Navy/DoD activities within the Ocala National Forest and Forest Plan goals, objectives, and actions related to timber, recreation, and cooperative relationships with other jurisdictional governments.

Maintenance activities of the FGT pipeline, depending on what they involve, can require deconfliction to ensure that some operations at Pinecastle Range are not concurrent with FGT pipeline maintenance. As the pipeline infrastructure continues to age, it is reasonably foreseeable that maintenance requirements may increase, resulting in increased time and frequency for maintenance activities that disrupt use of the range and existing safety measures (Department of the Navy 2017b).

Increased training operations present an incremental risk for wildfire. Fire suppression would continue to be managed by the USFS. There is a potential cumulative impact safety risk associated with wildfire, the use of heavy equipment (e.g., bulldozers) for fire control, and the vulnerability of the FGT pipeline to damage if heavy equipment drive over it as it is buried in relatively shallow sand. Taken in combination, there is cumulative increased risk of fire hazard to personnel and equipment. The incremental contribution associated with increased training operations associated with the Proposed Action to this risk is minimal. Additionally, the Navy, USFS, and FGT are coordinating regarding these known risks and management measures that can be taken to reduce them.

Therefore, overall implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would result in only minor cumulative airspace and/or range safety impacts within the ROI.

5.4.4 Biological Resources

5.4.4.1 Description of Geographic Study Area

The ROI for cumulative impacts associated with biological resources includes the PRC and Ocala National Forest.

5.4.4.2 Relevant Past, Present, and Future Actions

The projects listed in Table 5.3-1 are relevant since those projects have the potential to impact surface waters, terrestrial vegetation and wildlife, and/or produce noise. The more relevant actions are those that have the potential occur in a similar location or during a similar time period and therefore relate to natural resource and land use activities occurring nearest the existing/proposed aviation and ground operations at Pinecastle Range, Rodman Range, Lake George Range and in the present and reasonably foreseeable timeframe.

5.4.4.3 Cumulative Impact Analysis

Relevant cumulative actions would have the potential for mixed impacts to biological resources. The actions resulting in land disturbance and vegetation/habitat impacts and/or increased human activity and noise levels will have additive incremental impacts to include localized loss of native plant communities and reduction in habitat quality. However, the land management actions of the Navy's

Integrated Natural Resource Management Plan and the USFS Forest Plan would have countervailing beneficial impacts to vegetation, wildlife, special-status species (including those listed as RFSS), and wetlands. Overall, the additive impacts would not be expected to result in large-scale fragmentation of remaining natural habitats or the permanent loss of contiguous (interconnecting) native habitats such as migration or movement corridors.

As discussed in Section 4.4.2, implementation of BMPs would ensure the Proposed Action contributes minimally to adverse effects on biological resources. Similarly, the spatial and temporal extents of impacts on biological resources from other cumulative projects are expected to be limited due to implementation of BMPs, conservation measures, and any other permit conditions. As a result, the Proposed Action Alternative, combined with other cumulative projects, would result in only minor cumulative impacts on biological resources.

Additionally, in their Biological Evaluation noted in Table 5.3-1, the USFS evaluated land management activities such as timber management, road maintenance and prescribed burning and found those actions, when considered with past, present, and reasonably foreseeable future land management, would provide a beneficial impact to RFSS-listed species. The USFS determined their proposed action may impact individuals but would not be likely to result in a trend towards federal listing or loss of viability for species on the RFSS list. The actions evaluated in the USFS Biological Evaluation have similar stressors to the biological resources as the Navy's Proposed Action and therefore, similar cumulative impacts would be expected.

5.4.5 Water Resources

5.4.5.1 Description of Geographic Study Area

The ROI for cumulative impacts for water resources is the PRC and adjacent lands.

5.4.5.2 Relevant Past, Present, and Future Actions

The past actions listed in Table 5.3-1 are relevant in that they have the potential to impact water resources. The more relevant actions are those that have the potential occur in a similar location and therefore relate to natural resource and land use activities occurring nearest the existing/proposed aviation and ground military activities at Pinecastle Range, Rodman Range, Lake George Range and in the present and reasonably foreseeable timeframe.

5.4.5.3 Cumulative Impact Analysis

As discussed in Section 4.4.5, continued range management through implementation of SOPs, best management practices, and range clearance would ensure the Proposed Action contributes negligible impacts to water resources. Other cumulative actions would similarly implement measures to reduce impacts to water resources and be in compliance with all applicable regulations. As a result, the Proposed Action Alternative, combined with other cumulative projects, would result in only minor cumulative impacts on water resources.

5.4.6 Cultural Resources

Although potential impacts of the Proposed Action to cultural resources is evaluated in Section 4.5, the conclusion of impact is no effect/no adverse effect to cultural resources due to lack of presence/low potential presence and existing management protocols to address inadvertent discovery of cultural resources. Based on this assessment, no relationship could be established between the potential cultural resource effects of the Proposed Action and additive/interactive/countervailing impacts of past, present, or reasonably foreseeable actions. Therefore, implementation of the Proposed Action would not result in cumulative impacts to cultural resources within the ROI.

5.4.7 Recreational and Socioeconomic Resources

5.4.7.1 Description of Geographic Study Area

The ROI for cumulative impacts for recreation resources is the PRC and adjacent lands.

5.4.7.2 Relevant Past, Present, and Future Actions

The past actions listed in Table 5.3-1 are relevant in that they have had an impact on recreational use of Ocala National Forest and deconfliction of recreational use with PRC operations and training have been identified as having potential cumulative impacts to recreational resources. The present/reasonably foreseeable actions for the Florida Trail Improvements, Forest Plan Update, Timber Sale in and recreational use of Ocala National Forest also are highly relevant to the assessment of cumulative impacts to recreational and socioeconomic resources.

5.4.7.3 Cumulative Impact Analysis

Cumulative impacts to recreational and socioeconomic resources from past, present, and future actions within the ROI would be negligible because the impacts of the Proposed Action Alternative would be negligible as described in Section 4.7.2. Minor increase in noise and visual disturbance is not expected to be noticeable to users. While demand on recreational resources is expected to rise as noted in the Recreation Plan, there is the potential for long-term beneficial impacts from the Forest Plan update and the Florida Trail improvements. These actions improve access to and quality of recreational opportunities at the Ocala National Forest surrounding the PRC. Timber sales and silviculture operations throughout the Ocala National Forest are ongoing and have historically not been impacted by activities at the Pinecastle Range. Potential cumulative impacts to the timber sales could include decreased access to harvesting areas due to the possible increase in gate closures. The Navy would ensure the USFS is alerted to potential increases to the training operations that would result in noticeable changes in access to the harvesting areas. At this time, no noticeable increases in military activities are planned that would affect the timber sales at the Ocala National Forest.

Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects, would result in only negligible cumulative recreational and socioeconomic resource impacts within the ROI.

6 Other Considerations Required by NEPA

6.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 CFR section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state and local land use plans, policies, and controls. Table 6.1-1 identifies the principal federal and state laws and regulations that are applicable to the Proposed Action, and describes briefly how compliance with these laws and regulations would be accomplished.

Table 6.1-1. Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	***Status of Compliance***
NEPA; CEQ NEPA implementing regulations; Navy procedures for Implementing NEPA	This EA has been prepared in accordance with the CEQ regulations implementing NEPA, and Navy NEPA procedures. Appropriate public participation and review are being conducted in compliance with NEPA.
Clean Air Act	The applicable regulatory setting and impact analysis is discussed in Sections 3.2 and 4.2. The air quality analysis concludes that under the Proposed Action, emissions would not create a major regional source of air pollutants or affect the current attainment status at the PRC in Florida, and would comply with all applicable state and regional air agency rules and regulations.
Clean Water Act	Ongoing SOPs and best management practices would minimize impacts to surface water and groundwater from the Proposed Action. There would be no impacts to floodplains or wetlands.
Coastal Zone Management Act	The Navy has determined the Proposed Action would be consistent, to the maximum extent practicable, with the enforceable policies of the Florida Coastal Management Program.
National Historic Preservation Act	The Navy has concluded there would be no adverse effects to NRHP-listed or eligible cultural resources. Florida SHPO concurred in a letter dated June 17, 2020.
Endangered Species Act	May affect, but is not likely to adversely affect the red-cockaded woodpecker, wood stork, and West Indian manatee. The USFWS concurred with these determinations in a BO dated November 10, 2020. May affect, likely to adversely affect Florida scrub-jay, Eastern indigo snake, gopher tortoise, Florida bonamia, Lewton's polygala, and scrub buckwheat. No destruction or adverse modification to federally listed species' habitats, including critical habitat for the West Indian manatee, the only critical habitat in the ROI. On November 10, 2020, the USFWS issued a BO, with terms and conditions, that the Proposed Action is not likely to jeopardize the continued existence of these species.
Marine Mammal Protection Act	The West Indian manatee is protected under the ESA and MMPA; and the USFWS has primary management responsibility for management of the species under the ESA and MMPA. The Proposed Action would not result in the reasonably foreseeable take of a marine mammal species by harassment, injury, or mortality as defined under the MMPA.

Table 6.1-1. Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	*Status of Compliance*
Migratory Bird Treaty Act and Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds	As a military readiness activity, the Proposed Action is exempt from the take prohibitions of the MBTA, provided they would not result in a significant adverse effect on a population of migratory bird species. Migratory bird populations would not be significantly impacted from the proposed increases in training operations or related noise.
Bald and Golden Eagle Protection	No takes to bald and golden eagles under the Proposed Action; no permit is required under the Bald and Golden Eagle Protection Act.
Emergency Planning and Community Right-to-Know Act	The reporting of lead, aluminum, and any other chemicals exceeding thresholds emissions to the Toxics Release Inventory would continue to occur under EPCRA.
Resource Conservation and Recovery Act	The Proposed Action would not result in hazardous waste related impacts. Management protocols for hazardous substances would follow existing regulations and procedures.
Executive Order 11988, Floodplain Management	The Proposed Action does not involve construction or development in floodplains or wetlands and would comply with EO 11988, Floodplain Management, which requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development unless it is the only practicable alternative.
Executive Order 12088, Federal Compliance with Pollution Control Standards	The Navy would comply with environmental laws and fully cooperate with U.S. Environmental Protection Agency, state, interstate, and local agencies to prevent, control, and abate environmental pollution.
Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	The Navy has determined that the Proposed Action will not cause disproportionately high and adverse health or environmental effects on any minority or low-income populations.
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	The Navy concluded that the Proposed Action would not result in environmental health risks or safety risks that may disproportionately affect children.
Executive Order 13175, Consultation and Coordination with Indian Tribal Governments	No Tribe(s) with Usual and Accustomed grounds and stations have been identified at the PRC. The Navy consulted with federally recognized tribes: Miccosukee Tribe of Indians of Florida, Seminole Nation of Oklahoma, and Seminole Tribe of Florida (Appendix E). The tribes had no objections to the Proposed Action.
Executive Order 13834, Efficient Federal Operations	The Navy would implement environmental management systems to ensure integrated, continuously improving, efficient, and sustainable practices in federal facility operation.

6.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Implementation of the Proposed Action would involve human labor and the consumption of fuel, oil, and lubricants for aircraft. Implementing the Proposed Action would not result in significant irreversible or irretrievable commitment of resources.

6.3 Unavoidable Adverse Impacts

This EA has determined that the alternatives considered would not result in any significant unavoidable adverse impacts.

6.4 Relationship between Short-Term Use of the Environmental and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

As discussed in Chapters 4 and 5, environmental consequences for the Proposed Action would result in both short- and long-term environmental effects. However, implementation of the Proposed Action is not expected to result in the types of impacts that would significantly reduce environmental productivity, affect biodiversity, or permanently narrow the range of potential long-term beneficial uses of the environment.

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APPENDIX A
DISCUSSION OF NOISE AND ITS EFFECT ON THE ENVIRONMENT

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APPENDIX A — Discussion of Noise and Its Effect on the Environment

FINAL

WR 13-11
January 2014

APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE, SLEEP DISTURBANCE, HEARING IMPAIRMENT, HEALTH EFFECTS, APPENDIX A, NOISE EFECTS, SOUND LEVELS, SUPPLEMENTAL METRICS, ENVIRONMENT, HUMANS, ANNOYANCE, SPEECH INTEFERENCE,

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Section A.3.13, *Effects on Domestic Animals and Wildlife*, was prepared by team members over the course of several environmental analysis projects. It is included here for completeness. Wyle does not take credit for its content.

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Table of Contents

Sections

Figures

Tables

Acronyms & Abbreviations

ID	Definition
AAD	Annual Average Daily
AGL	Above Ground Level
ANSI	American National Standards Institute
ASHLA	American Speech-Language-Hearing Association
CHABA	Committee on Hearing, Bioacousitcis, and Biomechanics
CNEL	Community Noise Equivalent Level
$CNEL_{mr}$	Onset-Rate Adjusted Monthly Community Noise Equivalent Level
dB	Decibel
dBA	A-Weighted Decibels
dB(A)	A-Weighted Decibels
DLR	German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt e.V.)
DNL	Day-Night Average Sound Level
DOD	Department of Defense
FAA	Federal Aviation Administration (US)
FICAN	Federal Interagency Committee on Aviation Noise
FICON	Federal Interagency Committee on Noise
HA	Highly Annoyed
HYENA	Hypertension and Exposure to Noise near Airports
Hz	Hertz
ISO	International Organization for Standardization
L	Sound Level
L_{dn}	Day-Night Average Sound Level
L_{dnmr}	Onset-Rate Adjusted Monthly Day-Night Average Sound Level
L_{eq}	Equivalent Sound Level
$L_{eq(16)}$	Equivalent Sound Level over 16 hours
$L_{eq(24)}$	Equivalent Sound Level over 24 hours
$L_{eq(30min)}$	Equivalent Sound Level over 30 minutes
$L_{eq(8)}$	Equivalent Sound Level over 8 hours
$L_{eq(h)}$	Hourly Equivalent Sound Level
L_{max}	Maximum Sound Level
L_{pk}	Peak Sound Level

(Continued on next page)

ID	Definition
m	meter (distance unit)
mmHg	millimeters of mercury
MOA	Military Operations Area
MTR	Military Training Route
NA	Number of Events At or Above a Selected Threshold
NATO	North Atlantic Treaty Organization
NDI	Noise Depreciation Index
NIPTS	Noise-induced Permanent Threshold Shift
NSDI	Noise Sensitivity Depreciation Index
OR	Odd Ratio
POI	Point of Interest
PTS	Permanent Threshold Shift
RANCH	Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health
SEL	Sound Exposure Level
SIL	Speech Interference Level
SUA	Special Use Airspace
TA	Time Above
TTS	Temporary Threshold Shift
U.S.	United States
UKDfES	United Kingdom Department for Education and Skills
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WHO	World Health Organization

Appendix A

This appendix discusses sound and noise and their potential effects on the human and natural environment. Section A.1 provides an overview of the basics of sound and noise. Section A.2 defines and describes the different metrics used to describe noise. The largest section, Section A.3, reviews the potential effects of noise, focusing on effects on humans but also addressing effects on property values, terrain, structures, and animals. Section A.4 contains the list of references cited.

A.1 Basics of Sound

Section A.1.1 describes sound waves and decibels. Section A.1.2 review sounds levels and types of sounds.

A.1.1 Sound Waves and Decibels

Sound consists of minute vibrations in the air that travel through the air and are sensed by the human ear. Figure A-1 is a sketch of sound waves from a tuning fork. The waves move outward as a series of crests where the air is compressed and troughs where the air is expanded. The height of the crests and the depth of the troughs are the amplitude or sound pressure of the wave. The pressure determines its energy or intensity. The number of crests or troughs that pass a given point each second is called the frequency of the sound wave.

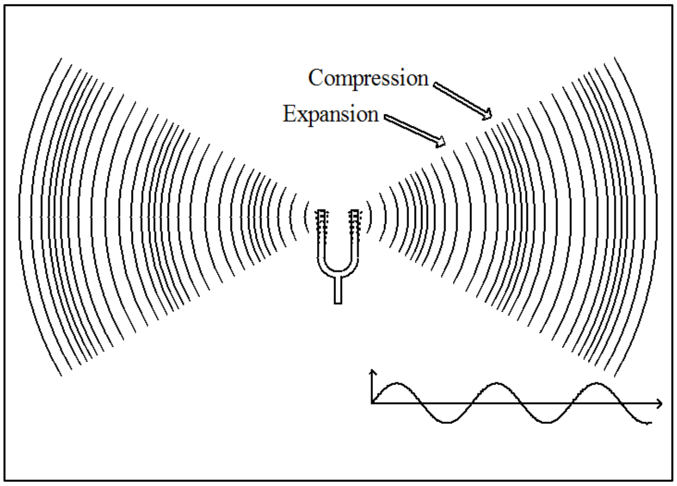


Figure A-1. Sound Waves from a Vibrating Tuning Fork

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration.

- Intensity is a measure of the acoustic energy of the sound and is related to sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound.
- Frequency determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.
- Duration or the length of time the sound can be detected.

As shown in Figure A-1, the sound from a tuning fork spreads out uniformly as it travels from the source. The spreading causes the sound's intensity to decrease with increasing distance from the source. For a source such as an aircraft in flight, the sound level will decrease by about 6 dB for every doubling of the distance. For a busy highway, the sound level will decrease by 3-4.5 dB for every doubling of distance.

As sound travels from the source it also gets absorbed by the air. The amount of absorption depends on the frequency composition of the sound, the temperature, and the humidity conditions. Sound with high frequency content gets absorbed by the air more than sound with low frequency content. More sound is absorbed in colder and drier conditions than in hot and wet conditions. Sound is also affected by wind and temperature gradients, terrain (elevation and ground cover) and structures.

The loudest sounds that can be comfortably heard by the human ear have intensities a trillion times higher than those of sounds barely heard. Because of this vast range, it is unwieldy to use a linear scale to represent the intensity of sound. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent the intensity of a sound. Such a representation is called a sound level. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot simply be added or subtracted and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

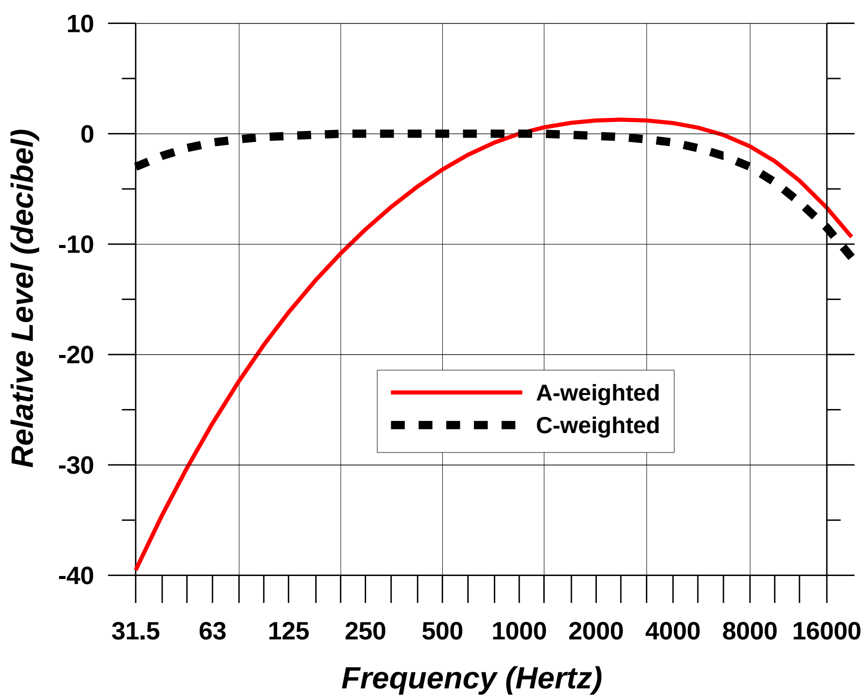
Because the addition of sound levels is different than that of ordinary numbers, this process is often referred to as "decibel addition."

The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness. This relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because the human ear does not respond linearly.

Sound frequency is measured in terms of cycles per second or hertz (Hz). The normal ear of a young person can detect sounds that range in frequency from about 20 Hz to 20,000 Hz. As we get older, we lose the ability to hear high frequency sounds. Not all sounds in this wide range of frequencies are heard equally. Human hearing is most sensitive to frequencies in the 1,000 to 4,000 Hz range. The notes on a piano range from just over 27 Hz to 4,186 Hz, with middle C equal to 261.6 Hz. Most sounds (including a single note on a piano) are not simple pure tones like the tuning fork in Figure A-1, but contain a mix, or spectrum, of many frequencies.

Sounds with different spectra are perceived differently even if the sound levels are the same. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. These two curves, shown in Figure A-2, are adequate to quantify most environmental noises. A-weighting puts emphasis on the 1,000 to 4,000 Hz range.

Very loud or impulsive sounds, such as explosions or sonic booms, can sometimes be felt, and can cause secondary effects, such as shaking of a structure or rattling of windows. These types of sounds can add to annoyance, and are best measured by C-weighted sound levels, denoted dBC. C-weighting is nearly flat throughout the audible frequency range, and includes low frequencies that may not be heard but cause shaking or rattling. C-weighting approximates the human ear's sensitivity to higher intensity sounds.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

Figure A-2. Frequency Characteristics of A- and C-Weighting

A.1.2 Sound Levels and Types of Sounds

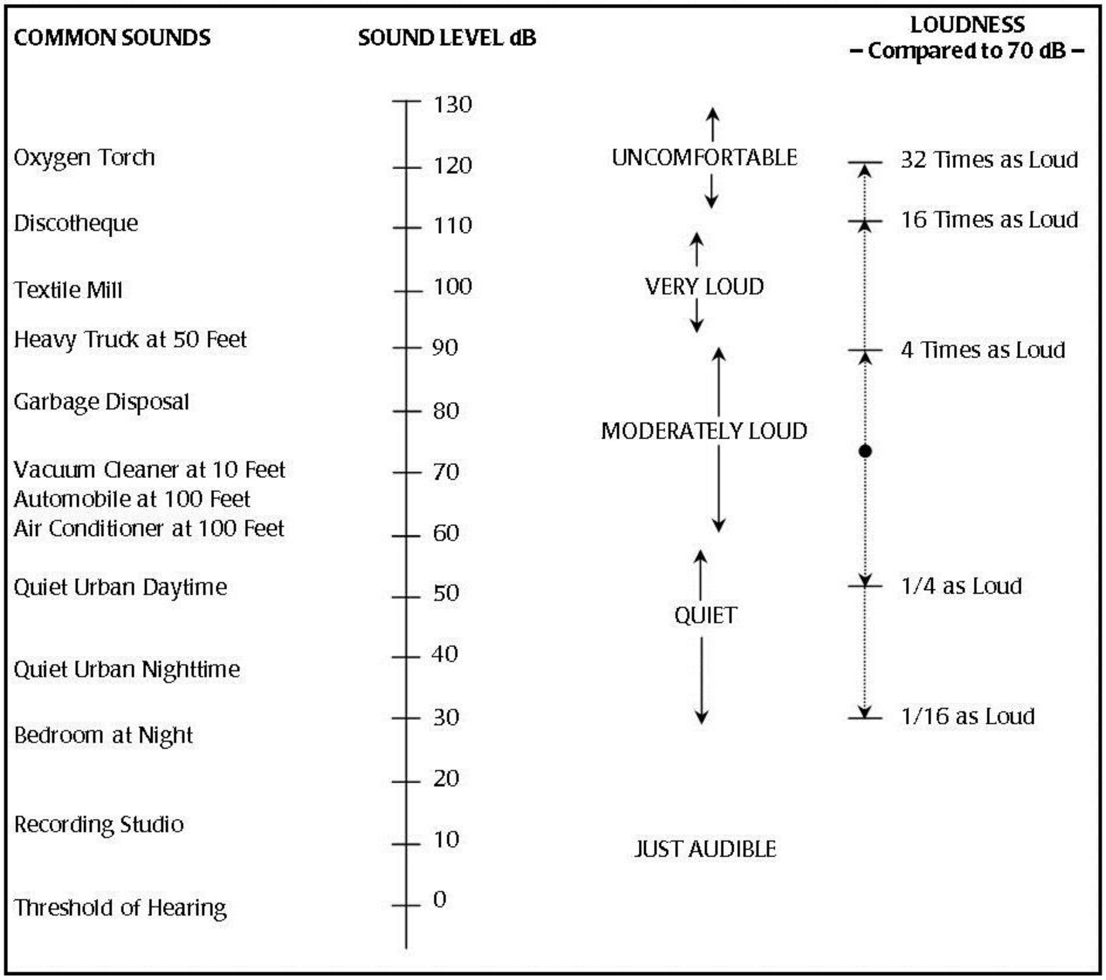
Most environmental sounds are measured using A-weighting. They're called A-weighted sound levels, and sometimes use the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the term "A-weighted" is often omitted and the unit dB is used. Unless otherwise stated, dB units refer to A-weighted sound levels.

Sound becomes noise when it is unwelcome and interferes with normal activities, such as sleep or conversation. Noise is unwanted sound. Noise can become an issue when its level exceeds the ambient or background sound level. Ambient noise in urban areas typically varies from 60 to 70 dB, but can be as high as 80 dB in the center of a large city. Quiet suburban neighborhoods experience ambient noise levels around 45-50 dB (U.S. Environmental Protection Agency (USEPA) 1978).

Figure A-3 is a chart of A-weighted sound levels from common sources. Some sources, like the air conditioner and vacuum cleaner, are continuous sounds whose levels are constant for some time. Some sources, like the automobile and heavy truck, are the maximum sound during an intermittent event like a vehicle pass-by. Some sources like "urban daytime" and "urban nighttime" are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods. These are discussed in detail in Section A.2.

Aircraft noise consists of two major types of sound events: flight (including takeoffs, landings and flyovers), and stationary, such as engine maintenance run-ups. The former are intermittent and the latter primarily continuous. Noise from aircraft overflights typically occurs beneath main approach and departure paths, in local air traffic patterns around the airfield, and in areas near aircraft parking ramps and staging areas. As aircraft climb, the noise received on the ground drops to lower levels, eventually fading into the background or ambient levels.

Impulsive noises are generally short, loud events. Their single-event duration is usually less than 1 second. Examples of impulsive noises are small-arms gunfire, hammering, pile driving, metal impacts during rail-yard shunting operations, and riveting. Examples of high-energy impulsive sounds are quarry/mining explosions, sonic booms, demolition, and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams (American National Standards Institute [ANSI] 1996).

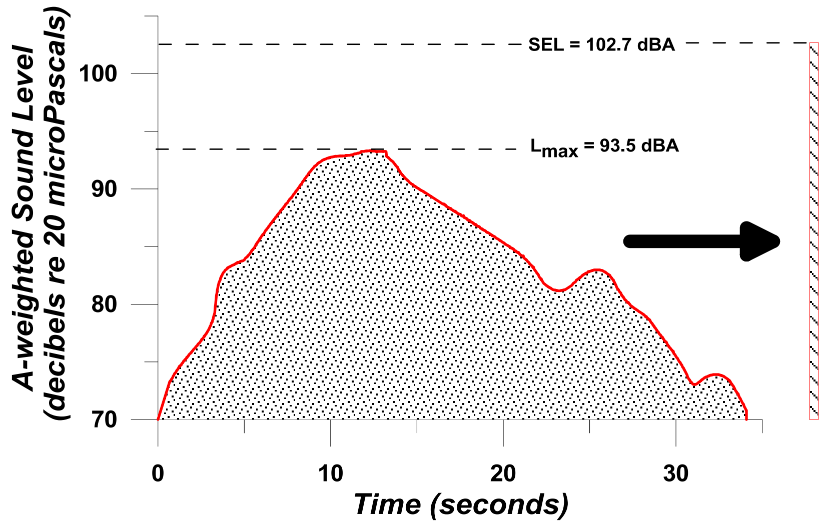


Sources: Harris 1979; Federal Interagency Committee on Aviation Noise (FICAN) 1997.

Figure A-3. Typical A-weighted Sound Levels of Common Sounds

A.2 Noise Metrics

Noise metrics quantify sounds so they can be compared with each other, and with their effects, in a standard way. The simplest metric is the A-weighted level, which is appropriate by itself for constant noise such as an air conditioner. Aircraft noise varies with time. During an aircraft overflight, noise starts at the background level, rises to a maximum level as the aircraft flies close to the observer, then returns to the background as the aircraft recedes into the distance. This is sketched in Figure A-4, which also indicates two metrics (L_{max} and SEL) that are described in Sections A.2.1 and A.2.3 below. Over time there can be a number of events, not all the same.



Source: Wyle Laboratories

Figure A-4. Example Time History of Aircraft Noise Flyover

There are a number of metrics that can be used to describe a range of situations, from a particular individual event to the cumulative effect of all noise events over a long time. This section describes the metrics relevant to environmental noise analysis.

A.2.1 Single-events

Maximum Sound Level (L_{max})

The highest A-weighted sound level measured during a single event in which the sound changes with time is called the maximum A-weighted sound level or Maximum Sound Level and is abbreviated L_{max}. The L_{max} is depicted for a sample event in Figure A-4.

L_{max} is the maximum level that occurs over a fraction of a second. For aircraft noise, the "fraction of a second" is one-eighth of a second, denoted as "fast" response on a sound level measuring meter (ANSI 1988). Slowly varying or steady sounds are generally measured over 1 second, denoted "slow" response. L_{max} is important in judging if a noise event will interfere with conversation, TV or radio listening, or other common activities. Although it provides some measure of the event, it does not fully describe the noise, because it does not account for how long the sound is heard.

Peak Sound Pressure Level (L_{pk})

The Peak Sound Pressure Level is the highest instantaneous level measured by a sound level measurement meter. L_{pk} is typically measured every 20 microseconds, and usually based on unweighted or linear response of the meter. It is used to describe individual impulsive events such as blast noise. Because blast noise varies from shot to shot and varies with meteorological (weather) conditions, the U.S. Department of Defense (DOD) usually characterizes L_{pk} by the metric PK 15(met), which is the L_{pk} exceeded 15% of the time. The "met" notation refers to the metric accounting for varied meteorological or weather conditions.

Sound Exposure Level (SEL)

Sound Exposure Level combines both the intensity of a sound and its duration. For an aircraft flyover, SEL includes the maximum and all lower noise levels produced as part of the overflight, together with how long each part lasts. It represents the total sound energy in the event. Figure A-4 indicates the SEL for an example event, representing it as if all the sound energy were contained within 1 second.

Because aircraft noise events last more than a few seconds, the SEL value is larger than L_{max}. It does not directly represent the sound level heard at any given time, but rather the entire event. SEL provides a much better measure of aircraft flyover noise exposure than L_{max} alone.

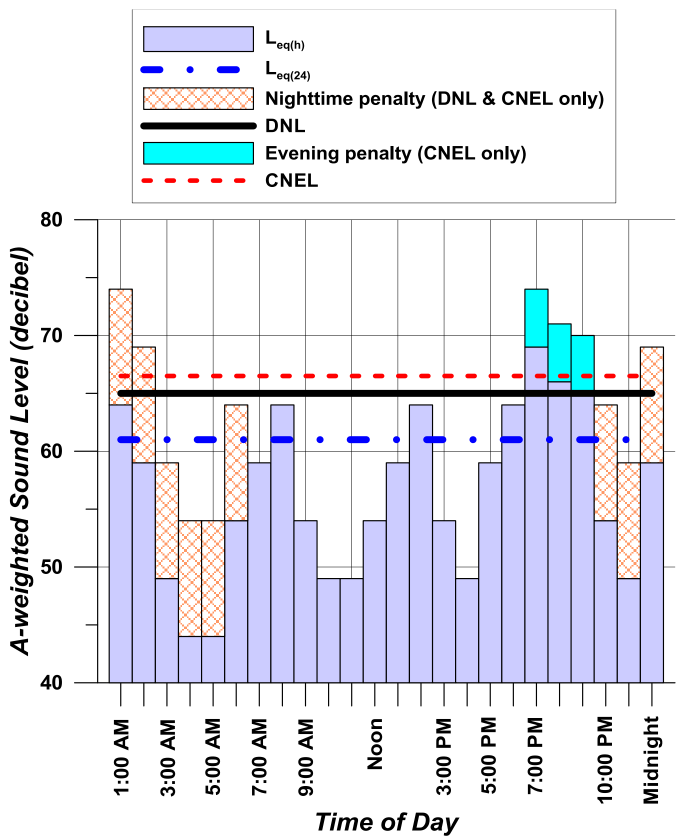
A.2.2 Cumulative Events

Equivalent Sound Level (L_{eq})

Equivalent Sound Level is a "cumulative" metric that combines a series of noise events over a period of time. L_{eq} is the sound level that represents the decibel average SEL of all sounds in the time period. Just as SEL has proven to be a good measure of a single event, L_{eq} has proven to be a good measure of series of events during a given time period.

The time period of an L_{eq} measurement is usually related to some activity, and is given along with the value. The time period is often shown in parenthesis (e.g., $L_{eq(24)}$ for 24 hours). The L_{eq} from 7 a.m. to 3 p.m. may give exposure of noise for a school day.

Figure A-5 gives an example of $L_{eq(24)}$ using notional hourly average noise levels ($L_{eq(h)}$) for each hour of the day as an example. The $L_{eq(24)}$ for this example is 61 dB.



Source: Wyle Laboratories

Figure A-5. Example of $L_{eq(24)}$, DNL and CNEL Computed from Hourly Equivalent Sound Levels

Day-Night Average Sound Level (DNL or L_{dn}) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level is a cumulative metric that accounts for all noise events in a 24-hour period. However, unlike $L_{eq(24)}$, DNL contains a nighttime noise penalty. To account for our increased sensitivity to noise at night, DNL applies a 10 dB penalty to events during the nighttime period, defined as 10:00 p.m. to 7:00 a.m. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent.

CNEL is a variation of DNL specified by law in California (California Code of Regulations Title 21, *Public Works*) (Wyle Laboratories 1970). CNEL has the 10 dB nighttime penalty for events between 10:00 p.m. and 7:00 a.m. but also includes a 4.8 dB penalty for events during the evening period of 7:00 p.m. to 10:00 p.m. The evening penalty in CNEL accounts for the added intrusiveness of sounds during that period.

For airports and military airfields, DNL and CNEL represent the average sound level for annual average daily aircraft events.

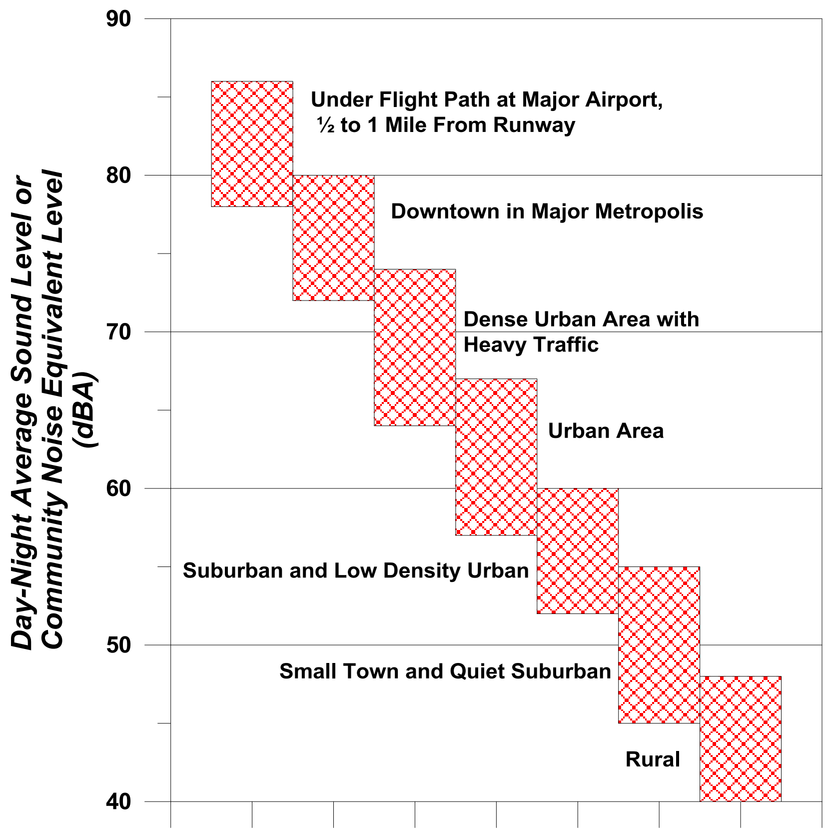
Figure A-5 gives an example of DNL and CNEL using notional hourly average noise levels ($L_{eq(h)}$) for each hour of the day as an example. Note the $L_{eq(h)}$ for the hours between 10 p.m. and 7 a.m. have a 10 dB penalty assigned. For CNEL the hours between 7p.m. and 10 p.m. have a 4.8 dB penalty assigned. The DNL for this example is 65 dB. The CNEL for this example is 66 dB.

Figure A-6 shows the ranges of DNL or CNEL that occur in various types of communities. Under a flight path at a major airport the DNL may exceed 80 dB, while rural areas may experience DNL less than 45 dB.

The decibel summation nature of these metrics causes the noise levels of the loudest events to control the 24-hour average. As a simple example, consider a case in which only one aircraft overflight occurs during the daytime over a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The DNL for this 24-hour period is 65.9 dB. Assume, as a second example that 10 such 30-second overflights occur during daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The DNL for this 24-hour period is 75.5 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events.

A feature of the DNL metric is that a given DNL value could result from a very few noisy events or a large number of quieter events. For example, 1 overflight at 90 dB creates the same DNL as 10 overflights at 80 dB.

DNL or CNEL do not represent a level heard at any given time, but represent long term exposure. Scientific studies have found good correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (Schultz 1978; USEPA 1978).



Source: DOD 1978.

Figure A-6. Typical DNL or CNEL Ranges in Various Types of Communities

Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}) and Onset-Rate Adjusted Monthly Community Noise Equivalent Level ($CNEL_{mr}$)

Military aircraft utilizing Special Use Airspace (SUA) such as Military Training Routes (MTRs), Military Operations Areas (MOAs), and Restricted Areas/Ranges generate a noise environment that is somewhat different from that around airfields. Rather than regularly occurring operations like at airfields, activity in SUAs is highly sporadic. It is often seasonal, ranging from 10 per hour to less than 1 per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, with rates of up to 150 dB per second.

The cumulative daily noise metric devised to account for the "surprise" effect of the sudden onset of aircraft noise events on humans and the sporadic nature of SUA activity is the Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}). Onset rates between 15 and 150 dB per second require an adjustment of 0 to 11 dB to the event's SEL, while onset rates below 15 dB per second require no adjustment to the event's SEL (Stusnick et al. 1992). The term 'monthly' in L_{dnmr} refers to the noise assessment being conducted for the month with the most operations or sorties -- the so-called busiest month.

In California, a variant of the L_{dnmr} includes a penalty for evening operations (7 p.m. to 10 p.m.) and is denoted $CNEL_{mr}$.

A.2.3 Supplemental Metrics

Number-of-Events Above (NA) a Threshold Level (L)

The Number-of-Events Above (NA) metric gives the total number of events that exceed a noise level threshold (L) during a specified period of time. Combined with the selected threshold, the metric is denoted NAL. The threshold can be either SEL or L_{max}, and it is important that this selection is shown in the nomenclature. When labeling a contour line or point of interest (POI), NAL is followed by the number of events in parentheses. For example, where 10 events exceed an SEL of 90 dB over a given period of time, the nomenclature would be NA90SEL(10). Similarly, for L_{max} it would be NA90L_{max}(10). The period of time can be an average 24-hour day, daytime, nighttime, school day, or any other time period appropriate to the nature and application of the analysis.

NA is a supplemental metric. It is not supported by the amount of science behind DNL/CNEL, but it is valuable in helping to describe noise to the community. A threshold level and metric are selected that best meet the need for each situation. An L_{max} threshold is normally selected to analyze speech interference, while an SEL threshold is normally selected for analysis of sleep disturbance.

The NA metric is the only supplemental metric that combines single-event noise levels with the number of aircraft operations. In essence, it answers the question of how many aircraft (or range of aircraft) fly over a given location or area at or above a selected threshold noise level.

Time Above (TA) a Specified Level (L)

The Time Above (TA) metric is the total time, in minutes, that the A-weighted noise level is at or above a threshold. Combined with the threshold level (L), it is denoted TAL. TA can be calculated over a full 24-hour annual average day, the 15-hour daytime and 9-hour nighttime periods, a school day, or any other time period of interest, provided there is operational data for that time.

TA is a supplemental metric, used to help understand noise exposure. It is useful for describing the noise environment in schools, particularly when assessing classroom or other noise sensitive areas for various scenarios. TA can be shown as contours on a map similar to the way DNL contours are drawn.

TA helps describe the noise exposure of an individual event or many events occurring over a given time period. When computed for a full day, the TA can be compared alongside the DNL in order to determine the sound levels and total duration of events that contribute to the DNL. TA analysis is usually conducted along with NA analysis so the results show not only how many events occur, but also the total duration of those events above the threshold.

A.3 Noise Effects

Noise is of concern because of potential adverse effects. The following subsections describe how noise can affect communities and the environment, and how those effects are quantified. The specific topics discussed are:

- Annoyance;
- Speech interference;
- Sleep disturbance;
- Noise-induced hearing impairment;
- Non-auditory health effects;
- Performance effects;
- Noise effects on children;
- Property values;
- Noise-induced vibration effects on structures and humans;
- Noise effects on terrain;
- Noise effects on historical and archaeological sites; and
- Effects on domestic animals and wildlife.

A.3.1 Annoyance

With the introduction of jet aircraft in the 1950s, it became clear that aircraft noise annoyed people and was a significant problem around airports. Early studies, such as those of Rosenblith et al. (1953) and Stevens et al. (1953) showed that effects depended on the quality of the sound, its level, and the number of flights. Over the next 20 years considerable research was performed refining this understanding and setting guidelines for noise exposure. In the early 1970s, the USEPA published its "Levels Document" (USEPA 1974) that reviewed the factors that affected communities. DNL (still known as L_{dn} at the time) was identified as an appropriate noise metric, and threshold criteria were recommended.

Threshold criteria for annoyance were identified from social surveys, where people exposed to noise were asked how noise affects them. Surveys provide direct real-world data on how noise affects actual residents.

Surveys in the early years had a range of designs and formats, and needed some interpretation to find common ground. In 1978, Schultz showed that the common ground was the number of people "highly annoyed," defined as the upper 28% range of whatever response scale a survey used (Schultz 1978). With that definition, he was able to show a remarkable consistency among the majority of the surveys for which data were available. Figure A-7 shows the result of his study relating DNL to individual annoyance measured by percent highly annoyed (%HA).

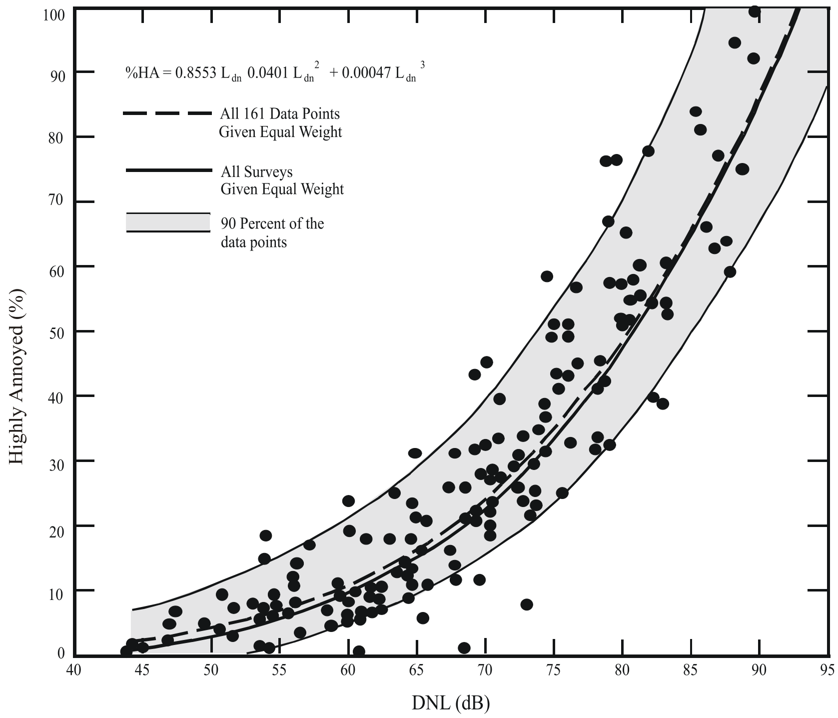


Figure A-7. Schultz Curve Relating Noise Annoyance to DNL (Schultz 1978)

Schultz's original synthesis included 161 data points. Figure A-8 compares revised fits of the Schultz data set with an expanded set of 400 data points collected through 1989 (Finegold et al. 1994). The new form is the preferred form in the US, endorsed by the Federal Interagency Committee on Aviation Noise (FICAN 1997). Other forms have been proposed, such as that of Fidell and Silvati (2004), but have not gained widespread acceptance.

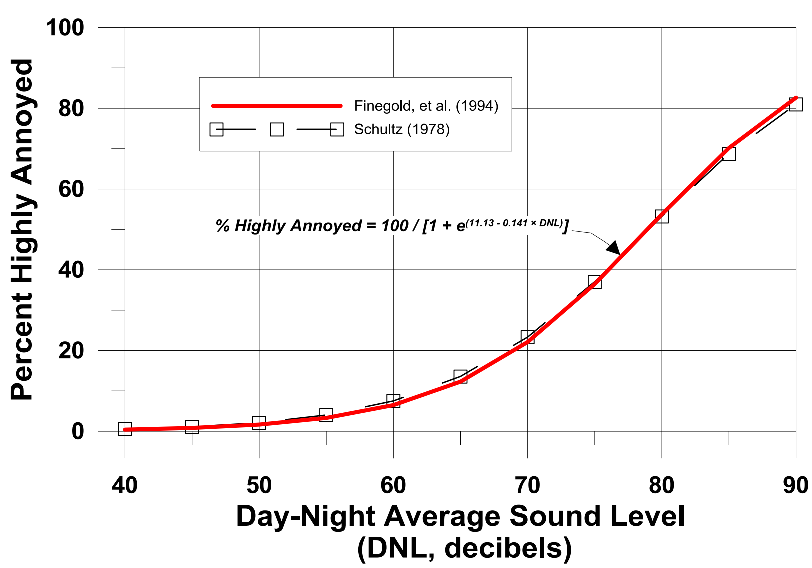


Figure A-8. Response of Communities to Noise; Comparison of Original Schultz (1978) with Finegold et al (1994)

When the goodness of fit of the Schultz curve is examined, the correlation between groups of people is high, in the range of 85-90%. The correlation between individuals is lower, 50% or less. This is not surprising, given the personal differences between individuals. The surveys underlying the Schultz curve include results that show that annoyance to noise is also affected by non-acoustical factors. Newman and Beattie (1985) divided the non-acoustic factors into the emotional and physical variables shown in Table A-1.

Table A-1. Non-Acoustic Variables Influencing Aircraft Noise Annoyance

Emotional Variables
Feeling about the necessity or preventability of the noise;
Judgement of the importance and value of the activity that is producing the noise;
Activity at the time an individual hears the noise;
Attitude about the environment;
General sensitivity to noise;
Belief about the effect of noise on health; and
Feeling of fear associated with the noise.

Physical Variables
Type of neighborhood;
Time of day;
Season;
Predicitabiltiy of the noise;
Control over the noise source; and
Length of time individual is exposed to a noise.

Schreckenberg and Schuemer (2010) recently examined the importance of some of these factors on short term annoyance. Attitudinal factors were identified as having an effect on annoyance. In formal regression analysis, however, sound level (L_{eq}) was found to be more important than attitude.

A recent study by Plotkin et al. (2011) examined updating DNL to account for these factors. It was concluded that the data requirements for a general analysis were much greater than most existing studies. It was noted that the most significant issue with DNL is that it is not readily understood by the public, and that supplemental metrics such as TA and NA were valuable in addressing attitude when communicating noise analysis to communities (DOD 2009a).

A factor that is partially non-acoustical is the source of the noise. Miedema and Vos (1998) presented synthesis curves for the relationship between DNL and percentage "Annoyed" and percentage "Highly Annoyed" for three transportation noise sources. Different curves were found for aircraft, road traffic, and railway noise. Table A-2 summarizes their results. Comparing the updated Schultz curve suggests that the percentage of people highly annoyed by aircraft noise may be higher than previously thought.

Table A-2. Percent Highly Annoyed for Different Transportation Noise Sources

DNL (dB)	Percent Hightly Annoyed (%HA)			
	Miedema and Vos			Schultz Combined
	Air	Road	Rail	
55	12	7	4	3
60	19	12	7	6
65	28	18	11	12
70	37	29	16	22
75	48	40	22	36

Source: Miedema and Vos 1998.

As noted by the World Health Organization (WHO), however, even though aircraft noise seems to produce a stronger annoyance response than road traffic, caution should be exercised when interpreting synthesized data from different studies (WHO 1999).

Consistent with WHO's recommendations, the Federal Interagency Committee on Noise (FICON 1992) considered the Schultz curve to be the best source of dose information to predict community response to noise, but recommended further research to investigate the differences in perception of noise from different sources.

A.3.2 Speech Interference

Speech interference from noise is a primary cause of annoyance for communities. Disruption of routine activities such as radio or television listening, telephone use, or conversation leads to frustration and annoyance. The quality of speech communication is important in classrooms and offices. In the workplace, speech interference from noise can cause fatigue and vocal strain in those who attempt to talk over the noise. In schools it can impair learning.

There are two measures of speech comprehension:

1. *Word Intelligibility* - the percent of words spoken and understood. This might be important for students in the lower grades who are learning the English language, and particularly for students who have English as a Second Language.
2. *Sentence Intelligibility* – the percent of sentences spoken and understood. This might be important for high-school students and adults who are familiar with the language, and who do not necessarily have to understand each word in order to understand sentences.

U.S. Federal Criteria for Interior Noise

In 1974, the USEPA identified a goal of an indoor $L_{eq(24)}$ of 45 dB to minimize speech interference based on sentence intelligibility and the presence of steady noise (USEPA 1974). Figure A-9 shows the effect of steady indoor background sound levels on sentence intelligibility. For an average adult with normal hearing and fluency in the language, steady background indoor sound levels of less than 45 dB L_{eq} are expected to allow 100% sentence intelligibility.

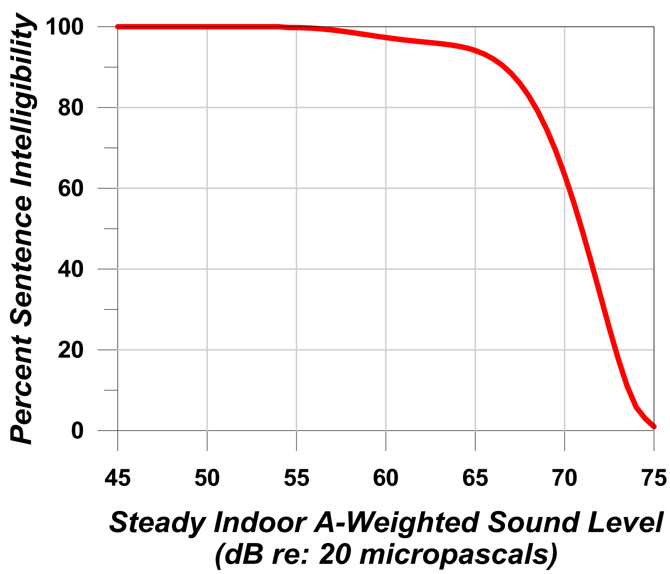


Figure A-9. Speech Intelligibility Curve (digitized from USEPA 1974)

The curve in Figure A-9 shows 99% intelligibility at L_{eq} below 54 dB, and less than 10% above 73 dB. Recalling that L_{eq} is dominated by louder noise events, the USEPA $L_{eq(24)}$ goal of 45 dB generally ensures that sentence intelligibility will be high most of the time.

Classroom Criteria

For teachers to be understood, their regular voice must be clear and uninterrupted. Background noise has to be below the teacher's voice level. Intermittent noise events that momentarily drown out the teacher's voice need to be kept to a minimum. It is therefore important to evaluate the steady background level, the level of voice communication, and the single-event level due to aircraft overflights that might interfere with speech.

Lazarus (1990) found that for listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., a comparison of the level of the sound to the level of background noise) is in the range of 15 to 18 dB. The initial ANSI classroom noise standard (ANSI 2002) and American Speech-Language-Hearing Association (ASLHA 1995) guidelines concur, recommending at least a 15 dB signal-to-noise ratio in classrooms. If the teacher's voice level is at least 50 dB, the background noise level must not exceed an average of 35 dB. The National Research Council of Canada (Bradley 1993) and WHO (1999) agree with this criterion for background noise.

For eligibility for noise insulation funding, the Federal Aviation Administration (FAA) guidelines state that the design objective for a classroom environment is 45 dB L_{eq} during normal school hours (FAA 1985).

Most aircraft noise is not continuous. It consists of individual events like the one sketched in Figure A-4. Since speech interference in the presence of aircraft noise is caused by individual aircraft flyover events, a time-averaged metric alone, such as L_{eq}, is not necessarily appropriate. In addition to the background level criteria described above, single-event criteria that account for those noisy events are also needed.

A 1984 study by Wyle for the Port Authority of New York and New Jersey recommended using Speech Interference Level (SIL) for classroom noise criteria (Sharp and Plotkin 1984). SIL is based on the maximum sound levels in the frequency range that most affects speech communication (500-2,000 Hz). The study identified an SIL of 45 dB as the goal. This would provide 90% word intelligibility for the short time periods during aircraft overflights. While SIL is technically the best metric for speech interference, it can be approximated by an L_{max} value. An SIL of 45 dB is equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler 1986).

Lind et al. (1998) also concluded that an L_{max} criterion of 50 dB would result in 90% word intelligibility. Bradley (1985) recommends SEL as a better indicator. His work indicates that 95% word intelligibility would be achieved when indoor SEL did not exceed 60 dB. For typical flyover noise this corresponds to an L_{max} of 50 dB. While WHO (1999) only specifies a background L_{max} criterion, they also note the SIL frequencies and that interference can begin at around 50 dB.

The United Kingdom Department for Education and Skills (UKDfES) established in its classroom acoustics guide a 30-minute time-averaged metric of $L_{eq(30min)}$ for background levels and the metric of $L_{A1,30min}$ for intermittent noises, at thresholds of 30-35 dB and 55 dB, respectively. $L_{A1,30min}$ represents the A-weighted sound level that is exceeded 1% of the time (in this case, during a 30-minute teaching session) and is generally equivalent to the L_{max} metric (UKDfES 2003).

Table A-3 summarizes the criteria discussed. Other than the FAA (1985) 45 dB L_{max} criterion, they are consistent with a limit on indoor background noise of 35-40 dB L_{eq} and a single event limit of 50 dB L_{max}. It should be noted that these limits were set based on students with normal hearing and no special needs. At-risk students may be adversely affected at lower sound levels.

Table A-3. Indoor Noise Level Criteria Based on Speech Intelligibility

Source	Metric/Level (dB)	Effects and Notes
U.S. FAA (1985)	$L_{eq(during\ school\ hours)}$ = 45 dB	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used.
Lind et al. (1998), Sharp and Plotkin (1984), Wesler (1986)	L_{max} = 50 dB / SIL 45	Single event level permissible in the classroom.
WHO (1999)	L_{eq} = 35 dB L_{max} = 50 dB	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB.
U.S. ANSI (2010)	L_{eq} = 35 dB, based on Room Volume (e.g., cubic feet)	Acceptable background level for continuous and intermittent noise.
U.K. DFES (2003)	$L_{eq(30min)}$ = 30-35 dB L_{max} = 55 dB	Minimum acceptable in classroom and most other learning environs.

A.3.3 Sleep Disturbance

Sleep disturbance is a major concern for communities exposed to aircraft noise at night. A number of studies have attempted to quantify the effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies. Emphasis is on studies that have influenced U.S. federal noise policy. The studies have been separated into two groups:

1. Initial studies performed in the 1960s and 1970s, where the research was focused on sleep observations performed under laboratory conditions.
2. Later studies performed in the 1990s up to the present, where the research was focused on field observations.

Initial Studies

The relation between noise and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep and the noise level, but also on the non-acoustic factors cited for annoyance. The easiest effect to measure is the number of arousals or awakenings from noise events. Much of the literature has therefore focused on predicting the percentage of the population that will be awakened at various noise levels.

FICON's 1992 review of airport noise issues (FICON 1992) included an overview of relevant research conducted through the 1970s. Literature reviews and analyses were conducted from 1978 through 1989 using existing data (Griefahn 1978; Lukas 1978; Pearsons et. al. 1989). Because of large variability in the data, FICON did not endorse the reliability of those results.

FICON did, however, recommend an interim dose-response curve, awaiting future research. That curve predicted the percent of the population expected to be awakened as a function of the exposure to SEL. This curve was based on research conducted for the U.S. Air Force (Finegold 1994). The data included most of the research performed up to that point, and predicted a 10% probability of awakening when exposed to an interior SEL of 58 dB. The data used to derive this curve were primarily from controlled laboratory studies.

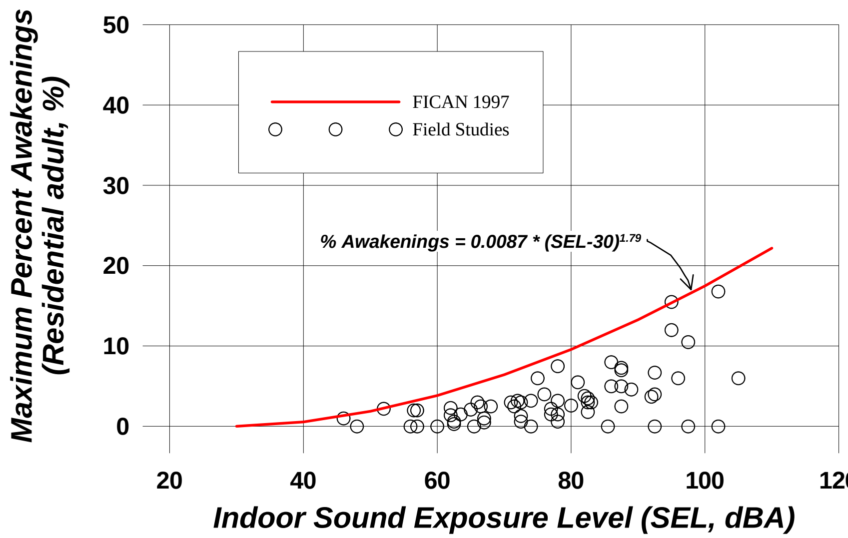
Recent Sleep Disturbance Research – Field and Laboratory Studies

It was noted that early sleep laboratory studies did not account for some important factors. These included habituation to the laboratory, previous exposure to noise, and awakenings from noise other than aircraft. In the early 1990s, field studies in people's homes were conducted to validate the earlier laboratory work conducted in the 1960s and 1970s. The field studies of the 1990s found that 80-90% of sleep disturbances were not related to outdoor noise events, but rather to indoor noises and non-noise factors. The results showed that, in real life conditions, there was less of an effect of noise on sleep than had been previously reported from laboratory studies. Laboratory sleep studies tend to show more sleep disturbance than field studies because people who sleep in their own homes are used to their environment and, therefore, do not wake up as easily (FICAN 1997).

FICAN

Based on this new information, in 1997 FICAN recommended a dose-response curve to use instead of the earlier 1992 FICON curve (FICAN 1997). Figure A-10 shows FICAN's curve, the red line, which is based on the results of three field studies shown in the figure (Ollerhead et al. 1992; Fidell et al. 1994; Fidell et al. 1995a, 1995b), along with the data from six previous field studies.

The 1997 FICAN curve represents the upper envelope of the latest field data. It predicts the maximum percent awakened for a given residential population. According to this curve, a maximum of 3% of people would be awakened at an indoor SEL of 58 dB. An indoor SEL of 58 dB is equivalent to an outdoor SEL of 83 dB, with the windows closed (73 dB with windows open).



Source: FICAN 1997

Figure A-10. FICAN 1997 Recommended Sleep Disturbance Dose-Response Relationship

Number of Events and Awakenings

It is reasonable to expect that sleep disturbance is affected by the number of events. The German Aerospace Center (DLR Laboratory) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and related factors (Basner 2004). The DLR study was one of the largest studies to examine the link between aircraft noise and sleep disturbance. It involved both laboratory and in-home field research phases. The DLR investigators developed a dose-response curve that predicts the number of aircraft events at various values of L_{max} expected to produce one additional awakening over the course of a night. The dose-effect curve was based on the relationships found in the field studies.

A different approach was taken by an ANSI standards committee (ANSI 2008). The committee used the average of the data shown in Figure A-10 (i.e., the blue dashed line) rather than the upper envelope, to predict average awakening from one event. Probability theory is then used to project the awakening from multiple noise events.

Currently, there are no established criteria for evaluating sleep disturbance from aircraft noise, although recent studies have suggested a benchmark of an outdoor SEL of 90 dB as an appropriate tentative criterion when comparing the effects of different operational alternatives. The corresponding indoor SEL would be approximately 25 dB lower (at 65 dB) with doors and windows closed, and approximately 15 dB lower (at 75 dB) with doors or windows open. According to the ANSI (2008) standard, the probability of awakening from a single aircraft event at this level is between 1 and 2% for people habituated to the noise sleeping in bedrooms with windows closed, and 2-3% with windows open. The probability of the exposed population awakening at least once from multiple aircraft events at noise levels of 90 dB SEL is shown in Table A-4.

Table A-4. Probability of Awakening from NA90SEL

Number of Aircraft Events at 90 dB SEL for Average 9-Hour Night	Minimum Probability of Awakening at Least Once	
	Windows Closed	Windows Open
1	1%	2%
3	4%	6%
5	7%	10%
9 (1 per hour)	12%	18%
18 (2 per hour)	22%	33%
27 (3 per hour)	32%	45%

Source: DOD 2009b.

In December 2008, FICAN recommended the use of this new standard. FICAN also recognized that more research is underway by various organizations, and that work may result in changes to FICAN's position. Until that time, FICAN recommends the use of the ANSI (2008) standard (FICAN 2008).

Summary

Sleep disturbance research still lacks the details to accurately estimate the population awakened for a given noise exposure. The procedure described in the ANSI (2008) Standard and endorsed by FICAN is based on probability calculations that have not yet been scientifically validated. While this procedure certainly provides a much better method for evaluating sleep awakenings from multiple aircraft noise events, the estimated probability of awakenings can only be considered approximate.

A.3.4 Noise-Induced Hearing Impairment

Residents in surrounding communities express concerns regarding the effects of aircraft noise on hearing. This section provides a brief overview of hearing loss caused by noise exposure. The goal is to provide a sense of perspective as to how aircraft noise (as experienced on the ground) compares to other activities that are often linked with hearing loss.

Hearing Threshold Shifts

Hearing loss is generally interpreted as a decrease in the ear's sensitivity or acuity to perceive sound (i.e., a shift in the hearing threshold to a higher level). This change can either be a Temporary Threshold Shift (TTS) or a Permanent Threshold Shift (PTS) (Berger et al. 1995).

TTS can result from exposure to loud noise over a given amount of time. An example of TTS might be a person attending a loud music concert. After the concert is over, there can be a threshold shift that may last several hours. While experiencing TTS, the person becomes less sensitive to low-level sounds, particularly at certain frequencies in the speech range (typically near 4,000 Hz). Normal hearing eventually returns, as long as the person has enough time to recover within a relatively quiet environment.

PTS usually results from repeated exposure to high noise levels, where the ears are not given adequate time to recover. A common example of PTS is the result of regularly working in a loud factory. A TTS can eventually become a PTS over time with repeated exposure to high noise levels. Even if the ear is given time to recover from TTS, repeated occurrence of TTS may eventually lead to permanent hearing loss. The point at which a TTS results in a PTS is difficult to identify and varies with a person's sensitivity.

Criteria for Permanent Hearing Loss

It has been well established that continuous exposure to high noise levels will damage human hearing (USEPA 1978). A large amount of data on hearing loss have been collected, largely for workers in manufacturing industries, and analyzed by the scientific/medical community. The Occupational Safety and Health Administration (OSHA) regulation of 1971 places the limit on workplace noise exposure at an average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period (U.S. Department of Labor 1971). Some hearing loss is still expected at those levels. The most protective criterion, with no measurable hearing loss after 40 years of exposure, is an average sound level of 70 dB over a 24-hour period.

The USEPA established 75 dB $L_{eq(8)}$ and 70 dB $L_{eq(24)}$ as the average noise level standard needed to protect 96% of the population from greater than a 5 dB PTS (USEPA 1978). The National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the lowest level at which hearing loss may occur (CHABA 1977). WHO concluded that environmental and leisure-time noise below an $L_{eq(24)}$ value of 70 dB "will not cause hearing loss in the large majority of the population, even after a lifetime of exposure" (WHO 1999).

Hearing Loss and Aircraft Noise

The 1982 USEPA Guidelines report (USEPA 1982) addresses noise-induced hearing loss in terms of the "Noise-Induced Permanent Threshold Shift" (NIPTS). This defines the permanent change in hearing caused by exposure to noise. Numerically, the NIPTS is the change in threshold that can be expected from daily exposure to noise over a normal working lifetime of 40 years. A grand average of the NIPTS over time and hearing sensitivity is termed the Average NIPTS, or Ave. NIPTS for short. The Ave. NIPTS that can be expected for noise measured by the $L_{eq(24)}$ metric is given in Table A-5. Table A-5 assumes exposure to the full outdoor noise throughout the 24 hours. When inside a building, the exposure will be less (Eldred and von Gierke 1993).

The Ave. NIPTS is estimated as an average over all people exposed to the noise. The actual value of NIPTS for any given person will depend on their physical sensitivity to noise – some will experience more hearing loss than others. The USEPA Guidelines provide information on this variation in sensitivity in the form of the NIPTS exceeded by 10% of the population, which is included in the Table A-5 in the "10th Percentile NIPTS" column (USEPA 1982). For individuals exposed to $L_{eq(24)}$ of 80 dB, the most sensitive of the population would be expected to show degradation to their hearing of 7 dB over time.

To put these numbers in perspective, changes in hearing level of less than 5 dB are generally not considered noticeable or significant. Furthermore, there is no known evidence that a NIPTS of 5 dB is perceptible or has any practical significance for the individual. Lastly, the variability in audiometric testing is generally assumed to be ±5 dB (USEPA 1974).

Table A-5. Ave. NIPTS and 10th Percentile NIPTS as a Function of $L_{eq(24)}$

$L_{eq(24)}$	Ave. NIPTS (dB)*	10th Percentile NIPTS (dB)*
75-76	1.0	4.0
76-77	1.0	4.5
77-78	1.6	5.0
78-79	2.0	5.5
79-80	2.5	6.0
80-81	3.0	7.0
81-82	3.5	8.0
82-83	4.0	9.0
83-84	4.5	10.0
84-85	5.5	11.0
85-86	6.0	12.0
86-87	7.0	13.5
87-88	7.5	15.0
88-89	8.5	16.5
89-90	9.5	18.0

** rounded to the nearest 0.5 dB*

Source: DOD 2012.

The scientific community has concluded that noise exposure from civil airports has little chance of causing permanent hearing loss (Newman and Beattie 1985). For military airbases, DOD policy requires that hearing risk loss be estimated for population exposed to $L_{eq(24)}$ of 80 dB or higher (DOD 2012), including residents of on-base housing. Exposure of workers inside the base boundary is assessed using DOD regulations for occupational noise exposure.

Noise in low-altitude military airspace, especially along MTRs where L_{max} can exceed 115 dB, is of concern. That is the upper limit used for occupational noise exposure (e.g., U.S. Department of Labor 1971). One laboratory study (Ising et al. 1999) concluded that events with L_{max} above 114 dB have the potential to cause hearing loss. Another laboratory study of participants exposed to levels between 115 and 130 dB (Nixon et al. 1993), however, showed conflicting results. For an exposure to four events across that range, half the subjects showed no change in hearing, a quarter showed a temporary 5 dB decrease in sensitivity, and a quarter showed a temporary 5 dB increase in sensitivity. For exposure to eight events of 130 dB, subjects showed an increase in sensitivity of up to 10 dB (Nixon et al. 1993).

Summary

Aviation noise levels are not comparable to the occupational noise levels associated with hearing loss of workers in manufacturing industries. There is little chance of hearing loss at levels less than 75 dB DNL. Noise levels equal to or greater than 75 dB DNL can occur near military airbases, and DOD policy specifies that NIPTS be evaluated when exposure exceeds 80 dB $L_{eq(24)}$ (DOD 2009c). There is some concern about L_{max} exceeding 115 dB in low altitude military airspace, but no research results to date have definitely related permanent hearing impairment to aviation noise.

A.3.5 Non-auditory Health Effects

Studies have been performed to see whether noise can cause health effects other than hearing loss. The premise is that annoyance causes stress. Prolonged stress is known to be a contributor to a number of health disorders. Cantrell (1974) confirmed that noise can provoke stress, but noted that results on cardiovascular health have been contradictory. Some studies have found a connection between aircraft noise and blood pressure (e.g., Michalak et al. 1990; Rosenlund et al. 2001), while others have not (e.g., Pulles et al. 1990).

Kryter and Poza (1980) noted, "It is more likely that noise related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body."

The connection from annoyance to stress to health issues requires careful experimental design. Some highly publicized reports on health effects have, in fact, been rooted in poorly done science. Meecham and Shaw (1979) apparently found a relation between noise levels and mortality rates in neighborhoods under the approach path to Los Angeles International Airport. When the same data were analyzed by others (Frerichs et al. 1980) no relationship was found. Jones and Tauscher (1978) found a high rate of birth defects for the same neighborhood. But when the Centers For Disease Control performed a more thorough study near Atlanta's Hartsfield International Airport, no relationships were found for levels above 65 dB (Edmonds et al. 1979).

A carefully designed study, Hypertension and Exposure to Noise near Airports (HYENA), was conducted around six European airports from 2002 through 2006 (Jarup et al. 2005, 2008). There were 4,861 subjects, aged between 45 and 70. Blood pressure was measured, and questionnaires administered for health, socioeconomic and lifestyle factors, including diet and physical exercise. Hypertension was defined by WHO blood pressure thresholds (WHO 2003). Noise from aircraft and highways was predicted from models.

HYENA results were presented as an odds ratio (OR). An OR of 1 means there is no added risk, while an OR of 2 would mean risk doubles. An OR of 1.14 was found for nighttime aircraft noise, measured by L_{night}, the L_{eq} for nighttime hours. For daytime aircraft noise, measured by $L_{eq(16)}$, the OR was 0.93. For road traffic noise, measured by the full day $L_{eq(24)}$, the OR was 1.1.

Note that OR is a statistical measure of change, not the actual risk. Risk itself and the measured effects were small, and not necessarily distinct from other events. Haralabidis et al. (2008) reported an increase in systolic blood pressure of 6.2 millimeters of mercury (mmHg) for aircraft noise, and an increase of 7.4 mmHg for other indoor noises such as snoring.

It is interesting that aircraft noise was a factor only at night, while traffic noise is a factor for the full day. Aircraft noise results varied among the six countries so that result is pooled across all data. Traffic noise results were consistent across the six countries.

One interesting conclusion from a 2013 study of the HYENA data (Babisch et al. 2013) states there is some indication that noise level is a stronger predictor of hypertension than annoyance. That is not consistent with the idea that annoyance is a link in the connection between noise and stress. Babisch et al. (2012) present interesting insights on the relationship of the results to various modifiers.

Two recent studies examined the correlation of aircraft noise with hospital admissions for cardiovascular disease. Hansell et al. (2013) examined neighborhoods around London's Heathrow airport. Correia et al. (2013) examined neighborhoods around 89 airports in the United States. Both studies included areas of various noise levels. They found associations that were consistent with the HYENA results. The authors of these studies noted that further research is needed to refine the associations and the causal interpretation with noise or possible alternative explanations.

Summary

The current state of scientific knowledge cannot yet support inference of a causal or consistent relationship between aircraft noise exposure and non-auditory health consequences for exposed residents. The large scale HYENA study, and the recent studies by Hansell et al. (2013) and Correia et al. (2013) offer indications, but it is not yet possible to establish a quantitative cause and effect based on the currently available scientific evidence.

A.3.6 Performance Effects

The effect of noise on the performance of activities or tasks has been the subject of many studies. Some of these studies have found links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies where noise levels are above 85 dB. Little change has been found in low-noise cases. Moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task.

While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

- A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.
- Noise is more inclined to affect the quality than the quantity of work.
- Noise is more likely to impair the performance of tasks that place extreme demands on workers.

A.3.7 Noise Effects on Children

Recent studies on school children indicate a potential link between aircraft noise and both reading comprehension and learning motivation. The effects may be small but may be of particular concern for children who are already scholastically challenged.

A.3.7.1 Effects on Learning and Cognitive Abilities

Early studies in several countries (Cohen et al. 1973, 1980, 1981; Bronzaft and McCarthy 1975; Green et al. 1982; Evans et al. 1998; Haines et al. 2002; Lercher et al. 2003) showed lower reading scores for children living or attending school in noisy areas than for children away from those areas. In some studies noise exposed children were less likely to solve difficult puzzles or more likely to give up.

More recently, the Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health (RANCH) study (Stansfeld et al. 2005; Clark et al. 2005) compared the effect of aircraft and road traffic noise on over 2.000 children in three countries. This was the first study to derive exposure-effect associations for a range of cognitive and health effects, and was the first to compare effects across countries.

The study found a linear relation between chronic aircraft noise exposure and impaired reading comprehension and recognition memory. No associations were found between chronic road traffic noise exposure and cognition. Conceptual recall and information recall surprisingly showed better performance in high road traffic noise areas. Neither aircraft noise nor road traffic noise affected attention or working memory (Stansfeld et al. 2005; Clark et al. 2006).

Figure A-11 shows RANCH's result relating noise to reading comprehension. It shows that reading falls below average (a z-score of 0) at L_{eq} greater than 55 dB. Because the relationship is linear, reducing exposure at any level should lead to improvements in reading comprehension.

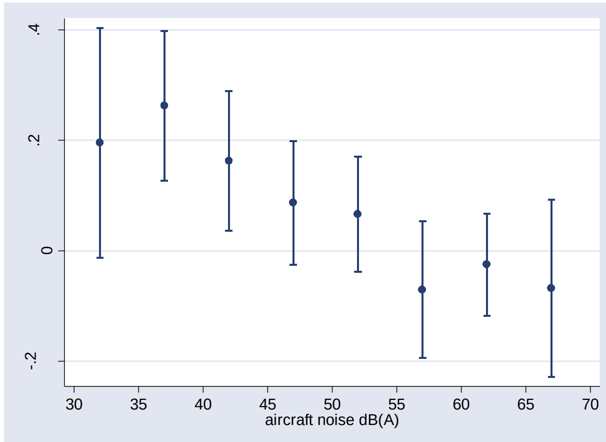


Figure A-11. RANCH Study Reading Scores Varying with L_{eq}
Sources: Stansfeld et al. 2005; Clark et al. 2006

An observation of the RANCH study was that children may be exposed to aircraft noise for many of their childhood years and the consequences of long-term noise exposure were unknown. A follow-up study of the children in the RANCH project is being analyzed to examine the long-term effects on children's reading comprehension (Clark et al. 2009). Preliminary analysis indicated a trend for reading comprehension to be poorer at 15-16 years of age for children who attended noise-exposed primary schools. There was also a trend for reading comprehension to be poorer in aircraft noise exposed secondary schools. Further analysis adjusting for confounding factors is ongoing, and is needed to confirm these initial conclusions.

FICAN funded a pilot study to assess the relationship between aircraft noise reduction and standardized test scores (Eagan et al. 2004; FICAN 2007). The study evaluated whether abrupt aircraft noise reduction within classrooms, from either airport closure or sound insulation, was associated with improvements in test scores. Data were collected in 35 public schools near three airports in Illinois and Texas. The study used several noise metrics. These were, however, all computed indoor levels, which makes it hard to compare with the outdoor levels used in most other studies.

The FICAN study found a significant association between noise reduction and a decrease in failure rates for high school students, but not middle or elementary school students. There were some weaker associations between noise reduction and an increase in failure rates for middle and elementary schools. Overall the study found that the associations observed were similar for children with or without learning difficulties, and between verbal and math/science tests. As a pilot study, it was not expected to obtain final answers, but provided useful indications (FICAN 2007).

While there are many factors that can contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led WHO and a North Atlantic Treaty Organization (NATO) working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (NATO 2000; WHO 1999). The awareness has also led to the classroom noise standard discussed earlier (ANSI 2002).

A.3.7.2 Health Effects

A number of studies, including some of the cognitive studies discussed above, have examined the potential for effects on children's health. Health effects include annoyance, psychological health, coronary risk, stress hormones, sleep disturbance and hearing loss.

Annoyance. Chronic noise exposure causes annoyance in children (Bronzaft and McCarthy 1975; Evans et al. 1995). Annoyance among children tends to be higher than for adults, and there is little habituation

(Haines et al. 2001a). The RANCH study found annoyance may play a role in how noise affects reading comprehension (Clark et al. 2005).

Psychological Health. Lercher et al. (2002) found an association between noise and teacher ratings of psychological health, but only for children with biological risk defined by low birth weight and/or premature birth. Haines et al. (2001b) found that children exposed to aircraft noise had higher levels of psychological distress and hyperactivity. Stansfeld et al. (2009) replicated the hyperactivity result, but not distress.

As with studies of adults, the evidence suggests that chronic noise exposure is probably not associated with serious psychological illness, but there may be effects on well-being and quality of life. Further research is needed, particularly on whether hyperactive children are more susceptible to stressors such as aircraft noise.

Coronary Risk. The HYENA study discussed earlier indicated a possible relation between noise and hypertension in older adults. Cohen et al. (1980, 1981) found some increase in blood pressure among school children, but within the normal range and not indicating hypertension. Hygge et al. (2002) found mixed effects. The RANCH study found some effect for children at home and at night, but not at school. Overall the evidence for noise effects on children's blood pressure is mixed, and less certain than for older adults.

Stress Hormones. Some studies investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group. Two studies analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise (Haines et al. 2001a, 2001b). In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Sleep Disturbance. A sub-study of RANCH in a Swedish sample used sleep logs and the monitoring of rest/activity cycles to compare the effect of road traffic noise on child and parent sleep (Ohrstrom et al. 2006). An exposure-response relationship was found for sleep quality and daytime sleepiness for children. While this suggests effects of noise on children's sleep disturbance, it is difficult to generalize from one study.

Hearing loss. A few studies have examined hearing loss from exposure to aircraft noise. Noise-induced hearing loss for children who attended a school located under a flight path near a Taiwan airport was greater than for children at another school far away (Chen et al. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was greater than 75 dB DNL and L_{max} were about 87 dB during overflights. Conversely, several other studies reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Andrus et al. 1975; Fisch 1977; Wu et al. 1995). It is not clear from those results whether children are at higher risk than adults, but the levels involved are higher than those desirable for learning and quality of life.

Ludlow and Sixsmith (1999) conducted a cross-sectional pilot study to examine the hypothesis that military jet noise exposure early in life is associated with raised hearing thresholds. The authors concluded that there were no significant differences in audiometric test results between military personnel who as children had lived in or near stations where fast jet operations were based, and a similar group who had no such exposure as children.

