Integrated Natural Resources Management Plan (INRMP)

Puerto Rico Air National Guard

February 2021

Air National Guard
3501 Fetchet Avenue
Joint Base Andrews, MD 20762

Puerto Rico Air National Guard
Muñiz Air National Guard Base
Luis Muñoz Marín International Airport
Carolina, PR 00979

Under Contract With:
US Army Corps of Engineers, Baltimore District
2 Hopkins Plaza
Baltimore, MD 21201

Contract:
W912DR18D0005

Prepared by:

AECOM

12420 Milestone Center Drive
Suite 150
Germantown, MD 20876

SIGNATURE PAGE

This Integrated Natural Resources Management Plan (INRMP) has been prepared for the 156 Airlift Wing (156 AW) of the Puerto Rico Air National Guard (Puerto Rico ANG). The Puerto Rico ANG includes the Muñiz Air National Guard Base (hereafter referred to as the Muñiz ANGB) and two Geographically Separated Units (GSUs) located at Punta Salinas (140 Air Defense Squadron) and at Punta Borinquen (141 Air Control Squadron) to manage significant natural resources in support of the training mission. Significant natural resources include the presence of waters of the United States (WOTUS) including mangrove swamp forest and the Atlantic Ocean, corals and threatened and endangered species. This INRMP meets the intent of the Sikes Act (16 United States Code [USC] § 670a–670l, 74 Stat. 1052).

To the extent that resources permit, the US Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), Puerto Rico Department of Natural and Environmental Resources (*Departamento de Recursos Naturales y Ambientales*; DRNA), and Muñiz ANGB, by signature of their agency representative, do hereby enter into an agreement for the conservation, protection, and management of the natural resources present on Muñiz ANGB and its two Geographically Separated Units (GSUs): Punta Salinas Radar Station (Punta Salinas) and Punta Borinquen Radar Station (Punta Borinquen). This agreement may be modified and amended by mutual agreement of the authorize representatives of the four agencies. The agreement will become effective upon the date of the last signatory and shall continue in full force for a period of 5 years or until terminated by written notice to the other parties, in whole or in part, by any of the parties signing the agreement.

By their signatures below, or an attached sheet, all parties grant their concurrence with and acceptance of the following document.

Approving Officials:

BOONE.PETER.M.1024136163 Digitally signed by BOONE.PETER.M.1024136163 Date: 2021.03.13 09:54:47 -04'00' — 13 Mar 2021

Col. Peter Boone, Installation Commander
Puerto Rico Air National Guard — Date

EDWIN MUNIZ Digitally signed by EDWIN MUNIZ Date: 2021.03.02 11:10:26 -04'00' — Mar 2, 2021

Edwin Muñiz, Field Supervisor
US Fish and Wildlife Service — Date

BERNHART.DAVID.M.1066125889 2021.03.02 13:06:20 -05'00' — 3/2/2021

David Bernhart, Assistant Regional Administrator for Protected Resources
National Oceanic and Atmospheric Administration — Date

30 MAR 2021

Rafael A. Machargo Maldonado, Director
Puerto Rico Department of Natural and Environmental Resources — Date

ANNUAL REVIEW DOCUMENTS

This page is used to certify the annual review and coordination of the Puerto Rico INRMP.

With the signature below, this document acknowledges that the annual review and coordination of the INRMP has occurred for the specified year.

Year: 2021

Puerto Rico Air National Guard	Date
US Fish and Wildlife Service	Date
National Oceanic and Atmospheric Administration	Date
Puerto Rico Department of Natural and Environmental Resources	Date

ANNUAL REVIEW DOCUMENTS

This page is used to certify the annual review and coordination of the Puerto Rico INRMP.

With the signature below, this document acknowledges that the annual review and coordination of the INRMP has occurred for the specified year.

Year: 2022

Puerto Rico Air National Guard	Date
US Fish and Wildlife Service	Date
National Oceanic and Atmospheric Administration	Date
Puerto Rico Department of Natural and Environmental Resources	Date

ANNUAL REVIEW DOCUMENTS

This page is used to certify the annual review and coordination of the Puerto Rico INRMP.

With the signature below, this document acknowledges that the annual review and coordination of the INRMP has occurred for the specified year.

Year: 2023

Puerto Rico Air National Guard	Date
US Fish and Wildlife Service	Date
National Oceanic and Atmospheric Administration	Date
Puerto Rico Department of Natural and Environmental Resources	Date

ANNUAL REVIEW DOCUMENTS

This page is used to certify the annual review and coordination of the Puerto Rico INRMP.

With the signature below, this document acknowledges that the annual review and coordination of the INRMP has occurred for the specified year.

Year: 2024

Puerto Rico Air National Guard	Date
US Fish and Wildlife Service	Date
National Oceanic and Atmospheric Administration	Date
Puerto Rico Department of Natural and Environmental Resources	Date

ANNUAL REVIEW DOCUMENTS

This page is used to certify the annual review and coordination of the Puerto Rico INRMP.

With the signature below, this document acknowledges that the annual review and coordination of the INRMP has occurred for the specified year.

Year: 2025

Puerto Rico Air National Guard	Date
US Fish and Wildlife Service	Date
National Oceanic and Atmospheric Administration	Date
Puerto Rico Department of Natural and Environmental Resources	Date

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DOCUMENT CONTROL

Record of Review - In accordance with the Sikes Act, Department of Defense Instruction (DoDI) 4715.03, *Natural Resources Conservation Program*, Department of Defense Manual (DoDM) 4715.03, *INRMP Implementation Manual*, and Air Force Manual (AFMAN) 32-7003, *Environmental Conservation*, an Integrated Natural Resources Management (INRMP) is required to be reviewed annually to ensure plans and projects remain current, and every 5 years for operation and effect. Annual reviews and updates are accomplished through annual meetings led by the base Environmental Manager (EM) and attended by the USFWS, NOAA, and DRNA. During the annual meetings, actions taken over the previous year are discussed and actions to be taken over the coming year are discussed and agreed to. The meeting is followed up in writing for concurrence by the EM and the representatives from the USFWS, NOAA, and DRNA. As part of the annual and 5-year reviews, the EM shall also hold meetings with internal stakeholders to ensure all personnel and tenants are informed of INRMP requirements.

ACRONYMS

140 ADS	140th Air Defense Squadron
141 ACS	141st Air Control Squadron
156 AW	156th Airlift Wing
156 CES	156th Civil Engineering Squadron
°C	degrees Celsius
°F	degrees Fahrenheit
ACS	Air Control Squadron
ADS	Air Defense Squadron
AFB	Air Force Base
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFPAM	Air Force Pamphlet
AGE	Aerospace Ground Equipment
amsl	above mean sea level
ANG	Air National Guard
ANGB	Air National Guard Base
BA	Biological Assessment
BASH	Bird/Wildlife Aircraft Strike Hazard
BMP	Best Management Practice
CE	Civil Engineer
CECOS	Civil Engineer Corps Officers School
CEQ	Council on Environmental Quality
CFR	*Code of Federal Regulations*
COOP	Cooperative Observer Program
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
DEPARC	Defense Environmental Programs Annual Report to Congress
DoD	Department of Defense
DoDI	Department of Defense Instruction
DRNA	Puerto Rico Department of Natural and Environmental Resources (*Departamento de Recursos Naturales y Ambientales*)
DUSD	Deputy Under Secretary of Defense
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EM	Environmental Manager
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
ft	feet
FY	Fiscal Year

GHCN ID	Global Historical Climatology Network Identification Number
GSU	Geologically Separate Unit
ha	hectare
ICRMP	Integrated Cultural Resources Management Plan
IFAW	International Fund for Animal Welfare
INRMP	Integrated Natural Resources Management Plan
IPaC	Information for Planning and Consultation
IPM	Integrated Pest Management
IPMC	Installation Pest Management Coordinator
IRP	Installation Restoration Program
JD	Jurisdictional Determination
km	kilometer(s)
km^2	square kilometer(s)
LEDPA	Least Damaging Practicable Alternative
LMMIAP	Luis Muñoz Marín International Airport
m	meter(s)
MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSGP	Multi-Sector General Permit
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGB	National Guard Bureau
NGB/A4VN NRPM	NGB/A4VN Natural Resources Program Manager
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
OPR	Office of Primary Responsibility
OWS	Oil Water Separator
POL	Petroleum, Oil, and Lubricants
PRCCC	Puerto Rico Climate Change Council
RC	Response Complete
SWAP	State Wildlife Action Plan
SWPPP	Stormwater Pollution Prevention Plan
US	United States
USACE	US Army Corps of Engineers
USAF	US Air Force
USC	United States Code
USDA	US Department of Agriculture
USDA-WS	US Department of Agriculture, Wildlife Services
USEPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service
UST	Underground Storage Tank

WEG	Wind Erodibility Group
WOTUS	Waters of the United States
WQC	Water Quality Certification

1.0 EXECUTIVE SUMMARY

The Sikes Act Improvement Act of 1997, 16 United States Code (USC) § 670a et seq.**,** as amended, (herein referred to as the Sikes Act) requires federal military installations with significant natural resources to develop a long-range INRMP and implement cooperative agreements with other agencies. The Sikes Act is implemented through Department of Defense (DoD) and United States (US) Air Force (USAF) instructions and manuals. The conservation measures discussed in the INRMP help manage water and mangrove forest resources, reduce bird/wildlife aircraft strike hazard (BASH) risk, manage federal- and Commonwealth-listed species and sustain natural resources. The Puerto Rico INRMP is intended to be in support of and consistent with the intent of the Sikes Act.

The Puerto Rico INRMP is the primary guidance document and tool for managing natural resources on Muñiz Air National Guard Base (ANGB) and its two geographically separated units (GSUs)[1] (Punta Salinas Radar Station [Punta Salinas] and Punta Borinquen Radar Station [Punta Borinquen]), hereafter collectively referred to as Puerto Rico Air National Guard (Puerto Rico ANG). Muñiz ANGB occupies approximately 96.0 acres (38.8 hectares [ha]) on the eastern edge of the Luis Muñoz Marín International Airport (LMMIAP) in the municipality of Carolina, Puerto Rico. Punta Salinas occupies approximately 34.4 acres (12.1 ha) on the Punta Salinas peninsula in northern Toa Baja, Puerto Rico; Punta Borinquen occupies approximately 24.0 acres (9.7 ha) next to the Rafael Hernández Airport in Aguadilla, Puerto Rico. The primary federal mission of the Puerto Rico ANG is to achieve and maintain the level of operational readiness that will provide trained and equipped combat-ready tactical units, capable of global deployment, ready for immediate integration into the active USAF to assure air offense, air defense, or joint action with ground forces. The primary Commonwealth mission of the Puerto Rico ANG is to provide disaster relief in the event of natural calamity, maintain public peace and order, and support civil defense and pre-attack planning, as directed by the Governor of Puerto Rico. The Puerto Rico ANG facilities contain limited, but important habitat and species that require active natural resource management.

Natural resource management activities on Puerto Rico ANG facilities must be conducted in a way that complies with applicable environmental laws and regulations and provides for “no net loss” in the capability to support the military mission. This INRMP provides a structure and plan to manage natural resources effectively and ensures that facilities remain available to support the installation’s military mission into the future.

Specific goals in the Puerto Rico INRMP are supported by its objectives and work plans, as well as management strategies and specific actions. Goals and objectives are listed in Section 8.0, and work plans are summarized in Section 9.0. The Puerto Rico INRMP provides a description of the installation, the military mission, the environment on the installation, and specific plans and strategies for natural resource management designed for sustainable military training. The implementation of the Puerto Rico INRMP will ensure the successful accomplishment of the military mission while promoting adaptive management that sustains ecosystem and biological integrity and provides for multiple uses of natural resources.

[1] St. Croix Air Guard Station, US Virgin Islands is no longer a GSU of the Puerto Rico ANG. As a result of the devastation caused by Hurricane Maria to both territories, this GSU was transferred to the Michigan ANG for operational purposes.

2.0 GENERAL INFORMATION

2.1 Purpose and Scope

This INRMP is the primary guidance document and tool for natural resource management at Puerto Rico ANG facilities that provides for sustainable, healthy ecosystems, complies with applicable environmental laws and regulations, real estate leases and licenses, and provides for "no net loss" in the capability of installation lands to support the military mission. The Installation Commander and Environmental Manager (EM) can use the Puerto Rico INRMP to manage natural resources more effectively to ensure that installation lands remain available and in good condition to support the installation's military mission over the long-term. The Puerto Rico INRMP is consistent with the Sikes Act as required by the DoD, USAF, and the National Guard Bureau (NGB). A multiple-use approach is implemented to allow for the presence of mission-oriented activities, as well as protecting environmental quality through the efficient management of natural resources.

This INRMP solely directs lands under the management authority of the Puerto Rico ANGB. If Puerto Rico ANGB facilities acquire additional lands at some future time, updates of the INRMP will provide management direction for such additional lands and any applicable natural resources management issues. The comprehensive planning process, which incorporates logistics and operations of Puerto Rico ANG facilities, should incorporate the concerns presented in this INRMP, so that the growth of the installation can progress in a manner consistent with, and complementary to, the objectives of the USAF with respect to the protection of natural resources.

2.2 Management Philosophy

2.2.1 Ecosystem Management

Natural resources at Puerto Rico ANG facilities are managed with an ecosystem management approach as directed by Air Force Manual (AFMAN) 32-7003, *Environmental Conservation*, Department of Defense Instruction (DoDI) 4715.03, *Natural Resources Conservation Program* and Department of Defense Manual (DoDM) 4715.03, *INRMP Implementation Manual* (Table 1). Ecosystem management may be defined as management to restore and maintain the health, sustainability, and biological diversity of ecosystems while supporting sustainable economies and communities. The goal of ecosystem management on military lands is to ensure that military lands support present and future training and testing requirements while preserving, improving, and enhancing ecosystem integrity.

Ecosystem management provides a means for the USAF to conserve biodiversity and to provide high-quality military readiness. This INRMP is a mechanism through which Puerto Rico ANG facilities can maintain sustainable land use through ecosystem management. Each of the management strategies described in this INRMP should be monitored so that modifications can be made during implementation as conditions change. Human communities are entirely and completely dependent on the goods and services provided by our diverse ecosystems (Bernstein, 2008). Decline of these ecosystems, and the biodiversity within them, is one of the foremost limitations to human prosperity. Ecosystem sustainability is the key to both biological diversity and human existence. It is the goal of this INRMP to successfully integrate ecological sustainability with goals and objectives that will sustain human communities and the operational missions of Puerto Rico ANG facilities. By protecting a mosaic of habitats that support the greatest variety of life, this INRMP helps perpetuate viable, sustainable populations of native species, and the communities they compose. The protection of these species and communities, in turn, promotes the sustainability of functional ecosystems across the landscape.

Table 1. Elements and Principles of Ecosystem Management

DoDI 4715.03 Elements	
1	Avoid single-species management and implement an ecosystem-based multiple species management approach that is consistent with the requirements of the Endangered Species Act (ESA).
2	Use an adaptive management approach to manage natural resources-related issues such as climate change.
3	Evaluate and engage in the formation of local or regional partnerships that benefit the goals and objectives of the INRMP.
4	Use the best available scientific information in decision-making and adaptive management techniques in natural resource management.
5	Foster long-term sustainability of ecosystem services.
AFMAN 32-7003 Principles	
1	Maintain or restore native ecosystem types across their natural range where practical and consistent with the military mission.
2	Maintain or restore natural ecological processes such as fire and other disturbance regimes where practical and consistent with the military mission.
3	Maintain or restore the hydrological processes in streams, floodplains, and wetlands when feasible and practical and consistent with the military mission.
4	Use regional approaches to implement ecosystem management on an installation by collaboration with other DoD components as well as other federal, Commonwealth and local agencies, and adjoining property owners.
5	Provide for outdoor recreation, agricultural production, harvesting of forest products, and other practical utilization of the land and its resources, provided that such use does not inflict long-term ecosystem damage or negatively impact the ANG mission.

2.2.2 Biodiversity

Biodiversity is the degree of variation of life within a given ecosystem, region, or even the entire planet. The DoD's challenge is to manage for biodiversity in a way that supports the military mission. Specific management practices identified in the Puerto Rico INRMP have been developed to enhance and maintain biological diversity within the installation's ecosystems. Ecosystem management includes biodiversity conservation and invasive species control as integral parts of ecosystem management. ANG installations maintain or reestablish viable populations of all native species when practical and consistent with the military mission. ANG installations also identify the presence of exotic and invasive species and implement programs to control and/or eradicate those species. Finally, when feasible, ANG installations develop joint control strategies with other federal, Commonwealth, and local cooperating agencies and adjacent landowners to increase the effectiveness of control measures and for the benefits illustrated in Figure 1.

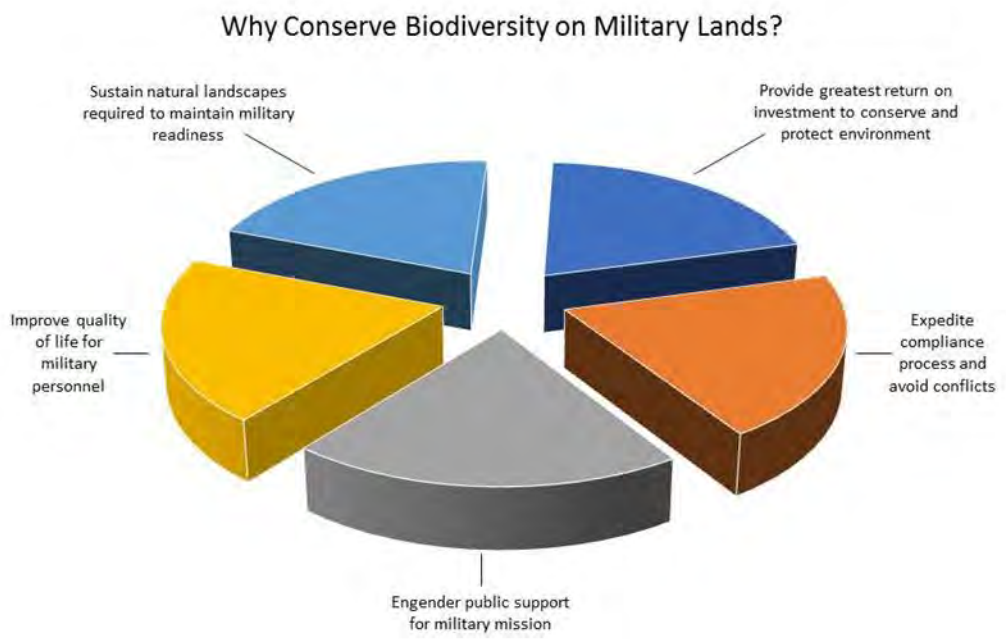


Figure 1. Why Conserve Biodiversity on Military Lands?
**Adapted from Keystone Center, 1996.*

2.3 Authority

2.3.1 Natural Resources Law, Regulations & Policy

The ANG, US Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), and the Puerto Rico Department of Natural and Environmental Resources (*Departamento de Recursos Naturales y Ambientales;* DRNA) determined an INRMP was required for the Puerto Rico ANG facilities due to the presence of significant natural resources such as water and mangrove forest resources and the Atlantic Ocean and federal and Commonwealth threatened and endangered listed species thereby necessitating conservation and management. To ensure proper consideration of fish, wildlife, and habitat needs, this INRMP was prepared in cooperation with the USFWS, NOAA, and DRNA. DoDI 4715.03, *Natural Resources Conservation Program*, identifies the DoD policies and procedures concerning natural resources management and INRMP reviews, public comment, and endangered species consultation. INRMPs are required to be jointly reviewed by the USFWS, NOAA, DRNA, and the ANG installation(s) for operation and effect on a regular basis, but not less than every 5 years. Minor updates and continued implementation of an existing INRMP do not require public comment. Major revisions to an INRMP do require an opportunity for public review. Specific projects in the INRMP may need informal or formal consultation under the Endangered Species Act (ESA) Section 7 at the time the projects begin the design process when impacts to natural resources are identified.