A.3.8 Property Values

Noise can affect the value of homes. Economic studies of property values based on selling prices and noise have been conducted to find a direct relation.

The value-noise relation is usually presented as the Noise Depreciation Index (NDI) or Noise Sensitivity Depreciation Index (NSDI), the percent loss of value per dB (measured by the DNL metric). An early study by Nelson (1978) at three airports found an NDI of 1.8-2.3% per dB. Nelson also noted a decline in NDI over time which he theorized could be due to either a change in population or the increase in commercial value of the property near airports. Crowley (1978) reached a similar conclusion. A larger study by Nelson (1980) looking at 18 airports found an NDI from 0.5 to 0.6% per dB.

In a review of property value studies, Newman and Beattie (1985) found a range of NDI from 0.2 to 2% per dB. They noted that many factors other than noise affected values.

Fidell et al. (1996) studied the influence of aircraft noise on actual sale prices of residential properties in the vicinity of a military base in Virginia and one in Arizona. They found no meaningful effect on home values. Their results may have been due to non-noise factors, especially the wide differences in homes between the two study areas.

Recent studies of noise effects on property values have recognized the need to account for non-noise factors. Nelson (2004) analyzed data from 33 airports, and discussed the need to account for those factors and the need for careful statistics. His analysis showed NDI from 0.3 to 1.5% per dB, with an average of about 0.65% per dB. Nelson (2007) and Andersson et al. (2013) discuss statistical modeling in more detail.

Enough data is available to conclude that aircraft noise has a real effect on property values. This effect falls in the range of 0.2 to 2.0% per dB, with the average on the order of 0.5% per dB. The actual value varies from location to location, and is very often small compared to non-noise factors.

A.3.9 Noise-Induced Vibration Effects on Structures and Humans

High noise levels can cause buildings to vibrate. If high enough, building components can be damaged. The most sensitive components of a building are the windows, followed by plaster walls and ceilings. Possibility of damage depends on the peak sound pressures and the resonances of the building. In general, damage is possible only for sounds lasting more than one second above an unweighted sound level of 130 dB (CHABA 1977). That is higher than expected from normal aircraft operations. Even low altitude flyovers of heavy aircraft do not reach the potential for damage (Sutherland 1990).

Noise-induced structural vibration may cause annoyance to dwelling occupants because of induced secondary vibrations, or "rattle", of objects within the dwelling – hanging pictures, dishes, plaques, and bric-a-brac. Loose window panes may also vibrate noticeably when exposed to high levels of airborne noise, causing homeowners to fear breakage. In general, rattling occurs at peak unweighted sound levels that last for several seconds at levels above 110 dB, which is well above that considered normally compatible with residential land use Thus, assessments of noise exposure levels for compatible land use will also be protective of noise-induced rattle.

The sound from an aircraft overflight travels from the exterior to the interior of the house in one of two ways: through the solid structural elements and directly through the air. Figure A-12 illustrates the sound transmission through a wall constructed with a brick exterior, stud framing, interior finish wall, and absorbent material in the cavity. The sound transmission starts with noise impinging on the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which in turn sets the interior finish surface vibrating, with some energy lost in the airspace. This surface then radiates sound into the dwelling interior. As the figure shows, vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.

Normally, the most sensitive components of a structure to airborne noise are the windows, followed by plastered walls and ceilings. An evaluation of the peak sound pressures impinging on the structure is normally sufficient to determine the possibility of damage. In general, at unweighted sound levels above 130 dB, there is the possibility of structural damage. While certain frequencies (such as 30 Hertz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a unweighted sound level of 130 dB are potentially damaging to structural components (von Gierke and Ward 1991).

In the assessment of vibration on humans, the following factors determine if a person will perceive and possibly react to building vibrations:

1. Type of excitation: steady state, intermittent, or impulsive vibration.
2. Frequency of the excitation. International Organization for Standardization (ISO) standard 2631-2 (ISO 1989) recommends a frequency range of 1 to 80 Hz for the assessment of vibration on humans.
3. Orientation of the body with respect to the vibration.
4. The use of the occupied space (i.e., residential, workshop, hospital).
5. Time of day.

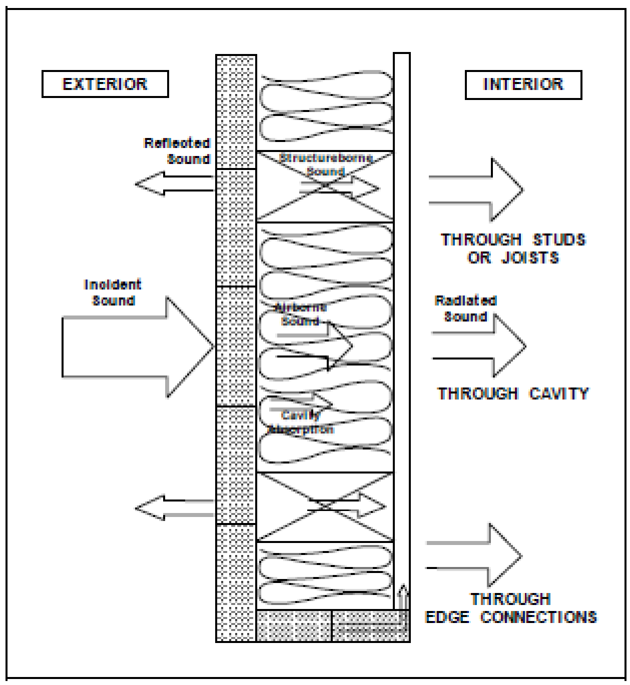


Figure A-12. Depiction of Sound Transmission through Built Construction

Table A-6 lists the whole-body vibration criteria from ISO 2631-2 for one-third octave frequency bands from 1 to 80 Hz.

Table A-6. Vibration Criteria for the Evaluation of Human Exposure to Whole-Body Vibration

	RMS Acceleration (m/s/s)		
Frequency (Hz)	Combined Criteria Base Curve	Residential Night	Residential Day
1.00	0.0036	0.0050	0.0072
1.25	0.0036	0.0050	0.0072
1.60	0.0036	0.0050	0.0072
2.00	0.0036	0.0050	0.0072
2.50	0.0037	0.0052	0.0074
3.15	0.0039	0.0054	0.0077
4.00	0.0041	0.0057	0.0081
5.00	0.0043	0.0060	0.0086
6.30	0.0046	0.0064	0.0092
8.00	0.0050	0.0070	0.0100
10.00	0.0063	0.0088	0.0126
12.50	0.0078	0.0109	0.0156
16.00	0.0100	0.0140	0.0200
20.00	0.0125	0.0175	0.0250
25.00	0.0156	0.0218	0.0312
31.50	0.0197	0.0276	0.0394
40.00	0.0250	0.0350	0.0500
50.00	0.0313	0.0438	0.0626
63.00	0.0394	0.0552	0.0788
80.00	0.0500	0.0700	0.1000

Source: ISO 1989.

A.3.10 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such events. It is improbable that such effects would result from routine subsonic aircraft operations.

A.3.11 Noise Effects on Historical and Archaeological Sites

Historical buildings and sites can have elements that are more fragile than conventional structures. Aircraft noise may affect such sites more severely than newer, modern structures. In older structures, seemingly insignificant surface cracks caused by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson et al. 1991). There are few scientific studies of such effects to provide guidance for their assessment.

One study involved measurements of noise and vibration in a restored plantation house, originally built in 1795. It is located 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. The aircraft measured was the Concorde. There was special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning (Wesler 1977).

As for conventional structures, noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites. Unique sites should, of course, be analyzed for specific exposure.

A.3.12 Effects on Domestic Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns are vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960s and 1970s on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci et al. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on hearing to avoid predators, obtain food, and communicate with, and attract, other members of their species. Aircraft noise may mask or interfere with these functions. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights.

Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith et al. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the Manci et al. (1988) literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci et al. (1988) reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

A.3.12.1 Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci et al. 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

Some reviewers have indicated that earlier studies, and claims by farmers linking adverse effects of aircraft noise on livestock, did not necessarily provide clear-cut evidence of cause and effect (Cottereau 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that summarized the literature on the impacts of low-altitude flights on livestock (and poultry) and includes specific case studies conducted in numerous airspaces across the country. Adverse effects have been found in a few studies but have not been reproduced in other similar studies. One such study, conducted in 1983, suggested that 2 of 10 cows in late pregnancy aborted after showing rising estrogen and falling progesterone levels. These increased hormonal levels were reported as being linked to 59 aircraft overflights. The remaining eight cows showed no changes in their blood concentrations and calved normally. A similar study reported abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft. Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994a).

A majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Studies presenting adverse effects to domestic animals have been limited. A number of studies (Parker and Bayley 1960; Casady and Lehmann 1967; Kovalcik and Sottnik 1971) investigated the effects of jet aircraft noise and sonic booms on the milk production of dairy cows. Through the compilation and examination of milk production data from areas exposed to jet aircraft noise and sonic boom events, it was determined that milk yields were not affected. This was particularly evident in those cows that had been previously exposed to jet aircraft noise.

A study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a 1-year time period and none were associated with aircraft disturbances (U.S. Air Force 1993). In 1987, researchers contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Of the 43 cattle previously exposed to low-altitude flights, 3 showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level (AGL) and 400 knots by running less than 10 meters (m). They resumed normal activity within 1 minute (U.S. Air Force 1994a). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30-60 feet overhead did not affect milk production and pregnancies of 44 cows in a 1964 study (U.S. Air Force 1994a).

Additionally, Beyer (1983) reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or disturb their pregnancies after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights. A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994a).

In a report to Congress, the U. S. Forest Service concluded that "evidence both from field studies of wild ungulates and laboratory studies of domestic stock indicate that the risks of damage are small (from aircraft approaches of 50-100 m), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50-100 m, there is no evidence that mothers and young are separated, that animals collide with obstructions (unless confined) or that they traverse dangerous ground at too high a rate." These varied study results suggest that, although the confining of cattle could magnify animal response to aircraft overflight, there is no proven cause-and-effect link between startling cattle from aircraft overflights and abortion rates or lower milk production.

Horses

Horses have also been observed to react to overflights of jet aircraft. Several of the studies reviewed reported a varied response of horses to low-altitude aircraft overflights. Observations made in 1966 and 1968 noted that horses galloped in response to jet flyovers (U.S. Air Force 1993). Bowles (1995) cites Kruger and Erath as observing horses exhibiting intensive flight reactions, random movements, and biting/kicking behavior. However, no injuries or abortions occurred, and there was evidence that the mares adapted somewhat to the flyovers over the course of a month (U.S. Air Force 1994a). Although horses were observed noticing the overflights, it did not appear to affect either survivability or reproductive success. There was also some indication that habituation to these types of disturbances was occurring.

LeBlanc et al. (1991), studied the effects of F-14 jet aircraft noise on pregnant mares. They specifically focused on any changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation. Their findings reported observations of "flight-fright" reactions, which caused increases in heart rates and serum cortisol concentrations. The mares, however, did habituate to the noise. Levels of anxiety and mass body movements were the highest after initial exposure, with intensities of responses decreasing thereafter. There were no differences in pregnancy success when compared to a control group.

Swine

Generally, the literature findings for swine appear to be similar to those reported for cows and horses. While there are some effects from aircraft noise reported in the literature, these effects are minor. Studies of continuous noise exposure (i.e., 6 hours, 72 hours of constant exposure) reported influences on short-term hormonal production and release. Additional constant exposure studies indicated the observation of stress reactions, hypertension, and electrolyte imbalances (Dufour 1980). A study by Bond et al. (1963), demonstrated no adverse effects on the feeding efficiency, weight gain, ear physiology, or thyroid and adrenal gland condition of pigs subjected to observed aircraft noise. Observations of heart rate increase were recorded; noting that cessation of the noise resulted in the return to normal heart rates. Conception rates and offspring survivorship did not appear to be influenced by exposure to aircraft noise.

Similarly, simulated aircraft noise at levels of 100-135 dB had only minor effects on the rate of feed utilization, weight gain, food intake, or reproduction rates of boars and sows exposed, and there were no injuries or inner ear changes observed (Gladwin et al. 1988; Manci et al. 1988).

Domestic Fowl

According to a 1994 position paper by the U.S. Air Force on effects of low-altitude overflights (below 1,000 feet) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994b). The paper did recognize that given certain circumstances, adverse effects can be serious. Some of the effects can be panic reactions, reduced productivity, and effects on marketability (e.g., bruising of the meat caused during "pile-up" situations).

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds, and birds not previously exposed, are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994b). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994b). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120-130 dB.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s. Many of the claims were disproved or did not have sufficient supporting evidence. The claims were filed for the following alleged damages: 55% for panic reactions, 31% for decreased production, 6% for reduced hatchability, 6% for weight loss, and less than 1% for reduced fertility (U.S. Air Force 1994b).

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles et al. 1990). Findings from the study suggested that turkeys habituated to jet aircraft noise quickly, that there were no growth rate differences between the experimental and control groups, and that there were some behavioral differences that increased the difficulty in handling individuals within the experimental group.

Low-altitude overflights were shown to cause turkey flocks that were kept inside turkey houses to occasionally pile up and experience high mortality rates due to the aircraft noise and a variety of disturbances unrelated to aircraft (U.S. Air Force 1994b).

A.3.12.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock. This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci et al. 1988).

Mammals

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dB can damage mammals' ears, and levels at 95 dB can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet AGL over important grizzly and polar bear habitat. Wolves have been frightened by low-altitude flights that were 25-1,000 feet AGL. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, rising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kilogram animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed (Weisenberger et al. 1996).

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, are not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci et al. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaska Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America 1980). Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dB caused a greater intensity of startle reactions than lower-intensity booms at 72-79 dB. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater "disturbance level" exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Park Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles et al. 1993).

Birds

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of 1,000 to 5,000 Hz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Ellis et al. 1991; Grubb and King 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant to 85 dB for crested tern (Brown 1990; Ward and Stehn 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by "raucous discordant cries." There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci et al. 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A cooperative study between the DOD and the U.S. Fish and Wildlife Service (USFWS), assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater et al. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater et al. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 m away and SELs were 70 dB.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for 10-20 seconds. No apparent nest failure occurred as a result of the sonic booms. Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4-8 m). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15-20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

Raptors

In a literature review of raptor responses to aircraft noise, Manci et al. (1988) found that most raptors did not show a negative response to overflights. When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis et al. (1991), performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest. Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Reoccupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or re-occupancy. Due to the locations of some of the nests, some birds may have been habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation (Ellis et al. 1991).

Manci et al. (1988), noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises. The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated the greatest reaction to overflights (approximately 98 dB) was "watching the aircraft fly by." No detrimental impacts to distribution, breeding success, or behavior were noted.

Bald Eagle. A study by Grubb and King (1991) on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances. The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 m away caused reactions similar to other disturbance types. Ellis et al. (1991) showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 m, rather than the noise level. Fleischner and Weisberg (1986) stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less. They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane.

The USFWS advised Cannon AFB that flights at or below 2,000 feet AGL from October 1 through March 1 could result in adverse impacts to wintering bald eagles (USFWS 1998). However, Fraser et al. (1985), suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less.

Osprey. A study by Trimper et al. (1998), in Goose Bay, Labrador, Canada, focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences. The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

Red-tailed Hawk. Anderson et al. (1989), conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests. Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (9 of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

Migratory Waterfowl

Fleming et al. (1996) conducted a study of caged American black ducks found that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects (Fleming et al. 1996).

Another study by Conomy et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dB. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38% to 6% in 17 days and remained stable at 5.8% thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward et al. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were less than 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci et al. 1988, reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards et al. 1979).

Wading and Shorebirds

Black et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dB on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology.

Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75% of the 220 observations. Approximately 90% displayed no reaction or merely looked toward the direction of the noise source. Another 6% stood up, 3% walked from the nest, and 2% flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85-100 dB on approach and 94-105 dB on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the Concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the Concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1970, sonic booms were potentially linked to a mass hatch failure of sooty terns on the Dry Tortugas (Austin et al. 1970). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, sooty terns were observed to react to sonic booms by rising in a “panic flight,” circling over the island, then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed normally. A colony of noddies on the same island hatched successfully in 1969, the year of the sooty tern hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Cottereau 1972; Cogger and Zegarra 1980; Bowles et al. 1991, 1994) failed to show adverse effects on hatching of eggs. A structural analysis by Ting et al. (2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger (1981) observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport. The Concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoot toads, may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American alligator and the spectacled caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including a DNL of 85 dB.

A.3.12.3 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the "startle" or "fright" response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

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APPENDIX B
PRC NOISE STUDY

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Blue Ridge Research and Consulting, LLC

Final Report

Noise Study for Training Operations at the Pinecastle Range Complex, Florida

September 2019

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List of Acronyms

ADNL	A-Weighted Day-Night Average Sound Level
$ADNL_{mr}$	A-weighted Onset Adjusted Day-Night Average Sound Level (or L_{dnmr})
AGL	Above Ground Level
AGM	Air-to-Ground Missile
AGNM	Air Gunnery Noise Model
AMM	Airborne Maritime Mining
AR	Army Regulation
BDU	Bomb Dummy Unit
BLU	Bomb Live Unit
BNoise	Large Arms Noise Assessment Model
BP	Bombing Pattern
BRRC	Blue Ridge Research and Consulting, LLC
CSAR	Combat Search and Rescue
dB	Decibel
dBA	A-Weighted Sound Pressure Level
dB_{Pk}	Peak Sound Pressure Level
dB_{Pk15}	Peak Sound Level Exceeded 15 Percent of the Time (see L_{Pk15})
CDNL	C-Weighted Day-Night Average Sound Level (or L_{Cdn})
DNL	Day-Night Average Sound Level
DoD	Department of Defense
EA	Environmental Assessment
EOD	Explosive Ordnance Disposal
FACSFAC JAX	Fleet Area Control and Surveillance Facility Jacksonville
Ft	Feet
GBU	Guided Bomb Unit
IOC	Initial Operational Capability
kts	Knots
HE	High Explosive
Hz	Hertz
lbs	Pounds
L_{Cdn}	C-weighted Day-Night Average Sound Level
L_{dn}	A-weighted Day-Night Average Sound Level
L_{dnr}	Onset-Rate Adjusted Day-Night Average Sound Level
LGTR	Laser Guided Training Round
L_{Pk15}	Peak Sound Level Exceeded 15 Percent of the Time (see dB_{Pk15})
LIA	Live Impact Area
LUPZ	Land Use Planning Zone
LZ	Landing Zone
m	Meter
MAX	Maximum
MCO	Marine Corps Order
MINEX	Mine Exercise
MK	Mark
MOA	Military Operations Area
MRNMap	MOA and Route NoiseMap Model

MSL	Mean Sea Level
MTR	Military Training Route
NA	No Action
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NM	Nautical Mile
PA	Proposed Action
PRC	Pinecastle Range Complex
PHC	Public Health Center
RAICUZ	Range Air Installations Compatible Use Zones
SARNAM	Small Arms Range Noise Assessment Model
SEL	Sound Exposure Level
SESAMS	Special Effects Small Arms Marking System
SUA	Special Use Airspace
TRA	Tactical Runway Area
USN	United States Navy
UTM	Universal Transverse Mercator

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1 Introduction

This noise analysis report supports the US Navy's (USN) preparation of an Environmental Assessment (EA) for existing operations and anticipated future training missions at the Pinecastle Range Complex (PRC). Areas surrounding PRC may be affected by noise related to PRC training operations, and the objective of this noise study is to describe the noise generated by existing and projected training activities at PRC so that the effects of changes in the noise environment can be assessed. Noise modeling is provided for existing operations, which consist of aviation training missions at Pinecastle, Rodman, and Lake George Ranges and small arms ground firing at Pinecastle and Rodman Ranges. Noise modeling for the anticipated future range mission requirements at the PRC include additional training missions of the A-29, F/A-18 Super Hornet, F-35A/B/C, T-45 and other aircraft as identified in the 2017 Range Air Installations Compatible Use Zones (RAICUZ) Study.[i]

This report is divided into sections that provide an overview of the study's objective, methodology, and results. Section 1 provides an overview of the No Action (NA) and Proposed Action (PA) alternatives, as well as an overview of PRC. Section 2 summarizes the noise metrics used to describe and quantify noise environments, with a brief description of the noise analysis models used to calculate the noise exposures. Section 3 provides descriptions of the training operations within PRC. Section 4 presents the calculated noise exposures from PRC operations, and Section 5 provides a list of applicable references.

1.1 Purpose

The objectives of this aircraft noise study are to model the community noise levels from all current and projected aircraft operations at PRC. This analysis includes aircraft subsonic noise and aerial weaponry munitions noise. The NA Scenario represents the current level of approximately 4,100 annual aircraft training sorties being conducted at PRC. For this noise study, a sortie is defined as one aircraft flying from home base into Pinecastle, Lake George, or Rodman Range via an applicable ingress MTR, conducting various training operations, and returning to home base via an egress MTR. The PA involves an increase in current aircraft training sorties and the addition of new aircraft types for an estimated annual sortie rate of 11,000. The PA does not involve any changes or modifications to the special use airspace boundaries and MTRs.

1.2 Description of Pinecastle Range Complex

PRC encompasses a vast area located in and around the Ocala National Forest north of Orlando, FL. Aircraft primarily originate from Naval Air Station Jacksonville or from aircraft carriers that are part of Carrier Strike Groups training in the Atlantic Ocean conducting large scale exercises before deployment. Additionally, as the only Navy training area authorized for live (high explosive) ordnance on the east coast, PRC is utilized by other area installations, as well.[ii] Training occurs in three primary regions of the PRC: Pinecastle Range to the south, Lake George to the east, and Rodman Range to the north. These training areas are overlain and surrounded by Special Use Airspace (SUA). Restricted Areas R-2910A/B/C/D/E, R-2907A/B/C, and R-2906 are associated with Pinecastle, Lake George, and Rodman, respectively.

Additionally, the Palatka 1 Military Operations Area (MOA) overlaps a majority of the restricted area associated with Pinecastle and Lake George and contains some additional area to the west. The Palatka 2 MOA overlaps R-2906 and portions of R-2907B/C as well as additional areas west, north, and east of R-2906. The SUA associated with the PRC is illustrated on Figure 1-1.

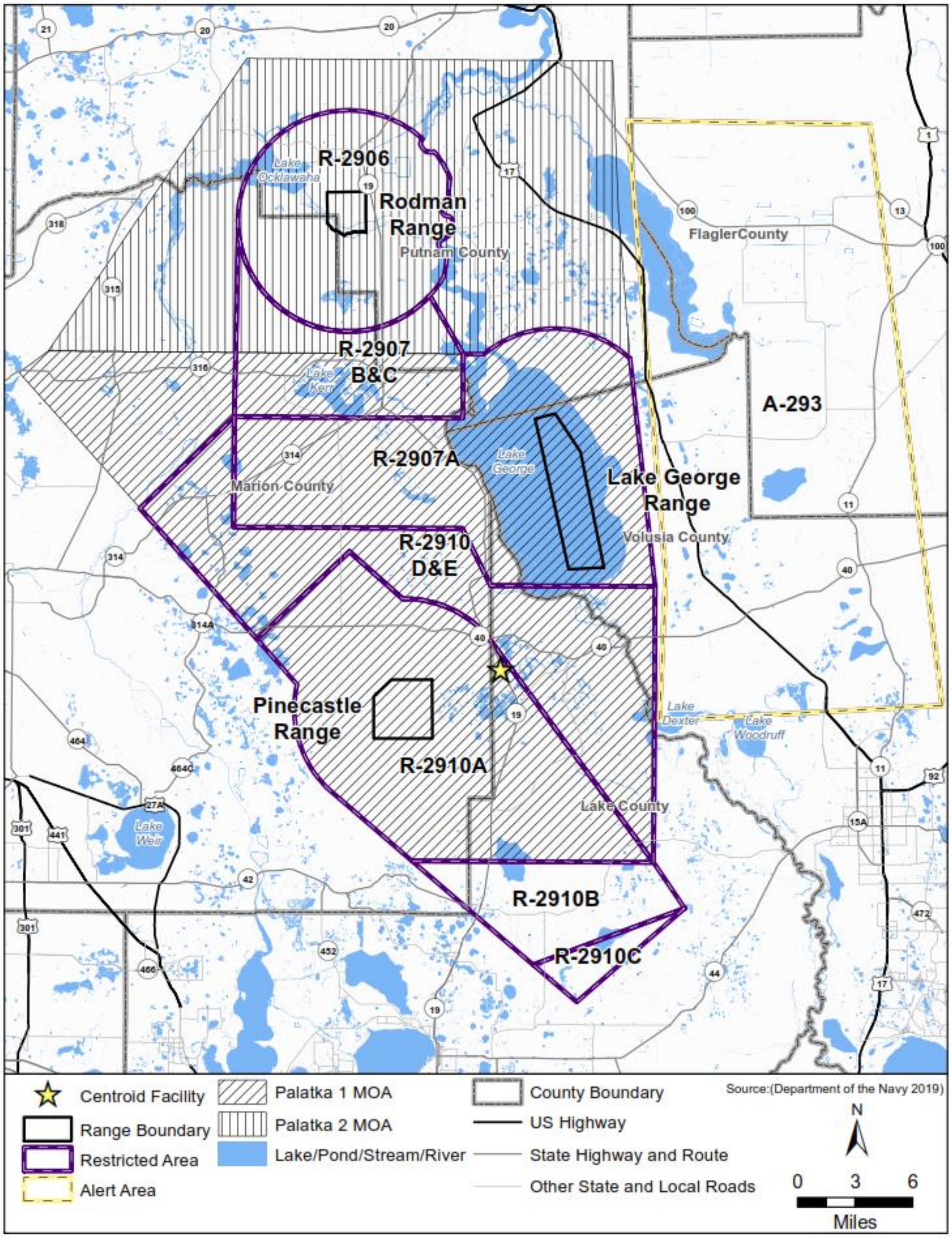

Figure 1-1. Pinecastle Range Complex Special Use Airspace

2 Noise Metrics, Effects, and Models

2.1 Noise Metrics and Effects

Noise is a prominent environmental issue associated with military training operations.[iii] The noise environment at military training areas, such as PRC, includes various types of noise sources that can either be classified as continuous or impulsive noise. *Transient noise* is a technical term describing a noise event, which has a gradual onset and has a duration greater than a few seconds, such as aircraft overflights, but not necessarily noise that is occurring at all times. In contrast, *impulsive noise* refers to sudden noise events with rapid onsets and very brief durations such as weapon-firing or the detonation of explosives.

The noise environment at PRC is dominated by aircraft flight and aerial weaponry events. Humans perceive and react differently to transient and impulsive noise events depending on the level, frequency and duration of the event. Because of the difference in human response to these types of noise events, military operational noise is assessed using several noise metrics. The two most commonly used metrics are the Day-Night Average Sound Level (DNL) and peak noise level (L_{Pk}).

The DNL is the federally recommended noise measure used for assessing cumulative sound levels occurring during a 24-hour period. DNL (which is sometimes denoted by L_{dn}) is an average sound level, expressed in decibels, which is commonly used to assess aircraft noise exposures in communities in the vicinity of airfields.[iv,v,vi] DNL values are related to compatible/incompatible land uses and do not directly relate to any singular sound event a person may hear. DNL includes a 10-dB adjustment for nighttime noise events. Acoustical daytime is defined as the period from 0700 to 2200 hours, and acoustical nighttime is the period from 2200 to 0700 hours the following morning. The 10-dB adjustment accounts for the generally lower background sound levels and greater community sensitivity to noise during nighttime hours.

To assess accurately the impacts on humans from these different types of noise events, the DNL metric is used along with different weighting factors that emphasize certain parts of the audio frequency spectrum. The normal human ear detects sounds in the range from 20 Hertz (Hz) to 20,000 Hz, and it is most sensitive to sounds in the 1,000 to 4,000 Hz range. Community noise is, therefore, assessed using a filter that approximates the frequency response of the human ear, adjusting low and high frequencies to match the sensitivity of the ear. This “A-weighting” filter is used to assess most community noise sources.

Aircraft noise generated in SUA are typically different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, overflights within SUA can be highly variable in occurrence and location. Individual military overflight events also differ from typical community noise events because noise from a low-altitude, high-airspeed flyover can have a sudden onset (i.e. exhibiting a rate of increase in sound level – onset rate – of up to 30 to 150 dB per second).

To represent the differences between military overflights and typical community noise events, the conventional DNL metric is adjusted to account for the “surprise” effect on humans from the sudden onset of aircraft noise events with an adjustment up to 11 dB above the normal Sound Exposure Level (SEL).[vii,viii] Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. This adjustment primarily applies to areas directly overflown by low-altitude, high-speed aircraft. The adjustment quickly diminishes with altitude and/or offset distance. This adjusted DNL is designated as the onset-rate adjusted day-night average sound level (L_{dnr}). L_{dnr} employs A-weighted sound levels in this analysis.

Aerial gunnery operations at PRC may produce substantial noise. This noise is impulsive in nature with sudden bursts of sound pressure originating from the expenditures of aerial munitions, such as the F/A-18 expenditures of 20 mm ammunition during strafing runs or the explosions of live bombs. For impulsive noise, C-weighted sound levels are used. "C-weighted" denotes an adjustment to the frequency content of a noise event to represent human response to louder noise levels. Compared to A-weighting, C-weighting enhances the lower frequency content of a noise event. Strafing noise has two components: ballistic waves (sonic booms) from the bullets, and muzzle blast from the weapon firing. The ballistic waves from the bullets only occur forward of the firing point, whereas muzzle blast can be heard in all directions. Explosions have a single component, which is the blast wave from the detonation of bomb. For these impulsive noise events, the DNL metric is also utilized to characterize munition noise, but C-weighted sound levels are used to account for the lower frequency content. For impulsive noise, the DNL is denoted as CDNL (or L_{Cdn}) to indicate that C-weighting is applied.

For small arms firing, the peak noise level (L_{Pk}) is used to describe its noise. L_{Pk} represents the highest instantaneous pressure level for a firing event. L_{Pk} is related only to a single event and is independent of the number of firing events. Thus, some judgment is required to estimated potential impacts from small arms firing noise based on the how often it occurs at a given location.

In this analysis, range noise was assessed using the DoD recommended noise metrics.[iii,ix] Aircraft flight noise was assessed using the A-weighted onset Adjusted Day-Night Average Sound Level ($ADNL_{mr}$ or L_{dnmr}), which is the equivalent to L_{dn}. The aerial weaponry noise, which includes low frequency and impulsive noise components, was assessed using CDNL, and ground-based small arms noise is described by dB_{Pk}. Table 2-1 provides the noise level limits associated with land use planning.[iii,ix] In general, most land uses are compatible within Noise Zone 1. For Noise Zone 2, some land uses are incompatible with the noise. Within Noise Zone 3, most land uses are incompatible.

Table 2-1. Noise Zone Definitions

Noise Zone	Aviation L_{dn} (dBA)	Impulsive L_{Cdn} (dBC)	Small Arms L_{Pk} (dB_{Pk})	Potential Impacts
1	<65	<62	<87	Lesser
2	65-75	62-70	87-104	Moderate
3	75+	70+	104+	Highest

2.2 Computerized Noise Exposure Models

Noise contours for aircraft operations were developed using a combination of NoiseMap and the MOA and Route NoiseMap Model (MRNMap).[x] Aerial gunnery noise was modeled using the Air Gunnery Noise Model (AGNM)[xi,xii] which models the noise from the muzzle blast, the sonic boom of a supersonic projectile, and rocket/missile firings from an elevated airborne platform. Aircraft sonic booms were modeled using the cumulative sonic boom model, BooMap.[xiii,xiv,xv] Ground-based large and small arms noise was modeled using the standard DoD computer noise models, Large Arms Noise Assessment Model (BNoise)[xvi] and Small Arms Range Noise Assessment Model (SARNAM)[xvii], respectively.

2.2.1 Subsonic Aircraft Noise Modeling

NoiseMap and MRNMap are the standard DoD computer noise models for estimating the aircraft subsonic noise exposures. Pattern-type training missions such as scored strafing patterns were modeled in NoiseMap; MRNMap was used to model less defined operations that are along routes, not tracks, and that occur within a general area. When using a combination of NoiseMap and MRNMap, a flat earth grid (constant ground elevation) is used for both models since MRNMap does not include the effects of terrain

NoiseMap and MRNMap are most accurate for comparing "before-and-after" community noise effects, which would result from the implementation of proposed changes or alternative noise control actions (when the calculations are made in a consistent manner). Both models allow noise predictions for such proposed actions without the actual implementation and noise monitoring of those actions. The noise modeling results of these computer programs, along with noise impact guidelines, provide a relative measure of noise effects around air facilities.

2.2.1.1 NoiseMap

Analyses of aircraft noise exposure around military airfield facilities are normally accomplished by using the NoiseMap program.[xix] NoiseMap can also be applied to operations within a range if the operations occur along a well-defined flight track. NoiseMap is a suite of computer programs that was developed by the US Air Force, which serves as the lead DoD agency for fixed-wing aircraft noise modeling. NoiseMap allows noise prediction without the actual implementation of the operations and noise monitoring of those actions.

The latest NoiseMap package of computer programs consists of BaseOps Version 7, OMEGA10, OMEGA11, NoiseMap Version 7.2, NMPlot Version 4.6, MRNMap 3.0, and the latest issue of NOISEFILE. NOISEFILE is the DoD noise database originating from noise measurements of controlled flyovers at prescribed power, speed, and drag configurations for many models of aircraft. With BaseOps the user enters the runway coordinates, airfield information, flight tracks, and flight profiles along each track by each aircraft, numbers of flight operations, run-up coordinates, run-up profiles, and run-up operations. After the operational parameters are defined, NoiseMap calculates DNL values on a grid of ground locations on and around the facility. The NMPlot program draws contours of equal DNL for overlay onto land-use maps.

2.2.1.2 MOA and Route NoiseMap Model (MRNMap)

Analyses of aircraft noise exposures and compatible land uses around and underneath SUAs are normally accomplished using MRNMap.[xix] The US Air Force developed this general-purpose computer model for calculating noise exposures occurring away from airbases, since aircraft noise is also an issue within MOAs and ranges, as well as along a Military Training Route (MTR). This model expands the calculation of noise exposures away from airbases by using algorithms from both NoiseMap and RouteMap.[xviii,xix,xx] MRNMap uses two primary noise models to calculate the noise exposure: track and area operations. Track operations are for operations that have a well-defined flight track, such as MTRs, aerial refueling, and strafing tracks. Area operations are for operations that do not have well defined tracks, but occur within a defined area, such as air-to-air combat within a MOA.

The program also uses the BaseOps user interface for the development of the input data. For track operations, input requirements are the same as for RouteMap, but more than just MTRs can be modeled. For area operations, the model allows flexibility. If little is known about the airspace utilization within a MOA, then the MOA boundaries can simply be used, and the operations are uniformly distributed within the defined area. However, if more is known about how and where the aircraft fly within the MOA, subareas can be defined within the MOA to more accurately model the noise exposure.

Once the airspace is defined, the user must describe the different types of missions occurring within each airspace segment. Individual aircraft missions include the altitude distribution, airspeed, and engine power settings. These individual profiles are coupled with airspace components and annual operational rates.

Once the airspace and operational parameters are defined, MRNMap calculates the resulting L_{dn} or L_{dnr}. The model calculates these noise metrics either for a user-defined grid or at user-defined specific points. The grid calculation can be passed to NMPlot to plot the noise contours as is provided in this analysis. The specific point calculation generates a table that provides the noise exposure, as well as the top contributors to the noise exposure. MRNMap does not include the effect of terrain and is a flat-earth model.

2.2.2 Air Gunnery Noise Model

A number of aircraft and ground-based weapon system noise models have been developed over the past 30 years to estimate noise levels from military operations. The results from these models are used to assess the potential for community and environmental impacts from existing and proposed operations. Current DoD noise models use common aircraft and weapon system source noise databases maintained by the Air Force Research Laboratory, US Army Construction Engineering Research Laboratory, and NAVFAC. However, these models and the source noise databases do not provide the capability to assess noise impacts due to airborne weapon operations. Thus, a new computer model has been developed to address the generation and propagation of noise from air-weaponry operations.[xxi,xxii,xxiii] The model handles the complexity of the distributed noise events while maintaining accurate acoustical modeling that is required for environmental noise analysis.

One of the complexities related to AGNM is that aircraft rarely fly the exact attack profile prescribed, and in some cases, the attack run is simply a generalized fan where the pilot can approach the target from a range of headings. To solve this problem of an unknown source location, a generalized statistical firing volume is used. This volume is defined by the parameters of the attack run with a three-dimensional Gaussian distribution of firing points. The noise footprint is then calculated to represent the noise from a single bullet fired from within the space. This statistical method is not representative of a single bullet fired, but it is rather the average noise expected once a statistically large number of bullets have been fired.

For this PRC study, a wide range of operations were modeled, from helicopter gunnery to Hellfire missiles. AGNM handles the noise from the actual firing as well as the ballistic wave of the projectile. As noted in the Large Arms Noise section below, the noise from high explosive blasts was modeled using BNoise. The AGNM results for this analysis involve L_{Cdn} noise contours, which include noise from muzzle blast, propulsion noise and ballistics wave of aerial weaponry training. The output is an NMPlot grid file that contains all of the case information and lists each of the modeled firing points together with their probabilities. For the final results, the AGNM results are combined with the large weaponry noise calculated by BNoise (see below) since they are both represented by the same noise metric, L_{Cdn}.

2.2.3 Large Arms Noise Assessment Model (BNoise)

The noise associated with the detonation of the high explosive (HE) rounds was modeled using BNoise. The explosive portion of Hellfire missile and live bomb impacts were combined with the AGNM results and are represented by 70, 62, and 57 dB CDNL. Per the BNoise software usage requirements, the model inputs and results were submitted to and approved by the Army Public Health Center (Army PHC).

2.2.4 Small Arms Range Noise Assessment Model (SARNAM)

The standard DoD model SARNAM computes a number of noise metrics including L_{Pk} based on the range description (geographic coordinates, size of the range, number of targets, and direction of fire), weapons and ammunition used (munition type and number of day/nighttime rounds fired), and atmospheric conditions. SARNAM was used in this analysis to calculate the buffer area distances for 87 dB_{Pk} and 104 dB_{Pk} for tactical small arms range operations in the PRC.

3 Training Operations

The types of training operations conducted at PRC are numerous and variable. Composite profiles provide accurate modeling of the overall noise from these various training missions. Assessment of aircraft noise at air-to-ground ranges requires a range of data to describe the types, frequency, and locations of noise-generating operations occurring within and around the range. The primary sources of data are the training and readiness manual, interviews with aircrews and range personnel, and annual reports. The primary missions executed at the PRC include ground attacks by fixed-wing aircraft, including the A-10, A-29, AV-8, AC-130, KC-130J, F-15, F-16, F/A-18C, F/A-18E/F, F-35A/B/C, P-3, P-8, and, T-45 airframes. For rotary-wing aircraft, the primary current users are H-60 and H-65 helicopters with additional future representative activities modeled as AH-1, UH-1, H-53 and V-22 airframes. For this analysis, the major users and their primary training missions are modeled at PRC to provide the overall noise exposure for the cumulative training operations. However, other potential users and/or training missions may occur, but they would not affect the cumulative noise exposures. For annual sortie rates, data records from 2013 through 2017 were used to establish the baseline conditions. Pilots and range personnel were interviewed to develop the projected future annual sortie rates. The set of modeled flight training missions is vast and includes landing zone operations at the Rodman and Pinecastle Ranges, as well as the CENTROID and US Forest Service helicopter base locations.

3.1 Pinecastle Range Flight Training Missions

Table 3-1 displays the general tracked training missions and area missions conducted by each airframe within the Pinecastle Range (R-2910). The mission types and the associated profiles for each aircraft type are described in detail in the following sections. The table lists the new aircraft that will be utilize at the ranges under the PA scenario. These new aircraft training missions are not included in the Baseline/NA scenario.

3.1.1 Ingress and Egress Routes

The Pinecastle Range has two designated aircraft ingress route types: fixed-wing and rotary-wing (as shown in Figure 3-1). The fixed-wing route approaches from the east and enters the southern portion of the Pinecastle Range airspace. This route has a wide corridor as indicated by the track widths. The rotary-wing route approaches the range from the east via the Centroid or USFS Helicopter Base Landing Zones (LZ). Fixed-wing aircraft travel along the southern ingress/egress route at 190-300 kts (A-10, A-29, AC-130, P-3, P-8, Cessna, and KC-130) to 450-500 kts (AV-8, EA-6, EA-18, F-15, F-16, F/A-18, F-35A/B/C, and T-45), 19,000’ to 22,000’ above mean sea level (MSL), and rotary-wing aircraft fly at 100 to 120 kts (H-60, H-65, V-22, H-53, AH-1, and UH-1), 500’ to 1,500’ above ground level (AGL). For the rotary-wing ingress and egress, operations are also modeled at the LZs for some of the operations. The tempo of these LZ operations are provided in Table 3-2, and the modeled areas are shown in Figure 3-1 and Figure 3-2. The modeled areas have two components: the approach/departure (larger area) and the LZ (smaller area). The large area has an altitude band of 100’ to 300’ AGF, and the smaller area has an altitude band of

1’ to 100’ AGL. For these LZ operations, the duration is 10 minutes with time equally split between the two areas.

3.1.2 Low and High Angle Strafe Patterns

A low and high angle strafe pattern consists of a rectangular flight track with varying dive angles. The F-15, F-16, F/A-18, F-35B/C, A-10, A-29, and AV-8 airframes conduct training missions using the impact strafe target within the Pinecastle Range. The low angle patterns include diving attack angles of 0° to 15°, and the high angle patterns consist of 15° to 30° dives. On average, F-15 and F-16 strafe patterns are conducted at 500 kts, F/A-18, F-35B/C, and AV-8 are at 450 kts, A-10 is at 400 kts, and A-29 is at 320 kts. Figure 3-3 and Figure 3-4 display the track and 38° clockwise direction flown for representative low and high angle strafe patterns, respectively.

Table 3-1. Mission Distribution for Pinecastle Range (R-2910)[1]

Aircraft	New Aircraft	Tracked Missions							Area Missions				
		Ingress/ Egress	Low Angle Strafe	High Angle Strafe	Bomb Delivery	TRA High Angle	Orbit	Rotorcraft Gunnery	CSAR	LZ	Palatka 1	R-2910 A/B/C	R-2910A
F/A-18E/F USN		✦	✦	✦	✦	✦			✦		✦	✦	✦
F/A-18C/D USN		✦	✦	✦	✦	✦			✦		✦	✦	✦
F/A-18C/D USMC[1]		✦	✦	✦	✦	✦					✦	✦	✦
F-16		✦	✦	✦		✦					✦	✦	✦
F-15		✦	✦	✦		✦					✦	✦	✦
A-10		✦	✦	✦		✦					✦	✦	✦
AV-8		✦	✦	✦		✦					✦	✦	✦
P-3		✦			✦								
P-8	✦	✦			✦								
EA-6		✦									✦		
EA-18G	✦	✦									✦		
V-22		✦						✦		✦			
Cessna		✦									✦		
AC-130		✦					✦						
H-60		✦						✦	✦	✦			
MH-65		✦						✦					
AH-1	✦	✦						✦		✦			✦
UH-1	✦	✦						✦		✦			✦
H-53	✦	✦						✦		✦			✦
KC-130	✦	✦					✦						
T-45	✦	✦			✦								
A-29	✦	✦	✦	✦		✦					✦	✦	✦
F-35A	✦	✦											✦
F-35B	✦	✦	✦	✦	✦	✦					✦	✦	✦
F-35C	✦	✦	✦	✦	✦	✦					✦	✦	✦

[1] The USMC does not perform operational activity with the F/A-18E/F.

Table 3-2. Rotary-wing Ingress/Egress Landing Zone Operation Distributions

Helicopter	Baseline	Proposed	Percent Landing		
			Centroid	USFS Helo Base	No Landing
H-60	253	300	30%	20%	50%
MH-65	21	50	10%	20%	70%
V-22	5	50	45%	45%	10%
AH-1	0	150	20%	50%	30%
UH-1	0	150	20%	50%	30%
H-53	0	150	20%	50%	30%
Total	279	850			

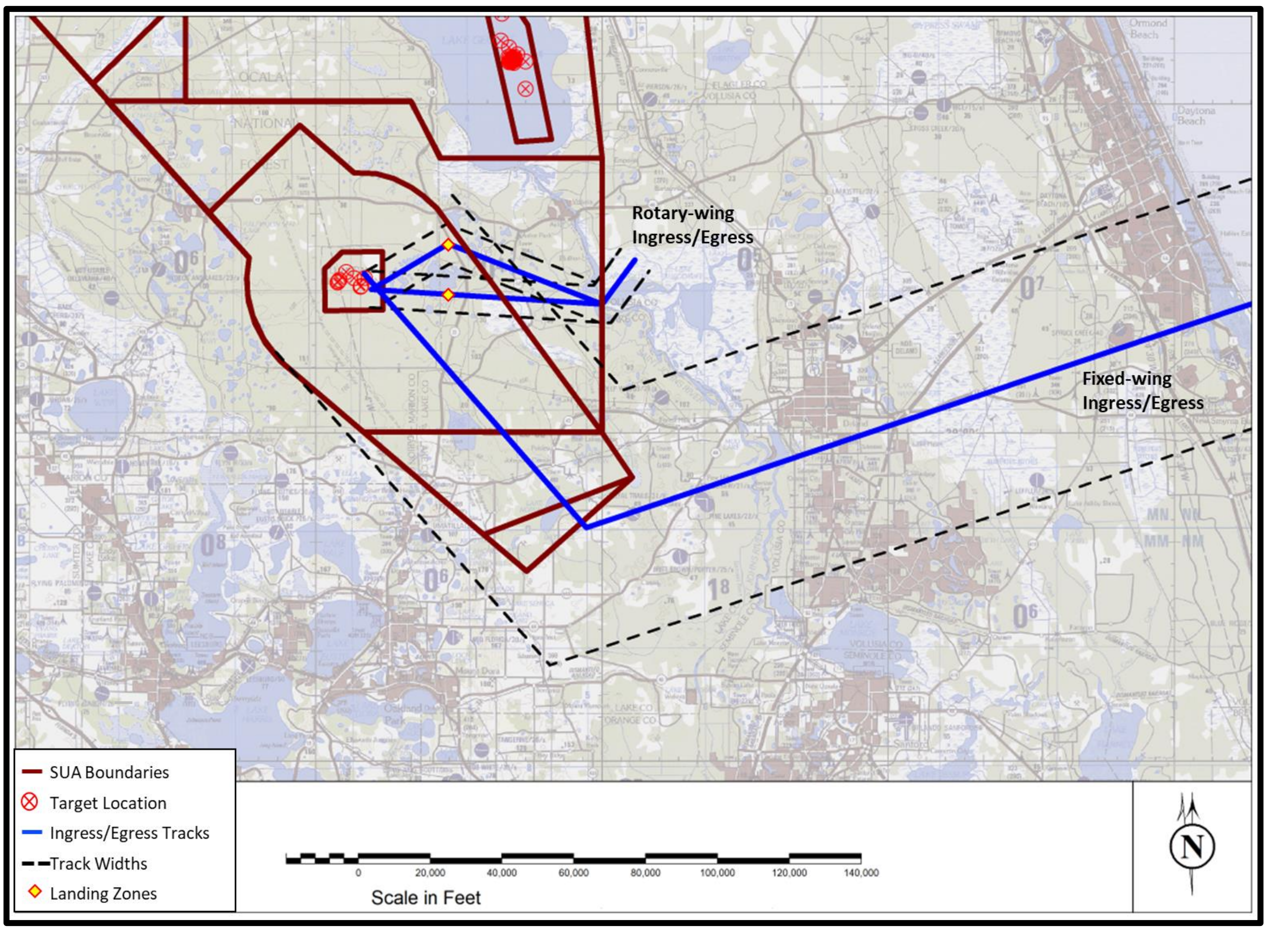

Figure 3-1. Ingress/Egress Routes Into/Out of Pinecastle Range (R-2910A)

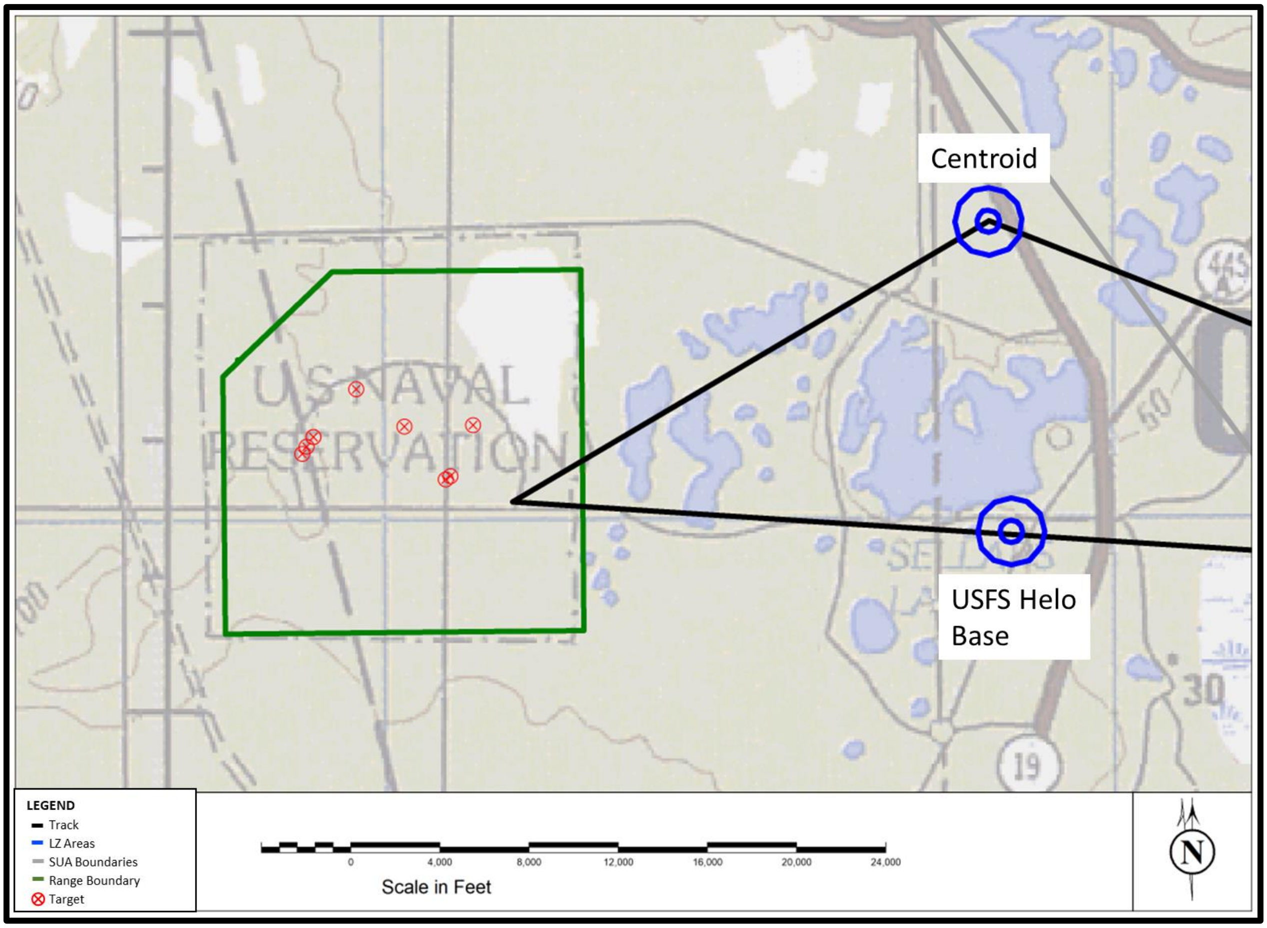

Figure 3-2. Rotary-wing Ingress and Egress Landing Zones

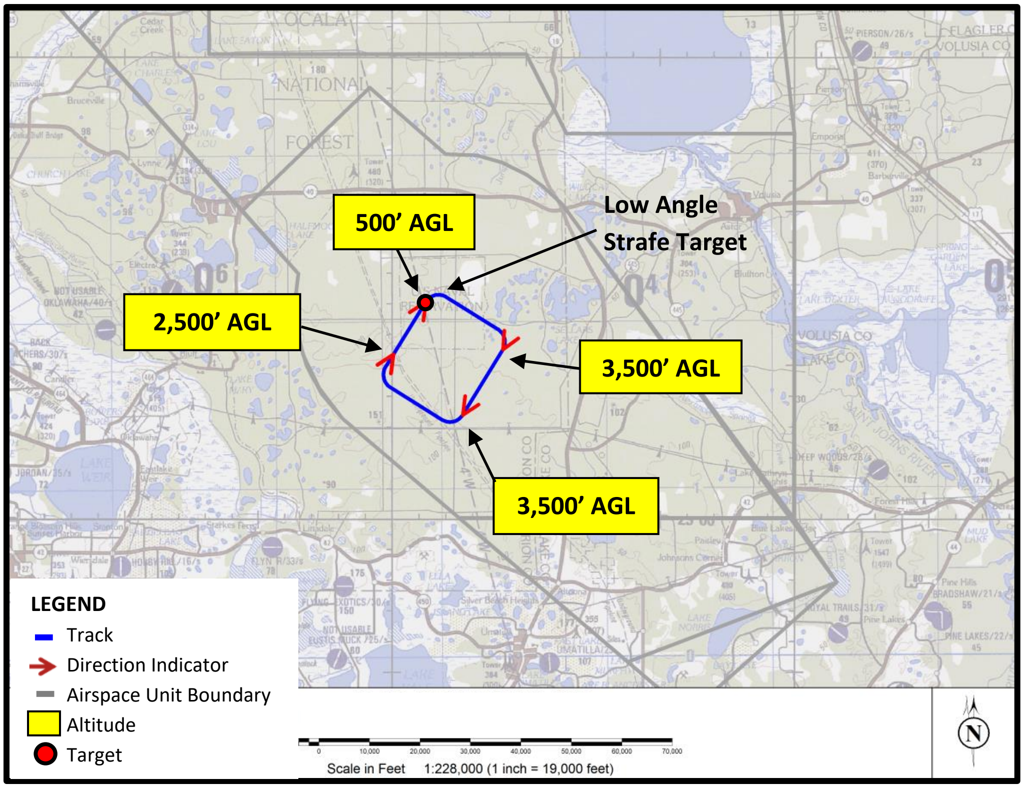

Figure 3-3. Low Angle Strafe Pattern with a 10° Dive

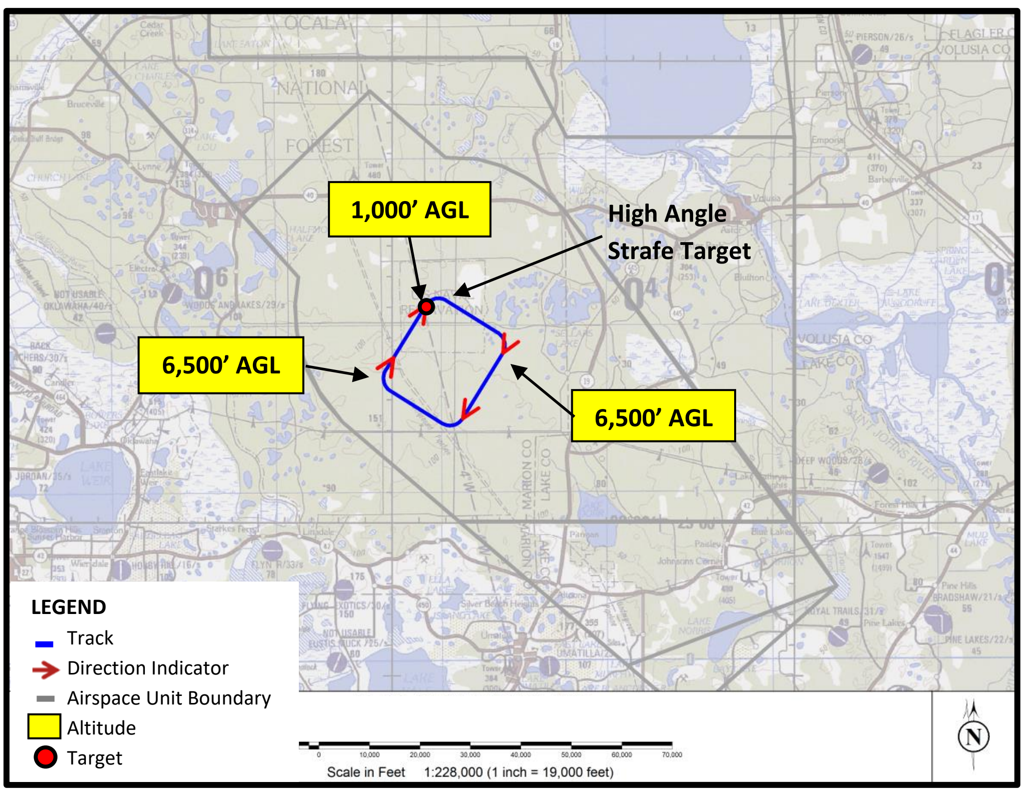

Figure 3-4. High Angle Strafe Pattern with a 25° Dive

3.1.3 Tactical Runway Area High Angle Strafe Pattern

High Angle Strafe Patterns along the Tactical Runway Area (TRA) are conducted by the F-15, F-16, F/A-18, F-35B/C, A-10, A-29, and AV-8 airframes within the Pinecastle Range. These high angle patterns include diving attack angles of 15° to 30° at a 142° heading. Consistent with the low and high angle strafe patterns aligned with the impact strafe target, the TRA high angle strafe pattern involves F-15 and F-16 speeds of 500 kts, F/A-18, F-35B/C, and AV-8 speeds of 450 kts, A-10 speed of 400 kts, and A-29 speed of 320 kts. Figure 3-5 displays the track and counterclockwise direction flown for a representative TRA high angle strafe pattern. The F-35B/C conducts strafing at the Village West Target at 450 kts and a 25° dive angle following the same altitude pattern as depicted in Figure 3-5.

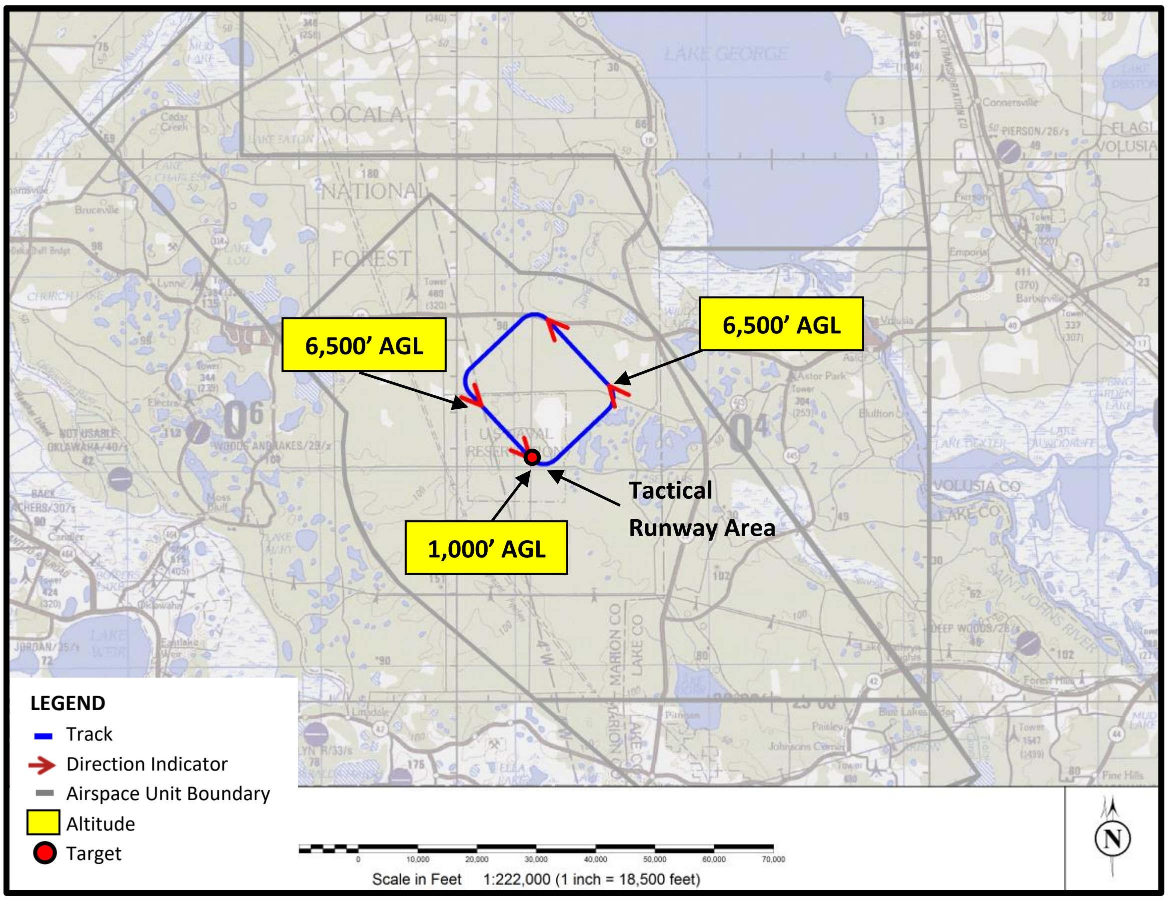

Figure 3-5. High Angle Strafe Pattern with a 25° Dive and 142° Heading

3.1.4 Bomb Delivery Patterns

Within the Pinecastle Range, bomb delivery patterns are represented at the Live Impact Area (LIA) by the F/A-18, F-35B/C, and T-45 aircraft, and at the TRA by the P-3 and P-8 aircraft. For the F/A-18 and F-35B/C representative bombing training missions (Figure 3-6), the bomb delivery patterns is nominally at a diving attack angle of 30° at headings of 317°, 169°, and 137°, and speeds averaging 400 to 500 kts. Figure 3-6 provides the profile details for the 137° attack heading, which follows a counterclockwise direction. The profile is the same for the two other attack headings.

For the P-3 and P-8 representative bombing training missions, the bombing delivery profiles are based on the TRA and include low altitude (Figure 3-7) and level (Figure 3-8) deliveries. The P-3 airspeed is modeled as 250 kts with the P-8 airspeed at 350 kts for these profiles.

The next series of bombing profile is for the additional training sorties for the T-45 aircraft. Three bombing profiles are modeled for these new training missions, and they include diving deliveries at 10°, 15°, and 30° at attack headings of 137° and 317°. The airspeed varies from 250 to 450 kts for these profiles. Figure **3-9** through Figure 3-11 display the nominal altitudes for these new bombing profiles for the 137° attack heading.

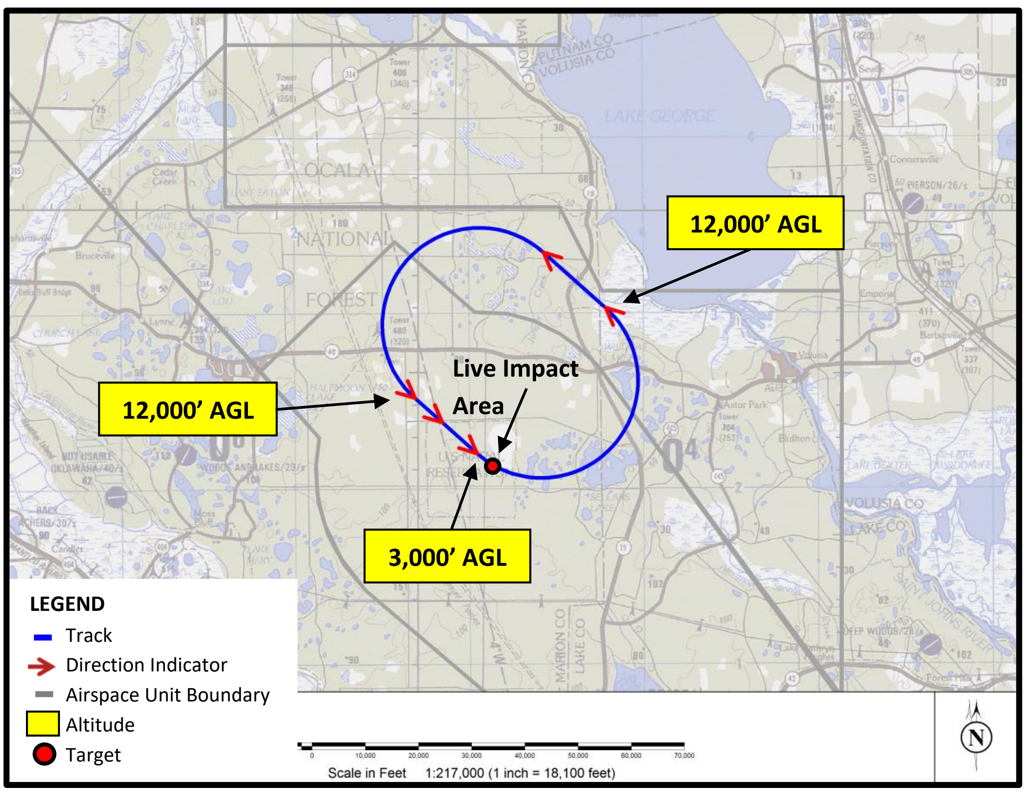

Figure 3-6. Bomb Delivery Pattern to Live Impact Area with a 30° Dive and a 137° Heading

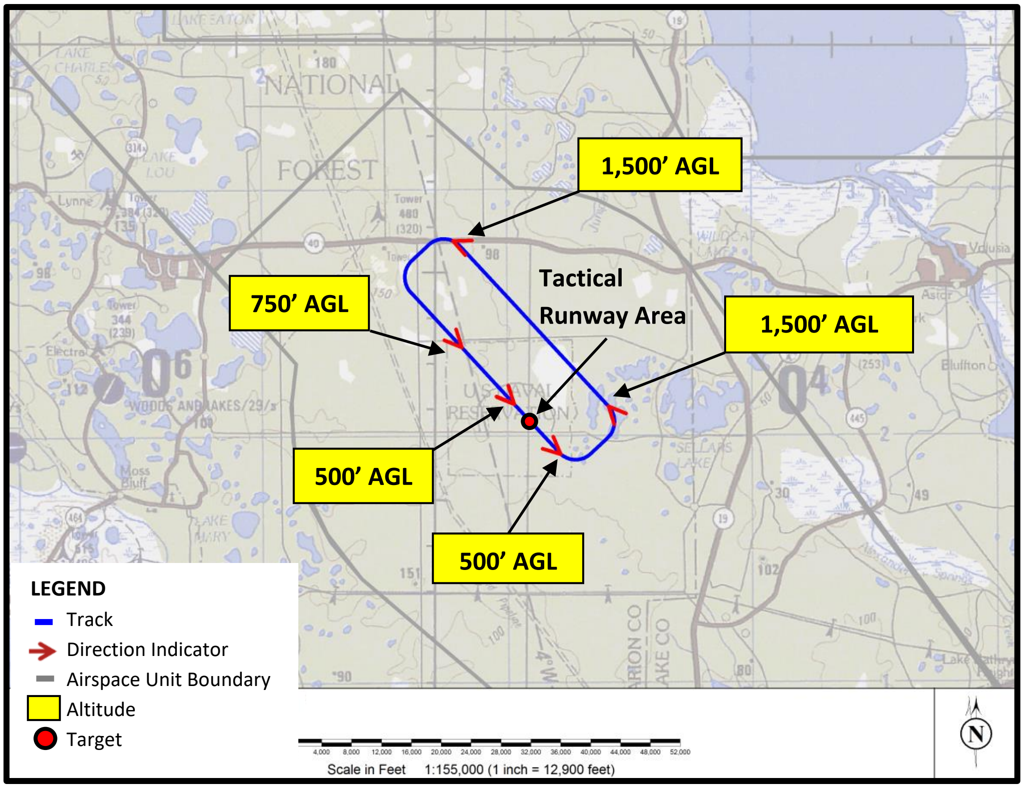

Figure 3-7. Bomb Delivery Pattern to Tactical Runway Area with a 137° Heading

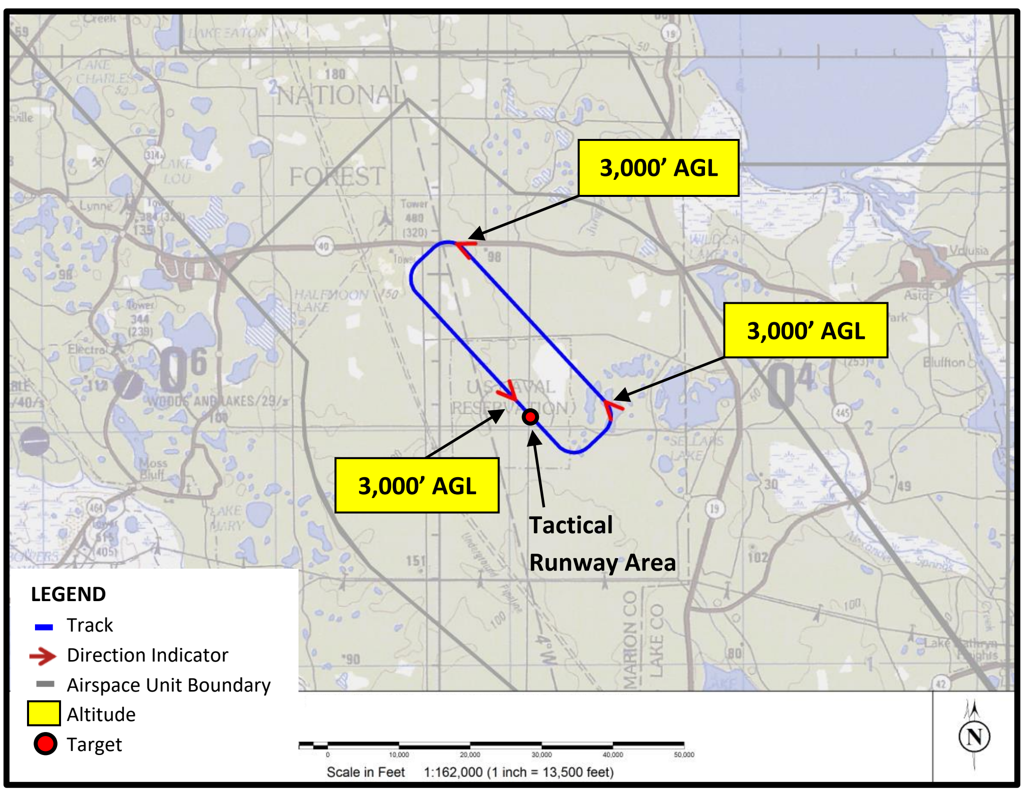

Figure 3-8. Level Bomb Delivery Pattern to Tactical Runway Area with a 137° Heading

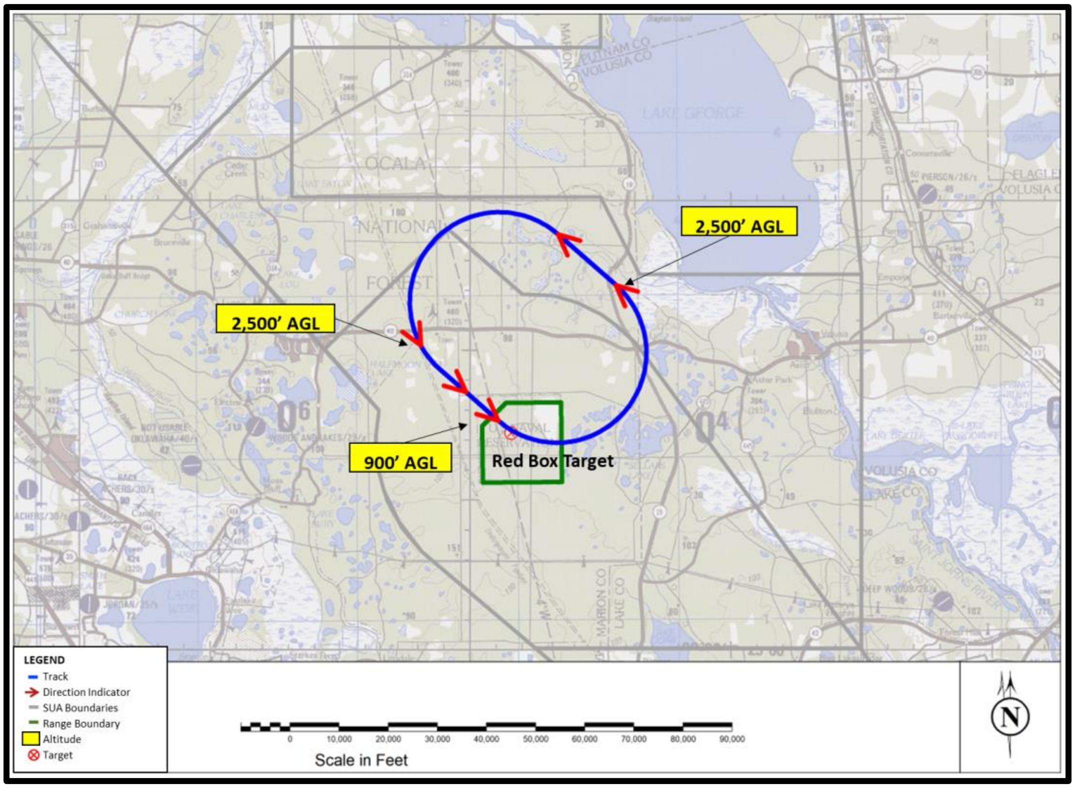

Figure 3-9. T-45 Bomb Delivery Pattern to Live Impact Area with a 10° Dive and a 137° Heading

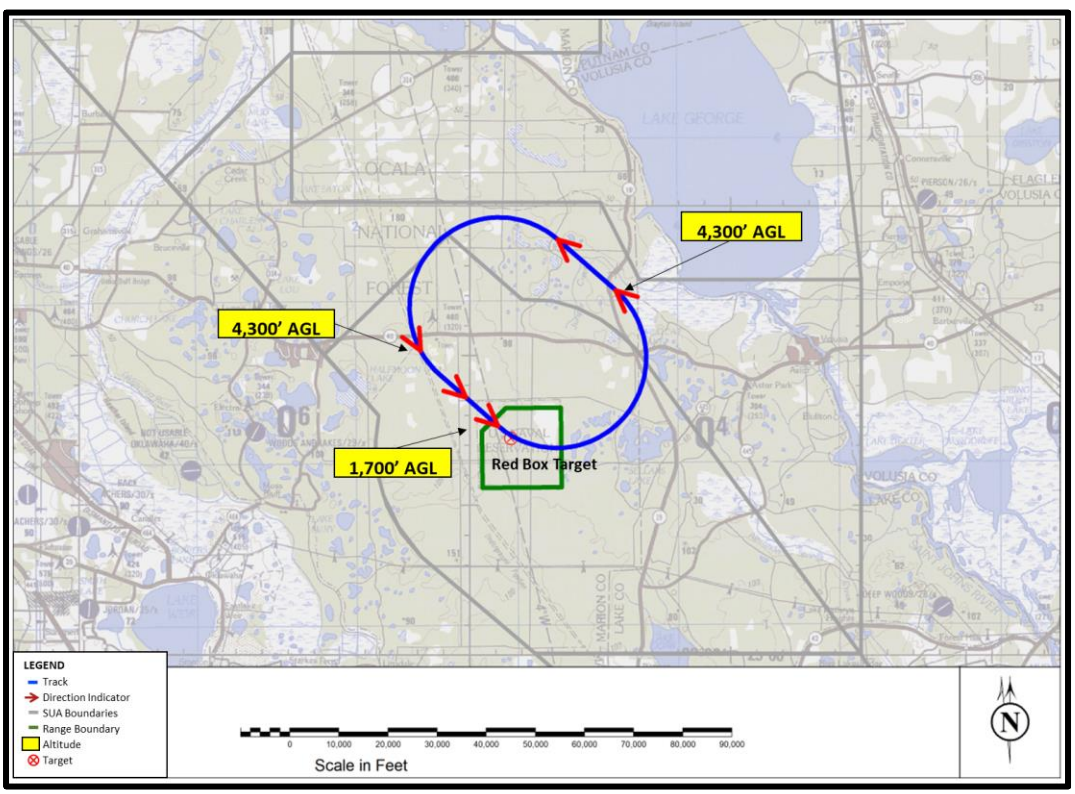

Figure 3-10. T-45 Bomb Delivery Pattern to Live Impact Area with a 15° Dive and a 137° Heading

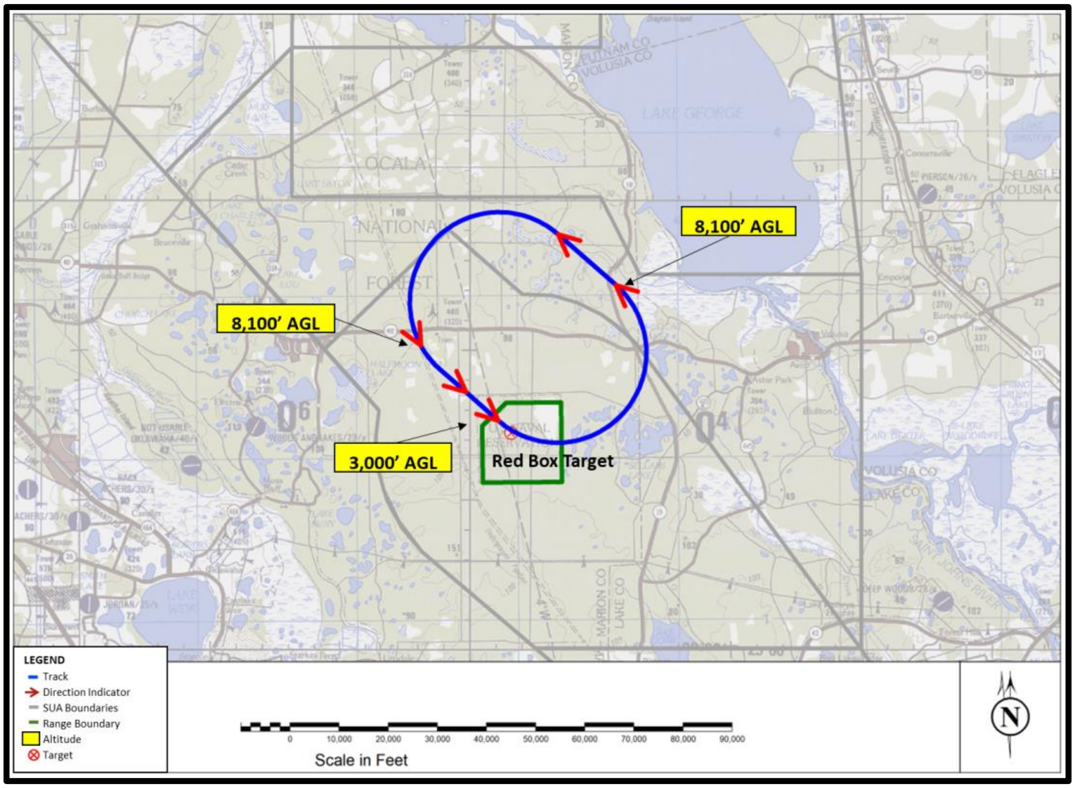

Figure 3-11. T-45 Bomb Delivery Pattern to Live Impact Area with a 30° Dive and a 137° Heading

3.1.5 Orbit Patterns

As shown in Figure 3-12 and Figure 3-13, the AC-130 and KC-130J airframes perform orbit patterns around the TRA and LIA, respectively. These counterclockwise patterns are flown at 190 kts on average and at 9,000' AGL for the AC-130 and 10,000' AGL for the KC-130J. The radius of the AC-130 orbit around the TRA is 1.3 NM, and the KC-130J orbit radius is 4.5 NM. Both orbits are entirely contained within the R-2910A SUA but not within the range boundary.