2.3.2 National Environmental Policy Act Compliance

The Environmental Impact Analysis Process (EIAP) is the process by which federal agencies facilitate compliance with environmental regulations. The primary legislation affecting these agencies' decision-making process is the National Environmental Policy Act of 1969 (NEPA; 42 USC § 4321 *et seq*.). NEPA requires that any organization using federal monies, proposing work on federal lands, or requiring a federal permit consider potential environmental consequences of proposed actions. The law's intent is to protect, restore, or enhance the environment through well-informed decisions.

The Council on Environmental Quality (CEQ) was established under NEPA for the purpose of implementing and overseeing federal policies as they relate to the NEPA process. The adoption of an INRMP can be considered a major federal action as defined by Section 1508.18 of the CEQ regulations. This requires an analysis of potential environmental impacts for the implementation of an INRMP, although a complete Environmental Assessment (EA) is not necessarily required as individual actions and projects for an INRMP typically undergo their own separate NEPA analysis.

The EIAP for the implementation of the Puerto Rico ANGB's 2015 INRMP was conducted in accordance with NEPA, CEQ *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 *Code of Federal Regulations* [CFR] § 1500-1508), and 32 CFR Part 989. The EIAP and decision-making process for the Proposed Action (implementation of the 2015 Puerto Rico INRMP) involved an examination of all environmental issues pertinent to the action proposed. Impact evaluations of the 2015 INRMP determined that no significant environmental impacts would result from implementation of the Proposed Action or any identified alternative. This determination was based on thorough review and analysis of existing resource information, and coordination with knowledgeable, responsible personnel from the Puerto Rico ANGB and other relevant local, Commonwealth, and federal agencies. A new EIAP is not required for this INRMP update as impacts to the environment have not changed since the initial EIAP analysis.

If a future action or project has the potential to impact the environment, the initial step in compliance with NEPA is to complete USAF Form 813 "Request for Environmental Impact Analysis". The form is prepared to aid in the development of the assessment, providing information on the proposed action and its alternatives, purpose, and potential environmental effects. This allows the proponent to identify potential environmental impacts early and facilitates making a determination about whether an EA or an Environmental Impact Statement (EIS) might be required for a specific action. Natural resources management actions in this INRMP at the time of implementation will be reviewed to determine if they qualify for a categorical exclusion, EA or would require an EIS depending on the impacts to the natural resources.

2.3.3 Responsibilities

The Puerto Rico INRMP has been organized to ensure the implementation of year-round, cost-effective management activities and projects that meet the requirements of the installation. Various personnel and organizations internal and external to the ANG that are responsible for the implementation of this INRMP are described in the following subsections.

2.3.3.1 *Installation Commander*

The Installation Commander oversees the installation and is responsible for ensuring that the goals and objectives of this INRMP are implemented to the fullest extent practicable based on funding and manpower availability. The Installation Commander is the official signatory for the Puerto Rico INRMP.

2.3.3.2 *Base Civil Engineer*

The Base Civil Engineer (CE) plans, budgets, approves, and oversees all maintenance and construction activities performed on the installation. All maintenance and construction-related projects or management activities proposed in this INRMP should be approved by the Base CE to ensure that funding is available and these projects are complementary to the installation's comprehensive planning processes.

2.3.3.3 *NGB/A4AM Natural Resources Program Manager*

The NGB/A4VN Natural Resources Program Manager (NGB/A4VN NRPM) is the technical point of contact on all natural resource related activities for the ANG. The NGB/A4VN NRPM tracks DoD and USAF policies and approves funding for projects identified as a priority in the Puerto Rico INRMP. The development of projects included in the INRMP and any deviations from those projects will be submitted to the NGB/A4VN NRPM for review. Decisions resulting from those reviews will be a cooperative effort between the NGB/A4VN NRPM and the EM and/or the installation's Natural Resources Manager, when applicable.

2.3.3.4 *Environmental Manager*

The EM plans, budgets, approves, and oversees all environmental activities performed on the installation and is responsible for ensuring that activities associated with the implementation of this INRMP adhere to applicable federal, Commonwealth, local, and USAF environmental regulations and guidelines. Projects proposed in the Puerto Rico INRMP are reviewed by the EM and the NGB/A4VN NRPM. The EM should independently review deviation from the projects proposed in this INRMP. Persons responsible for implementation of the INRMP are required to attend the Civil Engineer Corps Officers School (CECOS) DoD Natural Resources Compliance course (http://www.netc.navy.mil/centers/csfe/cecos/CourseDetail2.htm#tab25).

2.3.3.5 *Pest Management Coordinator*

The Installation Pest Management Coordinator (IPMC) is responsible for the control of undesirable and/or nuisance plants and animals (including insects), and prevention of damage to natural resources. Pest management personnel utilize Integrated Pest Management (IPM) approaches and are responsible for the implementation of the IPM Plan. The IPMC is also responsible for submitting monthly pesticide usage reports to the NGB/A4VN Pest Management Consultant. The IPMC is also responsible for coordinating with the installation's Public Health Officer and/or Medical offices to ensure monitoring efforts and control methods for potential disease vectors or animals of other medical importance are specified in the IPM Plan and reported on. The IPMC will coordinate pest management activities with the EM to ensure sensitive areas are identified and to ensure actions taken do not impact those sensitive areas. The IPMC will ensure the goals and objectives of pest management activities are explained in the INRMP and will report all pest management activities to the INRMP Working Group.

2.3.3.6 *Operations and Maintenance*

Operations and Maintenance personnel are responsible for all grounds maintenance activities on the installation. Operations and Maintenance personnel will assist the IPMC and the EM in the implementation of natural resource management projects when applicable. The Operations and Maintenance personnel will also periodically review grounds maintenance equipment to determine if new or additional equipment is needed for the proper maintenance of the installation's landscapes.

2.3.3.7 *Legal Office*

The Legal Office is responsible for ensuring the implementation of the management objectives contained within the Puerto Rico INRMP meet all regulatory and statutory requirements that pertain to natural resources management. The Legal Office will review any future natural resources management proposals and alert the Installation Commander and the EM should there be any regulatory conflicts or shortfalls. In addition, the Legal Office will keep participating INRMP parties informed of any new statutes or regulations that might affect natural resources management.

2.3.3.8 *Public Affairs Office*

The Public Affairs Office is responsible for the coordination of public access for events at Muñiz ANGB and its GSUs. The Public Affairs Office serves as the point of contact to interface between the Installation Commander and civilian groups interested in installations for environmental, educational, or other purposes.

2.3.3.9 *US Fish and Wildlife Service*

The USFWS is a signatory of the Puerto Rico INRMP and provides input regarding natural resource projects and operational component plans. The USFWS reviews and comments on the operations and effect update of the INRMP every 5 years and, when feasible, attends the task force meeting. The USFWS, when feasible, attends the annual meetings to discuss the status of the projects identified in the Annual Work Plans. At both the 5 year operations and effect and the annual meetings, the USFWS advises on the status of any pending additions or deletions to the federal threatened and endangered species list that have the potential for inhabiting Muñiz ANGB and its GSUs. When feasible the USFWS will support ANG wildlife and vegetation surveys conducted at Puerto Rico ANG facilities.

2.3.3.10 *National Oceanic and Atmospheric Administration*

The NOAA is a signatory of the Puerto Rico INRMP and provides input regarding natural resource projects and operational component plans with regard to the marine environment. NOAA reviews and comments on the operations and effect update of the INRMP every 5 years and, when feasible, attends the task force meeting. NOAA, when feasible, attends the annual meetings to discuss the status of the projects identified in the Annual Work Plans. At both the 5 year operations and effect and the annual meetings, NOAA advises on the status of any pending additions or deletions to the federal threatened and endangered species list, with respect to marine wildlife species, that have the potential for inhabiting Muñiz ANGB and its GSUs. When feasible NOAA will support ANG marine wildlife surveys conducted at Puerto Rico ANG facilities.

2.3.3.11 *Puerto Rico Department of Natural and Environmental Resources (Departamento de Recursos Naturales y Ambientales)*

The DRNA is the Commonwealth's environmental agency and is a signatory of the INRMP, providing input regarding natural resource projects and operational component plans. The DRNA reviews and comments on the operations and effect update of the INRMP every 5 years and, when feasible, attends the task force meeting. The DRNA, when feasible, also attends the annual meetings to discuss the status of the projects identified in the Annual Work Plans. At both the 5 year operations and effect and the annual meetings, the DRNA advises on the status of any pending additions or deletions to the Commonwealth threatened and endangered species list that have the potential for inhabiting Muñiz ANGB and its GSUs. Cooperation with the DRNA ensures the INRMP goals, objectives, and strategies are consistent with Puerto Rico's State Wildlife Action Plan (SWAP) (DRNA, 2015) . When feasible, the DRNA will support ANG wildlife and vegetation surveys conducted at Puerto Rico ANG facilities.

2.4 Integration with Other Plans

By its nature, an INRMP is multidisciplinary and provides a summary of natural resources and associated management at a specific installation. As a result, information from an INRMP is incorporated into other plans and other plans are written to support an INRMP. The Muñiz ANGB and its GSUs plans include the following:

- IPM Plan – provides a summary of management of pest species to minimize impact to mission, natural resources, and the environment (PRANG, 2019f).
- Stormwater Pollution Prevention Plan (SWPPP) – provides an overview of prevention and management of stormwater (PRANG, 2018c).
- 156th Airlift Wing (156 AW) BASH Plan – provides a summary of the BASH Program on Muñiz ANGB, including techniques, processes, responsibilities, and management recommendations (PRANG, 2020).
- Integrated Cultural Resources Management Plan (ICRMP) – provides an overview of known cultural resources at the Puerto Rico ANG facilities, and appropriate compliance and management activities (PRANG, 2010).

In addition, this INRMP is also integrated with the following plans from other agencies.

- Puerto Rico SWAP (DRNA, 2015). The DoD and ANG encourage integration of the SWAP as part of a comprehensive installation natural resources program.
- Luis Muñoz Marín International Airport Wildlife Hazard Management Plan. This Federal Aviation Administration (FAA)-approved plan directs BASH reduction efforts at and around the LMMIAP (Aerostar Airport Holdings LLC , 2013).

3.0 INSTALLATION OVERVIEW

3.1 Location and Area

3.1.1 Muñiz ANGB

Muñiz ANGB is located on the eastern edge of the LMMIAP property in the municipality of Carolina, approximately 7 miles (11.3 kilometers [km]) east of the city of San Juan, on the northern coast of Puerto Rico (Figure 3). The United States leases the land from the Puerto Rico Ports Authority and occupies approximately 91.5 acres (37.0 ha). The majority of the installation contains developed land in support of existing operations, upland scrub on artificial fill, and mangrove swamp forest on and directly adjacent to the installation. The Muñiz ANGB is bordered by mangrove swamp forest to the south and east, Laguna La Torrecilla to the east, a runway to the north, and airport facilities to the west (PRANG, 2015). The 156 AW is stationed at Muñiz ANGB. Muñiz ANGB also contains two GSUs: Punta Salinas Radar Station, which is home to the 140th Air Defense Squadron (140 ADS); and Punta Borinquen Radar Station, which is home to the 141st Air Control Squadron (141 ACS) (Figure 2), as described below.

3.1.2 Punta Salinas GSU

The Punta Salinas Radar Station occupies approximately 34.4 acres (13.9 ha) on the tip of the Punta Salinas peninsula (referred to as the Main Radar Site) and the adjacent East Island, in northern Toa Baja, Puerto Rico, approximately 5.5 miles (8.9 km) west of the city of San Juan and 12.4 miles (20.0 km) west of Muñiz ANGB (Figure 4). A causeway (East Island Road) connects the Main Radar Site to East Island (PRANG, 2015). The Main Radar Site is bound on the north by the Atlantic Ocean, by Bahía de Toa to the west, and by a public (recreational) beach at its southern boundary. East Island is surrounded by the Atlantic Ocean to the north, and by Ensenada de Boca Vieja to the east and south. East Island Road is located in the southwest, which connects to the Main Radar Site on the Punta Salinas peninsula (PRANG 2008). This causeway has created a crescent cove, known as La Playita, on its north side, separating the Main Radar Site and East Island. The majority of Punta Salinas consists of paved and developed land including roads, buildings, parking areas, areas of mowed maintained lawn, and deciduous forest along the hillsides.

Figure 2. Puerto Rico ANG Facilities Regional Map

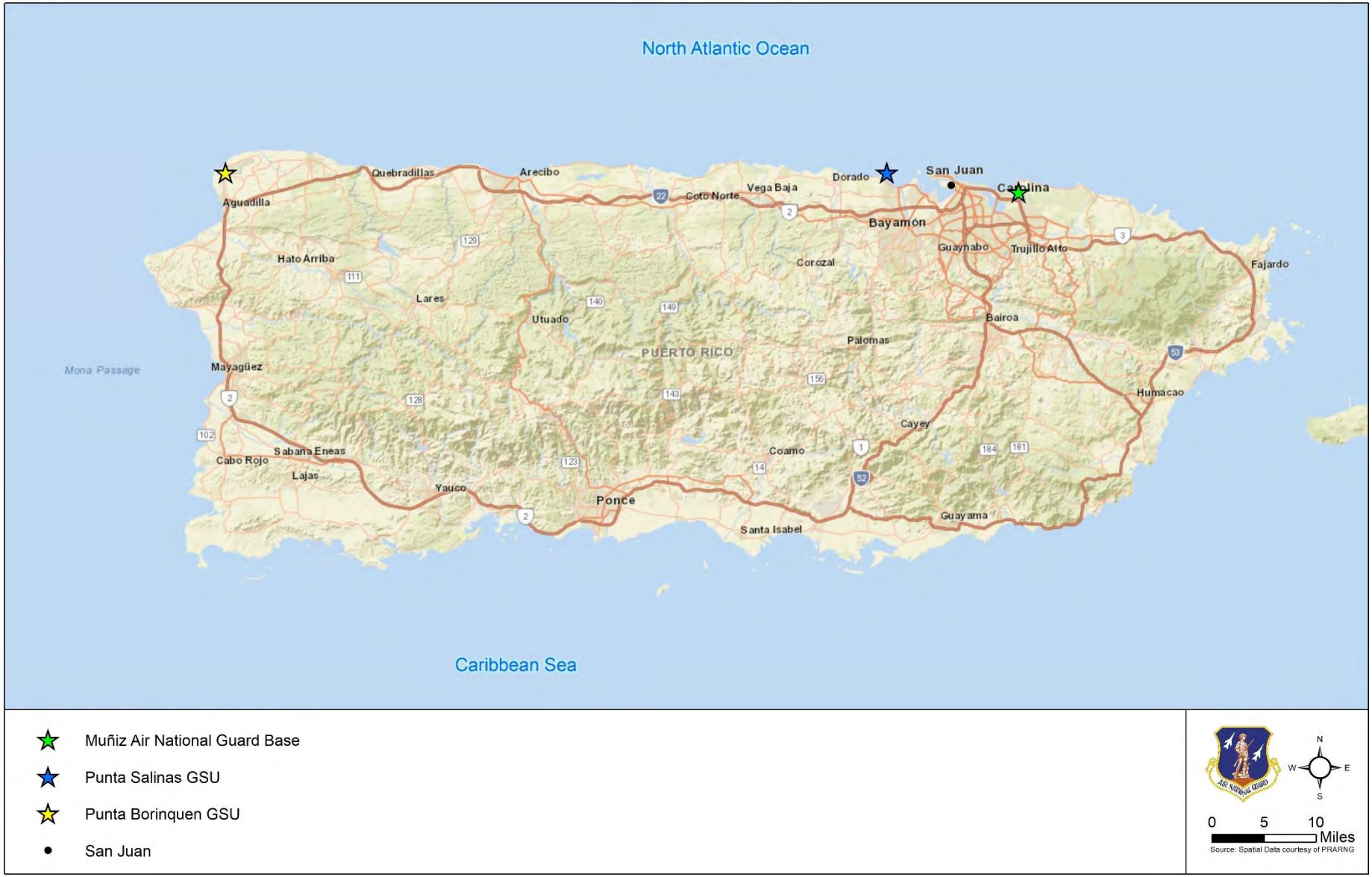


Figure 3. Muñiz ANGB Installation Map

Figure 4. Punta Salinas Radar Station Map

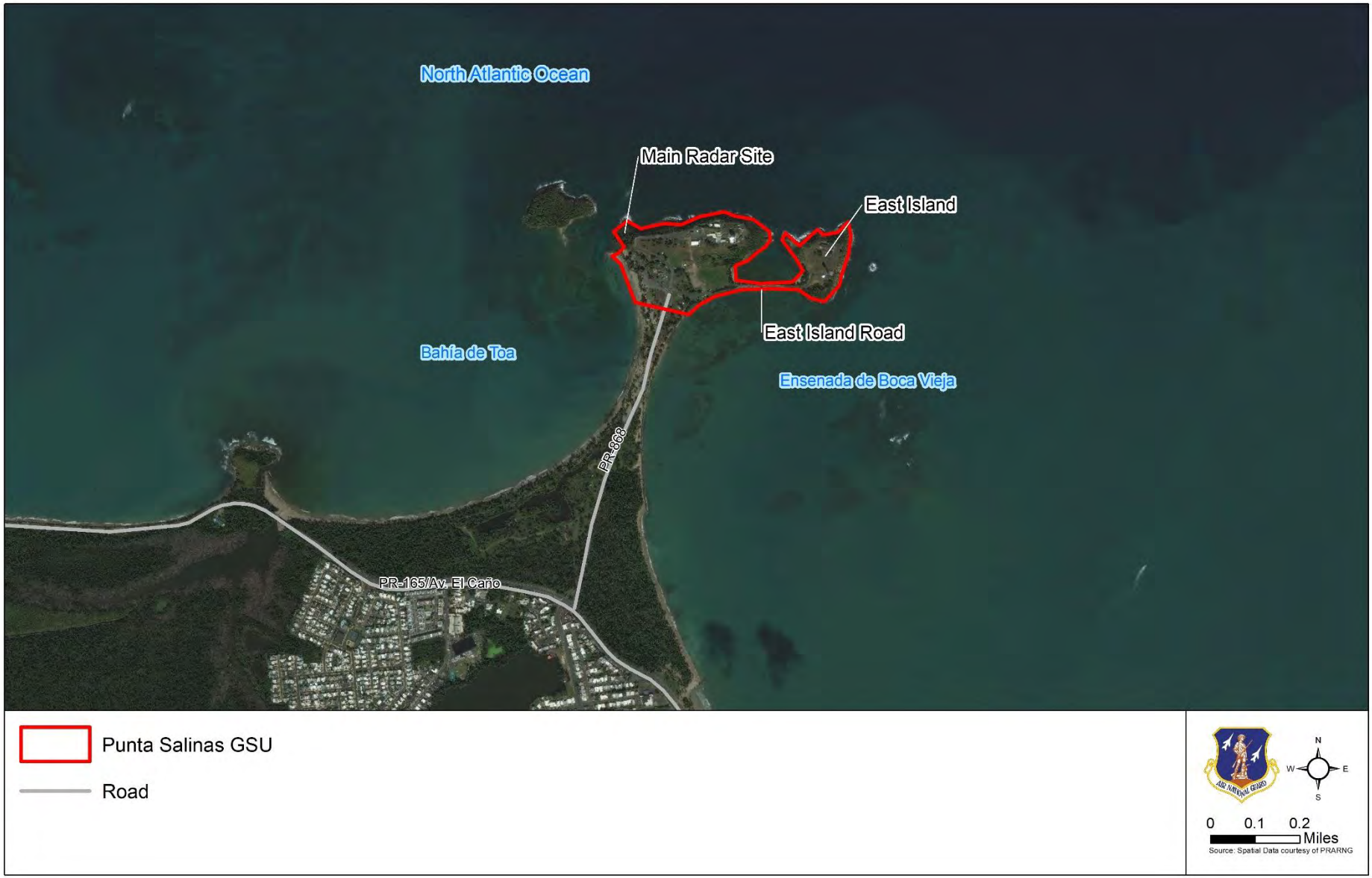


Figure 5. Punta Borinquen Radar Station Map

3.1.3 Punta Borinquen GSU

The 141st Air Control Squadron (ACS) is stationed at the Punta Borinquen Radar Station as a tenant of the Puerto Rico Ports Authority (Figure 5). The approximately 24-acre station is located in the municipality of Aguadilla, on the northwestern coast of Puerto Rico, and is located on the western end of the Rafael Hernández Airport. Aside from the airport to the west, Punta Borinquen is primarily surrounded by undeveloped forest and scrub-shrub areas. The majority of Punta Borinquen consists of paved and developed land including roads, buildings, and parking areas, as well as areas of mowed maintained lawn and forest.