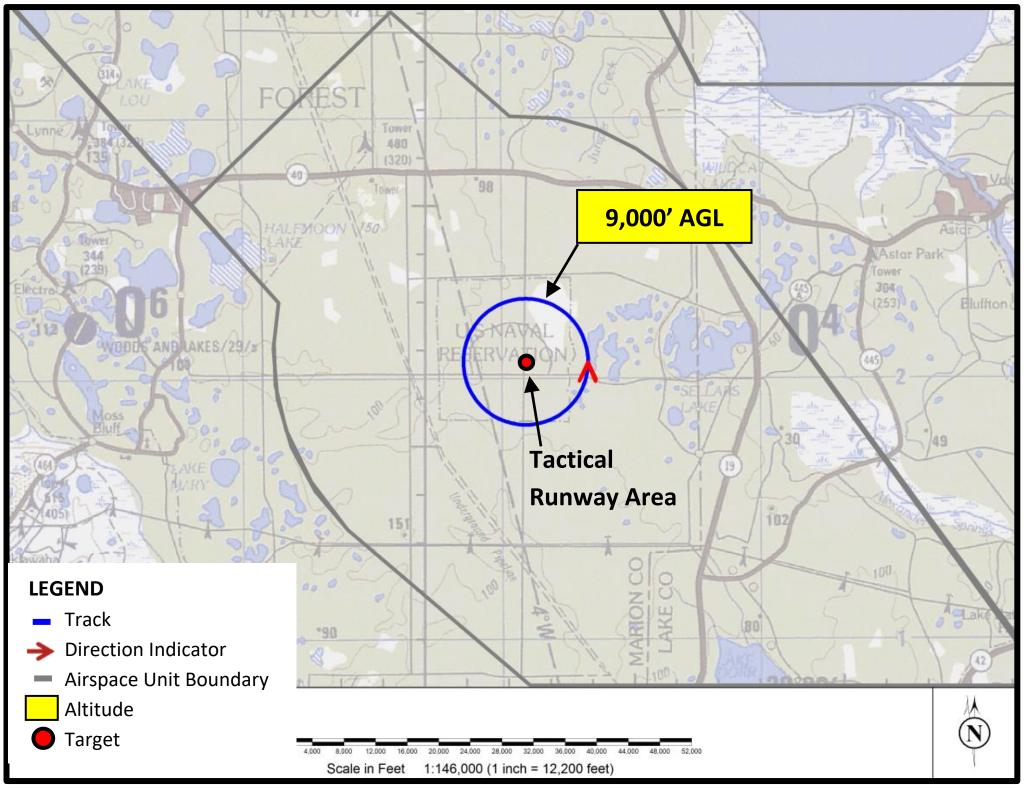

Figure 3-12. Orbit Pattern for the AC-130 Airframe around the TRA at 9,000' AGL

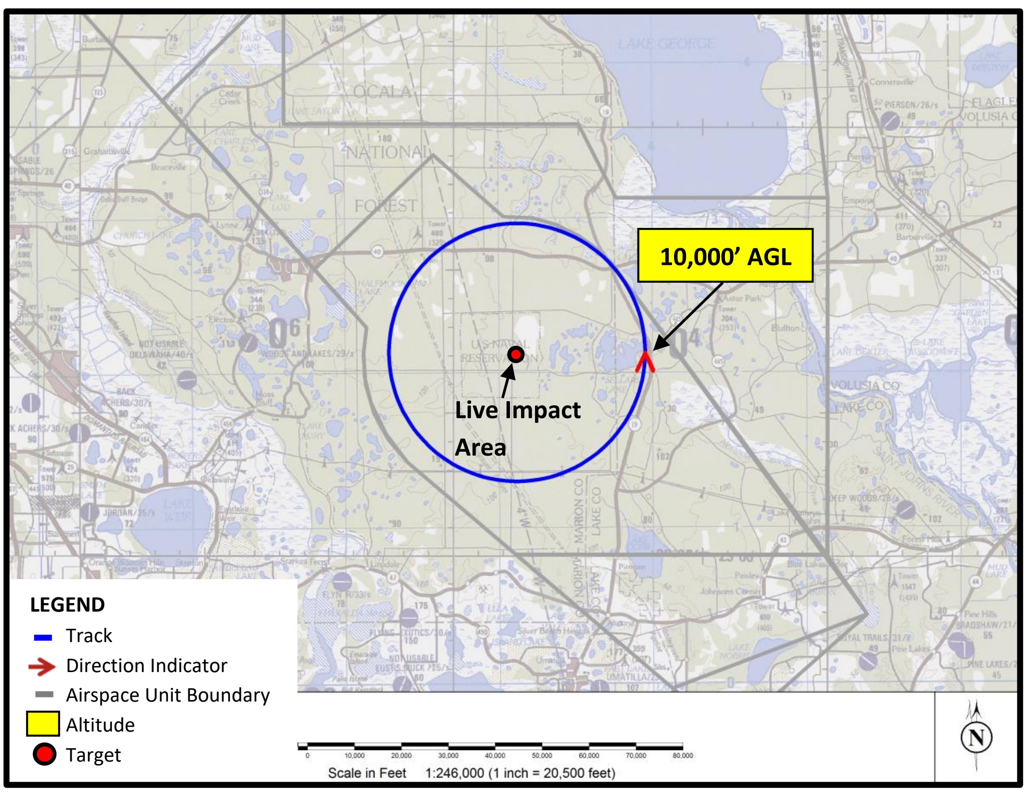

Figure 3-13. Orbit Pattern for the KC-130J Airframe around the LIA at 10,000' AGL

3.1.6 Rotary-wing Aircraft Air Gunnery Patterns

Varied air gunnery patterns are conducted within the Pinecastle Range by rotary-wing aircraft, including the AH-1, UH-1, H-53, H-60, H-65, and V-22 airframes. Figure 3-14 displays the four air gunnery side-fire lanes utilized by the H-60 and H-53 at 100’ AGL, and the UH-1 at 500’ AGL, following 137° and 317° headings. The H-60 conducts these side-fire operations at an average speed of 40 kts, the H-53 travels at a cruising speed of 120 kts, and the UH-1 travels at 80 kts.

The AH-1, UH-1, and H-60 conduct three variants of a forward-fire pattern at the TRA and Village West target areas. These patterns are flow at 500’ AGL and 100 kts by the AH-1, 500’ AGL and 80 kts by the UH-1, and 100’ AGL and 40 kts by the H-60. All three airframes use attack headings of 37°, 137°, and 317° as shown in Figure 3-15.

Figure 3-16 depicts the two HE patterns flown by the AH-1 at 500’ AGL and by the H-60 at 100’ AGL, along attack headings of 137° and 317°. Like the forward fire operations, the AH-1 and H-60 travel at 100 kts and 40kts, respectively. Rocket firings from H-60 rotary-wing aircraft occur within R-2910A, at 100’ AGL along headings of 137° and 317° at the TRA, as shown in Figure 3-17.

The V-22 performs tail and belly gun training at 500’ and 4,500’ AGL, respectively, along both 137° and 317° headings and at 80 kts (see Figure 3-18). Lastly, Figure 3-19 displays the flight pattern for air gunnery operations at the moving strafe target. The H-60, H-65 and AH-1 airframes perform training operations along a 317° heading at 100’, 200’ and 500’ AGL, respectively. The H-60 and H-65 traverse at 40 kts, and the AH-1 flies at an average of 100 kts.

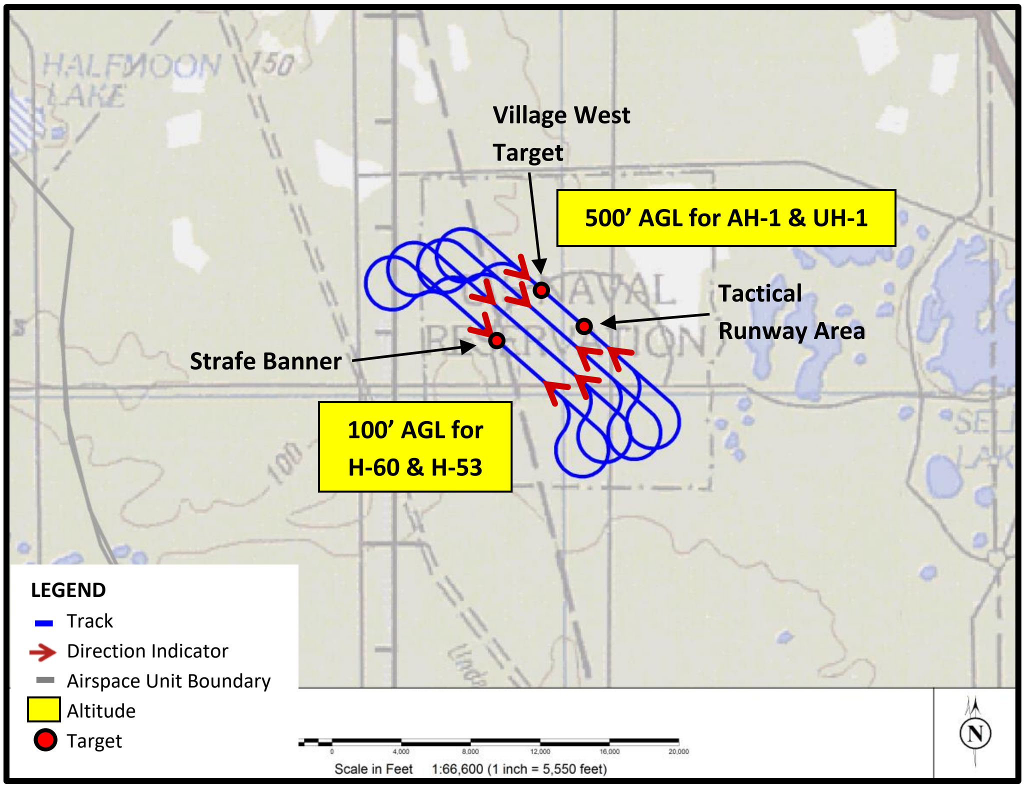

Figure 3-14. Air Gunnery Side-Fire Lanes for the Helicopters

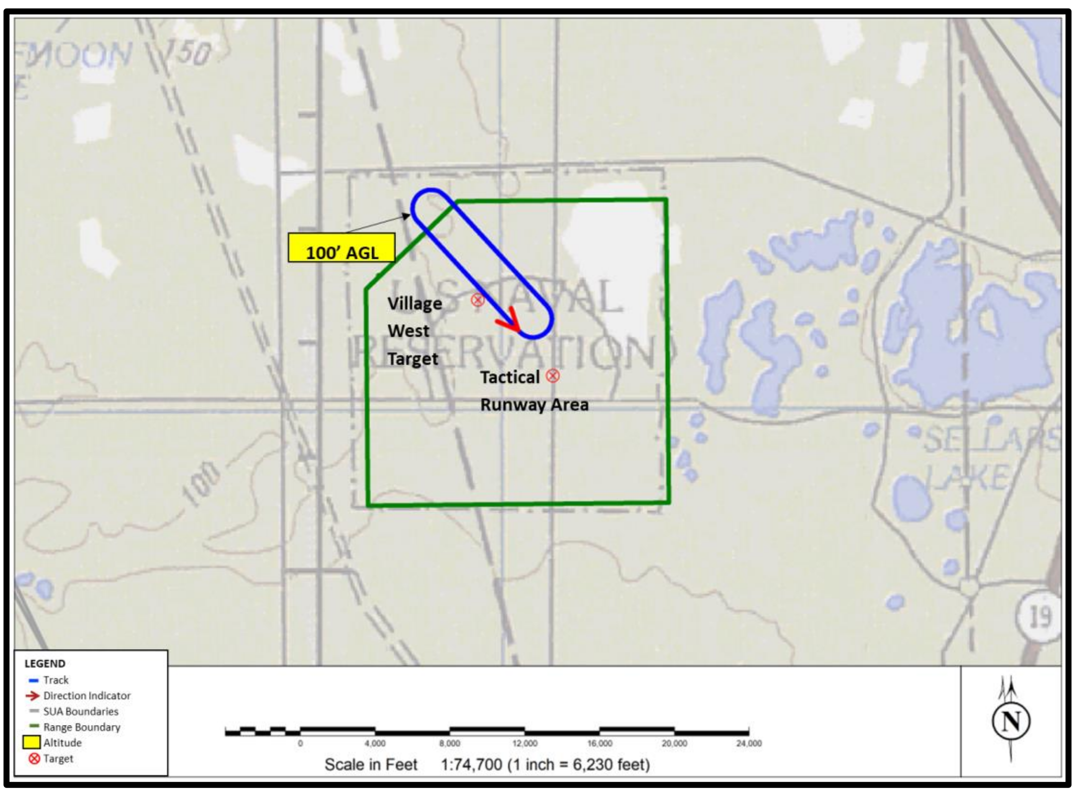

Figure 3-15. Air Gunnery Forward-Fire Patterns for the Helicopters

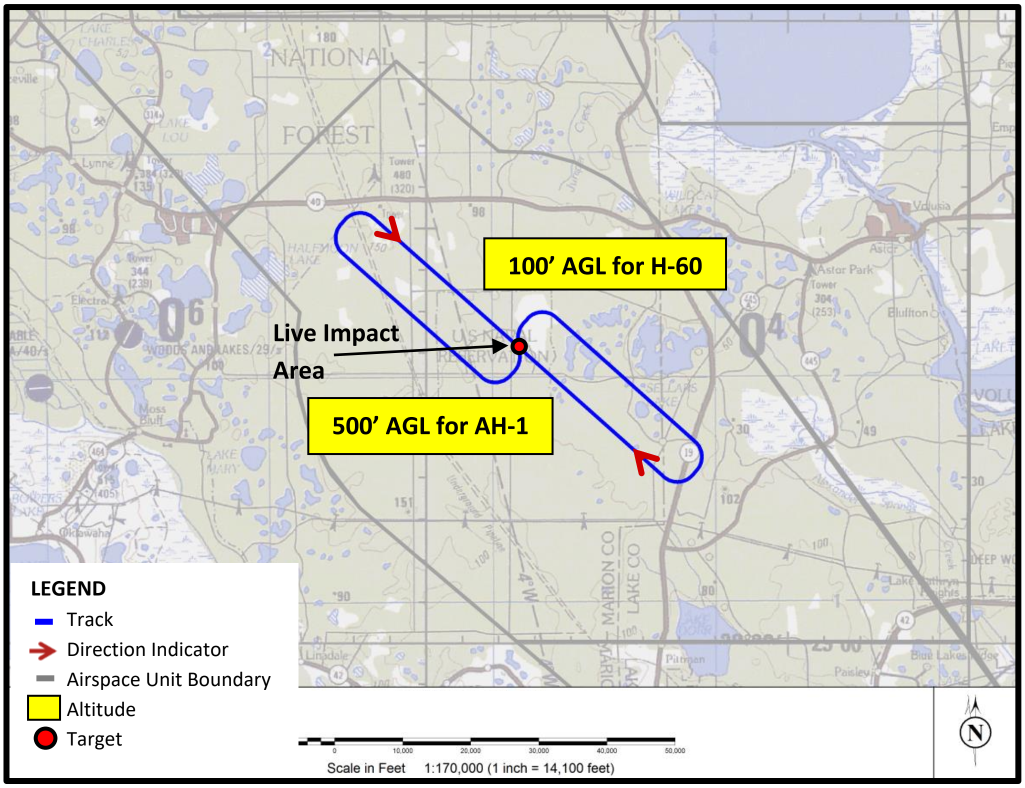

Figure 3-16. Air Gunnery HE Patterns for the Helicopters

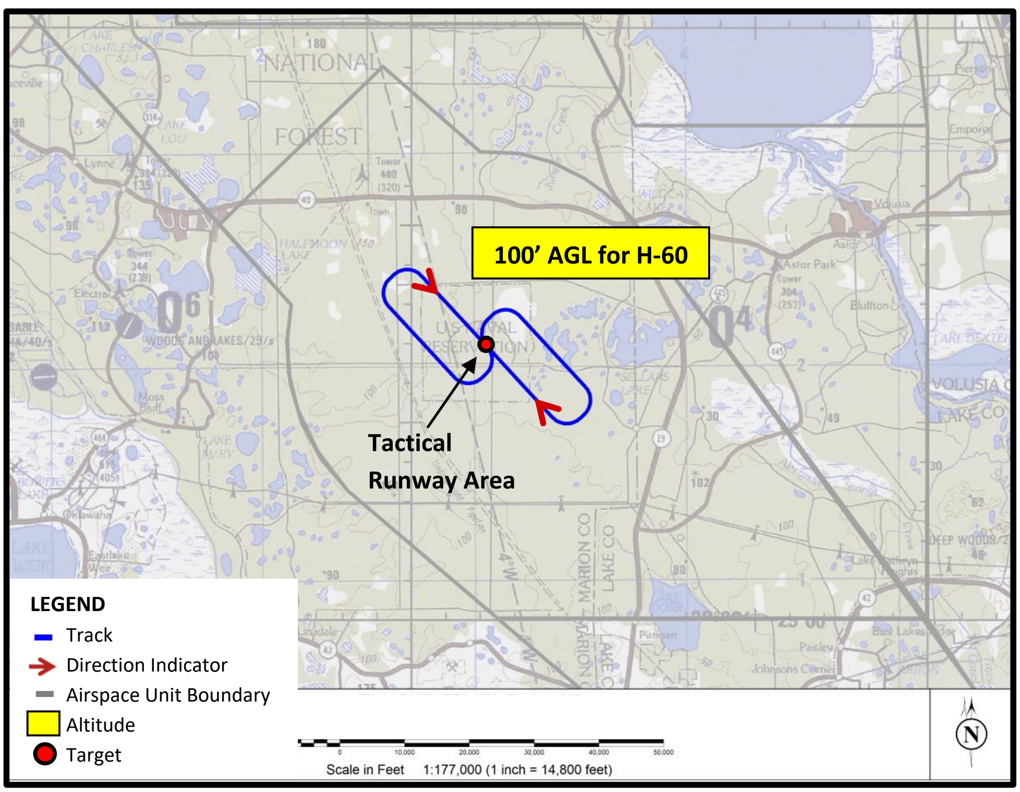

Figure 3-17. Air Gunnery Rocket Patterns for the Helicopters

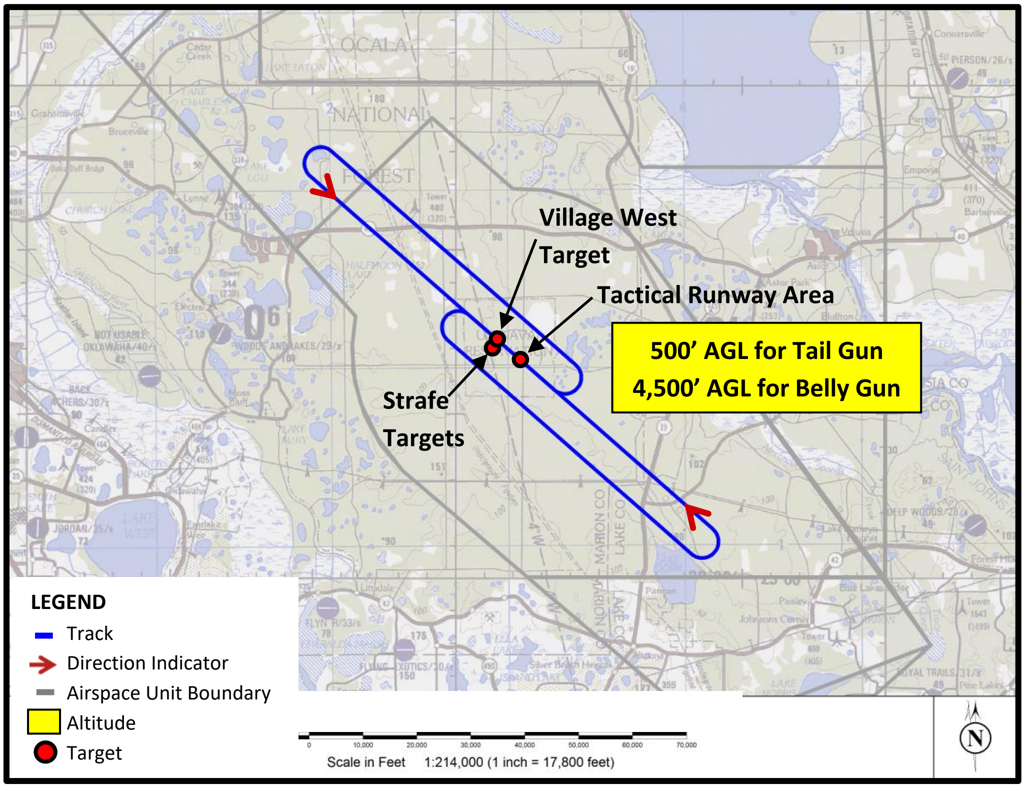

Figure 3-18. V-22 Tail & Belly Gun Patterns

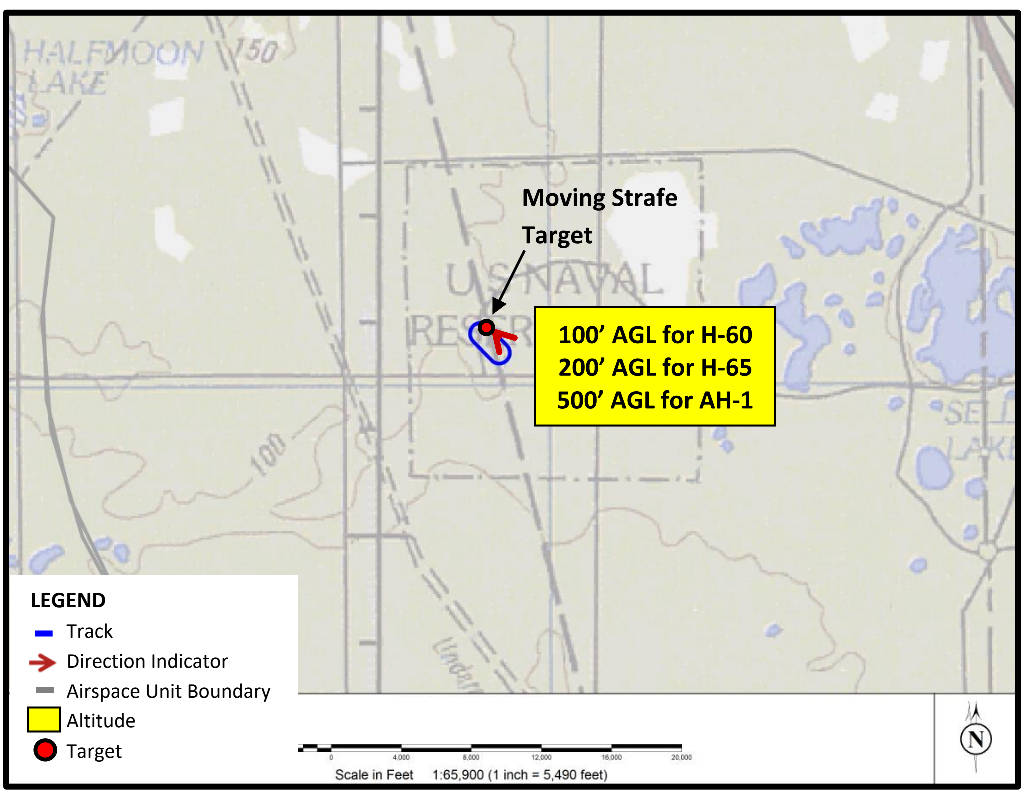

Figure 3-19. Air Gunnery Moving Strafe Patterns for the Helicopters

3.1.7 Combat Search and Rescue

Combat Search and Rescue (CSAR) events are conducted within the Pinecastle Range, and the noise from these events is represented by F-18, F-35C, and H-60 aircraft. Four circular areas with increasing radii were used to model these events, as shown in Figure 3-20. The fixed-wing aircraft operate within the outer circle at an altitude band of 5,000’ to 5,500’ AGL. The H-60 operate within the inner three circular areas with their altitude bands descending within the smaller areas, as indicated in the Figure 3-20.

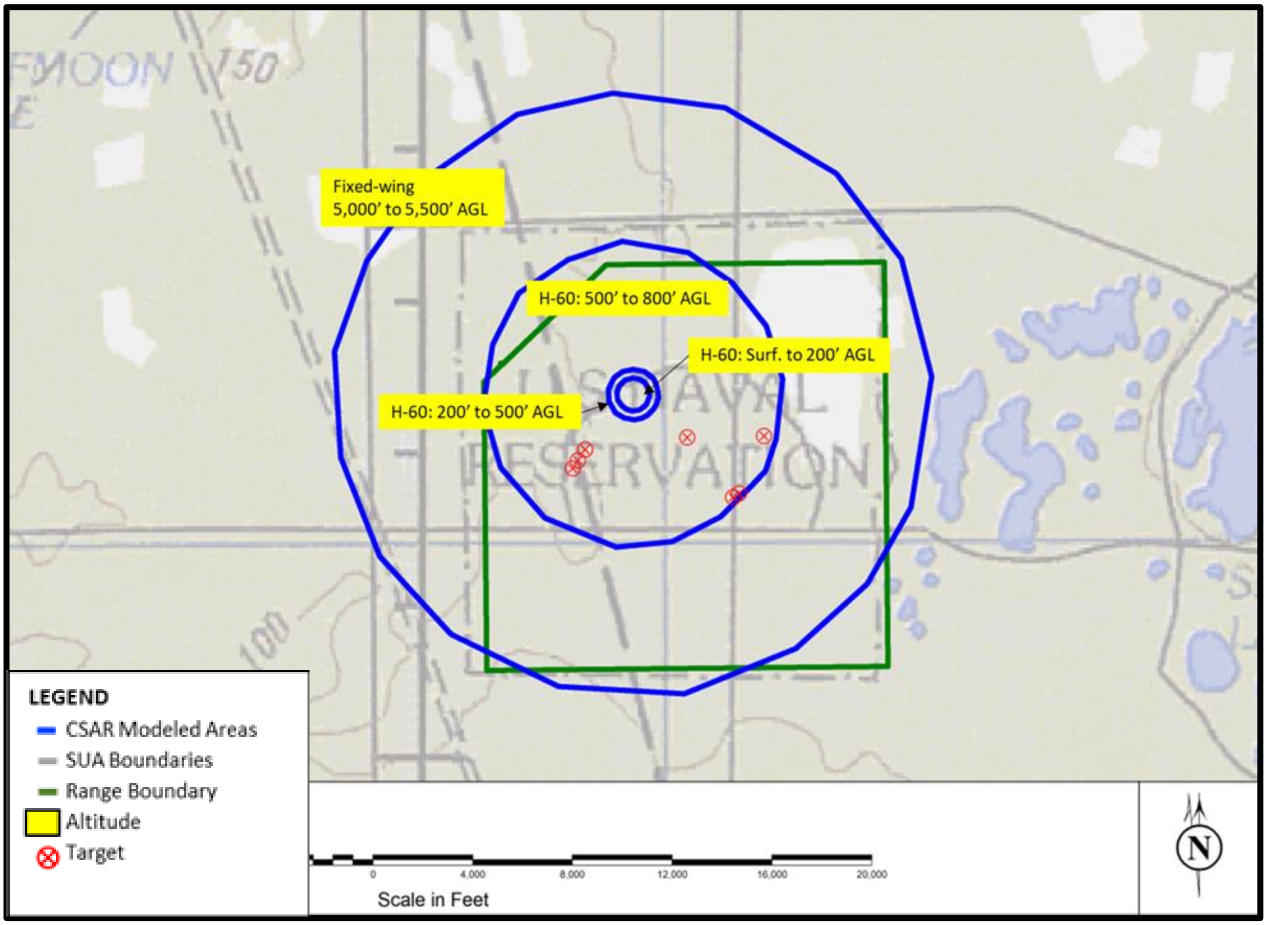

Figure 3-20. CSAR Operations within Pinecastle Range

3.1.8 Landing Zones

Pinecastle Range (R-2910A) features two landing zones (LZs) utilized by the H-53, H-60, AH-1, UH-1, and V-22 airframes. Figure 3-21 displays the input data used to model LZ activity within the Pinecastle Range. The model calculates the noise generated from LZ operations using a tiered altitude structure: the outer LZ area features rotary-wing aircraft traveling at 60 kts from 100’ to 300’ AGL, the inner LZ area uses an average of 20 kts at 0’ to 100’ AGL. This tiered altitude structure is designed to represent the approach and departure of rotary-wing aircraft into and from the LZ. In addition, access to these LZs were modeled via a designated ingress/egress MTR from the east, as shown in Figure 3-21.

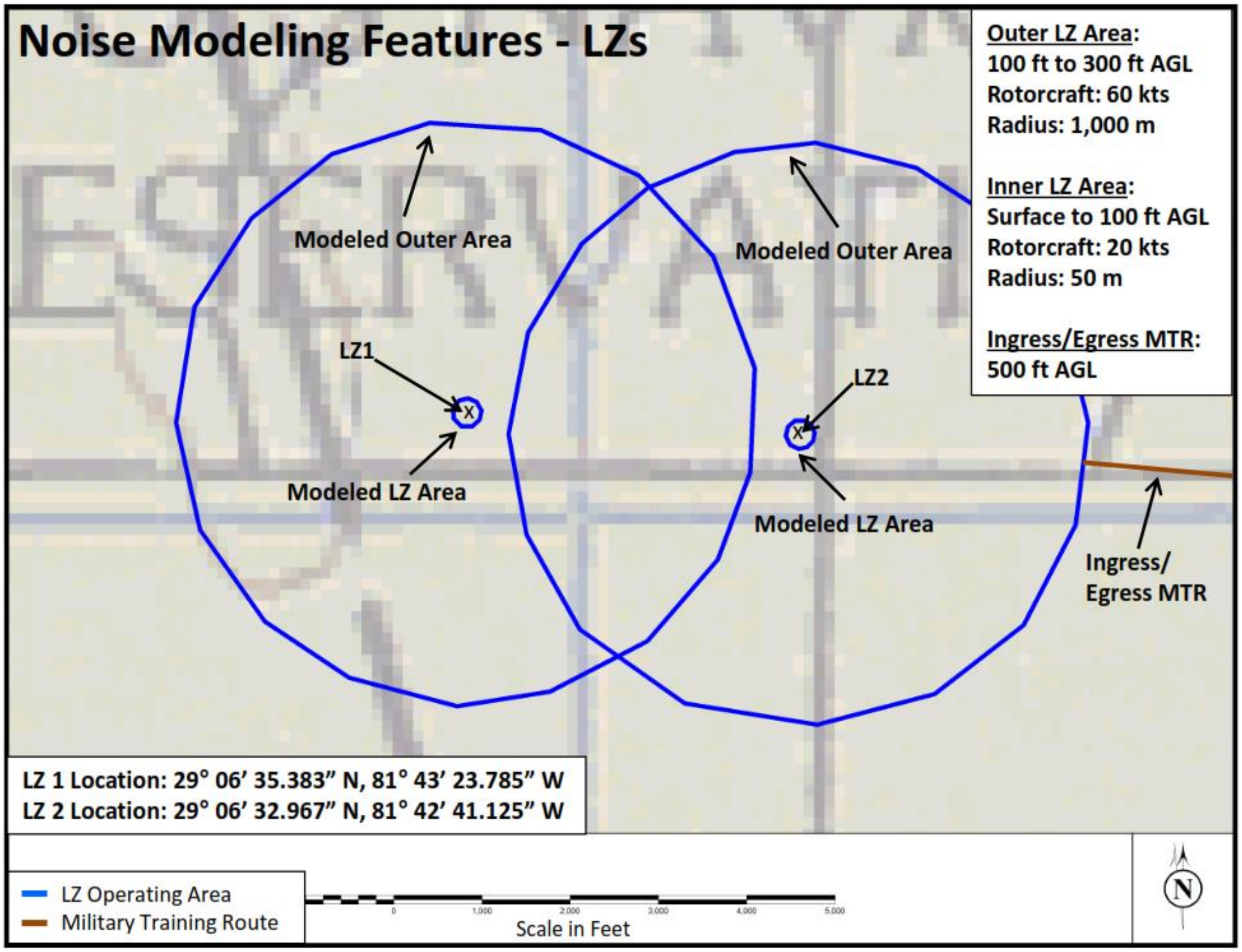

Figure 3-21. Landing Zone 1 & 2 with Ingress/Egress MTR in Pinecastle Range

3.1.9 Tactical Missions

Tactical missions within Pinecastle Range include activity within the SUAs outlined in Figure 3-1, and Figure 3-22 through Figure 3-24. R-2910A encompasses the air gunnery activity in and around the TRA and LIA, where flight altitudes range from the surface to 23,000’ AGL (Figure 3-1). Within R-2910A, tactical rotary-wing aircraft operations occur within the region outlined in Figure 3-24, centered around the TRA/LIA region (H-60, AH-1, and UH-1 travel at varied speeds from the surface to 2,000’ AGL). R-2910D/E occupies the area north of the primary Pinecastle Range and south of Lake George, with an altitude range of 500’ to 23,000’ AGL (Figure 3-22). R-2910B/C includes the southern region (Figure 3-23), with an altitude range from the surface to 6,000’ AGL. Fixed-wing airframes performing tactical missions within the Pinecastle Range SUAs were modeled as including the A-10 at 300 kts, AV-8, F/A-18C/D, and F/A-18E/F at 450 kts, F-35A/B/C at 475 kts, and F-15, F-16, and F/A-18E/F at 500 kts. Tactical missions do not involve repeated, tracked flight routes and the referenced fixed-wing airframes were modeled as operating throughout the Pinecastle Range SUAs. The noise contours will therefore align within the perimeters of the restricted airspace.

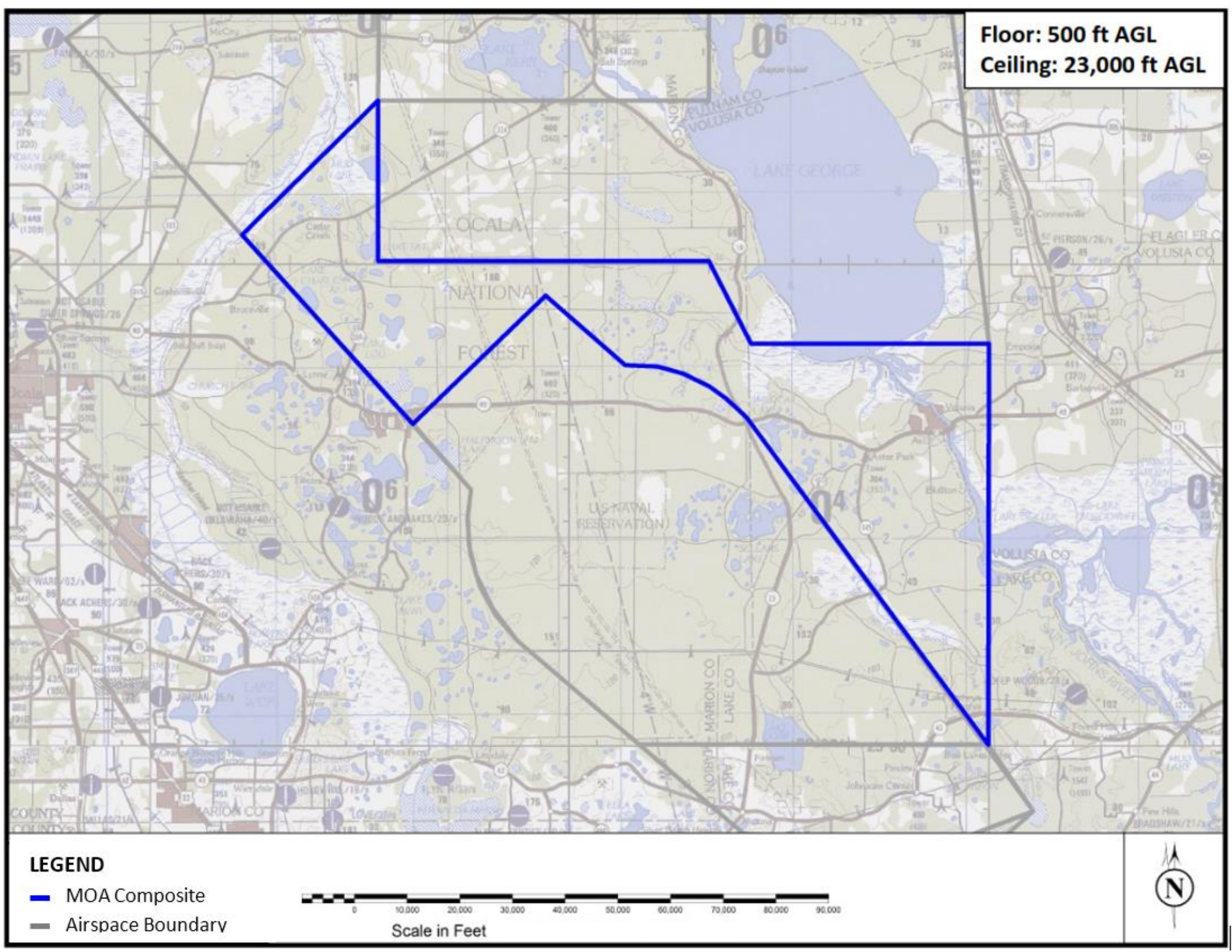

Figure 3-22. Pinecastle Area Operations Composite (R-2910D/E)

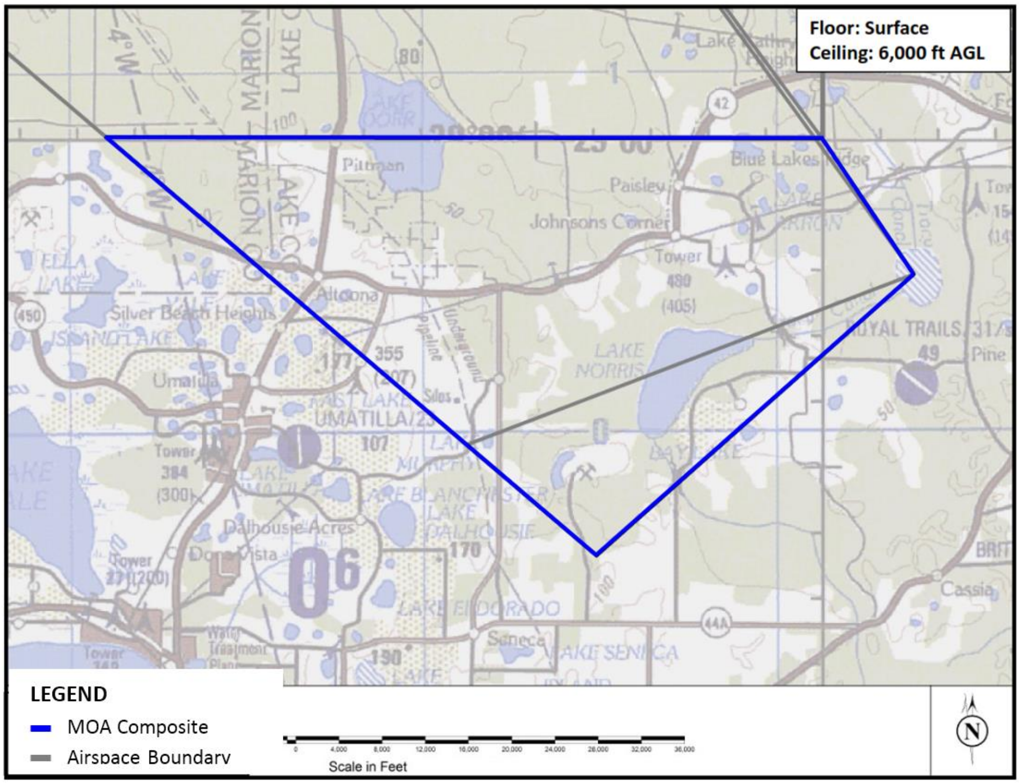

Figure 3-23. Pinecastle Area Operations Composite (R-2910B/C)

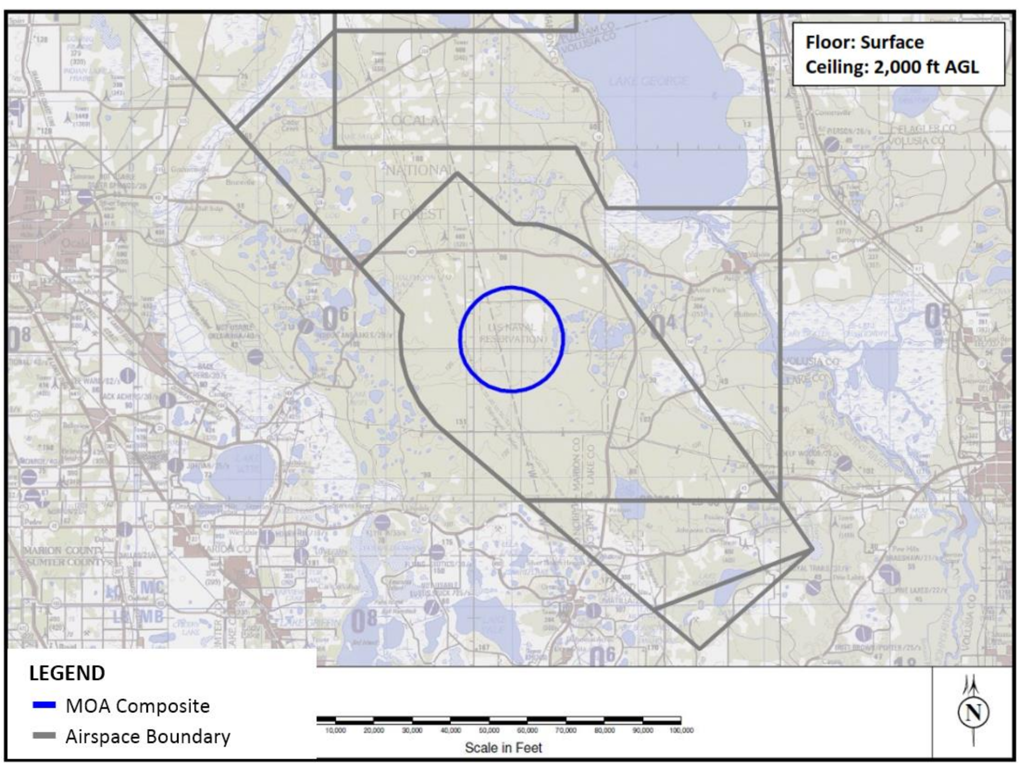

Figure 3-24. Tactical Rotary-wing Aircraft Area Operations (Noise Modeling Feature)

3.2 Lake George Training Operations

Table 3-3 displays the general tracked and area training missions each airframe conducts within Lake George, depicted in Figure 3-25 with an altitude range from the surface to 23,000' MSL. Tactical area missions were modeled as occurring throughout the Lake George Range restricted area (R-2907A), such that the cumulative noise contours will align with the R-2907A. The mission types and the associated profiles for each airframe are described in detail in the following sections.

Table 3-3. Mission Distribution for Lake George (R-2907)

Aircraft	New Aircraft	Tracked Missions			Area	
		Ingress/ Egress	Center Target	MINEX	Mining Exercises	R-2907A
F/A-18E/F		✦	✦		✦	✦
F/A-18C/D USN		✦	✦		✦	✦
F/A-18C/D USMC		✦	✦		✦	✦
F-16		✦	✦		✦	✦
F-15		✦	✦		✦	✦
A-10		✦	✦		✦	✦
AV-8		✦	✦		✦	✦
P-3		✦		✦		
P-8	✦	✦		✦		
EA-6		✦				✦
EA-18G	✦	✦				✦
E-2C		✦				✦
V-22		✦	✦			✦
Cessna		✦				✦
AC-130		✦				✦
H-60		✦	✦			✦
KC-130	✦	✦	✦			
A-29	✦	✦	✦		✦	✦
F-35A	✦	✦				✦
F-35B	✦	✦			✦	✦
F-35C	✦	✦			✦	✦

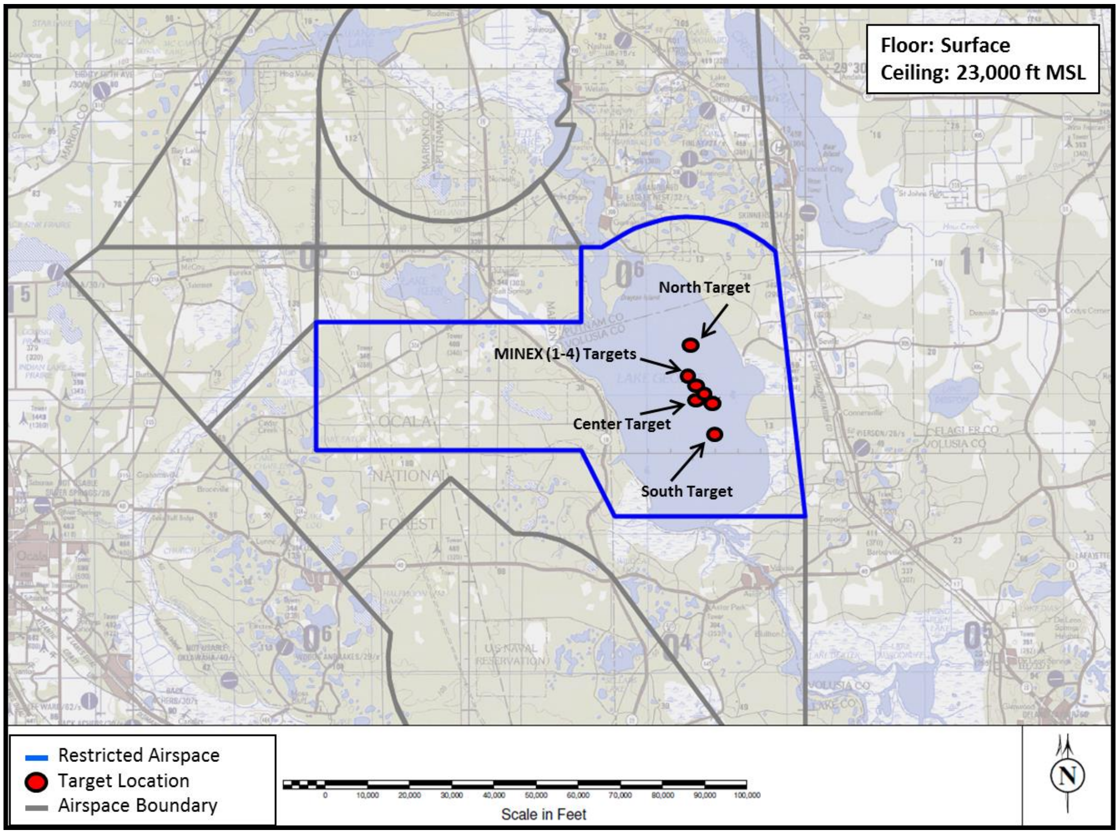

Figure 3-25. Lake George Range (R-2907A)

3.2.1 Center Target

H-60 flare drop training occurs within the Lake George Range, aligned with the Center Target identified in Figure 3-25. The H-60 follows an oblong flight track that descends from 800' AGL to 200' AGL, at 70 kts. The drop training activity occurs at 200' AGL over the Center Target (see Figure 3-26).

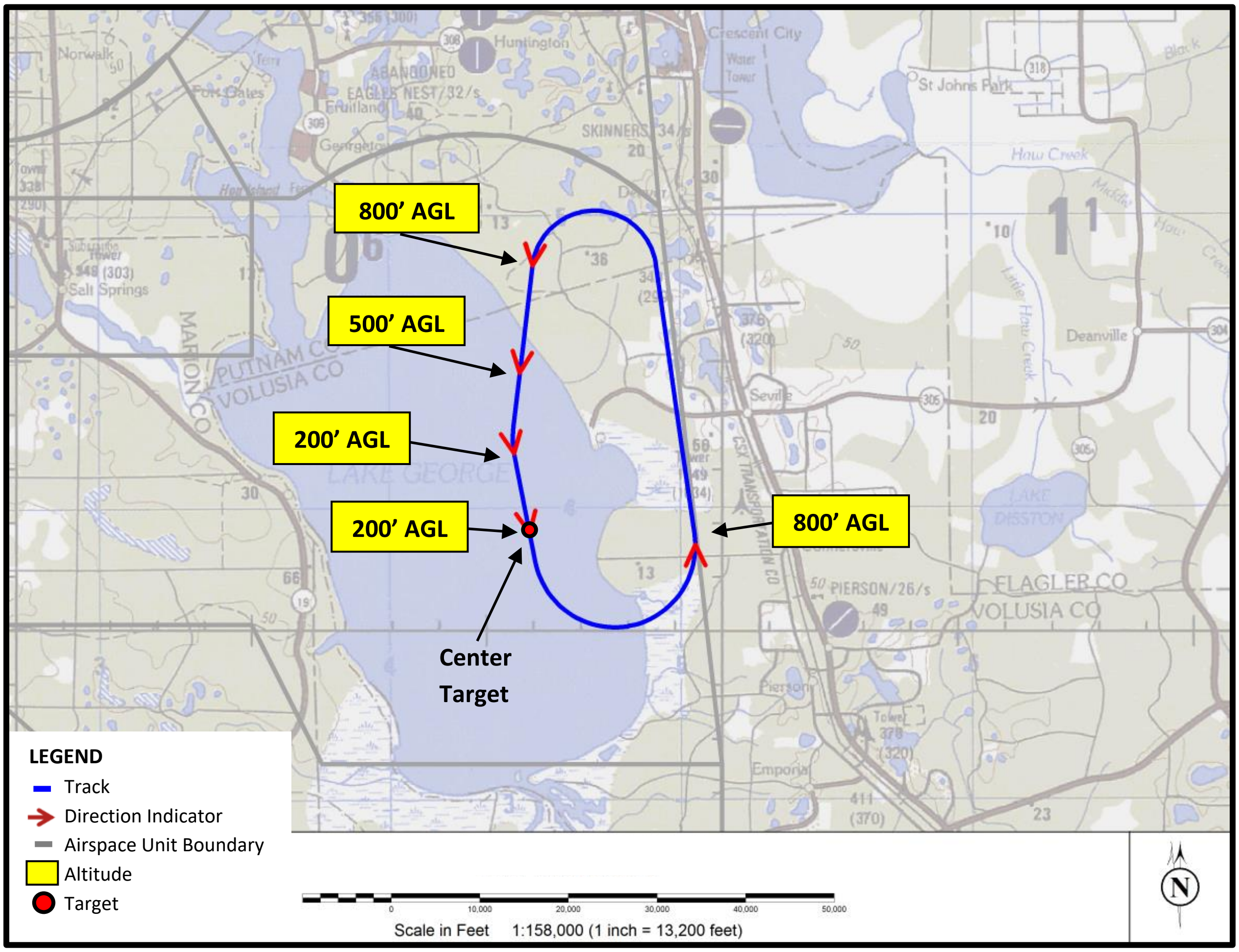

Figure 3-26. Air Gunnery Center Target Pattern for the Helicopters

3.2.2 Orbit Pattern

The KC-130J conducts an orbit pattern over Lake George at 10,000 ft AGL, traveling at 160 kts. Figure 3-27 displays the location and typical direction of the orbit, which has a radius of 3.5 NM. This orbit pattern is conducted for paraflare drop training over the Center Target within Lake George.

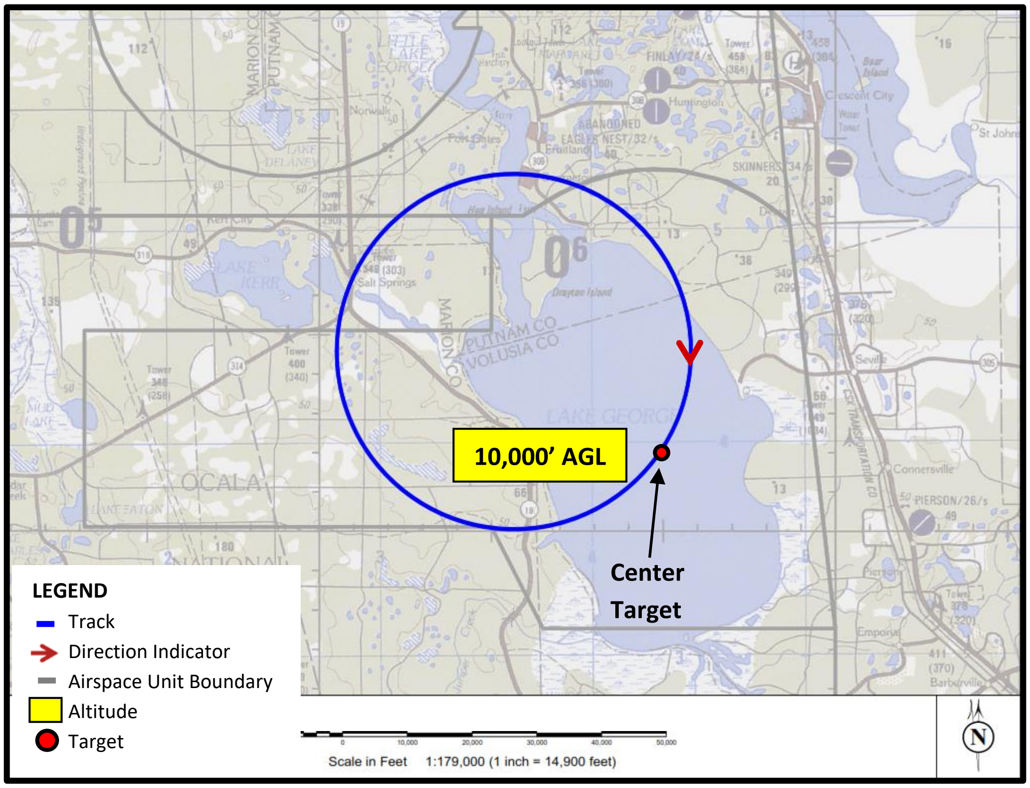

Figure 3-27. Orbit Pattern for the KC-130J

3.2.3 Mining Exercises

Fixed-wing aircraft can conduct various mining exercises within the Lake George Range. The primary exercises are Airborne Maritime Mining (AMM) and Mine Exercise (MINEX). These operations can approach the Center and MINEX target arrays from attack headings ranging from 90° to 180°. Thus, these events are modeled with three areas that represent the marshalling, run-in, and attack portions of the operations. These modeled areas are provided in Figure 3-28. The altitude bands for the three areas are the following:

- Marshalling: 750' to 1,500' AGL,
- Run-in: 500' to 1,000' AGL, and
- Attack: 350' to 650' AGL.

The airspeeds range from 300 to 500 knots with the lower airspeed occurring within the marshalling area and the faster airspeed within the attack area.

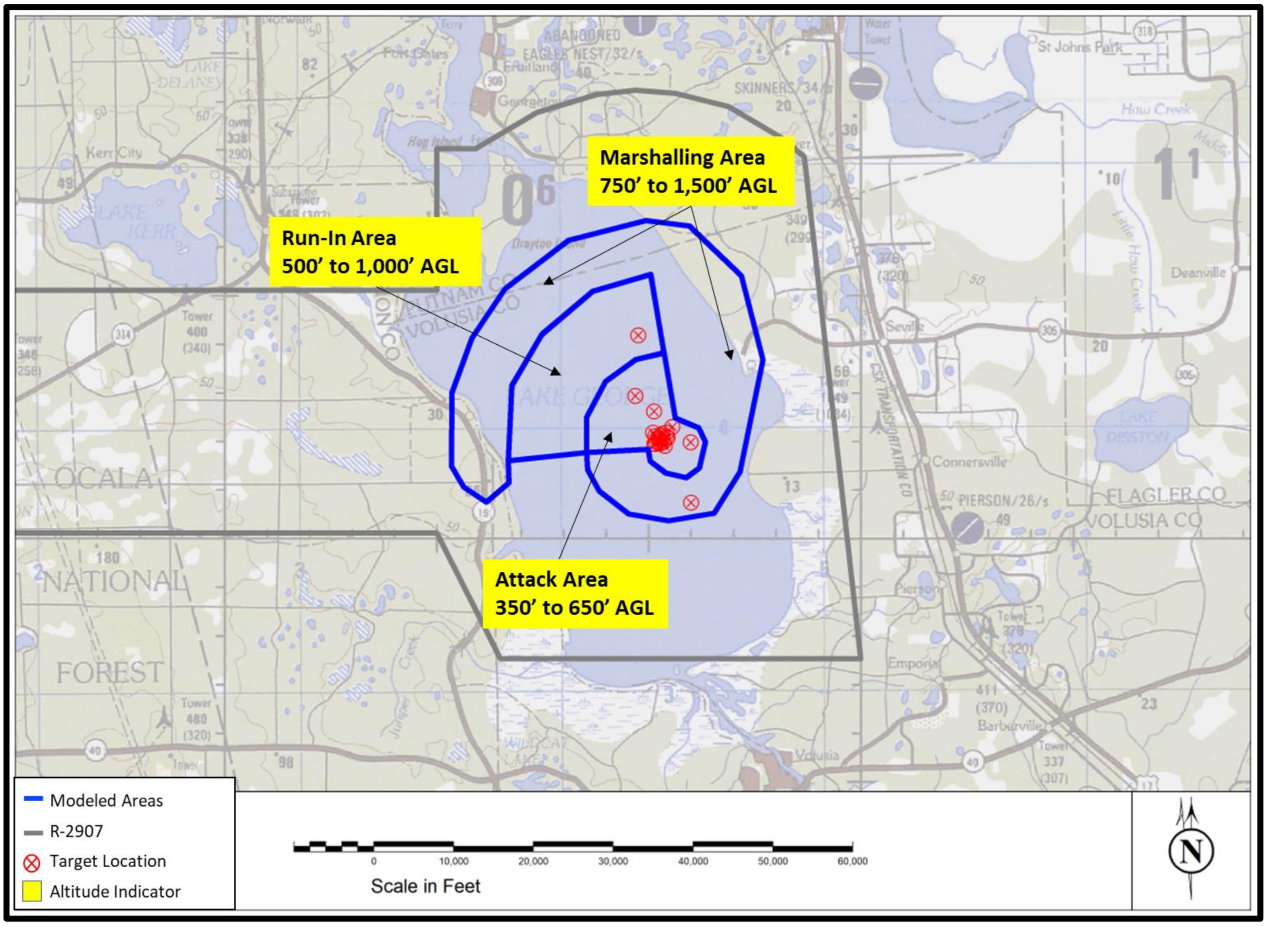

Figure 3-28. Modeled Mining Exercise Areas

3.2.4 P-3 and P-8 MINEX

P-3 and P-8 also performs MINEX patterns at Lake George. For these events, the aircraft perform clearing passes before performing their mine drops at Lake George (R-2907) at the target locations identified in Figure 3-25. The P-3 and P-8 perform clearing passes at altitudes from 1,500’ to 5,000’ AGL, followed by shape charge drops (four per pass) at 500’ AGL and targeted on the four MINEX targets (see Figure 3-29 through Figure 3-30).

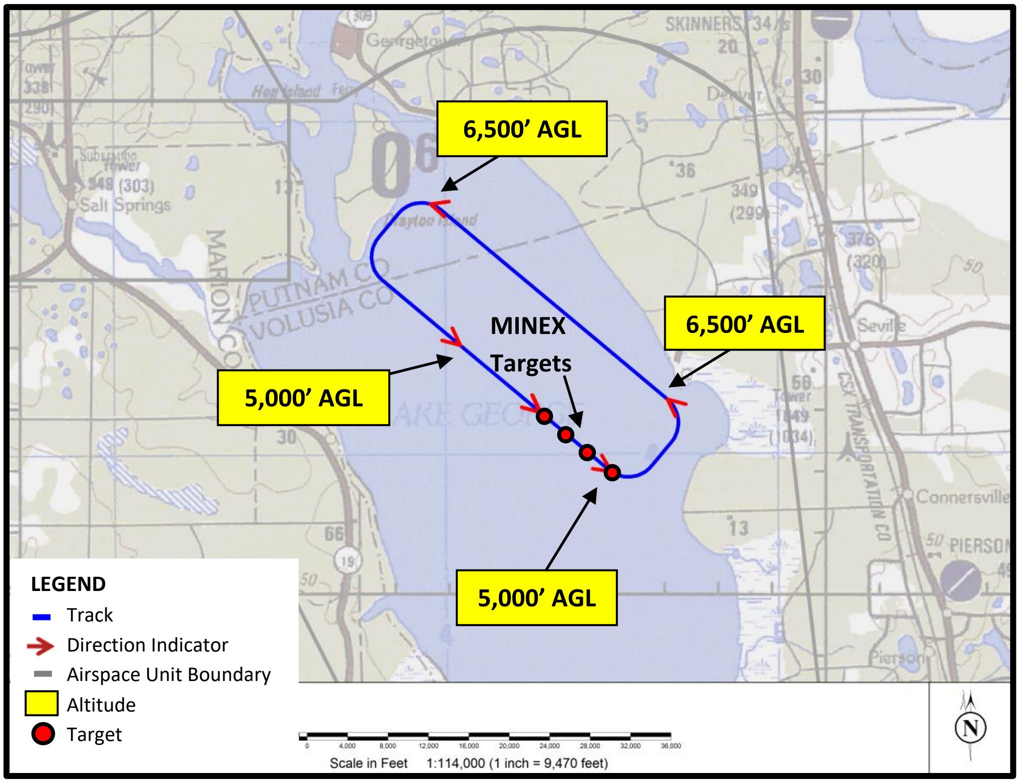

Figure 3-29. P-3 and P-8 MINEX High Pattern

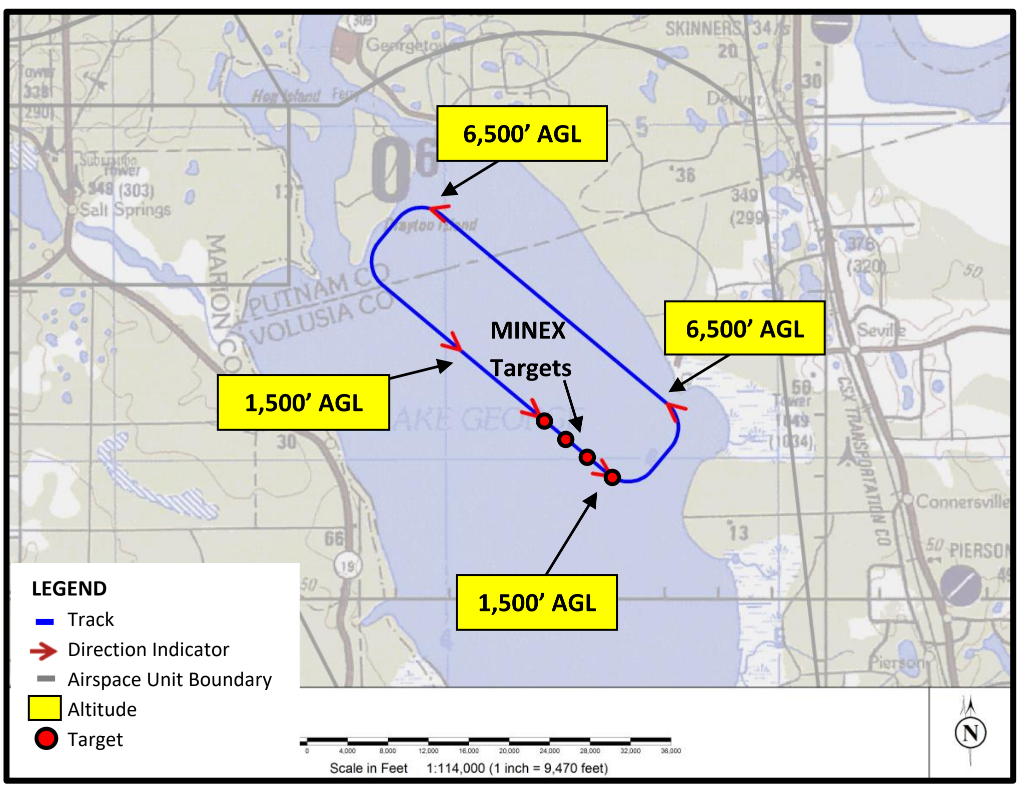

Figure 3-30. P-3 and P-8 MINEX Low Pattern

3.3 Rodman Range Training Operations

With the exception of ingress/egress tracked routes to/from Rodman Range (R-2906), operational activity within Rodman Range consists entirely of tactical missions by the aircraft listed in Table 3-4, resulting in noise contours that align with the Range perimeters. Figure 3-31 displays the north and east ingress/egress MTR by fixed-wing and rotary-wing aircraft, as well as the SUAs in which tactical activity occurs. Palatka 2 MOA has an operational altitude range from 3,000’ AGL to 18,000’ MSL, and R-2906 has an altitude range from the surface (e.g. rotary-wing aircraft LZs) to 14,000’ MSL.

Table 3-4. Mission Distribution for Rodman (R-2906)

Aircraft	New Aircraft	Tracked	Area Missions		
		Ingress/ Egress	LZ	Palatka 2	R-2906
F/A-18E/F		✦		✦	✦
F/A-18C/D USN		✦		✦	✦
F/A-18C/D USMC		✦		✦	✦
F-16		✦		✦	✦
F-15		✦		✦	✦
A-10		✦		✦	✦
AV-8		✦		✦	✦
EA-6		✦		✦	✦
EA-18G	✦	✦		✦	✦
E-2		✦		✦	✦
V-22		✦			✦
AC-130		✦		✦	✦
H-60		✦	✦		✦
AH-1	✦	✦			✦
UH-1	✦	✦	✦		✦
H-53	✦	✦	✦		✦
KC-130	✦	✦		✦	✦
T-45	✦	✦		✦	✦
A-29	✦	✦		✦	✦
F-35A	✦	✦		✦	
F-35B	✦	✦		✦	✦
F-35C	✦	✦		✦	✦

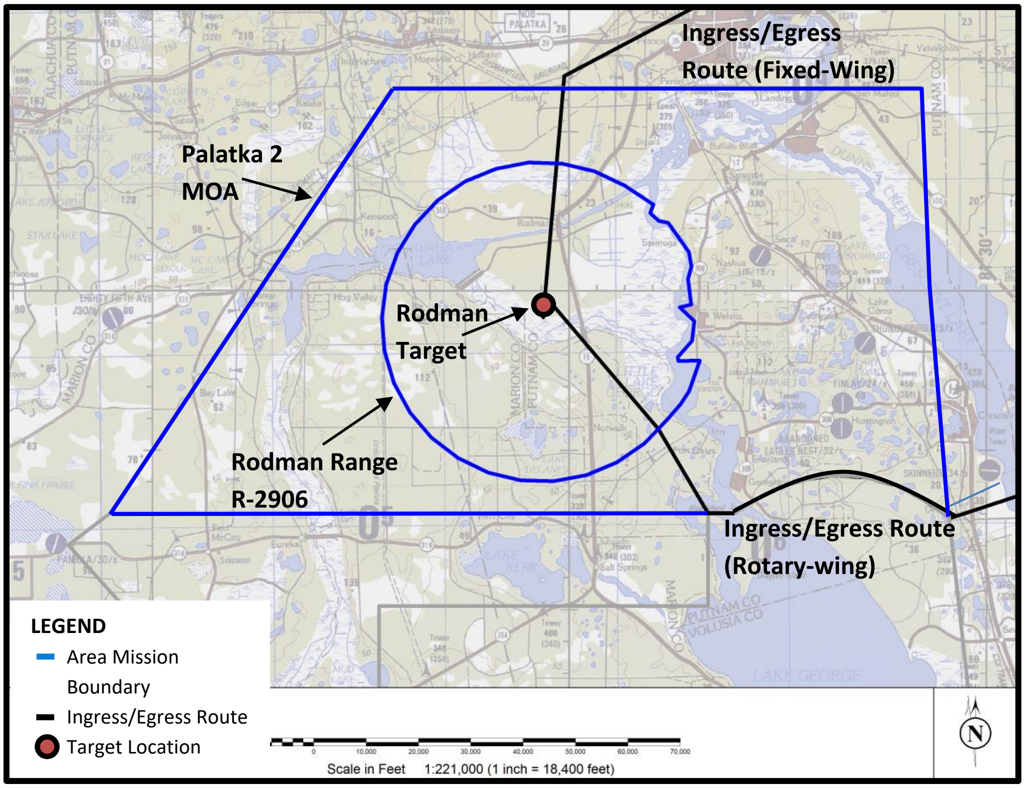

Figure 3-31. Ingress/Egress Routes Into/Out of Palatka 2 MOA and Rodman Range

3.3.1 Landing Zones

Rodman Range (R-2906) features eight LZs utilized by the H-53, H-60, AH-1, UH-1, and V-22 airframes at the locations listed in Table 3-5. Figure 3-32 displays a representative LZ used within the MRNMap model to calculate the noise generated from rotary-wing aircraft operations. As with the Pinecastle Range LZs, the eight Rodman Range LZs were modeled with a tiered altitude structure: the outer LZ area features rotary-wing aircraft traveling at 60 kts from 100’ to 300’ AGL, and the inner LZ area uses an average of 20 kts at 0’ to 100’ AGL. Access to these LZs were modeled via ingress/egress MTRs.

Table 3-5. Coordinates for Rodman Range LZs

LZ Name	Latitude	Longitude
Deer Camp	29° 29' 17.70"	81° 45' 35.93"
Trench	29° 29' 51.84"	81° 45' 52.12"
Black Hole	29° 30' 0.47"	81° 45' 35.92"
Village	29° 29' 24.60"	81° 46' 9.00"

LZ Name	Latitude	Longitude
Three Quarter	29° 30' 9.01"	81° 45' 44.60"
Moat	29° 30' 4.64"	81° 46' 8.11"
Open North	29° 30' 10.00"	81° 46' 13.71"
Open South	29° 29' 45.27"	81° 46' 25.80"

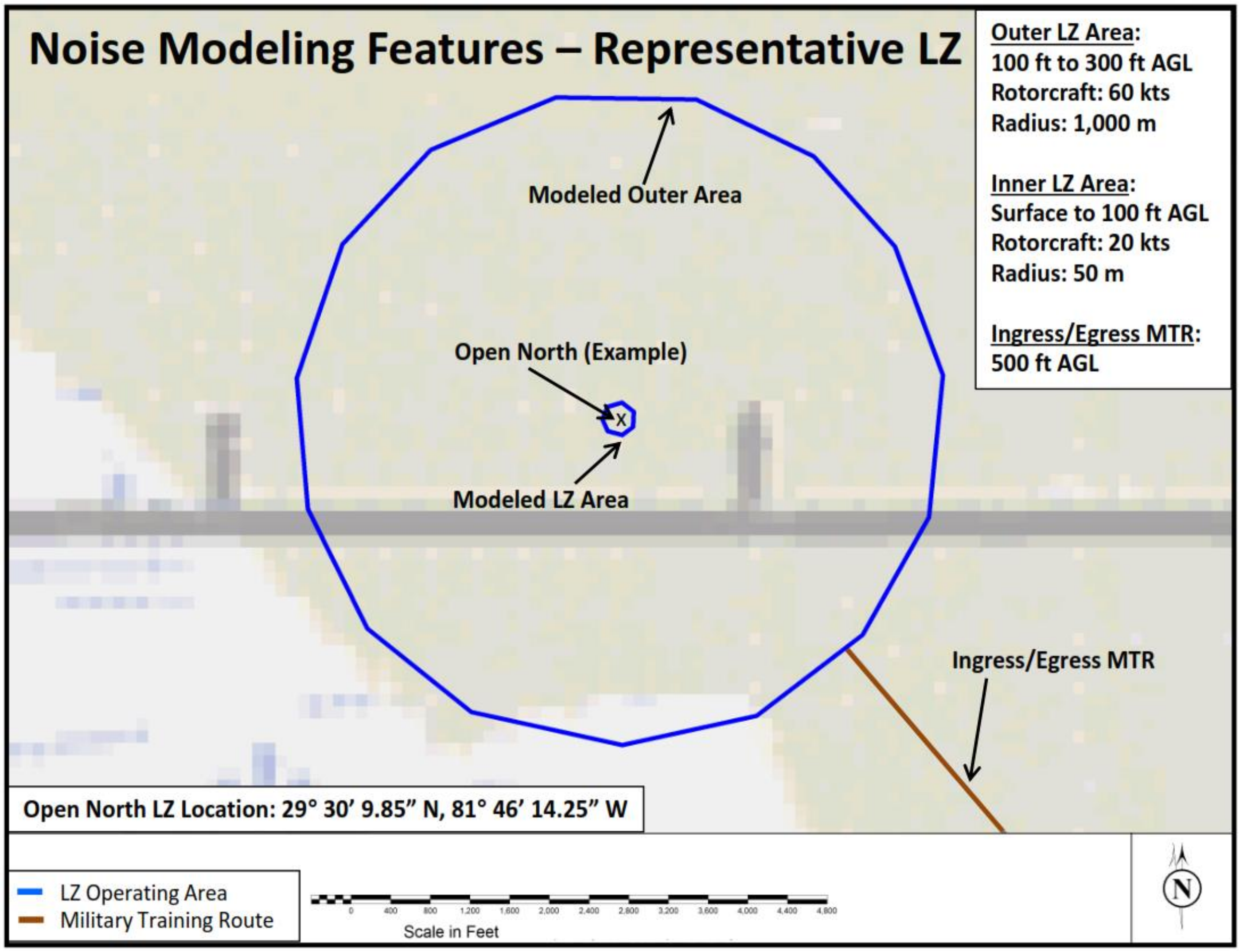

Figure 3-32. Example LZ within Rodman Range with an Associated Ingress/Egress MTR

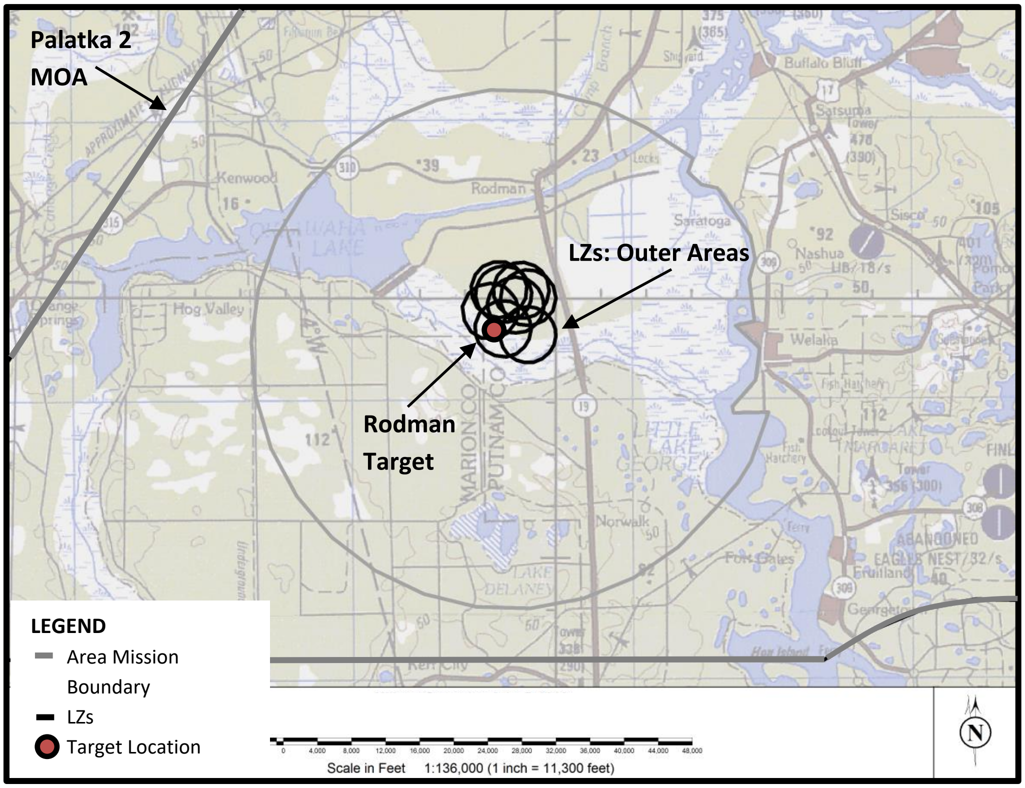

Figure 3-33. Ingress/Egress Routes into Area Missions Conducted within Palatka 2 MOA and Rodman Range

3.4 Mission Frequency and Distribution

With the various mission types defined, the next step in the noise modeling process is to develop the frequency of each training mission conducted throughout a normal training year. A component of this description includes annual sortie counts reconciled with information provided by aircrews. For this noise study, a sortie is defined as one aircraft flying from home base into Pinecastle, Lake George, or Rodman Range via an applicable ingress MTR, conducting various training operations, and returning to home base via an egress MTR. Table 3-6 lists the annual sorties conducted by each aircraft within each range, with the mission type identified in terms of percent-utilization for tracked and area training missions.

Table 3-8 details fixed-wing area operations within Pinecastle Range (i.e. R-2910A, R-2910A/B/C, and Pinecastle Area Operations Composite), as delineated by altitude distribution; rotary-wing aircraft area operations by altitude distribution are detailed in Table 3-9. Track and area operations for aircraft within the Lake George airspace (R-2907) are detailed in Table 3-10, and altitude distributions are itemized in Table 3-11. Rodman Range (R-2906 SUA and Palatka 2 MOA) contain only area operations, as detailed in Table 3-12 with the associated altitude distributions delineated in Table 3-13.