3.2 Installation History

3.2.1 Muñiz ANGB

Prior to 1951, the location of the Muñiz ANGB and the immediate surrounding area included mangrove swamps and a lagoon. Development of the LMMIAP was completed in 1955. Its development resulted in the conversion of mangrove swamp and portions of the lagoon for airfield use. Initial facilities construction, at what was then named the Puerto Rico ANGB, began in 1953 with the construction of a hangar and aircraft parking apron. In 1954, the 198th Interceptor Squadron and the 156th Tactical Fighter Group began moving operations from Isla Grande Airport (to the west of San Juan) to the ANGB on the LMMIAP. The Puerto Rico ANGB was in 1963 renamed Muñiz ANGB. Prior to 2019, Muñiz ANGB had a flying mission with various types of assigned aircraft over the years, such as F-104s, A-7s, F-16s and C-130s. Currently, Muñiz ANGB has a contingency response mission and combat communication mission, and no longer supports assigned aircraft. Since the Puerto Rico ANG began operations at Muñiz ANGB, the major environmentally relevant activities at the installation have been fuel/oil storage and aircraft/vehicle/Aerospace Ground Equipment (AGE) maintenance activities (PRANG, 2015).

3.2.2 Punta Salinas GSU

Punta Salinas was first developed for modern military use by the US Army during World War II. The US Army established Fort Mascaro at the site in 1941. Prior to that time, the only structure known to occur on the property was the remains of Fort Castro, an old Spanish fort located on East Island. After World War II, Fort Mascaro served as a training and recreational area for local military personnel until 1954, when the Air Force took over ownership of land at the tip of the Punta Salinas peninsula and East Island. In 1969, the Secretary of the Air Force licensed the property on Punta Salinas, comprising a portion of the former Fort Mascaro, to the Commonwealth of Puerto Rico for a period of five years for use by the Puerto Rico ANG. This license was renewed a number of times, and then extended indefinitely in 1984.

3.2.3 Punta Borinquen GSU

In 1939, the site for a major new air base was selected at Punta Borinquen. In 1948, it was renamed Ramey Air Force Base and became an important Strategic Air Command station in Puerto Rico during the early Cold War, hosting the 72d Bombardment Wing. The 60th Bomb Squadron first operated the B-52 from August of 1959 to June of 1971 while assigned to the 72nd Bomb Wing at Ramey Air Force Base (AFB), Puerto Rico. In 1971, B-52 operations ceased at Ramey AFB. In November 1971, the air station relocated to its present location at what was then Ramey AFB in Aguadilla; it became known as Air Station Puerto Rico. Two years later in 1971, the Ramey AFB was deactivated, and in 1978 the airfield portion was transferred to the Puerto Rico Ports Authority for commercial airport operations. The Puerto Rico ANG is co-located at the Rafael Hernández Airport, with the Punta Borinquen facility physically located across the road of the airfield to the west; the airport also hosts the US Coast Guard and US Customs & Immigration Service.

3.3 Military Missions

The ANG has a dual mission, one federal and one for the Commonwealth. In the event of a national emergency, the 156 AW, 140 ADS, and 141 ACS may be ordered to active duty by the President of the United States. The primary federal mission is to achieve and maintain the level of operational readiness that will provide trained and equipped combat-ready tactical units, capable of global deployment, ready for immediate integration into the active USAF to assure air offense, air defense, or joint action with ground forces. The Commonwealth mission for the Puerto Rico ANG is to provide disaster relief in the event of natural calamity, maintain public peace and order, and support civil defense and pre-attack planning, as directed by the Governor of Puerto Rico.

The ANG may be called up by the Governor of Puerto Rico to assist Commonwealth and local authorities in the event of a disaster, disturbance, or other emergency. The 156 AW, 140 ADS, and 141 ACS support rescue and relief operations and aid in recovery operations to protect the Commonwealth and the citizens of Puerto Rico.

The Puerto Rico ANG facilities perform three unique missions in training and preparing the citizen-airman to respond to the call of protecting the people and property of Puerto Rico or the call of the President in times of crisis. The 156 AW at Muñiz ANGB transitioned in 2019 from a C-130 flying mission to a combat communication mission and a contingency response mission, which include an increase in security forces and civil engineering services. Muñiz ANGB, however, will still maintain its airfields. The combat communication mission is meant to ensure complete mission readiness in support of USAF requirements and to provide reliable communication services. The contingency response mission is to prepare a team for deployment to provide the first on-scene USAF forces trained to command and prepare for expeditionary aerospace forces. The 140 ADS at Punta Salinas Radar Station works with a variety of satellites and systems that provide individuals in the field with real-time space situational awareness (PRANG, 2015). Functions within the 140 ADS include airfield management, air traffic control, intelligence, flight records, current operations scheduling, training, weapons and tactics, plans and mobility, and weather forecasting and warning services. The 141 ACS at Punta Borinquen Radar Station provides a mobile radar command, control, and communications element in support of the US Air Force Theater Air Control System. The unit performs battle management, weapons, surveillance, identification, and data link management (ANG, 2020).

3.4 Surrounding Communities

3.4.1 Municipality of Carolina

Muñiz ANGB is located in San Juan County in the municipality of Carolina. Carolina occupies 46.5 square miles (120.5 square kilometers [km^2]) and has a population of 186,076 residents (US Census Bureau, 2020a). This municipality is bordered by the Atlantic Ocean to the north, the municipalities of Trujillo Alto and San Juan to the west, Juncos and Gurabo to the south, and Canóvanas and Loiza to the east. Carolina is part of the San Juan–Caguas–Guaynabo metropolitan statistical area, which is the largest metropolitan area in Puerto Rico by population. Carolina is considered one of the most important tourist centers on the island with LMMIAP being the Commonwealth's main airport (Rivera, 2020). Carolina contains 13 barrios or minor civil divisions that are considered "neighborhoods" of the municipality. Muñiz ANGB is in the Cangrejo Arriba barrio. The population of Cangrejo Arriba has decreased approximately 6.7 percent from 17,041 residents to 15,897 residents between 2010 and 2018 (US Census Bureau, 2020a).

3.4.2 Municipality of Toa Baja

Punta Salinas is located approximately 12 miles (19.3 km) west of Muñiz ANGB, in the municipality of Toa Baja on the northern coast of Puerto Rico. The Atlantic Ocean bounds Toa Baja to the north, while the municipalities of Toa Alta and Bayamón are to the south, Dorado to the west, and Cataño to the east. Toa Baja occupies approximately 24 square miles (62 km^2) and has a population of 74,623 residents (US Census Bureau, 2020b). Toa Baja is also a part of the San Juan–Caguas–Guaynabo metropolitan statistical area. Dominant industries in the municipality include metal, plastic, concrete, textiles, electronic products, and liquor (Puerto Rico Endowment for the Humanities, 2020a). Punta Salinas is within the Sabana Seca barrio of Toa Baja. The population of Sabana Seca has decreased approximately 12 percent from 55,655 to 49,027 residents between 2010 and 2018 (US Census Bureau, 2020b).

3.4.3 Municipality of Aguadilla

Punta Borinquen is located in the municipality of Aguadilla on the northwestern tip of Puerto Rico. Aguadilla is bordered by the Atlantic Ocean to the north and west, Aguada and Moca to the south, and Isabela to the east. This municipality has a total population of 54,166 residents over 76.3 square miles (198 km^2) and is part of the Aguadilla–Isabela–San Sebastián metropolitan statistical area, the second largest metropolitan area in Puerto Rico by population (US Census Bureau, 2020c). Main industries in Aguadilla include pharmaceuticals, rubber, plastics, leather, textiles, metals, wood, electronic equipment and food processing (Puerto Rico Endowment for the Humanities, 2020b). Punta Borinquen is within the Borinquen barrio of Aguadilla, which contains a population of 6,374 residents as of 2018. The population has decreased approximately 18 percent since 2010 (US Census Bureau, 2020c).

3.5 Local and Regional Natural Areas

Significant natural areas in the vicinity of Puerto Rico ANG facilities are those areas that retain examples of the region's native landscape (Figure 6).

3.5.1 Muñiz ANGB

Historically, the native landscape in this region was characterized by mangrove forests and swamps. Today, land immediately surrounding the installation is primarily developed. Historical lagoons and mangrove forests in the area were filled as the result of dredging the Laguna La Torrecilla and creating land for the LMMIAP and industrial properties to the north and west. Natural land cover includes the mangrove swamp to the south, as well as the Laguna La Torrecilla and associated forest and wetland habitat on the installation perimeter to the east. Natural areas occurring within 5 miles (8 km) of Muñiz ANGB include mangrove swamp, as well as the four lagoons of the San Juan Bay estuary and the Piñones State Forest.

- The four lagoons (the San José, La Torrecilla, Piñones, and Condado) of the San Juan Bay estuary are designated as a national programmatic estuary system managed by the US Environmental Protection Agency (USEPA) in cooperation with various agencies of the Government of Puerto Rico, and are described as follows (PRANG, 2015):
    - Laguna San José is the largest lagoon in the system and connects to the Bay of San Juan Martin Peña Canal and Laguna La Torrecilla by the Canal Suárez. The lagoon receives runoff from the Juan Méndez and San Antón creeks.
    - Laguna La Torrecilla, the second largest lagoon in the system, is connected to San Jose by the Canal Suárez and the Laguna Piñones by the channel of Piñones. Laguna La Torrecilla is connected to the Atlantic Ocean through the Boca de Cangrejos.

Laguna La Torrecilla receives water from down flows of the Canal Blasina, as well as the underground system of wetlands that surrounds it.

- Laguna Piñones is east of Laguna La Torrecilla and is a hydrological wetland depression in the mangrove forest, receiving groundwater and runoff from the south of the area. During major floods, the Río Grande de Loíza floods the Piñones forest. These flood waters eventually flow to Laguna Piñones.
- Laguna Condado is the smallest lagoon in the system and is connected to the San Juan Bay by the San Antonio Canal and the Atlantic Ocean opening. Its water source is dispersed urban runoff and groundwater.

- The Piñones State Forest, operated by the DRNA, is located slightly east of the city of San Juan, adjacent to the LMMIAP, and along the coast of the Atlantic Ocean. The forest includes coastline and beaches (Laguna La Torrecilla and Laguna Piñones) and a natural reserve of mangroves, palm trees, and pine forest.

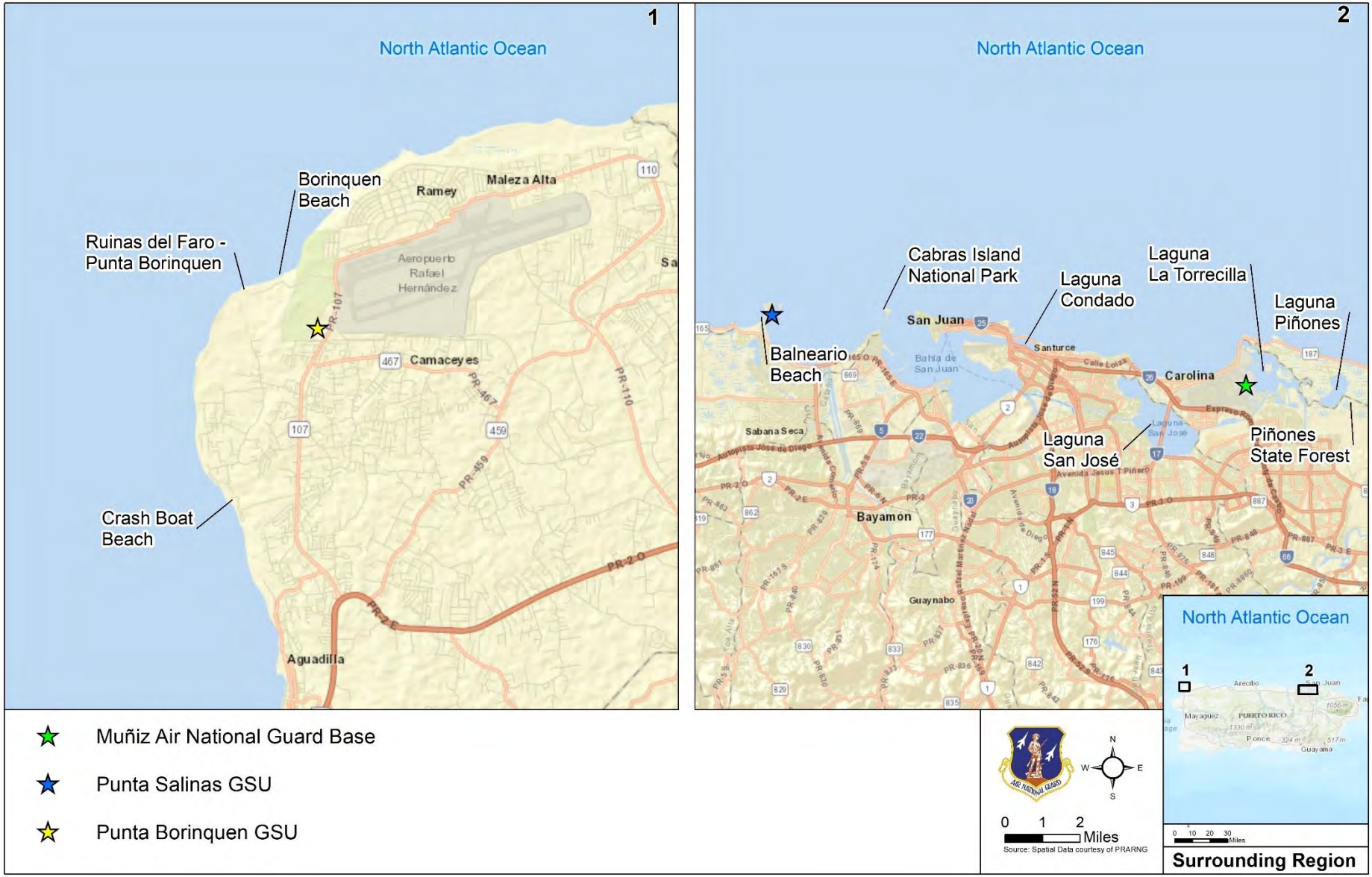
3.5.2 Punta Salinas GSU

Punta Salinas is surrounded to the north by the Atlantic Ocean, to the west by Bahía de Toa, and to the east by Ensenada de Boca Vieja. The southern boundary backs into the Balneario public beach on the western side of the peninsula. The public beach is used for swimming, fishing, kayaking, and many other recreational activities. The eastern side of the peninsula receives river runoff, which commonly litters the beach with trash and debris. As a result, public swimming in this area is not permitted. In addition, Cabras Island National Park is located approximately 3.1 miles (5.0 km) from Punta Salinas on the Isla de Cabras between Toa Baja and San Juan, Puerto Rico. The island park features a historic fort known as El Cañuelo built in the 1500s (and replaced by Spain in the 1600s). The stone fort remains today, as well as structural remnants of the leper colony that inhabited the island from the 1800s and 1900s.

3.5.3 Punta Borinquen GSU

Natural areas surrounding Punta Borinquen include the numerous beaches along the western coast of the island, less than 1 mile (1.6 km) away. The nearest public beach, Borinquen Beach (0.6 mile [1 km]), is a popular surfing area, while Crash Boat Beach (2 miles [3.2 km]) allows swimming, snorkeling, and kayaking. The Ruins of El Faro is a historical site adjacent to Borinquen Beach and contains the ruins of a lighthouse built in 1889 by the Spanish government. The lighthouse was severely damaged during an earthquake in 1918, but the ruins remain and are accessible to the public (Discover Puerto Rico, 2020).

Figure 6. Local and Regional Natural Areas near the Puerto Rico ANG Facilities



4.0 PHYSICAL ENVIRONMENT

4.1 Climate

The climate of northern Puerto Rico is characterized as tropical marine with warm, sunny days and a high relative humidity of 80 percent throughout most of the year. The normal average annual temperature ranges from a minimum of 75.4 degrees Fahrenheit (°F) (24.1° Celsius [C]) to a maximum of 86.7 °F (30.4°C). Annual total precipitation averages 56.4 inches, with the least rainfall occurring in January through March (NOAA, 2018). Hurricane season lasts from June to November, and contributes heavy rainfall and gusty winds (PRCCC, 2015).

Average monthly temperatures and precipitation data for Muñiz ANGB and Punta Salinas are based on data recorded at LMMIAP, as shown in Table 2. The nearest observation station to Punta Salinas is the Toa Baja Levittown Cooperative Observer Program (COOP) station. Insufficient data has historically been collected at this station to identify climate trends; however, due to the relatively close proximity of Punta Salinas to Muñiz ANGB, the climate data is likely similar between the two sites.

Table 2. Average Monthly Temperatures and Precipitation in the Muñiz ANGB and Punta Salinas Region, 1981-2010

Month	Average Low Temperature (°F)	Average High Temperature (°F)	Average Precipitation (inches)
January	72.0	83.2	3.76
February	72.0	83.7	2.39
March	72.9	84.9	1.95
April	74.4	86.2	4.68
May	76.3	87.5	5.90
June	77.7	88.9	4.41
July	78.1	88.7	5.07
August	78.2	89.2	5.46
September	77.8	89.2	5.77
October	76.9	88.4	5.59
November	75.2	85.9	6.35
December	73.4	83.9	5.02

Source: (NOAA, 2018)

Average monthly temperatures and precipitation data for Punta Borinquen are based on data recorded at Isabela Substation, as shown in Table 3. In comparison to Muñiz ANGB and Punta Salinas, the average temperatures are slightly lower year-round, while precipitation is slightly higher.

Table 3. Average Monthly Climate Data for Punta Borinquen GSU, 1981-2010

Month	Average Low Temperature (°F)	Average High Temperature (°F)	Average Precipitation (inches)
January	65.8	82.0	3.50
February	66.0	82.5	2.83
March	66.4	83.4	3.52
April	67.8	84.5	5.35
May	70.0	85.6	7.86
June	71.2	86.9	5.89
July	71.7	87.2	5.18
August	72.3	87.7	6.07
September	71.7	86.9	6.53
October	71.1	86.9	7.52
November	69.8	84.7	6.05
December	67.9	82.8	4.66

Source: (NOAA, 2020)

Climate Change

DoDI 4715.03 requires the INRMP to include an assessment of the potential impacts of climate change on natural resources and to adaptively manage such resources to minimize adverse mission impacts. In trying to project future climate scenarios, the Puerto Rico Climate Change Council (PRCCC) performed modeling with global climate models also used by the Intergovernmental Panel on Climate Change. The results of these studies generally predict warmer temperatures and a decrease in precipitation, with average projected temperature increasing by 1.26°F to 3.6 °F (0.7°C to 2°C) and average rainfall decreasing by a range of 10 to 20 percent by the end of the century (PRCCC, 2015).

The predicted average annual increase in temperature and decrease in precipitation is most likely to impact vegetation and water resources with further social and economic implications. Caribbean islands are likely to be more sensitive and vulnerable to climate change impacts when compared to mainland areas due to their size and isolation. Potential impacts in the Caribbean, including Puerto Rico, may include stronger and more frequent storms, ocean acidification, sea level rise, coastal erosion, saltwater intrusion, reduced agricultural productivity, and longer periods of drought, among others (USGCRP, 2018). Unique island ecosystems of Puerto Rico, such as coral reefs and mangrove forests already face stress from human activity, and are particularly sensitive to additional stresses from climate change (USEPA, 2016).

4.2 Landforms

The land area of Puerto Rico and adjacent islands is 3,435 square miles (8,897 km^2), with 311 miles (500 km) of coastline. The land cover is variable, with much of the center of the island consisting of high mountains (40 percent) surrounded by foothills (35 percent) and a narrow coastal plain (25 percent) (Miller & Lugo, 2009). The Puerto Rico ANG facilities are located in the coastal plains.

The topography of Muñiz ANGB is flat with an elevation range of 0 to 10 feet (ft) (0 to 3 meters [m]) above mean sea level (amsl) (PRANG, 2015). . The base is approximately 80 percent developed with buildings, paved roadways, and parking areas. The undeveloped portion of the installation consists of mangroves and tidal zones of Laguna La Torrecilla located to the east of the installation (PRANG, 2015).

Figure 7. Muñiz ANGB Landscape

Punta Salinas is located on a peninsula at an elevation of approximately 0 to 80 ft (0 to 24.4 m) amsl, with the highest elevation in the western portion of the site, and other high points at the developed portions of the Main Radar Site and East Island Site (Figure 8) (PRANG, 2018a; PRANG, 2015). The majority of the base contains paved and developed land including roads, buildings, parking areas, and maintained lawn. The undeveloped portion contains forested areas, beaches, and rocky shoreline (PRANG, 2018a).

Figure 8. Punta Salinas Landscape

Punta Borinquen is located slightly inland, and is approximately 0.6 mile (1.0 km) from the coastline. It has a flat topography with an elevation of approximately 240 to 260 ft (73.2 to 79.2 m) amsl, with the lowest elevation in the western portion of the site (Figure 9). The majority of the site is developed, and includes roads, buildings, parking areas, and mowed maintained lawn. Undeveloped areas within the site are located in the northern and western portions, and contain forested and scrub-shrub areas (PRANG, 2018b).

Figure 9. Punta Borinquen Landscape

4.3 Geology and Soils

The island of Puerto Rico consists of three physiographic provinces: the Uplands, the Northern Karst, and the Coastal Plains (Monroe, 1980). The Upland province includes the mountainous areas of Puerto Rico and associated foothills, and comprises the majority of the island's interior. The Northern Karst province is located north of the Uplands, and extends from Aguadilla, on the western coast, east to Loíza Aldea. This province contains thick limestone deposits from the Oligocene and Miocene Ages, and a variety of karst features, such as cones, sinks, caves, and mogotes (Monroe, 1980). The Coastal Plains province consists of lowlands that slope gently from the foothills to the sea, along all sides of the island. The Coastal Plains have been built up by surficial deposits consisting of sand, silt, and clay sediments from the Quaternary Age (PRANG, 2015).

Puerto Rico has a large variety of soils, with nine of the 11 possible soil orders found on the island. The majority of the island contains clayey soil types, which cover much of the interior areas. About 28 percent of the soils on Puerto Rico are suitable for agriculture, but these soils are rapidly disappearing due to development and urbanization (Miller & Lugo, 2009).

4.3.1 Muñiz ANGB

Muñiz ANGB is located within the Coastal Plains province on the northern side of Puerto Rico. The underlying geology at this facility is primarily Quaternary surficial deposits (Monroe, 1980). These deposits overlie the Aguada Limestone Formation from the Miocene Age, which contains approximately 246 feet (75 m) of clayey and chalky limestone that may contain scattered quartz or fossils (USGS, 2020a). Beneath the Aguada Limestone is the Cibao Formation from the Oligocene and Miocene Ages, with a maximum thickness of 853 feet (260 m) (USGS, 2020b). The Cibao Formation consists of interbedded marl, limestone, clay, sand, and gravel. This is underlain by the San Sebastián Formation from the Oligocene Age, which has a maximum thickness of 2,296.6 feet (700 m) and contains thick sandstone over volcanic, intrusive, and sedimentary rocks of the lower Tertiary and upper Cretaceous Ages (PRANG, 2015; USGS, 2020c). Muñiz ANGB is located on land consisting of artificial fill overlying swamp and marsh sediments.

Two soil types are mapped at Muñiz ANGB, artificial fill and "made land." Artificial fill is material from various sources used to fill low, swampy places to provide foundations for paved areas, including commercial, transportation, residential, and industrial development. The soil classified as "made land" consists of areas where the naturally occurring soil profile has been covered or destroyed by development (see Figure 10) (NRCS, 2020). No soil erodibility data is available for these soil types.

4.3.2 Punta Salinas GSU

Punta Salinas is located within the Coastal Plains province on the northern side of Puerto Rico. It has the same underlying geology and surficial deposits as Muñiz ANGB, as described above. The Punta Salinas peninsula and East Island, similar to other offshore islets in the Coastal Plains province, are formed by submerged cemented dunes. These dunes are Pleistocene, wind-deposited sands, cemented with calcium carbonate (PRANG, 2015; Monroe, 1980).

There are four soil series on Punta Salinas (NRCS, 2020). None of them characterized as hydric soils or prime farmland soils. The Tanama-Rock outcrop complex is in the northern part of the main radar site, and comprises the entire East Island. The rest of the main radar site is underlain by the Catano loamy sand, Tropopsamments, and Urban land-Durados complex. Generally, the soils on Punta Salinas have low susceptibility to erosion, as measured by the K-Factor. Values range from .05 to .10, which are relatively low on the scale from 0.02 for the least erodible soils to 0.64 for the most erodible. The wind erodibility group (WEG), which measures susceptibility to wind erosion, ranges from 1 to 4 on Punta Salinas. Soils assigned to WEG 1, such as Tropopsamments, are the most susceptible to wind erosion, while those assigned to group 8 are the least susceptible. Table 4 and Figure 11 further describe and display these soil series. Soil data were not available for the East Island access road (connecting the Main Radar Site and East Island Site), as it is a manmade causeway and does not contain natural soils.

Table 4. Soils Occurring on Punta Salinas GSU

Soil Mapping Unit Symbol	Soil Mapping Unit Name	Farmland Classification	Drainage Class	Hydric Soil?	K-Factor	WEG	Percent of Total Area (%)
Cn	Catano loamy sand, 0 to 2 percent slopes	Not prime farmland	Excessively drained	No	.05	2	12.5
TaF	Tanama-Rock outcrop complex, 20 to 60 percent slopes	Not prime farmland	Well drained	No	.10	4	65.7
Ts	Tropopsamments, 0 to 2 percent slopes	Not prime farmland	Excessively drained	No	.05	1	8.8
Ud	Urban land-Durados complex, 0 to 2 percent slopes	Not prime farmland	Excessively drained	No	N/A	N/A	13.0

Source: (NRCS, 2020)

4.3.3 Punta Borinquen GSU

Punta Borinquen is located within the Northern Karst province in the northwestern corner of Puerto Rico. The underlying geology is primarily Miocene deposits. The uppermost layer is the Aymamón Limestone Formation from the Miocene Age, which contains a mix of pure chalk and hard limestone. This formation has a maximum thickness of 1,000 feet (304.8 m) and is underlain by the Aguada Limestone Formation, the Cibao Formation, and the San Sebastián Formation, as described above (Monroe, 1980).

Soil types at Punta Borinquen have not been mapped by the Natural Resources Conservation Service (NRCS) (NRCS, 2020). Other surveys, however, have found soils at the property to be shallow, well-drained deposits that formed on limestone slopes of 20 to 60 percent. Both the surface soil and the subsoil are a reddish-brown clay (PRANG, 2019f).

Figure 10. Soil Map for Muñiz ANGB

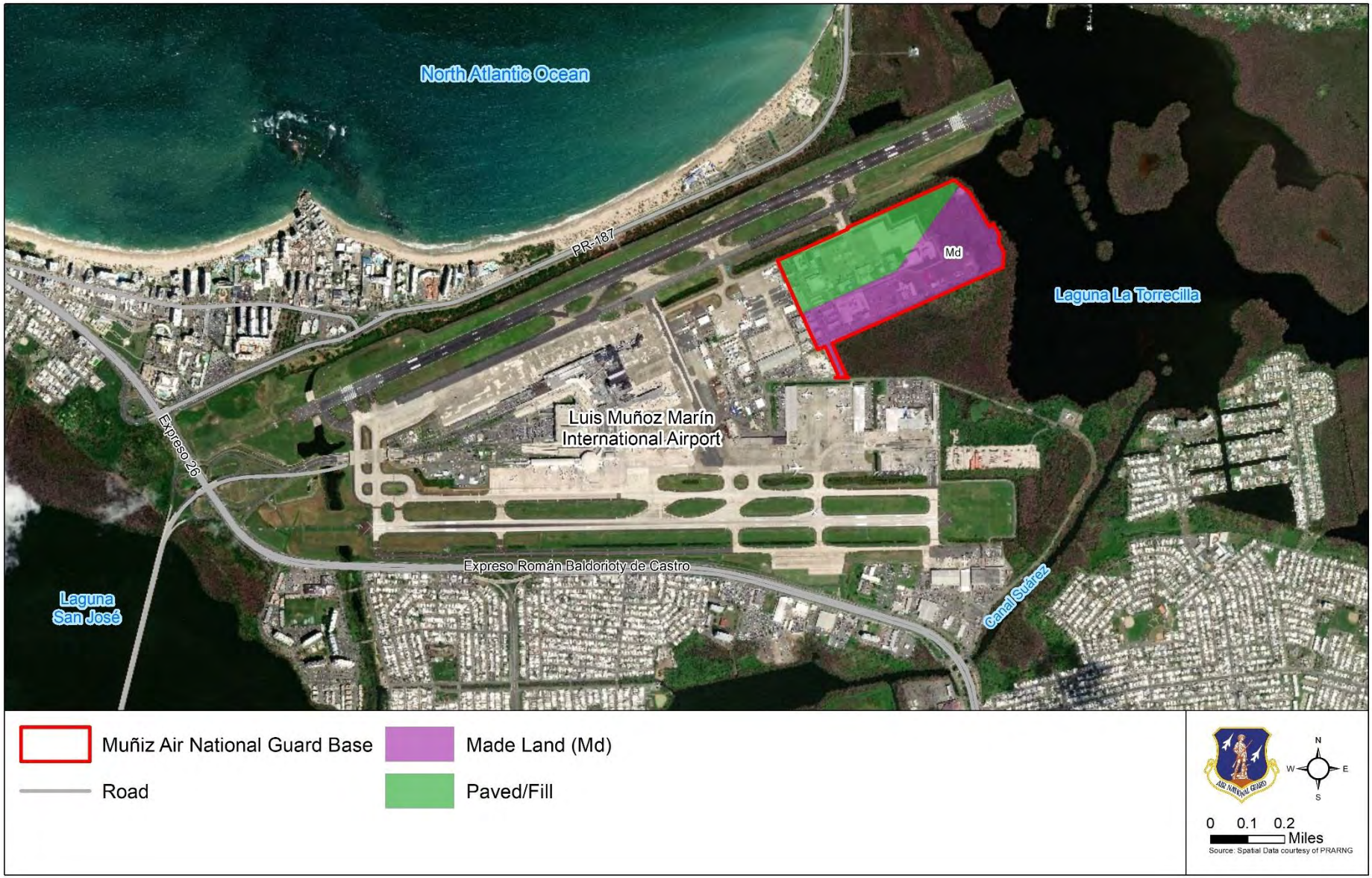


Figure 11. Soil Map for Punta Salinas GSU

4.4 Hydrology

4.4.1 Groundwater

The principal aquifer system in the northern part of Puerto Rico is the North Coast Limestone Aquifer. Muñiz ANGB and its GSUs are all located within this aquifer system, which consists of both an upper and a lower aquifer, separated by a confining unit. The upper aquifer is mostly unconfined, while the lower aquifer is mostly confined. It extends from the western edge of Puerto Rico in Aguadilla to the east of San Juan, and is comprised of rocks ranging from sand and clay to nearly pure limestone. Alluvial valley aquifers are also present along the northern coast of Puerto Rico. The alluvium may be up to 300 ft (91.4 m) thick along the north coast, and water is generally unconfined. These aquifers are hydrologically connected to the underlying North Coast Limestone aquifer system. This collective aquifer system is an important source of public water, but saltwater intrusion is becoming an issue; saline water is already found in the aquifer system within a couple of miles from the coast (Miller, Whitehead, Gingerich, Oki, & Olcott, 1999).

Due to the low quality of water in the aquifer system near Muñiz ANGB from saltwater intrusion, this water is not used for potable supply. Muñiz ANGB has been receiving drinking water from the Commonwealth of Puerto Rico since 1990 (PRANG, 2015). Groundwater use at Punta Salinas is also limited; drinking water is supplied by the Loíza and La Plata reservoirs via the Puerto Rico Aqueduct and Sewer Authority (PRANG, 2015). While groundwater wells serve as a secondary source of potable water at Punta Borinquen, drinking water is primarily supplied by the Lago Guajataca, Canal de Moca, and Río Culebrinas.

4.4.2 Surface Water

4.4.2.1 *Muñiz ANGB*

The closest surface water bodies to Muñiz ANGB are the Laguna La Torrecilla located at the installation's northeastern and eastern boundaries, and the North Canal located immediately to the north (see Figure 3). The Atlantic Ocean is located approximately 0.5 mile (0.8 km) to the north, across from the airport's runways. There are no streams or other surface water bodies on the installation (PRANG, 2015; PRANG, 2016).

4.4.2.2 *Punta Salinas GSU*

No surface water bodies are present at Punta Salinas; however, the facility is bound to the north, east, and west by the Atlantic Ocean, with the Bahía de Toa to the southwest, and the Ensenada de Boca Vieja to the southeast (see Figure 4). Stormwater flows southwest over natural land contours into the Atlantic Ocean, or into storm sewers that also discharge into the Atlantic Ocean. Recurrent flooding in the field south of the Main Radar Site at Punta Salinas has been identified as a management concern (PRANG, 2015).

4.4.2.3 *Punta Borinquen GSU*

No surface water bodies are present at Punta Borinquen (see Figure 5). This GSU is located approximately 0.6 mile (914.4 m) southeast of the Atlantic Ocean, and approximately 1,220 ft (371.9 m) west of an unnamed tributary that flows into the Canal de Aguadilla. Surface water runoff discharges to the Atlantic Ocean (PRANG, 2019f).

5.0 ECOSYSTEMS AND THE BIOTIC ENVIRONMENT

5.1 Ecosystem Classification

The Puerto Rico ANG facilities are located within the dry-humid mountains of the Puerto Rico province (Bailey, 1995). Mountainous terrain in the center of the island is flanked by marine limestone forming low plateaus with a karst topography (Bailey, 1995). Puerto Rico has six ecological life zones ranging from dry to wet forest (Ewel & Whitmore, 1973). All three Puerto Rico ANG facilities are located within the subtropical moist forest life zone, which is a bioclimatic classification assigned to this region, and which accounts for almost 3,418 square miles (5,500 km), or 59 percent of the six total life zones in Puerto Rico (Miller & Lugo, 2009). Most of the subtropical moist forest zone in Puerto Rico has been deforested due to human activities, and remains in some form of non-forest use (e.g., pasture and agricultural production) (Miller & Lugo, 2009).

5.2 Vegetation

5.2.1 Historic Vegetative Cover

Historically, vegetation within the Puerto Rico province primarily includes rainforest trees such as mahogany (*Swietenia macrophylla*), ebony (*Diospyros ebenium*), mamey (*Pouteria sapota*), tree ferns, sierra palm (*Prestoea montana*), mango (*Magifera indica*), Spanish cedar (*Cedrela odorata*), sandalwood (*Santalum album*), and rosewood (*Dalbergia sissoo*). Semiarid regions support a dry forest association of acacia, Puerto Rican royal palm (*Roystonea borinquena*), yucca, cacti, and dry grasses (Bailey, 1995).

On a regional scale, most of the subtropical moist forest ecological zone has been cleared of forest due to the region's favorable conditions for agriculture. Only small, scattered portions of the original forest remain. Historically, the regional species composition of vegetation varied with locality but generally included a large mixture of species with at least 200 kinds of trees. Characteristic trees of the moist forests on the north coast included the endemic Puerto Rican royal palm, ausubo (*Manilkara bidentate*), false mastic (*Sideroxylon foetidissimum*), roble blanco (i.e., white cedar, *Tabebuia angustata*), common guava (*Psidium guajava*), and Spanish cedar. Grasses, in both natural and unimproved pastures, dominate the landscape today (Miller & Lugo, 2009).

5.2.2 Current Vegetative Cover

5.2.2.1 *Muñiz ANGB*

A reconnaissance-level vegetation survey was conducted on Muñiz ANGB in 2016 to delineate habitat units and document plant species within the installation (PRANG, 2017). Muñiz ANGB is approximately 96 acres (38.8 ha) in size; however, only 88.1 acres (35.7 ha) within the installation boundary were surveyed. Six habitat units were identified in this area and described below (Figure 12).

- Habitat Unit 1: Deciduous forested habitat – This unit is a young forest site recovering from previous disturbance. It is approximately 7.5 acres (3.0 ha) in size, and is located in the eastern portion of Muñiz ANGB. The canopy is dominated by large royal ponciana trees (*Delonix regia*), and the understory by the white indigoberry shrub (*Randia aculeata*).
- Habitat Unit 2: Deciduous forested habitat – This unit is a very young forest site recovering from previous disturbance. It is approximately 1.6 acres (0.6 ha) in size, and is located in the eastern portion of the facility. It has a thin canopy dominated by young shrubs such as white

indigoberry, and the understory is dominated by a stand of boatlily (*Tradescantia spathacea*).

- Habitat Unit 3: Deciduous forested habitat – This unit is a mature forest approximately 1.8 acres (0.7 ha) in size, and located in the eastern portion of the facility. It is dominated by Australian pine (*Casuarina equisetifolia*). The understory is very open, and supports very little vegetation.
- Habitat Unit 4: Estuarine, intertidal, forested, broad-leaved, evergreen, irregularly exposed wetland – This unit is approximately 9.8 acres (4.0 ha), located in the east of the site along the shoreline of Laguna La Torrecilla. It contains an extremely dense stand of various mangrove species with no understory. Dominant mangrove species include red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*).
- Habitat Unit 5: Palustrine, emergent, persistent seasonally flooded wetland – This unit is approximately 0.4 acre (0.2 ha) and is located near the shoreline of Laguna La Torrecilla. Dominant vegetation includes southern cattail (*Typha domingensis*), hurricanegrass (*Fimbristylis cymose*), and numerous rush species (*Juncus* sp.).
- Habitat Unit 6: Paved and developed land – This unit is 67 acres (27.1 ha), and contains various buildings, paved areas, and ornamental landscaped plants. Dominant vegetation includes mowed grass and weeds such as Bermuda grass (*Cynodon dactylon*), hairy crabgrass (*Digitaria sanguinalis*), and various paspulum species (*Paspalum* sp.).

A total of 129 unique plant species were observed at Muñiz ANGB during the vegetation survey (Table 5). Only three documented plant species are invasive: Benghal dayflower (*Commelina benghalensis*), coatbuttons (*Tridax procumbens*), and punk tree (*Melaleuca quinquenervia*) (PRANG, 2017).