Table 3-6. 2018 (No Action) and Proposed Action Aircraft Sortie Operations and Mission Types

		Pinecastle Range (R-2910)				Lake George Range (R-2907)				Rodman Range (R-2906)				TOTALS	
		Sorties		Mission Type		Sorties		Mission Type		Sorties		Mission Type			
Aircraft	**Service**	**2018**	**Projected**	**Tracked**	**Area**	**2018**	**Projected**	**Tracked**	**Area**	**2018**	**Projected**	**Tracked**	**Area**	**2018**	**Projected**
F/A-18E/F	USN	473	700	16%	84%	458	700	-	100%	441	700	-	100%	1,372	2,100
F/A-18C/D	USN	118	-	16%	84%	115	-	-	100%	110	-	-	100%	343	-
F/A-18	USMC	43	100	32%	68%	43	100	-	100%	39	100	-	100%	125	300
F-16	USAF	44	100	22%	78%	44	100	-	100%	29	100	-	100%	117	300
F-15	USAF	166	200	22%	78%	165	200	-	100%	166	200	-	100%	497	600
A-10	USAF	375	400	43%	57%	335	400	-	100%	287	400	-	100%	997	1,200
AV-8	USMC	28	100	32%	68%	24	50	-	100%	24	50	-	100%	76	200
P-3	USN	11	-	100%	-	25	50	100%	-	-	-	-	-	36	50
P-8	USN	-	50	100%	-	-	100	100%	-	-	-	-	-	-	150
EA-6	USN	2	-	-	100%	2	-	-	100%	2	-	-	100%	6	-
EA-18G	USN	-	50	-	100%	-	50	-	100%	-	50	-	100%	-	150
E-2C	USN	-	-	-	-	1	50	-	100%	1	50	-	100%	2	100
V-22	USMC	5	50	75%	25%	5	50	23%	77%	5	50	-	100%	15	150
Cessna	USN	1	50	-	100%	1	50	-	100%	-	-	-	-	2	100
AC-130	USAF	5	50	100%	-	4	50	-	100%	2	50	-	100%	11	150
H-60	USN	253	300	75%	25%	91	200	100%	-	132	200	-	100%	476	700
MH-65	USCG	21	50	100%	-	-	-	-	-	-	-	-	-	21	50
AH-1	USMC	-	150	75%	25%	-	-	-	-	-	50	-	100%	-	200
UH-1	USMC	-	150	75%	25%	-	-	-	-	-	50	-	100%	-	200
H-53	USMC	-	150	75%	25%	-	-	-	-	-	50	-	100%	-	200
KC-130	USMC	-	50	100%	-	-	50	100%	-	-	50	-	100%	-	150
T-45	USN	-	720	100%	-	-	-	-	-	-	720	-	100%	-	1,440
A-29	USAF	-	100	43%	57%	-	50	-	100%	-	100	-	100%	-	250
F-35A	ANG	-	100	-	100%	-	100	-	100%	-	100	-	100%	-	300
F-35B	USMC	-	100	32%	68%	-	100	-	100%	-	100	-	100%	-	300
F-35C	USN	-	500	16%	84%	-	500	-	100%	-	500	-	100%		1,500
	TOTALS	**1,545**	**4,220**			**1,313**	**2,950**			**1,238**	**3,670**			**4,096**	**10,840**

Table 3-7. Distribution of Training Mission Types for Pinecastle Range

Pinecastle Range (R-2910)				Track Missions						Area Missions				
				Nominal Passes/ Sortie	Low Angle Strafe Target	High Angle Strafe Target	Live Impact Area	Tactical Runway Area	Rotorcraft Gunnery Tracks	Duration (less track ops time)	R-2910A or LZs	R-2910 A/B/C Composite	Pinecastle Area Operations Composite	Palatka 1 Lower MOA
Aircraft	Service	2018	Proposed							min				
F/A-18E/F	USN	473	700	4	10%	10%	50%	30%	-	33.5	40%	10%	50%	-
F/A-18C/D	USN	118	-	4	10%	10%	50%	30%	-	33.5	40%	10%	50%	-
F-18	USMC	43	100	6	10%	10%	50%	30%	-	20.3	87%	5%	8%	-
F-16	USAF	44	100	4	10%	10%	-	80%	-	23.5	40%	10%	50%	-
F-15	USAF	166	200	4	10%	10%	-	80%	-	23.5	40%	10%	50%	-
A-10	USAF	375	400	8	10%	10%		80%	-	17.0	87%	5%	8%	-
AV-8	USMC	28	100	6	10%	10%		80%	-	20.3	87%	5%	8%	-
P-3	USN	11	-	4	-	-	-	100%	-	-	-	-	-	-
P-8	USN	-	50	4	-	-	-	100%	-	-	-	-	-	-
EA-6	USN	2	-	-	-	-	-	-	-	30	-	-		100%
EA-18G	USN	-	50	-	-	-	-	-	-	30	-	-		100%
V-22	USMC	5	50	33	-	-	-	-	100%	-	100%	-	-	-
Cessna	USN	1	50	-	-	-	-	-	-	30	-	-	100%	-
AC-130	USAF	5	50	24	-	-	-	100%	-	-	-	-	-	-
H-60	USN	253	300	12	-	-	7%	13%	80%	60	100%	-	-	-
MH-65	USCG	21	50	6	-	-	-	-	100%	-	-	-	-	-
AH-1	USMC	-	150	12	-	-	33%	67%	-	60	100%	-	-	-
UH-1	USMC	-	150	12	-	-	-	-	-	60	100%	-	-	-
H-53	USMC	-	150	12	-	-	10%	-	90%	60	100%	-	-	-
KC-130	USMC	-	50	27	-	-	-	100%	-	-	-	-	-	-
T-45	USN	-	720	8	-	-	100%	-	-	-	-	-	-	-
A-29	USAF	-	100	8	10%	10%		80%	-	17.0	87%	5%	8%	-
F-35A	ANG	-	100	-	-	-	-	-	-	30	-	-	100%	-
F-35B	USMC	-	100	6	5%	10%	45%	40%	-	20	87%	5%	8%	-
F-35C	USN	-	500	4	10%	10%	50%	30%	-	33.5	40%	10%	50%	-

Table 3-8. Fixed-wing Altitude Distributions for Pinecastle Range

Pinecastle Range (R-2910)		Area Operations Altitude Distributions														
		R-2910 A					R-2910 A/B/C Composite					Pinecastle Area Operations Composite				
Aircraft	Service	Airspeed	Altitude (feet)				Airspeed	Altitude (feet)				Airspeed	Altitude (feet)			
		(kts)	500-8k	8k-15k	15k+		(kts)	500-8k	8k-15k	15k+		(kts)	500-8k	8k-15k	15k+	
F/A-18	USN	500	33%	33%	33%		500	33%	33%	33%		500	33%	33%	33%	
EA-6/EA-18G	USN	450	0%	100%	0%		450	0%	100%	0%		450	0%	100%	0%	
Cessna	USN	150	100%	0%	0%		150	100%	0%	0%		150	100%	0%	0%	
F-35C	USN	500	10%	30%	70%		500	10%	30%	70%		500	10%	30%	70%	
		Airspeed	Altitude (feet)				Airspeed	Altitude (feet)				Airspeed	Altitude (feet)			
		(kts)	500-3k	3k-10k	10k+		(kts)	500-3k	3k-10k	10k+		(kts)	500-3k	3k-10k	10k+	
F/A-18	USMC	450	16%	27%	57%		450	16%	27%	57%		450	16%	27%	57%	
F-35B	USMC	450	10%	30%	70%		450	10%	30%	70%		450	10%	30%	70%	
AV-8	USMC	450	10%	10%	80%		450	10%	10%	80%		450	10%	10%	80%	
		Airspeed	Altitude (feet)				Airspeed	Altitude (feet)				Airspeed	Altitude (feet)			
		(kts)	500-1k	1k-5k	5k-15k	15k-23k	(kts)	500-1k	1k-5k	5k-15k	15k-23k	(kts)	500-1k	1k-5k	5k-15k	15k-23k
F-16	USAF	500	5%	5%	20%	70%	500	5%	5%	20%	70%	500	5%	5%	20%	70%
F-15	USAF	500	5%	5%	20%	70%	500	5%	5%	20%	70%	500	5%	5%	20%	70%
A-10	USAF	300	20%	70%	10%	0%	300	20%	70%	10%	0%	300	20%	70%	10%	0%
F-35A	ANG											475	2%	3%	5%	90%
A-29	USAF	300	20%	70%	10%	0%	300	20%	70%	10%	0%	300	20%	70%	10%	0%

Table 3-9. Pinecastle Range Rotary-wing Aircraft Altitude Distributions

<table>
<tr><th colspan="2" rowspan="2">Pinecastle Range
(R-2910)</th><th colspan="4">Area Operations Altitude Distributions</th></tr>
<tr><th colspan="4">Rotorcraft Area Operations</th></tr>
<tr><th rowspan="2">Aircraft</th><th rowspan="2">Service</th><th>Airspeed</th><th colspan="3">Altitude (feet)</th></tr>
<tr><th>(kts)</th><th>50-200</th><th>200-1k</th><th>1k-2.5k</th></tr>
<tr><td>AH-1</td><td>USMC</td><td>100</td><td>10%</td><td>15%</td><td>75%</td></tr>
<tr><td>UH-1</td><td>USMC</td><td>100</td><td>10%</td><td>15%</td><td>75%</td></tr>
<tr><td>H-53</td><td>USMC</td><td>120</td><td>75%</td><td>20%</td><td>5%</td></tr>
<tr><th colspan="2" rowspan="2">Mission</th><th>Airspeed</th><th colspan="3" rowspan="2">Altitude (feet)</th></tr>
<tr><th>(kts)</th></tr>
<tr><td rowspan="3">CSAR</td><td>low</td><td>20</td><td>1-200</td><td></td><td></td></tr>
<tr><td>medium</td><td>40</td><td></td><td>200-500</td><td></td></tr>
<tr><td>high</td><td>60</td><td></td><td></td><td>500-800</td></tr>
<tr><td rowspan="2">LZ</td><td>low</td><td>20</td><td>1-100</td><td></td><td></td></tr>
<tr><td>high</td><td>60</td><td></td><td>100-300</td><td></td></tr>
</table>

Table 3-10. Lake George Track and Area Operations

Lake George Range (R-2907)				Tracked Missions			Area Missions		
				Nominal Passes/ Sortie	MINEX Targets	Center Target	Duration	Mining Exercises	R-2907A
Aircraft	Service	2018	Proposed				min		
F/A-18C/D	USN	458	700	-	-	-	40	10%	90%
F/A-18E/F	USN	115	-	-	-	-	40	10%	90%
F/A-18	USMC	43	100	-	-	-	30	10%	90%
F-16	USAF	44	100	-	-	-	30	10%	90%
F-15	USAF	165	200	-	-	-	30	10%	90%
A-10	USAF	335	400	-	-	-	30	10%	90%
AV-8	USMC	24	50	-	-	-	30	10%	90%
P-3	USN	25	50	4	100%	-	-	-	-
P-8	USN	-	100	4	100%	-	-	-	-
EA-6	USN	2	-	-	-	-	30	-	100%
EA-18G	USN	-	50	-	-	-	30	-	100%
E-2C	USN	1	50				30	-	100%
V-22	USMC	5	50	4	-	100%	23	-	100%
Cessna	USN	1	50	-	-	-	30	-	100%
AC-130	USAF	4	50	-	-	-	30	-	100%
H-60	USN	91	200	12	-	100%	-	-	-
KC-130	USMC	-	50	10	-	100%	-	-	-
A-29	USAF	-	50	-	-	-	30	10%	90%
F-35A	ANG	-	100	-	-	-	30	-	100%
F-35B	USMC	-	100	-	-	-	30	10%	90%
F-35C	USN	-	500	-	-	-	40	10%	90%

Table 3-11. Lake George Altitude Distributions for Fixed-wing and Rotary-wing Aircraft

Lake George Range (R-2907A)		Area Operations Altitude Distributions				
		R-2907A				
Aircraft	Service	Airspeed	Altitude (feet)			
		(kts)	500-8k	8k-15k	15k+	
F/A-18	USN	500	60%	20%	20%	
F-35C	USN	500	0%	30%	70%	
EA-6/EA-18G	USN	450	0%	100%	0%	
E-2C	USN	250	0%	0%	100%	
Cessna	USN	150	100%	0%	0%	
		Airspeed	Altitude (feet)			
		(kts)	500-3k	3k-10k	10k+	
F/A-18	USMC	450	16%	27%	57%	
F-35B	USMC	450	0%	30%	70%	
AV-8	USMC	450	10%	10%	80%	
		Airspeed	Altitude (feet)			
		(kts)	500-1k	1k-5k	5k-15k	15k-23k
F-16	USAF	500	5%	5%	20%	70%
F-15	USAF	500	5%	5%	20%	70%
F-35A	ANG	475	2%	3%	5%	90%
A-10	USAF	300	20%	70%	10%	0%
A-29	USAF	300	20%	70%	10%	0%
		Airspeed	Altitude (feet)			
		(kts)	500-3k	3k-10k	10k+	
AC-130	USAF	190	0%	0%	100%	
		Airspeed	Altitude (feet)			
		(kts)	50-200	200-1k	1k-2.5k	2.5k-10k
V-22	USMC	220	0%	0%	17%	83%

Table 3-12. Rodman Range Area Operations

Rodman Range (R-2906)				Area Operations			
				Duration	Landing Zones	R-2906	PALATKA 2 MOA
Aircraft	Service	2018	Proposed	min			
F/A-18E/F	USN	441	700	40	-	25%	75%
F/A-18C/D	USN	110	-	40	-	25%	75%
F/A-18	USMC	39	100	30	-	50%	50%
F-16	USAF	29	100	30	-	25%	75%
F-15	USAF	166	200	30	-	25%	75%
A-10	USAF	287	400	30	-	50%	50%
AV-8	USMC	24	50	30	-	50%	50%
EA-6	USN	2	-	30	-	-	100%
EA-18G	USN	-	50	30	-	-	100%
E-2	USN	1	50	30	-	-	100%
V-22	USMC	5	50	30	-	100%	-
AC-130	USAF	2	50	30	-	75%	25%
H-60	USN	132	200	90	67%	33%	-
AH-1	USMC	-	50	90	67%	33%	-
UH-1	USMC	-	50	90	67%	33%	-
H-53	USMC	-	50	90	67%	33%	-
KC-130	USMC	-	50	30	-	75%	25%
T-45	USN	-	720	30	-	25%	75%
A-29	USAF	-	100	30	-	50%	50%
F-35A	ANG	-	100	30	-	-	100%
F-35B	USMC	-	100	30	-	-	100%
F-35C	USN	-	500	40	-	25%	75%

Table 3-13. Rodman Range Area Operations Altitude Distributions

Rodman Range (R-2906)		Area Operations Altitude Distributions								
		R-2906					PALATKA 2			
Aircraft	Service	Airspeed (kts)	Altitude (feet) 500-8k	8k-15k	15k+		Airspeed (kts)	Altitude (feet) 500-8k	8k-15k	15k+	
F/A-18	USN	500	33%	33%	33%		500	33%	33%	33%	
T-45	USN	450	33%	33%	33%		450	33%	33%	33%	
F-35C	USN	500	0%	30%	70%		500	0%	30%	70%	
EA-6/EA-18G	USN						450	0%	100%	0%	
		Airspeed (kts)	Altitude (feet) 500-3k	3k-10k	10k+		Airspeed (kts)	Altitude (feet) 500-3k	3k-10k	10k+	
F/A-18	USMC	450	16%	27%	57%		450	16%	27%	57%	
F-35B	USMC	450	0%	30%	70%		450	0%	30%	70%	
AV-8	USMC	450	10%	10%	80%		450	10%	10%	80%	
		Airspeed (kts)	Altitude (feet) 500-1k	1k-5k	5k-15k	15k-23k	Airspeed (kts)	Altitude (feet) 500-1k	1k-5k	5k-15k	15k-23k
F-16	USAF	500	5%	5%	20%	70%	500	5%	5%	20%	70%
F-15	USAF	500	5%	5%	20%	70%	500	5%	5%	20%	70%
A-10	USAF	300	20%	70%	10%	0%	300	20%	70%	10%	0%
A-29	USAF	300	20%	70%	10%	0%	300	20%	70%	10%	0%
		Airspeed (kts)	Altitude (feet) 500-1k	1k-5k	5k-15k	15k-23k	Airspeed (kts)	Altitude (feet) 500-1k	1k-5k	5k-15k	15k-23k
F-35A	ANG						475	2%	3%	5%	90%
		Airspeed (kts)	Altitude (feet) 500-3k	3k-10k	10k+		Airspeed (kts)	Altitude (feet) 500-3k	3k-10k	10k+	
AC-130	USAF	190	0%	0%	100%		190	0%	0%	100%	
KC-130	USMC	190	0%	0%	100%		190	0%	0%	100%	
		Airspeed (kts)	Altitude (feet) 50-200	200-1k	1k-2.5k	2.5k-10k	Airspeed (kts)	Altitude (feet) 50-200	200-2k		
V-22	USMC	220	0%	0%	17%	83%					
H-60	USN	120	75%	20%	5%	0%					
AH-1	USMC	100	10%	15%	75%	0%					
UH-1	USMC	100	10%	15%	75%	0%					
H-53	USMC	120	75%	20%	5%	0%					

3.5 Air Gunnery Operations

For air gunnery noise modeling calculations, additional parameters are required beyond the flight patterns and mission types described in Sections 3.1 through 3.3. These additional parameters include the ordnance type, target location, attack lane limits, and the firing distances, as well as the annual ordnance expenditure and day/night activity. The percent-utilizations of acoustic day and night air gunnery training operations for each airframe, along with the other Pinecastle Range air gunnery parameters, are listed in Table 3-14, followed by the dataset for Lake George in Table 3-15, and Rodman in Table 3-16. Note that not every possible aircraft, weapon, and event combination are represented because only the loudest such combinations are relevant to the noise analysis. Where applicable, negative values in the “Attack Dive Min°” column indicate climb angles, and negative “End Fire (ft)” distances indicate firing after passing over the target, e.g. V-22 belly gun.

A broad set of munitions are expended during air gunnery training operations within the PRC. The modeled large arms types and annual expenditures for the baseline and projected conditions are listed in Table 3-17 for all three ranges within PRC. In addition to these large arms ordnance expenditures from air gunnery operations, there are projected small arms ordnance at the eight LZs within Rodman Range, as shown in Table 3-16.

Table 3-14. Air Gunnery Parameters at Pinecastle Range[2]

Aircraft Type	Ordnance Type	Total Annual Expenditures		Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures		Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
		2018	Proposed					2018	Proposed							
F/A-18 USN	20 mm	25000	33000	High Angle Strafe Targets	38	38	38	2500	3300	1000 to 6500	15	30	6900	3600	85%	15%
				Tactical Runway Area	142	137	147	20000	26400							
				Low Angle Strafe Targets	38	38	38	2500	3300	500 to 3500	0	15				
F/A-18 USMC	20 mm	4000	3000	High Angle Strafe Targets	38	38	38	400	300	1000 to 6500	15	30	6900	3600	98%	2%
				Tactical Runway Area	142	137	147	3200	2400							
				Low Angle Strafe Targets	38	38	38	400	300	500 to 3500	0	15				
F-16	20 mm	3000	3000	High Angle Strafe Targets	38	38	38	1500	1500	1000 to 6500	15	30	6900	3600	85%	15%
				Low Angle Strafe Targets				1500	1500	500 to 3000	0	15				
F-15	20 mm	4000	3000	High Angle Strafe Targets	38	38	38	2000	1500	1000 to 6500	15	30	6900	3600	85%	15%
				Low Angle Strafe Targets				2000	1500	500 to 3000	0	15				
A-10	30 mm	30603	40000	Impact Strafe Target	38	38	38	3060	4000	500 to 1500	15	30	4000	2000	85%	15%
				Tactical Runway Area	142	137	147	24482	32000				8700	4200		
				Low Angle Strafe Targets	38	38	38	3060	4000		0	15	4000	2000		
F-35B & C	25 mm	0	30000	High Angle Strafe Targets	38	38	38	0	3000	1000 to 6500	15	30	6900	3600	85%	15%
				Tactical Runway Area	142	137	147		24000							
				Low Angle Strafe Targets	38	38	38		3000		0	15				

[2] The C/D and E/F variants of the F/A-18 are combined in Table 3-13 for the USN because the munitions are the same for both airframes.

{Table 3-14 continued…}

Aircraft Type	Ordnance Type	Total Annual Expenditures		Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures		Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
		2018	Proposed					2018	Proposed							
AV-8	5" Rocket	0	20	Live Impact Area	169	160	178	0	7	2000 to 5000	5	25	8700	4200	100%	0%
					317	307	327		7							
					137	127	147		7							
	2.75" Rocket	23	60		169	160	178	8	20							
					317	307	327	8	20							
					137	127	147	8	20							
	25 mm	0	10000	High Angle Strafe Targets	38	38	38	0	5000	2000 to 3500	15	30	6500	5000		
				Low Angle Strafe Targets					5000	1500 to 2500	0	15	5500	4000		
V-22	7.62 mm	2000	10000	High Angle Strafe Targets	38	38	38	2000	10000	1000 to 4500	0	0	900	-3000	95%	5%
	0.50 Cal	500	2000	Low Angle Strafe Targets				500	2000	50 to 500						
	0.50 Cal	500	2000	Sidefire (Multiple	317	307	327	500	2000	1000 to 2000			3000	-2000		
	7.62 mm	2000	10000					2000	10000	100 to 500						
AC-130	105 mm	0	300	Tactical Runway Area	142	137	147	0	300	9000	0	0	7900	7900	100%	0%
	40 mm		600						600							
	25 mm		10000	High Angle Strafe Targets	38	38	38		5000							
				Low Angle Strafe Targets					5000							

{Table 3-14 continued…}

Aircraft Type	Ordnance Type	Total Annual Expenditures 2018	Total Annual Expenditures Proposed	Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures 2018	Individual Expenditures Proposed	Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
KC-130	AGM-114P	0	50	Tactical Runway Area	169	160	178	0		10000	0	0	14582	12760	100%	0%
					317	307	327		25							
					137	127	147		25							
	AGM-114Q		10		317	307	327		5				12760	14582		
					137	127	147		5							
	AGM-176		50		169	160	178						30000	9000		
					317	307	327		25							
					137	127	147		25							
H-60	20 mm	6790	5000	Tactical Runway Area	142	137	147	3395	2500	50 to 2500	15	30	4000	650	95%	5%
				Village West	142	132	152	3395	2500							
	0.50 Cal	15000	24000	Sidefire (Multiple	317	307	327	15000	24000	100 to 400	0	0	6100	160		
	7.62 mm	61000	350000					61000	350000		0	0	4000			
	2.75" Rocket	76	180	Live Impact Area	169	160	178	25	60	50 to 2500	5	20	4000	650	100%	0%
					317	307	327	25	60							
					137	127	147	25	60							
	2.75" Rocket (Inert)	577	600	Tactical Runway Area	317	307	327	289	300				3000			
					137	127	147	289	300							
	AGM-114B (A-F)	20	50	Tactical Runway Area Spot #4	155	150	160	20	50	50 to 3000	0	0	26300	1500		
	AGM-114Q (Inert)	0	40		155	150	160	0	40				14582	12760		

{Table 3-14 continued…}

Aircraft Type	Ordnance Type	Total Annual Expenditures		Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures		Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
		2018	Proposed					2018	Proposed							
MH-65	0.50 Cal	2000	4000	Moving Strafe Target	38	38	38	2000	4000	50 to 100	0	5	300	225	100%	0%
	7.62 mm	12387	30000					12387	30000							
AH-1	20 mm	0	3000	Tactical Runway Area	317	307	327	0	0	700 to 2000	0	5	6100	656	95%	5%
					142	132	152		1020							
				High Angle Strafe Targets	38	38	38		990	50 to 1200						
				Low Angle Strafe Targets					990							
	AGM-114K/M/		50	Tactical Runway Area Spot #4	155	150	160		50	50 to 5000	0	20	26248	1641	100%	0%
	5" Rocket		80	Live Impact Area	169	160	178		27		0	30	8531	1312		
					317	307	327		26							
					137	127	147		26							
	2.75" Rocket		30		169	160	178		10		-16*	30				
					317	307	327		10							
					137	127	147		10							
UH-1	0.50 Cal	0	6000	Sidefire (Multiple Targets)	317	307	327	0	6000	100 to 2000	0	20	4600	656	95%	5%
	2.75" Rocket		30	Live Impact Area	169	160	178		10	50 to 5000	-16*	30	8531	1312	100%	0%
					317	307	327		10							
					137	127	147		10							
H-53	0.50 Cal	0	12000	Sidefire (Multiple Targets)	317	307	327	0	12000	100 to 2000	0	20	4600	656	95%	5%
Rotor -craft	7.62mm (blanks)	0	5000	Landing Zones	n/a	n/a	n/a	0	5000	100 to 300	n/a	n/a	n/a	n/a	25%	75%

Table 3-15. Air Gunnery Parameters at Lake George

Aircraft Type	Ordnance Type	Total Annual Expenditures		Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures		Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
		2018	Proposed					2018	Proposed							
Fixed-wing	2.75" Rocket (Inert)*	0	25	Center Target	135	90	180	0	25	2000 to 6500	5	25	8700	4200	100%	0%
	5" Rocket (inert)	0	100	Center Target	135	90	180	0	100	2000 to 5000	5	25	8700	4200	100%	0%
H-60	2.75" Rocket (Inert)*	0	75	Center Target	135	90	180	0	75	50 to 2500	5	20	4000	650	100%	0%

Table 3-16. Air Gunnery Parameters at Rodman Range

Aircraft Type	Ordnance Type	Total Annual Expenditures		Target	Attack ° Mag	Left ° Limits	Right ° Limits	Individual Expenditures		Altitude Range (ft AGL)	Attack Dive ° Min	Attack Dive ° Max	Start Fire (ft)	End Fire (ft)	Acoustic Day %	Acoustic Night %
		2018	Proposed					2018	Proposed							
Helos	7.62mm	0	5000	8x LZ	0	180	180	0	5000	50 to 1000	0	0	6000	100	100%	0%

Table 3-17. Ordnance Expenditures for Explosive Noise at Pinecastle, Lake George, and Rodman Range

Ordnance Type	2018 BL	Proposed
Pinecastle Range (R-2910)		
2.75" Rocket (i)	577	900
2.75" Rocket (L)	99	400
20 mm	42,790	50,000
25 mm	-	50,000
30 mm	30,603	40,000
40 mm	-	600
105 mm	-	300
5" Rocket	-	100
AGM-114B (A-F)	8	50
ATM-114B	20	50
AGM-114K/M/N	-	50
AGM-114P	-	50
AGM-114Q	-	50
AGM-175/176	-	50
BDU-33	796	600
BDU-45	68	100
BDU-48/MK-106	-	100
BDU-50	30	100
BLU-110	22	200
BLU-111	241	500
GBU-10 (L)	-	200
GBU-10 (i)	-	200
GBU-24 (i)	-	100
GBU-31 (i)	1	500
GBU-32 (i)	27	500
GBU-38 (i)	-	500
GBU-44 (i)	-	100
GBU-54 (i)	-	100
GBU-12 (i)	78	500
GBU-12 (L)	25	100
GBU-16 (i)	9	500
GBU-16 (L)	2	100
LGTR	128	500
MK-76	173	6,060
MK-81	-	100
MK-82 (i)	6	250
MK-82 (L)	232	500
MK-83 (i)	-	250
MK-83 (L)	37	500
MK-84 (L)	26	250
TOTAL	**75,998**	**154,860**

Ordnance Type	2018 BL	Proposed
Lake George Range (R-2907)		
2.75" Rocket (i)	0	100
BDU-33	6	100
BDU-45	16	100
BDU-48/MK-106	39	200
BDU-50	0	100
MK-62 (i)	60	250
MK-63 (i)	22	100
MK-82 (i)	0	100
5" Rocket (i)	0	100
MK-81 (i)	0	100
MK-83 (i)	0	100
MK-84 (i)	0	100
MK-76	15	100
TOTAL	**158**	**1,550**

Ordnance Type	2018 BL	Proposed
Rodman Range (R-2906)		
BDU-33	16	100
MK-76	6	5,000
BDU-45	0	100
BDU-48/MK-106	0	100
BDU-50	0	100
TOTAL	**22**	**5,400**

3.6 Ground-to-Ground Small Arms Expenditures

Ground-based small arms expenditures (munitions smaller than 20 mm) were modeled with SARNAM and reviewed by Army PHC. Pinecastle and Rodman Range feature live and inert firings in the quantities specified in Table 3-18, including Special Effects Small Arms Marking System (SESAMS).

Table 3-18. Small Arms Ordnance Type and Scenario Expenditures for Pinecastle Range

Ordnance Type	Existing Condition	2020 Projected Ordnance
Pinecastle Range (R-2910)		
12 Gauge	0	250
5.56 mm	12,000	15,000
5.56 mm (blanks)	0	5,000
SESAM	0	2,000
7.62 mm	392,410	397,410
9 mm	1,200	2,000
.50 Caliber	27,620	30,620
TOTAL	**433,230**	**452,280**

Table 3-19. Small Arms Ordnance Type and Scenario Expenditures for Rodman Range

Ordnance Type	Existing Condition	2020 Projected Ordnance
Rodman Range (R-2906)		
5.56 mm (blanks)	0	10,000
SESAM	0	2,000
TOTAL	**0**	**12,000**

4 Projected Aircraft Noise Exposure

The operational training parameters described in Section 3 were used to calculate the noise exposures at PRC. Noise calculations involve four distinct noise sources: aircraft flight activity, air gunnery operations, large arms explosions, and small arms ground fire. The cumulative noise exposure from aircraft flight activity is described by the A-weighted DNL. The cumulative noise exposure from air gunnery operations and large arms explosions are combined and described by CDNL. Noise from small arms ground firing is described by L_{Pk}. These different acoustical metrics are discussed in Section 2.1.

4.1 Aircraft Noise

Aircraft noise is represented by annual average DNL noise contours. These contours were developed through a combination of NoiseMap and MRNMap, as described in Section 2. The resulting DNL contours for PRC are shown in Figure 4-1 through Figure 4-3, with contours drawn from 65 to 75 dBA where applicable. As discussed in Sections 3.1.7, 3.2, and 3.3, tactical missions do not consist of repeated, tracked flight routes; flight operations are therefore modeled as occurring throughout the applicable boundaries of the restricted airspace. As a result, the modeled noise contours will align with the perimeters of the restricted airspace.

For Pinecastle Range, the cumulative noise is concentrated over the target areas for both the NA and PA conditions (Figure 4-1); the DNL contours expand in the PA scenario due to the increase in training mission sorties as well as the addition of new aircraft. Even with this increase, the 65 dBA DNL contour remains well within the Pinecastle Range boundary and around the two ingress/egress LZs within R2910.

The overall cumulative noise for Lake George Range and its associated SUA is below 60 dBA DNL under the NA scenario because the dominate training mission types are area/tactical flight activity. Correspondingly, the operations are modeled as spread equally and thus, the resultant noise occupies the space in which the flight activity occurs. However, for the PA scenario the increase in the mining exercises are estimated to generate cumulative noise levels above 65 dBA DNL (Figure 4-2). Both the 65 dBA and 70 dBA DNL contour remain overwater and follow the modeled mining exercise areas (Figure 3-28).

Rodman Range features tactical missions exclusively, such that noise is distributed across Palatka 2 MOA and R-2906 with the majority of the area exposed to a predicted noise level of 50 dBA DNL for both the NA and PA scenarios. Additionally, training operations at the LZ do concentrate the noise around these specific LZs (Figure 4-3). For locations centered on these LZs, the noise levels are predicted to reach at least 65 dBA DNL for the NA scenario and at least 80 dBA DNL for the PA scenario. However, these high noise areas occur well within the Rodman Range boundary.

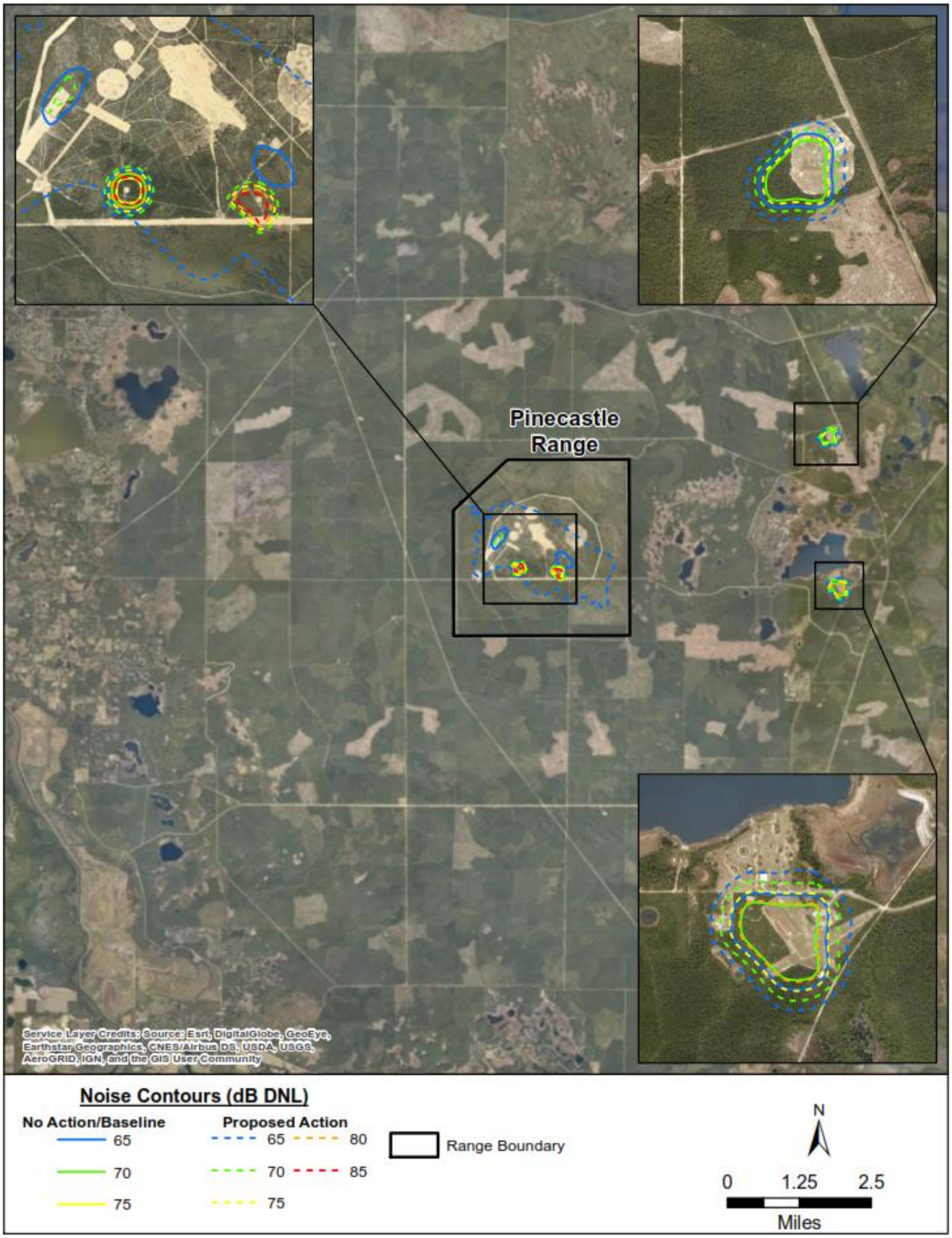

Figure 4-1. Comparison of Subsonic Aircraft Noise (DNL) Results at Pinecastle Range and Associated SUA

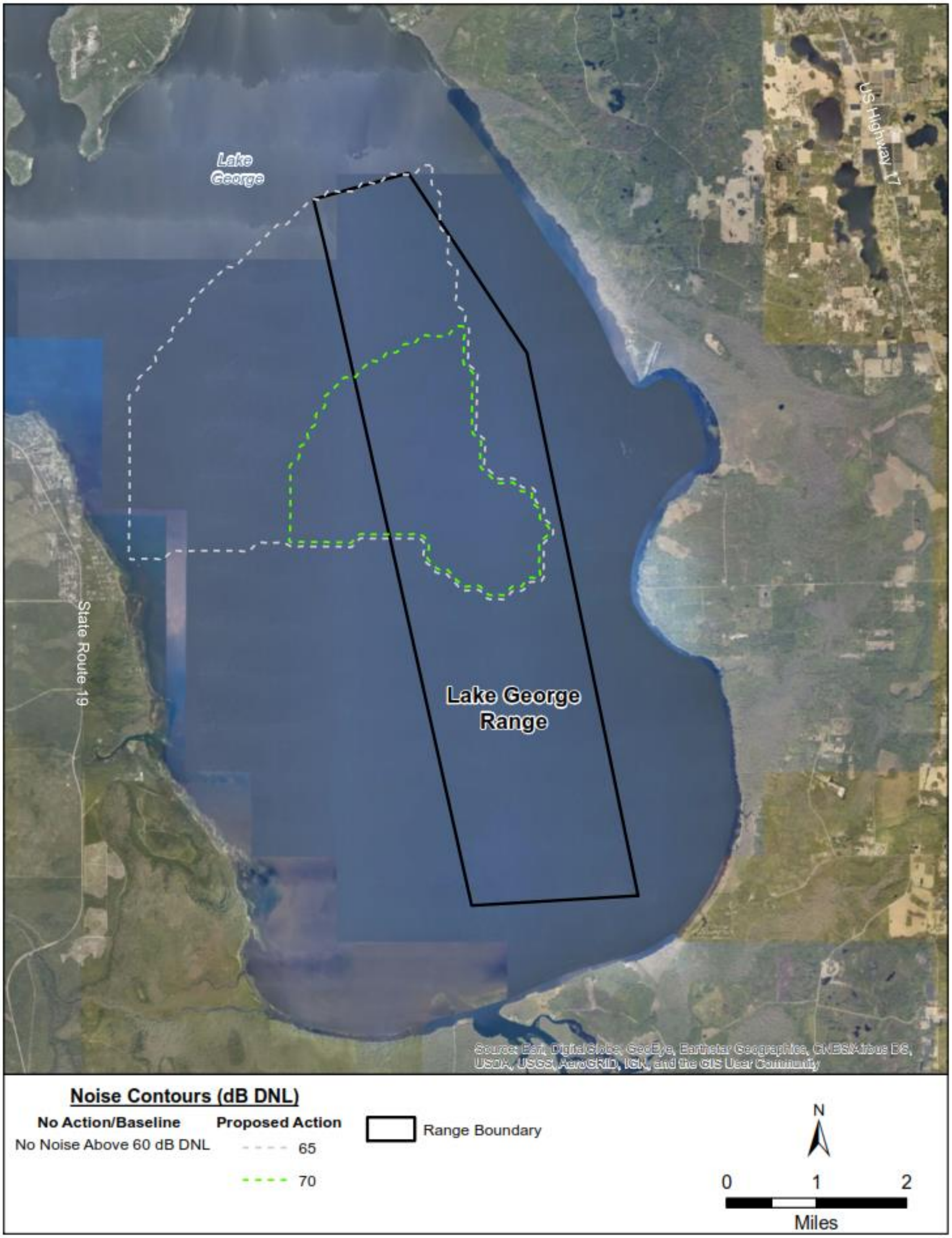

Figure 4-2. Comparison of Subsonic Aircraft Noise (DNL) Results at Lake George Range and Associated SUA

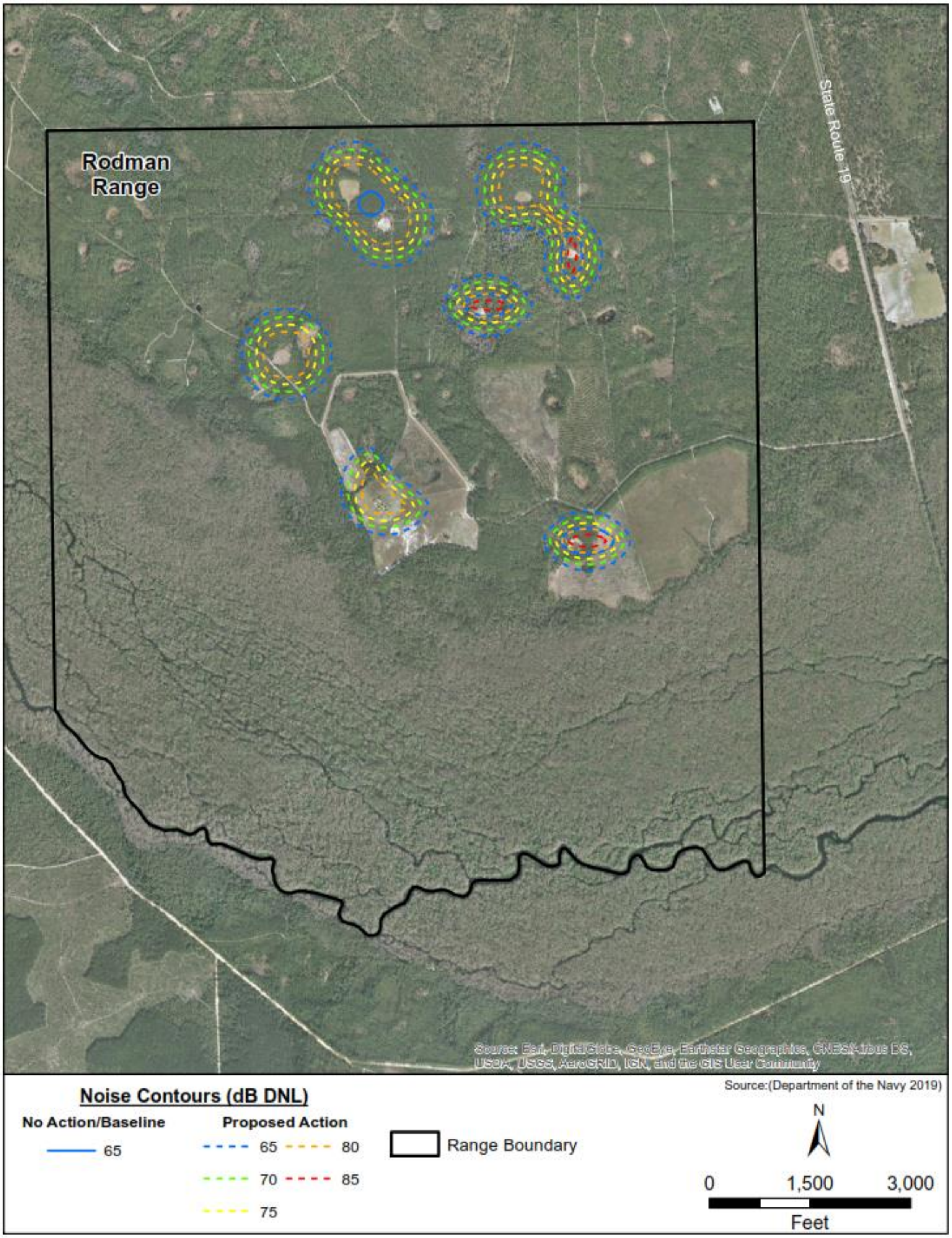

Figure 4-3. Comparison of Subsonic Aircraft Noise (DNL) Results at Rodman Range and Associated SUA

4.2 Impulsive Noise

Several of the air gunnery operations conducted within PRC involve HE. For example, non-inert Hellfire missiles have HE warheads. This impulsive noise is modeled with both the AGNM (air gunnery operations) and BNoise (ground explosions). The results from the two models were combined to provide the overall CDNL exposure for Pinecastle Range and Lake George Range. For Rodman Range, the proposed air gunnery operations are for small arms firing, so Peak contour levels are provided for the PA scenario. For Pinecastle Range, both NA and PA scenarios are provided since impulsive noise is currently occurring at this range. For Lake George and Rodman Ranges, only new proposed impulsive noise is provided since training involving impulsive noise is a PA.

Figure 4-4 provides the CDNL noise levels from air gunnery operations at Pinecastle Range for both the NA and PA scenarios. For the NA scenario, the non-circular shape in the contours on the western side of the range is driven by air gunnery noise, whereas the circular portions of the contours are driven by explosive weapons. This figure demonstrated the large increase in the impulsive noise for the PA. The 70 dBC CDNL contour for the PA is similar to the NA's 62 dBC CDNL contour, which represents an 8 dBC increase. For the PA scenario, the 62 and 57 dBC CDNL contours are circular (driven by explosive weapon noise) and occur well outside of the Pinecastle Range boundary. This large increase in impulsive noise is driven by the large increase in explosive weapons (see Table 3-17).

CDNL contours for the PA new air gunnery operations within Lake George are small, and they are the result of rocket propulsion noise and sonic boom. The cumulative noise contours occur near the targets and are within the range boundary (Figure 4-5). For Rodman Range, air gunnery operations consisting of small arms fire (7.62mm) from helicopters at all eight LZs. The resultant Peak contours (Figure 4-6) lie mostly outside of the range boundary but well within R2906 boundaries.

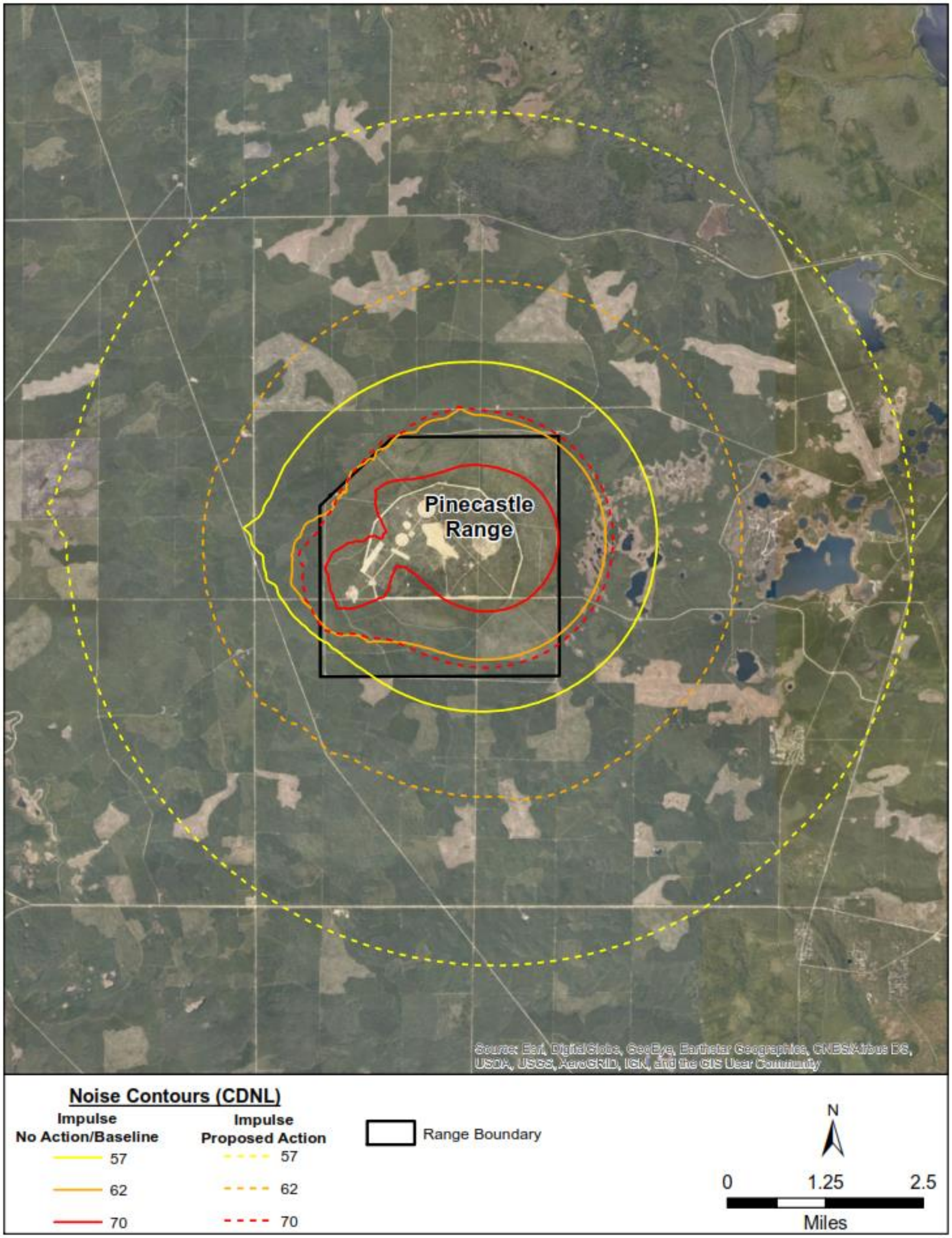

Figure 4-4. Pinecastle Range Results for Air Gunnery Operations (CDNL, Baseline and Proposed Action)

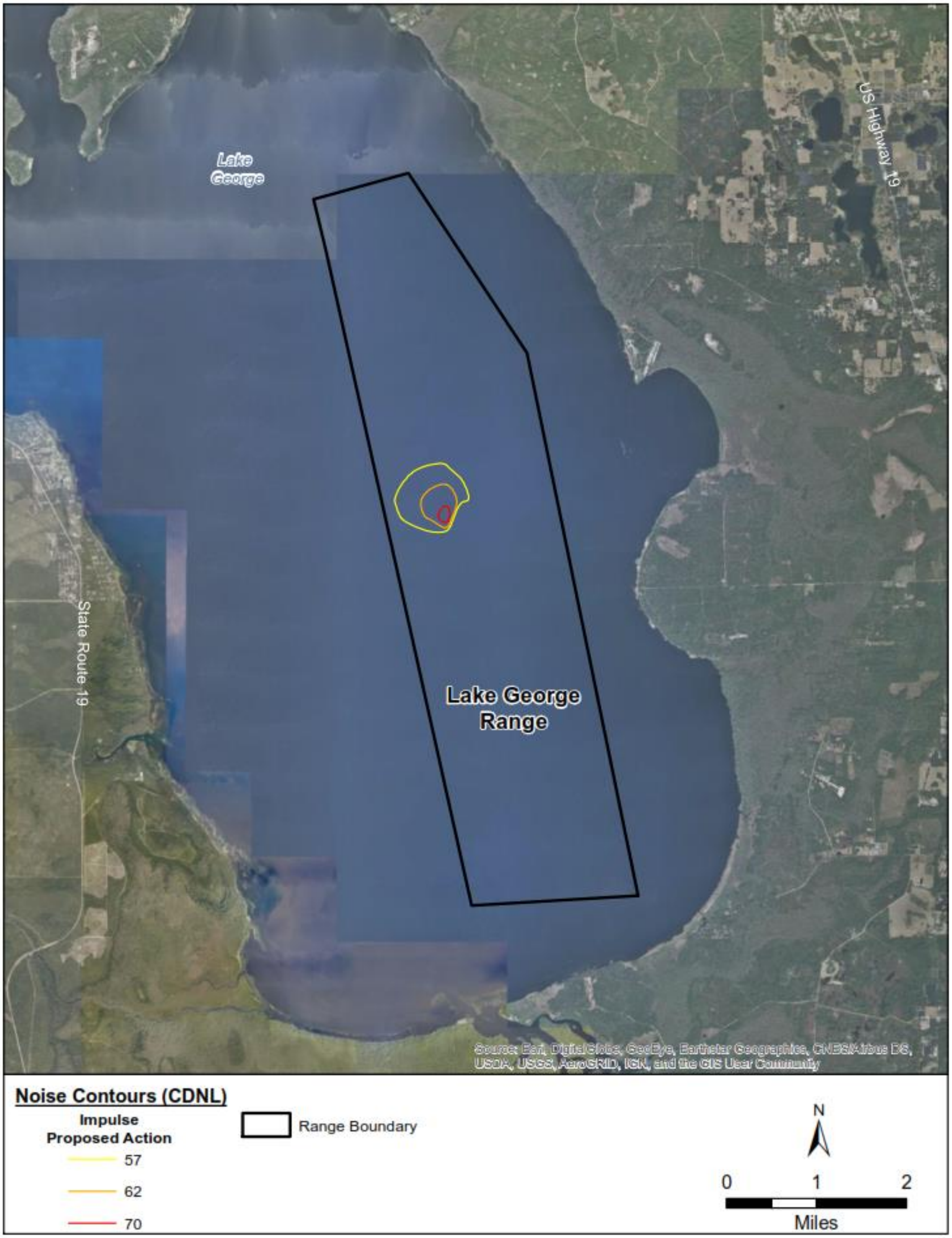

Figure 4-5. Lake George Range Results for Impulsive Noise (CDNL Proposed Action)

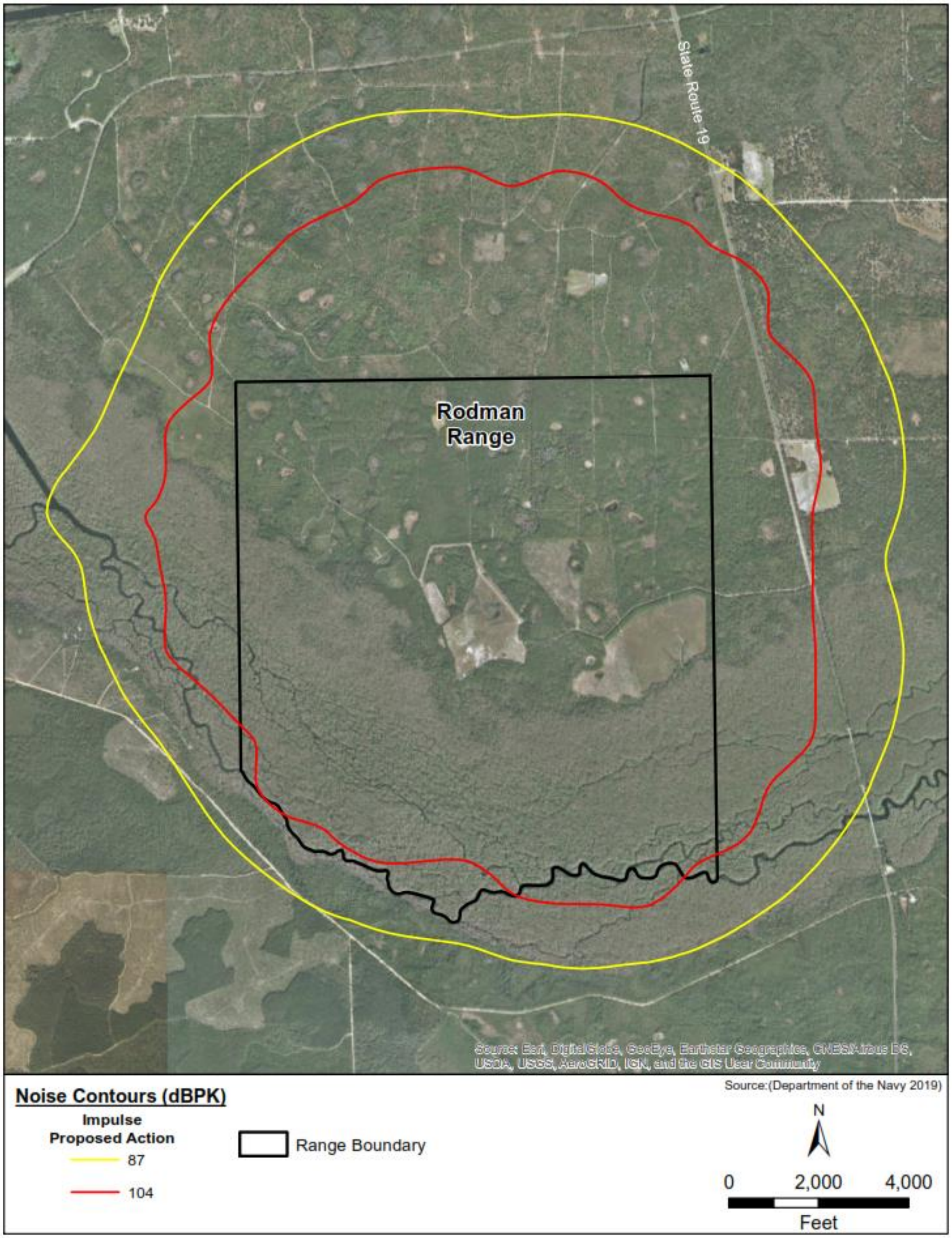

Figure 4-6. Rodman Range Results for Impulsive Noise (dBPK Proposed Action)

4.3 Ground Fire Small Arms Noise

4.3.1 Pinecastle Range

Pinecastle Range (R-2910) contains multiple small arms ranges and areas where both blank and live-fire rounds are expended. Selected locations are tactical training areas without set firing lanes, while others have specific firing points and targets. The Urban Complex and Village West (shown in Figure 4-7) are locations without designated firing directions, while locations along Road 38 and the Sniper Range have specific firing points with identified targets.

Noise analysis for areas without specific targets is best served by creating a "noise buffer area." For the Urban Complex and the Village West, the loudest weapon fired are 0.50 Cal blank rounds. Therefore, through discussion and concurrence with Army PHC, BRRC developed buffer areas using SARNAM. From these calculations it was determined that the distance to the 87 $dBPk_{15}$ contour level from a 0.50 Cal blank round is 1,963 m. For 104 $dBPk_{15}$, the distance is 541 m.

For the Road 038 and Sniper Ranges, BRRC completed a full noise analysis with SARNAM using the NA and PA scenarios. The results of this noise analysis are shown in Figure 4-8 for both target area. Because the noise from live rounds generate much larger peak noise contours than blank rounds (due to the ballistic waves emanating from the traveling bullet), the buffer areas are encompassed by the live fire contours. The live fire results features noise contours that expand to the southwest, relative to the blank rounds results, although both contours remain within the R-2910A SUA boundary.

Figure 4-7. Regions of Permissible Ground Based Small Arms Fire at (a) the Urban Complex, (b) the Village West (Images Courtesy of Ecology & Environment)

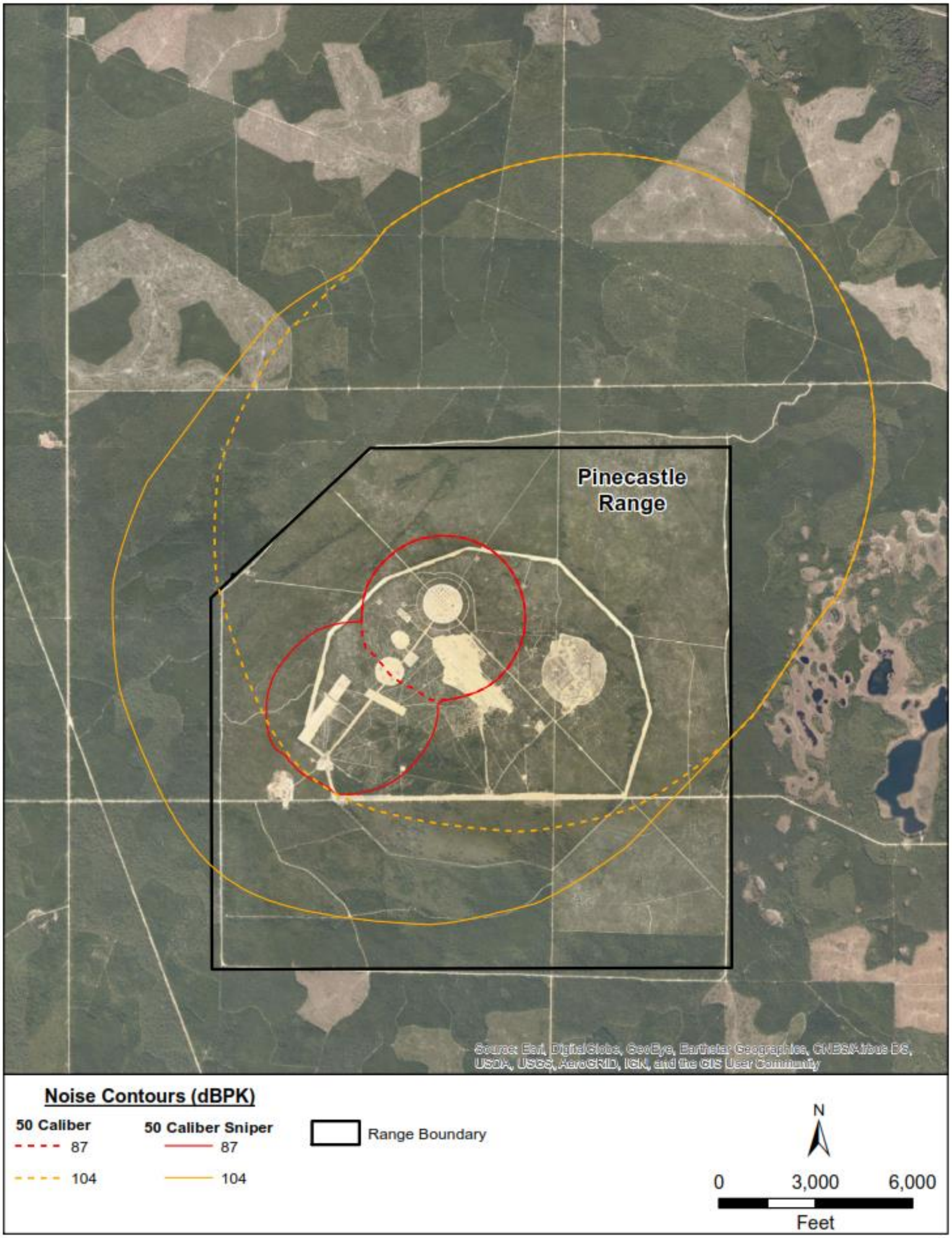

Figure 4-8. Pinecastle Range Results for Ground-based Small Arms Fire (Peak, Current Condition)

4.3.2 Rodman Range

The PA scenario at Rodman Range includes small arms fire, including 5.56 mm and SESAMS rounds. Like Pinecastle Range, small arms activity at Rodman Range was modeled using buffer areas determined by 5.56 mm blank rounds using SARNAM. From these calculations, it was determined that the distance to the 87 $dBPk_{15}$ contour level from a 5.56 mm blank round is 249 m. For 104 $dBPk_{15}$, the distance is 42 m.

To determine the total buffer area, the 249 m and 42 m offsets were first applied to the outside perimeter of the Small Arms Range within Rodman Range (Figure 4-9). Then, these same offsets were also applied to each of the LZs, together with an additional 305 m standoff distance. Therefore, the total buffer zone for the 87 $dBPk_{15}$ level is 554 m from the center of each LZ. The distance to the 104 $dBPk_{15}$ buffer is 347 m from the center of the LZs. Combining the offset for the Ground Fire Area with the offsets for the LZs create a composite buffer (Figure 4-9). This can be used as a functional noise footprint for determining impact. Both the 87 and 104 dBPK would remain within the range boundary except for the 87 dBPK to the north. These areas result from firing operation near two LZs.

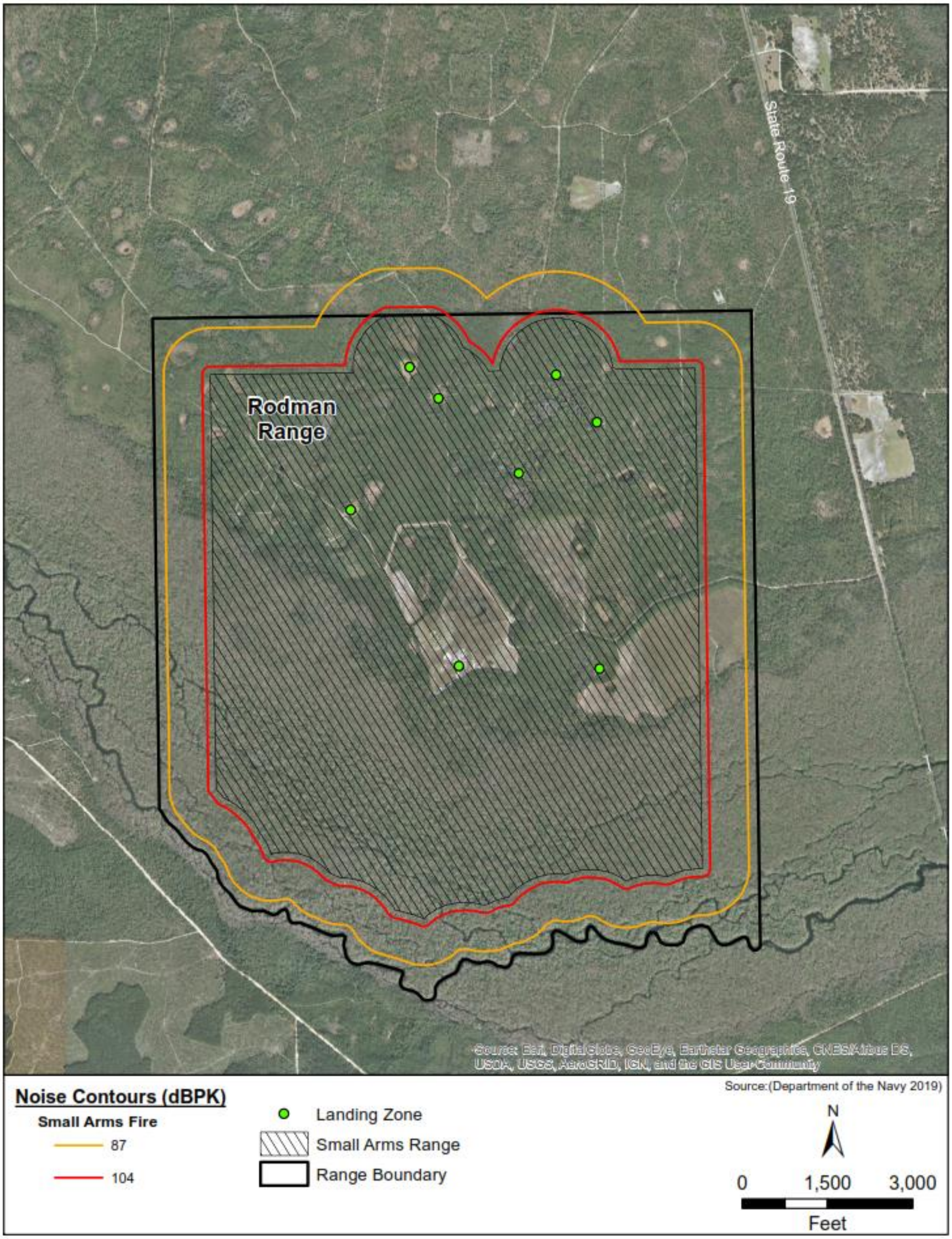

Figure 4-9. Rodman Range Results for Ground-based Small Arms Fire around the Eight LZs (Peak15, Projected FY2020 Condition)

5 References

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APPENDIX C
AIR QUALITY CALCULATIONS

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Table C-1. No Action Alternative Aircraft Emissions - Pinecastle Range

Aircraft Type	Service	No Action Annual Sorties[1]	Total time per Sortie (min)[6]	Total Annual time (min)	*Aircraft Cruise Emission Factors (lb/op)*[2]							*Annual No Action Alternative Emissions (tons)*						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[4]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
PINECASTLE																		
A-10	USAF	375	11.35	4256.3	13.11	0.05	0.32	-	1.76	1.76	1444	18.6	0.1	0.5	-	2.5	2.5	2048.7
A-29	Navy	0	9.35	0	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC-130[3]	USAF	5	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	0	90	0	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.0	0.0	0.0	-	0.0	0.0	0.0
AV-8	USMC	28	3.525	98.7	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.2	0.0	0.0	0.0	0.0	0.0	34.5
Cessna[5]	Navy	1	9.9	9.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G	Navy	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[3]	Navy	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	591	7.7	4550.7	13.11	0.05	0.32	-	1.76	1.76	1444	19.9	0.1	0.5	-	2.7	2.7	2190.4
F/A-18C/D	USMC	43	4.74	203.82	13.11	0.05	0.32	-	1.76	1.76	1444	0.9	0.0	0.0	-	0.1	0.1	98.1
F/A-18E/F	Navy	0	7.7	0	13.11	0.05	0.32	-	1.76	1.76	1444	0.0	0.0	0.0	-	0.0	0.0	0.0
F-15	USAF	166	2.7625	458.58	13.11	0.05	0.32	-	1.76	1.76	1444	2.0	0.0	0.0	-	0.3	0.3	220.7
F-16	USAF	44	2.7625	121.55	13.11	0.05	0.32	-	1.76	1.76	1444	0.5	0.0	0.0	-	0.1	0.1	58.5
F-35A	USAF	0	1.05	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35B	USMC	0	3.525	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35C	Navy	0	4.35	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H-53	USMC	0	90	0	93.865	0.403	9.217	-	0.678	0.678	-	0.0	0.0	0.0	-	0.0	0.0	-
H-60	Navy	253	90	22770	7.68	0.66	7.5	-	5.04	5.04	3,864.67	1.5	0.1	1.4	-	1.0	1.0	733.3
KC-130[3]	USMC	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-1. No Action Alternative Aircraft Emissions - Pinecastle Range

Aircraft Type	Service	No Action Annual Sorties[1]	Total time per Sortie (min)[6]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[2]							Annual No Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[4]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
MH-65	USCG	21	15	315	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.0	0.0	0.0	-	0.0	0.0	7.2
P-3	Navy	11	3	33	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	1.0
P-8	Navy	0	2	0	13.11	0.05	0.32	-	1.76	1.76	1444	0.0	0.0	0.0	-	0.0	0.0	0.0
T-45	Navy	0	12	0	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UH-1	USMC	0	90	0	4.01	0.09	0.7	0.28	2.91	2.91	-	0.0	0.0	0.0	-	0.0	0.0	-
V-22	USMC	5	15	75	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	2.2
	Total	1,545										**43.6**	**0.3**	**2.5**	**0.0**	**6.6**	**6.6**	**5,394.7**

Notes:

1) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.
2) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.
3) No time spent below 3000 feet.
4) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.
5) Cessna contributions are assumed to be negligible.
6) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-2. Preferred Alternative Aircraft Emissions - Pinecastle Range

Aircraft Type	Service	Proposed Action Annual Sorties	Total time per Sortie (min)[5]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[1]							Annual Proposed Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[3]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
PINECASTLE																		
A-10	USAF	400	11.35	4540	13.11	0.05	0.32	-	1.76	1.76	1444	19.8	0.1	0.5	-	2.7	2.7	2185.3
A-29	Navy	100	9.35	935	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.2	0.0	0.1	0.1	39.2
AC-130[2]	USAF	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	150	90	13500	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.5	0.1	1.0	-	0.4	0.4	307.6
AV-8	USMC	100	3.525	352.5	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.6	0.0	0.1	0.0	0.2	0.2	123.3
Cessna[4]	Navy	50	9.9	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[2]	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	100	7.7	770	13.11	0.05	0.32	-	1.76	1.76	1444	3.4	0.0	0.1	-	0.5	0.5	370.6
F/A-18C/D	USMC	100	4.74	474	13.11	0.05	0.32	-	1.76	1.76	1444	2.1	0.0	0.1	-	0.3	0.3	228.2
F/A-18E/F	Navy	600	7.7	4620	13.11	0.05	0.32	-	1.76	1.76	1444	20.2	0.1	0.5	-	2.7	2.7	2223.8
F-15	USAF	200	2.7625	552.5	13.11	0.05	0.32	-	1.76	1.76	1444	2.4	0.0	0.1	-	0.3	0.3	265.9
F-16	USAF	100	2.7625	276.25	13.11	0.05	0.32	-	1.76	1.76	1444	1.2	0.0	0.0	-	0.2	0.2	133.0
F-35A	USAF	100	1.05	105	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.2	0.0	0.0	0.0	0.0	0.0	36.7
F-35B	USMC	100	3.525	352.5	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.6	0.0	0.1	0.0	0.2	0.2	123.3
F-35C	Navy	500	4.35	2175	2.08	0.04	0.32	0.05	0.55	0.55	419.9	3.8	0.1	0.6	0.1	1.0	1.0	761.1
H-53	USMC	150	90	13500	93.865	0.403	9.217	-	0.678	0.678	-	10.6	0.0	1.0	-	0.1	0.1	-
H-60	Navy	300	90	27000	7.68	0.66	7.5	-	5.04	5.04	3,864.67	1.7	0.1	1.7	-	1.1	1.1	869.6
KC-130[2]	USMC	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-2. Preferred Alternative Aircraft Emissions - Pinecastle Range

Aircraft Type	Service	Proposed Action Annual Sorties	Total time per Sortie (min)[5]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[1]							Annual Proposed Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[3]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
MH-65	USCG	50	15	750	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.0	0.0	0.1	-	0.0	0.0	17.1
P-3	Navy	0	3	0	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	0.0
P-8	Navy	50	2	100	13.11	0.05	0.32	-	1.76	1.76	1444	0.4	0.0	0.0	-	0.1	0.1	48.1
T-45	Navy	720	12	8640	0.079	0.034	0.446	0.011	0.214	0.214	83.80	0.3	0.1	1.9	0.0	0.9	0.9	362.0
UH-1	USMC	150	90	13500	4.01	0.09	0.7	0.28	2.91	2.91	-	0.5	0.0	0.1	-	0.3	0.3	-
V-22	USMC	50	15	750	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.1	0.0	0.0	-	0.0	0.0	22.3
	Total	4,270										**68.5**	**0.7**	**8.0**	**0.2**	**11.0**	**11.0**	**8,117.0**

Notes:

1) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.

2) No time spent below 3000 feet.

3) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.

4) Cessna contributions are assumed to be negligible.

5) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-3. No Action Alternative Aircraft Emissions - Rodman Range

Aircraft Type	Service	No Action Annual Sorties[1]	Total time per Sortie (min)[6]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[2]							Annual No Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[4]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
RODMAN																		
A-10	USAF	287	16.5	4735.5	13.11	0.05	0.32	-	1.76	1.76	1444	20.7	0.1	0.5	-	2.8	2.8	2279.4
A-29	Navy	0	16.5	0	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC-130[3]	USAF	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	0	30	0	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.0	0.0	0.0	-	0.0	0.0	0.0
AV-8	USMC	24	3	72	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.1	0.0	0.0	0.0	0.0	0.0	25.2
Cessna[5]	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[3]	-	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G[3]	Navy	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[3]	Navy	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	551	8	4408	13.11	0.05	0.32	-	1.76	1.76	1444	19.3	0.1	0.5	-	2.6	2.6	2121.7
F/A-18C/D	USMC	39	4.8	187.2	13.11	0.05	0.32	-	1.76	1.76	1444	0.8	0.0	0.0	-	0.1	0.1	90.1
F/A-18E/F	Navy	0	8	0	13.11	0.05	0.32	-	1.76	1.76	1444	0.0	0.0	0.0	-	0.0	0.0	0.0
F-15	USAF	166	2.25	373.5	13.11	0.05	0.32	-	1.76	1.76	1444	1.6	0.0	0.0	-	0.2	0.2	179.8
F-16	USAF	29	2.25	65.25	13.11	0.05	0.32	-	1.76	1.76	1444	0.3	0.0	0.0	-	0.0	0.0	31.4
F-35A	USAF	0	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35B	USMC	0	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35C	Navy	0	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H-53	USMC	0	30	0	93.865	0.403	9.217	-	0.678	0.678	-	0.0	0.0	0.0	-	0.0	0.0	-
H-60	Navy	132	30	3960	7.68	0.66	7.5	-	5.04	5.04	3,864.67	0.3	0.0	0.2	-	0.2	0.2	127.5
KC-130[3]	USMC	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-3. No Action Alternative Aircraft Emissions - Rodman Range

Aircraft Type	*Service*	*No Action Annual Sorties*[1]	*Total time per Sortie (min)*[6]	*Total Annual time (min)*	*Aircraft Cruise Emission Factors (lb/op)*[2]							*Annual No Action Alternative Emissions (tons)*						
					NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*[4]	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
MH-65	USCG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-8	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-45	Navy	0	6	0	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UH-1	USMC	0	30	0	4.01	0.09	0.7	0.28	2.91	2.91	-	0.0	0.0	0.0	0.0	0.0	0.0	-
V-22	USMC	5	6.9	34.5	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	1.0
	Total	1,238										**43.1**	**0.2**	**1.3**	**0.0**	**5.9**	**5.9**	**4,856.1**

Notes:

1) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.

2) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.

3) No time spent below 3000 feet.

4) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.

5) Cessna contributions are assumed to be negligible.

6) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-4. Preferred Alternative Aircraft Emissions - Rodman Range

Aircraft Type	*Service*	*Proposed Action Annual Sorties*	*Total time per Sortie (min)*[5]	*Total Annual time (min)*	*Aircraft Cruise Emission Factors (lb/op)*[1]							*Annual Proposed Action Alternative Emissions (tons)*						
					NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*[3]	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
RODMAN																		
A-10	USAF	400	16.5	6600	13.11	0.05	0.32	-	1.76	1.76	1444	28.8	0.1	0.7	-	3.9	3.9	3176.8
A-29	Navy	100	16.5	1650	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.1	0.0	0.4	0.0	0.2	0.2	69.1
AC-130[2]	USAF	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	50	30	1500	4.72	0.48	8.96	-	3.57	3.57	2734.47	0.1	0.0	0.1	-	0.0	0.0	34.2
AV-8	USMC	50	3	150	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.3	0.0	0.0	0.0	0.1	0.1	52.5
Cessna[4]	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[2]	-	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G[2]	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[2]	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	100	8	800	13.11	0.05	0.32	-	1.76	1.76	1444	3.5	0.0	0.1	-	0.5	0.5	385.1
F/A-18C/D	USMC	100	4.8	480	13.11	0.05	0.32	-	1.76	1.76	1444	2.1	0.0	0.1	-	0.3	0.3	231.0
F/A-18E/F	Navy	600	8	4800	13.11	0.05	0.32	-	1.76	1.76	1444	21.0	0.1	0.5	-	2.8	2.8	2310.4
F-15	USAF	200	2.25	450	13.11	0.05	0.32	-	1.76	1.76	1444	2.0	0.0	0.0	-	0.3	0.3	216.6
F-16	USAF	100	2.25	225	13.11	0.05	0.32	-	1.76	1.76	1444	1.0	0.0	0.0	-	0.1	0.1	108.3
F-35A	USAF	100	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35B	USMC	100	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35C	Navy	500	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H-53	USMC	50	30	1500	93.865	0.403	9.217	-	0.678	0.678	-	1.2	0.0	0.1	-	0.0	0.0	-
H-60	Navy	200	30	6000	7.68	0.66	7.5	-	5.04	5.04	3,864.67	0.4	0.0	0.4	-	0.3	0.3	193.2
KC-130[2]	USMC	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-4. Preferred Alternative Aircraft Emissions - Rodman Range

Aircraft Type	*Service*	*Proposed Action Annual Sorties*	*Total time per Sortie (min)*[5]	*Total Annual time (min)*	*Aircraft Cruise Emission Factors (lb/op)*[1]							*Annual Proposed Action Alternative Emissions (tons)*						
					NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*[3]	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
MH-65	USCG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-8	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T-45	Navy	720	6	4320	0.079	0.034	0.446	0.011	0.214	0.214	83.80	0.2	0.1	1.0	0.0	0.5	0.5	181.0
UH-1	USMC	50	30	1500	4.01	0.09	0.7	0.28	2.91	2.91	-	0.1	0.0	0.0	0.0	0.0	0.0	-
V-22	USMC	50	6.9	345	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	10.2
	Total	3,720										**60.6**	**0.4**	**3.4**	**0.0**	**8.9**	**8.9**	**6,968.5**

Notes:

1) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.

2) No time spent below 3000 feet.

3) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.

4) Cessna contributions are assumed to be negligible.

5) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-5. No Action Alternative Aircraft Emissions – Lake George Range

Aircraft Type	Service	No Action Annual Sorties[1]	Total time per Sortie (min)[6]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[2]							Annual No Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[4]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
LAKE GEORGE																		
A-10	USAF	335	18.5	6193.1	13.11	0.05	0.32	-	1.76	1.76	1444	27.1	0.1	0.7	-	3.6	3.6	2981.0
A-29	Navy	0	18.5	0	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC-130[3]	USAF	4	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AV-8	USMC	24	6.6	159.2	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.3	0.0	0.0	0.0	0.1	0.1	55.7
Cessna[5]	Navy	1	10.0	10.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[3]	-	1	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G[3]	Navy	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[3]	Navy	2	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	573	11.3	6456.6	13.11	0.05	0.32	-	1.76	1.76	1444	28.2	0.1	0.7	-	3.8	3.8	3107.8
F/A-18C/D	USMC	43	8.2	353.2	13.11	0.05	0.32	-	1.76	1.76	1444	1.5	0.0	0.0	-	0.2	0.2	170.0
F/A-18E/F	Navy	0	11.3	0	13.11	0.05	0.32	-	1.76	1.76	1444	0.0	0.0	0.0	-	0.0	0.0	0.0
F-15	USAF	165	6.0	986.0	13.11	0.05	0.32	-	1.76	1.76	1444	4.3	0.0	0.1	-	0.6	0.6	474.6
F-16	USAF	44	6.0	262.9	13.11	0.05	0.32	-	1.76	1.76	1444	1.1	0.0	0.0	-	0.2	0.2	126.6
F-35A	USAF	0	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35B	USMC	0	4.0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35C	Navy	0	4.0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H-53	USMC	-	-	-	93.865	0.403	9.217	-	0.678	0.678	-	-	-	-	-	-	-	-
H-60	Navy	91	30.0	2730.0	7.68	0.66	7.5	-	5.04	5.04	3,864.67	0.2	0.0	0.2	-	0.1	0.1	87.9
KC-130[3]	USMC	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table C-5. No Action Alternative Aircraft Emissions – Lake George Range

Aircraft Type	Service	No Action Annual Sorties[1]	Total time per Sortie (min)[6]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[2]							Annual No Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[4]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
MH-65	USCG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3	Navy	25	4.0	100.0	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	3.0
P-8	Navy	0	4.0	0	13.11	0.05	0.32	-	1.76	1.76	1444	0.0	0.0	0.0	-	0.0	0.0	0.0
T-45	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1	USMC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V-22	USMC	5	12.2	61.1	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	1.8
	Total	1,318										**62.8**	**0.3**	**1.7**	**0.0**	**8.6**	**8.6**	**7,008.3**

Notes:
1) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.
2) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.
3) No time spent below 3000 feet.
4) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.
5) Cessna contributions are assumed to be negligible.
6) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-6. Preferred Alternative Aircraft Emissions – Lake George Range

Aircraft Type	Service	Proposed Action Annual Sorties	Total time per Sortie (min)[5]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[1]							Annual Proposed Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[3]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
LAKE GEORGE																		
A-10	USAF	400	18.5	7394.8	13.11	0.05	0.32	-	1.76	1.76	1444	32.3	0.1	0.8	-	4.3	4.3	3559.4
A-29	Navy	50	18.5	924.4	0.079	0.034	0.446	0.011	0.214	0.214	83.801	0.0	0.0	0.2	0.0	0.1	0.1	38.7
AC-130[2]	USAF	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AH-1	USMC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AV-8	USMC	50	6.6	331.7	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.6	0.0	0.1	0.0	0.2	0.2	116.1
Cessna[4]	Navy	50	10.0	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E-2[2]	-	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EA-6B[2]	Navy	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F/A-18C/D	Navy	100	11.3	1126.8	13.11	0.05	0.32	-	1.76	1.76	1444	4.9	0.0	0.1	-	0.7	0.7	542.4
F/A-18C/D	USMC	100	8.2	821.4	13.11	0.05	0.32	-	1.76	1.76	1444	3.6	0.0	0.1	-	0.5	0.5	395.4
F/A-18E/F	Navy	600	11.3	6760.8	13.11	0.05	0.32	-	1.76	1.76	1444	29.5	0.1	0.7	-	4.0	4.0	3254.2
F-15	USAF	200	6.0	1195.1	13.11	0.05	0.32	-	1.76	1.76	1444	5.2	0.0	0.1	-	0.7	0.7	575.2
F-16	USAF	100	6.0	597.6	13.11	0.05	0.32	-	1.76	1.76	1444	2.6	0.0	0.1	-	0.4	0.4	287.6
F-35A	USAF	100	0	0	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F-35B	USMC	100	4.0	400	2.08	0.04	0.32	0.05	0.55	0.55	419.9	0.7	0.0	0.1	0.0	0.2	0.2	140.0
F-35C	Navy	500	4.0	2000	2.08	0.04	0.32	0.05	0.55	0.55	419.9	3.5	0.1	0.5	0.1	0.9	0.9	699.8
H-53	USMC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H-60	Navy	200	30.0	6000	7.68	0.66	7.5	-	5.04	5.04	3,864.67	0.4	0.0	0.4	-	0.3	0.3	193.2

Table C-6. Preferred Alternative Aircraft Emissions – Lake George Range

Aircraft Type	Service	Proposed Action Annual Sorties	Total time per Sortie (min)[5]	Total Annual time (min)	Aircraft Cruise Emission Factors (lb/op)[1]							Annual Proposed Action Alternative Emissions (tons)						
					NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$[3]	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
KC-130[2]	USMC	50	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MH-65	USCG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3	Navy	50	4.0	200	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.0	0.0	0.0	-	0.0	0.0	5.9
P-8	Navy	100	4.0	400	13.11	0.05	0.32	-	1.76	1.76	1444	1.7	0.0	0.0	-	0.2	0.2	192.5
T-45	Navy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UH-1	USMC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
V-22	USMC	50	12.2	610.8	4.4	0.003	0.17	-	0.5	0.5	1008.74	0.1	0.0	0.0	-	0.0	0.0	18.1
	Total	3,000										**85.2**	**0.4**	**3.3**	**0.1**	**12.3**	**12.3**	**10,018.6**

Notes:

1) AESO 9933E, Nov 2015 F/A-18E/F missile firing run emission factors are used for the following aircraft: A-10, F/A-18C/D, F/A-18E/F, F-15, F-16, P-8.
AESO 2010-09, Sep 2010 T-45 cruise emission factors are used for the following aircraft: A-29 & T-45.
AESO 9824C, Nov 2015 AH-1 cruise emission factors are used for the following aircraft: AH-1 & MH-65.
AESO 9963C, Nov 2009 AV-8B missile / rocket firing / strafing / bombing run max day or night emission factors are used for the following aircraft: AV-8, F-35A, F-35B, F-35C.
AESO 2015-01B, Sep 2015 CH-53K cruise emission factors are used for the following aircraft: H-53.
AESO 9929C, Jan 2016 H-60 cruise emission factors are used for the following aircraft: H-60.
AESO 9965C, Nov 2015 V-22 strafing run emission factors are used for the following aircraft: P-3 & V-22.
AESO 9904A, May 1999 HH/UH-1N cruise emission factors are used for the following aircraft: UH-1.

2) No time spent below 3000 feet.

3) $PM_{2.5}$ emission factors are assumed to be the same as PM10 for the following aircraft: A-29, AV-8, F-35A, F-35B, F-35C, T-45, UH-1.

4) Cessna contributions are assumed to be negligible.

5) Time per sortie is based on inputs from noise modeling (BRRC, May 22, 2019).

Table C-7. Total Aircraft Emissions

Range	*Annual Emissions (tons)*																				
	NO ACTION							*PROPOSED ACTION*							*NET CHANGE*						
	NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO2*
PINECASTLE	43.6	0.3	2.5	0.0	6.6	6.6	5,394.7	68.5	0.7	8.0	0.2	11.0	11.0	8,117.0	24.9	0.4	5.5	0.2	4.4	4.4	2,722.4
RODMAN	43.1	0.2	1.3	0.0	5.9	5.9	4,856.1	60.6	0.4	3.4	0.0	8.9	8.9	6,968.5	17.5	0.2	2.1	0.0	3.0	3.0	2,112.4
LAKE GEORGE	62.8	0.3	1.7	0.0	8.6	8.6	7,008.3	85.2	0.4	3.3	0.1	12.3	12.3	10,018.6	22.5	0.2	1.5	0.1	3.8	3.8	3,010.3
ALL RANGES	149.4	0.7	5.5	0.0	21.1	21.1	17,259.1	214.3	1.5	14.7	0.3	32.3	32.3	25,104.1	64.9	0.8	9.1	0.3	11.1	11.1	7,845.1

Table C-8. No Action Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	Munitions Type	No Action Alternative[10]	Emission Factors (lb/item)							Annual No Action Emissions (tons)						
			NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
PINECASTLE																
Large Arms	2.75" Rocket (i)[1]	577	2.6E-02	0.0E+00	1.5E+00	0.0E+00	1.1E-01	1.0E-01	2.4E+00	7.5E-03	0.0E+00	4.3E-01	0.0E+00	3.2E-02	2.9E-02	6.9E-01
	2.75" Rocket (L)[1,2]	99	3.2E-02	0.0E+00	1.9E+00	0.0E+00	3.5E-01	2.2E-01	3.1E+00	1.6E-03	0.0E+00	9.4E-02	0.0E+00	1.7E-02	1.1E-02	1.5E-01
	20 mm[3]	42,790	4.3E-04	0.0E+00	3.3E-02	0.0E+00	6.6E-04	4.6E-04	1.6E-02	9.2E-03	0.0E+00	7.1E-01	0.0E+00	1.4E-02	9.8E-03	3.4E-01
	25 mm[3]	0	1.5E-03	0.0E+00	8.5E-02	0.0E+00	3.3E-03	1.7E-03	4.3E-02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	30 mm[4]	30,603	2.0E-04	0.0E+00	8.6E-04	0.0E+00	3.9E-03	2.5E-03	4.4E-03	3.1E-03	0.0E+00	1.3E-02	0.0E+00	6.0E-02	3.8E-02	6.7E-02
	40 mm[4]	0	3.6E-05	0.0E+00	3.5E-04	0.0E+00	2.6E-05	2.3E-05	2.6E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	105 mm[5]	0	6.2E-02	0.0E+00	3.8E-01	0.0E+00	4.7E-01	1.8E-01	1.1E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	5" Rocket[6,7]	0	1.0E-03	0.0E+00	6.4E-03	1.2E-03	3.4E-02	0.0E+00	9.1E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	AGM-114B (A-F)[7,8]	16	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	2.0E-04	0.0E+00	9.0E-04	6.2E-05	1.0E-02	0.0E+00	4.5E-01
	AGM-114K/M/N[7,8]	0	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	AGM-114P[7,8]	0	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	AGM-114Q[7,8]	0	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	AGM-175/176[7,8]	0	2.4E-02	0.0E+00	9.0E-02	7.3E-03	9.4E-01	0.0E+00	5.1E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	BDU-33[9]	796	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[9]	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[9]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[9]	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BLU-110[7]	22	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	2.9E-04	0.0E+00	2.2E-02	4.9E-04	3.3E-01	0.0E+00	4.7E+00
	BLU-111[7]	241	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	1.4E-03	0.0E+00	1.0E-01	2.3E-03	1.6E+00	0.0E+00	2.2E+01

Table C-8. No Action Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	*Munitions Type*	*No Action Alternative*[10]	*Emission Factors (lb/item)*							*Annual No Action Emissions (tons)*						
			NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
	GBU-10 (i)[9]	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-24 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-31 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-32 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-38 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-44 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-54 (i)[9]	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-12 (i)[9]	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-12 (L)[7]	25	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	1.4E-04	0.0E+00	1.1E-02	2.4E-04	1.6E-01	0.0E+00	2.3E+00
	GBU-16 (i)[9]	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-16 (L)[7]	2	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	2.6E-05	0.0E+00	2.0E-03	4.5E-05	3.0E-02	0.0E+00	4.3E-01
	LGTR[9]	128	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[9]	173	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-81[7]	0	5.7E-03	0.0E+00	4.2E-01	9.6E-03	6.5E+00	0.0E+00	9.3E+01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	MK-82 (i)[9]	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-82 (L)[7]	232	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	1.3E-03	0.0E+00	9.8E-02	2.2E-03	1.5E+00	0.0E+00	2.2E+01
	MK-83 (i)[9]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-83 (L)[7]	37	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	4.9E-04	0.0E+00	3.6E-02	8.2E-04	5.6E-01	0.0E+00	8.0E+00
	MK-84 (L)[7]	26	5.6E-02	0.0E+00	4.2E+00	9.5E-02	6.4E+01	0.0E+00	9.2E+02	7.2E-04	0.0E+00	5.4E-02	1.2E-03	8.4E-01	0.0E+00	1.2E+01
Small Arms, Air Gunnery	7.62 mm[3]	77,387	4.1E-05	0.0E+00	3.0E-03	0.0E+00	8.2E-05	5.8E-05	1.7E-03	1.6E-03	0.0E+00	1.2E-01	0.0E+00	3.2E-03	2.2E-03	6.6E-02
	7.62 mm (blanks)[3]	0	4.4E-05	0.0E+00	6.8E-04	3.5E-07	1.7E-05	1.5E-05	9.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	0.50 Cal[3]	18,000	3.3E-05	0.0E+00	1.6E-02	0.0E+00	9.7E-04	4.4E-04	9.2E-03	3.0E-04	0.0E+00	1.4E-01	0.0E+00	8.7E-03	4.0E-03	8.3E-02
	12 Gauge[3]	0	4.2E-05	0.0E+00	1.5E-03	0.0E+00	7.4E-05	6.7E-05	1.3E-03	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00

Table C-8. No Action Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	*Munitions Type*	*No Action Alternative*[10]	*Emission Factors (lb/item)*							*Annual No Action Emissions (tons)*						
			NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
Small Arms, Ground	5.56 mm[3]	12,000	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	5.1E-04	0.0E+00	9.6E-03	0.0E+00	2.3E-04	1.7E-04	5.2E-03
	5.56 mm (blanks)[3]	0	2.0E-05	0.0E+00	2.8E-04	9.8E-08	6.9E-06	6.0E-06	2.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	SESAM[3]	0	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	7.62 mm[3]	392,410	4.1E-05	0.0E+00	3.0E-03	0.0E+00	8.2E-05	5.8E-05	1.7E-03	8.0E-03	0.0E+00	5.9E-01	0.0E+00	1.6E-02	1.1E-02	3.3E-01
	9 mm[3]	1,200	1.5E-05	0.0E+00	3.1E-04	8.2E-08	2.4E-05	2.0E-05	2.0E-04	9.0E-06	0.0E+00	1.9E-04	4.9E-08	1.4E-05	1.2E-05	1.2E-04
	0.50 Cal[3]	27,620	3.3E-05	0.0E+00	1.6E-02	0.0E+00	9.7E-04	4.4E-04	9.2E-03	4.6E-04	0.0E+00	2.2E-01	0.0E+00	1.3E-02	6.1E-03	1.3E-01
	Total	**604,602**								**3.7E-02**	**0.0E+00**	**2.7E+00**	**7.4E-03**	**5.2E+00**	**1.1E-01**	**7.4E+01**

Notes
1) Propellant Emission Factor Source: USEPA AP-42, Ch 15.6.
2) Explosive Emission Factor Source: USEPA AP-42, Ch 15.6.
3) Propellant Emission Factor Source: USEPA AP-42, Ch 15.1.
4) Propellant Emission Factor Source: USEPA AP-42, Ch 15.2.
5) Propellant and Explosive Emission Factor Source: USEPA AP-42, Ch 15.3.
6) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. MK-6 as propellant.
7) Explosive Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. HBX as explosive.
8) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. M-43 as propellant.
9) Non-explosive bomb, zero emissions.
10) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.

Table C-9. Preferred Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	*Munitions Type*	*Proposed Action Alternative*	*Emission Factors (lb/item)*							*Annual Proposed Action Emissions (tons)*						
			NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
PINECASTLE																
Large Arms	2.75" Rocket (i)[1]	600	2.6E-02	0.0E+00	1.5E+00	0.0E+00	1.1E-01	1.0E-01	2.4E+00	7.8E-03	0.0E+00	4.5E-01	0.0E+00	3.3E-02	3.0E-02	7.2E-01
	2.75" Rocket (L)[1,2]	300	3.2E-02	0.0E+00	1.9E+00	0.0E+00	3.5E-01	2.2E-01	3.1E+00	4.7E-03	0.0E+00	2.9E-01	0.0E+00	5.3E-02	3.3E-02	4.7E-01
	20 mm[3]	50,000	4.3E-04	0.0E+00	3.3E-02	0.0E+00	6.6E-04	4.6E-04	1.6E-02	1.1E-02	0.0E+00	8.3E-01	0.0E+00	1.7E-02	1.2E-02	4.0E-01
	25 mm[3]	50,000	1.5E-03	0.0E+00	8.5E-02	0.0E+00	3.3E-03	1.7E-03	4.3E-02	3.8E-02	0.0E+00	2.1E+00	0.0E+00	8.3E-02	4.3E-02	1.1E+00
	30 mm[4]	40,000	2.0E-04	0.0E+00	8.6E-04	0.0E+00	3.9E-03	2.5E-03	4.4E-03	4.0E-03	0.0E+00	1.7E-02	0.0E+00	7.8E-02	5.0E-02	8.8E-02
	40 mm[4]	600	3.6E-05	0.0E+00	3.5E-04	0.0E+00	2.6E-05	2.3E-05	2.6E-04	1.1E-05	0.0E+00	1.1E-04	0.0E+00	7.8E-06	6.9E-06	7.8E-05
	105 mm[5]	300	6.2E-02	0.0E+00	3.8E-01	0.0E+00	4.7E-01	1.8E-01	1.1E+01	9.3E-03	0.0E+00	5.7E-02	0.0E+00	7.1E-02	2.7E-02	1.6E+00
	5" Rocket[6,7]	100	1.0E-03	0.0E+00	6.4E-03	1.2E-03	3.4E-02	0.0E+00	9.1E-01	5.1E-05	0.0E+00	3.2E-04	5.8E-05	1.7E-03	0.0E+00	4.5E-02
	AGM-114B (A-F)[7,8]	50	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	6.1E-04	0.0E+00	2.8E-03	2.0E-04	3.2E-02	0.0E+00	1.4E+00
	AGM-114K/M/N[7,8]	50	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	6.1E-04	0.0E+00	2.8E-03	2.0E-04	3.2E-02	0.0E+00	1.4E+00
	AGM-114P[7,8]	50	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	6.1E-04	0.0E+00	2.8E-03	2.0E-04	3.2E-02	0.0E+00	1.4E+00
	AGM-114Q[7,8]	50	2.5E-02	0.0E+00	1.1E-01	7.8E-03	1.3E+00	0.0E+00	5.6E+01	6.1E-04	0.0E+00	2.8E-03	2.0E-04	3.2E-02	0.0E+00	1.4E+00
	AGM-175/176[7,8]	50	2.4E-02	0.0E+00	9.0E-02	7.3E-03	9.4E-01	0.0E+00	5.1E+01	6.1E-04	0.0E+00	2.3E-03	1.8E-04	2.4E-02	0.0E+00	1.3E+00
	BDU-33[9]	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BLU-110[7]	200	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	2.6E-03	0.0E+00	2.0E-01	4.5E-03	3.0E+00	0.0E+00	4.3E+01
	BLU-111[7]	500	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	2.8E-03	0.0E+00	2.1E-01	4.8E-03	3.3E+00	0.0E+00	4.7E+01

Table C-9. Preferred Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	*Munitions Type*	*Proposed Action Alternative*	*Emission Factors (lb/item)*							*Annual Proposed Action Emissions (tons)*						
			NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
	GBU-10 (i)[9]	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-24 (i)[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-31 (i)[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-32 (i)[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-38 (i)[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-44 (i)[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-54 (i)[9]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-12 (i)[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-12 (L)[7]	100	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	5.7E-04	0.0E+00	4.2E-02	9.6E-04	6.5E-01	0.0E+00	9.3E+00
	GBU-16 (i)[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	GBU-16 (L)[7]	100	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	1.3E-03	0.0E+00	9.8E-02	2.2E-03	1.5E+00	0.0E+00	2.2E+01
	LGTR[9]	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[9]	6060	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-81[7]	100	5.7E-03	0.0E+00	4.2E-01	9.6E-03	6.5E+00	0.0E+00	9.3E+01	2.8E-04	0.0E+00	2.1E-02	4.8E-04	3.3E-01	0.0E+00	4.7E+00
	MK-82 (i)[9]	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-82 (L)[7]	500	1.1E-02	0.0E+00	8.4E-01	1.9E-02	1.3E+01	0.0E+00	1.9E+02	2.8E-03	0.0E+00	2.1E-01	4.8E-03	3.3E+00	0.0E+00	4.7E+01
	MK-83 (i)[9]	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-83 (L)[7]	500	2.6E-02	0.0E+00	2.0E+00	4.5E-02	3.0E+01	0.0E+00	4.3E+02	6.6E-03	0.0E+00	4.9E-01	1.1E-02	7.6E+00	0.0E+00	1.1E+02
	MK-84 (L)[7]	250	5.6E-02	0.0E+00	4.2E+00	9.5E-02	6.4E+01	0.0E+00	9.2E+02	7.0E-03	0.0E+00	5.2E-01	1.2E-02	8.0E+00	0.0E+00	1.1E+02
Small Arms, Air Gunnery	7.62 mm[3]	400,000	4.1E-05	0.0E+00	3.0E-03	0.0E+00	8.2E-05	5.8E-05	1.7E-03	8.2E-03	0.0E+00	6.0E-01	0.0E+00	1.6E-02	1.2E-02	3.4E-01
	7.62 mm (blanks)[3]	5,000	4.4E-05	0.0E+00	6.8E-04	3.5E-07	1.7E-05	1.5E-05	9.5E-04	1.1E-04	0.0E+00	1.7E-03	8.8E-07	4.3E-05	3.8E-05	2.4E-03
	0.50 Cal[3]	50,000	3.3E-05	0.0E+00	1.6E-02	0.0E+00	9.7E-04	4.4E-04	9.2E-03	8.3E-04	0.0E+00	4.0E-01	0.0E+00	2.4E-02	1.1E-02	2.3E-01
	12 Gauge[3]	250	4.2E-05	0.0E+00	1.5E-03	0.0E+00	7.4E-05	6.7E-05	1.3E-03	5.3E-06	0.0E+00	1.9E-04	0.0E+00	9.3E-06	8.4E-06	1.6E-04

Table C-9. Preferred Alternative Munitions Emissions - Pinecastle Range

Ordnance Group	*Munitions Type*	*Proposed Action Alternative*	*Emission Factors (lb/item)*							*Annual Proposed Action Emissions (tons)*						
			NO_X	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*	*NO_X*	*HC*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*CO_2*
Small Arms, Ground	5.56 mm[3]	15,000	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	6.4E-04	0.0E+00	1.2E-02	0.0E+00	2.9E-04	2.1E-04	6.5E-03
	5.56 mm (blanks)[3]	5,000	2.0E-05	0.0E+00	2.8E-04	9.8E-08	6.9E-06	6.0E-06	2.3E-04	5.0E-05	0.0E+00	7.0E-04	2.5E-07	1.7E-05	1.5E-05	5.8E-04
	SESAM[3]	2,000	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04
	7.62 mm[3]	397,410	4.1E-05	0.0E+00	3.0E-03	0.0E+00	8.2E-05	5.8E-05	1.7E-03	8.1E-03	0.0E+00	6.0E-01	0.0E+00	1.6E-02	1.2E-02	3.4E-01
	9 mm[3]	2,000	1.5E-05	0.0E+00	3.1E-04	8.2E-08	2.4E-05	2.0E-05	2.0E-04	1.5E-05	0.0E+00	3.1E-04	8.2E-08	2.4E-05	2.0E-05	2.0E-04
	0.50 Cal[3]	30,620	3.3E-05	0.0E+00	1.6E-02	0.0E+00	9.7E-04	4.4E-04	9.2E-03	5.1E-04	0.0E+00	2.4E-01	0.0E+00	1.5E-02	6.7E-03	1.4E-01
	Total	**1,062,640**								**1.2E-01**	**0.0E+00**	**7.4E+00**	**4.2E-02**	**2.8E+01**	**2.4E-01**	**4.1E+02**

Notes
1) Propellant Emission Factor Source: USEPA AP-42, Ch 15.6.
2) Explosive Emission Factor Source: USEPA AP-42, Ch 15.6.
3) Propellant Emission Factor Source: USEPA AP-42, Ch 15.1.
4) Propellant Emission Factor Source: USEPA AP-42, Ch 15.2.
5) Propellant and Explosive Emission Factor Source: USEPA AP-42, Ch 15.3.
6) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. MK-6 as propellant.
7) Explosive Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. HBX as explosive.
8) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. M-43 as propellant.
9) Non-explosive bomb, zero emissions.

Table C-10. No Action Alternative Munitions Emissions – Rodman Range

Ordnance Group	Munitions Type	No Action Alternative[3]	Emission Factors (lb/item)							Annual No Action Emissions (tons)						
			NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
RODMAN																
Large Arms	BDU-33[1]	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[1]	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[1]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[1]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[1]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Small Arms, Air Gunnery	7.62 mm (blanks)[2]	0	4.4E-05	0.0E+00	6.8E-04	3.5E-07	1.7E-05	1.5E-05	9.5E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Small Arms, Ground	5.56 mm (blanks)[2]	0	2.0E-05	0.0E+00	2.8E-04	9.8E-08	6.9E-06	6.0E-06	2.3E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	SESAM[2]	0	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Total	**22**								**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**

Notes
1) Non-explosive bomb, zero emissions.
2) Propellant Emission Factor Source: USEPA AP-42, Ch 15.1.
3) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.

Table C-11. Preferred Alternative Munitions Emissions – Rodman Range

Ordnance Group	Munitions Type	Proposed Action Alternative	Emission Factors (lb/item)							Annual Proposed Action Emissions (tons)						
			NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
RODMAN																
Large Arms	BDU-33[1]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[1]	5,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[1]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[1]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[1]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Small Arms, Air Gunnery	7.62 mm (blanks)[3]	5,000	4.4E-05	0.0E+00	6.8E-04	3.5E-07	1.7E-05	1.5E-05	9.5E-04	1.1E-04	0.0E+00	1.7E-03	8.8E-07	4.3E-05	3.8E-05	2.4E-03
Small Arms, Ground	5.56 mm (blanks)[3]	10,000	2.0E-05	0.0E+00	2.8E-04	9.8E-08	6.9E-06	6.0E-06	2.3E-04	1.0E-04	0.0E+00	1.4E-03	4.9E-07	3.5E-05	3.0E-05	1.2E-03
	SESAM[3]	2,000	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04	8.5E-05	0.0E+00	1.6E-03	0.0E+00	3.9E-05	2.8E-05	8.7E-04
	Total	**22,400**								**3.0E-04**	**0.0E+00**	**4.7E-03**	**1.4E-06**	**1.2E-04**	**9.6E-05**	**4.4E-03**

Notes
1) Non-explosive bomb, zero emissions.
2) Propellant Emission Factor Source: USEPA AP-42, Ch 15.1.

Table C-12. No Action Alternative Munitions Emissions – Lake George Range

Ordnance Group	Munitions Type	No Action Alternative[4]	Emission Factors (lb/item)							Annual No Action Emissions (tons)						
			NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Lake George																
Large Arms	2.75" Rocket (i)[1]	0	2.6E-02	0.0E+00	1.5E+00	0.0E+00	1.1E-01	1.0E-01	2.4E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	BDU-33[2]	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[2]	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[2]	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[2]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-62 (i)[2]	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-63 (i)[2]	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-82 (i)[2]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5" Rocket(i)[3]	0	1.0E-03	0.0E+00	4.2E-03	1.1E-03	0.0E+00	0.0E+00	4.2E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	MK-81(i)[2]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-83 (i)[2]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-84 (i)[2]	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[2]	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**158**								**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**0.0E+00**

Notes
1) Propellant Emission Factor Source: USEPA AP-42, Ch 15.6.
2) Non-explosive bomb, zero emissions.
3) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. MK-6 as propellant.
4) The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.

Table C-13. Preferred Alternative Munitions Emissions – Lake George Range

Ordnance Group	Munitions Type	Proposed Action Alternative	Emission Factors (lb/item)							Annual No Action Emissions (tons)						
			NO_x	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_x	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Lake George																
Large Arms	2.75" Rocket (i)[1]	100	2.6E-02	0.0E+00	1.5E+00	0.0E+00	1.1E-01	1.0E-01	2.4E+00	1.3E-03	0.0E+00	7.5E-02	0.0E+00	5.5E-03	5.0E-03	1.2E-01
	BDU-33[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-45[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-48/MK-106[2]	200	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BDU-50[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-62 (i)[2]	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-63 (i)[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-82 (i)[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5" Rocket(i)[3]	100	1.0E-03	0.0E+00	4.2E-03	1.1E-03	0.0E+00	0.0E+00	4.2E-01	5.0E-05	0.0E+00	2.1E-04	5.5E-05	0.0E+00	0.0E+00	2.1E-02
	MK-81(i)[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-83 (i)[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-84 (i)[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	MK-76[2]	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**1,550**								**1.4E-03**	**0.0E+00**	**7.5E-02**	**5.5E-05**	**5.5E-03**	**5.0E-03**	**1.4E-01**

Notes
1) Propellant Emission Factor Source: USEPA AP-42, Ch 15.6.
2) Non-explosive bomb, zero emissions.
3) Propellant Emission Factor Source: USEPA, Emission Factors for the Disposal of Energetic Materials by Open Burning and Open Detonation (OB/OD), Aug 1998. MK-6 as propellant.

Table C-14. Total Munitions Emissions

Range	Annual Emissions (tons)																				
	NO ACTION							PROPOSED ACTION							NET CHANGE						
	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2	NO_X	HC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
PINECASTLE	0.0	0.0	2.7	0.0	5.2	0.1	73.8	0.1	0.0	7.4	0.0	28.2	0.2	406.7	0.1	0.0	4.8	0.0	23.0	0.1	332.9
RODMAN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LAKE GEORGE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1
ALL RANGES	0.0	0.0	2.7	0.0	5.2	0.1	73.8	0.1	0.0	7.5	0.0	28.2	0.2	406.8	0.1	0.0	4.8	0.0	23.0	0.1	333.1

APPENDIX D
BIOLOGICAL ASSESSMENT AND BIOLOGICAL OPINION

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Final

Programmatic Biological Assessment for Training Operations at the Pinecastle Range Complex, Florida

April 2020

Acronyms and Abbreviations

%	percent
BO	Biological Opinion
DoD	Department of Defense
ESA	Endangered Species Act
FFWCC	Florida Fish and Wildlife Conservation Commission
FNAI	Florida Natural Areas Inventory
INRMP	Integrated Natural Resources Management Plan
LRMP	Land and Resource Management Plan
MINEX	Mine Exercises
MOA	Military Operations Area
NAS	Naval Air Station
ONF	Ocala National Forest
PBA	Programmatic Biological Assessment
PRC	Pinecastle Range Complex
RCZ	Range Compatibility Zone
U.S.	United States
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

Final
PROGRAMMATIC BIOLOGICAL ASSESSMENT
TRAINING OPERATIONS AT
PINECASTLE RANGE COMPLEX, FLORIDA

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CHAPTER 1
INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. This Programmatic Biological Assessment (PBA) is intended to support formal consultation between the United States (U.S.) Fleet Forces Command, a Command of the U.S. Navy (hereinafter, jointly referred to as the Navy) and the U.S. Fish and Wildlife Service (USFWS) as required by 50 Code of Federal Regulations 402.14(c) and section 7 of the ESA regarding the likelihood of an adverse effect ("take") of any listed species. It provides the best available scientific and commercial data for the federally listed threatened or endangered species in the action area.

This PBA has been prepared by the Navy in support of existing operations and anticipated future training range missions at the Pinecastle Range Complex (PRC). This PBA describes the potential effects on federally listed species that would potentially be impacted from the implementation of the Proposed Action. Direct, indirect, and cumulative effects are analyzed. Conservation measures (Section 2.3) have been incorporated into the Proposed Action to avoid or minimize potential effects on federally listed species.

1.1 PROJECT LOCATION

The Proposed Action would be implemented at the PRC (Figure 1-1). The PRC is located in and around the Ocala National Forest (ONF) in north central Florida, and includes two land ranges (Pinecastle Range and Rodman Range), and one freshwater range (Lake George Range). Pinecastle Range and a control area that is referred to as the Centroid Facility are located fully within the boundary of the ONF; Rodman Range is just north of the ONF; Lake George is east of the ONF (Figure 1-1). In total, Pinecastle Range represents approximately 1.5 percent of the total land within the ONF, while the actual cleared target areas represent approximately 0.1 percent of the total land within the ONF (Navy 2017).

1.2 BACKGROUND

The PRC is an integral part of the Navy's East Coast Tactical Training, which supports Naval intermediate and advanced training in preparation for deployment. The PRC's primary mission is to provide an environment for Navy, Marine Corps, and U.S. Air Force (Air Force) personnel to learn the proper maneuvering tactics and techniques required while delivering air-to-ground weapons to targets within a potentially hostile environment, thus enhancing the potential for increased aircrew survivability and weapons delivery accuracy. Pinecastle Range is the Navy's only air-to-ground range on the East Coast authorized to use high explosives (Rodman and Lake George are inert-only ranges), and is thus critical to the Navy's training mission.

Access to capable range facilities located in the vicinity of homeports and air stations is a critical component of naval readiness. The PRC also accommodates military aircraft training units from Naval Station Mayport, Robbins Air Force Base, Moody Air Force Base, Marine Corps Air Station Beaufort, Naval Air Station (NAS) Jacksonville, several state Air National Guard units, and other military aircraft participating in advanced fleet training exercises off the southeastern coast of the United States.

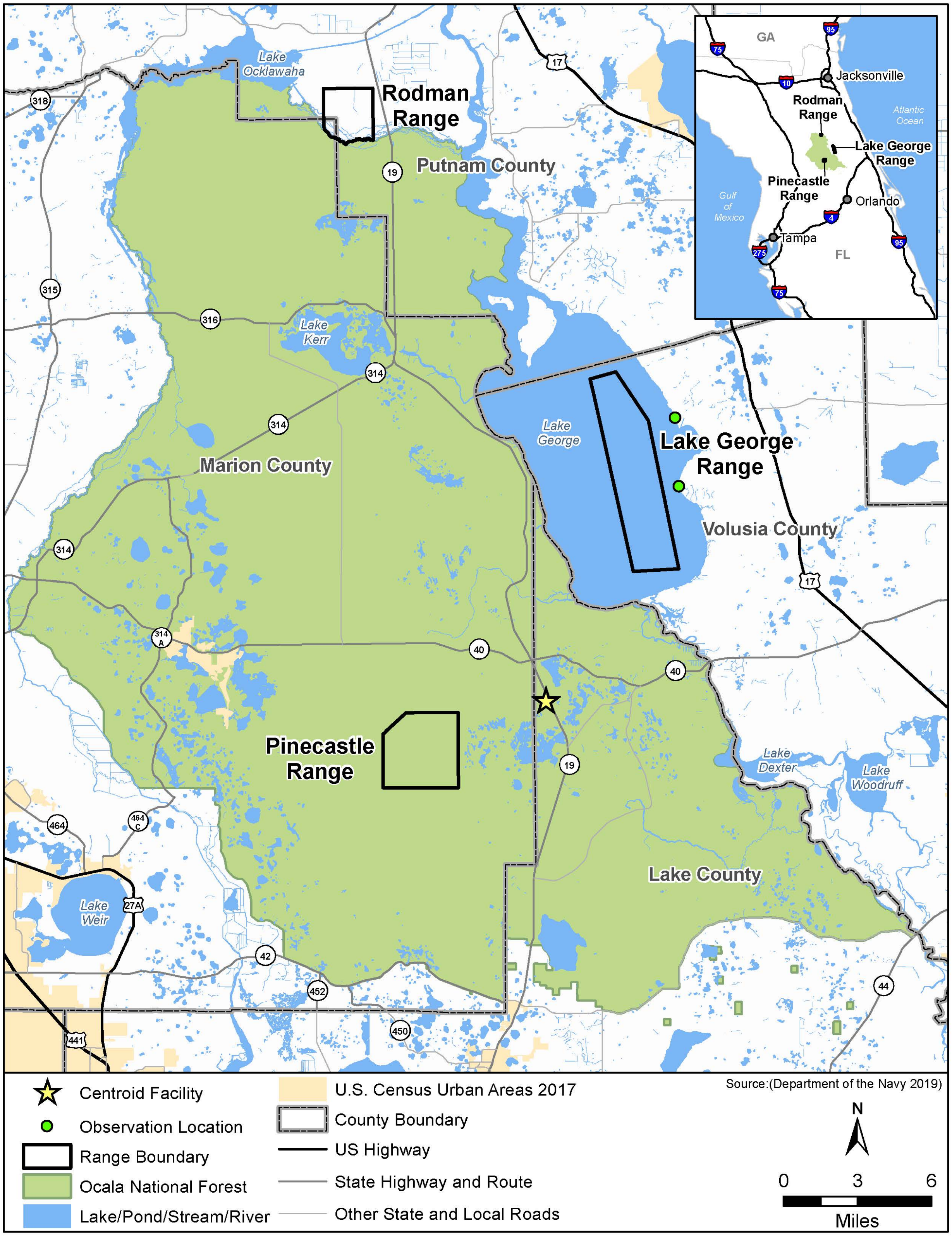

Figure 1-1. Pinecastle Range Complex Location Map

The PRC is also used by the U.S. Coast Guard (Coast Guard), and other federal and state agencies and law enforcement organizations. The PRC regularly supports training for installations located primarily in Florida, Georgia, North Carolina, South Carolina, and Virginia (Navy 2017). The three ranges in the Complex can be scheduled separately or scheduled jointly for combined training use.

1.2.1 Overview of Training Activities

Training operations at the PRC utilize ground and water ranges, Special Use Airspace, and Military Training Routes. Training activities include air-to-ground explosive and non-explosive ordnance delivery, lasing, air-to-ground gunnery strafing, and ground-to-ground small arms qualification and weapons familiarization training. Rodman Range, Lake George Range, and Pinecastle Range provide realistic air-to-ground weapons delivery training using a variety of targets for explosive and inert ordnance (e.g., bombs and rockets). Air-to-ground gunnery strafing at the Pinecastle Range includes helicopter and fixed-wing using munitions up to 30 millimeters. Small arms ground firing occurs at Pinecastle and Rodman Ranges.

1.2.1.1 Rodman Range

Rodman Range (Figure 1-2) is a Navy-owned, unmanned day/night rocket/inert bomb and helicopter proficiency training target area approximately 58 miles south of Jacksonville and 40 miles west of the Atlantic coast. The range supports air-to-ground training using sub-caliber inert practice bombs (training devices that are typically smaller than operational munitions). No live ordnance or gunnery is authorized. The Ocklawaha River separates the Rodman Range from the northern border of the ONF. The range is primarily in Putnam County, situated east of the Rodman Reservoir and west of the St. Johns River; although, a small portion of its southwestern corner is within Marion County. Rodman Range contains a 600-foot diameter cleared area with a central target equipped with a lighting system to accommodate night ordnance training.

Military expended material (i.e., consumed rockets and inert bombs) is recovered in accordance with Navy and Department of Defense (DoD) requirements as defined in the Operational Range Clearance Plan for Rodman Range. Rodman Range also supports combat search and rescue training and is a major southeast training site for land-based helicopter search and rescue training.

1.2.1.2 Lake George Range

Lake George Range (Figure 1-3) is a water range located along the east side of Lake George in Volusia County. The Navy operates the range under a Sovereignty Submerged Land Letter of Consent with the State of Florida, as the State owns the sovereign submerged lands.

Operations include Mine Warfare and Mine Laying. Airborne mine laying training uses two types of training operations: Mine Exercises (MINEX) and Mine Readiness Certification Inspections. In the typical mining training profile, MINEX usually involve a single aircraft sortie planting several non-explosive training mine shapes in the water. The aircrew drops a series of (usually four) training shapes in the water at pre-planned splash points. There are four impact targets on the range, all of which are located on the lake surface. These consist of the North Target, Center Target, and South Target, and the four MINEX Splashdown Points. Lake George Range targets are located in the lake waters.

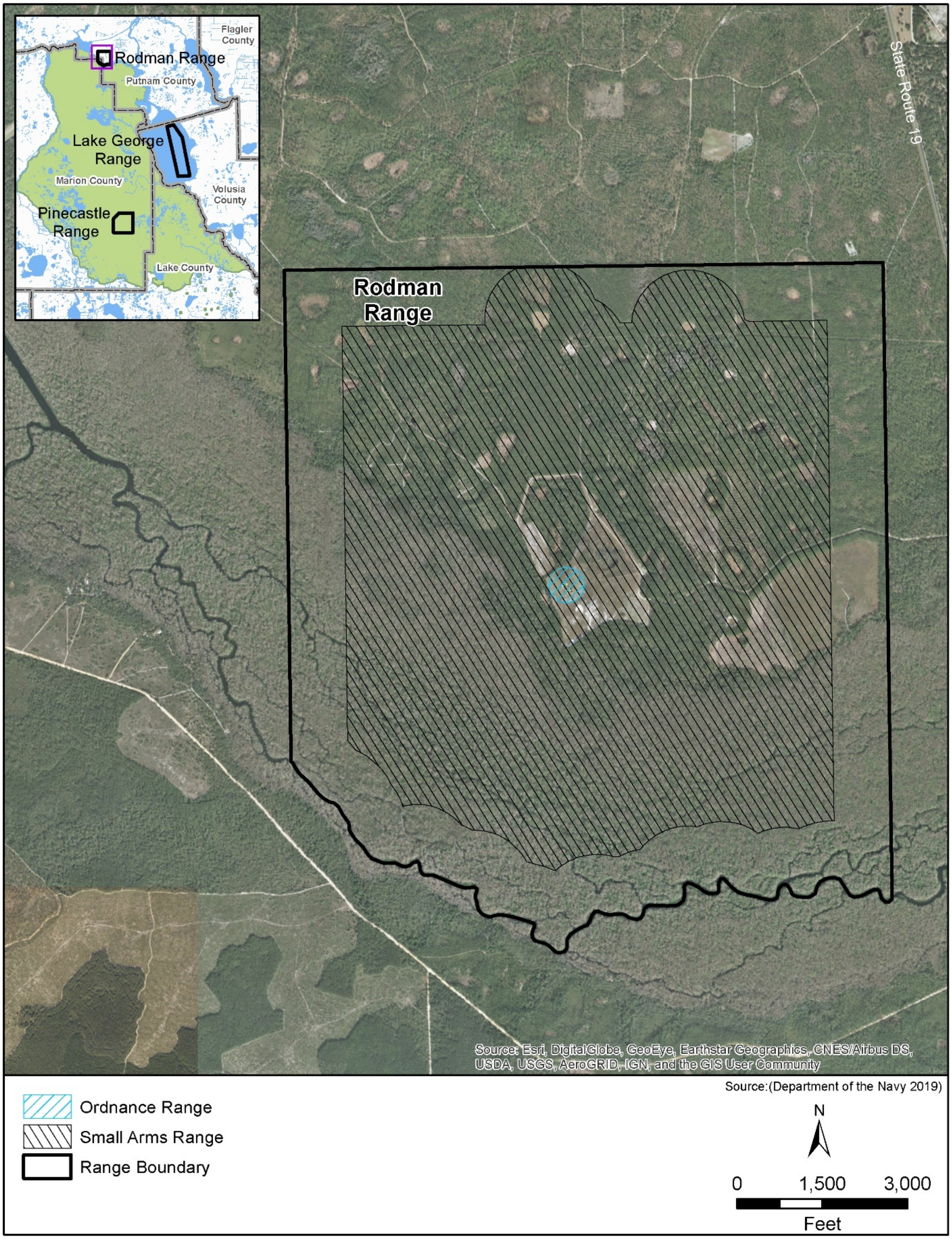

Figure 1-2. Rodman Range

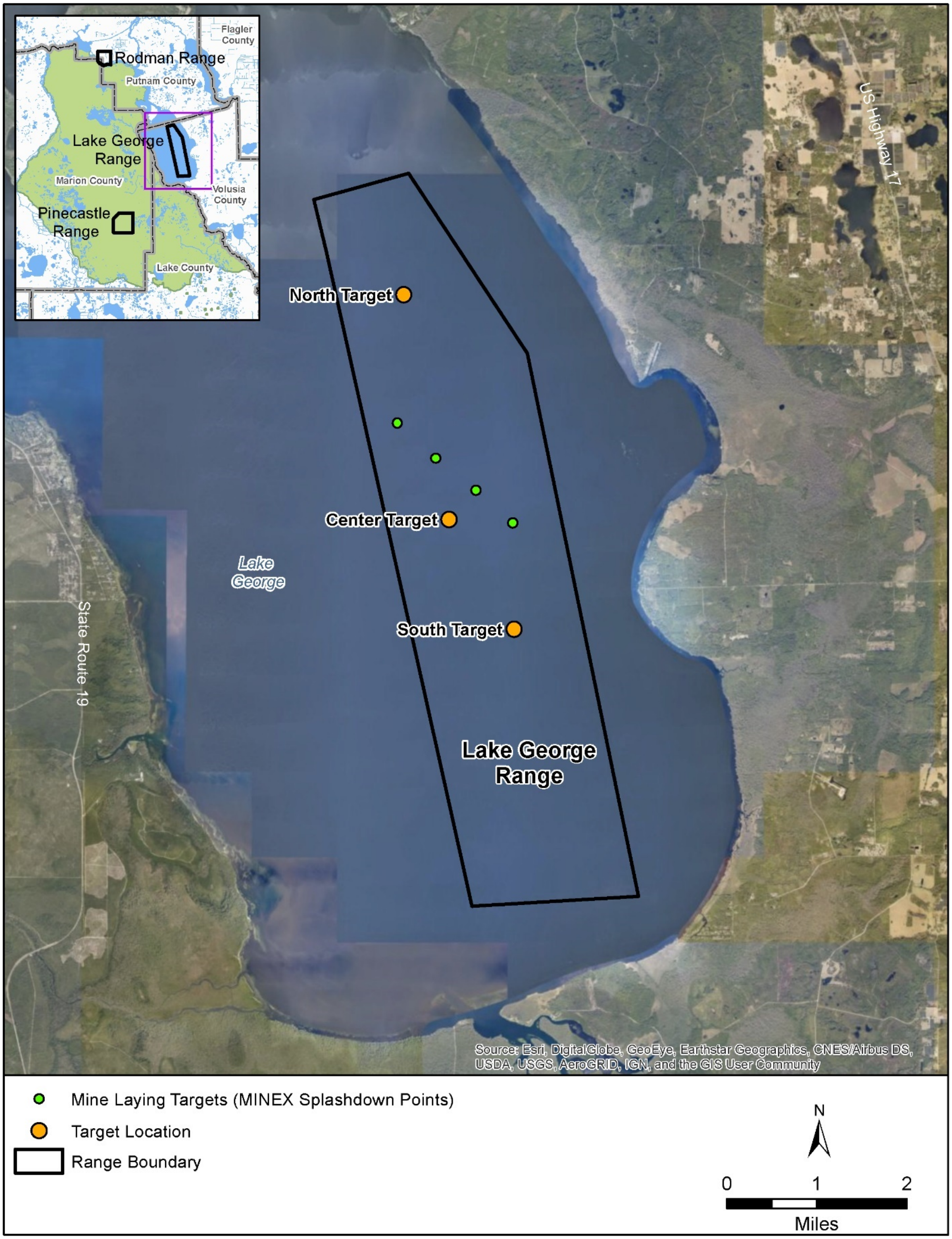

Figure 1-3. Lake George Range

1.2.1.3 Pinecastle Range

The Pinecastle Range (Figure 1-4) lies entirely within the ONF in Marion County, approximately 75 miles from NAS Jacksonville. The range is accessible from the north and south by State Road 19, and from the east and west by State Road 40. The Navy has used the Pinecastle Range since 1951 under various agreements between the Navy and the USDA. The U.S. Forest Service (USFS) manages the ONF, and the Navy operates the Pinecastle Range under a special use authorization by the USFS. During times when the range is in use, the USFS assists with potential wildfire management and controlling public access in the vicinity of the Pinecastle Range for some training events.

The Pinecastle Range is comprised of two non-contiguous areas, the target and buffer area and the Centroid. The target and buffer area is 5,698 acres and consists of two high-explosive ordnance target areas, eight inert ordnance target areas, a strafe pit with three different target areas, and a laser target that can be scored. Of the 5,698 acres, the cleared target areas comprise approximately 400 acres. The size of the cleared target areas can fluctuate within the firebreak area to allow for changes in training. The targets are maintained clear of vegetation to facilitate the monitoring of bombing accuracy and the improvement of fire safety. The remaining approximate 5,300 acres of the target and buffer area are vegetated landscape (predominantly a sand pine-scrub oak vegetative community) designed to isolate the targets and provide a safety buffer for released ordnance that misses the target or ricochets away from the target. The Centroid area, located approximately 3 miles northeast of the target and buffer boundary, is 44 acres and houses the control center for the Range. The Centroid is not an impact area and contains no targets or target arrays.

Two broad levels of training that differ in complexity and requirements occur at Pinecastle Range: unit level training and major training exercises. The unit level training is considered the primary mode of operation. In general, these training activities involve aircraft launching from an airfield, conducting a mission (which usually involves the release of non-explosive munitions), and then returning to base in a single flight.

The Pinecastle Range is also used to support major training exercises, which typically involve the entire air wing from an aircraft carrier located in the Jacksonville Operations Area and have a much greater frequency of flights to the Range than do unit level training exercises. Examples of major training exercises are the Composite Training Unit Exercises and Joint Task Force Exercises, each of which involves multiple ships and aircraft. Further, each of these exercises is an integrated exercise and involves aircraft exercises from fleet training operations occurring off the southeast coast of the United States. Approximately four major training exercises are currently planned per year at Pinecastle Range, with each exercise occurring over a one- to four-week period. Each exercise involves approximately five to eight days of potential Guided Bomb Unit usage at Pinecastle Range per exercise, approximately 20 to 32 days annually. The Range Compatibility Zone (RCZ)-I is not enacted for the entire day during the training exercise, but only implemented (off limits to the general public) for specified time periods, ranging from approximately 20 to 60 minutes per event with approximately one to four events occurring per day during the approximate 20 to 32 days. The RCZ-I has the potential to be active for a minimum of 7 hours annually and approximately 128 hours annually.

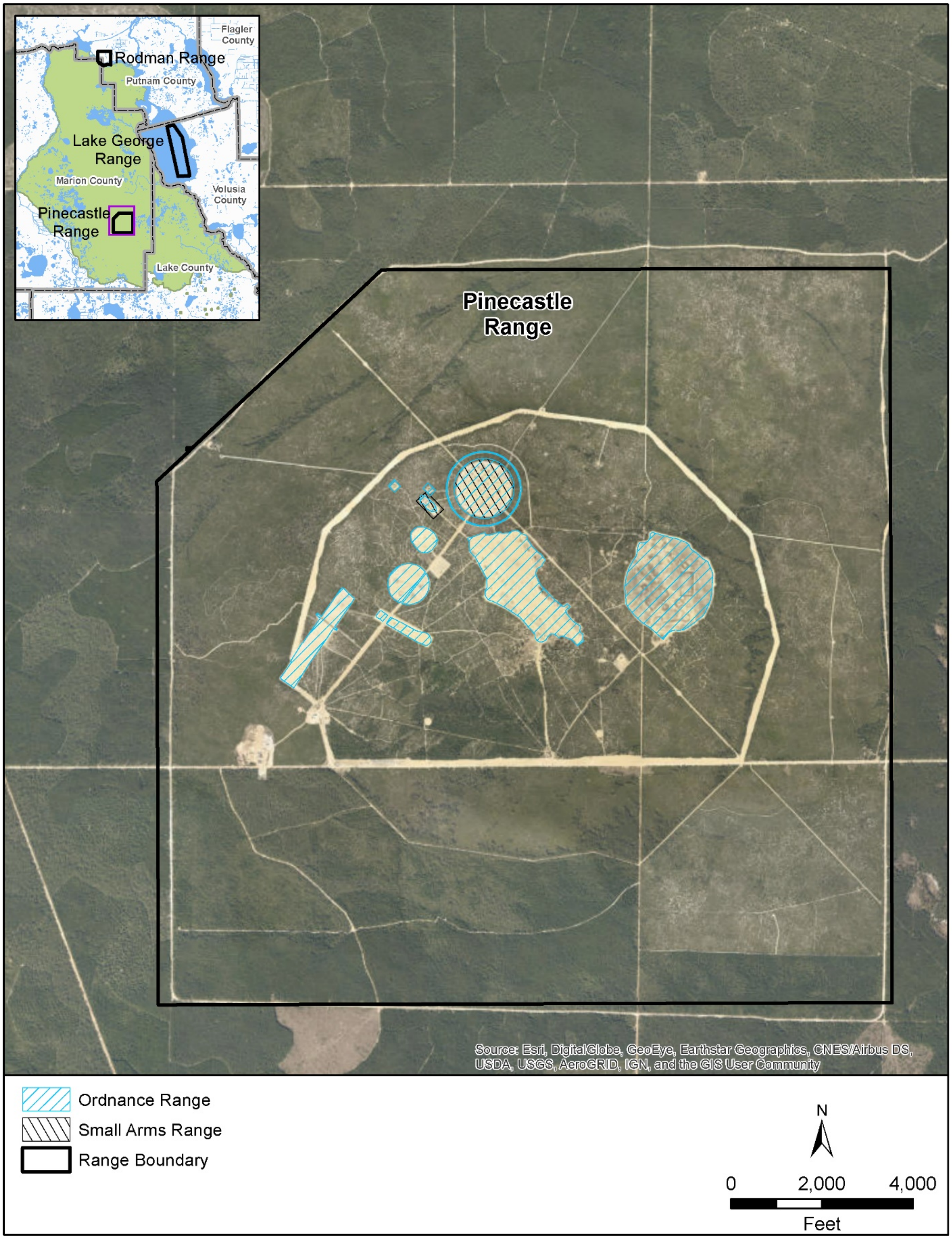

Figure 1-4. Pinecastle Range

1.2.2 Special Use Airspace

Special use airspace within the PRC includes Restricted Areas, Military Operations Areas (MOAs) (Figure 1-5), Alert Areas, Air Traffic Control Assigned Airspace, and Military Training Routes (Figure 1-6).

The airspace over the PRC comprises three interconnected Restricted Areas corresponding with the three ranges:

- Pinecastle Range, Restricted Area-2910A/B/C/D/E;
- Lake George Range, Restricted Area-2907A/B/C; and
- Rodman Range, Restricted Area-2906.

Additionally, the Palatka MOA is divided into two parts, which surround and overlap a majority of the Restricted Area. Other special use airspace associated with the PRC are the Pinecastle Air Traffic Control Assigned Airspace, which overlies the Palatka MOA, and eight Military Training Routes that either originate or terminate within the designated PRC special use airspace (Navy 2017).

The eight Military Training Routes include:

- VR-1005
- VR-1008
- VR-1009
- VR-1010
- VR-1039
- VR-1040
- VR-1041
- IR-023

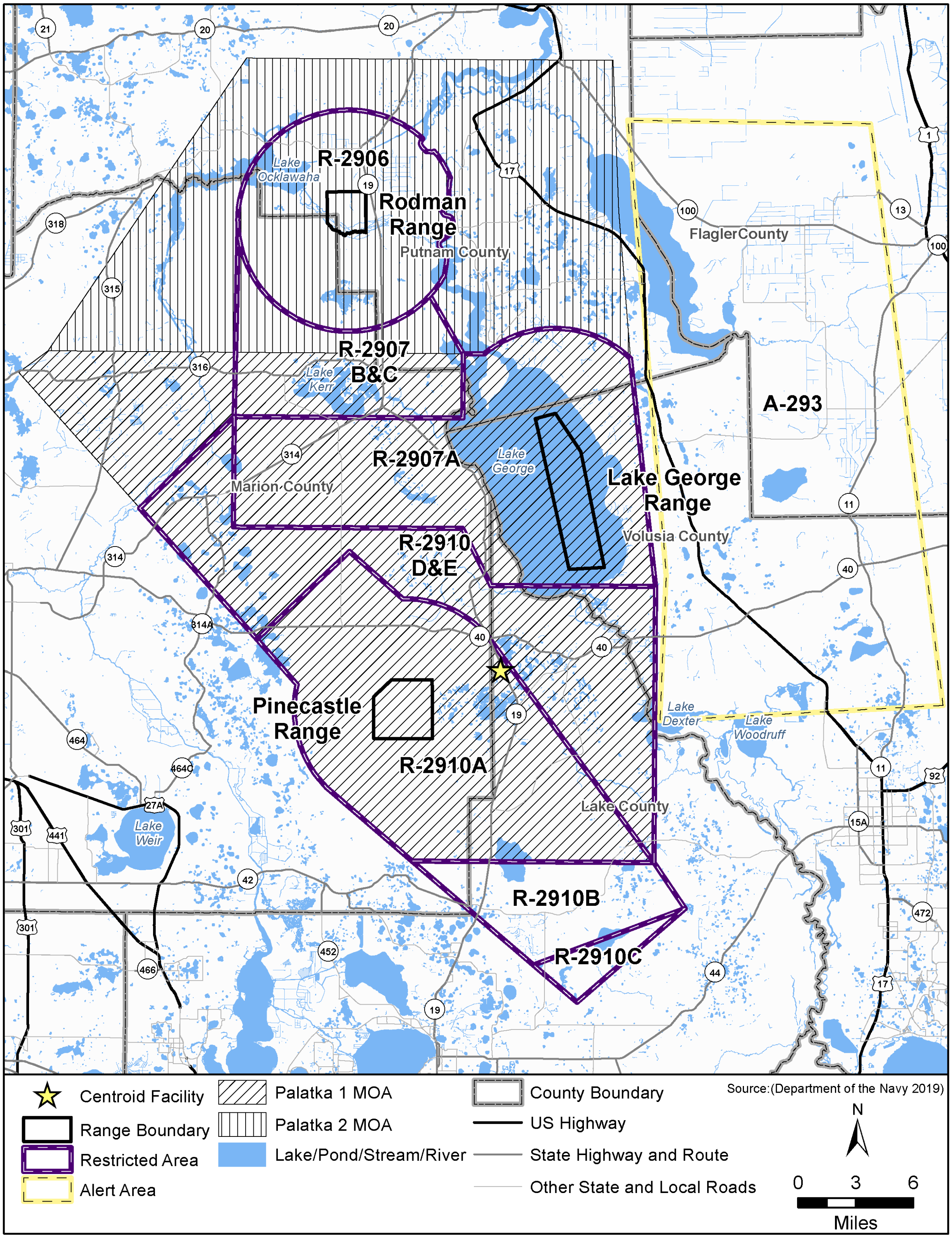

Figure 1-5. Military Operations Areas Associated with PRC Special Use Airspace

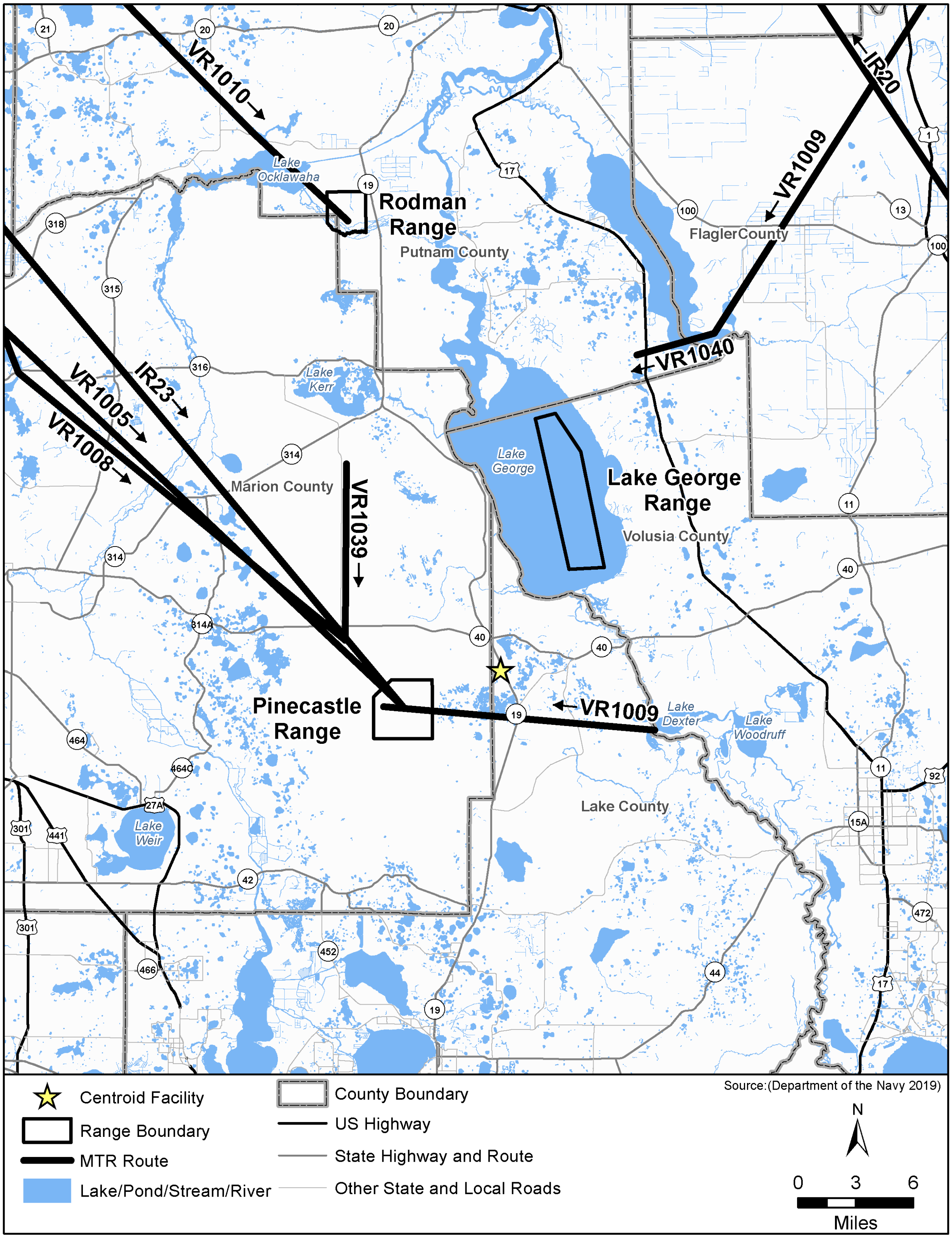

Figure 1-6. Military Training Routes Associated with PRC Special Use Airspace

1.3 ACTION AREA

The action area for the Proposed Action is defined as the area that encompasses potential direct and indirect project effects. The action area for the Proposed Action includes the Rodman, Pinecastle, and Lake George ranges, as well the special use airspace described in Section 1.2.3.

1.4 LISTED AND/OR PROPOSED SPECIES OR CRITICAL HABITAT WITHIN THE ACTION AREA

The potential occurrence of federally listed threatened and endangered species in the action area is summarized in Table 1-1. Potential species occurrence is based on a USFWS Information for Planning and Consultation search of the three ranges in the action area (USFWS 2019a); past USFWS consultations; existing documents, including the NAS Jacksonville Complex Integrated Natural Resources Management Plan (INRMP) (Navy 2019), the Supplemental Environmental Impact Statement for Renewal of Authorization to Use Pinecastle Range (Navy 2010), and the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2009); and Florida Natural Areas Inventory (FNAI) data searches for the three ranges in the action area (FNAI 2019).

Table 1-1. Threatened and Endangered Species Known to Occur or Potentially Occurring in the Action Area

Common Name	*Scientific Name*	*Federal Listing Status*	*Potential to Occur*			*Critical Habitat Present?*
			Pinecastle Range	*Lake George Range*	*Rodman Range*	
Florida scrub-jay	*Aphelocoma coerulescens*	T	Known	Likely[1]	Likely	No
Red-cockaded woodpecker	*Picoides borealis*	E	Potential	Likely[1]	Potential	No
Wood stork	*Mycteria americana*	T	Known	Likely	Known	No
American alligator	*Alligator mississippiensis*	T	-	Known	Known	No
Eastern indigo snake	*Drymarchon couperi*	T	Known	Likely[1]	Likely	No
Gopher tortoise	*Gopherus polyphemus*	C	Known	Likely[1]	Known	No
Sand skink	*Plestiodon reynoldsi*	T	Known	Likely[1]	Potential	No
West Indian manatee	*Trichechus manatus*	T	-	Potential	Potential	All of Lake George
Britton's beargrass	*Nolina brittoniana*	E	Potential	-	-	No
Clasping warea	*Warea amplexifolia*	E	-	-	Potential	No
Florida bonamia	*Bonomia grandiflora*	T	Known	-	-	No
Lewton’s polygala	*Polygala lewtonii*	E	Known	-	Potential	No
Scrub buckwheat	*Eriogonum longifolium* var. *gnaphalifolium*	T	Known	-	Potential	No
Scrub pigeon-wing	*Clitoria fragrans*	T	Potential	-	Potential	No

Notes: [1]Species likely occurs in the terrestrial habitats surrounding Lake George, but is not likely to occur within the Lake George Range (open water habitat). C = candidate species for listing, E = endangered, T = threatened.
Sources: FNAI 2019; USFWS 2019a.

The American alligator is known to occur in or near the Rodman Range and Lake George Range and is listed as "threatened due to similarity of appearance" to other listed crocodilians. The purpose of the listing is to regulate the intentional taking of alligators and to prevent the taking of other crocodilian species. The alligator is not biologically threatened in Florida and ESA section 7 consultation requirements do not apply to this species. Therefore, the American alligator is not addressed further.

The ONF contains a small group of Britton's beargrass individuals only in the western section of the forest boundary (USFS 2016). There are no known occurrences in the Rodman or Pinecastle ranges. Likewise, although potential habitat for clasping warea occurs at the Rodman Range (FNAI 2019), the species is not known to occur there (Navy 2019). It is reasonable to assume that no effects to these species will occur from the Proposed Action, and Britton's beargrass and clasping warea are not addressed further.

Species carried forward for analysis in this PBA include the Florida scrub-jay, red-cockaded woodpecker, wood stork, eastern indigo snake, gopher tortoise, sand skink, West Indian manatee, Florida bonamia, Lewton's polygala, and scrub buckwheat. Although the gopher tortoise is a candidate species, it is known to occur in the action area, and is therefore included in this analysis.

The entire Lake George Range occurs within critical habitat for the West Indian manatee. No other critical habitat occurs within the action area.

CHAPTER 2
PROPOSED ACTION

The Proposed Action is to continue existing military readiness activities and conduct anticipated future military readiness activities at the PRC. Current military readiness activities consist of aviation and ground activities at Pinecastle Range, Rodman Range, and aviation activities at Lake George Range. Collectively, these three ranges support rotary, fixed-wing, and tilt-rotor aircraft traveling from land military bases and sea-based military platforms. Anticipated future range mission requirements at the PRC include the incorporation of mobile and stationary electronic warfare equipment, and mission support for the A-29, F/A-18 Super Hornet, F-35, T-45 and other aircraft as identified in the 2017 Range Air Installations Compatible Use Zones (RAICUZ) Study.

2.1 EXISTING OPERATIONS

The continuation of existing operations includes the following:

- Landing operations at Centroid/USFS Helibase/Pinecastle Range/Rodman Range by Marine Corps, Army, Air Force, Navy, and Coast Guard rotary-wing aircraft (Navy 2018).
- Pinecastle Range:
    - Air-to-ground training, including air-to-ground bombing (inert and high explosive ordnance), lasing, and strafing
    - Ground operations related to small arms fire
    - Helicopter operations at Landing Zones and combat search and rescue training
    - Aerial lasing operations that are used for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.
    - Four major training exercises per year involving the entire air wing from an aircraft carrier in the Jacksonville Operations Area
- Lake George Range:
    - Air-to-surface inert ordnance delivery by fixed-wing aircraft
    - Sea search and rescue training and mine warfare exercises in Lake George
    - Tactical use of flares
    - Temporary electronic warfare equipment (i.e., man-portable air defense systems and mobile threat emitters)
    - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft

- Rodman Range:
  - Helicopter operations at Landing Zones and combat search and rescue training
  - Helicopter training operations can include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crew member by winch for search and rescue training.
  - Air-to-ground training, including air-to-ground bombing (inert ordnance only)

2.2 ANTICIPATED FUTURE TRAINING

Anticipated future range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges.
  - Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, NAS Jacksonville, Naval Station Mayport, and the commercial airfield at Cecil Field.
  - Training events would usually occur over a three week period consisting of approximately 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
  - Aircraft would be on-range up to 40 minutes at a time
  - Total training at either range (Pinecastle or Rodman) would consist of approximately 180 events and 720 sorties annually (Navy 2018).

Four major training exercises currently occur annually at Pinecastle Range involving the entire air wing from an aircraft carrier in the Jacksonville Operations Area; additional major training exercises could occur as part of the Proposed Action. The number of estimated annual sorties and ordnance expenditure associated with additional major training exercises are included within the Proposed Action and evaluated in this PBA.

The Proposed Action calls for new aircraft as identified in the 2017 RAICUZ Study to be introduced to the PRC. This includes both fixed-wing (e.g., T-45, and F-35) as well as rotary-wing (e.g., UH-1 and H-53) aircraft. Additionally, the Navy is coordinating with the USFS in identifying several potential locations in the PRC for siting mobile emitters used for electronic warfare equipment.

Mobile emitters transmit radio frequency energy directed at training aircraft. The radio frequency energy used at all locations is regulated and approved by the Federal Communications Commission. The frequency band that the mobile emitters are capable of transmitting within is 4 to 8 gigahertz (GHz). Mobile emitter vehicles are similar to television news satellite trucks in that they broadcast a signal skyward, but, rather than broadcasting to a satellite, these will be aimed at the participating training aircraft. The mobile emitters will send signals that are similar to some satellite communications, Wi-Fi devices, cordless phones, Bluetooth devices and weather radar systems (Navy 2019a).

Currently, up to six electronic warfare training exercises occur each year and last for three weeks. During that training period, there may be up to 12 electronic warfare threat training events (72 events/year). Previous fixed electronic warfare locations include a) two sites at the Centroid/R-2910, b) one site at Tower 2-2/R-2910, c) one site at Rodman/R-2906, and d) one site at Lake George/R-2907A. Several site surveys were conducted in order to identify new potential electronic warfare emitter locations and assess previous electronic warfare sites. Previous locations are shown on Figure 2-1 (Navy 2019b).

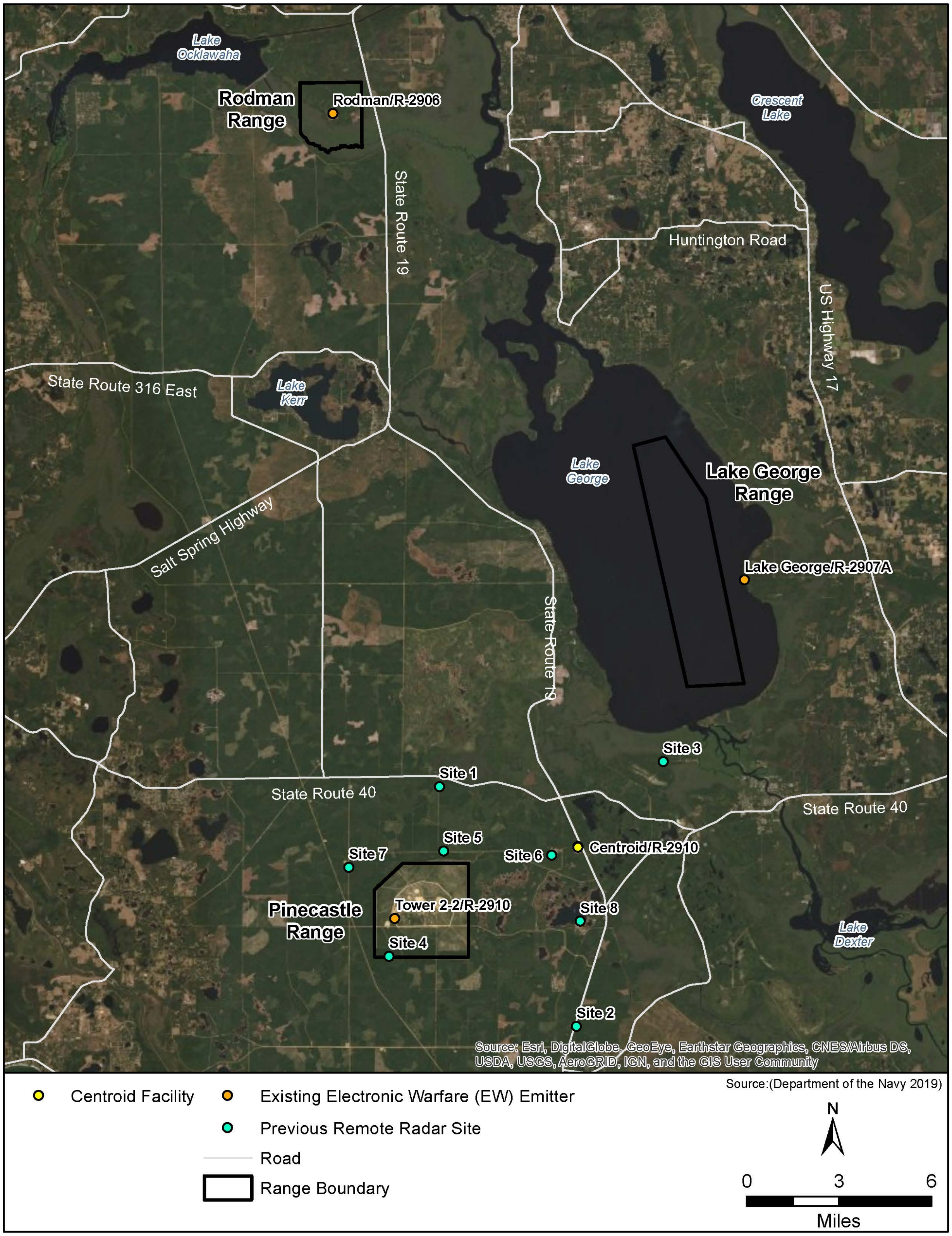

Figure 2-1. Existing Electronic Warfare Emitters and Radar Sites at PRC

Figure 2-1 only illustrates previous radar site locations; however, the new mobile emitters could go anywhere in the ONF, aside from protected areas such as wetlands. Electronic warfare emitters would be parked on established roads and would not require clearance of any habitat. The Navy would coordinate with the USFS when siting potential emitter locations in the ONF.

Pyrotechnic simulators are used during the electronic warfare threat training for visual cueing. The simulators are composed of a sealed cartridge approximately 1.5 inches in length with a plastic igniter-less cartridge that is consumed in flight with no falling debris. Under the Proposed Action, the number of pyrotechnic simulator rounds expected to be used per year at the PRC is approximately 120-180 (Navy 2019b).

Table 2-1 presents a comparison of the estimated number of annual sorties at the PRC for the representative baseline/No Action Alternative and Proposed Action. Overall, the total number of Proposed Action annual sorties would increase by approximately 7,000 sorties when compared to the baseline/No Action Alternative.

Table 2-1. Comparison of Estimated Annual Sorties at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Aircraft Type	*Service*	*Representative Baseline/ No Action Alternative*(1)	*Proposed Action*(2)
PINECASTLE			
Cessna	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F-35C	Navy	0	500
F/A-18C/D	Navy	118	0
F/A-18E/F	Navy	473	700
H-60	Navy	253	300
P-3	Navy	11	0
P-8	Navy	0	50
T-45	Navy	0	720
UAS(3)	Navy	12	100
AH-1	Marine Corps	0	150
AV-8	Marine Corps	28	100
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	43	100
H-53	Marine Corps	0	150
KC-130	Marine Corps	0	50
UH-1	Marine Corps	0	150
A-10	Air Force	375	400
A-29	Air Force	0	100
AC-130	Air Force	5	50
F-15	Air Force	166	200
F-16	Air Force	44	100
F-35A	Air Force	0	100
V-22	Marine Corps	5	50
MH-65	Coast Guard	21	50
	Subtotal	1,557	4,320
RODMAN			
E-2	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F-35C	Navy	0	500
F/A-18C/D	Navy	110	0
F/A-18E/F	Navy	441	700
H-60	Navy	132	200
T-45	Navy	0	720
UAS(3)	Navy	12	100
AH-1	Marine Corps	0	50
AV-8	Marine Corps	24	50
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	39	100
H-53	Marine Corps	0	50
KC-130	Marine Corps	0	50
UH-1	Marine Corps	0	50
V-22	Marine Corps	5	50
A-10	Air Force	287	400
A-29	Air Force	0	100

Table 2-1. Comparison of Estimated Annual Sorties at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Aircraft Type	*Service*	*Representative Baseline/ No Action Alternative[1]*	*Proposed Action[2]*
AC-130	Air Force	2	50
F-15	Air Force	166	200
F-16	Air Force	29	100
F-35A	Air Force	0	100
	Subtotal	*1,250*	*3,770*
LAKE GEORGE			
Cessna	Navy	1	50
E-2	Navy	1	50
EA-6B	Navy	2	0
EA-18G	Navy	0	50
F/A-18C/D	Navy	115	0
F/A-18E/F	Navy	458	700
F-35C	Navy	0	500
H-60	Navy	91	200
P-3	Navy	25	50
P-8	Navy	0	100
UAS[3]	Navy	12	100
AV-8	Marine Corps	24	50
F-35B	Marine Corps	0	100
F/A-18C/D	Marine Corps	43	100
KC-130	Marine Corps	0	50
V-22	Marine Corps	5	50
A-10	Air Force	335	400
A-29	Air Force	0	50
AC-130	Air Force	4	50
F-15	Air Force	165	200
F-16	Air Force	44	100
F-35A	Air Force	0	100
	Subtotal	*1,325*	*3,050*
TOTAL		**4,132**	**11,140**

Notes: 1. The representative baseline/No Action Alternative reflects peak data for each aircraft type from 2013 to 2017.
2. Aircraft types listed under Proposed Action are representative of those aircraft that typically conduct sorties at PRC. Other DoD and foreign aircraft may use the PRC and associated airspace; it is anticipated those DoD/foreign aircraft sorties would generally be included in the overall total number of estimated annual sorties listed for the Proposed Action, and therefore, are addressed in the impact analysis in this PBA.
3. UAS = Unmanned Aircraft System and includes all UAS, unmanned aerial vehicles and small UAS classes. UASs are remotely piloted or self-piloted (i.e., preprogrammed flight pattern) aircraft that include fixed-wing, rotary-wing, and other vertical takeoff vehicles. They can carry cameras, sensors, communications equipment, or other payloads.

Table 2-2 presents a comparison of the estimated annual ordnance expenditure at the PRC for the representative baseline/No Action Alternative and Proposed Action. Overall, the total number of Proposed Action ordnance expenditure would increase by approximately 484,490 when compared to the baseline/No Action Alternative.

Table 2-2. Comparison of Estimated Annual Ordnance Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	*Ordnance Type(1)*	*Representative Baseline/ No Action Alternative(2)*	*Proposed Action*
PINECASTLE			
Large Arms	2.75" Rocket (i (3)	577	900
	2.75" Rocket (L)(3)	99	400
	20 mm	42,790	50,000
	25 mm	0	50,000
	30 mm	30,603	40,000
	40 mm	0	600
	105 mm	0	300
	5" Rocket	0	100
	ATM-114B	20	50
	AGM-114B (A-F)	8	50
	AGM-114K/M/N	0	50
	AGM-114P	0	50
	AGM-114Q	0	50
	AGM-175/176	0	50
	BDU-33	796	600
	BDU-45	68	100
	BDU-48/MK-106	0	100
	BDU-50	30	100
	BLU-110	22	200
	BLU-111	241	500
	GBU-10 (L)	0	200
	GBU-10 (i)	0	200
	GBU-24 (i)	0	100
	GBU-31 (i)	1	500
	GBU-32 (i)	27	500
	GBU-38 (i)	0	500
	GBU-44 (i)	0	100
	GBU-54 (i)	0	100
	GBU-12 (i)	78	500
	GBU-12 (L)	25	100
	GBU-16 (i)	9	500
	GBU-16 (L)	2	100
	LGTR	128	500
	MK-76	173	6,060
	MK-81	0	100
	MK-82 (i)	6	250
	MK-82 (L)	232	500
	MK-83 (i)	0	250
	MK-83 (L)	37	500
	MK-84 (L)	26	250
	Subtotal	*75,998*	*156,010*

Table 2-2. Comparison of Estimated Annual Ordnance Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	Ordnance Type(1)	Representative Baseline/ No Action Alternative(2)	Proposed Action
Small Arms, Air Gunnery	7.62 mm	77,387	400,000
	7.62 mm (blanks)	0	5,000
	0.50 Cal	18,000	50,000
	Subtotal	*95,387*	*455,000*
Small Arms, Ground	12 Gauge	0	250
	5.56 mm	12,000	15,000
	5.56 mm (blanks)	0	5,000
	SESAM	0	2,000
	7.62 mm	392,410	397,410
	9 mm	1,200	2,000
	0.50 Cal	27,620	30,620
	Subtotal	*433,230*	*452,280*
Other	Countermeasures(4)	56	100
	Signaling Device(5)	26	100
	Visual Cues(5)	72	200
	Subtotal	*154*	*400*
	Pinecastle Total	*604,769*	*1,063,690*
RODMAN			
Large Arms	BDU-33 (i)	16	100
	MK-76 (i)	6	5,000
	BDU-45 (i)	0	100
	BDU-48/MK-106 (i)	0	100
	BDU-50 (i)	0	100
	Subtotal	*22*	*5,400*
Small Arms, Air Gunnery	7.62 mm (blanks)	0	5,000
	Subtotal	*0*	*5,000*
Small Arms, Ground	5.56 mm (blanks)	0	10,000
	Special Effect Small Arms Marking System	0	2,000
	Subtotal	*0*	*12,000*
Other	Signaling Device(5)	26	100
	Visual Cues(6)	72	200
	Subtotal	*98*	*300*
	Rodman Total	*120*	*22,700*

Table 2-2. Comparison of Estimated Annual Ordnance Expenditure at the PRC for Representative Baseline/No Action Alternative and Proposed Action

Ordnance Group	Ordnance Type(1)	Representative Baseline/ No Action Alternative(2)	Proposed Action
LAKE GEORGE			
Large Arms	2.75" Rocket (i)	0	100
	BDU-33	6	100
	BDU-45	16	100
	BDU-48/MK-106	39	200
	BDU-50	0	100
	MK-62 (i)	60	250
	MK-63 (i)	22	100
	MK-82 (i)	0	100
	5" Rocket (i)	0	100
	MK-81 (i)	0	100
	MK-83 (i)	0	100
	MK-84 (i)	0	100
	MK-76	15	100
	Subtotal	*158*	*1,550*
Other	Countermeasures(4)	1,063	2,500
	Signaling Devices(5)	26	100
	Visual Cues(6)	72	200
	Subtotal	*1,161*	*2,800*
	Lake George Total	*1,319*	*4,350*
	TOTAL	**606,208**	**1,090,740**

Notes: 1. i = inert; L = live; Inert ordnance, such as BDU-33, may contain marking or spotting charges, which provide a puff of smoke for scoring.
2. The representative baseline/No Action Alternative reflects peak data for each ordnance type from 2013 to 2017.
3. Some 2.75" rockets at Pinecastle Range would have advanced precision kill weapon system guidance system.
4. Countermeasures includes all countermeasures deployed at PRC (MJU-27, SM-875, etc.).
5. Signaling Devices includes all devices that are utilized during ground operations (smoke grenade, signaling flare, etc.).
6. Visual Cues includes all the visual cues utilized at PRC (e.g., Smokey SAMS and OMEGAS).
7. AGM = air-to-ground missile; BDU = bomb dummy unit; BLU = bomb live unit; GBU = glide bomb unit; MK = mark; LGTR = laser guided training round; SESAM = special effect small arms marking.
8. Ordnance types listed under Proposed Action are representative of those typically delivered at the PRC. Other similar ordnance may be delivered at the PRC; it is anticipated those similar types of ordnance would generally be included in the overall total number of estimated ordnance expenditures listed for the Proposed Action, and therefore, are addressed in the impact analysis in this PBA.

2.3 CONSERVATION MEASURES PROPOSED TO AVOID, MINIMIZE, AND COMPENSATE FOR EFFECTS TO FEDERALLY LISTED SPECIES

The Proposed Action would include the measures provided below to minimize potential effects on federally listed species. These measures have been developed iteratively in conjunction with the impact analyses in Chapter 5 of this PBA.

2.3.1 Rodman Range Conservation Measures

Consistent with the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2009), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Rodman Range.

1. The INRMP for NAS Jacksonville (Navy 2019) was developed in cooperation with the USFWS and Florida Fish and Wildlife Conservation Commission (FFWCC). This plan includes management actions for Rodman Range and is updated annually to provide benefits to threatened and endangered species. Natural resources at the Rodman Range would continue to be managed in accordance with this INRMP.
2. The Navy would continue to manage the Rodman Range in accordance with the Candidate Conservation Agreement for the Gopher Tortoise (Gopher Tortoise Team 2019). The goal of the Candidate Conservation Agreement is to organize a cooperative range-wide approach to gopher tortoise management and conservation in its eastern range. As part of the agreement, the Navy conducts gopher tortoise population and habitat assessment surveys at the Rodman Range. The agreement also provides indirect benefits to eastern indigo snake by monitoring the occurrence of burrows on Rodman Range.
3. The Navy would continue to relocate gopher tortoises discovered in areas where training activities expose the species to higher likelihood of impact. Relocation of tortoises and removal of burrows from activity areas such as the target at Rodman Range (in the event that a burrow occurred in the target area) also benefits commensal species such as the eastern indigo snake by precluding suitable habitat in the target area. Thus, a conservation benefit is provided to both species by encouraging the tortoise and eastern indigo snake to occupy compatible areas of the range.

2.3.2 Lake George Range Conservation Measures

Consistent with the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2009), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Lake George Range.

4. Prior to releasing non-explosive munitions, P-8 aircraft would continue to do a pass at 300 ft., ~200 knots as a clearing run looking for boats, fishermen, large fish, and manatees.
5. To enhance the ability of the P-8 aircrew to spot a manatee or large fish (such as a sturgeon) near the target area, the aircrew would continue to use the Electro Optic/Infra-Red sensors which would enable the aircrew to detect surfacing animals.
6. The tower and range cameras will continue to observe range/impact areas for 5 minutes following the sortie (after the last non-explosive munition is dropped) to observe if any manatee or fish was injured by the exercise.
7. The pilot and at least one observer on board will continue to be trained to look for marine mammals/large fish and have completed the U.S. Navy Marine Species Awareness Training.

2.3.3 Pinecastle Range Conservation Measures

Consistent with the Final Supplemental Environmental Impact Statement to the Final Environmental Impact Statement for Renewal of Authorization to Use Pinecastle Range (Navy 2010), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Pinecastle Range.

8. Within their authority, the Navy would restore or rehabilitate any National Forest lands damaged in the use of the Pinecastle Range.

9. The Navy would notify the USFS, without delay, upon the occurrence or sighting of any fire whether controlled by them or not.
10. The Navy would dispose of refuse resulting from this use, including waste materials, garbage, and rubbish of all kinds, in the following manner, and shall guard the purity of streams and living waters: Rubbish shall be taken to an approved sanitary landfill or collection point. Unsalvageable scrap metal or waste material will not be buried on site, but will be properly disposed of by approved regulations, as funding allows.
11. The Navy would receive prior approval from the Forest Supervisor or District Ranger before conducting any activity outside the permitted area.
12. The Navy would notify the USFS, without delay, of any ordnance, explosive, or non-explosive that is dropped outside the Range boundary. Any such ordnance shall be located and removed as soon as possible and any damage repaired.
13. The Navy would cooperatively work with USFS personnel on approving and implementing a management plan inside the designated Range to improve habitat conditions for existing threatened and endangered species. These resource activities will include prescribed burning, monitoring studies, and other activities identified in the Resource Management Plan for Pinecastle Range and approved by the Navy.
14. The Navy would immediately notify the District Ranger upon the discovery of any dead sand skink, eastern indigo snake, or Florida scrub-jay. All reasonable measures will be taken to preserve said discoveries.
15. The Navy would immediately suspend bombing operations when a fire or other emergency occurs on or near the Range, at such times and conditions as described below.
16. The use of air-delivered ordnance, to include both explosive and non-explosive, will be prohibited with the following Burning Indexes and Keetch-Byram Drought Index:
    - Burning Index 70 or less − No prohibitions providing the Keetch-Byram Drought Index is less than 400.
    - Burning Index 71 + − No air delivered ordnance with Keetch-Byram Drought Index over 400, unless approved by the USFS.

    In special situations when the Burning Index exceeds 70, the Navy may request permission to use air delivered ordnance, and the District Ranger may approve such request if predicted weather allows.

    On days when the Burning Index is less than 71, the Range may be closed by the District Ranger for the use of air-delivered ordnance due to unusual circumstances such as fire occurrence on the ONF.

CHAPTER 3
EXISTING CONDITIONS AND DESCRIPTION OF THE SPECIFIC AREA AFFECTED BY THE ACTION

This chapter describes the existing environmental conditions in the action area.

3.1 RODMAN RANGE

The majority of the Rodman Range (Figure 1-2) is undeveloped and consists of forested uplands and wetlands. Approximately 52 percent (1,390 acres) of the range consists of natural vegetation communities including approximately 1,200 acres of floodplain swamp and bottomland forest along the Ocklawaha River in the southern part of the property (Navy 2009). Flatwoods located on the north part of the range are composed of mostly mature slash pine plantations with a heavy saw palmetto understory.

Numerous small depression marshes and dome swamps are interspersed throughout the flatwood plantations. Rodman Range has a main target area of about 100 acres, which is maintained by routine mowing and occasional plowing to meet operational and safety requirements. Vegetation in the target area consists of grasses and other herbaceous plants (Navy 2009).

Vegetation at the range is managed in accordance with the INRMP to support the mission and to provide for sustained, multiple uses (Navy 2019). Prescribed fire is used as a management tool throughout the range and silvicultural practices are used in the pine plantations. Lands surrounding Rodman Range are undeveloped and primarily forested. The ONF borders the range to the south and west.

3.2 LAKE GEORGE RANGE

No land areas or terrestrial vegetation occur on the Lake George Range (Figure 1-3). However, one existing fixed electronic warfare location (Lake George/R-2907A) occurs outside of the range along the shore of the lake (Figure 2-1). Lands surrounding Lake George are largely undeveloped and the vegetation primarily consists of forested uplands and wetlands. The St. Johns River system, including Lake George, has a diverse set of plant communities, with submerged, emergent, and floating vegetation (Navy 2009). While comprehensive submerged aquatic vegetation mapping has not been completed for Lake George, mapping conducted in nearby areas on the St. Johns River shows that vegetation is limited to the littoral (nearshore) zone, and generally only occurs at depths of 5 feet or less (Dobberfuhl and Trahan 2003). The Lake George Range is located 0.6 to 1.9 miles off the lake's eastern shoreline and 2.4 to 4.7 miles off the western shoreline, and occurs in waters ranging from 8 to 11 feet deep. Therefore, submerged aquatic vegetation is not expected to occur within the Lake George Range boundaries.

3.3 PINECASTLE RANGE

The Pinecastle Range is 5,698 acres in size (Figure 1-4). While 383 acres consist of cleared target areas and ancillary facilities such as roads and an observation tower, the remaining 5,315 acres comprise a buffer area and are vegetated. The Pinecastle Range is located inside the “Big Scrub Complex.” “Big Scrub” is an expansive area of Central Florida dominated by sand pine (*Pinus clausa*), evergreen oaks, and shrubs, and is subject to frequent fires. The area is predominately sandhills, sand pine scrub, and dry hammock. Scrub is found on excessively well-drained sandy soil associated with the Central Florida ridge. Scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire. There are no wetlands or open water areas within the boundary of the Pinecastle Range.

3.4 Special Use Airspace

The action area also includes the special use airspace discussed in Section 1.2.3 and displayed on Figures 1-5 and 1-6. Special use airspace within the PRC includes Restricted Areas, MOAs, Alert Areas (Figure 1-5), Air Traffic Control Assigned Airspace, and Military Training Routes (Figure 1-6). The special use airspace overlies all three ranges, all of Lake George, and a portion of the ONF. While the action area includes the lands below the special use airspace, the analysis in this PBA largely focuses on the impacts that would occur in the range areas due to the higher likelihood of potential impacts occurring on the ranges.

CHAPTER 4
DESCRIPTION OF LISTED SPECIES THAT MAY BE AFFECTED BY THE PROPOSED ACTION

4.1 FLORIDA SCRUB-JAY

The Florida scrub-jay is endemic to Florida's sand scrub habitats. Florida scrub-jays are extremely habitat-specific, non-migratory, and not highly mobile. They reside in scrub habitat that typically contains sand live oak (*Quercus geminata*), myrtle oak (*Quercus myrtifolia*), inopine oak (*Quercus inopina*), Chapman oak (*Quercus chapmanii*), saw palmetto (*Sereno repens*), scrub palmetto (*Sabal etonia*), young sand pines, and rosemary (*Ceratiola ericoides*).

Florida scrub-jays maintain a social structure that involves cooperative breeding (Woolfenden and Fitzpatrick 1984). Florida scrub-jays live in groups ranging from two (a single mated pair) up to large, extended families of eight adults and one to four juveniles. Fledgling scrub-jays remain with the breeding pair in their natal territory as "helpers," forming a closely knit, cooperative family group. There is only one breeding pair within a group and the non-breeding individuals help rear the young (Woolfenden and Fitzpatrick 1984).

Habitat is the greatest limiting factor for this species. The ecology of the scrub habitat is driven by disturbance, mainly fire. The USFS manages scrub-jay habitat in the ONF through management practices such as prescribed fire and clear-cutting. Approximately 200,000 acres of sand pine scrub are within the ONF and the land is managed in such a way that 40,000 acres at any given time are available scrub-jay habitat.

Three large metapopulations of Florida scrub-jays exist in Florida. One of these populations is within the ONF. All three of the large metapopulations are thought to contain sufficient numbers to ensure long-term viability (USFWS 2015). Surveys for Florida scrub-jays on the ONF conducted in 2012-2014 yielded estimates of 1,100-1,250 groups, which translates into approximately 2,530-2,875 individuals if an average observed group size of 2.3 birds per group is extrapolated to the entire population (Miller et al. 2015). The Florida scrub-jay population on the ONF has not been as thoroughly surveyed as the other two major populations due to the vast amount of potential habitat present and the infeasibility of conducting statistically robust surveys.

The Pinecastle Range, with the exception of the target areas, is actively managed for scrub habitat. Approximately 1,517 acres of scrub-jay habitat occurs within the Pinecastle Range. The density of scrub-jay groups has been found to be one group per 40 acres within the Pinecastle Range, a higher density than other parts of the ONF (Navy 2002), because of the prescribed burning conducted on the Range by the USFS in cooperation with the Navy. Surveys conducted at the Pinecastle Range in 2011 observed 53 groups of scrub-jays (127 individuals), while 2012 surveys observed 38 groups of scrub-jays (101 individuals) (Naval Facilities Engineering Command Southeast 2012). The survey report noted that scrub-jays were absent from stands that had recently burned, and that this typically takes 5-18 years for scrub habitat to become optimal for scrub-jays following a burn (Naval Facilities Engineering Command Southeast 2012).

The Florida scrub-jay was not observed during FNAI (1997) surveys at Rodman Range and suitable habitat is not present (Navy 2019). Mapping provided by FFWCC showed several occurrence records for this species south of the range in the ONF, but none within the range boundaries. The Florida scrub-jay is not expected to occur at Rodman Range based on the lack of sightings and lack of suitable habitat.

The Florida scrub jay is not expected to use the open water habitats within the Lake George Range, but could potentially occur in scrub habitat in lands surrounding Lake George.

4.2 RED-COCKADED WOODPECKER

The red-cockaded woodpecker is a small woodpecker that, like the Florida scrub-jay, engages in a cooperative breeding system. They live in groups containing a single breeding pair, while others help incubate eggs, feed nestlings and fledglings, and defend territories (USFWS 2019b).

Red-cockaded woodpeckers inhabit open, mature pine woodlands. Optimal habitat is characterized as a broad savanna with a scattered overstory of large pines and a dense groundcover containing a diversity of grass, forb, and shrub species. This habitat is characterized by low intensity fire, which historically occurred during the growing season at intervals of about 1-10 years. Therefore, fire suppression can have a detrimental impact on red-cockaded woodpecker populations. Landscape features, such as fragmentation of foraging habitat, total area of foraging habitat, percentage of pinewood or hardwood cover, contiguity of the canopy and forest cover, and habitat patch size and shape may affect the habitat quality (NatureServe 2019).

Short-term rotation timber management has eliminated mature diseased pines required for roosting, nesting, and foraging; fire suppression has allowed invasion of pine stands by hardwoods. However, recent management innovations have alleviated threats and resulted in population increases in some areas (NatureServe 2019). Management goals for the species include maintaining old-growth pine forests and establishing an effective prescribed burning program. Burns conducted in spring and summer are most effective in controlling hardwood encroachment.

In the ONF, the red-cockaded woodpecker typically nests in mature longleaf pine. No suitable habitat for red-cockaded woodpecker exists at the Pinecastle Range. The red-cockaded woodpecker has not been observed at Rodman Range and the range generally lacks suitable open, mature pine woodland habitat for this species. Most of the pine forest habitats at the Rodman Range are composed of mature slash pine plantations with a heavy saw palmetto understory (Navy 2005). The FNAI Biodiversity Matrix (FNAI 2019) indicates that this species has the potential to occur in the general vicinities of the Rodman and Pinecastle ranges, but does not contain records for documented occurrences at either range. The red-cockaded woodpecker is not expected to occur at Rodman Range based on lack of sightings and lack of suitable habitat.

The red-cockaded woodpecker is not expected to use the open water habitats within Lake George Range, but mapping provided by FFWCC shows several occurrence records for this species west of Lake George in the ONF (FFWCC 2020a).

4.3 WOOD STORK

Wood storks are large wading birds that inhabit freshwater marshes, swamps, lagoons, ponds, and flooded fields. The wood stork can also occur in brackish wetlands. Wood storks nest mostly in upper parts of cypress trees, mangroves, or dead hardwoods situated over water, on islands along streams, or adjacent to shallow lakes. Nesting is tied to receding water levels and concentration of food sources, regardless of the time of year. Colonies are made up of a few to thousands of nesting pairs (NatureServe 2019).

Wood storks feed predominantly in the areas in which they nest. The wood stork eats mainly small fish, though it will also eat other miscellaneous small animals detected with its touch-sensitive bill. They forage mainly in shallow water and flooded fields. Areas with falling water levels attract these birds as they have more highly concentrated food sources (NatureServe 2019).

The current population of adult birds is difficult to estimate, since not all nest each year. Presently, the wood stork breeding population is believed to be greater than 8,000 nesting pairs (16,000 breeding adults) (USFWS 2013).

There are no known wood stork rookeries in the ONF, and no nesting habitat is located on the Pinecastle Range. Shallow water and emergent wetlands containing foraging areas for wood storks are located within two miles of the Pinecastle Range. This area is not a major feeding site as indicated by the low number of wood storks seen within this area. The USFWS determined that operations at the Pinecastle Range would have no effect on wood storks (Navy 2002). No known wood stork colonies or their core foraging areas are located in or near the Pinecastle Range based on mapping produced by the USFWS (2019c).

The wood stork has been documented at Rodman Range; however, nesting has not been documented at the range. The FNAI Biodiversity Matrix also indicates that wood storks have been documented in the vicinity of Rodman Range (FNAI 2019). Wood storks are expected to occasionally use Rodman Range for foraging, but nesting is not expected. No known wood stork colonies or their core foraging areas are located in or near the Rodman Range based on mapping produced by the USFWS (2019c). A majority of foraging activity is expected to occur in the floodplain swamp community in the southern part of the Rodman Range along the Ocklawaha River.

The wood stork is not expected to use the open water habitats within Lake George Range. The FNAI Biodiversity Matrix contains no records of documented, likely, or potential occurrence of wood storks in the Lake George Range (FNAI 2019). No known wood stork colonies or their core foraging areas are located in the Lake George Range based on mapping produced by the USFWS (2019c). Despite the lack of documented occurrences, it is expected that wood storks would occasionally forage or travel through the Lake George Range.

4.4 EASTERN INDIGO SNAKE

The eastern indigo snake is a large, black, non-venomous snake found in the southeastern U.S. It uses a variety of habitats that include pine flatwoods, scrubby flatwoods, high pine, dry prairie, hardwood hammocks, edges of freshwater wetlands, agricultural land, coastal dunes, and disturbed areas (Navy 2002). A study in the Gulf Hammock Wildlife Management Area to the west of the ONF found that eastern indigo snakes have home ranges of approximately 158 to 390 acres and were found in association with ponds and wetlands 25% to 68% of the time (Navy 2002).

Eastern indigo snakes are often associated with the burrows of the gopher tortoise, where they seek shelter from thermal stress and lay eggs (Navy 2002). A study in Georgia found that 77% of indigo snake dens were in tortoise burrows. In areas lacking tortoise burrows, decayed stumps and logs are important habitat features for cover. Indigo snakes eat a variety of small mammals and herpetofauna, including gopher tortoise hatchlings (Navy 2002).

There has been no detailed survey work on the ONF over the last ten years and there are no references in the literature regarding empirically derived estimates of the eastern indigo snake population on the ONF. Individuals are known to occur in the Forest based on confirmed sightings from ONF personnel and cooperators (Enge et al. 2013). Based on the presence of the range of preferred habitat types and a gopher tortoise population present in the xeric habitats, eastern indigo snake occurrence within suitable habitats on the ONF can be assumed. The USFWS has estimated that there are nearly 363,500 acres of potential indigo snake habitat in the ONF. While the eastern indigo snake has been recorded in a variety of scrub, sandhills, and flatwoods habitats in the ONF, surveys in 1993, 1997, and 2001 did not confirm its presence in the Pinecastle Range (Navy 2002). However, due to availability of suitable habitat, the eastern indigo snake is likely to occur in the Pinecastle Range. The Pinecastle Range and the surrounding area support a substantial population of gopher tortoises, further enhancing the available habitat for eastern indigo snakes in this area (Navy 2002).

Suitable eastern indigo snake habitat likely exists at Rodman Range based on the interspersion of xeric uplands with gopher tortoise burrows and wetlands. The FNAI (2004) conducted eastern indigo snake surveys at Rodman Range in 2003 – 2004 by searching gopher tortoise burrows with a burrow camera. No eastern indigo snakes or signs of the snakes were found during the surveys. While these surveys indicate that eastern indigo snakes were not using the burrows surveyed at Rodman Range, they are not considered definitive in determining the absence of this species at Rodman Range. Additional herpetofauna surveys were conducted at the Rodman Range in 2017, where no eastern indigo snakes were discovered; however, suitable habitat was determined to exist within the Rodman Range (LG2 Environmental Solutions, Inc. 2018).

The eastern indigo snake is not expected to use the open water habitats within the Lake George Range. The FNAI Biodiversity Matrix contains no records of documented, likely, or potential occurrence of eastern indigo snakes in the Lake George Range (FNAI 2019). However, eastern indigo snakes are known to use edges of freshwater wetlands and have the potential to occur in lands surrounding Lake George.

4.5 GOPHER TORTOISE

Gopher tortoises usually live in relatively well-drained, sandy soils that are often associated with longleaf pine and dry oak sandhills. They also live in scrub, dry hammock, pine flatwoods, dry prairie, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of habitats that have been disturbed or altered by man, such as power line rights-of-way, and along roadsides (USFWS 2019d). Gopher tortoises are most active in warmer months, but spend most of their lives underground in their burrows. As a result, gopher tortoises do not seem to be heavily impacted by noise (Bowles et al. 1999). Additionally, individuals will dig and use many burrows throughout the active season. The burrows can vary from 3 to 52 feet long and 9 to 23 feet deep (USFWS 2019d). Their burrows provide important refuge and protection for a variety of species including the eastern indigo snake.

Threats to the gopher tortoise include habitat destruction, fragmentation, and degradation; predation; inadequacy of regulatory mechanisms; and incompatible use of herbicides in forest management and some silvicultural activities (USFWS 2019d). Gopher tortoises need large parcels of undeveloped land not fragmented by roads, buildings, parking lots, and other structures. Such barriers in natural habitat limit food availability and burrow space for tortoises plus expose them to closer contact with humans and their vehicles. Roadkill is one of the major causes of death for adult tortoises (USFWS 2019d).

Counts of gopher tortoise burrows at the Rodman Range between 2009 and 2011 included 23 active burrows and 22 inactive burrows (Navy 2019). Survey results from 1996 to 1997 found the densities of gopher tortoises at the Rodman Range to be 4.4/hectare in scrub habitat and 0.5/hectare in scrubby flatwoods habitat (Navy 2019). More recently, surveys in 2017 of all suitable habitat at the Rodman Range found 73 active, 11 potentially occupied, and 4 abandoned gopher tortoise burrows (LG^2 Environmental Solutions, Inc. 2018). At the time of the 2017 survey, it was noted that all suitable habitat at the Rodman Range was occupied and that it should be allowed to naturally reach carrying capacity with existing populations (LG^2 Environmental Solutions, Inc. 2018). Gopher tortoises are managed and protected at the Rodman Range in accordance with the INRMP (Navy 2019) and Gopher Tortoise Management Plan (NAS Jacksonville 2006), which were developed cooperatively with the USFWS and FFWCC.

The Pinecastle Range and the surrounding area support a substantial population of gopher tortoises, and the species is known to occur throughout the Range (Navy 2010). Gopher tortoise burrows are abundant in disturbed areas of the Pinecastle Range, and are typically concentrated along openings such as roads and trails in old stands of sand pine at the Range.

The gopher tortoise does not occur in the open water habitats within Lake George Range. However, they can potentially occur in land surrounding Lake George in scrub, dry hammock, pine flatwoods, dry prairie, coastal grasslands and dunes, mixed hardwood-pine communities, and a variety of habitats that have been disturbed or altered by man (USFWS 2019d).

4.6 SAND SKINK

The sand skink is a fossorial lizard (i.e., adapted to digging and living underground) with vestigial legs, allowing it to move in a snake-like fashion through loose sand and requiring loose sand for locomotion and foraging (Navy 2002). The sand skink is active throughout the year, eating a variety of insects that are available a few inches below the ground surface.

Sand skinks prefer moist soil, exhibiting a narrow tolerance for soil moisture in the range of 20 to 27% for efficient burrowing in loose sand under laboratory conditions (Navy 2002). They are found from surface debris to 18 inches deep, depending on the length of time since recent rainfall, and probably do not penetrate more than a few inches below the surface in tightly packed soil. Sand skinks prefer areas with low soil compaction, which allows them to move more freely through surficial sediment layers, and their presence is also linked with larger particle size and low soil temperature (USFWS 2007a). While logs and woody debris on the surface are important cover, pocket gopher mounds are also important microhabitat for sand skinks (Navy 2002).

The sand skink is one of the USFS Land and Resource Management Plan (LRMP) indicator species for the scrub community, inhabiting a variety of scrub habitat types (USFS 1999). In the sand pine scrub, sand skinks appear to be restricted to the youngest or most open stands, while in sandhills the species appears to be restricted to areas with a low density of longleaf pines and wiregrass (Navy 2002). The sand skink's primary habitat has been identified in areas south of the ONF in the Lake Wales Ridge area (USFS 2005).

Based on vegetation and soil criteria, the USFS (2005) estimated approximately 224,750 acres of potential sand skink habitat in the ONF and approximately 5,308 acres in the Pinecastle Range. Using cover boards and mark-recapture techniques, surveys have found densities in the ONF between 36 and 275 individuals per hectare (Navy 2002). Cover board surveys resulted in three site records in 1997 and eight additional site records in 2001 in the Pinecastle Range, all on open sand sites. This indicates that the sand skink may be restricted in scrub habitat to open sand areas or that the species is difficult to observe elsewhere.

The sand skink was not observed at the Rodman Range during surveys conducted by the FNAI in 1997 (FNAI 1997). The FNAI Biodiversity Matrix does not have records of documented occurrences for this species in the general vicinity, but indicates that occurrence is likely in the general area (FNAI 2019). If present, the area of suitable habitat would be limited because about 70 percent of the Rodman Range consists of wetlands. The Rodman Range target area is not expected to provide suitable habitat for the sand skink because it is maintained through mowing and occasional plowing. The sand skink is not expected to occur at Rodman Range based on available survey data and the limited potential for suitable habitat to be present. A survey conducted in 2009 observed no presence of sand skinks within their potential habitat in the Rodman Range (Gulf South Research Corporation 2009). An additional herpetofauna survey conducted in 2017 determined that there were no sand skink individuals, nor potential habitat observed within the Rodman Range (LG2 Environmental Solutions, Inc. 2018). However, the sand skink may occur outside the Rodman Range boundaries, within areas of scrub.

The sand skink is not expected to use the open water habitats within the Lake George Range. However, they can potentially occur in land surrounding Lake George in scrub habitat.

4.7 West Indian Manatee

Critical habitat for the West Indian manatee was designated under 41 FR 41914 in 1976 with an augmentation and correction in 1977 (USFWS 1976). The habitat extends in the state of Florida and encompasses the St. Johns River, including Lake George.

West Indian manatees can be found throughout the Upper St. Johns River system in summer, but during the winter months (generally December through February) animals are found in or near warm-water refuge sites (Volusia County Government 2001; Bengtson 1981). A network of primary and secondary warm-water refuge sites exist in the Upper St. Johns River region. Primary warm-water refuge sites have a consistent water temperature range sufficient to maintain manatees over a cold winter and/or support consistent or dependent use by 50 or more manatees. Secondary refuge sites can have variable thermal plume temperatures, sporadic manatees use, and/or are used predictably by manatees, but not consistently. Blue Spring, located approximately 22 miles upstream (south) of Lake George, is the only primary refuge site in the Upper St. Johns River region. Silver Glen Springs and Salt Springs, which discharge flow into Lake George along the western shoreline, are secondary warm-water refuge sites (USFWS 2007b).

West Indian manatee data are limited for the St. Johns River system in comparison to some waters of the state. Overhanging vegetation and dark waters, which obscure visibility, limit the usefulness of aerial surveys (Volusia County Government 2001). Demographic indicators summarized by USFWS (2007b) indicate a minimum population size of 112 for the Upper St. Johns River Management Unit and a population growth rate of 6.2 percent per year from 1990 through 1999. This is the highest population growth rate for any management unit.

It is likely that West Indian manatees commonly travel through and forage in Lake George during warmer months. Manatees probably occur in Lake George in winter; at least sporadically. Manatees using Silver Glen Spring and Salt Spring as a warm-water refuge during the winter must travel through Lake George to access the springs. Manatees using these springs in the winter could also move in and out of Lake George to forage. Patterns may vary from year to year based on weather conditions. Manatees likely use the springs as stop over points when traveling to and from Blue Spring during cold weather, indicating that manatees also move through Lake George during the winter (Navy 2009).

The FFWCC West Indian manatee Mortality Database is another source of information regarding manatee occurrence in Lake George. The database has one record of manatee mortality (cold stress) in Lake George for the period of January 2018 through January 2020 (FFWCC 2020b). The spatial distribution of West Indian manatees in Lake George is expected to vary seasonally and may be largely driven by food availability and the presence of warm-water refuge sites on the western shoreline. Manatee foraging would be limited to littoral areas where submerged aquatic vegetation grows. Traveling manatees could occur throughout the lake, especially during warmer months, but most travel routes are expected to be relatively close to shore (Bengtson 1981). The Lake George Range is located approximately 0.6 to 1.9 miles from the eastern shoreline and 2.4 to 4.7 miles from the western shoreline. The Lake George Range target area lacks submerged aquatic vegetation and warm-water refuge sites do not exist within the target area. While manatees probably travel through the target area occasionally, they are not expected to spend extended periods of time in the target area based on available data. Sufficient data do not exist to calculate density estimates.

West Indian manatees may occur in the Ocklawaha River along the southern boundary of the Rodman Range. No training operations take place in or near the river. Therefore, the Proposed Action at the Rodman Range would have no effect on the manatee and manatees are not analyzed in further detail for the Rodman Range.

4.8 FLORIDA BONAMIA

Florida bonamia is a perennial, trailing vine endemic to scrub and scrub edge that typically occurs in open, sunny areas. It can grow in the filtered light of closed canopy areas when the shrub canopy is open, but flowering is not prolific (Navy 2002). The species has evolved in fire-maintained xeric communities, including oak-dominated scrub and sandhills (USFWS 2007c).

The population of Florida bonamia throughout the ONF, including the Pinecastle Range, is large. Surveys in 1993, 1997, and 2001 recorded numerous individual plants at a variety of sites in accessible areas along roadsides near the Pinecastle Range (Navy 2002). The number of sites increased from six (with a total of 210 plants) in 1993 to 19 (more than 200 plants) in 2001. The 2001 survey showed that large populations were being supported in areas that had been harvested since 1995 and burned since 1988 and in an adjacent area maintained as open sand (Navy 2002). The species was last formally monitored in 2007 (Jenkins et al. 2007), when observers described the presence of Florida Bonamia in survey areas as “widespread and numerous” in suitable habitat. The species is frequently seen flowering within a year of timber harvest by ONF personnel. An analysis of land cover in the vicinity of the Pinecastle Range identified large areas of potential habitat for the Florida bonamia in the area. Monitoring results at the ONF suggest that the local population follows “boom and decline” responses to management, (e.g., prescribed burning) (USFWS 2007c).

Florida bonamia is not known to occur at the Rodman Range (Navy 2019), and the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Florida bonamia at the Rodman and Lake George ranges are not addressed in further detail.

4.9 LEWTON’S POLYGALA

Lewton’s polygala is found in a variety of habitats, including transitional habitats between high pine and turkey barrens, oak scrub, and high pine communities (USFWS 1999). There is a significant population of the species in and around Pinecastle Range, making the area important for the conservation of the species. It includes a significant number of the known locality records, the second largest population overall, and the largest scrub population in ONF (Navy 2002). Surveys in 1993, 1997, and 2001 identified up to 17 sites consisting of 37 to 76 individual plants as well as small clumps (Navy 2002).

Lewton’s polygala potential habitat occurs in the general vicinity of Rodman Range (FNAI 2019). However, the species has never been observed at Rodman Range, and training operations at Rodman Range would not affect vegetation outside the range boundaries. During a Rare, Threatened, and Endangered plant survey conducted in 2017, no occurrence of Lewton’s polygala was observed within the Rodman Range (LG2 Environmental Solutions, Inc. 2018). In addition, the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Lewton’s polygala at the Rodman and Lake George ranges are not addressed in further detail.

4.10 SCRUB BUCKWHEAT

Scrub buckwheat occurs in oak-hickory scrub, sandhills, and turkey barrens communities (USFWS 2008a). This species occurs within ONF, which is considered the northern limits of its range. The species was not found in Pinecastle Range in surveys conducted in 1993, 1997, and 2001, although suitable habitat is found on the site (Navy 2002). The current management practices prescribing frequent disturbances are conducive to establishing scrub habitat for scrub buckwheat. As such, there is the potential for this species to occur in the Pinecastle Range.

Scrub buckwheat potential habitat occurs in the general vicinity of Rodman Range (FNAI 2019). However, the species has never been observed at Rodman Range, and training operations at Rodman Range would not affect vegetation outside the range boundaries. In addition, the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to scrub buckwheat at the Rodman and Lake George ranges are not addressed in further detail.

CHAPTER 5
ANALYSIS OF EFFECTS AND DESCRIPTION OF THE MANNER IN WHICH THE ACTION MAY AFFECT ANY LISTED SPECIES

5.1 APPROACH TO ANALYSIS

This chapter presents an analysis of potential direct, indirect, temporary, and permanent effects on listed species that would result from the Proposed Action. Chapter 6 considers potential cumulative effects and the effects of interrelated and interdependent actions.

Direct effects are the immediate result of project-related activities (e.g., direct mortality of species or removal of vegetation and habitat). Direct effects may be either temporary (reversible) or permanent (irreversible).

Indirect effects are caused by or result from project-related activities, but occur later in time or are spatially removed from the activities (e.g., shifts in vegetation composition or increased predation risk over time). Indirect effects are diffuse, resource-specific, and less amenable to quantification or mapping than direct effects, but still need to be considered.

Potential project effects are described as temporary or permanent based on their anticipated longevity. All project effects are described as they would occur after the conservation measures described in Section 2.3 are implemented. The analysis of project effects includes consideration of any interrelated and interdependent actions that may be planned in the action area that effect federally listed species or their habitat.

5.2 GENERAL EFFECTS TO HABITAT AND INDIVIDUALS

Under the Proposed Action, there would be no anticipated ground impacts outside of the Pinecastle or Rodman target boundaries. Non-explosive ordnance can create soil disturbance and damage vegetation. Statistically, the chances of an individual listed species being hit by a non-explosive ordnance are unlikely. Explosive ordnance (only at the Pinecastle Range) can create a larger area of soil/vegetation disturbance. Mortality from explosions could occur; however, this is difficult to quantify. In the unlikely event that non-explosive ordnance exceeds target boundaries, vegetation damage could occur from the impact and subsequent removal of the ordnance. This damage would be minimized to the extent necessary to ensure the safety of personnel. There may also be effects to the habitat due to the removal of pine trees at the Pinecastle Range. Trees that obscure the camera scoring system's line-of-sight are removed every four to five years. The trees can be up to 70 feet tall, are cut using either equipment or by hand, and once cut, are left in place.

Under the Proposed Action, non-explosive ordnance would impact the water surface within the target area at the Lake George Range, resulting in short-term and localized disturbance to the water column. Localized disturbances to benthic habitat would be expected based on the relatively shallow depth of Lake George (8 to 11 feet in the target area). Impact with the lake bottom could create small craters and bottom sediments would be temporarily re-suspended, resulting in increased water turbidity. The effects would be short-term and localized. Turbidity levels would return to normal shortly after an event and benthic habitat would recover through natural sedimentation processes. No terrestrial habitat/vegetation occurs in the Lake

George Range, and the Proposed Action would have no effect on terrestrial habitats in the vicinity of the range.

Noise would also potentially affect wildlife. Ordnance impact creates a loud noise that lasts for a short duration but can be audible for miles. Aircraft noise also has been found to be disruptive to wildlife. Use of aircraft, particularly low-level flights and landings/takeoffs would cause noise and visual disturbance to wildlife. Impacts to wildlife from aircraft noise and visual stressors can include: a startle reflex that induces running or flight, increased expenditure of energy, decreased time and energy spent on life functions such as feeding and mating, increased likelihood of predation, and interruption of breeding or nursing behavior (Larkin 1996; Efroymson et al. 2000). Effects related to rotor wash and noise from rotary-wing and tilt-rotor aircraft would diminish with distance from the source, and exposure to elevated noise levels would generally be localized around landings, takeoffs, and low-level hovering but diminish with distance.

Noises that are close, loud, sudden, and combined with a visual stimulus produce the most intense reactions in animals (Bowles et al. 1999). Rotary-wing and tilt-rotor aircraft generally induce the startle effect more frequently than fixed-wing aircraft (Frid 2003). Some bird and mammal species habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Conomy et al. 1998; Krausman et al. 1996). As the Proposed Action would allow continued aircraft and ordnance training, it is assumed that wildlife in the action area is already partially habituated to such visual and aural disturbance. Wildlife exposed to low altitude aircraft overflights and ordnance noise could exhibit short-term behavioral and/or physiological responses, but not to the extent where the general health of individuals or populations would be compromised. These impacts are not expected to result in chronic stress based on the short duration and infrequency of exposure.

Wildlife/aircraft strikes could cause harm to federally listed bird species. While the Proposed Action represents an increase in the tempo of aircraft overflights, the potential for aircraft strikes on federally listed birds would remain very low. Fixed-wing aircraft would typically operate higher than 1,500 feet above ground level and do not take off or land at the ranges. While rotary-wing aircraft operate at lower altitudes, they also fly at relatively low airspeeds during training exercises (Navy 2009). This increases the likelihood that wildlife could hear or see an oncoming rotary-wing aircraft, flee the immediate area, and avoid being struck. Lower airspeeds also provide pilots an opportunity to identify safety concerns and to avoid a strike by maneuvering the helicopter.

An indirect effect associated with use of explosive ordnance at the Pinecastle Range is habitat alteration that may occur due to fire. There is a high probability of a fire igniting in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries. A fire could result in the loss of some individuals and cause an immediate change in the habitat. Adverse effects on species' populations would result immediately from the fire; however, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire (Menges and Kohfeldt 1995; Breininger et al. 2017). The Florida scrub-jay, sand skink, eastern indigo snake, gopher tortoise, Florida bonamia, scrub buckwheat, and Lewton's polygala are all associated with early-successional scrub habitat. In addition, they are all adapted to living in fire-dependent ecosystems. The recovery of any burned area after a fire would be suitable habitat for these species and it is anticipated that they would re-colonize the area. As noted in the *Final SEIS to the Final EIS for Renewal of Authorization to Use Pinecastle Range*, the use of air-delivered ordnance, to include both explosive and non-explosive, is prohibited with the following Burning Indexes and Keetch-Byram Drought Index to minimize the potential for fire:

- Burning Index 70 or less − No prohibitions providing the Keetch-Byram Drought Index is less than 400.

- Burning Index 71 + − No air delivered ordnance with Keetch-Byram Drought Index over 400, unless approved by the USFS.

5.3 EFFECTS ON FEDERALLY LISTED SPECIES

5.3.1 Florida Scrub-Jay

5.3.1.1 Habitat

As described in Section 5.2, there are no anticipated ground/vegetation impacts outside of the Pinecastle or Rodman target boundaries. In the unlikely event that non-explosive ordnance exceeds target boundaries, damage to scrub-jay habitat could occur from the impact and subsequent removal of the ordnance. This damage would be minimized to the extent necessary to ensure the safety of personnel. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, scrub-jay habitat could immediately be impacted. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and scrub-jays could benefit from an increase in early-successional scrub habitat. Additionally, the periodic removal of tall pine trees that obscure the camera scoring system, benefits scrub jays as they prefer more open scrub habitat. Conversely, scrub-jay habitat could be affected by the periodic removal of vegetation associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, the target areas are heavily disturbed and are not expected to be occupied by scrub-jays.

5.3.1.2 Individuals

As described in Section 5.2, Florida scrub-jays would be exposed to an increase in aircraft overflights in the vicinity of the Pinecastle and Rodman ranges and in lands underneath the special use airspace. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes overhead. Florida scrub-jays exposed to low-altitude aircraft overflights could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. The action area has been and is currently used for aircraft and military training activities, and although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli associated with the increased training tempo to adversely impact Florida scrub-jays in the action area. Although some bird and mammal species habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Krausman et al. 1996; Conomy et al. 1998), bird species in the vicinity of airports have been shown to habituate to aircraft noise and show little to no increase in physiological stress (Wolfenden 2017). The proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. These effects are also unlikely to cause mortality, and scrub-jays temporarily affected would be able to resume normal behaviors and to utilize areas from which they have been deterred by the activity. In addition, Florida scrub-jays in the action area are currently exposed to aircraft overflights and it is assumed that the species is already partially habituated to visual and aural disturbance associated with aircraft overflights.

Individuals would be exposed to the potential for direct impact from inert ordnance or explosions from explosive ordnance (only at Pinecastle Range). However, the likelihood of an individual Florida scrub-jay being hit by ordnance or occurring in the explosion radius within the target area is extremely low. In addition, the likelihood of an aircraft striking an individual scrub-jay is negligible, as the species only occurs in scrub and scrubby flatwoods habitats (USFWS 2015), and is not likely to occur at heights of aircraft overflights.

Individuals could be affected by the removal of scrub-jay habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual was in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

5.3.1.3 Conclusion

Consistent with past section 7 consultations (USFWS 2008b, 2010), the Proposed Action may affect and is likely to adversely affect the Florida scrub-jay due to the potential for fire caused by explosive ordnance, mortality from explosions, and increased exposure to aircraft overflights. It is expected that a relatively low but unquantifiable number of Florida scrub-jays may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the action area is unlikely; however, if any incidental take did occur it would not result in impacts at the population level.

5.3.2 Red-Cockaded Woodpecker

5.3.2.1 Habitat

Due to lack of occurrence and suitable habitat at the Pinecastle and Rodman ranges, there are no anticipated impacts to red-cockaded woodpecker habitat under the Proposed Action.

5.3.2.2 Individuals

As described in Section 4.2, red-cockaded woodpeckers are not expected to occur at the Pinecastle and Rodman ranges due to lack of observations and suitable habitat. Red-cockaded woodpeckers in the vicinity of the Lake George Range (woodland and forested habitats surrounding the lake) and in lands underneath the special use airspace could be exposed to an increase in aircraft overflight noise disturbance. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes nearby or overhead. Red-cockaded woodpeckers in the vicinity of the Lake George Range and in lands underneath the special use airspace could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. Impacts to the red-cockaded woodpecker would not be significant because the action area and special use airspace have been and are currently used for aircraft and military training activities. Although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli associated with the increased training tempo to adversely impact red-cockaded woodpeckers in the action area. An increased tempo in overhead flights will not likely adversely impact red-cockaded woodpeckers in the action area because aircrafts pass overhead rapidly, allowing noise levels to return to their natural setting in between flights. Therefore, enabling individuals to resume their natural behavior. Additionally, some bird species have been shown to habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Krausman et al. 1996; Conomy et al. 1998). Specifically, bird species in the vicinity of airports have been shown to habituate to aircraft noise and show little to no increase in physiological stress (Wolfenden 2017). Furthermore, the proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. These effects are also unlikely to cause mortality, and red-cockaded woodpeckers temporarily affected would be able to resume normal behaviors and to utilize areas from which they have been deterred by the activity.

In addition, the likelihood of an aircraft striking an individual red-cockaded woodpecker is negligible, as the species is not migratory and is typically only found in pine woodland habitats (NatureServe 2019).

Moreover, the red-cockaded woodpecker is not known to leave the tree canopy area, as all their foraging, breeding, and nesting activities occur at or below the uppermost part of the tree canopy (DeLotelle et al. 1987). Therefore, the species is not likely to occur in the flight path of military aircraft.

5.3.2.3 Conclusion

Consistent with past section 7 consultations (USFWS 2008b, 2010), the Proposed Action may affect, but is not likely to adversely affect the red-cockaded woodpecker due to the lack of impact to the species' habitat and the low likelihood of impacts to individuals associated with increased exposure to aircraft overflights.

5.3.3 Wood Stork

5.3.3.1 Habitat

Wood stork habitat is largely restricted to freshwater marshes, swamps, lagoons, ponds, brackish wetlands, and flooded fields. Such habitats are not expected to be impacted by the Proposed Action.

5.3.3.2 Individuals

As described in Section 4.3, there are no known occurrences and no suitable habitat for wood storks at the Pinecastle Range.

Wood storks are expected to occasionally forage or travel through Rodman Range, but nesting has not been documented in the area. If present during training operations, wood storks would be exposed to fixed-wing and helicopter overflights and could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. Aircraft overflights are not expected to result in chronic stress based on the short duration and infrequency of exposure.

The probability of an aircraft striking a wood stork at Rodman Range and in lands underneath the special use airspace is extremely low based on the low number of sorties and the fact that the aircraft would operate at heights above those that wood storks would typically fly at (wood storks in the vicinity of Rodman Range or in lands underneath the special use airspace would be expected to be at or near ground level). The wood stork uses many habitat types, but is most likely to forage in forested swamps at Rodman Range. While it is unknown if wood storks roost at Rodman Range, roosting birds could be flushed by nighttime helicopter operations and become more susceptible to an aircraft strike. Therefore, wood storks are susceptible to aircraft strike at the Rodman Range.

Wood storks in the vicinity of the Lake George Range (marsh/wetland habitats surrounding the lake) and in lands underneath the special use airspace could be exposed to aircraft overflight noise disturbance. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes nearby or overhead. Wood storks in the vicinity of the Lake George Range and in lands underneath the special use airspace could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. Impacts to the wood stork would not be significant because the action area and special use airspace have been, and are currently used for aircraft and military training activities. Although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli associated with the increased training tempo to adversely impact wood storks in the action area. An increased tempo in overhead flights will not likely adversely impact wood storks in the action area because aircrafts pass overhead rapidly, allowing noise levels to return to their natural setting in between flights. Therefore, enabling individuals to resume their natural behavior. Additionally, some bird species have been shown to habituate to repetitive noises, especially noise associated with overflight of fixed-wing aircraft, better than other species (Krausman et al. 1996; Conomy et al. 1998). Specifically, bird species in the vicinity of airports have been shown to habituate to aircraft noise and show little to no increase in physiological stress (Wolfenden 2017). Furthermore, the proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. These effects are also unlikely to cause mortality, and wood storks temporarily affected would be able to resume normal behaviors and to utilize areas from which they have been deterred by the activity.

5.3.3.3 Conclusion

Consistent with past section 7 consultations (USFWS 2008b, 2010), the Proposed Action may affect, but is not likely to adversely affect the wood stork due to the lack of impact to the species' habitat, the low likelihood of impacts to individuals associated with increased exposure to aircraft overflights, and the low likelihood of an aircraft striking an individual in the Lake George Range or in lands underneath the special use airspace.

5.3.4 Eastern Indigo Snake

5.3.4.1 Habitat

As described in Section 5.2, there are no anticipated ground/vegetation impacts outside of the Pinecastle or Rodman target boundaries. In the unlikely event that non-explosive ordnance exceeds target boundaries, damage to eastern indigo snake habitat could occur from the impact and subsequent removal of the ordnance. This damage would be minimized to the extent necessary to ensure the safety of personnel. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, eastern indigo snake habitat could immediately be impacted. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and eastern indigo snakes could benefit from an increase in or maintenance of early-successional scrub habitat. Scrub habitat could be affected by the removal of vegetation associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, the target areas are heavily disturbed and are already regularly maintained.

5.3.4.2 Individuals

As described in Section 4.4, eastern indigo snakes have never been documented in the Pinecastle and Rodman ranges, however suitable habitat does occur in both ranges. Any eastern indigo snakes in the vicinity of the Pinecastle and Rodman ranges and underneath the special use airspace would be exposed to an increase in aircraft overflights. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes overhead. Snakes and lizards have been shown to have behavioral and physiological responses to aircraft and other instantaneous anthropogenic noises, but not more than brief alerting behavior/movements (Manci et al. 1988). Eastern indigo snakes exposed to low-altitude aircraft overflights could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. The action area has been and is currently used for aircraft and military training activities, and although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, the proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. Aircraft overflights are not expected to result in chronic stress based on the short duration and infrequency of exposure. In addition, eastern indigo snakes in the action area are currently exposed to aircraft overflights and it is assumed that the species is already partially habituated to visual and aural disturbance associated with aircraft overflights.

Individuals in the Pinecastle Range could be exposed to vehicle traffic associated with mobile electronic warfare emitters. Mobile electronic warfare emitters would be parked in established areas (e.g., dirt roads); however, in the occurrence that movement is required, there is potential for an eastern indigo snake to be run over. However, vehicular movement and traffic associated with electronic warfare emitters would be sparse and sporadic, and visible wildlife would be avoided.

Individuals would be exposed to the potential for direct impact from inert ordnance or explosions from explosive ordnance (only at Pinecastle Range). However, the likelihood of an individual eastern indigo snake being hit by ordnance or occurring in the explosion radius within the target area is extremely low. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, eastern indigo snakes would be susceptible to mortality or injury. However, the species occurs in fire-adapted habitats and could potentially seek refuge underground.

Individuals could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual was in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

5.3.4.3 Conclusion

Consistent with past section 7 consultations (USFWS 2008b, 2010), the Proposed Action may affect and is likely to adversely affect the eastern indigo snake due to the potential for fire caused by explosive ordnance, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights. It is expected that a relatively low but unquantifiable number of eastern indigo snakes may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the action area is unlikely; however, if any incidental take did occur it would not result in impacts at the population level.

5.3.5 Gopher Tortoise

5.3.5.1 Habitat

As described in Section 5.2, there are no anticipated ground/vegetation impacts outside of the Pinecastle or Rodman target boundaries. In the unlikely event that non-explosive ordnance exceeds target boundaries, damage to gopher tortoise habitat could occur from the impact and subsequent removal of the ordnance. This damage would be minimized to the extent necessary to ensure the safety of personnel. Gopher tortoise burrows are known to occur in and in the vicinity of the target areas at the Rodman and Pinecastle ranges. Therefore, burrows would be exposed to direct impact from ordnance strikes. However, there has been no known direct strikes to burrows. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, gopher tortoise habitat could immediately be impacted. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and gopher tortoises could benefit from an increase in or maintenance of early-successional scrub habitat. Scrub habitat could be affected by the removal of vegetation associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, the target areas are heavily disturbed and are already regularly maintained.

5.3.5.2 Individuals

As described in Section 5.2, gopher tortoises would be exposed to an increase in aircraft overflights in the vicinity of the Pinecastle and Rodman ranges and underneath the special use airspace. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes overhead. Gopher tortoises exposed to low-altitude aircraft overflights could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. The action area has been and is currently used for aircraft and military training activities, and although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli to impact tortoises for the vast majority of the year for the following reasons: (1) gopher tortoises spend the majority of their lives underground (USFWS 2019d), (2) tortoise species do not appear to be heavily affected by noise (Bowles et al. 1999), (3) the proposed activities would not be continuous as they would occur sporadically throughout the year, and (4) disturbance would cease upon training event completion. These effects are also unlikely to cause mortality, and tortoises temporarily affected would be able to resume normal behaviors and to utilize areas from which they have been deterred by the activity. In addition, gopher tortoises in the action area are currently exposed to aircraft overflights and it is assumed that the species is already partially habituated to visual and aural disturbance associated with aircraft overflights.

Individuals would be exposed to the potential for direct impact from inert ordnance or explosions from explosive ordnance (only at Pinecastle Range). However, the likelihood of an individual gopher tortoise being hit by ordnance or occurring in the explosion radius within the target area is extremely low. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, gopher tortoises would be susceptible to mortality or injury. However, the species occurs in fire-adapted habitats and could potentially seek refuge in underground burrows.

Individuals could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual was in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

5.3.5.3 Conclusion

The Proposed Action may affect and is likely to adversely affect the gopher tortoise due to the potential for fire caused by explosive ordnance, mortality from explosions, and increased exposure to aircraft overflights. It is expected that a relatively low but unquantifiable number of gopher tortoises may be affected by the Proposed Action, representing a small fraction of the population. In addition, continuation of gopher tortoise conservation measures in Section 2.3 would impart beneficial impacts on the species. The potential for direct harm to individuals within the action area is unlikely; however, if any incidental take did occur it would not result in impacts at the population level.

5.3.6 Sand Skink

5.3.6.1 Habitat

As described in Section 5.2, there are no anticipated ground/vegetation impacts outside of the Pinecastle or Rodman target boundaries. In the unlikely event that non-explosive ordnance exceeds target boundaries, damage to sand skink habitat could occur from the impact and subsequent removal of the ordnance. This damage would be minimized to the extent necessary to ensure the safety of personnel. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, sand skink habitat could immediately be impacted. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and sand skinks could benefit from an increase in or maintenance of early-successional scrub habitat.

Scrub habitat could be affected by the removal of vegetation associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, the target areas are heavily disturbed and are already regularly maintained.

5.3.6.2 Individuals

Sand skinks in the vicinity of the Pinecastle and Rodman ranges and underneath the special use airspace would be exposed to an increase in aircraft overflights. The duration of exposure to aircraft noise would be very brief (seconds) as an aircraft quickly passes overhead. Snakes and lizards have been shown to have behavioral and physiological responses to aircraft and other instantaneous anthropogenic noises, but not more than brief alerting behavior/movements (Manci et al. 1988). Sand skinks exposed to low-altitude aircraft overflights could exhibit short-term behavioral and/or physiological responses, but not to the extent where the fitness of individuals or populations would be compromised. The action area has been and is currently used for aircraft and military training activities, and although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli associated with the increased training tempo to adversely impact sand skinks in the action area. Specifically, the proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion. Additionally, aircraft overflights are not expected to result in chronic stress based on the short duration and infrequency of exposure. Moreover, sand skinks in the action area are currently exposed to aircraft overflights and it is assumed that the species is already partially habituated to visual and aural disturbance associated with aircraft overflights.

Individuals in the Pinecastle Range could be exposed to vehicle traffic associated with mobile electronic warfare emitters. Mobile electronic warfare emitters would be parked in established areas (e.g., dirt roads); however, in the occurrence that movement is required, there is potential for sand skinks to be run over. However, vehicular movement and traffic associated with electronic warfare emitters would be sparse and sporadic, and, therefore, the likelihood of individuals being run over is very low.

Individuals would be exposed to the potential for direct impact from inert ordnance or explosions from explosive ordnance (only at Pinecastle Range). However, the likelihood of an individual sand skink being hit by ordnance or occurring in the explosion radius within the target area is extremely low. In the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and igniting a fire, sand skinks would be susceptible to mortality or injury. However, the species occurs in fire-adapted habitats and could potentially seek refuge underground.

Individuals could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual was in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

5.3.6.3 Conclusion

Consistent with past section 7 consultations (USFWS 2008b, 2010), the Proposed Action may affect and is likely to adversely affect the sand skink due to the potential for fire caused by explosive ordnance, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights. It is expected that a relatively low but unquantifiable number of sand skinks may be affected by the Proposed Action, representing a small fraction of the population. The potential for direct harm to individuals within the action area is unlikely; however, if any incidental take did occur it would not result in impacts at the population level.

5.3.7 West Indian Manatee

5.3.7.1 Habitat

Lake George is designated as critical habitat for the West Indian manatee under the ESA. Other than brief and intermittent changes to ambient sound levels, aircraft overflights would have no effect on manatee habitat, including foraging habitat and warm-water refuge sites. Aircraft overflights in the Lake George Range would not adversely affect critical habitat for the manatee.

The Proposed Action would involve an increase in non-explosive ordnance delivery at the Lake George Range. Non-explosive ordnance would impact the water surface within the designated target area at Lake George Range, resulting in short-term and localized disturbance to the water column. Velocity of the non-explosive ordnance would decrease upon contact with the water. Nonetheless, localized disturbances to benthic habitat would be expected based on the shallow depth of Lake George (8 to 11 feet in the target area). Impact with the lake bottom could create small craters and bottom sediments would be re-suspended, resulting in increased water turbidity. Bottom sediments in the target area most likely consist of sand. The effects would be short-term and localized because only four non-explosive ordnances would be released per training event. Turbidity levels would return to normal shortly after an event and benthic habitat would recover through natural sedimentation processes. Non-explosive ordnance would have no effect on important manatee habitats such as foraging areas or warm-water refuge sites. Non-explosive ordnance would not adversely affect critical habitat for the manatee.

5.3.7.2 Individuals

As discussed in Section 4.7, the likelihood of a West Indian manatee occurring in the Lake George Range is low. However, individuals that may potentially transit the Lake George Range may be exposed to aircraft overflights if they are in the vicinity of an aircraft's flight track. The relatively narrow cone where noise would be transmitted into the water and the low likelihood of manatee occurrence in the Lake George Range indicate that West Indian manatees would not be exposed to overflights very often. Manatees could exhibit short-term behavioral responses to aircraft sound, the shadow of a low-flying aircraft and, in the case of helicopters, surface disturbance from the downdraft, but not to the extent where natural behavioral patterns would be abandoned or significantly altered.

Available data on manatee occurrence in Lake George suggest that the highest probability of exposure exists along the western shoreline. Manatees are generally not expected to occur in the target area, with the exception of an occasional traveling animal. Therefore, the potential for exposure to overflights in the target area is low. The target area is located 0.6 to 1.9 miles off the lake's eastern shoreline and 2.4 to 4.7 miles off the western shoreline.

Aircraft overflights are not expected to result in chronic stress because the duration of exposure would be brief (seconds) as the aircraft quickly passes overhead. The Lake George Range has been and is currently used for aircraft and military training activities, and although the Proposed Action represents an increase in the tempo and magnitude of ongoing noise disturbances, there is little potential for noise or visual stimuli associated with the increased training tempo to adversely impact West Indian manatees in the action area. The proposed aircraft activities would not be continuous as they would occur sporadically throughout the year, and disturbance would cease upon training event completion.

In the unlikely event that a West Indian manatee is transiting the Lake George Range target area during training activities, it could be injured or killed by non-explosive ordnance. However, per the conservation measures in Section 2.3.2, visual observation by aircraft overflight would occur prior to and after any inert ordnances are dropped. If manatees are spotted in the Lake George Range, inert ordnance training would halt until the animal(s) leave the range, thereby reducing the likelihood of direct impact to an individual. Additionally, various factors suggest that manatees are generally not expected to occur in the target area, with the exception of an occasional animal traveling through the area. Food sources (aquatic vegetation) and warm-water refuge sites, which tend to concentrate manatees, do not exist in the target area. The probability of a manatee being in the target area and at the point of physical impact at the time of ordnance delivery would be extremely low.

If a West Indian manatee were in the immediate vicinity of the target area at the time of ordnance delivery, the sound could elicit a short-term behavioral and/or physiological response, but not to the extent where natural behavioral patterns would be abandoned or significantly altered. Additionally, non-explosive military expended material does not present an ingestion risk to West Indian manatees based on the size of the material (Navy 2009). The effects of non-explosive ordnance use are considered discountable because the effects are extremely unlikely to occur.

Flare end-caps sink and could potentially be ingested by manatees while foraging on the bottom. Manatees are not expected to forage in the range area based on the lack of submerged aquatic vegetation, but some end-caps could drift outside the target area via wind and/or water currents. The likelihood of end-caps drifting to littoral areas where submerged aquatic vegetation grows and manatees forage is low based on the distance of the range from the shoreline (0.6 to 4.7 miles).

West Indian manatees are known to ingest anthropogenic debris (USFWS 2001), as are other marine mammals. Walker and Coe (1990) theorized that for larger animals, such as beaked whales, it would take a high volume of foreign debris to result in death or debilitation resulting from impaction. This can be extrapolated to manatees as well. Although instances of impacts from ingestion of debris have been recorded, it is extremely unlikely that a manatee would ingest an end-cap, much less a harmful quantity. The low concentration of end-caps that could occur in manatee foraging habitat makes the potential effects discountable.

5.3.7.3 Conclusion

Based on the low likelihood of occurrence of manatees occurring in the Lake George Range during training activities, the potential for impacts to individuals is minimal. Therefore, and consistent with past section 7 consultation (USFWS 2008b), the Proposed Action may affect, but is not likely to adversely affect the West Indian manatee. As described above, the Proposed Action would not adversely affect critical habitat for the species.

5.3.8 Florida Bonamia

5.3.8.1 Habitat

There is a high probability of a fire igniting in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries. A fire could result in an immediate change to Florida bonamia habitat. However, a positive effect could result over time. Florida bonamia is associated with early successional-scrub habitat. In addition, the species is adapted to living in a fire-dependent ecosystem. The recovery of the area after a fire would be suitable habitat for Florida bonamia and it is anticipated that the species would re-colonize the area.

5.3.8.2 Individuals

Individuals of Florida bonamia could potentially be burned in the unlikely event of an explosive ordnance starting a fire at the Pinecastle Range. However, Florida bonamia is adapted to living in fire-dependent, early-successional scrub habitat. The recovery of any burned area after a fire would be suitable habitat for the species, and fire would likely impart beneficial impacts overall to the habitat by maintaining it as early-successional scrub, allowing for individuals to re-colonize the area.

5.3.8.3 Conclusion

Although Florida bonamia populations may benefit from overall beneficial impacts to habitat that may occur in the unlikely event of a fire induced by explosive ordnance exceeding the Pinecastle Range target boundaries, fire would potentially kill individuals in the near term. Therefore, the Proposed Action may affect and is likely to adversely affect Florida bonamia. The potential for direct harm to individuals within the action area is unlikely; however, if any individuals are lost due to fire, it would not result in impacts at the population level.

5.3.9 Lewton's Polygala

5.3.9.1 Habitat

There is a high probability of a fire igniting in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries. A fire could result in an immediate change to Lewton's polygala habitat. However, a positive effect could result over time. Lewton's polygala is associated with early successional-scrub habitat. In addition, the species is adapted to living in a fire-dependent ecosystem. The recovery of the area after a fire would be suitable habitat for Lewton's polygala and it is anticipated that the species would re-colonize the area.

5.3.9.2 Individuals

Individuals of Lewton's polygala could potentially be burned in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and starting a fire. However, Lewton's polygala is adapted to living in fire-dependent, early-successional scrub habitat. The recovery of any burned area after a fire would be suitable habitat for the species, and fire would likely impart beneficial impacts overall to the habitat by maintaining it as early-successional scrub.

5.3.9.3 Conclusion

Although Lewton's polygala populations may benefit from overall beneficial impacts to habitat that may occur in the unlikely event of a fire induced by explosive ordnance exceeding the Pinecastle Range target boundaries, fire would potentially kill individuals in the near term. Therefore, the Proposed Action may affect and is likely to adversely affect Lewton's polygala. The potential for direct harm to individuals within the action area is unlikely; however, if any individuals are lost due to fire, it would not result in impacts at the population level.

5.3.10 Scrub Buckwheat

5.3.10.1 Habitat

There is a high probability of a fire igniting in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries. A fire could result in an immediate change to scrub buckwheat habitat. However, a positive effect could result over time. Scrub buckwheat is associated with early successional-scrub habitat. In addition, the species is adapted to living in a fire-dependent ecosystem. The recovery of the area after a fire would be suitable habitat for scrub buckwheat and it is anticipated that the species would re-colonize the area.

5.3.10.2 Individuals

Individuals of scrub buckwheat could potentially be burned in the unlikely event of an explosive ordnance exceeding the Pinecastle Range target boundaries and starting a fire. However, the species is adapted to living in fire-dependent, early-successional scrub habitat. The recovery of any burned area after a fire would be suitable habitat for the species, and fire would likely impart beneficial impacts overall to the habitat by maintaining it as early-successional scrub.

5.3.10.3 Conclusion

Although scrub buckwheat populations may benefit from overall beneficial impacts to habitat that may occur in the unlikely event of a fire induced by explosive ordnance exceeding the Pinecastle Range target boundaries, fire would potentially kill individuals in the near term. Therefore, the Proposed Action may affect and is likely to adversely affect scrub buckwheat. The potential for direct harm to individuals within the action area is unlikely; however, if any individuals are lost due to fire, it would not result in impacts at the population level.

CHAPTER 6 CUMULATIVE EFFECTS AND INTERRELATED/INTERDEPENDENT ACTIONS

6.1 CUMULATIVE EFFECTS

Under the ESA, cumulative effects are the effects of future non-federal actions that are unrelated to the project and are reasonably certain to occur within the action area. The purpose of the cumulative effects analysis under the ESA is informational; cumulative effects are not part of the effects determinations made by the federal action agencies. No known tribal, state, local government, or commercial projects are reasonably certain to occur in the future in the action area. Non-federal activities that occur on federal land, (e.g., the maintenance of power transmission lines), are subject to federal ESA requirements and would not contribute to cumulative effects.

Recreational use of the ONF and Lake George would continue to occur in the future. The USFS manages the ONF according to the LRMP (USFS 1999). When a potential change to the LRMP is identified, it is analyzed to determine the potential effects on forest resources and public use. The land management actions of the Navy's INRMPs and the USFS' LRMP would have countervailing beneficial impacts to listed species. The Navy operates the Lake George Range under a Sovereignty Submerged Land Letter of Consent with the State of Florida, as the State owns the sovereign submerged lands. The State of Florida implements rules and regulations to protect listed species, including the West Indian manatee. Therefore, no adverse cumulative effects are expected in conjunction with past, present, or reasonably foreseeable future actions.

6.2 INTERRELATED/INTERDEPENDENT ACTIONS

No interrelated/interdependent actions are known. Any such actions would be subject to separate review under the ESA.

CHAPTER 7
CONCLUSION

Based on the analysis of effects presented in Chapter 5, Table 7-1 presents the Navy's effects determinations for federally listed species from implementation of the Proposed Action within the action area.

Table 7-1. Effects Determinations for Federally Listed Species

Species	Effects Determination
Florida scrub-jay	May affect, likely to adversely affect
Red-cockaded woodpecker	May affect, not likely to adversely affect
Wood stork	May affect, not likely to adversely affect
Eastern indigo snake	May affect, likely to adversely affect
Gopher tortoise	May affect, likely to adversely affect
Sand skink	May affect, likely to adversely affect
West Indian manatee	May affect, not likely to adversely affect; No effect to critical habitat
Florida bonamia	May affect, likely to adversely affect
Lewton's polygala	May affect, likely to adversely affect
Scrub buckwheat	May affect, likely to adversely affect

CHAPTER 8
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Biological Opinion

U.S. Fleet Forces Command (Navy)
Training Operations at the Pinecastle Complex
Florida

FWS Log #: 04EF1000-2020-F-0869

Prepared by:

U.S. Fish and Wildlife Service
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CECELIA DZIERGOWSKI Digitally signed by CECELIA DZIERGOWSKI
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For Jay B. Herrington - Field Supervisor   Date

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CONSULTATION HISTORY

This section lists key events and correspondence during the course of this consultation. A complete administrative record of this consultation is on file in the Service's North Florida Ecological Services Office.

2019-08-28 The initial meeting among stakeholders occurred to readdress potential impacts to listed species from ongoing activities and present anticipated future training range missions at the Pinecastle Range Complex. Those in attendance included: Commander Robert D. Hale, Aaron Benoit, Don Heaton, Ryan Schultz, Ryan Winz (U.S. Navy); Heather Ellison, Jay Garcia, William Lucas, Carrie Sekerak, John Vinson (U.S. Forest Service); and Todd Mecklenborg (U.S. Fish and Wildlife Service).

2020-04-14 The U.S. Navy initiated formal consultation with the Service in accordance with § 7(a)(2) of the endangered Species Act of 1973 as amended (16 U.S.C. § 1536), and the consultation procedures in 50 C.F.R. Part 402.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the findings of the U.S. Fish and Wildlife Service (Service) required under section 7 of the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the U.S. Navy's Training Operations at Pinecastle Complex, Florida. The Navy proposes the support of existing operations and anticipated future training range missions at Pinecastle Range Complex (PRC). This BO considers the effects of the Action on the Florida Scrub-Jay (*Aphelocoma coerulescens*), Eastern Indigo Snake (*Drymarchon couperi*), Sand Skink (*Neoseps reynoldsi = Plestiodon reynoldsi*), Florida Bonamia (*Bonamia grandiflora*), Lewton's Polygala (*Polygala lewtonii*), Scrub Buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*), and the at-risk species Gopher Tortoise (*Gopherus polyphemus*). The Action does not affect designated critical habitat; therefore, this BO does not address critical habitat.

The Navy determined that the Action is not likely to adversely affect the Red-cockaded Woodpecker (*Picoides borealis*), Wood Stork (*Mycteria americana*), and West Indian Manatee (*Trichechus manatus latirostris*). The Service concurs with these determinations.

<u>BO Analytical Framework</u>

A BO that concludes a proposed Federal action is *not* likely to *jeopardize the continued existence* of listed species and is *not* likely to result in the *destruction or adverse modification* of critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

> "*Jeopardize the continued existence* means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR §402.02).
>
> "*Destruction or adverse modification* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR §402.02).

The Service determines in a BO whether we expect an action to satisfy these definitions using the best available relevant data in the following analytical framework (see 50 CFR §402.02 for the regulatory definitions of *action, action area, environmental baseline, effects of the action*, and *cumulative effects*).

a. *Proposed Action*. Review the proposed Federal action and describe the environmental changes its implementation would cause, which defines the action area.
b. *Status*. Review and describe the current range-wide status of the species or critical habitat.
c. *Environmental Baseline*. Describe the condition of the species or critical habitat in the action area, without the consequences to the listed species caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early consultation, and the impacts of State or private actions which are contemporaneous with the consultation.
d. *Effects of the Action*. Predict all consequences to species or critical habitat caused by the proposed action, including the consequences of other activities caused by the proposed action, which are reasonably certain to occur. Activities caused by the proposed action would not occur but for the proposed action. Effects of the action may occur later in time and may include consequences that occur outside the action area.
e. *Cumulative Effects*. Predict all consequences to listed species or critical habitat caused by future non-Federal activities that are reasonably certain to occur within the action area.
f. *Conclusion*. Add the effects of the action and cumulative effects to the environmental baseline, and in light of the status of the species, formulate the Service's opinion as to whether the action is likely to jeopardize species or adversely modify critical habitat.

2. PROPOSED ACTION

The Navy proposes the support of existing operations and anticipated future training range missions at PRC (Rodman Range, Lake George Range, and Pinecastle Range). The PRC's primary mission is to provide an environment for Navy, Marine Corps, and Air Force personnel to learn the proper maneuvering tactics and techniques required while delivering air-to-ground weapons to targets within a potentially hostile environment, thus enhancing the potential for increased aircrew survivability and weapons delivery accuracy. Pinecastle Range is the Navy's only air-to-ground range on the East Coast authorized to use high explosives (Rodman and Lake George are inert-only ranges), and is thus critical to the Navy's training mission.

Training operations at the PRC utilize ground and water ranges, Special Use Airspace, and Military Training Routes. Training activities include air-to-ground explosive and non-explosive munitions delivery, lasing, air-to-ground gunnery strafing, and ground-to-ground small arms qualification and weapons familiarization training. Rodman Range, Lake George Range, and Pinecastle Range provide realistic air to-ground weapons delivery training using a variety of targets for explosive and inert munitions (e.g., bombs and rockets). Air-to-ground gunnery strafing at the Pinecastle Range includes helicopter and fixed-wing using munitions up to 30 millimeters. Small arms ground firing occurs at Pinecastle and Rodman Ranges.

2.1. Rodman Range

The Rodman Range is a Navy-owned, unmanned day/night rocket/inert bomb and helicopter proficiency training target area approximately 58 miles south of Jacksonville and 40 miles west of the Atlantic coast. The range supports air-to-ground training using sub-caliber inert practice bombs (training devices that are typically smaller than operational munitions). No live munitions or gunnery is authorized. The Ocklawaha River separates the Rodman Range from the northern border of the Ocala National Forest (ONF). The range is primarily in Putnam County, situated east of the Rodman Reservoir and west of the St. Johns River, although, a small portion of its southwestern corner is within Marion County. Rodman Range contains a 600-foot diameter cleared area with a central target equipped with a lighting system to accommodate night munitions training.

Military expended material (i.e., consumed rockets and inert bombs) is recovered in accordance with Navy and Department of Defense (DoD) requirements as defined in the Operational Range Clearance Plan for Rodman Range. Rodman Range also supports combat search and rescue training and is a major southeast training site for land-based helicopter search and rescue training.

2.2. Lake George Range

The Lake George Range is a water range located along the east side of Lake George in Volusia County. The Navy operates the range under a Sovereignty Submerged Land Letter of Consent with the State of Florida, as the State owns the sovereign submerged lands. Operations include Mine Warfare and Mine Laying. Airborne mine laying training uses two types of training operations: Mine Exercises (MINEX) and Mine Readiness Certification Inspections. In the typical mining training profile, MINEX usually involve a single aircraft sortie planting several non-explosive training mine shapes in the water. The aircrew drops a series of (usually four) training shapes in the water at pre-planned splash points. There are four impact targets on the range, all of which are located on the lake surface. These consist of the North Target, Center Target, and South Target, and the four MINEX Splashdown Points. Lake George Range targets are located in the lake waters.

2.3. Pinecastle Range

The Pinecastle Range lies entirely within the ONF in Marion County, approximately 75 miles from NAS Jacksonville. The range is accessible from the north and south by State Road 19, and from the east and west by State Road 40. The Navy has used the Pinecastle Range since 1951 under various agreements between the Navy and the United States Department of Agriculture. The U.S. Forest Service (USFS) manages the ONF, and the Navy operates the Pinecastle Range under a special use authorization by the USFS. During times when the range is in use, the USFS assists with potential wildfire management and controlling public access in the vicinity of the Pinecastle Range for some training events.

The Pinecastle Range is comprised of two non-contiguous areas, the target and buffer area and the Centroid. The target and buffer area is 5,698 acres and consists of two high-explosive target areas, eight inert target areas, a strafe pit with three different target areas, and a laser target that can be scored. Of the 5,698 acres, the cleared target areas comprise approximately 400 acres. The size of the cleared target areas can fluctuate within the firebreak area to allow for changes in training. The targets are maintained clear of vegetation to facilitate the monitoring of bombing accuracy and the improvement of fire safety. The remaining approximately 5,300 acres of the target and buffer area are vegetated landscape (predominantly a sand pine-scrub oak vegetative community) designed to isolate the targets and provide a safety buffer for released munitions that miss targets or ricochet away from the target. The Centroid area, located approximately 3 miles northeast of the target and buffer boundary, is 44 acres and houses the control center for the Range. The Centroid is not an impact area and contains no targets or target arrays. Electronic warfare training would employ mobile emitter vehicles, similar to television news satellite trucks, to transmit radio frequency energy directed at training aircraft. Mobile emitter vehicles could go anywhere in the ONF except for protected areas such as wetlands.

Two broad levels of training that differ in complexity and requirements occur at Pinecastle Range: unit level training and major training exercises. The unit level training is considered the primary mode of operation. In general, these training activities involve aircraft launching from an airfield or ships at sea, conducting a mission (which usually involves the release of non-explosive munitions), and then returning to base in a single flight.

The Pinecastle Range is also used to support major training exercises, which typically involve multiple events of multiple aircraft in each event from an aircraft carrier located in the Jacksonville Operations Area and have a much greater frequency of flights to the Range than do unit level training exercises. Examples of major training exercises are the Composite Training Unit Exercises and Joint Task Force Exercises, each of which involves multiple ships and aircraft. Further, each of these exercises is an integrated exercise and involves aircraft exercises from fleet training operations occurring off the southeast coast of the United States. Approximately four to six major training exercises are currently planned per year at Pinecastle Range, with each exercise occurring over a one- to four-week period. Examples of major training exercises are the Composite Training Unit Exercises and Joint Task Force Exercises, each of which involves multiple ships and aircraft. Further, each of these exercises is an integrated exercise and involves aircraft exercises from fleet training operations occurring off the southeast coast of the United States. Approximately four to six major training exercises are currently planned per year at Pinecastle Range, with each exercise occurring over a four week period, involving multiple coordinated air-to-ground operations for approximately five to eight days.

2.4. Special Use Airspace

Special use airspace within the PRC includes Restricted Areas, Military Operations Areas (MOAs); Alert Areas, Air Traffic Control Assigned Airspace, and Military Training Routes. The airspace over the PRC comprises three interconnected Restricted Areas corresponding with the three ranges (Pinecastle Range, Restricted Area-2910A/B/C/D/E; Lake George Range, Restricted Area-2907A/B/C; and Rodman Range, Restricted Area-2906).