Table 5. Observed Plant Species at Muñiz ANGB

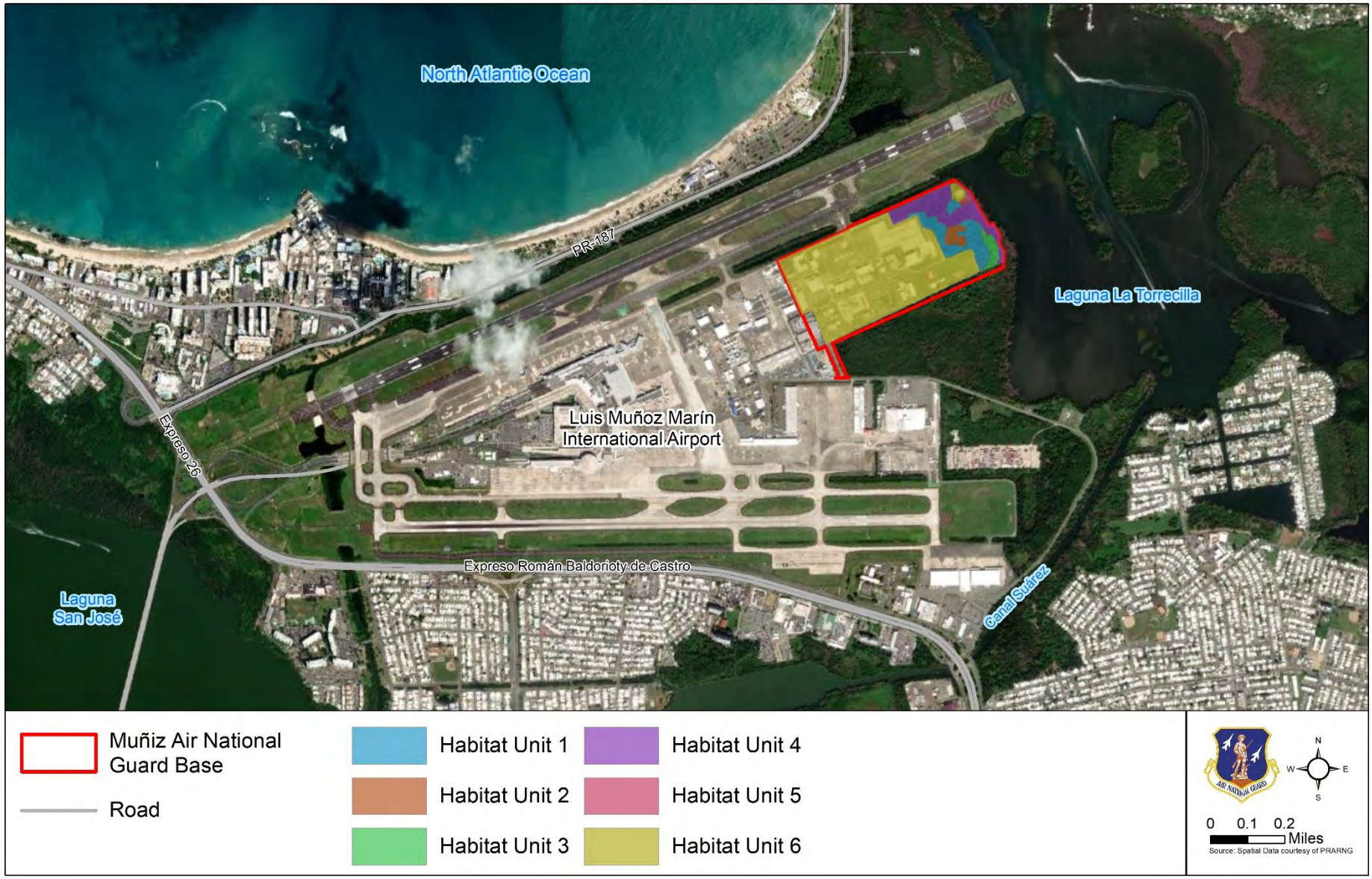
Scientific Name	Common Name	Scientific Name	Common Name
Abildgaardia orate	Flatspike sedge	*Acrostrichum aureum*	Golden leather fern
Amaranthus dubius	Red spinach	*Ammannia latifolia*	Pink redstem
Andropogon bicornis	Barbas de indio	*Archontophoenix* sp.	Palm species
Ardisia solanacea	China-shrub	*Arundo donax*	Giant read
Avicennia germinans	Black mangrove	*Bacopa monnieri*	Herb of grace
Bidens Pilosa	Spanish needle	*Bismarckia nobilis*	Bismarck palm
Boertavia coccinea	Hogweed	*Bougainvillea* sp.	Bougainvillea species
Bourreria succulenta	Bahama strongbark	*Bucida buceras*	Gregorywood
Callistemom citrinus	Crimson bottlebrush	*Canavalia rosea*	Beach bean
Casuarina sp.	Australian pine	*Cenchrus echinatus*	Southern sandbur
Cenchrus purpureus	Schumach	*Chamaedaphne calyculata*	Leatherleaf
Chamaesyce hyssopifolia	Hysspleaf sandmat	*Chloris barbata*	Swollen fingergrass
Chlorophytum comosum	Spider plant	*Cladium jamaicaense*	Saw-grass
Cocos nucifera	Coconut palm	*Commelina benghalensis*	Benghal dayflower
Commelina diffusa	Climbing dayflower	*Conocarpus erectus*	Button mangrove
Crotalaria retusa	Rattleweed	*Cuphea viscosissima*	Blue waxweed

Scientific Name	Common Name	Scientific Name	Common Name
Cyanthillium cinereum	Little ironweed	*Cynodon dactylon*	Bermudagrass
Cynosurus indicus	Goosegrass	*Cyperus odoratus*	Flagrant flatsedge
Cyperus sp.	Sedge	*Datura stramonium*	Jimsonweed
Delonix regia	Royal ponciana	*Desmanthus virgatus*	Wild tantan
Desmodium incanum	Zarzabacoa comun	*Digitaria insularis*	Sourgrass
Digitaria sanguinalis	Hairy crabgrass	*Dracaena fragrans*	Corn plant
Dracaena marginata	Dragon tree	*Ehritia tinifolia*	Bastard cherry
Eleocharis sp.	Sedge	*Eleusine indica*	Indian goosegrass
Eleusine tristachya	Threespike goosegrass	*Emilia fosbergii*	Florida tassleflower
Eucalyptus delgupta	Rainbow eucalyptus	*Euphorbia hirta*	Hairy spurge
Euphorbia prostrata	Prostrate spurge	*Ficus elastica*	Rubber fig
Ficus sp.	Fig	*Fimbristylis cymose*	Hurricanegrass
Gomphrena serrata	Arrasa con todo	*Heliconia* sp.	Heliconia species
Indigofera spicata	Creeping indigo	*Ipomoea* sp.	Morning glory
Ixora coccinea	Jungle geranium	*Juncus* sp.	Rush
Kallstroemia maxima	Big caltrop	*Kyllinga nemoralis*	White-flowered kyllinga
Laguncularia racemosa	White mangrove	*Lantana involucrate*	Buttonsage
Leucaena leucocephala	White lead tree	*Lythrum* sp.	Loosestrife
Mangifera indica	Mango	*Manlikara bidentata*	Bulletwood
Megathyrsus maximus	Guinea grass	*Melalueca quinquenervia*	Punk tree
Melinis repens	Natal grass	*Merremia quinquefolia*	Rock rosemary
Mimosa pudica	Shameplant	*Musa* sp.	Banana
Nephrolepis exaltata	Sword fern	*Nephrolepis falcata*	Fishtail swordfern
Neptunia plena	Dead and Awake	*Ochoa serrulate*	Mickey Mouse plant
Oxalis conniculata	Creeping woodsorrel	*Panicum* sp.	Grass
Parthenium hysterophorus	Santa Maria feverfew	*Paspalum distichum*	Knot grass
Paspalum fasciculatum	Mexican crowngrass	*Paspalum plicatulum*	Brownseed paspalum
Paspalum vaginatum	Seashore paspalum	*Passiflora foetida*	Fetid passionflower
Passiflora suberosa	Corkystem passionflower	*Paullina pinnata*	Bread and cheese
Phoenix sp.	Date palm species	*Phyla nodiflora*	Turkey tangle frogfruit
Pithecellobium dulce	Monkeypod	*Platycerium* sp.	Staghorn fern species
Plumeria pudica	Plumeria	*Priva lappulacea*	Catstongue
Prunus amygdalus	Almond tree	*Pseudophoenix sargentii*	Florida cherry palm
Pueraria phaseoloides	Tropical kudzu	*Randia aculeata*	White indigoberry
Randia sp.	Indigoberry	*Rhizophora mangle*	Red mangrove
Rhynchospora colorata	Starrush whitetop	*Ricinus communis*	Castorbean
Rivina humilis	Pigeonberry	*Roystonea borinquena*	Royal palm
Ruellia tuberosa	Minnieroot	*Saccharum spontaneum*	Wild sugarcane
Schinus terebinthifolius	Brazilian peppertree	*Scleria lithosperma*	Florida Keys nutrush
Sesuvium portulacastrum	Shoreline seapurslane	*Setaria viridis*	Green bristlegrass
Sphagneticola trilobata	Creeping-oxeye	*Sporobolus virginica*	Seashore dropseed

Scientific Name	Common Name	Scientific Name	Common Name
Stachytarpheta jamaicaensis	Blue porterweed	*Stylosanthes hamata*	Cheesytoes
Tabebuia aurea	Caribbean trumpet tree	*Tabebuia heterophylla*	Pink trumpet tree
Terminalia catappa	Tropical almond	*Thespesia populnea*	Portia tree
Tradescantia spathaea	Boatlily	*Tridax procumbens*	Coatbuttons
Trifolium repens	White clover	*Typha domingensis*	Southern cattail
Urochloa subquadripera	Tropical signal grass	*Verbena* sp.	Vervain
Waltheria indica	Uhaloa	*Zamia* sp.	Cycad

Source: (PRANG, 2017)

Figure 12. Habitat Distribution at Muñiz ANGB



5.2.2.2 *Punta Salinas GSU*

A reconnaissance-level vegetation survey was conducted at Punta Salinas GSU in 2017 to delineate habitat units and document plant species within the facility. Punta Salinas is approximately 34.4 acres (13.9 ha) in size, and is located on a peninsula with beaches and rocky shorelines. The site consists of forested areas and developed land containing various buildings, paved areas, and ornamental landscaped plants. It can be divided into five habitat units (Figure 13) (PRANG, 2019b):

- Habitat Unit 1: Deciduous forested habitat – This unit is approximately 10.1 acres (4.1 ha) and fringes most of the boundary of the facility along the coastal area. It is dominated by a canopy of sea grape (*Coccoloba uvifera*) along the shoreline, and inland dominant canopy species include marbletree (*Cassine xylocarpa*) and blacktorch (*Erithalis fruticosa*).
- Habitat Unit 2: Mowed and maintained lawn and landscaped areas – This unit is located in the central portion of the site and includes approximately 21.0 acres (8.5 ha). It is dominated by Kelberg's bluestem (*Dichanthium annulatum*), crabgrass, and crowngrass. Weedy herbaceous species are also present, such as Bay Biscayne creeping oxeye (*Sphagneticola triobata*).
- Habitat Unit 3: Deciduous forested habitat – This unit is a young and maintained forest habitat located in the southwestern portion of the site, and which includes approximately 1.2 acres (0.5 ha). Tropical almond (*Terminalia catappa*) is the dominant overstory species, and Bay Biscayne creeping oxeye is the dominant understory species.
- Habitat Unit 4: Monotypic stand of wild sugarcane (*Saccharum spontaneaum*) – This unit is approximately 1.8 acres (0.7 ha) and is located in the east and west portions of the facility.
- Habitat Unit 5: Shrubby vegetation along rocky shorelines – This unit encompasses approximately 0.3 acre (0.1 ha), and is found along the lower rocky shores at the mouth of the lagoon. It is dominated by seaside tansy (*Borrichia arborescens*) and seashore dropseed (*Sporobolus virginicus*).

A reconnaissance-level seagrass and mangrove survey was also conducted at Punta Salinas in 2019 to identify the potential presence of these resources (PRANG, 2019a). No mangroves were identified; however, seagrass beds and algae were identified in the La Playita cove north of the East Island access road, as well as on the southern side of this road. Eight species of algae (Table 7) and two seagrass species, manateegrass (*Syringodium filiforme*) and turtlegrass (*Thalassia testudinum*), were observed during this survey.

A total of 76 unique plant species were observed at Punta Salinas during the 2017 vegetation survey and 2019 seagrass and mangrove survey (Table 6). Only three documented plant species are invasive: coatbuttons, jio (*Commelina benghalensis*), and wild sugarcane (PRANG, 2019b; PRANG, 2019a).

Table 6. Observed Plant Species at Punta Salinas GSU

Scientific Name	Common Name	Scientific Name	Common Name
Abildgaardia ovata	Flatspike sedge	*Abrus precatorius*	Jumbee beads
Alysicarpus vaginalis	White moneywort	*Andira inermis*	Cabbagebark tree
Bidens pilosa	Hairy beggarticks	*Borrichia arborescens*	Tree seaside tansy
Bourreria succulenta	Bodywood	*Bromeliad* spp.	Bromeliad (no flower)
Bursera simaruba	Gumbo limbo	*Cassine xylocarpa*	Marbletree
Casuarina equisetifolia	Australian pine	*Cenchrus echinarus*	Southern sandbur
Chloris barbata	Swollen fingergrass	*Chrysobalanus icaco*	Coco plum
Cleodendrum aculeatum	Haggarbush	*Coccoloba uvifera*	Sea grape
Cocos nucifera	Coconut palm	*Commelina benghalensis*	Jio
Commelina diffusa	Climbing dayflower	*Commelina* spp.	Dayflower
Cyanthillium cinereum	False ironweed	*Cyperus* spp. #1	Flatsedge species
Cyperus spp. #2	Flatsedge species	*Dichanthium annulatum*	Kelberg's bluestem
Dieffenbachia seguine	Dumbcane	*Digitaria* spp.	Crabgrass
Diodia sarmentosa	Tropical buttonweed	*Eleusine tristachya*	Threespike goosegrass
Episcia spp.	Episcia species	*Erithalis fruticose*	Blacktorch
Eupatorium spp.	Thoroughwort	*Euphorbia heterophylla*	Wild poinsettia
Ficus citrifoilia	Wild banyantree	*Ficus elastica*	Indian rubberplant
Ficus spp.	Fig species	*Fimbristylis cymosa*	Hurricanegrass
Gomphrena serrata	Arrasa con todo	*Hymenocallis* spp.	Spiderlily
Ixora coccinea	Scarlet jungleflame	*Leucaena leucocephala*	White leadtree
Merremia quinquefolia	Rock rosemary, five-fingered morning glory	*Mimosa pudica*	Shameplant
Mimosa spp.	Sensitive plant	*Neptunia plena*	Water dead and awake
Nerium oleander	Oleander species	*Oxalis* spp.	Woodsorrel (no flower)
Paspalum spp.	Crowngrass	*Paspalum vaginatum*	Seashore paspalum
Passiflora foetida	Fetid passionflower	*Paullinia pinnata*	Bread and cheese
Philodendron spp.	Philodendron	*Phyla nodiflora*	Turkey tangle frogfruit
Pithecellobium dulce	Monkeypod	*Pithecellobum unguis-cati*	Catclaw blackbead
Plumeria alba	Nosegay tree	*Polystichum* spp.	Hollyfern
Rauvolfia nitida	Palo amargo	*Ricinus communis*	Castorbean
Roystonea regia	Royal palm	*Saccharum spontaneum*	Wild sugarcane
Sansevieria trifasciata	Viper's bowstring hemp	*Spartina patens*	Saltmeadow cordgrass
Spermacoce verticillate	Shrubby false buttonweed	*Sphagneticola triobata*	Bay Biscayne creeping-oxeye
Sporobolus virginicus	Seashore dropweed	*Stachytarpheta jamaicaensis*	Light blue snakeweed
Syringodium filiforme	Manateegrass	*Tabebuia pentaphylla*	Pink poui
Terminalia catappa	Tropical almond	*Thalassia testudinum*	Turtlegrass
Thespesia populnea	Seaside maho	*Tradescantia* spp.	Spiderwort
Tridax procumbens	Coatbuttons	*Tripascum latifolium*	Wideleaf gamagrass
Urochloa maxima	Guineagrass		

Source: (PRANG, 2019b; PRANG, 2019a)

Table 7. Observed Algae Species at Punta Salinas GSU

Group	Scientific Name	Common Name
Algae	*Bryothamnion triquetrum*	N/A
	Caulerpa lanuginosa	N/A
	Caulerpa racemosa	N/A
	Chaetomorpha linum	Flax brickweed
	Dasycladus vermicularis	N/A
	Padina sanctae-crucis	N/A
	Penicillus dumentosus	N/A
	Valonia macrophysa	N/A

Source: (PRANG, 2019a)

Figure 13. Habitat Distribution at Punta Salinas GSU

5.2.2.3 *Punta Borinquen GSU*

A reconnaissance-level vegetation survey was conducted at Punta Borinquen GSU in 2017 to delineate habitat units and document plant species within the facility. Punta Borinquen primarily consists of open, maintained grassland and developed land containing various buildings, paved areas, and ornamental landscaped plants (PRANG, 2019c). The site is approximately 24 acres (9.6 ha) in size, and is divided into two habitat units (Figure 14) (PRANG, 2019c):

- Habitat Unit 1: Mowed and maintained areas – This unit encompasses approximately 18.1 acres (7.3 ha) and is located in the central and eastern portions of the site. It is dominated by herbaceous grasses and forb species, such as saltgrass (*Distichlis spicata*) and Kelberg's bluestem.
- Habitat Unit 2: Deciduous forested habitat – This unit is approximately 5.6 acres (2.3 ha) and is located in the western portion of the site. It is a previously disturbed forest, with a canopy dominated by white leadtree (*Leucaena leucocephala*) and a shrubby understory dominated by viper's bowstring hemp (*Sanserviera trifasciata*), guaco (*Mikania congesta*), and white indigoberry.

A total of 96 unique plant species were observed at the Punta Borinquen study area during the 2017 vegetation survey (Table 8). Only two documented plant species are invasive: coatbuttons, and jio or Benghal dayflower (PRANG, 2019c).

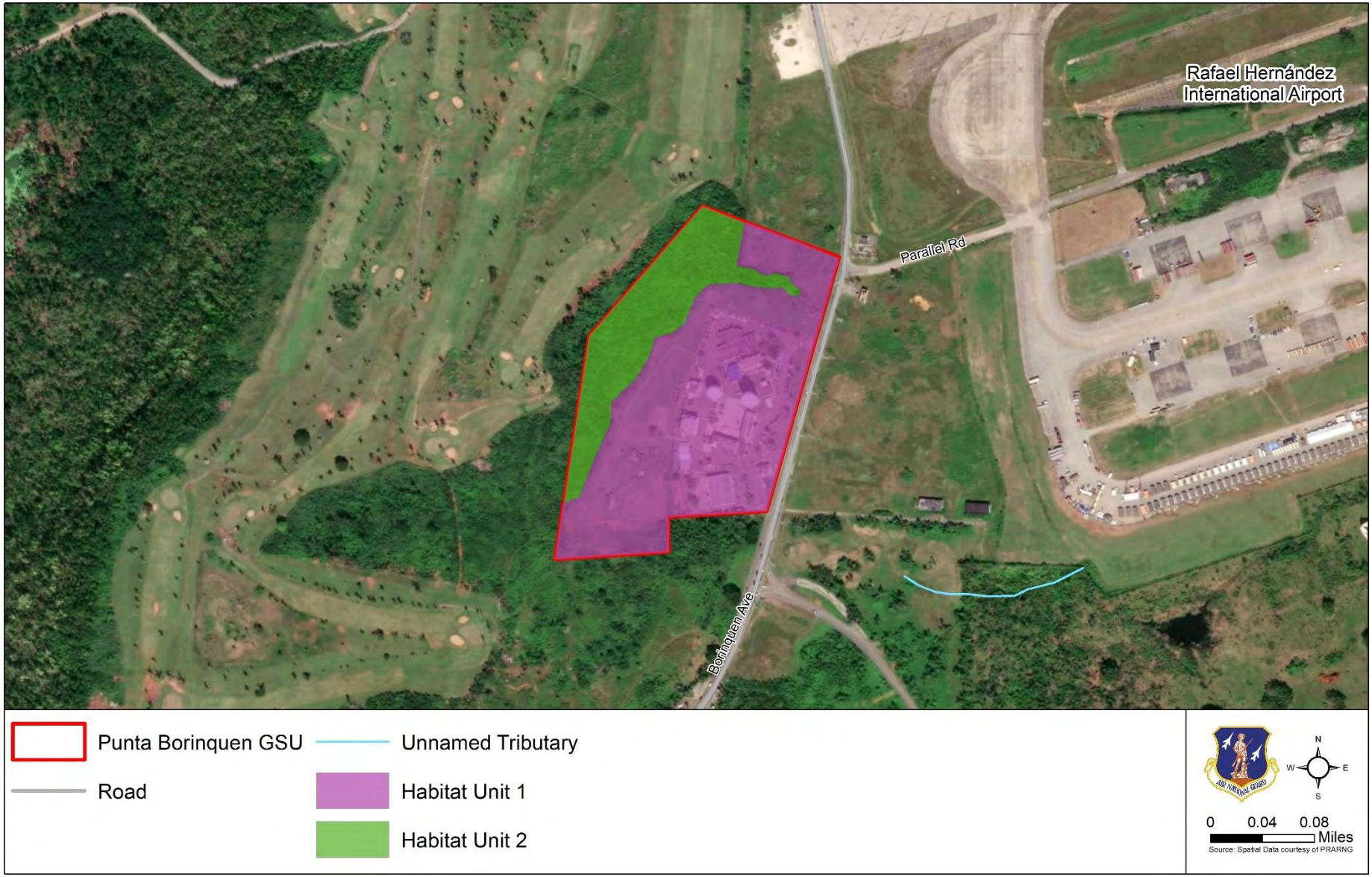
Table 8. Observed Plant Species at Punta Borinquen GSU

Scientific Name	Common Name	Scientific Name	Common Name
Abildgaardia ovata	Flatspike sedge	*Agave missionum*	Corita, century plant
Agave ssp. (no flowers)	Agave	*Albizia lebbek*	Indian albizzia
Alysocarpus vaginalis	White moneywort	*Annona muricate*	Soursop
Arundo donax	Giant reed	*Asparagus aethiopicus*	Sprenger's asparagus fern
Asystasia gangetica	Chinese violet	*Bidens pilosa*	Hairy beggarticks
Boerhavia coccinea	Scarlet spiderling	*Bromeliad* spp.	Bromeliad
Bursera simaruba	Gumbo limbo	*Callistemon lanceolatus*	Crimson bottlebrush
Calophyllum inophyllum	Alexandrian laurel	*Canna* x *generalis*	Canna lily
Caryota spp.	Fishtail palm species	*Cenchrus echinarus*	Southern sandbur
Centrosema spp.	Butterfly pea species	*Chamaesyce hyssopifolia*	Hyssopleaf sandmat
Chloris barbata	Swollen fingergrass	*Chlorophytum* spp.	Spider plant
Chromolaena odorata	Bitterbush	*Cocos nucifera*	Coconut palm
Commelina benghalensis	Jio	*Commelina diffusa*	Climbing dayflower
Comocladia glabra	Maidenplum	*Cordia lutea*	Yellow cordia
Crescentia cujete	Calabash	*Crotalaria pallida* var. *obovata*	Smooth rattlebox
Croton flavens	Yellow balsam	*Cyanthillium cinereum*	False ironweed
Cyperus spp.	Flatsedge	*Delonix regia*	Royal ponicana, flamboyant tree
Desmodium incanum	Zarzabacoa comun	*Dichanthium annulatum*	Kelberg's bluestem
Dieffenbachia spp.	Dumb cane	*Diodia sarmentosa*	Tropical buttonweed
Distichlis spicata	Saltgrass	*Dracaena* spp.	Dracaena species
Duranta erecta	Golden dewdrop	*Emilia fosbergii*	Florida tasselflower

Scientific Name	Common Name	Scientific Name	Common Name
Euphorbia heterophylla	Mexican fireplant	*Euphorbia hirta*	Hairy spurge
Gomphrena serrata	Arrasa con todo	*Indigofera spicata*	Trailing indigo
Ipomoea tiliacea	Bejuco blanco	*Ixora coccinea*	Scarlet jungleflame
Kallestroemia maxima	Big caltrop	*Lantana camara*	Lantana, red sage
Launaea intybacea	Achicoria azul	*Lepidium virginicum*	Virginia pepperweed
Leucaena leucocephala	White leadtree	*Macroptilium atripurpureu*	Purple bushbean
Mangifera indica	Mango	*Melochia pyramidata*	Pyramidflower
Merremia dissecta	Noyau vine	*Microgamma* spp.	Snakefern
Mikania congesta	Guaco	*Mimosa pudica*	Shameplant
Mimosa spp.	Mimosa species (no flower)	*Moromordica charantia*	Jumbee pumpkin
Orchidaceae spp. #1	Orchid species	*Orchidaceae* spp. #2	Orchid species
Oxalis corniculata	Creeping woodsorrel	*Passiflora* spp.	Passion flower species (no flower)
Passiflora suberosa	Corkystem passionflower	*Pennisetum* spp.	Red fountain grass
Persea americana	Avocado	*Pilea microphylla*	Rockweed
Pithecellobium dulce	Monkeypod	*Pithecellobium unguis-catti*	Catclaw blackbead
Priva lappulacea	Castongue	*Randia aculeata*	White indigoberry
Rauvolfa nitida	Palo amargo	*Roystonea regia*	Royal palm
Sabal causiarum	Puerto Rican hat palm	*Sanservieria trifasciata*	Viper's bowstring hemp
Sida acuta	Common wireweed	*Solanum* spp.	Nightshade
Sorghum halepense	Johnsongrass	*Spathodea campanulate*	African tulip tree
Sphagneticola triloba	Bay Biscayne creeping-oxeye	*Stachytarpheta jamaicaensis*	Light blue snakeweed
Steraculia foetida	East Indian almond	*Stylosanthes hamata*	Cheesytoes
Symphyotrichum spp.	Aster	*Tabebuia pentaphylla*	Pink poui
Thunbergia alata	Blackeyed Susan vine	*Thunbergia fragrans*	Whitelady
Tridax procumbens	Coatbuttons	*Urochloa maxima*	Guineagrass
Vigna luteola	Hairypod cowpea	*Walthera indica*	Uhaloa
Zanthoxylum spp.	Pricklyash		

Source: (PRANG, 2019c)

Figure 14. Habitat Distribution at Punta Borinquen GSU



5.3 Fish and Wildlife

Suitable and desirable habitat for wildlife is generally limited to the unimproved areas of the three Puerto Rico ANG facilities, located outside of the fences surrounding the buildings and paved areas. These areas provide some terrestrial habitat and limited aquatic habitat. However, wildlife species have been observed within the developed habitat units at each facility. The following sections describe the animal species that have either been observed at the Puerto Rico ANG facilities, or are expected to occur as a result of available habitat and the relative abundance of the species in the region.

5.3.1 Muñiz ANGB

Bird, amphibian, invertebrate, and reptile observations were recorded throughout the installation across all habitat units during reconnaissance-level fauna surveys in 2016. No mammals were observed at the installation during the survey. A total of 28 fauna species were observed during the survey at Muñiz ANGB, including 14 birds, 3 amphibians, 7 invertebrates, and 4 reptiles (Table 9). Only two invasive species were identified: the Afro-American house gecko (*Hemidactylus mabouia*) and the green iguana (*Iguana iguana*) (PRANG, 2017). In recent years, the green iguana has become a nuisance species within Muñiz ANGB, and overpopulation has warranted pest management control measures. The iguanas are often struck by vehicles and have become a potential aircraft strike hazard (PRANG, 2015). Although not identified during the fauna survey, the invasive reptile caiman (*Caiman* sp.) has also been observed at Muñiz ANGB.

Table 9. Wildlife Species Observed at Muñiz ANGB

Group	Scientific Name	Common Name
Bird	*Ardea alba*	Great egret
	Buteo jamaicaensis	Red-tailed hawk
	Butorides virescens	Green heron
	Charadrius vociferous	Killdeer
	Coccyzus minor	Mangrove cuckoo
	Coereba flaveola	Bananaquit
	Columbina passerine	Ground dove
	Lonchura cucullate	Bronze mannakin
	Melanerpes portoricensis	Puerto Rican woodpecker
	Mimus polyglottos	Northern mockingbird
	Quiscalus niger	Greater Antillean grackle
	Tyrannus caudifasciatus	Loggerhead kingbird
	Vidua macroura	Pin-tailed whydah
	Zenaida asiatica	White-winged dove
Amphibian	*Eleutherodactylus coqui*	Common coquí
	Hemidactylus mabouia	Afro-American house gecko
	Leptodactylus albilabris	White-lipped frog
Invertebrate	*Aratus pisonii*	Mangrove tree crab
	Caracolus caracolla	Tree snail
	Cardisoma guanhumi	Blue land crab
	Crassostrea sp.	Oyster species
	Nasutitermes sp.	Termite
	Schistosoma anostoma	Red land snail
	Uca rapax	Mudflat fiddler crab

Group	Scientific Name	Common Name
Reptile	*Ameiva exsul*	Puerto Rican giant ameiva
	Anolis cristatellus	Puerto Rican crested anole
	Anolis pulchellus	Puerto Rican bush anole
	Iguana iguana	Green iguana

Source: (PRANG, 2017)

No fish species are expected to occur at Muñiz ANGB due to the absence of water bodies within the installation boundaries. As such, no fish surveys have been conducted at the installation. However, fish species and/or Essential Fish Habitat (EFH) may occur in Laguna La Torrecilla, which contains mangrove swamp to the east of Muñiz ANGB. Mangrove swamps are dominant coastal wetland systems of Puerto Rico and create EFH for many species. EFH may include all types of aquatic habitat – wetlands, coral reefs, seagrasses, and mangroves – where fish spawn, breed, feed, or grow to maturity (PRANG, 2015).

EFH for the following species could potentially occur in Laguna La Torrecilla at the eastern boundary of Muñiz ANGB: Caribbean reef shark (*Carcharhinus perezi*), oceanic whitetip shark (*Carcharhinus longimanus)*, corals, queen conch (*Strombus gigas*), two species of spiny lobster, and 43 species of reef fish (NOAA, 2019). The presence or absence of these species or of other non-EFH fish species around the installation is not known.

5.3.2 Punta Salinas GSU

Bird, mammal, invertebrate, and reptile observations were recorded throughout Punta Salinas during reconnaissance-level fauna surveys in 2017, with all observations occurring in only three habitat units: the two deciduous forest habitat units, and maintained developed areas. A total of 14 fauna species were observed during the 2017 survey at Punta Salinas, including 7 birds, 2 terrestrial invertebrates, 4 reptiles, and 1 mammal (Table 10). The green iguana was the only invasive species documented (PRANG, 2019b). A reconnaissance-level coral, seagrass, and mangrove survey was conducted at Punta Salinas in 2019 to identify the potential presence of these resources. No coral species were documented around Punta Salinas, but 11 aquatic invertebrates were observed in the surrounding waters (Table 10) (PRANG, 2019a).

Table 10. Wildlife Species Observed at Punta Salinas GSU

Group	Scientific Name	Common Name
Bird	*Ardea alba*	Great egret
	Coereba flaveola	Bananaquit
	Mimius gilvus	Tropical mockingbird
	Pelecanus occidentalis	Brown pelican
	Quiscalus niger	Greater Antillean grackle
	Tyrannus dominicensis	Gray kingbird
	Zenaida aurita	Zenaida dove
Terrestrial Invertebrate	*Coenobita clypeatys*	Hermit crab
	Nasutitermes corniger	Termites
Aquatic Invertebrate	*Acanthopleura granulata*	Chiton
	Astichopus multifidus	Furry sea cucumber
	Echinometra lucunter	Rock-boring urchin
	Fasciolaria tulipa	True tulip
	Nerita peloronita	Bleeding tooth

Group	Scientific Name	Common Name
Aquatic Invertebrate (continued)	*Nerita tesselata*	Tessellate nerite
	Nerita versicolor	Four-toothed nerite
	Neritina clenchi	Chlench's nerite
	Tripneustes ventricosus	West Indian sea egg
	Turbo canaliculatus	Channeled turban
	Zoanthus pulchellus	Mat zoanthid
Reptile	*Ameiva exsul*	Puerto Rican giant ameiva
	Anolis christatellus christatellus	Puerto Rican crested anole
	Anolis pulchellus	Puerto Rican bush anole
	Iguana iguana	Green iguana
Mammal	*Canis lupus familiaris*	Dog

Source: (PRANG, 2019b; PRANG, 2019a)

No fish species are expected to occur at Punta Salinas due to the absence of water bodies. As such, no fish surveys have been conducted. However, fish species and/or EFH may occur in any of the water bodies surrounding the peninsula (e.g., Atlantic Ocean, Bahía de Toa, and Ensenada de Boca Vieja).

EFH for the following species could potentially occur in the waters surrounding Punta Salinas: blue marlin (*Makaira nigricans*), Caribbean reef shark, oceanic whitetip shark, sailfish (*Istiophorus platypterus*), white marlin (*Kajika albidus*), corals, queen conch, two species of spiny lobster, and 43 species of reef fish (NOAA, 2019). Except for corals, the presence or absence of these species or of other non-EFH fish species around Punta Salinas is not known. No coral species were observed during the 2019 coral survey in the waters within 25 feet (7.6 m) of Punta Salinas. However, benthic surveys conducted in support of the Guantanamo Bay to Punta Salinas Submarine Fiber Optic Cable System project found several hard and soft coral species (e.g., hexacorallia and octocorallia) and sponges in the waters north of Punta Salinas (Vicente & Associates, Inc., 2017). In addition, observations of the invasive lionfish (Pterois volitans) have been reported around Punta Salinas (PRANG, 2015). The lionfish has recently invaded the Caribbean region, and is rapidly becoming an ecological and human health concern; the potential presence of this species in the waters around the facility may warrant pest management control measures.

5.3.3 Punta Borinquen GSU

Bird, mammal, insect, and reptile observations were recorded throughout Punta Borinquen during reconnaissance-level fauna surveys in 2017, with most wildlife species observed in the maintained and developed habitat unit. A total of 16 fauna species were observed during the survey at Punta Borinquen, including 7 birds, 4 invertebrates, 4 reptiles, and 1 mammal (Table 11). Two invasive species were identified, the green iguana and the monk parakeet (*Myiopsitta monachus*) (PRANG, 2019c).

Table 11. Wildlife Species Observed at Punta Borinquen GSU

Group	Scientific Name	Common Name
Bird	*Ardea alba*	Great egret
	Colombina passerine	Common ground-dove
	Margarops fuscatus	Pearly-eyed thrasher
	Myiopsitta monachus	Monk parakeet
	Quiscalus niger	Greater Antillean grackle
	Tyrannus dominicensis	Gray kingbird
	Zenaida aurita	Zenaida dove
Invertebrate	*Diplopoda* spp.	Millipede
	Erythrodiplax umbrata	Band-winged dragonlet
	Gasteracantha spp.	Spiny orb-weaver
	Heliconius charithonia	Zebra heliconian
Reptile	*Ameiva exsul*	Puerto Rican giant ameiva
	Anolis cristatellus	Puerto Rican crested anole
	Anolis pulchellus	Puerto Rican bush anole
	Iguana iguana	Green iguana
Mammal	*Equus calabus*	Horse

Source: (PRANG, 2019c)

No fish species are expected to occur at Punta Borinquen due to the absence of water bodies; as such, no fish surveys have been conducted. The inland position of the facility further limits the potential for fish or EFH species to occur around the boundaries of Punta Borinquen. However, the Atlantic Ocean to the northwest of the Punta Borinquen contains EFH for the Caribbean reef shark (NOAA, 2019). The presence of this species or other non-EFH fish species in these waters of the Atlantic Ocean is not known. No corals, seagrasses, or mangroves are present at or immediately surrounding Punta Borinquen due to its inland location (PRANG, 2019a).

5.4 Threatened and Endangered Species and Species of Concern

Federal status as a threatened or endangered species is derived from the ESA of 1973 (16 USC § 1531 et seq.) and administered, depending on the species, by the USFWS or the National Marine Fisheries Service (NMFS) under NOAA. The DRNA identifies and designates rare, threatened, or endangered species within the Commonwealth of Puerto Rico, and maintains a list of these species. Table 12 identifies all the federal and Commonwealth-listed species with the potential to occur on the three Puerto Rico ANG facilities.

According to the USFWS Information for Planning and Consultation (IPaC) database, the endangered Puerto Rican boa (*Chilabothrus inornatus*) is the only federally listed species with the potential to occur at Muñiz ANGB and Punta Borinquen (USFWS, 2020a). In addition to the Puerto Rican boa, the federally listed leatherback sea turtle (*Dermochelys coriacea*), hawksbill sea turtle (*Eretmochelys imbricate*), and West Indian manatee (*Trichechus manatus*), specifically the subspecies Antillean manatee (*Trichechus manatus manatus*), have the potential to occur at Punta Salinas (Table 12) (USFWS, 2020a).

The DRNA identifies one listed species, the West Indian whistling duck (*Dendrocygna arborea*), as occurring in the municipality of Carolina (DRNA, 2016). Four Commonwealth-listed fauna species may occur in the municipality of Toa Baja, and an additional six may occur in all coastal waters (Table 12). In the municipality of Aguadilla, the DRNA has identified seven species that may occur

(Table 12). While the Puerto Rican boa and the West Indian manatee were not identified by the DRNA as having potential occurrence at the Puerto Rico ANG facilities, both species are Commonwealth-listed. In addition, the DRNA identified three Commonwealth-listed endangered plant species with potential to occur in the municipality of Toa Baja, as well as three Commonwealth-listed endangered plants with potential to occur in the municipality of Aguadilla. No plants were identified by DRNA with potential occurrence in the municipality of Carolina.

No federal- or Commonwealth-listed threatened and endangered species were documented during the flora and fauna surveys conducted at the Puerto Rico ANG facilities (PRANG, 2017; PRANG, 2019c; PRANG, 2019b). Additionally, no federally threatened or endangered coral or fish species were documented within the La Playita cove or nearshore areas of Punta Salinas during the coral, seagrass, and mangrove survey (PRANG, 2019a).

Table 12. Federal and Commonwealth Listed Threatened and Endangered Species with the Potential to Occur on the Puerto Rico ANG Facilities

Scientific Name	Common Name	Federal Status	Territory Status	Habitat Preferences	Puerto Rico ANG Facility
Banara vanderbiltii	Vanderbilt's palo de Ramón	Endangered	Endangered	limestone substrates	Punta Salinas
Chelonia mydas	Green sea turtle	Threatened	Endangered	coastal waters, in particular, seagrass meadows and coral reefs; nest along sandy beaches	Punta Salinas
Chilabothrus inoratus	Puerto Rican boa	Endangered	Threatened	forested areas up to 3,773 ft (1,150 m) in elevation	Muñiz ANGB, Punta Salinas, Punta Borinquen
Daphnopsis helleriana	Heller's cieneguillo	Endangered	Endangered	semi-evergreen and evergreen forests in the karst zone	Punta Salinas
Dendrocygna arborea	West Indian whistling duck	--	Endangered	freshwater forested marshes, salty lagoons, and isolated mangroves	Muñiz ANGB
Dermochelys coriacea	Leatherback sea turtle	Endangered	Endangered	open waters of the Atlantic Ocean; nests on sandy beaches	Punta Salinas
Eleutherodactylus juanariveroi	Plain coqui	Endangered	Endangered	vegetated wetlands at low altitudes	Punta Salinas
Epinephelus itajara	Atlantic Goliath grouper	--	Endangered	coastal areas, in particular, mangroves and coral reefs	Punta Salinas
Epinephelus striatus	Nassau grouper	Threatened	Endangered	coastal areas, in particular, coral reefs	Punta Salinas
Eretmochelys imbricate	Hawksbill sea turtle	Endangered	Endangered	coral reefs; nests in vegetation on sandy and rocky beaches	Punta Salinas
Gaussia attenuate	Puerto Rican Gaussian palm	--	Endangered	hillsides, mogotes, and limestone terrain at middle and low elevations	Punta Salinas
Megaptera novaeangliae	Humpback whale	--	Threatened	open ocean waters	Punta Salinas, Punta Borinquen
Monophyllus redmani	Greater Antillean long tongued bat	--	Threatened	warm caves	Punta Borinquen

Scientific Name	Common Name	Federal Status	Territory Status	Habitat Preferences	Puerto Rico ANG Facility
Ottoschulzia rhodoxylon	Palo de rosa	Endangered	Endangered	serpentine and limestone terrain, and mogote hillsides in the karst zone of the north coast	Punta Borinquen
Pteronotous parnellii	Parnell's mustached bat	--	Threatened	warm and humid caves	Punta Borinquen
Pteronotus quadridens	Sooty mustached bat	--	Threatened	depths of warm caves	Punta Borinquen
Sabal causiarum	Palma de sombrero	--	Proposed Threatened	coastal fields and mogote hills at low elevations in the north	Punta Borinquen
Schoepfia arenaria	Arana	Endangered	Endangered	low elevations (between 493-1148 ft [150-350 m]) in evergreen forests in the coastal zone and on mogote hillsides	Punta Borinquen
Trichechus manatus	West Indian manatee	Threatened	Endangered	coastal areas including river mouths and estuaries	Punta Salinas

Source: (DRNA, 2016; USFWS, 2020a)

5.5 Waters of the US, Wetlands, and Floodplains

5.5.1 Muñiz ANGB

A review and delineation of Waters of the US (WOTUS), including wetlands, was conducted at Muñiz ANGB in 2013 to locate all jurisdictional waterways on the site (PRANG, 2016). Wetlands were delineated and classified using the Cowardin classification system (Cowardin, Carter, Golet, & LaRoe, 1979). Four jurisdictional wetlands, comprising approximately 17.9 acres (7.2 ha), were delineated as described and displayed in Table 13 and Figure 15. Wetland types identified include: PEM1C (palustrine, emergent, persistent, seasonally flooded); E2FO3M (estuarine, intertidal, forested, broad-leaved evergreen, irregularly exposed); and PFO3C (palustrine, persistent/forested, broad-leaved evergreen, seasonally flooded). The health of mangrove wetlands at Muñiz ANGB is generally good, although primary disturbance occurs from wind and tidal currents driving large amounts of trash and debris. Other forested wetlands at the installation are somewhat degraded by the number of naturalized but non-native species present at the site. USACE issued an approved jurisdictional determination (JD) for the delineated wetlands in 2015.