Additionally, the Palatka MOA is divided into two parts, which surround and overlap a majority of the Restricted Area. Other special use airspace associated with the PRC are the Pinecastle Air Traffic Control Assigned Airspace, which overlies the Palatka MOA, and eight Military Training Routes that either originate or terminate within the designated PRC special use airspace (Navy 2017).

2.5. Other Activities Caused by the Action

A BO evaluates all consequences to species or critical habitat caused by the proposed Federal action, including the consequences of other activities caused by the proposed action, that are reasonably certain to occur (see definition of "effects of the action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed action (but not part of the proposed action) are reasonably certain to occur. These factors include, but are not limited to:

(1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;
(2) existing plans for the activity; and
(3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the Navy did not describe, and the Service is not aware of, any additional activities caused by the Action that are not included in the previous description of the proposed Action. Therefore, this BO does not address further the topic of "other activities" caused by the Action.

2.6. Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.02). Delineating the action area is necessary for the Federal action agency to obtain a list of species and critical habitats that may occur in that area, which necessarily precedes any subsequent analyses of the effects of the action to particular species or critical habitats.

It is practical to treat the action area for a proposed Federal action as the spatial extent of its direct and indirect "modifications to the land, water, or air" (a key phrase from the definition of "action" at 50 CFR §402.02). Indirect modifications include those caused by other activities that would not occur but for the action under consultation. The action area determines any overlap with critical habitat and the physical and biological features therein that we defined as essential to the species' conservation in the designation final rule. For species, the action area establishes the bounds for an analysis of individuals' exposure to action-caused changes, but the subsequent consequences of such exposure to those individuals are not necessarily limited to the action area.

Figure 2-1 shows the locations of all activities that the proposed Action would cause and the spatial extent of reasonably certain changes to land, water, or air caused by these activities, based on the descriptions and analyses of these activities in sections 2.1–2.4. The Action Area for this BO includes the Rodman, Lake George and Pinecastle ranges, as well the special use airspace described previously.

2.7. Tables and Figures

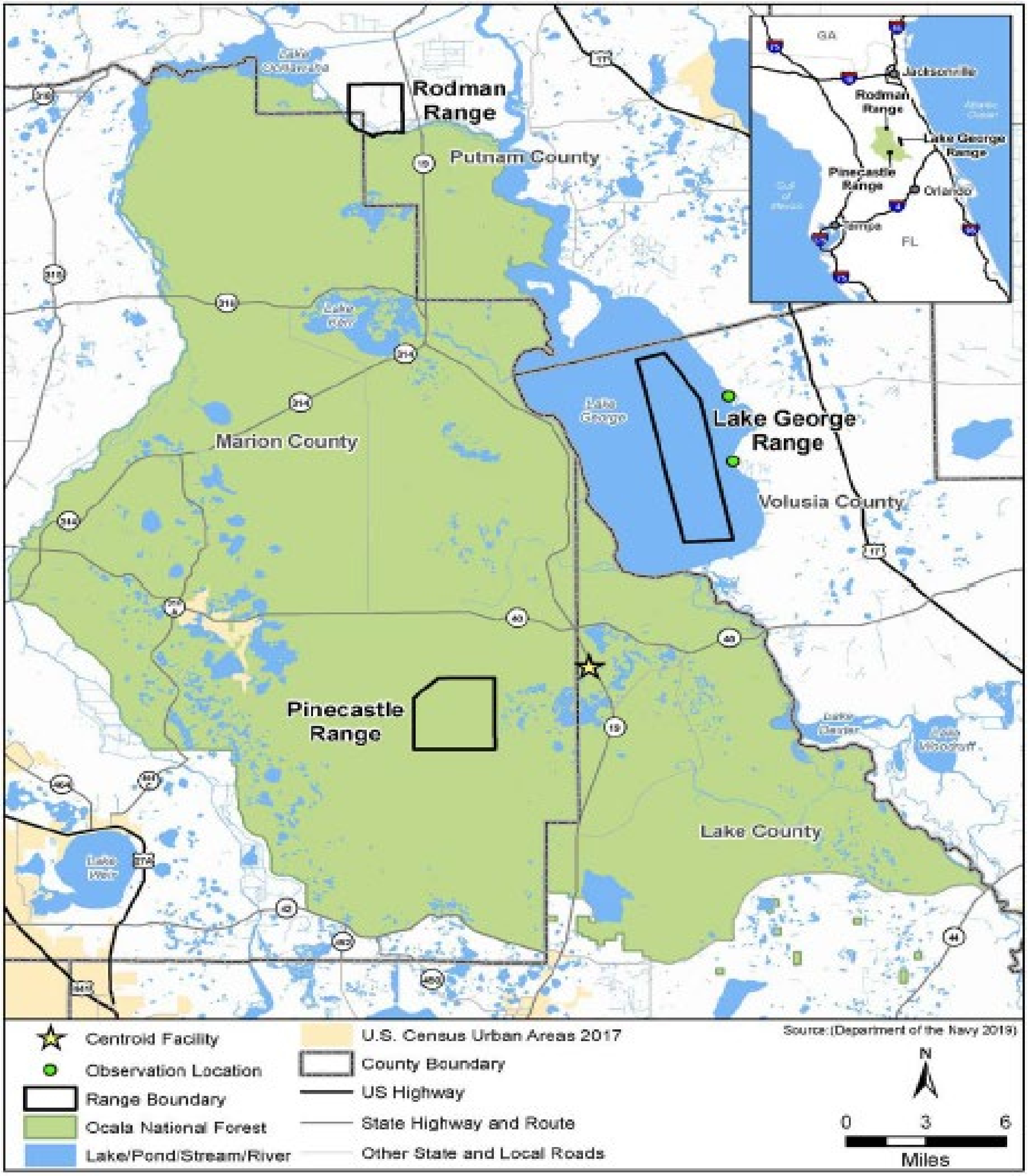

Figure 2-1. Pinecastle Range Complex Location Map

3. SOURCES OF CUMULATIVE EFFECTS

A BO must predict the consequences to species caused by future non-Federal activities within the action area, *i.e.,* cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include, but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the Navy did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

4. FLORIDA SCRUB-JAY

This section provides the Service's biological opinion of the Action for the Florida Scrub-Jay.

4.1. Status of Species

This section summarizes best available data about the biology and current condition of the Florida Scrub-Jay (*Aphelocoma coerulescens*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the Florida Scrub-Jay as threatened on June 3, 1987 (52 FR 20719).

4.1.1. Species Description

Florida Scrub-Jays are about 25 to 30 cm (10 to 12 in) long and weigh about 77 g (3 oz). The Florida Scrub-Jay's head, nape, wings, and tail are pale blue, and its body is pale gray on its back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-gray "bib" (Woolfenden and Fitzpatrick 1996a). Florida Scrub-Jay sexes are not distinguishable by plumage in the visible spectrum (Woolfenden and Fitzpatrick 1984); however, males and females have plumage dimorphism in the ultraviolet spectrum (Tringali and Bowman 2012). Males, on average, are only slightly larger than females (Woolfenden 1978). The sexes may be identified by the female-specific call of jays and relatives most often called the "rattle"; the phrase "hiccup" is most appropriate only for the Lake Wales Ridge populations, as elsewhere they actually do make more of a rattle (Woolfenden and Fitzpatrick 1984, 1986). Florida Scrub-Jays that are less than about five months of age are easily distinguishable from adults; their plumage is smoky grey on the head and back, and they lack the blue crown and nape of adults.

4.1.2. Life History

Florida Scrub-Jays forage mostly on or near the ground, often along the edges of natural or man-made openings. They visually search for food by hopping or running along the ground beneath the scrub, or by jumping from shrub to shrub. Insects, particularly orthopterans and lepidopteran larvae, comprise the majority of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Acorns are by far the most important plant food (Fitzpatrick et al. 1991). Other small nuts, fruits, and seeds also are eaten. Vertebrate prey items comprise a minority of the diet, but may include a wide array of species weighing up to 25 g.

Florida Scrub-Jays have a social structure that involves cooperative breeding, a trait that the western North American populations of other Scrub-Jays species do not exhibit (Woolfenden and Fitzpatrick 1984). Florida Scrub-Jays live in groups ranging from two (a single mated pair) to large, extended families. Surviving offspring typically delay breeding and remain with the breeding pair in their natal territory as “helpers” for at least one year after fledging, with some – especially males – remaining for as long as three years or more before becoming breeders. Pre-breeding numbers are generally reduced to a pair either with no helpers or with families of three or four individuals (a breeding pair plus one or two helpers).

Florida Scrub-Jay pairs occupy year-round, multi-purpose territories (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991, 1994). Territory size averages 9 to 10 ha (22 to 25 ac), with a minimum size of about 5 ha (12 ac). The availability of territories is a limiting factor for Florida Scrub-Jay populations.

Florida Scrub-Jay nests are typically placed in shrubby oaks. Nests are an open cup with the outer basket bulky and constructed of coarse twigs from oaks and other vegetation, and the inside is lined with tightly wound palmetto or cabbage palm fibers.

Nesting is synchronous, normally occurring from 1 March through 30 June (Woolfenden and Fitzpatrick 1990; Fitzpatrick et al. 1994). On the Atlantic Coastal Ridge and southern Gulf Coast, nesting may be protracted through the end of July. In suburban habitats, nesting is consistently initiated earlier than in natural scrub habitat (Fleischer 1996). Nesting failures are almost always caused by predation, most frequently by ground-based predators.

Clutch size ranges from one to five eggs, but is typically three or four eggs. Clutch size is generally larger (up to six eggs) in suburban habitats, and the birds attempt to rear more broods (Fleischer 1996). Eggs are incubated for 17 to 18 days, and fledging occurs 16 to 21 days after hatching (Woolfenden 1974, 1978; Fitzpatrick et al. 1998). Only the breeding female incubates and broods eggs and nestlings (Woolfenden and Fitzpatrick 1984). Average production of young is two fledglings per pair (Woolfenden and Fitzpatrick 1990), and the presence of helpers improves fledging success (Mumme 1992). Offspring production is significantly higher for groups with helpers than without, but the increase clearly drops with greater than four helpers (Fitzpatrick and Bowman 2016).

Fledglings depend on adults for food for about 10 weeks, during which time they are fed by both breeders and helpers (Woolfenden 1975; McGowan and Woolfenden 1990). In optimal scrub, survival of Florida Scrub-Jay fledglings to yearling age class averages about 33%. Survival of nonbreeders between ages 1 and 2 years is about 81% for males, which tend to remain in their natal territory, but only 65% for females, which engage in frequent dispersal forays (Woolfenden and Fitzpatrick 1996b). Annual survival of breeding adult males and females is equal and averages around 78% (Woolfenden and Fitzpatrick 1996b).

Based on data from Archbold Biological Station (ABS), the modal age of breeders is 3 years, median age is roughly 5.5 years, and 20% of breeders are older than 10 years (Woolfenden and Fitzpatrick 1984). The maximum observed lifespan of a Florida Scrub-Jay at ABS is 15.5 years (Woolfenden and Fitzpatrick 1996b). Additional lifespan longevity examples surpassing 15 years include a Florida Scrub-Jay banded at Avon Park Air Force Bombing Range in April of 1993 that was last observed in April of 2009 (M. Dent pers. comm.). Another documented Florida Scrub-Jay from Cape Canaveral Air Force Station was banded as a juvenile in June of 2001 (mostly likely hatched in April) that was recaptured in March of 2018 (A. Chambers, R. Brust pers. comm.).

4.1.3. Numbers, Reproduction, and Distribution

Florida Scrub-Jays once occupied 39 of the 40 counties south of, and including Levy, Gilchrist, Alachua, Clay, and Duval counties. Historically, many of these counties would have contained hundreds or even thousands of breeding pairs (Fitzpatrick et al. 1994). Only the southernmost county, Monroe, lacked Florida Scrub-Jays (Woolfenden and Fitzpatrick 1996a).

Considerable evidence exists that the extant populations of Florida Scrub-Jays have declined to less than 10% of their historic, pre-European settlement numbers (Boughton and Bowman 2011). Byrd (1927) first noted the decline in Florida Scrub-Jay population numbers in the literature, though Cox (1987) posited that Florida Scrub-Jay numbers probably had been declining since well before that time.

By 1983, Florida Scrub-Jays had become extirpated from 7 of the original 39 counties: Broward (mid-1970s), Dade (1960), Duval (1940-50), Gilchrest (1900), Hendry (1970) Pinellas (1960), and St. Johns (1970) (Woolfenden and Fitzpatrick 1996b). Cox (1987) estimated between 15,600-22,800 individual Florida Scrub-Jays remained on the landscape in the early 1980's and speculated a 50% decline over the past century, suggesting a potential historic range from 31,200-45,600 birds in the late 1800's.

An extensive, range-wide survey of Florida Scrub-Jays in 1992-93 estimated 3,961 Florida Scrub-Jay family groups with 10,972 individuals (Fitzpatrick et al. 1994). As of 1993, Florida Scrub-Jays were extirpated from 9 of the 39 counties previously occupied (Alachua, Broward, Clay, Dade, Duval, Gilchrest, Hendry, Pinellas, and St. Johns) and most likely extirpated or nearly so (functionally extirpated) from an additional 12 counties.

Boughton and Bowman (2011) estimated 2,400-2,600 Florida Scrub-Jay groups remaining, excluding ONF. Based on extrapolated data of known Florida Scrub-Jay group densities in timber management areas of ONF to other areas of suitable habitat (~ 2-meter vegetative structure height) of unknown occupancy, the population has been estimated at greater than 1,000 Florida Scrub-Jay groups within the forest boundaries (Miller FWC and Garcia USFS pers. comm. 2017). Range-wide, Florida Scrub-Jay groups could be 3,400-3,600 providing the assumptions for the estimates are valid.

Post-breeding 2015 surveys suggests extirpation from an addition 4 counties (Collier, Flagler, Levy, and Palm Beach) resulting in 13 of the original 39 counties lacking occupancy on public conservation lands.

4.1.4. Conservation Needs and Threats

Florida Scrub-Jays are restricted to scrub, scrubby flatwoods, and the immediately adjacent natural communities, with few exceptions. Within these natural communities, Florida Scrub-Jays require a low, open structure maintained by periodic disturbance (fire) in order to persist. Florida Scrub-Jays need sufficient shrub-sized oaks within each territory to provide cover from predators, acorns, and nest sites. Florida Scrub-Jays are extremely territorial, with territories that average 10 ha (25 acres) in size in optimal quality habitat. Without sufficient immigration, small isolated local populations of Florida Scrub-Jays are highly vulnerable to extirpation. Given the size of Florida Scrub-Jay territories and the short dispersal distances exhibited by the species, it is critical to maintain large, contiguous blocks of Florida Scrub-Jay habitat to support local populations that are relatively resistant to local extinction. Florida Scrub-Jays natural dispersal behavior is short-distance, resulting high levels of local inbreeding even within large contiguous populations (Aguillon et al. 2017). When populations lose connectivity with other Florida Scrub-Jay populations on a regional scale, they are prone to become inbred, thereby reducing reproductive success and launching them in the extinction vortex. This constraint may become the most important one of all if the trend toward further isolation of separate populations continue (Fitzpatrick pers. comm.).

Climate Change

“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, sea level has risen, and the concentrations of greenhouse gases have increased. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing (balance of incoming and outgoing energy), observed warming, and understanding of the climate system. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions” (IPCC, 2013).

The National Climate Team summarized the following scientific and ecological information on climate change and implications to Service and staff from the 2014 publication entitled *Climate Change Impacts in the United States: The Third National Climate Assessment* (NCA) (NCA, 2014). This team also summarized the 2013 publication from the IPCC entitled *Highlights of the IPCC 5th Assessment Report: The Physical Science Basis of Climate Change (WGI), Summary for Policymakers* (IPCC, 2013). This information is further condensed with a primary focus on Florida. Florida is exceptionally vulnerable to sea level rise, extreme heat events, and hurricanes. With an ever-growing population within Florida’s coastal plain, annual visitors range from 10 to 15 million stressing the already decreasing water availability.

The common thread regarding weather predictions for Florida is that extreme events will become more extreme and more frequent. This will increase annual variation and likely increase annual variation in Florida Scrub-jay demographic rates. Increasing variation increases the strength of stochastic effects and typically has the greatest effects on small populations, hence greatly increasing their extinction risk.

Currently, not all climate change consequences relevant to Florida Scrub-Jays are predictable with absolute certainty such as possible negative effects of increase temperature along with drought on insect prey abundance or growth rate and acorn production of scrub oaks. Decreases in precipitation could make it more difficult to apply prescribed fire safely. Conversely, sea level rise along with extreme events (e.g. hurricanes) will certainly have negative impacts on coastal Florida Scrub-Jay populations.

4.2. Environmental Baseline

This section describes the best available data about the condition of the Florida Scrub-Jay in the Action Area without the consequences caused by the proposed Action.

4.2.1. Action Area Numbers, Reproduction, and Distribution

Ocala National Forest's roughly 226,000 acres of scrub habitat is the largest contiguous landscape remaining in peninsular Florida that supports the largest population of Florida Scrub-Jays throughout this species' range. Beginning in 1999, the USFS established the initial Scrub-Jay Management Area 8.4 (MA 8.4) focusing management actions to provide high-quality Florida Scrub-Jay habitat in perpetuity. Prior to the creation of the MA 8.4 category, Florida Scrub-Jays occupied areas of sand pine harvest (Timber Management Area MA 8.2) when the vegetative structure is suitable for occupancy after seedling planting or direct seeding and prior to harvest (3 to12-year succession). Management Areas 8.4 are created from MA 8.2 after the timber has been harvested and are maintained through mechanical reduction or prescribed fire or a combination of treatments. The initial MA 8.4 in 1999 was 1,874 acres in size. A second MA 8.4 added 988 acres in 2007. The Forest Plan was further amended in 2016, establishing 11 new MA 8.4 and significantly expanding the MA 8.4 category to approximately 51,850 acres of scrub habitat. There are currently 7,102 acres of suitable Florida Scrub-Jay habitat within MA 8.4 and at least 850 acres of new sand pine harvests are planned for 2020. Additionally, suitable scrub habitat and Florida Scrub-Jay occupancy occurs in MA 8.2 (timber harvest areas), Juniper Wilderness Area, and the Navy's Pinecastle Bombing Range. Monitoring data in study plots in MA 8.2 stands during 2011-2016 suggest a stable or increasing population will result as acreage of early successional habitat increases through the expansion on MA 8.4 during the next decade.

Surveys for Florida Scrub-Jays on the ONF conducted in 2012-2014 yielded estimates of 1,100-1,250 groups, which translates into approximately 2,530-2,875 individuals if an average observed group size of 2.3 birds per group is extrapolated to the entire population (Miller et al. 2015). The Florida Scrub-Jay population on the ONF has not been as thoroughly surveyed due to the vast amount of potential habitat present and the infeasibility of conducting statistically robust surveys. The Pinecastle Range, with the exception of the target areas, is actively managed for scrub habitat. Approximately 1,517 acres of potentially suitable habitat occurs within the Pinecastle Range. The density of Florida Scrub-Jay groups has been found to be one group per 40 acres within the Pinecastle Range, a higher density than other parts of the ONF (Navy 2002), because of the prescribed burning conducted on the Range by the USFS in cooperation with the Navy. Surveys conducted at the Pinecastle Range in 2011 observed 53 family groups of Florida Scrub-Jays (127 individuals), while 2012 surveys observed 38 family groups of Florida Scrub-Jays (101 individuals) (Naval Facilities Engineering Command Southeast 2012). The survey report noted that Florida Scrub-Jays were absent from stands that had recently burned (Naval Facilities Engineering Command Southeast 2012).

4.3. Effects of the Action

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. Our analyses of the consequences caused by each of these activities follows.

There are no anticipated ground/vegetation impacts outside of the Pinecastle Range target boundaries. In the unlikely event that non-explosive munitions exceeds target boundaries, damage to Florida Scrub-Jay habitat could occur from the impact and subsequent removal of the munitions. This damage would be minimized to the extent necessary to ensure the safety of personnel. In the unlikely event of an explosive munitions exceeding the Pinecastle Range target boundaries and igniting a fire, Florida Scrub-Jay habitat could immediately be impacted. Loss of more than 30 percent of the vegetation in a territory would result in loss of feeding and sheltering opportunities until the vegetative structure is reestablished. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and Florida Scrub-Jays could benefit from an increase in early-successional scrub habitat. Additionally, the periodic removal of tall pine trees that obscure the camera scoring system, benefits Florida Scrub-Jays as they prefer more open scrub habitat. Conversely, Florida Scrub-Jay habitat could be affected by the periodic removal of vegetation associated with transporting targets within the target areas of the Pinecastle Range. However, the target areas are heavily disturbed and are not expected to be occupied by Florida Scrub-Jays.

Individual Florida Scrub-Jays would be exposed to the potential for direct impact from inert munitions or explosions from explosive munitions at Pinecastle Range. However, the likelihood of an individual Florida Scrub-Jay being hit by munitions or occurring in the explosion radius within the target area is extremely low. In addition, the likelihood of an aircraft striking an individual Florida Scrub-Jay is negligible, as the species only occurs in scrub and scrubby flatwoods habitats (Service 2015), and is not likely to occur at heights of aircraft overflights.

Individuals Florida Scrub-Jays could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual Florida Scrub-Jay were in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

4.4. Cumulative Effects

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to Florida Scrub-Jays are not relevant to formulating our opinion for the Action.

4.5. Conclusion

In this section, we summarize and interpret the findings of the previous sections (Status of the Species, Environmental Baseline, Effects of the Action, and Cumulative Effects) relative to the purpose of the BO for the Florida Scrub-Jays, which is to determine whether the Action is likely to jeopardize its continued existence.

Consistent with past section 7 consultations (Service 2008b, 2010), the Proposed Action may affect and is likely to adversely affect the Florida Scrub-Jay due to the potential for fire caused by explosive munitions, mortality from explosions, and increased exposure to aircraft overflights.

Opinion

After reviewing the Status of the Species, the Environmental Baseline for the Action Area, the Effects of the Action and the Cumulative Effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Florida Scrub-Jay.

5. EASTERN INDIGO SNAKE

This section provides the Service's biological opinion of the Action for the eastern indigo snake.

5.1. Status of Species

This section summarizes best available data about the biology and current condition of eastern indigo snake *(Drymarchon couperi)* throughout its range that are relevant to formulating an opinion about the Action. The eastern indigo snake was listed as threatened under the Endangered Species Act on March 3, 1978 (43 FR 4026 4029). Critical habitat has not been designated for the eastern indigo snake.

At the time of listing, the eastern indigo snake was considered a subspecies, *Drymarchon corais couperi*. Currently, the eastern indigo snake is accepted by the scientific community as a separate species, *Drymarchon couperi* (Crother 2000). In 1991, Collins elevated this lineage to specific status based on allopatric speciation and diagnosability. Subsequent work has supported this designation (Wuster et. al. 2000).

In addition to the assessment below, the most recent review of this species is found in the *Eastern Indigo Snake* (*Drymarchon couperi*) *Species Status Assessment (SSA) Report* (Service 2018). This review builds on information found in the *Eastern Indigo Snake Recovery Plan* (Service 1982) and uses the *Species Status Assessment (SSA)* framework (Smith et al. 2018, entire). These documents are incorporated by reference and can be used to obtain more detailed information about this species.

5.1.1. Species Description

Eastern indigo snakes are among the largest non-venomous snakes in North America, obtaining lengths of up to 2.6 m (8.5 ft) (Moler 1992). Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes the cheeks. The scales are large and smooth with 17 anterior and mid-body scale rows (occasionally 18-19), and 14-15 scale rows above the vent. The anal plate is undivided. In the Florida Keys, adult eastern indigo snakes seem to have less red on their faces or throats compared to most mainland specimens (Lazell 1989). A study by Krysko et al. 2016 has suggested dividing populations of eastern indigo snakes between an Atlantic and Gulf population segments based on genetic and morphological differences between these populations.

Presently, there are no studies on the longevity of wild eastern indigo snakes, though the oldest published record in captivity for eastern indigo snakes is 25 years and 11 months (Shaw 1959). Other information from captive breeding populations indicates some individuals may have lived up to 28 years old in captivity, though the date of acquisition of specimens older than 26 are not vouchered (Hoffman pers. comm. 2017). Because wild eastern indigos experience higher environmental and anthropogenic pressures than in captivity, life spans are likely reduced.

5.1.2. Life History

Most information on the reproductive cycle of eastern indigo snakes is from data collected in north Florida. In this geographical area, breeding occurs between November and April, and females deposit 4 to 12 eggs during May or June (Moler 1992). Speake et al. (1987) reported an average clutch size of 9.4 for 20 captive bred females. Throughout the entire range, eggs are laid from late May through August, and young hatch in approximately 3 months. Peak hatching activity occurs between August and September, and yearling activity peaks in April and May (Groves 1960, Smith 1987). Limited information on the reproductive cycle in south-central Florida suggests that the breeding and egg-laying season may be extended. In this region, breeding extends from June to January, laying occurs from April to July, and hatching occurs during mid-summer to early fall (Layne and Steiner 1996).

Analogous with many other species of snakes, female eastern indigo snakes can store sperm and delay fertilization of eggs. There is a single record of a captive snake laying five eggs (at least one of which was fertile) after being isolated for more than four years (Carson 1945). It has long been assumed that this event resulted from sperm storage. However, there have been several recent reports of parthenogenetic reproduction by virginal snakes. Hence, sperm storage may not have been involved in Carson's (1945) example (P. Moler, GFC, personal communication 1998). There is no information on how long eastern indigo snakes live in the wild. In captivity, the longest an eastern indigo snake has lived was 25 years, 11 months (Shaw 1959).

Eastern indigo snakes spend a great deal of time foraging and searching for mates. The species is diurnal throughout its range (Service 2008). The eastern indigo snake will eat most vertebrates small enough to be overpowered and swallowed. Food items include fish, frogs, toads, snakes (venomous, as well as non-venomous), lizards, turtles, turtle eggs, small alligators, birds, and small mammals (Keegan 1944; Babis 1949; Kochman 1978; Steiner et al. 1983; Stevenson et al. 2010).

Population Dynamics

Few detailed studies of population dynamics of eastern indigo snakes have been conducted, primarily because the species is secretive and difficult to study. Although the sex ratio at birth and in juveniles is not different from 1:1 (Moulis 1976, Steiner et al. 1983), adult sex ratios in the wild are strongly biased in favor of males (Layne and Steiner 1996, Stevenson et al. 2009). Stevenson et al. (2009) attributed this bias to lower rates of survival in females, even though males have larger home range sizes and greater daily movement distances than females (Hyslop 2007).

Adult males are also significantly longer and heavier than females, which is attributed to male-male combat in this species (Shine 1994, Stevenson et al. 2009). Although both sexes mature at about the same total length (150 cm), males continue to grow after sexual maturity, whereas females apparently devote most available energy to vitellogenesis (Service 2008, Stevenson et al. 2009). Maturity is reached in 3-4 years (Service 2008).

Within Florida and southern Georgia, the eastern indigo snake occupies a wide range of habitat types including pine flatwoods, scrubby flatwoods, scrub and sandhill, oak and maritime hammocks, wetlands, coastal dunes, and human-altered habitats (Service 2008). Belowground refugia include the burrows of gopher tortoises, nine-banded armadillos (*Dasypus novemcinctus*), rodents, and land crabs (*Cardisoma guanhumi*), as well as hollow logs, stump holes, and other crevices (Hyslop 2007, Hyslop et al. 2009).

Seasonal shifts in habitat use have been widely reported, especially in areas north of the frost line, with eastern indigo snakes typically spending the winter in gopher tortoise burrows in xeric uplands and foraging more frequently in wetlands during the warmer months (Layne and Steiner 1996, Hyslop 2007, Hyslop et al. 2009, Stevenson et al. 2009). In addition, many eastern indigos are known to return to the same hibernacula annually for over wintering (Speake 1978, Hyslop 2007).

Behavior and home range size are variable depending on the climate of the region. In the milder climates of south-central and southern Florida, over wintering sites may not be as important. However, gopher tortoise burrows and other refugia are important for refuge from high temperature conditions (Speake and Mount 1973, Lawler 1977, Landers and Speake 1980, Smith 1987). In the Gulf Hammock Wildlife Management Area, hollow root channels and rodent burrows in the base of live oak trees were the most common den sites, and the edges of wetlands were favored foraging locations (Moler 1985).

Home range and life history is variable based on the ecoclimate of the region, availability of habitat, and connectivity of those areas. Above the frost line in Florida, the species is known to have significantly higher fidelity for gopher tortoise burrows than below the frost line (Enge et al. 2013). These areas are likely still used during short cold snaps and to escape extreme heat and desiccation (Hyslop et al. 2009). Eastern indigos are known to utilize large home ranges, which is variable throughout their range (Breininger et al. 2011, Dodd and Barichivich 2007, Moler 1992, Bauder and Jenkins 2013, Hyslop 2007, Kehl et al. 1991, Layne and Steiner 1996, Moler 1985, Smith 1987, Speak et al. 1978). Male eastern indigos are known to have larger home range sizes than females, likely due to searching for mates in the area or due to their larger sexually dimorphic size (Dodd and Barichivich 2007, Moler 1985, Smith 1987).

Radiotelemetry and mark-recapture techniques have been used to estimate home range size (minimum convex polygon; MCP), daily and seasonal movement patterns, habitat use, and the extent of habitat required to support population of this species. Because of the wide range of the species, behavior and home ranges size is variable in different portions of their extant range. In central Florida, Layne and Steiner (1996) estimated the mean home range size of 12 males to be 74.3 ha (183.6 ac) and seven females to be 18.6 ha (46.0 ac). Males also moved significantly more often between successive locations and moved greater distances. In the Gulf Hammock region of Florida, Moler (1985) reported mean home ranges of 48.2 ha - 533.0 ha (119.1 ac - 1,317.0 ac) for four males and 50.8 ha (125.5 ac) for one female. A single male occupied a home range of 185 ha (457.1 ac) in north-central Florida (Dodd and Barichivich 2007). In southern Georgia the mean home range of 19 males (520.0 ha; 1,285.0 ac) was significantly larger than 13 females (103.4 ha; 255.5 ac), and males move more frequently and greater distances (Hyslop 2007).

Using a combination of radiotelemetry and population models, Breininger et al. (2004) investigated the effects of habitat fragmentation on the viability of eastern indigo snake populations in east-central Florida. In this study males had an average home range size of 120 ha (296.5 ac) and females were 41 ha (101.3 ac) (Breininger et al. 2004), snakes living along primary roads soon died, and edge/area effects were more important than area alone in determining population survival. Studies by Layne and Steiner (1996), Enge and Wood (2002), and Hyslop (2007) also found roads to be an important source of mortality in eastern indigo snakes. A study by Moler (1992) suggested that at least 1,000 ha (2,470 ac) of contiguous habitat is required to sustain eastern indigo snakes long term, though indigos often are present on smaller patch sizes when habitat has become isolated and fragmented.

Movement between habitat types varies between northern and southern portions of the species' range, possibly based on location above and below the frost line (near the latitude of Gainesville, Florida) and a need for more winter protection from the cold above the frost line. In the more northern parts of the species' range (i.e., Georgia and North Florida), habitat use often varies seasonally between upland and lowland areas, especially where the snakes habitually overwinter in gopher tortoise burrows in xeric sandhill habitats (Hyslop et al. 2009). Northern winter home ranges tend to be small (less than 10 ha [25 ac]), in spite of evidence of breeding activity, when compared to home ranges in spring through autumn (up to 1,500 ha [3,700 ac]) when more diverse habitats are occupied (Speake et al. 1978, Stevenson et al. 2009, Hyslop et al. 2014). In more southern parts of their range in Peninsular Florida, eastern indigo snakes become more habitat generalists and move among the available habitat types but maintain a strong affinity to 31 upland habitats (Bauder et al. 2016, Bauder et al. 2018). Unlike in northern regions, male eastern indigo snakes take longer, more frequent movements and have larger home ranges during the winter breeding season, although both male and female home ranges tend to be smaller overall than those in the north (Bauder et al. 2016). A comparison of Peninsular Florida mean annual home range size with mean annual home range size in Southeast Georgia indicated the male home range of 149 ha (369 ac) in Peninsular Florida versus 510 ha (1,260 ac) in Southeast Georgia; female home range of 49 ha (121 ac) in Peninsular Florida versus 102 ha (252 ac) in Southeast Georgia (Service 2109).

5.1.3. Numbers, Reproduction, and Distribution

The eastern indigo snake ranges from the southeastern United States to northern Argentina (Conant and Collins 1998). Two species occur in the United States: the eastern indigo and the Texas indigo (*D. corais*). In the United States, the eastern indigo snake historically occurred throughout Florida and in the coastal plain of Georgia and has been recorded in Alabama and Mississippi (Diemer and Speake 1983; Moler 1985b). It may have occurred in southern South Carolina, but its occurrence there cannot be confirmed. Florida and Georgia currently support the remaining endemic populations of the eastern indigo snake (Lawler 1977). The eastern indigo snake occurs throughout most of Florida and is absent only from the Dry Tortugas and Marquesas Keys, and regions of north Florida where cold temperatures and deeper clay soils exist (Cox and Kautz 2000).

Current population size range-wide is unknown.

5.1.4. Conservation Needs and Threats

Throughout the eastern indigo snake's range, expanding urban areas are creating barriers to the dispersal of individuals and gene flow between populations, and habitat loss and degradation are a threat to the species (Lawler 1977, Moler 1985b). In northern areas of its range in Georgia and peninsular Florida, the species is impacted by a decline in longleaf pine forests, gopher tortoises, and gopher tortoise habitat (Van Lear et al. 2005). In central and southern Florida, the eastern indigo snake is less dependent on any one habitat type, but does avoid developed areas (Lawler 1977, Moler 1985a, Hyslop 2007). Throughout Florida, developed areas are expanding rapidly with population growth at the expense of wildlife habitat (Cerulean 2008).

At the time of listing, other threats to the eastern indigo snake included commercial collection for the pet trade and mortality during the gassing of gopher tortoise burrows by individuals attempting to drive rattlesnakes out for collection (43 FR 4026 4029). Since their listing additional potential threats to the species have expanded to include disease, road mortality, kills of indigo snakes by landowners and pets, and ATV use in gopher tortoise habitat (Service 2008).

Major threats to the eastern indigo snake include habitat fragmentation, destruction, and reduced gene flow. At the current time, the range-wide status of the species is unknown. Range-wide surveys and monitoring are required to help understand the current status of the species. The recovery strategy for the eastern indigo snake consists of maintaining and enhancing existing populations; monitoring the status of existing populations; identifying and securing additional eastern indigo snake populations and habitat; establishing new populations through translocations or reintroductions; and supporting research that guides land management and provides demographic and ecological data. Management plans should be developed and implemented for all recovery populations. Appropriate habitat management includes maintaining road-less corridors allowing dispersal between occupied upland and wetland habitats; minimizing soil disturbance and loss of native herbaceous groundcover vegetation; conducting prescribed burning, particularly during the growing season; maintaining appropriate wetland habitat; and restoring degraded upland habitat.

Monitoring programs to track population trends and the response of this species to habitat management activities are needed for all recovery populations. Gopher tortoise populations should be regularly monitored, and augmented if necessary, at areas where both indigo snakes and tortoises co-occur. Monitoring programs should be critically evaluated and revised as needed. Since recovery of the eastern indigo snake will necessitate finding or creating new, currently unknown populations, assessment of potentially suitable habitat within the range of the species and additional presence/absence surveys are needed. Suitable habitat for translocations/reintroductions needs to be identified, and programs developed and implemented to establish and monitor these new populations and manage the habitat that supports them.

Tracts of habitat in private ownership that could be managed for eastern indigo snakes need to be identified. Site analyses and habitat management actions that improve the connectivity between upland and wetland habitats utilized by indigo snakes are needed.

Additional research is needed to gain a better understanding of the natural history of the eastern indigo snake and its habitat for use in developing and implementing management plans. Data gathered from these studies will ensure that recovery efforts are supported by the best available scientific information.

Climate Change

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, sea level has risen, and the concentrations of greenhouse gases have increased. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing (balance of incoming and outgoing energy), observed warming, and understanding of the climate system. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions" (IPCC, 2013).

The National Climate Team summarized the following scientific and ecological information on climate change and implications to Service and staff from the 2014 publication entitled *Climate Change Impacts in the United States: The Third National Climate Assessment* (NCA) (NCA, 2014). This team also summarized the 2013 publication from the IPCC entitled *Highlights of the IPCC 5th Assessment Report: The Physical Science Basis of Climate Change (WGI), Summary for Policymakers* (IPCC, 2013). This information is further condensed with a primary focus on Florida. Florida is exceptionally vulnerable to sea level rise, extreme heat events, and hurricanes. With an ever-growing population within Florida's coastal plain, annual visitors range from 10 to 15 million stressing the already decreasing water availability.

The common thread regarding weather predictions for Florida is that extreme events will become more extreme and more frequent. This will increase annual variation and likely increase annual variation in eastern indigo snake demographic rates. Increasing variation increases the strength of stochastic effects and typically has the greatest effects on small populations, hence greatly increasing their extinction risk.

5.2. Environmental Baseline

This section describes the best available data about the condition of the eastern indigo snakes in the Action Area without the consequences caused by the proposed Action.

Eastern indigos are often difficult to detect during surveys based on the biology of the species and its cryptic nature. Many species observations in the Service's records are opportunistic or are from long-term surveys performed by researchers. Current survey methodology recommends a 5-day survey period during the winter season. However, even during appropriate winter temperature windows, eastern indigos may not be detected by surveyors due to the species camouflage, ability to shelter in below ground refugia, short survey duration, variable temperature windows, and the species general cryptic nature. Further, detecting eastern indigos within gopher tortoise burrows may be difficult because burrows are often structurally complex, containing several corkscrew type passages and side passages which are habitable by eastern indigo snakes, but are not accessible to surveyors (Doonan and Stout 1994).

The eastern indigo snake is known to utilize a variety of habitats in Florida, including pine flatwoods, scrubby flatwoods, high pine, dry prairie, xeric oak, xeric oak scrub, turkey-oak barrons, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats (Service 1999). Additionally, the presence of a mosaic of habitats including uplands and wetlands, and presence of gopher tortoises and other refugia, are important for the eastern indigo snake (Landers and Speake 1980, Auffenberg and Franz 1982).

The Action Area is located within ONF, a contiguous landscape of nearly 363,500 acres of potentially suitable eastern indigo snake habitat.

Rodman Range is roughly 2,650 acres consisting of forest uplands and wetlands of which about 100 acres has a main target area cleared of vegetation. Vegetation at the range is managed in accordance with the INRMP to support the mission and to provide for sustained, multiple uses (Navy 2019). Prescribed fire is used as a management tool throughout the range and silvicultural practices are used in the pine plantations. Lands surrounding Rodman Range are undeveloped and primarily forested. The ONF borders the range to the south and west.

Lake George Range is entirely open water and is located 0.6 to 1.9 miles off the lake's eastern shoreline and 2.4 to 4.7 miles off the western shoreline, and occurs in waters ranging from 8 to 11 feet deep

Pinecastle Range is approximately 5,700 acres of sandhill, sand pine scrub, and dry hammock communities with 383 acres of cleared target areas. The Pinecastle Range is located inside the "Big Scrub Complex." "Big Scrub" is an expansive area of Central Florida dominated by sand pine (Pinus clausa), evergreen oaks, and shrubs, and is subject to frequent fires. The area is predominately sandhills, sand pine scrub, and dry hammock. Scrub is found on excessively well-drained sandy soil associated with the Central Florida ridge. Scrub vegetation is adapted to a high level of disturbance, especially disturbance by intense fire.

5.3. Effects of the Action

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. Our analyses of the consequences caused by each of these activities follows.

Individuals in the Pinecastle Range and within ONF could be exposed to vehicle traffic associated with mobile electronic warfare emitters. Mobile electronic warfare emitters may travel on roads within ONF and would be parked in established areas (e.g., dirt roads); however, in the occurrence that movement is required, there is potential for an eastern indigo snake to be run over. However, vehicular movement and traffic associated with electronic warfare emitters would be sparse and sporadic, and visible wildlife would be avoided.

Individuals would be exposed to the potential for direct impact from inert munitions or explosions from explosive munitions (only at Pinecastle Range). However, the likelihood of an individual eastern indigo snake being hit by munitions or occurring in the explosion radius within the target area is extremely low. In the unlikely event of an explosive munitions exceeding the Pinecastle Range target boundaries and igniting a fire, eastern indigo snakes would be susceptible to mortality or injury. However, the species occurs in fire-adapted habitats and could potentially seek refuge underground.

Individuals could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area. If an individual was in the vicinity of vegetation removal activities, it would likely vacate the area and be able to return once such activities were complete.

5.4. Cumulative Effects

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to eastern indigo snakes are not relevant to formulating our opinion for the Action.

5.5. Conclusion

In this section, we summarize and interpret the findings of the previous sections (Status of the Species, Environmental Baseline, Effects of the Action, and Cumulative Effects) relative to the purpose of the BO for the eastern indigo snake, which is to determine whether the Action is likely to jeopardize its continued existence.

Consistent with past section 7 consultations, the Proposed Action may affect and is likely to adversely affect the eastern indigo snake due to the potential for fire caused by explosive munitions, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights.

Opinion

After reviewing the Status of the Species, the Environmental Baseline for the Action Area, the Effects of the Action and the Cumulative Effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the eastern indigo snake.

6. SAND SKINK

This section provides the Service's biological opinion of the Action for the sand skink.

6.1. Status of Species

This section summarizes best available data about the biology and condition of the sand skink (*Neoseps reynoldsi*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the sand skink as threatened under the Endangered Species Act on November 6, 1987 (52 FR 42658). Critical habitat has not been designated for the sand skink.

The taxonomic classification of the sand skink has been reevaluated since it was listed as *Neoseps reynoldsi* in 1987, and the commonly accepted scientific name for the sand skink is now *Plestiodon reynoldsi* (Brandley et al. 2005; Smith 2005).

6.1.1. Species Description

The sand skink is a small, fossorial lizard that reaches a maximum length of about 5 inches. The tail makes up about half the total body length. The body is shiny and usually gray to grayish-white in color, although the body color may occasionally be light tan. Hatchlings have a wide black band located along each side from the tip of the tail to the snout. This band is reduced in adults and may only occur from the eye to snout on some individuals (Telford 1959). Sand skinks contain a variety of morphological adaptations for a fossorial lifestyle. The legs are vestigial and practically nonfunctional, the eyes are greatly reduced, the external ear openings are reduced or absent (Greer 2002), the snout is wedge-shaped, and the lower jaw is countersunk.

6.1.2. Life History

The sand skink is highly adapted for life in the sand. It spends the majority of its time below the surface where it burrows through loose sand in search of food, shelter, and mates. Sand skinks feed on a variety of hard and soft-bodied arthropods that occur below the ground surface. The diet consists largely of beetle larvae and termites (*Prorhinotermes* spp.). Spiders, larval ant lions, lepidopteran larvae, roaches, and adult beetles are also eaten (Myers and Telford 1965; Smith 1982).

Sand skinks are most active during the morning and evening in spring and at mid-day in winter, the times when body temperatures can easily be maintained at a preferred level between 82 and 88 degrees Fahrenheit in open sand (Andrews 1994). During the hottest parts of the day, sand skinks move under shrubs to maintain their preferred body temperatures (Andrews 1994) in order to remain active near the surface. With respect to season, Telford (1959) reported skinks are most active from early March through early May, whereas Sutton (1996) found skinks are most active from mid-February to late April. Based on monthly sampling of pitfall traps, Ashton and Telford (2006) found that captures peaked in March at Archbold Biological Station (ABS), but in May at ONF. All of these authors suggested the spring activity peak was associated with mating. At ABS, Ashton and Telford (2006) noted a secondary peak in August that corresponded with the emergence of hatchling sand skinks.

Telford (1959) assumed that sand skinks become sexually mature during the first year following hatching, at a size of 1.78 inches snout-vent length. He suspected that most of the breeders in his study were in their second year and measured between 1.78 and 2.24 inches snout-vent length (Telford 1959). However, Ashton (2005) determined that sand skinks become sexually mature between 19 and 23 months of age and have a single mating period each year from February through May. Sand skinks first reproduce at 2 years of age and females produce a single clutch in a season, although some individuals reproduce biennially or less frequently (Ashton 2005). Sand skinks lay between two and four eggs typically in May or early June (Ashton 2005; Mushinsky in Service 2007) under logs or debris, approximately 55 days after mating (Telford 1959). The eggs hatch from June through July. Sand skinks can live at least to 10 years of age (Meneken et al. 2005). Gianopulos (2001) found that the sex ratio of sand skinks did not differ significantly from 1:1, which is consistent with the findings of Sutton (1996).

Most sand skinks move less than 40 m (130 ft) between captures, but some move over 140 m (460 ft) in 2 weeks (Mushinsky et al. 2001). Limited dispersal ability has been suggested to explain the relatively high degree of genetic structure within and among sand skink populations (Branch et al. 2003; Reid et al. 2004).

6.1.3. Numbers, Reproduction, and Distribution

The current status of the sand skink throughout its geographic range is unclear because recent comprehensive, range-wide surveys have not been conducted. At the time of Federal listing in 1987, FNAI had recorded 31 known sites for the sand skink. By September 2006, 132 localities were known by FNAI (Griffin 2007). This increase is largely the result of more intensive sampling of scrub habitats in recent years and does not imply this species is more widespread than originally supposed. Nonetheless, except for a few locations where intensive research has been conducted, limited information about the presence or abundance of sand skinks exists. Reptile surveys in a variety of scrub habitats in the ONF did not detect sand skinks (Greenberg et al. 1994). Telford (1998) cited the ephemeral nature of early successional scrub habitats due to dynamic changes as an important confounding factor in the evaluation of the sand skink's present status in the ONF. At least two persistent populations are known from the ONF (Telford 1998), where sand skinks have been collected for genetic analysis (Branch et al. 2003) and population studies (Ashton and Telford 2006). Additional studies have provided presence/absence information that has been used to determine the extant range of the species (Mushinsky and McCoy 1991; Stout and Corey 1995). However, few long-term monitoring efforts have been undertaken to evaluate the population size, or population trends, of sand skinks at these sites, on remaining scrub habitat on private lands, or range-wide.

The population dynamics of sand skinks within their extant ranges are not well known because the skinks' small size and secretive habits make their study difficult. Sand skinks are known to exhibit life-history traits that are also found in a number of other fossorial lizard species, such as: delayed maturity, a small clutch size of relatively large eggs, low frequency of reproduction, and a long lifespan (Ashton 2005). Such character traits may have resulted from, and be indicative of, high intraspecific competition or predation.

The sand skink occurs on the sandy ridges of interior central Florida from Marion County south to Highlands County. The extant range of the sand skink includes Highlands, Lake, Marion, Orange, Osceola, Polk, and Putnam Counties (Christman 1988; Telford 1998). Principal populations occur on the Lake Wales Ridge (LWR) and Winter Haven Ridges (WHR) in Highlands, Lake, and Polk Counties (Christman 1992; Mushinsky and McCoy 1991). The sand skink is uncommon on the Mount Dora Ridge (MDR), including sites within the ONF (Christman 1970; 1992). Despite intensive sampling efforts in scrub habitat with similar herpetofauna, the sand skink has not been recorded at Avon Park Air Force Range on the Bombing Range Ridge (Branch and Hokit 2000). Although we do not have estimates of acreage for all of the ridges, we do know the largest of these, the LWR, encompasses approximately 517,303 ac (209,300 ha) (Weekley et al. 2008). According to the Florida Natural Areas Inventory (FNAI) database, updated as of September 2006, there were 132 locality records for the sand skink, including 115 localities on the LWR, 7 on the MDR, and 4 on the WHR (Griffin 2007). FNAI also reports four localities for this species west of the MDR in Lake County and two localities between the LWR and the Lake Hendry Ridge.

6.1.4. Conservation Needs and Threats

Comparisons of persistence, recruitment, and survival were used to determine translocation success of sand skinks on two restored scrub sites for 6 years following relocation (Mushinsky et al. 2001; Penney 2001; Penney et al. 2001). One site established a self-sustaining population, while the other did not. It was determined that site location, habitat suitability, and initial propagule size were the factors affecting success (Mushinsky et al. 2001; Penney et al. 2001). Researchers concluded that the chances of long-term survival may improve when habitat is restored and skinks are introduced to sites close to intact scrub, rather than to isolated sites (Mushinsky et al. 2001; Penney 2001).

Delayed maturity, a small clutch size of relatively large eggs, low frequency of reproduction, and a long lifespan in sand skinks are life-history traits that also characterize a number of other fossorial lizards that occur in high densities (Ashton 2005). Such character traits may reflect high intraspecific competition or predation (Ashton 2005).

The modification and destruction of xeric upland communities in central Florida were a primary consideration in listing the sand skink. By some estimates, as much as 90 percent of the scrub ecosystem has already been lost to residential development and conversion to agriculture, primarily citrus groves (Kautz 1993; Turner et al. 2006b). Xeric uplands remaining on private lands are especially vulnerable to destruction because of increasing residential and agricultural pressures.

Climate Change

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, sea level has risen, and the concentrations of greenhouse gases have increased. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing (balance of incoming and outgoing energy), observed warming, and understanding of the climate system. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions" (IPCC, 2013).

The National Climate Team summarized the following scientific and ecological information on climate change and implications to Service and staff from the 2014 publication entitled *Climate Change Impacts in the United States: The Third National Climate Assessment* (NCA) (NCA, 2014). This team also summarized the 2013 publication from the IPCC entitled *Highlights of the IPCC 5th Assessment Report: The Physical Science Basis of Climate Change (WGI), Summary for Policymakers* (IPCC, 2013). This information is further condensed with a primary focus on Florida. Florida is exceptionally vulnerable to sea level rise, extreme heat events, and hurricanes. With an ever-growing population within Florida's coastal plain, annual visitors range from 10 to 15 million stressing the already decreasing water availability.

The common thread regarding weather predictions for Florida is that extreme events will become more extreme and more frequent. This will increase annual variation and likely increase annual variation in eastern indigo snake demographic rates. Increasing variation increases the strength of stochastic effects and typically has the greatest effects on small populations, hence greatly increasing their extinction risk.

6.2. Environmental Baseline

This section describes the best available data about the condition of the sand skink in the Action Area without the consequences caused by the proposed Action.

Using cover boards and mark-recapture techniques, surveys have found densities in the ONF between 36 and 275 individuals per hectare (15 – 111 per acre) (Navy 2002). Cover board surveys resulted in three site records in 1997 and eight additional site records in 2001 in the Pinecastle Range, all on open sand sites. This indicates that the sand skink may be restricted in scrub habitat to open sand areas or that the species is difficult to observe elsewhere.

6.3. Effects of the Action

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. Our analyses of the consequences caused by each of these activities follows.

There are no anticipated ground/vegetation impacts outside of the Pinecastle Range target boundaries. In the unlikely event that non-explosive munitions exceeds target boundaries, damage to sand skink habitat could occur from the impact and subsequent removal of the munitions. This damage would be minimized to the extent necessary to ensure the safety of personnel. In the unlikely event of an explosive munitions exceeding the Pinecastle Range target boundaries and igniting a fire, sand skink habitat could immediately be impacted. However, a positive effect could result over time because scrub vegetation is adapted to a high level of disturbance by fire (Menges and Kohfeldt 1995; Breininger et al. 2017), and sand skinks could benefit from an increase in or maintenance of early-successional scrub habitat. Scrub habitat could be affected by the removal of vegetation associated with transporting targets within the target areas of the Pinecastle and Rodman ranges. However, the target areas are heavily disturbed and are already regularly maintained.

Individuals in the Pinecastle Range could be exposed to vehicle traffic associated with mobile electronic warfare emitters. Mobile electronic warfare emitters would be parked in established areas (e.g., dirt roads); however, in the occurrence that movement is required, there is potential for sand skinks to be run over. However, vehicular movement and traffic associated with electronic warfare emitters would be sparse and sporadic, and, therefore, the likelihood of individuals being run over is very low. Individuals would be exposed to the potential for direct impact from inert munitions or explosions from explosive munitions. However, the likelihood of an individual sand skink being hit by munitions or occurring in the explosion radius within the target area is extremely low. In the unlikely event of an explosive munitions exceeding the Pinecastle Range target boundaries and igniting a fire, sand skinks would be susceptible to mortality or injury. However, the species occurs in fire-adapted habitats and could potentially seek refuge underground. Individuals could be affected by the removal of scrub habitat associated with transporting targets within the target areas of the Pinecastle Range. However, such an impact would be of short-duration, temporary, and would occur in an already disturbed target area.

6.4. Cumulative Effects

In section 3, we did not identify any activities that satisfy the regulatory criteria for sources of cumulative effects. Therefore, cumulative effects to sand skinks are not relevant to formulating our opinion for the Action.

6.5. Conclusion

In this section, we summarize and interpret the findings of the previous sections (Status of the Species, Environmental Baseline, Effects of the Action, and Cumulative Effects) relative to the purpose of the BO for the sand skink, which is to determine whether the Action is likely to jeopardize its continued existence.

Consistent with past section 7 consultations (Service 2008b, 2010), the Proposed Action may affect and is likely to adversely affect the sand skink due to the potential for fire caused by explosive munitions, mortality from explosions, vehicle traffic on the range, and increased exposure to aircraft overflights

Opinion

After reviewing the Status of the Species, the Environmental Baseline for the Action Area, the Effects of the Action and the Cumulative Effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the sand skink.

7. FLORIDA BONAMIA, LEWTON'S POLYGALA, SCRUB BUCKWHEAT

This section provides the Service's biological opinion of the Action for the Florida Bonamia, Lewton's polygala, and scrub buckwheat.

7.1. Status of Species

This section summarizes best available data about the biology and condition of the Florida bonamia (*Bonamia grandiflora*), Lewton's polygala (*Polygala lewtonii*), and scrub buckwheat (*Eriogonum longifolium* var. *gnaphalifolium*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the Florida bonamia as threatened on November 2, 1987 (52 FR 42068); Lewton's polygala as endangered on April 27, 1993 (58 FR 25746); and scrub buckwheat as threatened on April 27, 1993 (58 FR 25746).

7.1.1. Species Description, Habitat and Conservation Needs and Threats

Florida Bonamia

Florida bonamia is a perennial trailing vine with stout stems up to 3 feet long, leaves 1-2 inches long, flowers 3-4 inches long, solitary, with 5 lobes and 5 leathery, unequal sepals in two series. Flowers are bright blue with a white throat in the morning but fading to pale blue by early afternoon when they close; somewhat resembles a common morning-glory.

Florida bonamia is endemic to scrub and scrub edge that typically occurs in openings or disturbed areas in white sand scrub on central Florida ridges, with scrub oaks, sand pine, and lichens. It can grow in the filtered light of closed canopy areas when the shrub canopy is open, but flowering is not prolific (Navy 2002). The species has evolved in fire-maintained xeric communities, including oak-dominated scrub and sandhills. It occurs in Marion, Lake, Orange, Volusia, Polk, Highlands, Hillsborough, Hardee, Manatee and Sarasota counties.

Lewton's Polygala

Lewton's polygala is a relatively short-lived (5 to 10 years) perennial herb reaching a height of ~ 8 inches. Each plant produces one to several annual stems, which are spreading, upward curving or erect, and are often branched. The leaves are small, sessile, and tend to overlap along the stem. Lewton's polygala occurs in xeric upland habitats on the Lake Wales Ridge and Mount Dora Ridge in Ocala National Forest (Menges and Weekley 2002). It occurs almost exclusively on yellow sands in sandhill (high pine) and oak-hickory scrub (Menges and Weekley 2003), and transition zones between these two communities. It occurs in Marion, Lake, Osceola, Orange, Polk, and Highlands counties.

Scrub Buckwheat

Scrub buckwheat is a long-lived perennial herb with a substantial taproot that probably provides ample food reserves for resprouting (McConnell and Menges 2002), basal rosettes, and one to three or more leafless, upright above-ground flowering stems up to 3 feet tall, but upwards of 10 stems have been observed in vigorous specimens, especially post-fire. Scrub buckwheat occurs in oak-hickory scrub, sandhills, and turkey barrens communities in Putnam, Marion, Lake, Seminole, Osceola, Orange, Pasco, Hillsborough, Polk and Highlands counties.

Climate Change

"Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, sea level has risen, and the concentrations of greenhouse gases have increased. Human influence on the climate system is clear. This is evident from the increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing (balance of incoming and outgoing energy), observed warming, and understanding of the climate system. Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions" (IPCC, 2013).

The National Climate Team summarized the following scientific and ecological information on climate change and implications to Service and staff from the 2014 publication entitled *Climate Change Impacts in the United States: The Third National Climate Assessment* (NCA) (NCA, 2014). This team also summarized the 2013 publication from the IPCC entitled *Highlights of the IPCC 5th Assessment Report: The Physical Science Basis of Climate Change (WGI), Summary for Policymakers* (IPCC, 2013). This information is further condensed with a primary focus on Florida. Florida is exceptionally vulnerable to sea level rise, extreme heat events, and hurricanes. With an ever-growing population within Florida's coastal plain, annual visitors range from 10 to 15 million stressing the already decreasing water availability.

The common thread regarding weather predictions for Florida is that extreme events will become more extreme and more frequent. This will increase annual variation and likely increase annual variation in eastern indigo snake demographic rates. Increasing variation increases the strength of stochastic effects and typically has the greatest effects on small populations, hence greatly increasing their extinction risk.

7.2. Environmental Baseline

This section describes the best available data about the condition of the Florida bonamia, Lewton's polygala, and scrub buckwheat in the Action Area without the consequences caused by the proposed Action.

Florida Bonamia

The population of Florida bonamia throughout the ONF, including the Pinecastle Range, is large. Surveys in 1993, 1997, and 2001 recorded numerous individual plants at a variety of sites in accessible areas along roadsides near the Pinecastle Range (Navy 2002). The number of sites increased from six (with a total of 210 plants) in 1993 to 19 (more than 200 plants) in 2001. The 2001 survey showed that large populations were being supported in areas that had been harvested since 1995 and burned since 1988 and in an adjacent area maintained as open sand (Navy 2002). The species was last formally monitored in 2007 (Jenkins et al. 2007), when observers described the presence of Florida Bonamia in survey areas as "widespread and numerous" in suitable habitat. The species is frequently seen flowering within a year of timber harvest by ONF personnel. An analysis of land cover in the vicinity of the Pinecastle Range identified large areas of potential habitat for the Florida bonamia in the area. Monitoring results at the ONF suggest that the local population follows "boom and decline" responses to management, (e.g., prescribed burning) (Service 2007c).

Florida bonamia is not known to occur at the Rodman Range (Navy 2019), and the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Florida bonamia at the Rodman and Lake George ranges are not addressed in further detail.

Lewton's Polygala

There is a significant population of the species in and around Pinecastle Range, making the area important for the conservation of the species. It includes a significant number of the known locality records, the second largest population overall, and the largest scrub population in ONF (Navy 2002). Surveys in 1993, 1997, and 2001 identified up to 17 sites consisting of 37 to 76 individual plants as well as small clumps (Navy 2002).

Lewton's polygala potential habitat occurs in the general vicinity of Rodman Range (FNAI 2019). However, the species has never been observed at Rodman Range, and training operations at Rodman Range would not affect vegetation outside the range boundaries. During a Rare, Threatened, and Endangered plant survey conducted in 2017, no occurrence of Lewton's polygala was observed within the Rodman Range (LG2 Environmental Solutions, Inc. 2018). In addition, the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to Lewton's polygala at the Rodman and Lake George ranges are not addressed in further detail.

This species occurs within ONF, which is considered the northern limits of its range. The species was not found in Pinecastle Range in surveys conducted in 1993, 1997, and 2001, although suitable habitat is found on the site (Navy 2002). The current management practices prescribing frequent disturbances are conducive to establishing scrub habitat for Lewton's polygala. As such, there is the potential for this species to occur in the Pinecastle Range.

Scrub Buckwheat

Scrub buckwheat potential habitat occurs in the general vicinity of Rodman Range (FNAI 2019). However, the species has never been observed at Rodman Range, and training operations at Rodman Range would not affect vegetation outside the range boundaries. In addition, the Lake George Range has no terrestrial habitats to support plants. Therefore, potential impacts to scrub buckwheat at the Rodman and Lake George ranges are not addressed in further detail.

7.3. Effects of the Action

In a BO for a listed species, the effects of the proposed action are all reasonably certain consequences to the species caused by the action, including the consequences of other activities caused by the action. Activities caused by the action would not occur but for the action. Consequences to species may occur later in time and may occur outside the action area.

We identified and described the activities included in the proposed Action in sections 2.1–2.4. Our analyses of the consequences caused by each of these activities follows.

There is a high probability of a fire igniting in the unlikely event of an explosive munitions exceeding the Pinecastle Range target boundaries. A fire could result in an immediate change to Florida bonamia, Lewton's polygala, and scrub buckwheat habitat. However, a positive effect could result over time. Florida bonamia, Lewton's polygala, and scrub buckwheat are associated with early successional scrub habitat. In addition, the species' is adapted to living in a fire-dependent ecosystem. The recovery of the area after a fire would be suitable habitat for Florida bonamia, Lewton's polygala, and scrub buckwheat and it is anticipated that the species' would re-colonize the area.

Individuals of Florida bonamia, Lewton's polygala, and scrub buckwheat could potentially be burned in the unlikely event of an explosive munitions starting a fire at the Pinecastle Range. However, Florida bonamia, Lewton's polygala, and scrub buckwheat are adapted to living in fire-dependent, early-successional scrub habitat. The recovery of any burned area after a fire would be suitable habitat for the species, and fire would likely impart beneficial impacts overall to the habitat by maintaining it as early successional scrub, allowing for individuals to re-colonize the area.

7.4. Conclusion

In this section, we summarize and interpret the findings of the previous sections (status, baseline, effects, and cumulative effects) relative to the purpose of the BO for the Florida bonamia, Lewton's polygala, and scrub buckwheat, which is to determine whether the Action is likely to jeopardize its continued existence.

Although Florida bonamia, Lewton's polygala, and scrub buckwheat populations may benefit from overall beneficial impacts to habitat that may occur in the unlikely event of a fire induced by explosive munition exceeding the Pinecastle Range target boundaries, fire would potentially kill individuals in the near term. Therefore, the Proposed Action may affect and is likely to adversely affect Florida bonamia, Lewton's polygala, and scrub buckwheat. The potential for direct harm to individuals within the action area is unlikely; however, if any individuals are lost due to fire, it would not result in impacts at the population level.

Opinion

After reviewing the Status of the Species, the Environmental Baseline for the Action Area, and the Effects of the Action, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the Florida bonamia, Lewton's polygala, and scrub buckwheat.

8. GOPHER TORTOISE

This section provides the Service's biological opinion of the Action for the gopher tortoise (*Gopherus polyphemus*).

The gopher tortoise is not currently a protected species under the Endangered Species Act of 1973, as amended. Currently, the species is considered an at-risk species under federal purview. Gopher tortoises are a threatened species and protected by state law (Chapter 68A-27, Florida Administrative Code). The Service encourages the Navy to coordinate with the Florida Fish and Wildlife Conservation Commission and the U.S. Forest Service regarding this species. If the species is listed in the future, re-initiation of this consultation will be warranted to provide coverage for the species.

9. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3(19)). In regulations, the Service further defines:

- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" (50 CFR §17.3) and
- "incidental take" as "takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant" (50 CFR §402.02).

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to a Federal agency action that would not violate ESA §7(a)(2) is not considered prohibited, provided that such taking is in compliance with the terms and conditions of an incidental take statement (ITS).

The Action evaluated in this BO meets the regulatory definition of a "mixed programmatic action" (50 CFR §402.02) for purposes of an ITS, which is a Federal action that:

- approves action(s) that *are not* subject to further §7 consultation; and
- approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and *are* subject to further §7 consultation.

For a mixed programmatic action, an incidental take statement is required at the programmatic level only for those activities that are reasonably certain to cause take and are not subject to further §7 consultation (50 CFR §402.14(i)(6)). The following sections of this ITS address such activities of the proposed Action, but not the program activities that are subject to further §7 consultation. As appropriate and considering best available data at the time, the Service may rely on the conclusion(s) of this BO in responding to consultation requests for future Navy actions that are consistent with the framework activities of this programmatic Action, and as necessary, provide project-level ITSs.

This BO evaluated effects of the Action on the threatened Florida bonamia, endangered Lewton's polygala, and threatened scrub buckwheat. ESA §7(b)(4) and §7(o)(2), which provide the authority for issuing an ITS, do not apply to listed plant species. However, ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including:

(a) remove and reduce to possession from areas under Federal jurisdiction;
(b) maliciously damage or destroy on areas under Federal jurisdiction; and
(c) remove, cut, dig up, or damage or destroy on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (not the purpose of) an otherwise lawful activity is not prohibited.

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the Navy must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action. The Navy has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the Navy fails to:

- assume and implement the terms and conditions; or
- require a permittee, contractor, or grantee to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the Navy must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

9.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section(s) of this BO.

Table 9-1 identifies the species, life stages, estimated number of individuals, the form of take anticipated, and the section of the BO that contains the supporting analysis. The amounts specified are an annual recurring level of take for the duration of the Pinecastle Range Complex training missions. These levels of incidental take are not expected to occur every year, as they are dependent on the individual training mission's complexity and seasonality (weather conditions) of when they occur. The target areas are cleared of vegetation, so the incidental take mainly occurs when a munition ignites the adjacent vegetation. Incidental take can also occur during ground training activities and equipment movement. The scrub habitat on the Pinecastle Range and the frequency of the small burns more or less mitigate the intensity and size of the fires. The USFS generally allows the fires to burn-out, but monitor the flare-ups closely and take action to suppress them if conditions favor intensification. The following describes the fire history resulting from ordinance ignitions based on fire data from 2009 through 2019:

- 27 unplanned fires occurred during this timeframe;
- unplanned fires ranged from zero acres burned in 2016 to 9 events totaling 3,133 acres in 2010;
- largest fire was 3,110 acres in 2010;
- the four largest fires include 450, 462, 589, and 3,111 acres;
- the average fire is 423 acres with a median of 1 acre.

Based on the past fire history at the Pinecastle Range, the Service anticipates that no more than 1,000 acres would be impacted in any given year. The Service recognizes a catastrophic fire may occur over a similar timeframe that could affect up to 3,500 acres during a dry year with high mission activities and numerous fire events. Providing the average number of acres affected during a ten-year timeframe remain under 1,000 acres, reinitiation will not be required.

Florida Scrub-Jay

The proposed action may result in mortality, injury, and the loss of breeding, feeding and sheltering opportunities of up to 65 individual Florida Scrub-Jays in any given year, mainly from escaped wildfires from mission activities. This number is derived from the amount of potential acreage impact (1,000 ac) divided by the average territory size (40 ac) within Pinecastle Range (25 family groups with an average of 2.6 individuals per group).

Eastern Indigo Snake

The proposed action may result in mortality, injury, and the loss of breeding, feeding and sheltering opportunities of up to 12 eastern indigo snakes (3 males, 9 females). These numbers are generated by dividing the average home range size of eastern indigo snakes in peninsula Florida (369 ac for males, 121 ac for females) by 1,000 acres of potential impacts.

Sand Skink

Because skinks are patchily distributed across the landscape and fires do not burn all habitat, many skinks are likely to survive fires. Habitat subject to burning may be low quality, containing dense scrub vegetation that is unsuitable for skinks. Therefore, it is likely that only a portion of the area is inhabited by skinks. Thus, 1,000 acres may be burned per year. Because an undetermined amount of the habitat is overgrown and skinks are patchily distributed, we anticipate that up to 50%, or 500 acres, may be occupied. Because of their biology, we do not have precise population estimates for skinks; therefore, the upper number of the range reported in 6.2 Environmental Baseline will be utilized as the metric for take (111 sand skinks per acre). The proposed action may result in mortality, injury, and the loss of breeding, feeding and sheltering opportunities of up to 55,500 sand skinks.

Table 9-1. Estimates of the amount of take (# of individuals) caused by the Action, by species, life stage, and form of take, collated from the cited BO effects analyses.

Common Name	Life Stage	# of Individuals	Form of Take	BO Effects Analysis Section
Florida Scrub-Jay	all	65	Harm/Harass	4.3.
Eastern Indigo Snake	all	12	Harm/Harass	5.3.
Sand Skink	all	55,500	Harm/Harass	6.3.

* Reinitiation will not be required, provided the average number of acres affected during a ten-year timeframe remains less than 1,000 acres per year.

Surrogate Measures for Monitoring

For the Florida Scrub-Jay, eastern indigo snake, and sand skink, detecting take that occurs incidental to the Action is not practical. The Service anticipates incidental take of these species will be difficult to detect and quantify for the following reasons:

1. Not all habitat that has the potential to be impacted by the training missions will be occupied during an activity and the amount of habitat affected can vary greatly. Depending on the seasonality and the suitability of the habitat over the years, species' may or may not be present. This applies to all species covered in this BO.

2. Florida Scrub-Jays are relatively easy to census, but it is possible that not all nests will be known prior to a fire ignition munitions. In the unlikely event that nests are destroyed, finding nest remnants after a fire would be nearly impossible. Adult (and post-fledging) Florida Scrub-Jays can escape fires but are expected to lose feeding and sheltering opportunities if the fire affects more than 30 percent of their territory. Therefore, measuring take is inherently difficult.

2. Incidental take of the eastern indigo snake will be difficult to detect for the following reasons:

   - wide-ranging distribution, not restricted to specialized habitats;

- patchy distribution within suitable habitats.

3. Sand skink will be difficult to detect for the following reasons:

   - its fossorial behavior, with individuals usually just beneath the surface of loose sand;
   - low density within suitable scrub and similar habitats within its limited range.

When it is not practical to monitor take in terms of individuals of the listed species, the regulations at 50 CFR §402.14(i)(1)(i) indicate that an ITS may express the amount or extent of take using a surrogate (*e.g.,* a similarly affected species, habitat, or ecological conditions), provided that the Service also:

- describes the causal link between the surrogate and take of the listed species; and
- sets a clear standard for determining when the level of anticipated take has been exceeded.

We have identified surrogate measures in our analyses of effects that satisfy these criteria for monitoring take of the species named above during Action implementation. Table 9-2 lists the species, life stage, surrogate measure, and the section of the BO that explains the causal link between the surrogate and the anticipated taking. We describe procedures for this monitoring in section 9.4.

Table 9-2. Surrogate measures for monitoring take of listed wildlife species caused by the Action, based on the cited BO effects analyses.

Common Name	Life Stage	Surrogate (units)	Quantity	BO Effects Analysis Section
Florida Scrub-Jay	all	acres	1,000	4.3.
Eastern Indigo Snake	all	acres	1,000	5.3.
Sand Skink	all	acres	1,000	6.3.

9.2. Reasonable and Prudent Measures

The Service believes the reasonable and prudent measures (RPMs) we describe in this section for the species named in Table 9-1 are necessary or appropriate to minimize the impact, *i.e.,* the amount or extent, of incidental take caused by the Action.

An overall RPM for the Pinecastle Range Complex:

1. Monitor threatened and endangered species populations in order to detect population trends, which may assist in determining the quantification of take from military and natural resource management activities.

Rodman Range

Consistent with the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2009), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Rodman Range.

2. The INRMP for NAS Jacksonville (Navy 2019) was developed in cooperation with the Service and Florida Fish and Wildlife Conservation Commission (FFWCC). This plan includes management actions for Rodman Range and is updated annually to provide benefits to threatened and endangered species. Natural resources at the Rodman Range would continue to be managed in accordance with this INRMP.

3. The Navy would continue to manage the Rodman Range in accordance with the Candidate Conservation Agreement for the Gopher Tortoise (Gopher Tortoise Team 2019). The goal of the Candidate Conservation Agreement is to organize a cooperative range-wide approach to gopher tortoise management and conservation in its eastern range. As part of the agreement, the Navy conducts gopher tortoise population and habitat assessment surveys at the Rodman Range. The agreement also provides indirect benefits to eastern indigo snake by monitoring the occurrence of burrows on Rodman Range.

4. The Navy would continue to relocate gopher tortoises discovered in areas where training activities expose the species to higher likelihood of impact. Relocation of tortoises and removal of burrows from activity areas such as the target at Rodman Range (in the event that a burrow occurred in the target area) also benefits commensal species such as the eastern indigo snake by precluding suitable habitat in the target area. Thus, a conservation benefit is provided to both species by encouraging the tortoise and eastern indigo snake to occupy compatible areas of the range.

Lake George Range

Consistent with the Jacksonville Range Complex Final Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2009), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Lake George Range.

5. Prior to releasing non-explosive munitions, aircraft would continue to do a pass at 300 ft., ~200 knots as a clearing run looking for boats, fishermen, large fish, and manatees.

6. To enhance the ability of the P-8 aircrew to spot a manatee or large fish (such as a sturgeon) near the target area, the aircrew would continue to use the Electro Optic/Infra-Red sensors which would enable the aircrew to detect surfacing animals.

7. The tower and range cameras will continue to observe range/impact areas for 5 minutes following the sortie (after the last non-explosive munition is dropped) to observe if any manatee or fish was injured by the exercise.

8. The pilot and at least one observer on board will continue to be trained to look for marine mammals/large fish and have completed the U.S. Navy Marine Species Awareness Training.

Pinecastle Range

Consistent with the Final Supplemental Environmental Impact Statement to the Final Environmental Impact Statement for Renewal of Authorization to Use Pinecastle Range (Navy 2010), the following measures would continue to be implemented to protect and mitigate impacts to federally listed species at the Pinecastle Range.

9. Within their authority, the Navy would restore or rehabilitate any National Forest lands damaged in the use of the Pinecastle Range.

10. The Navy would notify the USFS, without delay, upon the occurrence or sighting of any fire whether controlled by them or not.

11. The Navy would dispose of refuse resulting from this use, including waste materials, garbage, and rubbish of all kinds, in the following manner, and shall guard the purity of streams and living waters: Rubbish shall be taken to an approved sanitary landfill or collection point. Unsalvageable scrap metal or waste material will not be buried on site, but will be properly disposed of by approved regulations, as funding allows.

12. The Navy would receive prior approval from the Forest Supervisor or District Ranger before conducting any activity outside the permitted area.

13. The Navy would notify the USFS, without delay, of any munitions, explosive, or non-explosive that is dropped outside the Range boundary. Any such munitions shall be located and removed as soon as possible and any damage repaired.

14. The Navy would cooperatively work with USFS personnel on approving and implementing a management plan inside the designated Range to improve habitat conditions for existing threatened and endangered species. These resource activities will include prescribed burning, monitoring studies, and other activities identified in the Resource Management Plan for Pinecastle Range and approved by the Navy.

15. The Navy would immediately notify the District Ranger and Service upon the discovery of any dead or injured Florida Scrub-Jays, eastern indigo snakes, or sand skinks. All reasonable measures will be taken to preserve said discoveries.

16. The Navy would immediately suspend bombing operations when a fire or other emergency occurs on or near the Range, at such times and conditions as described below.

17. The use of air-delivered munitions, to include both explosive and non-explosive, will be prohibited with the following Burning Indexes and Keetch-Byram Drought Index:

• Burning Index 60 or less − No prohibitions providing the Keetch-Byram Drought Index is less than 400.

• Burning Index 61 + − No air delivered munition with Keetch-Byram Drought Index over 400, unless approved by the USFS.

In special situations when the Burning Index exceeds 60, the Navy may request permission to use air delivered munitions, and the District Ranger may approve such request if predicted weather allows.

On days when the Burning Index is less than 61, the Range may be closed by the District Ranger for the use of air-delivered munitions due to unusual circumstances such as fire occurrence on the ONF.

9.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the Navy must comply with the terms and conditions (T&Cs) of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the Navy must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that the Navy includes in the permit, contract, or grant document.

1. Continue to monitor and manage threatened and endangered species (i.e., both animal and plant) populations at a level that enables the Navy to contribute to quantifying the amount of take from military and natural resource management activities. Additionally, due to live-fire mission of Pinecastle, monitoring on the ONF immediately surrounding Pinecastle. This includes identifying important areas that threatened and endangered species are using for feeding, breeding and sheltering.

2. The Navy shall incorporate the Standard Protective Measures for the Eastern Indigo Snake.

3. Relocation of all gopher tortoises within an impact footprint shall be in accordance with FWC *Gopher Tortoise Permitting Guidelines*.

4. Disposition of dead or injured specimens (salvage).

   Care must be taken in handling any dead specimens found in the project area to preserve the specimen or its remains in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the Act. Unauthorized take of Florida Scrub-Jays, eastern indigo snakes, or sand skinks associated with the proposed activities should be immediately reported by notifying the Jacksonville Ecological Services Field Office at 904-731-3336. If dead Florida Scrub-Jay or eastern indigo snake is found in the project area, the specimens should be thoroughly soaked in water and frozen for later analysis of cause of death.

Any eastern indigo snakes that are found injured within the Action Area shall be placed within a secure container with ample ventilation and notification shall be made to the District Ranger and Service immediately. If the Service is unable to be reached, the Navy shall notify the Florida Fish and Wildlife Conservation Commission Wildlife Alert Hotline at 1-888-404-3922, and follow up notification to the Service shall be made the next business day.

9.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Navy must report the progress of the Action and its impact on the species to the Service as specified in the ITS (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting (M&R), including procedures for handling and disposing of any individuals of a species actually killed or injured. These M&R requirements are mandatory. We identify whether the Navy, the Applicant, or both are responsible.

As necessary and appropriate to fulfill this responsibility, the Navy must require any permittee, contractor, or grantee to accomplish the M&R through enforceable terms that the Navy includes in the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the Navy and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

The Navy shall submit an annual report documenting all known incidental take of species covered in this BO or the acreage of the surrogate habitat impacted that occurred during the missions carried out at the Navy's Pinecastle Complex for each calendar year.

9.5. CONSERVATION RECOMMENDATIONS

§7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers no conservation recommendations that are relevant to the listed species at this time.

9.6. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the Navy retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;

c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the Navy is required to immediately request a reinitiation of formal consultation.

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APPENDIX E
TRIBAL GOVERNMENT-TO-GOVERNMENT DOCUMENTATION AND NHPA SECTION 106 CONSULTATION

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser EV23/0262
February 26, 2020

Mr. Kevin Donaldson
Miccosukee Tribe of Indians
PO Box 44021
Miami, FL 33144

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT, TRAINING OPERATIONS AT PINECASTLE RANGE COMPLEX, FLORIDA

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    - Sea search and rescue training and mine warfare exercises in Lake George.
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    - Temporary electronic warfare equipment (i.e., man-portable air defense systems and mobile threat emitters) may be installed to support flare operations.
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    - Helicopter training operations may include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crewmember by winch for search and rescue training.
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Places (NRHP) and no additional archaeological investigation was recommended. The survey report concludes that due to the results of the predictive model and the large area examined during the survey, it is unlikely that NRHP-eligible archaeological resources are located at the Pinecastle Range (Johnson 1999). The Florida State Historic Preservation Officer (SHPO) concurred with the findings of the survey in a letter dated December 20, 1999.