Table 13. Wetlands Identified at Muñiz ANGB

Wetland Name	Cowardin Classification	Acres	Location on Muñiz ANGB	Federal JD
Wetland A	E2FO3M	9.4	Within the mangrove fringe along the eastern boundary	Jurisdictional
Wetland B	PF03C	8.5	Slightly upgradient from Wetland A; near the northeast corner of the installation	Jurisdictional
Wetland C	PEM1C	<0.01	Along the edge of Wetland B and the installation security fence to the north	Jurisdictional
Wetland D	PEM1C	0.03	Within a mowed area adjacent to an access road along the southern boundary	Jurisdictional
Total		**<17.9 acres**		

Source: (PRANG, 2016)

Floodplains are lowlands and relatively flat areas adjoining waters that are subject to flooding. The 100-year floodplain is designated based on different factors on the Federal Insurance Rate Maps (FIRM) along with other flooding and storm surge information. With respect to occurrence a 100-year flood has a one percent chance of occurring in any given year and the 500-year flood has a 0.2 percent chance in any given year. The limits to which that flood reaches, defines the floodplains.

The majority of the eastern portion of Muñiz ANGB (58.6 acres [23.7 ha]) is located within the 100-year floodplain associated with Laguna La Torrecilla (58.6 acres [23.7 ha]) (Figure 15). In addition, 2.8 acres (1.1 ha) along the northern boundary is situated within the 500-year floodplain (FEMA, 2020). Existing development within this floodplain includes the aircraft parking apron, command and operations support facilities, recreational development, and roadways (PRANG, 2015).

5.5.2 Punta Salinas GSU

A review and delineation of WOTUS, including wetlands, was conducted at Punta Salinas in 2017 to locate all jurisdictional waterways, including wetlands, on the site (Figure 16) (USFWS, 2020b). No wetlands were identified within Punta Salinas as a result of the on-site delineation, which was confirmed by the approved USACE JD obtained in 2018. However, surrounding marine waters are jurisdictional, and any ANG activities conducted below the mean high water line in the Atlantic Ocean, and/or the discharge of dredged or fill material into the Atlantic Ocean would require additional consultation (PRANG, 2019d).

The edges of Punta Salinas and the isthmus connecting the two parts of the facility are located within the 100-year floodplain associated with the surrounding coastal waters, totaling approximately 16.4 acres (Figure 16). The northern boundary of the main peninsula, the connecting isthmus, and the borders of the eastern peninsula are considered high risk areas, and have an additional flooding hazard associated with storm waves (FEMA, 2020). Most developed areas within Punta Salinas, including buildings and roadways, are located outside of the floodplain. The 500-year floodplain does not occur within or near the site.

5.5.3 Punta Borinquen GSU

A review and delineation of WOTUS, including wetlands, was conducted at Punta Borinquen in 2017 to locate all jurisdictional waterways, including wetlands, on the facility (Figure 17). No wetlands were identified within Punta Borinquen as a result of the on-site delineation, which was confirmed by the approved USACE JD obtained in 2018 (PRANG, 2019e).

Off-shore areas and the coastline to the north and west of Punta Borinquen are located within the 100-year floodplain. These coastal waters are considered high risk areas and have an additional flooding hazard associated with storm waves. This floodplain does not extend to the site, and the entirety of Punta Borinquen is located outside of the 100-year and 500-year floodplains (FEMA, 2020).

Figure 15. Delineated Surface Water Features on Muñiz ANGB

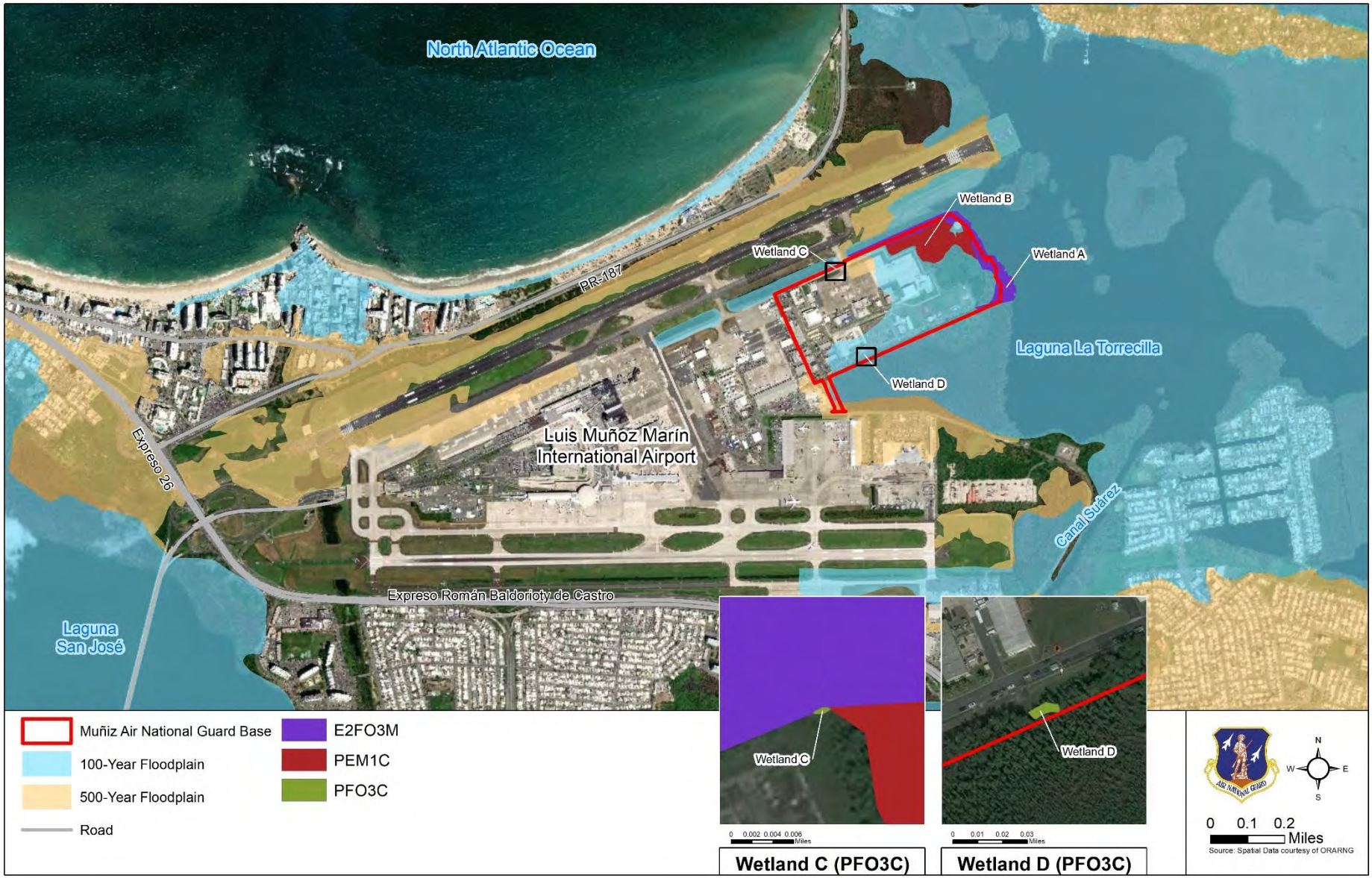


Figure 16. Delineated Surface Water Features on Punta Salinas GSU

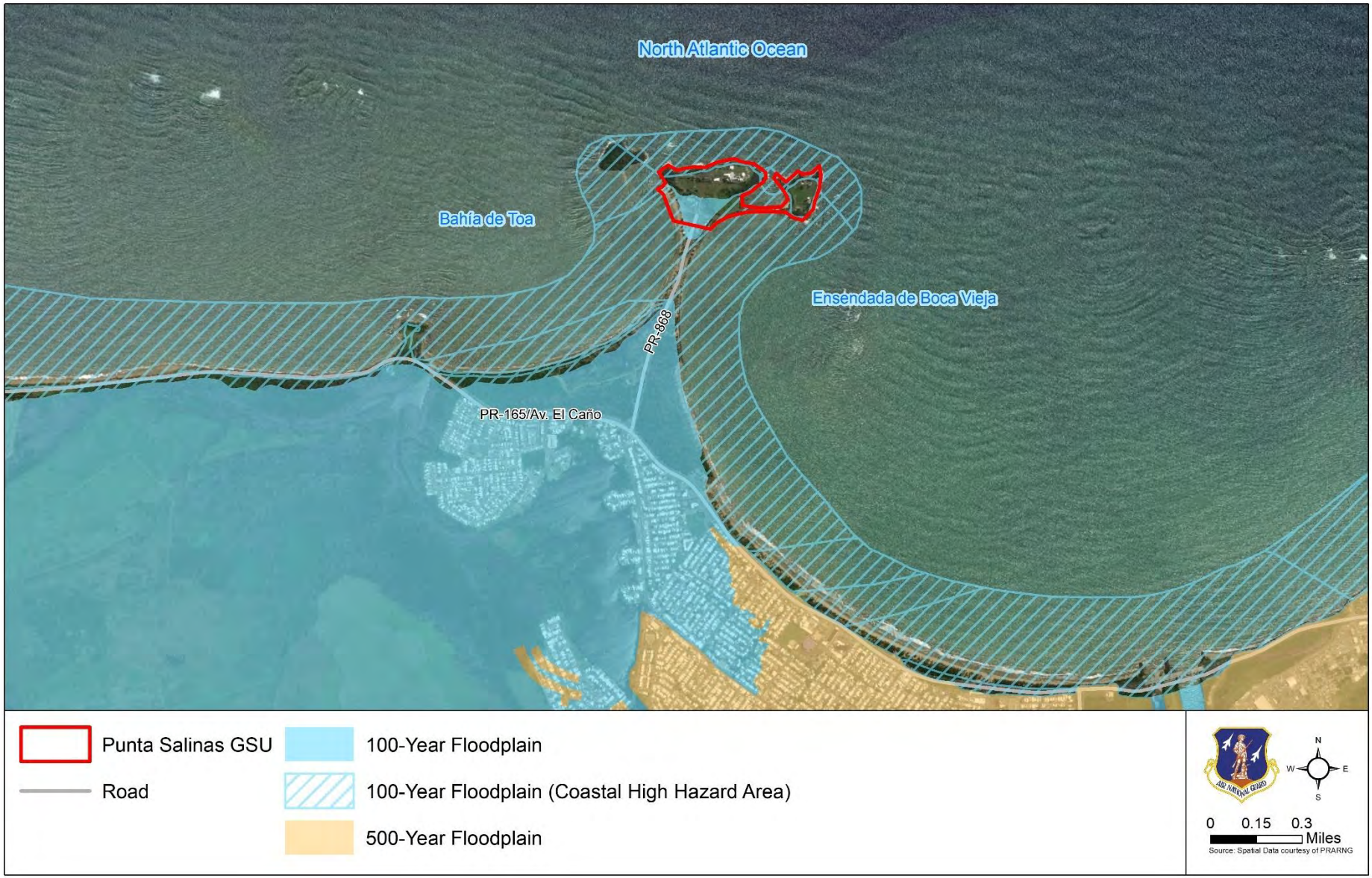


Figure 17. Delineated Surface Water Features on Punta Borinquen GSU

6.0 MISSION IMPACTS ON NATURAL RESOURCES

6.1 Natural Resources Needed to Support the Military Mission

The Puerto Rico ANG facilities require operation areas to serve as a buffer to provide support facilities and functions. The military mission and training requirements are dynamic and can change over time, requiring potential changes to natural resource needs to support the mission. Degradation of natural resources can result in unintended impacts to the military mission, impaired readiness, and increased expenses for natural resources management rather than the military mission. The Puerto Rico ANG needs the land and its natural resources to function together in a healthy ecosystem to support the military mission. Management activities in this INRMP are designed to support the desired habitats and ecosystem functions to meet the military mission.

6.2 Natural Resources Constraints to Mission and Mission Planning

The natural resources constraints to installation planning and mission are summarized as:

- Any project which is anticipated to impact WOTUS, including wetlands, must obtain a Section 404 Permit from the USACE Jacksonville District and Section 401 Water Quality Certification (WQC) from the DRNA. A delineation of the boundaries of all onsite WOTUS including wetlands was completed for Muñiz ANGB, Punta Salinas, and Punta Borinquen. Written Approved Jurisdictional Determinations were obtained from the USACE Jacksonville District. WOTUS, including wetlands, were found on Muñiz ANGB. Punta Salinas is bordered by the Atlantic Ocean but no wetlands were found. No WOTUS, including wetlands, were found on or adjacent to Punta Borinquen.
- Any project that is anticipated to impact floodplains must undergo the NEPA process per 32 CFR Part 989. For any project that alters the hydrology of the floodplain, the installation will also work with the Puerto Rico Planning Board (PRPB), the Commonwealth agency that is responsible for the administration of floodplain laws and regulations.

6.2.1 Land Use

The scope and intensity of land management depends on the land-use category. The land-use categories at Muñiz ANGB include improved (approximately 67.4 acres [27.3 ha]) and unimproved grounds (approximately 24.1 acres [9.7 ha]). At Punta Salinas, the improved area consists of approximately 21.0 acres (8.5 ha) and the unimproved area is approximately 13.4 acres (5.4 ha). At Punta Borinquen, approximately 18.1 acres (7.3 ha) are improved and approximately 5.6 acres (2.3 ha) are unimproved. No semi-improved grounds occur at the Puerto Rico ANG facilities.

Improved grounds include the land occupied by buildings and other permanent structures, including the administrative and support facilities, hangars, and radar sites, as well as other paved areas, lawns, and landscape plantings in these areas. INRMP activities in improved areas include grounds maintenance, stormwater management, and pest management.

Unimproved grounds include mangrove forests, wetlands, and any areas where natural vegetation is allowed to grow unimpeded by maintenance activities. At Muñiz ANGB, the limited unimproved grounds include the eastern portion of the property that is currently occupied by mangrove and upland forest. At Punta Salinas, the limited unimproved grounds occur along the coastline and include an interior forested area and interior stand of wild sugarcane. At Punta Borinquen, the limited unimproved grounds include the western boundary, which is occupied by forested areas.

INRMP activities in unimproved areas include water resource management, grounds maintenance, and BASH management.

6.2.2 Current Major Impacts

Mission activities at Muñiz ANGB include those related to combat communication and contingency response. Combat communication involves readiness training to support USAF emergency requirements and to provide tactical cyber services, while contingency response activities focus on developing capabilities to deploy a specialized team in under 12 hours and training to prepare a base for expeditionary aerospace forces. Operations at Punta Salinas GSU include radar and communication equipment maintenance, fueling of ground vehicles, and facilities maintenance. Punta Borinquen GSU serves as an early warning radar site (PRANG, 2010). Impacts to natural resources are more likely to result from mission support activities, including aircraft and other vehicle maintenance, runway-related activities, and facility and utility maintenance activities. In addition, support and non-mission related activities, such as management and disposal of hazardous substances, industrial operations, and landscape maintenance activities can potentially affect natural resources. Potential conflicts with the acceptable stewardship of military lands at the Puerto Rico ANG facilities are avoided through active planning, education, and management activities. The current major impacts to natural resources from the Puerto Rico ANG military missions include:

- Impacts to native vegetation from the introduction of invasive weeds through support and non-mission related activities
- Impacts to the environment from the use of hazardous materials, pesticides, and herbicides
- Impacts from Environmental Restoration sites

6.2.2.1 *Encroachment*

Encroachment is defined as the impacts of community actions on military activities as well as the impact of the military's actions on the surrounding community. The Puerto Rico ANG facilities are not likely to be subject to future encroachment issues. Muñiz ANGB is bounded by the LMMIAP and various water and mangrove wetland features, where future development would not be feasible. Punta Salinas is located on a small peninsula, which prevents extensive development due to natural barriers. There is a slight potential for expansion near Punta Borinquen, as it is surrounded by undeveloped land to the north and west, but the proximity of the Rafael Hernández airport is likely to deter development.

6.2.2.2 *Hazardous Materials and Waste*

Hazardous materials and petroleum products are used throughout the Puerto Rico ANG facilities for various functions, including vehicle maintenance and washing; petroleum oil lubricant distribution and management; and facilities maintenance. Hazardous materials used in these functions include fuels and lubricating oils, solvents, paints and thinners, antifreeze, and acids. Issues associated with hazardous material and waste typically center around the storage, transport, use, and disposal of these substances. When such materials are improperly used in any way, they can threaten the health and well-being of wildlife species, habitats, and soil and water systems, as well as humans.

Hazardous wastes are managed at the Puerto Rico ANG facilities through the base-level Hazardous Waste Management Plan in accordance with Air Force Instruction (AFI) 32-7042, *Solid and Hazardous Waste Compliance*. The *Oil and Hazardous Substance Spill Prevention and Response Plan* provides guidance to Puerto Rico ANG personnel on the handling, storage, and disposal of hazardous materials; this plan will implement the "cradle-to-grave" management control of hazardous waste, as mandated by the USEPA (PRANG, 2019g). Hazardous materials, with the

exception of fuels, are managed through a centralized base Hazardous Material Pharmacy, located at Building 106 at Muñiz ANGB, using an Environmental Management Information System, which tracks the inventory and acquisition of hazardous materials along with hazardous waste disposal and health and safety information. The *Oil and Hazardous Substances Spill Prevention and Response Plan* (PRANG, 2019g) was prepared in accordance with good engineering practices and also functions as the *Spill Prevention, Control & Countermeasure Plan* (SPCCP) (in accordance with 40 CFR 112). The SPCCP provides guidance on petroleum storage, spill prevention measures, and contingency procedures including spill containment and cleanup. This plan establishes responsibilities for handling fuels and other hazardous fluids, containing and recovering spills, spill training, and spill reporting procedures.

6.2.2.3 *Installation Restoration Program Sites*

Nine active Installation Restoration Program (IRP) sites are located at Muñiz ANGB, one at Punta Salinas, and one at Punta Borinquen. As of Fiscal Year (FY) 2020, these 11 sites had not achieved a status of response complete (RC), a milestone which indicates that site cleanup activities are complete. The existing IRP sites were expected to take between 3 and 7 years to achieve RC (DoD, 2018). While contamination at these sites still needs to be addressed, there is also the potential that new IRP sites at the Puerto Rico ANG facilities could be identified if new or suspected contamination is identified. Table 14 contains a summary of the existing IRP sites at the Puerto Rico ANG facilities.