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The analysis of GIS and secondary sources indicated that the majority of the listings within the Lake George Range are not associated with cultural resources. Although twelve archaeological sites have been identified within .5 miles of Lake George, there are no known terrestrial archaeological sites located within the Lake George Range. A submerged Paleoindian site (8PU1470) and the shipwreck Isis have been identified in Lake George but they are located outside of the limits of the range (Thulman 2009). The Krivor memorandum concludes by stating that the application of an archaeological predictive model indicates that there is a low probability for cultural resources being located in the Lake George Range. The Krivor report was referenced in the 2009 Jacksonville Range Complex Final Environmental Impact Statement (FEIS); the Florida SHPO responded to the FEIS with a "no comment" statement in a letter dated October 10, 2007.

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number of operations would increase under the Proposed Action, no changes are planned for the target areas at the Rodman Range. Existing SOPs for protection of cultural resource sites within the APE would continue.

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Sincerely,

W. B. POWERS, PE
Environmental Business Line Leader
By direction of the
Commanding Officer

Enclosure: Project Location Map

DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser EV23/0263
February 26, 2020

Mr. Theodore Isham, HPO
Seminole Nation of Oklahoma
PO Box 1498
Wewoka, OK 74884

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Commanding Officer

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser EV23/0264
February 26, 2020

Ms. Hope Lovemore
Miccosukee Tribe of Indians
PO Box 44021
Miami, FL 33144

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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser EV23/0265
February 26, 2020

Mr. Bradley Mueller
Compliance Review Specialist
Seminole Tribe of Florida
30290 Josie Billie Highway
Clewiston, FL 33440

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  - Aerial lasing operations for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.

- Lake George Range:
  - Sea search and rescue training and mine warfare exercises in Lake George.
  - Use of flares for small missile simulation.
  - Temporary electronic warfare equipment (i.e., man-portable air defense systems and mobile threat emitters) may be installed to support flare operations.
  - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft.

- Rodman Range:
  - Helicopter operations at landing zones and combat search and rescue training.
  - Helicopter training operations may include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crewmember by winch for search and rescue training.
  - Air-to-ground training for bombing exercises conducted by fixed-wing aircraft.

Anticipated future ground/airspace range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges.
  - Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, NAS Jacksonville, Naval Station Mayport, and the commercial airfield at Cecil Field.
  - Training events would usually occur over a three-week period consisting of approximately 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
  - Aircraft would fly in sections of four and be on-range approximately 20 to 40 minutes at a time
  - Total training at either range (Pinecastle or Rodman) would consist of approximately 180 events and 720 sorties annually.

No Action Alternative

Under the No Action Alternative, operations at PRC would continue at their current pace, tempo, and form.

Archaeological Resources

Pinecastle Range

Robert Johnson performed an intensive archaeological reconnaissance survey at the Pinecastle Range in 1999; the results are found in a report entitled *An Archaeological Reconnaissance Survey of a Portion of the U.S. Navy Pinecastle Range, Ocala National Forest, Marion County, Florida.* Prior to field investigations, a predictive model specific to Pinecastle Range was prepared by examining previously identified archaeological sites within a 625 square mile area that included the Pinecastle Range. Following preparation of the predictive model, a pedestrian and all-terrain vehicle reconnaissance survey was performed. The survey resulted in the identification of one prehistoric archaeological site (8MR2717) that consisted of a surface scatter of non-diagnostic prehistoric ceramic sherds. The site, located outside the current limits of Pinecastle Range, was determined not eligible for inclusion in the National Register of Historic

Places (NRHP) and no additional archaeological investigation was recommended. The survey report concludes that due to the results of the predictive model and the large area examined during the survey, it is unlikely that NRHP-eligible archaeological resources are located at the Pinecastle Range (Johnson 1999). The Florida State Historic Preservation Officer (SHPO) concurred with the findings of the survey in a letter dated December 20, 1999.

Rodman Range

Archaeological surveys were performed between 1996 and 1999 on the entire Rodman Range. These results were analyzed in 2015 by Robert Austin and Greg Hendryx in a report entitled *NRHP Evaluation of 12 Archaeological Sites at the Rodman Bombing Range, Putnam County, Florida*. The original surveys identified 12 sites and one archaeological occurrence within the boundaries of Rodman Range. The 2015 report recommended that four sites are eligible for listing in the NRHP (8PU1223, 8PU1225, 8PU1226, and 8PU1229) and eight sites lack integrity or research potential and are not eligible for listing (8PU1224, 8PU1227, 8PU1228, and 8PU1230-8PU1234). The Florida SHPO concurred with the findings of the 2015 report in a letter dated December 18, 2015.

Lake George Range

In 2009, a report entitled *Technical Memorandum Submerged Cultural Resource Predictive Model for the Jacksonville Range Complex* was prepared by Michael Krivor. This memorandum identified known cultural resources within three Potential Bottom Impact Areas located in the Jacksonville Range Complex Operations Area, including the Lake George Range. The analysis used several Geographic Information System (GIS) sources, including the National Oceanic and Atmospheric Administration Automated Wreck and Obstruction Information System, the U.S. Coast Guard Hazards to Navigation database, and the Florida State Master File, as well as several additional secondary sources.

The analysis of GIS and secondary sources indicated that the majority of the listings within the Lake George Range are not associated with cultural resources. Although twelve archaeological sites have been identified within .5 miles of Lake George, there are no known terrestrial archaeological sites located within the Lake George Range. A submerged Paleoindian site (8PU1470) and the shipwreck Isis have been identified in Lake George but they are located outside of the limits of the range (Thulman 2009). The Krivor memorandum concludes by stating that the application of an archaeological predictive model indicates that there is a low probability for cultural resources being located in the Lake George Range. The Krivor report was referenced in the 2009 Jacksonville Range Complex Final Environmental Impact Statement (FEIS); the Florida SHPO responded to the FEIS with a "no comment" statement in a letter dated October 10, 2007.

Effects Analysis
Archaeological Resources

The Navy has determined through survey and analysis of the Area of Potential Effects (APE) that there is a low potential for occurrence of intact archaeological sites that are eligible for listing in the NRHP. Although there are four archaeological sites eligible for listing on the NRHP on Rodman Range, these sites are located outside of the existing target areas. While the

number of operations would increase under the Proposed Action, no changes are planned for the target areas at the Rodman Range. Existing SOPs for protection of cultural resource sites within the APE would continue.

If previously unidentified sites are discovered during training activities, the steps identified in *SOP 5, Inadvertent Discoveries*, in the *NAS Jacksonville and Rodman Bombing Range Integrated Cultural Resources Management Plan* will be followed. If archaeological resources are inadvertently discovered, training activities will stop immediately, and the Cultural Resources Manager will be notified.

Based on the discussion above, we have determined that the implementation of the Proposed Action warrants a finding of NO HISTORIC PROPERTIES AFFECTED with respect to archaeological resources. We have sought concurrence with this finding with the Florida State Historic Preservation Officer pursuant to the terms of Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations found at 36CFR800: Protection of Historic Properties.

Available records indicate that there are no sacred sites or Traditional Cultural Properties in the APE of the Proposed Action. Please inform us of any questions, comments or concerns you may have with this project, or if you have any special knowledge of the area. The Navy will consult with your tribe in the event that sites of religious or cultural importance are identified; in the event that artifacts subject to the Native American Graves Protection and Repatriation Act of 1990 are identified the Inadvertent Discovery provisions found at 43 CFR 10.4 will be invoked.

If you have any questions regarding this matter, my point of contact is Dr. John Calabrese, Staff Archaeologist, who may be reached at commercial phone (904) 542-6985 or email: john.calabrese@navy.mil.

Sincerely,

W. B. POWERS, PE
Environmental Business Line Leader
By direction of the
Commanding Officer

Enclosure: Project Location Map

HISTORIC PRESERVATION OFFICE

SEMINOLE NATION OF OKLAHOMA

P.O. Box 1498

Wewoka, Oklahoma 74884

Phone: 405-234-5218

03/11/2020

To: Dr. John Calabrese

Staff Archaeologist

Greetings from Seminole Nation of Oklahoma,

This letter of response regarding request to review cultural site assessment is being provided by the Federally-Recognized Tribe Seminole Nation of Oklahoma's Historic Preservation Office. After reviewing all pertinent information and our records, we recommend a finding of "No Historic Properties Affected" for the proposed undertaking. The Seminole Nation of Oklahoma has no objection to the proposed, we concur.

Pine Castle Range Complex, Florida

Because of to the historic presence of our people in the project area, if inadvertent discoveries of human remains and related Native American Graves Protection and Repatriation Act, (NAGPRA) items occur in areas of existing or prior development. We request all work cease and the Seminole Nation of Oklahoma, and other appropriate agencies be immediately notified. It is the duty of the agency official to "acknowledge that Indian tribes and Native Hawaiian organizations possess special expertise in assessing the eligibility of historic properties that may possess religious and cultural significance to them."

If you have any questions, please feel free to contact me at (405) 234-5218 or by e-mail at Franks.D@sno-nsn.gov
T

Respectfully,

David Frank THPO

Historic and Cultural Preservation Specialist

Emily Ferguson

From: [redacted]
Sent:
To:

Cc:
Subject: FW: Pinecastle Range Complex STOF Consultation Letter

Categories: tribal consult

FYI

[redacted]
Subject: FW: Pinecastle Range Complex STOF Consultation Letter

For your records.

[redacted]
Subject: [Non-DoD Source] RE: Pinecastle Range Complex STOF Consultation Letter

Thank you for the additional info. No need for us to change anything in our comment/consultation letter.

Respectfully,

Bradley Mueller

[redacted]
Subject: RE: Pinecastle Range Complex STOF Consultation Letter

Mr. Mueller:

I did not accurately answer your question about the terrestrial component at the Lake George Range in my e-mail yesterday. The Navy in fact maintains three towers in the vicinity of the Lake George range for communications and observation of range activities.

Facility Number	Name	Year Built	Construction Type
18	9 Mile Point Tower	1968	Metal Tower
18A	100’ Antenna Tower 9 Mile Point	2007	Metal Antenna
19UC	Pine Island Tower	1968	Metal Tower

These towers are sited on a very small footprint and no ground-disturbing actions are planned for these within the EA currently under consideration. Survey was not undertaken during the 1968 construction of the observation towers, nor was it undertaken during construction of the antenna tower in 2007, as it is on the same site as the earlier 1968 construction. Should the Navy consider removing or altering these facilities, appropriate cultural resources consultation will occur.

Very Respectfully,

John Calabrese

John A. Calabrese, Phd
Staff Archaeologist
Naval Facilities Engineering Command Southeast
[redacted]

[redacted]
Subject: [Non-DoD Source] RE: Pinecastle Range Complex STOF Consultation Letter

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE

TRIBAL HISTORIC PRESERVATION OFFICE
SEMINOLE TRIBE OF FLORIDA
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CLEWISTON, FL 33440
THPO PHONE: (863) 983-6549
FAX: (863) 902-1117
THPO WEBSITE: WWW.STOFTHPO.COM

April 15, 2020

Subject: U.S. Navy – Pinecastle Range Complex, Florida.

THPO Compliance Tracking Number: 0032373

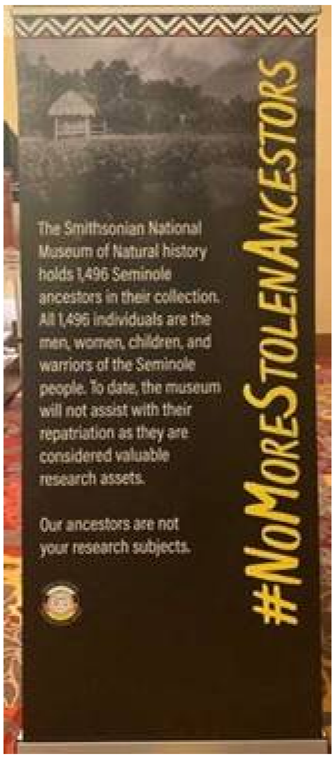
Dr. Calabrese,

Thank you for you quick response to my request or additional information. Based on your responses we have no objections to the proposed undertaking at this time. Please notify us if any archaeological, historical, or burial resources are inadvertently discovered during project implementation and feel free to contact us with any questions or concerns.

Respectfully,

Bradley M. Mueller

Bradley M. Mueller, MA, Compliance Specialist
STOF-THPO, Compliance Review Section
[redacted]



https://indiancountrytoday.com/news/seminole-museum-to-smithsonian-no-more-stolen-ancestors-3IEwu0-F-0Gv84kN0iQhJw

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[redacted]

Subject: Pinecastle Range Complex STOF Consultation Letter

Mr. Mueller:

Thank you for your letter dated 10 April 2020 regarding the Pinecastle Range Complex EA. I address your questions below.

Pinecastle Range

- Q. The 1999 Robert Johnson investigations were described as a reconnaissance survey. Considering that this work is now 20 years old would it meet today's best practices and comply with the Florida Division of Historical Resources *Module Three Guidelines for use by Historic Preservation Professionals*?
- A. Yes. The methodology employed by Johnson is consistent with current standards and approaches to work at the larger Pinecastle Range Complex.

- Q. Based on the title of the 1999 report it appears that only "…a portion of the U.S. Navy Pincecastle Range…" was surveyed. Are there still unsurveyed portions of the range that could be impacted by the proposed undertaking?

- A. All areas of the PRC that could subject to adverse effects from ongoing range activities have been surveyed (Johnson 1999). The Centroid Area and Administration Area were completely surveyed, while the Target and Safety Buffer Zone, which is not subject to active range use and management, was not surveyed. No ground-disturbing activities are planned for the Target and Safety Buffer Zone. The FL SHPO concurred with the survey methodology employed and provided concurrence with the Navy's finding of significance and effects for the Environmental Impact State for the Range at that time. We would not contemplate performing a survey today at Pinecastle Range in another manner.

Rodman Range

- Q. Archaeological surveys of the Rodman Range where reported to have occurred between 1996 and 1999. Similar to our first question above, how would those surveys compare to today's best practices? Did Austin and Hendryx comment on the quality of the field work in their 2015 analysis of the 1996 to 1999 work?
- A. The 1996 to 1999 fieldwork at Rodman Range was completed by 1999, but was not formalized as a report until 2015. SEARCH (Austin and Hendryx), under Navy supervision and in close coordination with the FL SHPO, analyzed the data generated by Johnson and the Navy made Determinations of Eligibility (DOEs) based on this analysis. FL SHPO concurred with our DOEs. I personally oversaw the 2015 Rodman effort and can attest to the quality of the earlier data and its sufficiency to make Determinations of Eligibility.

Lake George Range

- Q. The project location map the Navy provided indicates that the Lake George Range is entirely on or over water. Is there a terrestrial component to this Range? If there is, has that component been part of a Phase I Cultural Resources Assessment Survey?
- A. There is no terrestrial component to the Lake George Range.

If you have any further questions or comments, please do not hesitate to contact me.

Very Respectfully,

John Calabrese

[redacted]

Subject: [Non-DoD Source] Revised Pinecastle Range Complex STOF Consultation Letter

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE
AH-TAH-THI-KI MUSEUM

TRIBAL HISTORIC PRESERVATION OFFICE
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TRIBAL OFFICERS

MARCELLUS W. OSCEOLA JR.
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LAVONNE ROSE
SECRETARY

PETER A. HAHN
TREASURER

April 10, 2020

Dr. John Calabrese
Staff Archaeologist
Department of the Navy
[redacted]

Subject: U.S. Navy - Draft EA Pinecastle Range Complex Project, Florida
THPO Compliance Tracking Number: 0032373

Dear Dr. Calabrese,

This letter/email has been revised to show the correct original send date. Thank you for bringing this to my attention.

Thank you for contacting the Seminole Tribe of Florida – Tribal Historic Preservation Office (STOF-THPO), Compliance Section regarding the U.S. Navy - Draft EA Pinecastle Range Complex Project, Florida. The proposed undertakings fall within the STOF Area of Interest. We have reviewed the documents you provided and would like to request some additional information that would make it easier for us to send you our final comments. I have separated the questions by Range.

Pinecastle Range

- The 1999 Robert Johnson investigations were described as a reconnaissance survey. Considering that this work is now 20 years old would it meet today's best practices and comply with the Florida Division of Historical Resources *Module Three Guidelines for use by Historic Preservation Professionals*?

- Based on the title of the 1999 report it appears that only "…a portion of the U.S. Navy Pincecastle Range…" was surveyed. Are there still unsurveyed portions of the range that could be impacted by the proposed undertaking?

Rodman Range

- Archaeological surveys of the Rodman Range where reported to have occurred between 1996 and 1999. Similar to our first question above, how would those surveys compare to today's best practices? Did Austin and Hendryx comment on the quality of the field work in their 2015 analysis of the 1996 to 1999 work?

Lake George Range

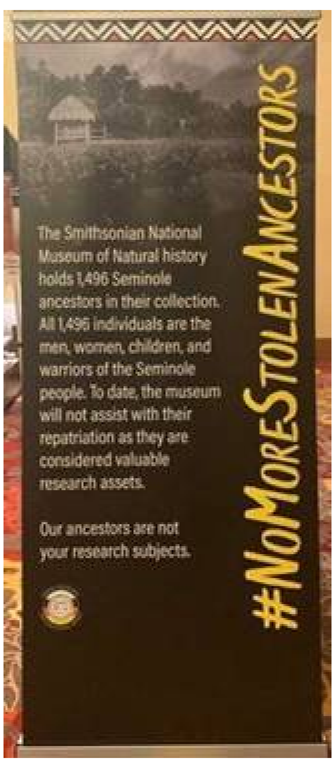
- The project location map the Navy provided indicates that the Lake George Range is entirely on or over water. Is there a terrestrial component to this Range? If there is, has that component been part of a Phase I Cultural Resources Assessment Survey?

Thank you again, we appreciate your assistance with this matter and look forward to hearing from you.

Respectfully,

Bradley M. Mueller

Bradley M. Mueller, MA, Compliance Specialist
STOF-THPO, Compliance Review Section
[redacted]



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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND SOUTHEAST
JACKSONVILLE, FL 32212-0030

5090
Ser EV23/0261
February 26, 2020

Mr. Jason Aldridge, Deputy SHPO
Florida Department of State
Compliance and Review Supervisor
Division of Historical Resources
500 South Bronough Street
Tallahassee, FL 32399-0250

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT, TRAINING OPERATIONS AT PINECASTLE RANGE COMPLEX, FLORIDA

The United States Navy (Navy) is preparing an Environmental Assessment (EA) for continuing operations at the Pinecastle Range Complex (PRC), located in and around the Ocala National Forest in north central Florida. The PRC includes two land ranges (Pinecastle Range and Rodman Range) and one freshwater range (Lake George Range). Pinecastle Range and a control area that is referred to as the Centroid Facility are located fully within the boundary of the Ocala National Forest; Rodman Range is just north of the Ocala National Forest; Lake George Range is east of the Ocala National Forest (Enclosure 1).

The purpose of this letter is to initiate consultation pursuant to the terms of Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations found at 36 CFR 800, with your office for effects and determinations of eligibility on architectural and archaeological resources located at Pinecastle Range, Rodman Range and Lake George Range.

The Proposed Action

The Proposed Action is to continue existing military readiness activities and conduct anticipated future military readiness activities at the PRC. Current training activities consist of aviation and ground activities at Pinecastle Range, Rodman Range, and aviation activities at Lake George Range. Collectively, these three ranges support rotary, fixed-wing, and tilt-rotor aircraft traveling from land military bases and sea-based military platforms. Anticipated future range mission requirements at the PRC include the incorporation of mobile and stationary electronic warfare equipment, and mission support for the A-29, F/A-18 Super Hornet, F-35, T-45 and other aircraft as identified in the 2017 Range Air Installations Compatible Use Zones (RAICUZ) Study. The continuation of existing operations include:

- Landing operations at Centroid/ United States Forest Service (USFS) Helibase/Pinecastle Range/Rodman Range by Marine Corps, Army, Air Force, Navy, and Coast Guard rotary-wing aircraft.
- Pinecastle Range:
    - Live ordnance training (including air-to-ground bombing), lasing, and strafing
    - Ground operations related to small arms fire

- Helicopter operations at Landing Zones and combat search and rescue training
- Aerial lasing operations for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.

- Lake George Range:
  - Sea search and rescue training and mine warfare exercises in Lake George
  - Use of flares for small missile simulation
  - Temporary electronic warfare equipment (i.e., man-portable air defense systems and mobile threat emitters) may be installed to support flare operations.
  - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft
- Rodman Range:
  - Helicopter operations at landing zones and combat search and rescue training
  - Helicopter training operations can include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crewmember by winch for search and rescue training.
  - Air-to-ground training for bombing exercises conducted by fixed-wing aircraft

Anticipated future ground/airspace range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges.
  - Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, NAS Jacksonville, NS Mayport, and the commercial airfield at Cecil Field.
  - Training events would usually occur over a three-week period consisting of approximately 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
  - Aircraft would fly in sections of four and be on-range approximately 20 to 40 minutes at a time
  - Total training at either range (Pinecastle or Rodman) would consist of approximately 180 events and 720 sorties annually.

No Action Alternative

Under the No Action Alternative, operations at PRC would continue at their current pace, tempo, and form.

Architectural Resources, Determinations of Eligibility
Pinecastle Range and Rodman Range

Pinecastle Range includes forty buildings/structures located within boundaries of the target and buffer area. These facilities are summarized in Table 1. Photographs of each facility are presented in Enclosure 2.

Table 1. Facilities at Pinecastle Range.

Facility Number	Name	Year Built	Construction Type
100	Range Headquarters Building	2012	Hardened Trailer
110	Communications Trailer	1985	Hardened Trailer
120	Contractor Administration Building	1985	Hardened Trailer
123	Cover, Vehicle Lift	2008	Metal Utility Cover
130	Facility Maintenance Supply	Post-1970	Hardened Trailer
131	Lawn Equipment Shed	2007	Metal Shed
134	Facility Maintenance Shop	2007	Metal Shed
143	Covered Fuel Storage	2007	Metal Utility Cover
146	Emergency Generator Cover	2007	Metal Utility Cover
147	Emergency Generator Switch Bldg.	1968	Cinder Block
148	Range Operation Q/C Office	Post-1970	Hardened Trailer
149	Range Operations Center	1968	Metal Building
150	Potable Water Pumphouse	2007	Metal Shed
151	Well Water Distribution	1985	Metal shed/Utility Cover
152	Helicopter Landing Pad	2007	Concrete Pad
155	110' Antenna Tower	1968	Metal Antenna
157	50' Antenna Tower	1968	Metal Antenna

158	150' Antenna Tower	1968	Metal Antenna
159	Electrical Equipment Storage	2016	Metal Shed
163	Electronic Equipment Storage	2007	Cinder Block Building
164	Electronic Equipment Storage	2007	Cinder Block Building
170	Wind Sock	2007	Metal/Fabric
171	ASOS System	2007	Metal Utility
221	Tower 2-1, Impact	1960	Metal Tower
222	Tower 2-2, Impact	1960	Metal Tower
223	North Tower, Impact	2013	Metal Tower
230	Pilot Safety Briefing	1985	Hardened Trailer
231	Building Over Well	2005	Metal Shed/Utility Cover
232	Well Water Distribution	1985	Metal
235	Impact Range ASOS	2007	Metal
236	Fuel Tank Cover	2008	Metal Utility Cover
237	Vehicle Wash Rack	2014	Metal Utility Cover
238	Compressor Well	2010	Metal Shed/Utility Cover
239	Vehicle Maintenance Shop	2008	Pre-fabricated Metal Building
241	Weighing Facility	2009	Metal Building
149A	Storage Shed	2007	Metal Shed
149B	Outdoor Storage Shed	2007	Metal Shed
E2	Vehicle Maintenance Shed	2007	Metal Shed
E3	Tool Storage Building	2007	Metal Shed
X22A	Ready Service Magazine	1968	Metal Munitions Storage

Rodman Range includes eight buildings/structures located within boundaries of the target and buffer area. These facilities are summarized in Table 2. Photographs of each facility are presented in Enclosure 2.

Table 2. Facilities at Rodman Range.

Facility Number	Name	Year Built	Construction Type
5QA	Observation Tower	1961	Metal Observation Tower
300	Repeater Building	2007	Metal Shed
301	200' Antenna Tower	2007	Metal
302	Unmanned Tower	1961	Metal Tower
303	Range Breakroom	1985	Hardened Trailer
304	Target Lighting Receiver Building	1961	Metal Shed
305	Manned Tower	1961	Metal Tower
306	Non-potable Water Pumphouse	Post-1970	Metal Shed/Utility Cover

Lake George Range includes four buildings/structures located within boundaries of the target and buffer area. These facilities are summarized in Table 3. Photographs of each facility are presented in Enclosure 2.

Table 3. Facilities at Lake George.

Facility Number	Name	Year Built	Construction Type
18	9 Mile Point Tower	1968	Metal Tower
18A	100' Antenna Tower 9 Mile Point	2007	Metal Antenna
19UC	Pine Island Tower	1968	Metal Tower
19UCA	200' Antenna Tower Pine Island	2007	Metal Antenna

All of the facilities at Pinecastle Range, Rodman Range, and Lake George Range have been used in support of the larger training mission of the Navy and other service branches since their respective construction dates. Facilities 147, 149, 155, 157, 158, 221, 222, and X22A at Pinecastle Range, Facilities 5QA, 302, 304 and 305 at Rodman range, and Facilities 18 and 19UC at Lake George Range exceed 50 years of age. Given the training function of the range, none of these facilities are not associated with any significant events or persons in the history of the nation, the region, or the locality. Similarly, none of these facilities are distinctive examples of an architectural style or associated with the work of a master nor do they exhibit research potential. As a result, the Navy has determined that none of these facilities possess those qualities of significance necessary for inclusion in the National Register of Historic Places (NRHP) under criteria A, B, C, or D.

By contrast, the remaining 38 facilities at all three locations constitute recent utility constructions that do not qualify for consideration to the NRHP as Criteria Consideration G resources.

Archaeological Resources

Pinecastle Range

Robert Johnson performed an intensive archaeological reconnaissance survey at the Pinecastle Range in 1999; the results are found in a report entitled *An Archaeological Reconnaissance Survey of a Portion of the U.S. Navy Pinecastle Range, Ocala National Forest, Marion County, Florida*. Prior to field investigations, a predictive model specific to Pinecastle Range was prepared by examining previously identified archaeological sites within a 625 square mile area that included the Pinecastle Range. Following preparation of the predictive model, a pedestrian and all-terrain vehicle reconnaissance survey was performed. The survey resulted in the identification of one prehistoric archaeological site (8MR2717) that consisted of a surface scatter of non-diagnostic prehistoric ceramic sherds. The site, located outside the current limits of Pinecastle Range, was determined not eligible for inclusion in the NRHP and no additional archaeological investigation was recommended. The survey report concludes that due to the results of the predictive model and the large area examined during the survey, it is unlikely that NRHP-eligible archaeological resources are located at the Pinecastle Range (Johnson 1999). The Florida State Historic Preservation Officer (SHPO) concurred with the findings of the survey in a letter dated December 20, 1999.

Rodman Range

Archaeological surveys were performed between 1996 and 1999 on the entire Rodman Range. These results were analyzed in 2015 by Robert Austin and Greg Hendryx in a report entitled *NRHP Evaluation of 12 Archaeological Sites at the Rodman Bombing Range, Putnam County, Florida*. The original surveys identified 12 sites and one archaeological occurrence within the boundaries of Rodman Range. The 2015 report recommended that four sites are eligible for listing in the NRHP (8PU1223, 8PU1225, 8PU1226, and 8PU1229) and eight sites lack integrity or research potential and are not eligible for listing (8PU1224, 8PU1227, 8PU1228, and

8PU1230-8PU1234). The Florida SHPO concurred with the findings of the 2015 report in a letter dated December 18, 2015.

Lake George Range

In 2009, a report entitled *Technical Memorandum Submerged Cultural Resource Predictive Model for the Jacksonville Range Complex* was prepared by Michael Krivor. This memorandum identified known cultural resources within three Potential Bottom Impact Areas located in the Jacksonville Range Complex Operations Area, including the Lake George Range. The analysis used several Geographic Information System (GIS) sources, including the National Oceanic and Atmospheric Administration Automated Wreck and Obstruction Information System, the U.S. Coast Guard Hazards to Navigation database, and the Florida State Master File, as well as several additional secondary sources.

The analysis of GIS and secondary sources indicated that the majority of the listings within the Lake George Range are not associated with cultural resources. Although twelve archaeological sites have been identified within .5 miles of Lake George, there are no known terrestrial archaeological sites located within the Lake George Range. A submerged Paleoindian site (8PU1470) and the shipwreck Isis have been identified in Lake George but they are located outside of the limits of the range (Thulman 2009). The Krivor memorandum concludes by stating that the application of an archaeological predictive model indicates that there is a low probability for cultural resources being located in the Lake George Range. The Krivor report was referenced in the 2009 Jacksonville Range Complex Final Environmental Impact Statement (FEIS); the Florida SHPO responded to the FEIS with a "no comment" statement in a letter dated October 10, 2007.

Effects Analysis

Architectural Resources

Under the Proposed Action, all the built facilities described above would be exposed to slightly higher aviation noise levels (65 dB DNL under the Proposed Action as compared to <65 dB DNL the No Action Alternative) and similar levels of noise exposure from air-to-ground bombing (70 CDNL under both the Proposed Action and No Action Alternative). The levels of noise exposure associated with the Proposed Action will not negatively affect the physical integrity of the architectural resources discussed above, irrespective of their NRHP status; none of the facilities will be altered or razed under the Proposed Action.

Archaeological Resources

The Navy has determined through survey and analysis of the Area of Potential Effects (APE) that there is a low potential for occurrence of intact archaeological sites that are eligible for listing in the NRHP. Although there are four archaeological sites eligible for listing on the NRHP on Rodman Range, these sites are located outside of the existing target areas. While the number of operations would increase under the Proposed Action, no changes are planned for the target areas at the Rodman Range. Existing SOPs for protection of cultural resource sites within the APE would continue.

5090
EV23/0261
February 26, 2020

If previously unidentified sites are discovered during training activities, the steps identified in *SOP 5, Inadvertent Discoveries*, in the *NAS Jacksonville and Rodman Bombing Range Integrated Cultural Resources Management Plan* will be followed. If archaeological resources are inadvertently discovered, training activities will stop immediately, and the Cultural Resources Manager will be notified.

Based on the discussion above, we have determined that the implementation of the Proposed Action warrants a finding of NO HISTORIC PROPERTIES AFFECTED with respect to both architectural and archaeological resources. As discussed above, we have also determined that neither the 14 built resources meeting or exceeding 50 years of age, nor those 38 facilities younger than 50 years at Pinecastle Range, Rodman Range and Lake George Range, qualify for inclusion in the NRHP. We seek your concurrence with these determinations pursuant to the terms of Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations found at 36CFR800: Protection of Historic Properties.

If you have any questions regarding this matter, my point of contact is Dr. John Calabrese, Staff Archaeologist, who may be reached at commercial phone (904) 542-6985 or email: john.calabrese@navy.mil.

Sincerely,

W. B. POWERS, PE
Environmental Business Line Leader
By direction of the
Commanding Officer

Enclosures: 1. Project Location Map
2. Photographs of Facilities

FLORIDA DEPARTMENT of STATE

RON DESANTIS
Governor

LAUREL M. LEE
Secretary of State

Mr. W.B. Powers
Environmental Business Line Leader
Naval Facilities Engineering Command Southeast
Jacksonville, Florida 32312

June 17, 2020

RE: DHR Project File No.: 2020-3385
Draft Environmental Assessment for the Training Operations at Pinecastle Range Complex
Marion, Putnam and Volusia Counties

Dear Mr. Powers:

The Florida State Historic Preservation Officer reviewed the referenced project in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, and its implementing regulations in *36 CFR Part 800: Protection of Historic Properties.*

We note that the Pinecastle Range Complex includes two land ranges (Pinecastle Range and Rodman Range) and one freshwater range (Lake George Range).

Pinecastle Range: Based on the information provided, this office concurs with your determinations that Facilities 100, 110, 120, 123, 130, 131, 134, 143, 146, 147, 148, 149, 150, 151, 152, 155, 157, 158, 159, 163, 164, 170, 171, 221, 222, 223, 230, 231, 232, 235, 236, 237, 238, 239, 241, 149A, 149B, E2, E3, and X22A do not appear to meet the criteria for listing in the *National Register*. Therefore, it is the opinion of this office the proposed undertaking will have no effect on historic properties conditioned that a contingency plan is in place in the event that fortuitous finds or unexpected discoveries are encountered during ground disturbing activities within the project area.

Rodman Range: Based on the information provided, this office concurs with your determinations that Facilities 5QA, 300, 301, 302, 303, 304, 305, and 306 do not appear to meet the criteria for listing in the *National Register*. Therefore, it is the opinion of this office the proposed undertaking will have no effect on historic properties conditioned that a contingency plan is in place in the event that fortuitous finds or unexpected discoveries are encountered during ground disturbing activities within the project area.

Division of Historical Resources
R.A. Gray Building • 500 South Bronough Street• Tallahassee, Florida 32399
850.245.6300 • 850.245.6436 (Fax) • FLHeritage.com

Lake George Range: Based on the information provided, this office concurs with your determinations that Facilities 18, 18A, 19UC, and 19UCA do not appear to meet the criteria for listing in the *National Register*. Therefore, it is the opinion of this office the proposed undertaking will have no effect on historic properties conditioned that a contingency plan is in place in the event that fortuitous finds or unexpected discoveries are encountered during ground disturbing activities within the project area.

If you have any questions, please contact Scott Edwards, Historic Preservationist, by electronic mail *scott.edwards@dos.myflorida.com*, or at 850.245.6333 or 800.847.7278.

Sincerely,

Jason Aldridge
For

Timothy A. Parsons, Ph.D.
Director, Division of Historical Resources
and State Historic Preservation Officer

APPENDIX F
COASTAL CONSISTENCY DETERMINATION

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Coastal Zone Management Act

In 1972, Congress enacted the CZMA to preserve, protect, develop, restore, and enhance the nation's coastal zone resources. The CZMA encouraged coastal states to develop comprehensive management plans to achieve these objectives. In response to this legislation, the State of Florida developed the Florida Coastal Management Program, which was approved by the National Oceanic and Atmospheric Administration in 1981. The Florida Coastal Management Program coordinates the actions of 11 agencies and five water management districts, using 24 Florida Statutes to ensure the wise use and protection of the state's coastal zone resources. The Florida Department of Community Affairs is the state's lead coastal agency responsible for coordinating the consistency review process under the Florida Coastal Management Program.

Provisions of the CZMA require Federal development projects conducted in designated coastal zones to be consistent with the policies contained in the respective state Coastal Management Plan. Florida has limited its federal consistency review of federally licensed and permitted activities to the federal licenses or permits specified in section 380.23(3) (c), Florida Statutes. As a federal agency, the Navy is required to determine whether the Proposed Action would affect the coastal zone. This determination is made in the form of a Coastal Consistency Determination or a Negative Determination. All elements of the Proposed Action in this EA were reviewed for consistency with the federally enforceable policies of the Florida Statutes that comprise the Florida Coastal Management Program consistency review. Based on this analysis presented in Table F-1 the Navy has determined the Proposed Action would be consistent, to the maximum extent practicable, with the enforceable policies of the Florida Coastal Management Program. The Navy submitted the Draft EA to Florida Clearinghouse and requested their concurrence with this determination.

Table F-1. Florida Coastal Zone Management Plan Consistency Determination

Florida Statute	***Scope***	***Consistency Determination***
Chapter 62, Asbestos Program	Requires a Notice of Asbestos Renovation or Demolition and must be submitted to FDEP at least 10 business days prior to initiating a facility demolition, or facility renovation that will disturb more than 160 square feet, 260 linear feet, or 35 cubic feet of regulated asbestos.	The Proposed Action does not involve military construction or changes to infrastructure.
Chapter 161, Beach and Shore Preservation	Authorizes the Bureau of Beaches and Coastal Systems within the FDEP to regulate construction on or seaward of the state's beaches.	The Proposed Action would not adversely affect coastal areas that could jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties, or interfere with public beach access. In addition, the Proposed Action would not remove vegetation on the coastal areas or construct structures on the beach or shore.

Table F-1. Florida Coastal Zone Management Plan Consistency Determination

Florida Statute	*Scope*	*Consistency Determination*
Chapter 163, Part II, Growth Policy; County and Municipal Planning; Land Development Regulation *Note: enforceable policy only includes Sections 163.3164;.3177(6)(a), (10)(h&l), & (11)(a&c);.3178(1) & (2)(d-j);.3180(2)(a-c), (5)(a&c), (6), & (8);.3194(1)(a);.3202(2)(a-h); and.3220(2)&(3).*	Requires local governments to prepare, adopt, and implement comprehensive plans that encourage the most appropriate use of land and natural resources in a manner consistent with the public interest.	There is no change in population that would affect growth management or urbanization, and no off-installation development would occur. In addition, there would be no destruction or damage to coastal resources.
Chapter 186, State and Regional Planning	Details state-level comprehensive planning requirements. Requires the development of goals, objectives, and policies for the social, economic, and physical growth of the state.	The Proposed Action was coordinated with the Florida State Clearinghouse during the planning process. The Proposed Action is consistent with the goals of this Chapter.
Chapter 252, Emergency Management	Provides for planning and implementation of the state's response to, efforts to recover from, and the mitigation of natural and manmade disasters.	The Proposed Action would have no effect on the state's vulnerability to natural disasters, nor affect the ability of the state to respond to or recover from natural or manmade disasters.
Chapter 253, State Lands *Note: Section 253.61(1)(d) is not approved as an enforceable policy.*	Addresses the state's administration of public lands and property of this state and provides direction regarding the acquisition, disposal, and management of all state lands.	Implementation of the Proposed Action does not require acquisition of state lands or change the status of the submerged land letter of consent for Lake George.
Chapter 258, State Parks and Preserves	Addresses administration and management of state parks, aquatic preserves, and recreation areas.	The Proposed Action would not result in a change to existing coordination with the Florida agencies administering state park, aquatic preserves, and recreation areas within the PRC.
Chapter 259, Land Acquisition for Conservation or Recreation	Addresses public ownership of natural areas for the purposes of maintaining the state's unique natural resources, promoting restoration activities on public lands, and providing lands for natural resource based recreation.	Implementation of the Proposed Action does not require acquisition of state lands, nor would the Proposed Action affect the manner in which state lands are managed.

Table F-1. Florida Coastal Zone Management Plan Consistency Determination

Florida Statute	*Scope*	*Consistency Determination*
Chapter 260, Recreational Trails System	Establishes a statewide system of greenways and trails in order to conserve, develop, and use the natural resources of Florida for recreational purposes.	Implementation of the Proposed Action does not require acquisition of state lands, nor would the Proposed Action adversely affect the greenways and trails system.
Chapter 267, Historical Resources	Addresses management and preservation of the state's archaeological and historical resources.	No known archaeological and historical resources are within the Proposed Action area. Furthermore, noise effects would not adversely affect the significance or integrity of NRHP-listed or eligible sites.
Chapter 288, Commercial Development and Capital Improvements *Note: Section 288.853 is not approved as an enforceable policy.*	Provides the framework for promoting and developing the general business, trade, and tourism components of the state economy.	The Proposed Action would not affect the promotion of natural, coastal, historical, or cultural tourism assets of the state, or affect its growth and economic development.
Chapter 334, Transportation Administration	Addresses the state's policy concerning transportation administration and establishes the responsibilities of the state, counties, and municipalities to assure the development of an integrated, balanced statewide transportation system.	The Proposed Action would not have an effect on the state's policy concerning transportation administration. In addition, the Proposed Action would not disrupt current transportation patterns or affect existing levels of traffic safety.
Chapter 339, Transportation Finance and Planning	Addresses the finance and planning needs of the state's transportation system.	The Proposed Action would not affect the finance and planning needs of the state's transportation system.
Chapter 373, Water Resources	Addresses sustainable water management; conservation of surface and ground waters; preservation of natural resources, fish, and wildlife; protection of public land; and promotion of health and welfare of Floridians.	The Proposed Action would not have additional impacts to water resources.
Chapter 375, Multipurpose Outdoor Recreation; Land Acquisition, Management, and Conservation	Addresses development of a comprehensive multipurpose outdoor recreation plan to document recreational supply and demand, describe current recreational opportunities, estimate need for additional recreational opportunities, and propose means to meet the identified needs.	The Proposed Action would not affect opportunities for recreation on state lands. There would be minor impacts to recreational access to the Ocala National Forest.
Chapter 376, Pollutant Discharge Prevention and Removal	Regulates transfer, storage, and transportation of pollutants, and cleanup of pollutant discharges.	The Proposed Action does not involve large-scale new construction or land disturbance; effects to water quality would not occur.

Table F-1. Florida Coastal Zone Management Plan Consistency Determination

Florida Statute	***Scope***	***Consistency Determination***
Chapter 377, Energy Resources *Note: Sections 377.06, .24(9), and 242(1)(a) are not approved as enforceable policies.*	Addresses the regulation, planning, and development of energy resources of the state.	The Proposed Action does not involve the exploration, drilling, or production of gas, oil, or petroleum products.
Chapter 379, Fish and Wildlife Conservation *Note: Sections 379.2251 and.362 are not approved as enforceable policies.*	Provides the framework for the management and protection of the state of Florida's wide diversity of fish and wildlife resources.	The Proposed Action would not affect the conservation, preservation, or management of the state's fish and wildlife resources.
Chapter 380, Land and Water Management *Note: Section 380.23(3)(d) is not approved as an enforceable policy.*	Establishes land and water management policies to guide and coordinate local decisions relating to growth and development.	The Proposed Action would not affect development of state lands with regional effects, change coastal infrastructure, or use state funds for infrastructure planning, designing, or construction.
Chapter 381, Public Health, General Provisions *Note: enforceable policy includes only Sections 381.001,.0011,.0012,.006, 0061,.0065,.0066, and.0067.*	Establishes public policy concerning the state's public health system.	The Proposed Action would not affect the state's public health system.
Chapter 388, Mosquito Control	Addresses mosquito control efforts in the state.	The Proposed Action would not affect mosquito control efforts.
Chapter 403, Environmental Control *Note: Section 403.7125(2) and (3) is not approved as an enforceable policy.*	Provides wide-ranging authority to address various environmental control concerns including air and water pollution, electrical power plan and transmission line siting, Interstate Environmental Control Compact, resource recovery and management, solid and hazardous waste management, drinking water protection, pollution prevention, ecosystem management, and natural gas transmission pipeline siting.	The Proposed Action would not result in any adverse effects. A copy of the EA has been sent to appropriate resource agencies including the Florida Department of Environmental Protection for review.
Chapter 553, Building and Construction Standards *Note: enforceable policy includes only Sections 553.73 and.79.*	Addresses building construction standards and provides for a unified Florida Building Code.	The Proposed Action does not involve military construction or changes to infrastructure.
Chapter 582, Soil and Water Conservation	Provides for the control and prevention of soil erosion, prevention of floodwater and sediment damages, and further	The Proposed Action does not involve military construction or changes to infrastructure.

Table F-1. Florida Coastal Zone Management Plan Consistency Determination

Florida Statute	*Scope*	*Consistency Determination*
	conservation, development, and use of soil and water resources.	
Chapter 597, Aquaculture	Establishes public policy concerning the cultivation of aquatic organisms in the state.	The Proposed Action would not affect aquatic organisms.

Emily Ferguson

From:	Biemiller, Stephen F CIV USN NAVFAC SE JAX FL (USA) [redacted]
Sent:	Monday, July 29, 2019 2:48 PM
To:	State.Clearinghouse@dep.state.fl.us
Cc:	Winz, Ryan D CIV USN USFFC (US); Emily Ferguson
Subject:	COASTAL CONSISTENCY DETERMINATION FOR TRAINING OPERATIONS AT PINECASTLE RANGE COMPLEX, FL
Attachments:	Enclosures 1 2 3.pdf

To Mr. Chris Stahl, Clearinghouse Coordinator,
Office of Intergovernmental Programs,
Florida Department of Environmental Protection

Greetings,

The Department of the Navy (Navy) is preparing an Environmental Assessment (EA) for training operations at the Pinecastle Range Complex. Training activities include air-to-ground explosive and non-explosive ordnance delivery, lasing, air-to-ground gunnery strafing, and ground-to-ground small arms qualification and weapons familiarization training. A description of the project is in Enclosure 1 (attached). The project's location/features maps and consistency review analysis are included in Enclosures 2 and 3, respectively (also attached).

The Navy is evaluating the impacts to environmental resources that may be affected by the Proposed Action. In accordance with the Coastal Zone Management Act and 15 CFR 930, the Navy has prepared a Coastal Consistency Determination and is requesting coordination with the Florida State Clearinghouse concerning the potential effects to coastal resources within the project area.

Based on the information and analysis presented in Enclosure 3, the Florida Coastal Management Program Consistency Review, we have concluded that the Proposed Action would be undertaken in a manner consistent to the maximum extent practicable with the enforceable policies of the federally approved Florida Coastal Management Program. In accordance with 15 CFR 930.36, the Navy requests concurrence with this determination. Please provide your response within 60 days of receiving this correspondence.

Thanks,

Stephen Biemiller
Biologist, NEPA Compliance (EV21)
Naval Facilities Engineering Command
Navy Region SE
[redacted]

Enclosure 1
Project Description

Background

The Pinecastle Range Complex (PRC) is a set of three individual separate bombing ranges that are located in and around the Ocala National Forest in north central Florida. The PRC includes two land ranges (Pinecastle Range and Rodman Range), and one freshwater range (Lake George Range). Pinecastle Range and a control area that is referred to as the Centroid Facility are located fully within the boundary of the Ocala National Forest. Rodman Range is just north of the Ocala National Forest while Lake George is just to the east. The Pinecastle Range is the Navy's only air-to-ground range on the East Coast that is authorized for the use of high explosives (Rodman and Lake George Ranges are inert-only ranges). The PRC is mainly used for air-to-ground ordnance delivery training for U.S. Navy and Marine Corps pilots, but is also used for ground-to-ground small arms qualifications and weapons familiarization training, and is used by the U.S. Air Force, U.S. Coast Guard, and other federal and state agencies and law enforcement organizations.

Proposed Action

The Proposed Action is to continue existing operations and conduct anticipated future training range missions at the PRC. Existing operations include current mission training consisting of aviation and ground operations at Pinecastle Range, Rodman Range, Lake George Range, which support rotary, fixed-wing, and tilt-rotor aircraft traveling from land and sea-based military air bases. Anticipated future range mission requirements at the PRC would include the incorporation of mobile and stationary electronic warfare equipment, and provide range mission support for the A-29, F/A-18 Super Hornet, F-35, T-45 and other various aircraft.

Purpose and Need

The purpose of the Proposed Action is to achieve, sustain, and maintain fleet training and aviation readiness using the PRC to support and conduct current, emerging, and future training activities; as well as support a renewed special use authorization with the U.S. Forest Service. The Proposed Action is needed to maintain and expand Fleet operational readiness to support national defense requirements under Title 10 United States Code (U.S.C.) section 5062. The proximity of the PRC to homeports and air stations in the Atlantic Fleet is a critical component of naval readiness. Naval forces must be prepared for a broad and changing range of capabilities—from full-scale armed conflict in a variety of different geographic areas to disaster relief efforts—prior to deployment. To learn these capabilities, personnel must train at the PRC with the equipment and systems they require to achieve military objectives. The Navy needs to continue use of the PRC to accomplish Navy and Marine Corps required aviation training, as well as use by other DoD and federal agencies.

Alternatives

The EA includes an analysis of potential environmental impacts associated with the Proposed Action and the No Action Alternative. The Proposed Action is the only action alternative that was analyzed in detail.

Proposed Action Alternative (Existing and Proposed Future Operations)
The continuation of existing operations include:

- Landing operations at Centroid/ U.S. Forest Service Helibase/Pinecastle Range/Rodman Range by Marine Corps, Army, Air Force, Navy, and Coast Guard rotary-wing aircraft.
- Pinecastle Range:
  - Live ordnance training (including air-to-ground bombing), lasing, and strafing
  - When air-delivered ordnance training is scheduled at the range under authorized conditions, an air support helicopter (located at the U.S. Forest Service helicopter base just outside the Pinecastle Range boundary) is on standby to suppress any wildfires as needed.
  - Ground operations related to small arms fire
  - Helicopter operations at Landing Zones and combat search and rescue training
  - Aerial lasing operations that are used for target designating; weaponized lasers are not used. Lasing can occur in combination with bombing operations or alone.
- Lake George Range:
  - Sea search and rescue training and mine warfare exercises in Lake George
  - Approved use of flares for small missile simulation
  - Temporary electronic warfare equipment (i.e., man-portable air defense systems and mobile threat emitters) can be installed to support flare operations.
  - Air-to-surface training for mine laying exercises conducted by fixed-wing aircraft
- Rodman Range:
  - Helicopter operations at Landing Zones and combat search and rescue training
  - Helicopter training operations can include training in a variety of aviation tasks including low-level flight and hoisting operations that involve lowering a crew member by winch for search and rescue training.
  - Air-to-ground training for bombing exercises conducted by fixed-wing aircraft

Anticipated future ground/airspace range missions would consist of the following:

- Training by Chief of Naval Air Training T-45 (Goshawk) aircraft at Pinecastle and Rodman Ranges.
  - Training staging and flying would originate from local existing airfields that are currently being used by DoD Services. These include, but are not limited to, NAS Jacksonville, Naval Station Mayport, and the commercial airfield at Cecil Field.
  - Training events would be over a three week period consisting of 60 events and 240 sorties, occurring under the regular training schedule and operating hours of when the designated range is open.
  - Aircraft would fly in sections of four and be on-range approximately 20 to 40 minutes at a time.
  - Total training at either range (Pinecastle or Rodman) would consist of 180 events and 720 sorties annually.

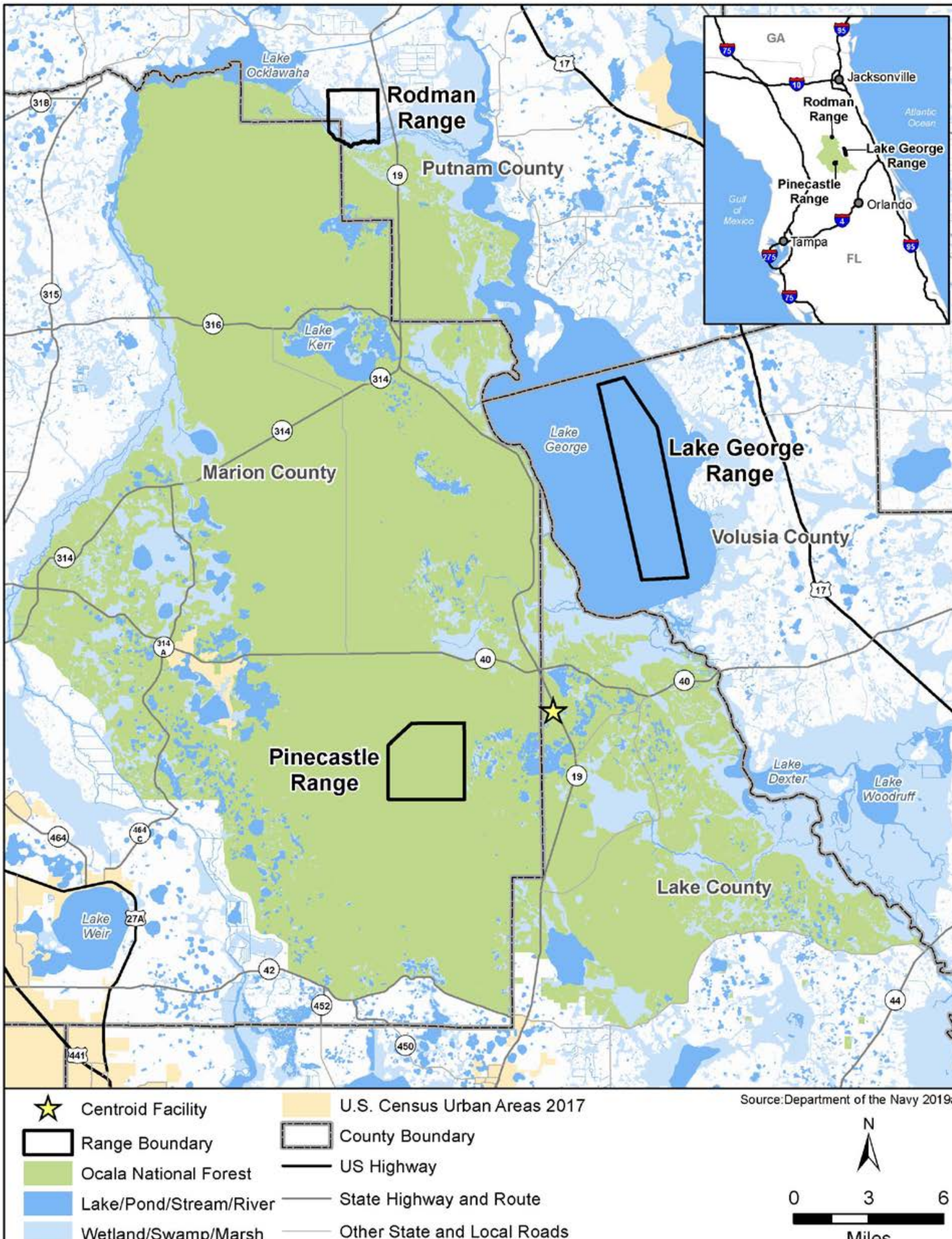
- Training for new aircraft to be introduced to the PRC.
  - Fixed-wing aircraft (e.g., T-45, and F-35).
  - Rotary-wing aircraft (e.g., UH-1 and H-53).

Additionally, the Navy is coordinating with the U.S. Forest Service in identifying several potential locations in the PRC for siting electronic warfare equipment. Fixed electronic warfare sites were located in the PRC from 1968 to mid-1990s until the permanent systems moved to MCAS Cherry Point, North Carolina. Pyrotechnic Simulators or flares are used during the electronic warfare threat training for visual cueing. The flare is composed of a sealed cartridge approximately 1.5 inches in length with a plastic igniter-less cartridge that is consumed in flight with no falling debris. Under the Proposed Action, the number of flare rounds expected to be used per year at the PRC is approximately 120-180.

No Action Alternative (Existing Operations Only)
Under the No Action Alternative, existing operations would continue, but there would be no new additional future training and range missions, and no new aircraft and associated operations would be introduced to the PRC. Mobile and stationary electronic warfare equipment and associated training operations would not be incorporated.

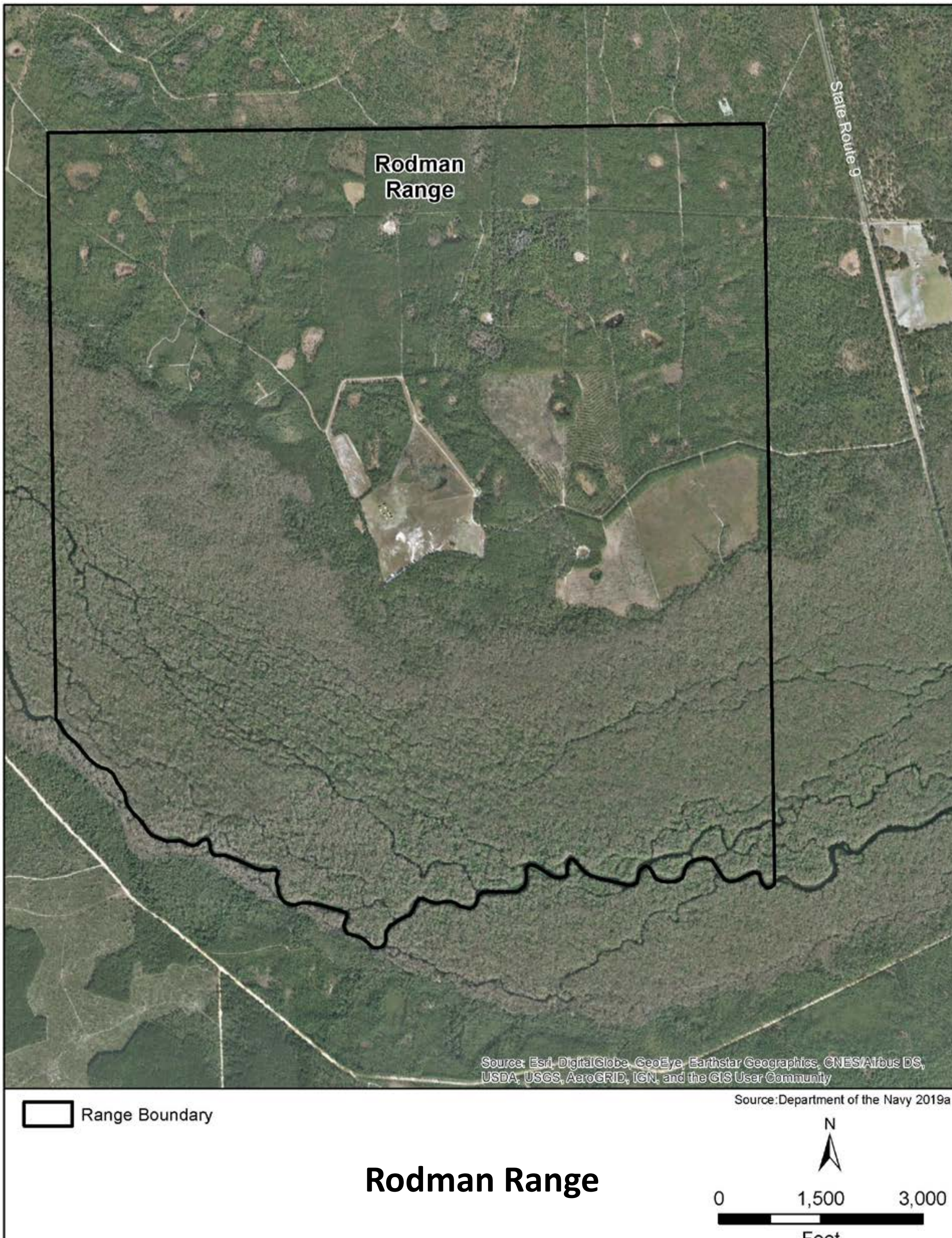
Maps and additional project description details are included in Enclosures 2 (maps) and 3 (coastal consistency review analysis).

Enclosure 2
Maps



Pinecastle Range Complex

Pinecastle Range



Rodman Range

Lake George Range

Enclosure 3

Florida Coastal Management Program Consistency Review

Florida's Coastal Management Program is composed of 24 Florida Statutes to ensure the wise use and protection of the state's coastal zone resources. The table below reviews the Proposed Action's consistency with the enforceable policies of the Florida Coastal Management Program.

Florida Statute	***Scope***	***Consistency Determination***
Chapter 62, Asbestos Program	Requires a Notice of Asbestos Renovation or Demolition and must be submitted to FDEP at least 10 business days prior to initiating a facility demolition, or facility renovation that will disturb more than 160 square feet, 260 linear feet, or 35 cubic feet of regulated asbestos.	The Proposed Action does not involve military construction or changes to infrastructure.
Chapter 161, Beach and Shore Preservation	Authorizes the Bureau of Beaches and Coastal Systems within the FDEP to regulate construction on or seaward of the state's beaches.	The Proposed Action would not adversely affect coastal areas that could jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties, or interfere with public beach access. In addition, the Proposed Action would not remove vegetation on the coastal areas or construct structures on the beach or shore.
Chapter 163, Part II, Growth Policy; County and Municipal Planning; Land Development Regulation *Note: enforceable policy only includes Sections 163.3164;.3177(6)(a), (10)(h&l), & (11)(a&c);.3178(1) & (2)(d-j);.3180(2)(a-c), (5)(a&c), (6), & (8);.3194(1)(a);.3202(2)(a-h); and.3220(2)&(3).*	Requires local governments to prepare, adopt, and implement comprehensive plans that encourage the most appropriate use of land and natural resources in a manner consistent with the public interest.	There is no change in population that would affect growth management or urbanization, and no off-installation development would occur. In addition, there would be no destruction or damage to coastal resources.
Chapter 186, State and Regional Planning	Details state-level comprehensive planning requirements. Requires the development of goals, objectives, and policies for the social, economic, and physical growth of the state.	The Proposed Action is being coordinated with the Florida State Clearinghouse during the planning process. The Proposed Action is consistent with the goals of this Chapter.
Chapter 252, Emergency Management	Provides for planning and implementation of the state's response to, efforts to recover from, and the mitigation of natural and manmade disasters.	The Proposed Action would have no effect on the state's vulnerability to natural disasters, nor affect the ability of the state to respond to or recover from natural or manmade disasters.

Florida Statute	*Scope*	*Consistency Determination*
Chapter 253, State Lands *Note: Section 253.61(1)(d) is not approved as an enforceable policy.*	Addresses the state's administration of public lands and property of this state and provides direction regarding the acquisition, disposal, and management of all state lands.	Implementation of the Proposed Action does not require acquisition of state lands or change the status of the submerged land letter of consent for Lake George.
Chapter 258, State Parks and Preserves	Addresses administration and management of state parks, aquatic preserves, and recreation areas.	The Proposed Action would not result in a change to existing coordination with the Florida agencies administering state parks, aquatic preserves, and recreation areas within the PRC.
Chapter 259, Land Acquisition for Conservation or Recreation	Addresses public ownership of natural areas for the purposes of maintaining the state's unique natural resources, promoting restoration activities on public lands, and providing lands for natural resource based recreation.	Implementation of the Proposed Action does not require acquisition of state lands, nor would the Proposed Action affect the manner in which state lands are managed.
Chapter 260, Recreational Trails System	Establishes a statewide system of greenways and trails in order to conserve, develop, and use the natural resources of Florida for recreational purposes.	Implementation of the Proposed Action does not require acquisition of state lands, nor would the Proposed Action adversely affect the greenways and trails system.
Chapter 267, Historical Resources	Addresses management and preservation of the state's archaeological and historical resources.	No known archaeological and historical resources are within the Proposed Action area. Furthermore, noise effects would not adversely affect the significance or integrity of NRHP-listed or eligible sites.
Chapter 288, Commercial Development and Capital Improvements *Note: Section 288.853 is not approved as an enforceable policy.*	Provides the framework for promoting and developing the general business, trade, and tourism components of the state economy.	The Proposed Action would not affect the promotion of natural, coastal, historical, or cultural tourism assets of the state, or affect its growth and economic development.
Chapter 334, Transportation Administration	Addresses the state's policy concerning transportation administration and establishes the responsibilities of the state, counties, and municipalities to assure the development of an integrated, balanced statewide transportation system.	The Proposed Action would not have an effect on the state's policy concerning transportation administration. In addition, the Proposed Action would not disrupt current transportation patterns or affect existing levels of traffic safety.
Chapter 339, Transportation Finance and Planning	Addresses the finance and planning needs of the state's transportation system.	The Proposed Action would not affect the finance and planning needs of the state's transportation system.
Chapter 373, Water Resources	Addresses sustainable water management; conservation of surface and ground waters; preservation of natural resources, fish, and wildlife; protection of public land; and	The Proposed Action would not have impacts to water resources.

Florida Statute	*Scope*	*Consistency Determination*
	promotion of health and welfare of Floridians.	
Chapter 375, Multipurpose Outdoor Recreation; Land Acquisition, Management, and Conservation	Addresses development of a comprehensive multipurpose outdoor recreation plan to document recreational supply and demand, describe current recreational opportunities, estimate need for additional recreational opportunities, and propose means to meet the identified needs.	The Proposed Action would not affect opportunities for recreation on state lands. There would be minor impacts to recreational access to the Ocala National Forest.
Chapter 376, Pollutant Discharge Prevention and Removal	Regulates transfer, storage, and transportation of pollutants, and cleanup of pollutant discharges.	The Proposed Action does not involve large-scale new construction or land disturbance; effects to water quality would not occur.
Chapter 377, Energy Resources *Note: Sections 377.06, .24(9), and 242(1)(a) are not approved as enforceable policies.*	Addresses the regulation, planning, and development of energy resources of the state.	The Proposed Action does not involve the exploration, drilling, or production of gas, oil, or petroleum products.
Chapter 379, Fish and Wildlife Conservation *Note: Sections 379.2251 and.362 are not approved as enforceable policies.*	Provides the framework for the management and protection of the state of Florida's wide diversity of fish and wildlife resources.	The Proposed Action would not affect the conservation, preservation, or management of the state's fish and wildlife resources.
Chapter 380, Land and Water Management *Note: Section 380.23(3)(d) is not approved as an enforceable policy.*	Establishes land and water management policies to guide and coordinate local decisions relating to growth and development.	The Proposed Action would not affect development of state lands with regional effects, change coastal infrastructure, or use state funds for infrastructure planning, designing, or construction.
Chapter 381, Public Health, General Provisions *Note: enforceable policy includes only Sections 381.001,.0011,.0012,.006, 0061,.0065,.0066, and.0067.*	Establishes public policy concerning the state's public health system.	The Proposed Action would not affect the state's public health system.
Chapter 388, Mosquito Control	Addresses mosquito control efforts in the state.	The Proposed Action would not affect mosquito control efforts.
Chapter 403, Environmental Control *Note: Section 403.7125(2) and (3) is not approved as an enforceable policy.*	Provides wide-ranging authority to address various environmental control concerns including air and water pollution, electrical power plan and transmission line siting, Interstate Environmental Control Compact, resource recovery and management, solid and hazardous waste management, drinking water protection,	The Proposed Action would be consistent with Ch. 403, F.S. The Proposed Action does not involve construction or development and proposed changes in munitions delivery would be at existing, established range sites with ongoing standard operating procedures and best management practices to avoid or minimize impacts to air and water resources.

Florida Statute	*Scope*	*Consistency Determination*
	pollution prevention, ecosystem management, and natural gas transmission pipeline siting.	There would be no new discharges of any pollutants into waters of the State. The Proposed Action would add CO_2 emissions from the combustion of fossil fuels. These emissions would constitute approximately a 0.1 percent increase over the existing greenhouse gas inventory in the three counties in which the proposed training activities would be located. This increase would not contribute to global warming to any discernable extent. The Proposed Action would not involve the use or generation of hazardous materials or wastes or toxic substances. The Proposed Action would result in an increase in sound levels, but the areas are already currently exposed to noise from aircraft operations and ordnance expenditure. The noise contours at Pinecastle Range and Lake George Range would extend beyond their range boundaries but no noise-sensitive receptors would be impacted in these areas. The Proposed Action's sound levels would not constitute a dramatic change to the intensity of noise in the local environment.
Chapter 553, Building and Construction Standards *Note: enforceable policy includes only Sections 553.73 and.79.*	Addresses building construction standards and provides for a unified Florida Building Code.	The Proposed Action does not involve building construction.
Chapter 582, Soil and Water Conservation	Provides for the control and prevention of soil erosion, prevention of floodwater and sediment damages, and further conservation, development, and use of soil and water resources.	The Proposed Action would not cause soil erosion, increase flood risk, or affect conservation, development, and use of soil and water resources.
Chapter 597, Aquaculture	Establishes public policy concerning the cultivation of aquatic organisms in the state.	The Proposed Action would not affect cultivation of aquatic organisms.

From:	Stahl, Chris
To:	Biemiller, Stephen F CIV USN NAVFAC SE JAX FL (USA)
Cc:	State_Clearinghouse
Subject:	[Non-DoD Source] State_Clearance_Letter_For_FL201907308687C_Environmental Assessment (EA) Scoping for Training Operations at the Pinecastle Range Complex in and near Ocala National Forest, Florida
Date:	Thursday, September 26, 2019 3:15:33 PM

September 26, 2019

Stephen Biemiller
Department of the Navy
NAVFAC Southeast - NEPA Compliance EV21
[redacted]

RE: Department of Defense, Department of the Navy, Environmental Assessment (EA) Scoping for Training Operations at the Pinecastle Range Complex in and near Ocala National Forest, Florida
SAI # FL201907308687C

Dear Stephen:

Florida State Clearinghouse staff has reviewed the original proposal as well as the additional riprap placement site under the following authorities: Presidential Executive Order 12372; § 403.061(42), Florida Statutes; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

The Florida Department of Environmental Protection, Central District has noted that the proposed project may require an ERP Permit. Please coordinate activities with the District office to ensure compliance. https://floridadep.gov/central/cd-permitting

If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.

Based on the information submitted and minimal project impacts, the state has no objections to the subject project and, therefore, it is consistent with the Florida Coastal Management Program (FCMP). Thank you for the opportunity to review the proposed plan. If you have any questions or need further assistance, please don't hesitate to contact me at (850) 717-9076.

Sincerely,

Chris Stahl

Chris Stahl, Coordinator
Florida State Clearinghouse
Florida Department of Environmental Protection
[redacted]

APPENDIX G
REGIONAL FORESTERS SENSITIVE SPECIES LIST

Species	Latin Name	Common Name	Habitat Associations
Amphibian	*Lithobates capito*	Gopher Frog	sandhill upland lake; depression marsh; mesic flatwoods, scrub, scrubby flatwoods, xeric
Amphibian	*Notophthalmus perstriatus*	Striped Newt	sinkhole lake; depression marsh; mesic flatwoods, scrub, scrubby flatwoods, sandhill;
Bird	*Antigone canadensis pratensis*	Florida Sandhill Crane	wet prairie, depression marsh, basin marsh, swale; dry prairie;
Bird	*Peucaea aestivalis*	Bachman's Sparrow	mesic flatwoods, upland pine forest, sandhill, dry prairie;
Crustacean	*Crangonyx hobbsi*	Hobbs' Cave Amphipod	aquatic cave
Crustacean	*Procambarus attiguus*	Silver Glen Springs Cave Crayfish	aquatic cave
Crustacean	*Procambarus delicatus*	Big Cheeked Cave Crayfish	aquatic cave
Fish	*Pteronotropis welaka*	Bluenose Shiner	medium river, low gradient, pool, spring-run stream, blackwater stream, alluvial stream;
Insect	*Danaus plexippus*	Monarch Butterfly	all terrestrial communities
Insect	*Hydroptila wakulla*	Wakulla Springs Vari-colored Microcaddisfly	medium river, creek, spring-run stream, blackwater stream;
Insect	*Libellula jesseana*	Purple Skimmer	sandhill upland lake;
Insect	*Melanoplus nanciae*	Ocala Claw-Cercus Grasshopper	scrub;
Insect	*Peltotrupes youngi*	Ocala Deepdigger Scarab Beetle	scrub;
Mammal	*Corynorhinus rafinesquii*	Rafinesque's Big-eared Bat	dome swamp, wet flatwoods, hydric hammock, floodplain forest, floodplain swamp, bottomland forest; upland hardwood forest, upland mixed forest; terrestrial cave
Mammal	*Myotis austroriparius*	Southeastern Bat	dome swamp, wet flatwoods, wet prairie, hydric hammock, floodplain forest, floodplain swamp, baygall, bottomland forest, depression marsh, basin marsh; mesic flatwoods, upland hardwood forest, upland glade, upland mixed forest, slope forest, scrub, scrubby flatwoods, xeric hammock, upland pine forest, sandhill; terrestrial cave
Mammal	*Perimyotis subflavus*	Eastern Pipistrelle	dome swamp, wet flatwoods, hydric hammock, floodplain forest, floodplain swamp, baygall, bottomland forest, basin swamp, alluvial forest; mesic flatwoods, slope forest, xeric hammock, maritime hammock, terrestrial cave, mesic hammock, upland mixed woodland;
Mammal	*Podomys floridanus*	Florida Mouse	scrub, scrubby flatwoods, xeric hammock, sandhill;
Mammal	*Sciurus niger shermani*	Sherman's Fox Squirrel	dome swamp; mesic flatwoods, scrub, scrubby flatwoods, upland pine forest, sandhill,
Mollusk	*Aphaostracon pycnus*	Dense Hydrobe Snail	spring-run stream;
Mollusk	*Floridobia alexander*	Alexander Siltsnail	medium river, spring-run stream;
Mollusk	*Floridobia leptospira*	Flatwood Siltsnail	spring-run stream;
Non-Vascular Plant	*Frullania donnellii*		
Reptile	*Crotalus adamanteus*	Eastern Diamondback Rattlesnake	seepage slope, dome swamp, wet flatwoods, wet prairie, strand swamp, slough, hydric hammock, floodplain forest, floodplain swamp, baygall, bottomland forest, marl prairie, bog, depression marsh, basin marsh, freshwater tidal swamp, basin swamp, swale, coastal interdunal swale; mesic flatwoods, upland hardwood forest, upland glade, upland mixed forest, rockland hammock, slope forest, scrub, scrubby flatwoods, xeric hammock, pine rockland, coastal berm, maritime hammock, upland pine forest, prairie hammock, beach dune, coastal strand, sandhill, shell mound, sinkhole, dry prairie, coastal rock barren, coastal grassland;
Reptile	*Gopherus polyphemus*	Gopher Tortoise	mesic flatwoods, scrub, scrubby flatwoods, xeric hammock, pine rockland, coastal berm, beach dune, coastal strand, sandhill, dry prairie, coastal grassland, upland mixed woodland;
Reptile	*Heterodon simus*	Southern Hognose Snake	depression marsh; scrub, xeric hammock, coastal berm, beach dune, coastal strand, sandhill, mesic hammock, upland mixed woodland, upland pine;
Reptile	*Sceloporus woodi*	Florida Scrub Lizard	scrub, sandhill;
Vascular Plant	*Calopogon multiflorus*	many-flowered grass-pink	mesic flatwoods
Vascular Plant	*Carex chapmanii*	Chapman's sedge	hydric hammock, floodplain forest;
Vascular Plant	*Centrosema arenicola*	sand butterfly pea	scrubby flatwoods, sandhill
Vascular Plant	*Cleistesiopsis bifaria*	Fernald's pogonia	seepage slope, wet flatwoods, wet prairie; mesic flatwoods
Vascular Plant	*Coelorachis tuberculosa*	Piedmont jointgrass	sandhill upland lake, marsh lake; wet prairie, depression marsh;
Vascular Plant	*Ctenium floridanum*	Florida toothache grass	wet flatwoods, depression marsh; mesic flatwoods, scrubby flatwoods
Vascular Plant	*Echinodorus tenellus*	dwarf burrhead	wet prairie, depression marsh, basin marsh;
Vascular Plant	*Forestiera godfreyi*	Godfrey's swampprivet	upland hardwood forest, slope forest
Vascular Plant	*Hartwrightia floridana*	hartwrightia	seepage slope, wet flatwoods, baygall, bog; mesic flatwoods
Vascular Plant	*Hasteola robertiorum*	Florida hasteola	hydric hammock;
Vascular Plant	*Illicium parviflorum*	star anise	spring-run stream, seepage stream; hydric hammock, baygall, bottomland forest;
Vascular Plant	*Litsea aestivalis*	pondspice	dome swamp, hydric hammock, baygall;
Vascular Plant	*Monotropsis reynoldsiae*	pygmy pipes	upland hardwood forest
Vascular Plant	*Myriophyllum laxum*	Piedmont water milfoil	blackwater stream; dome swamp, floodplain swamp;
Vascular Plant	*Najas filifolia*	narrowleaf naiad	blackwater stream; clastic upland lake, flatwoods/prairie lake, sandhill upland lake;
Vascular Plant	*Nemastylis floridana*	celestial lily	seepage slope, dome swamp, wet flatwoods, wet prairie; mesic flatwoods
Vascular Plant	*Nolina atopocarpa*	Florida beargrass	mesic flatwoods
Vascular Plant	*Parnassia grandifolia*	large-leaved grass-of-parnassus	spring-run stream, blackwater stream; seepage slope, dome swamp; mesic flatwoods
Vascular Plant	*Pinckneya bracteata*	fever tree	dome swamp, wet flatwoods, baygall;
Vascular Plant	*Polygala leptostachys*	Georgia milkwort	sandhill
Vascular Plant	*Pteroglossaspis ecristata*	giant orchid	mesic flatwoods, upland hardwood forest, scrubby flatwoods, pine rockland

Vascular Plant	*Pycnanthemum floridanum*	Florida mountain-mint	wet flatwoods, floodplain forest; upland mixed forest, sandhill
Vascular Plant	*Rhynchospora galeana*	Short-bristle Baldrush	wet flatwoods, wet prairie, depression marsh;
Vascular Plant	*Rhynchospora pleiantha*	coastal beaksedge	sandhill upland lake; depression marsh;
Vascular Plant	*Salix floridana*	Florida willow	spring-run stream; hydric hammock, bottomland forest;
Vascular Plant	*Spiranthes longilabris*	giant spiral ladies'-tresses	wet flatwoods, wet prairie;
Vascular Plant	*Sporobolus curtissii*	Curtiss' dropseed	wet flatwoods; mesic flatwoods
Vascular Plant	*Stylisma abdita*	scrub stylisma	scrub, sandhill
Vascular Plant	*Verbesina heterophylla*	variable-leaf crownbeard	mesic flatwoods, sandhill
Vascular Plant	*Vicia ocalensis*	Ocala vetch	spring-run stream;

Calopogon multiflorus	many-flowered grass-pink	mesic flatwoods
Carex chapmanii	Chapman's sedge	hydric hammock, floodplain forest;

Latin Name	**Common Name**	**Habitat Type**
Calopogon multiflorus	many-flowered grass-pink	mesic flatwoods
Carex chapmanii	Chapman's sedge	hydric hammock
Cleistesiopsis bifaria	Fernald's pogonia	mesic flatwoods & prairies
Coelorachis tuberculosa	Piedmont jointgrass	wet prairie, depression marsh
Ctenium floridanum	Florida toothache grass	mesic flatwoods
Echinodorus tenellus	dwarf burrhead	wet prairie, depression marsh
Forestiera godfreyi	Godfrey's swampprivet	upland hardwood forest
Hartwrightia floridana	hartwrightia	mesic flatwoods
Hasteola robertiorum	Florida hasteola	hydric hammock
Illicium parviflorum	star anise	spring-run stream
Litsea aestivalis	pondspice	hydric hammock
Monotropsis reynoldsia	pygmy pipes	upland hardwood forest
Myriophyllum laxum	Piedmont water milfoil	floodplain swamp
Najas filifolia	narrowleaf naiad	sandhill upland lake
Nemastylis floridana	celestial lily	mesic flatwoods
Nolina atopocarpa	Florida beargrass	mesic flatwoods
Parnassia grandifolia	large-leaved grass-of-parna	mesic flatwoods
Pinckneya bracteata	fever tree	wet flatwoods
Polygala leptostachys	Georgia milkwort	sandhill
Pteroglossaspis ecristat	giant orchid	mesic flatwoods
Pycnanthemum floridar	Florida mountain-mint	wet flatwoods, sandhill
Rhynchospora galeana	Short-bristle Baldrush	wet flatwoods, wet prairie
Rhynchospora pleianth	coastal beaksedge	sandhill upland lake
Salix floridana	Florida willow	spring-run stream
Spiranthes longilabris	giant spiral ladies'-tresses	wet flatwoods, wet prairie
Sporobolus curtissii	Curtiss' dropseed	wet flatwoods; mesic flatwoods
Verbesina heterophylla	variable-leaf crownbeard	mesic flatwoods, sandhill
Vicia ocalensis	Ocala vetch	spring-run stream