Table 14. Summary of IRP Sites at the Puerto Rico ANG Facilities

Installation	Site Identifier	Site Description	Number of Years to Achieve RC
Muñiz ANGB	OW012	OWS system at Building 12	4
Muñiz ANGB	OW013	OWS at Hush House	3
Muñiz ANGB	PL016	Former POL area/dry wells	3
Muñiz ANGB	PL017	Former POL area	7
Muñiz ANGB	TU011	UST site 6/16/19/22	3
Muñiz ANGB	TU014	Hydrazine tank, Building 83	3
Muñiz ANGB	TU015	Building 29 UST/Transformer pad	3
Muñiz ANGB	TU018	Former fuel dock hangar	7
Muñiz ANGB	TU020	Building 29 UST/Transformer pad	3
Punta Salinas GSU	TU005	Diesel storage tank pit	4
Punta Borinquen GSU	TU002	Underground waste oil transfer lines and containment	4
Note: OWS – Oil Water Separator; POL – Petroleum, oils, and lubricants; UST – underground storage tank			

Source: (DoD, 2018)

7.0 NATURAL RESOURCES PROGRAM MANAGEMENT

7.1 Natural Resources Program Management

The guiding philosophy of this INRMP is to take an ecosystems approach to managing natural resources. Ecosystem management is based on clearly stated goals and objectives, and associated projects. This INRMP identifies goals and objectives, and presents the means to accomplish them as well as the methodologies to monitor results.

7.2 Fish and Wildlife Management

Wildlife management involves manipulating various aspects of an ecosystem to benefit chosen wildlife species. Management of habitats generally is focused to benefit native species, particularly rare species and game species. Fish and wildlife management at the Puerto Rico ANG facilities include maintaining and enhancing biodiversity while supporting the ANG mission. Management of these resources is a stewardship responsibility of the Puerto Rico ANG. The primary fish and wildlife management concerns at the Puerto Rico ANG facilities include migratory birds, nuisance wildlife, and other wildlife habitat management. There are no hunting and fishing opportunities at the Puerto Rico ANG facilities. Authority for fish and wildlife management is outlined in AFMAN 32-7003, *Environmental Conservation*. Relevant laws include the ESA and the MBTA.

Puerto Rico has developed a SWAP that identifies the goals and conservation focus of the Commonwealth. Where feasible, the fish and wildlife management goals of this INRMP are integrated with the goals of the SWAP. These include the goals to maintain species diversity on the installation, preserve and protect species of conservation concern, and protect wetland resources on the installation.

7.2.1 Federal Wildlife Policies and Regulations

Endangered Species Act

The ESA of 1973, as amended (16 USC §1531 et seq.) provides for the identification and protection of threatened and endangered plants and animals, including their critical habitats. The ESA requires federal agencies to conserve threatened and endangered species and cooperate with state or Commonwealth and local authorities to resolve water resources issues in concert with the conservation of threatened and endangered species. This law establishes a consultation process involving federal agencies with input from state or Commonwealth agencies to minimize impacts to the greatest extent practicable by agency action that would adversely affect species or habitat. Further, it prohibits all persons subject to US jurisdiction from taking, including any harm or harassment, endangered or threatened species.

Migratory Bird Treaty Act

The MBTA prohibits, unless permitted by regulations, the pursuit, hunting, take, capture, killing or attempting to take, capture, kill, or possess any migratory bird included in the Act, including any part, nest, or egg of any such bird (16 USC § 703). The DoD has a Memorandum of Understanding (MOU) with the USFWS pursuant to Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, which outlines a collaborative approach to promote the conservation of migratory bird populations. This MOU specifically pertains to natural resource management activities, including, but not limited to, habitat management, erosion control, forestry activities, invasive weed management, and prescribed burning. It also pertains to installation support functions, operation of industrial activities, construction and demolition activities, and hazardous waste cleanup. In February 2007, the USFWS finalized regulations for issuing incidental take permits to the DoD (50 CFR 21.15). If any of the Armed Forces determine that a proposed or an ongoing military readiness activity may result in a significant adverse effect on a population of migratory bird species, then they must confer and cooperate with the USFWS to develop appropriate and reasonable conservation measures to minimize or mitigate identified significant adverse effects (50 CFR Part 21).

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC 668-668c), enacted in 1940 and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase of barter, transport, export or import, at any time of any manner, any bald eagle… [or any golden eagle], alive or dead, or any part, nest, or egg thereof."

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously-used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habitats, and causes injury, death, or nest abandonment.

7.2.2 Nuisance Wildlife and Wildlife Diseases

With no flying mission that would present a BASH risk, the Puerto Rico ANG facilities have very few nuisance wildlife species. Future nuisance wildlife problems will be evaluated and solutions will follow the IPM Plan. Any large-scale fish and wildlife deaths and unnatural behavior occurring on the installation will be reported, recorded, and investigated in conjunction with USFWS, USEPA, and DRNA personnel, as appropriate.

7.2.3 Management of Threatened and Endangered Species and Habitats

This section presents information about the management of priority species that are located within or have the potential to occur at the Puerto Rico ANG facilities, along with requirements and strategies for their management. As additional surveys and natural resources management activities are conducted, it is possible other species may be added in the future.

7.2.3.1 *Federally listed Special Status Wildlife Species*

No federally listed species have been documented at the Puerto Rico ANG facilities (Section 5.4) (PRANG, 2019b; PRANG, 2019c; PRANG, 2017).

7.2.3.2 *Commonwealth Special Status Species*

No Commonwealth-listed species have been documented at the Puerto Rico ANG facilities (Section 5.4) (PRANG, 2019b; PRANG, 2019c; PRANG, 2017).

7.2.3.3 *Management Strategies for Special Status Species*

In order to facilitate the continuation of the military mission and meet natural resource management objectives while minimizing impacts to special status species, the Puerto Rico ANG will:

- Update biological inventories regularly as the occurrence of listed species is subject to change over time as a result of either recruitment, responses to management activities, identification of additional protected species, or changes in the status of species currently present at the Puerto Rico ANG facilities.
- Where feasible, maintain existing forested areas, grasslands, and wetlands, and minimize disturbance in riparian and wetland buffers.

7.3 Water and Wetland Resource Protection

Aquatic habitats at the Puerto Rico ANG facilities consist of four wetlands, including mangrove swamp, on Muñiz ANGB. Other surface water features occur outside of the boundaries of, but adjacent to, the Puerto Rico ANG facilities. These consist of additional mangrove swamp and Laguna La Torrecilla at Muñiz ANGB; and the Atlantic Ocean, Bahía de Toa, and Ensenada de Boca Vieja at Punta Salinas. These surface water and wetland features provide habitat for amphibians, reptiles, fish, waterfowl, and wading birds. Water resource protection is important to natural resources management because it directly affects surface water quality and the value of aquatic habitats. Wetlands, floodplains, and surface water buffers are critical in the protection and maintenance of wildlife resources. The Puerto Rico ANG facilities currently protect their water resources through compliance with a number of federal, Commonwealth, and local environmental regulations that require the installation to have detailed spill control and response procedures and to implement stormwater pollution prevention best management practices (BMPs). The objective of these regulations is to prevent pollutants (e.g., fuels, solvents, sediments) from entering surface waters.

7.3.1 Regulatory and Permitting

The Clean Water Act (CWA) (33 USC 1251 et seq.) is the primary federal statute that protects the nation's waters. The intent of the CWA is to prevent, reduce and eliminate pollution in the nation's waters for the purposes of restoring and maintaining the chemical, physical and biological integrity of the nation's waters. WOTUS include, but are not limited to, coastal and inland waters, lakes, rivers, ponds, streams, intermittent streams, vernal pools and wetlands. See 33 CFR Part 328.3(a) for the full list of WOTUS.

The three primary sections of the CWA that may affect day to day operations are Sections 404, 401 and 402. The USACE is the regulatory agency responsible for implementation of the CWA and the USEPA has oversight over the CWA. Section 404 regulates the discharge of dredged or fill material into WOTUS, including wetlands. When impacts to WOTUS, including wetlands cannot be avoided, a Section 404 permit must be obtained from the USACE. When a Section 404 permit is required, a Section 401 WQC is also required.

Section 10 of the Rivers and Harbors Act (33 USC 403) regulates the placement of any obstructions in and the excavation or fill in any navigable WOTUS. The USACE is the regulatory agency responsible for implementation of the Rivers and Harbors Act.

Management of wetlands on federal lands, including military installations, is further governed by EO 11990 and DoDI 4715.03. Under EO 11990 and DoDI 4715.03, wetlands are required to be managed for no net loss. This means short- and long-term impacts to WOTUS and wetlands must be avoided. If they cannot be avoided, the impacts must be minimized to the least damaging practicable alternative (LEDPA). When impacts cannot be avoided, they must be mitigated to ensure there is no net loss of acreage.

To obtain Section 404 and Section 10 permits and Section 401 WQC, applicants are, depending on the state or Commonwealth in which the installation is located, required to submit permit applications individually to the USACE and the state or Commonwealth agency responsible for implementation of Section 401 or through a Joint Permit Application. In Puerto Rico, the Commonwealth agency responsible for implementation of Section 401 is the DRNA. There are different types of Section 404 and Section 10 permits that include but are not limited to individual and Nationwide Permits. The specific type of permit is based on the total area of impact and the overall impact to the system. WQCs can be individual or they can be issued as part of a Nationwide Permit.

Applications for Section 404 permits must include an avoidance and minimization analysis that addresses the USEPA Section 404(b)(1) Guidelines (40 CFR Part 230.10). The analysis must demonstrate the effort made to first avoid the impacts and then the rationale for the selected LEDPA. The analysis must also demonstrate the impacts will not cause or contribute to violations of state or Commonwealth water quality standards and the activity does not jeopardize listed species or sensitive cultural resources (33 CFR Part 320.3 [e] and [g]). The analysis must also identify mitigation alternatives and the preferred alternative selected to meet mitigation requirements. Wastewater, construction, stormwater, and pretreatment discharges, also known as point source discharges, are managed through the National Pollution Discharge Elimination System (NPDES) Permit Program as authorized by Section 402 of the CWA. In Puerto Rico, the USEPA is the NPDES permitting authority. Muñiz ANGB is covered under an Industrial Stormwater Multi-Sector General Permit (MSGP) (PRANG, 2015). NPDES permits are not required at either Punta Salinas or Punta Borinquen, as site activities are not considered industrial activities as defined by the stormwater regulations (PRANG, 2014; PRANG, 2013). All point source discharges must have a NPDES permit. NPDES permits require specific actions including monitoring and analysis work that must be conducted during the lifetime of the permit.

EO 11988, *Floodplains Management*, requires all federal agencies to provide leadership and take action to reduce the risk of floodplain loss; minimize the impacts of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values of floodplains when acquiring, managing, or disposing of federal lands. In addition, if action is taken that permits an encroachment within the floodplain that alters the flood hazards on a national FIRM (e.g., changes to the floodplain boundary), the Puerto Rico ANG must submit an analysis reflecting those changes to FEMA. FEMA headquarters can be contacted at 202-646-3461 to obtain booklet MT-2, Revisions to National Flood Insurance Program Maps, for further guidance. The PRPB is the Commonwealth's agency that coordinates National Flood Insurance Program (NFIP) activities in Puerto Rico.

This INRMP focuses mainly on the potential impacts to water resources related to ground disturbance and stormwater associated with changes in impervious areas. Specific watershed protection measures used by the Puerto Rico ANG facilities include:

- Implementing the Stormwater Pollution Prevention Plan (SWPPP) for each facility, which provides engineering and management strategies designed to improve the quality of stormwater runoff from the Puerto Rico ANG facilities and thereby improve the quality of receiving waters (PRANG, 2013; 2014; 2018c).
- Implementing the NPDES Industrial Stormwater MSGP for Muñiz ANGB (PPR053228), effective from 3 December 2015 to 4 June 2020. An administrative extension for this permit was issued by the USEPA on 4 May 2020 and remains valid until the new MSCGP is issued.
- Obtaining a Construction General Permit for Discharge of Stormwater and Dewatering Wastewaters, through the USEPA, for construction that disturbs greater than 1 acre (0.4 ha). Ensuring BMPs designated under the regulations are implemented
- Obtaining a Section 404 permit and a Section 401 WQC prior to the commencement of construction and land disturbing activities. Mitigation may be required for the loss of acreage.
- Obtaining a Coastal Zone Management (CZM) consistency statement or a waiver for all construction and land disturbing activities.

- Obtain PRPB approval for all development activities within the 100- and 500-year floodplains.
- Managing invasive species by promoting the use of native species.

7.3.2 Coastal Management Zones

Puerto Rico's coastal zone generally extends 0.6 mile (1 km) inland and contains the Puerto Rico ANG facilities. The Coastal Zone Management Act (CZMA) of 1972 was enacted to develop a national program to manage and balance competing uses of and impacts to coastal resources. Under the CZMA, activities requiring federal permits must be consistent with a state or Commonwealth's approved CZM program. Puerto Rico's CZM program was approved by NOAA in 1978 with the DRNA serving as the lead agency. It is responsible for managing the maritime zone, coastal waters, and submerged lands. The PRPB serves as the primary agency for managing coastal development. Other Commonwealth agencies that are part of the CZM program include the DRNA, Regulations and Permits Administration, Department of Recreation and Sports, National Park Company, Department of Agriculture, and Institute of Puerto Rican Culture.

7.3.3 Vegetative Buffers

Vegetative buffers (e.g., grass filter strips, forested buffers) improve stormwater runoff quality by slowing down the rate of flow, trapping sediment and other pollutants, and increasing infiltration into the ground. The Puerto Rico ANG facilities maintain buffers around surface water and wetland resources.

7.4 Grounds Maintenance

The land at the Puerto Rico ANG facilities is maintained based on ground maintenance categories: improved (approximately 106.5 acres [43.1 ha]) and unimproved grounds (approximately 43.1 acres [17.4 ha]). The improved areas (i.e., administrative areas) and unimproved grounds at the Puerto Rico ANG facilities are managed by the 156th Civil Engineering Squadron (156 CES).

Urban forestry is the management of woody landscape plant populations in developed or improved environments. The Puerto Rico ANG EM is mandated by AFMAN 32-7003 to provide proper care and maintenance of the base's urban forest. Current management activities include replacing trees, pruning or removing hazardous trees, and ensuring that contractors comply with approved planting specifications.

Landscape designs for the Puerto Rico ANG facilities are developed by contractors and submitted to the EM for selection. The use of native plants and trees is encouraged in all landscape plans and designs, but is not required. However, native species are used whenever possible as identified in EO 13148. Appendix C contains a list of suitable native tree species for use at the Puerto Rico ANG facilities.

7.5 Wildland Fire Management

The threat of wildfire to the mission and natural resources is extremely low and a wildland fire management plan for the Puerto Rico ANG facilities is not required.

7.6 Forest Management

The Puerto Rico ANG facilities have little natural forest habitat and forest management is limited to the mangrove swamp and a forested wetland at Muñiz ANGB, some deciduous forest on the hillsides at Punta Salinas, and landscaping trees at all three facilities. Current management activities at the Puerto Rico ANG facilities include replacing trees, pruning or removing hazardous trees, and

ensuring that contractors comply with approved planting specifications. INRMP management activities focus on the routine maintenance of the forest resources at the Puerto Rico ANG facilities to maintain a healthy tree community. A list of recommended native plants for landscaping is included in Appendix C. It is the responsibility of the EM to coordinate activities with grounds maintenance and contracting. No management issues or concerns were identified for the management of forests.

7.7 Soil Conservation and Sediment Management

The soils at the Puerto Rico ANG facilities are susceptible to water erosion and are somewhat susceptible to wind erosion if not protected with vegetation or other cover. Maintenance of key ecosystem functions, such as erosion control and sediment retention, require a healthy, uniform ground cover be established as quickly as possible following land use conversion or disturbance, and that interim soil stabilization measures be implemented. Sites where soils are exposed to environmental variables (i.e., water and wind) can have erosion and sedimentation problems. Sedimentation occurs when soil particles are suspended in surface runoff or wind and are deposited in streams or other water bodies. Sediments affect water clarity, decrease oxygen levels in water, and transport pollutants. Construction activities that disturb the ground surface can accelerate erosion by removing vegetation, compacting or disturbing the soil, changing natural drainage patterns, and by covering the ground with impermeable surfaces (i.e., pavement, concrete, buildings). When the land surface is impermeable, stormwater can no longer infiltrate, resulting in larger amounts of water that can move more quickly across a site and which can carry larger amounts of sediment and other pollutants into stormwater drains and drainage basins and ultimately into streams and rivers. As soil quality declines, adverse impacts to on-site and off-site environments increase. Therefore, the maintenance of soil quality is important for efficient and productive land management and utilization. Soil drainage, texture, strength, and erodibility all determine the suitability of the ground to support man-made structures, facilities, and military activities. The plan for water resources at the Puerto Rico ANG facilities specifically focuses on stormwater drainage and retention.

The Puerto Rico facilities operate under a NPDES, which provides engineering and management strategies designed to improve the quality of stormwater runoff from the installation and thereby improve the quality of receiving waters. Construction activities that disturb one or more acres are regulated under the federal NPDES construction stormwater program and would need a Construction General Permit. The USEPA is the permitting authority for the Commonwealth and administers all NPDES permits, including the Construction General Permit, in Puerto Rico. To protect surface water quality, the Puerto Rico ANG implements the following strategies:

- Monitor surface water quality.
- Implement BMPs for construction and industrial activities.
- Prevent surface water pollution by ensuring environmental plans (e.g. SWPPP, SPCC) are implemented.
- Minimize the use of pesticides.
- Maintain vegetation buffers around water resources.
- Re-seed disturbed areas after construction.

7.8 Outdoor Recreation, Public Access, and Public Outreach

As defined in AFMAN 32-7003, suitable outdoor areas are classified into three classes of use based on outdoor recreation potential and ecosystem sustainability: Class I areas (developed recreation

areas, such as campgrounds and picnic areas), Class II areas (dispersed recreation areas used for activities such as fishing, bird watching, and hiking), and Class III areas (special interest areas that contain valuable archeological, ecological, or other features that warrant special protection and access control).

The Puerto Rico ANG facilities contain limited areas suitable for outdoor recreation. Class I areas include the recreational field and the Master Sergeant Francisco Rivera Frank Beach Area at Punta Salinas. The Puerto Rico ANG facilities do not include any Class II or Class III recreational areas. There are no outdoor recreation resources available for use by the general public.

7.9 Conservation Law Enforcement

Currently, there is no hunting or managed fishing at the Puerto Rico ANG facilities; therefore, no management issues or concerns have been identified regarding conservation law enforcement.

7.10 Geographic Information Systems

Geographic Information System (GIS) is used to manage and catalog information acquired in natural resources research. GIS assists in planning by charting areas of environmental concern and providing a baseline for analyzing the potential impacts of any proposed natural resources management action. Managers can implement the capabilities of a GIS to watershed, wetlands, wildlife, and various other natural resource management applications. GIS needs and requirements will be addressed through the ANG GeoBase Program.

7.11 Other Plans

7.11.1 Integrated Pest Management Plan

The Puerto Rico ANG IPM Plan (PRANG, 2019f) describes how the Puerto Rico ANG will manage and control pests while complying with the applicable rules and regulations. The purpose of IPM is to prevent or control pests and disease vectors that may adversely impact readiness or military operations by affecting the health of personnel, or by damaging structures, material, or property. Pest management at the Puerto Rico ANG facilities incorporates continuous monitoring, education, recordkeeping, and communication to prevent pests and disease vectors from causing unacceptable damage to operations, people, property, material, or the environment.

Public-health related pests, structural pests, vertebrate pests, and undesirable vegetation have been identified at the Puerto Rico ANG facilities. The public-health related pests identified at the facilities include small rodents (rats and mice) and various insects (cockroaches, bees, hornets, wasps, ants, mosquitoes, and spiders). Termites are a structural pest that can or have occurred in the past at the Puerto Rico ANG facilities.

DoDI 4150.07, *Pest Management Program*, also requires installations to implement vertebrate pest management programs to prevent vertebrate pest interference with operations, destruction of real property, and adverse impacts on health and morale. Common vertebrate pests known to occur at the Puerto Rico ANG facilities include various birds, iguanas, and feral animals. These include the bananaquit (*Coereba flaveola*), Antillean grackle (*Quiscalus niger*), green iguana, and feral dogs (*Canis lupus familiaris*). These pests can transmit diseases, parasites, and can cause extensive damage to landscape and structures. Nest removal, good housekeeping, and the installation of barriers, screens, and mesh are some vertebrate control methods utilized at the Puerto Rico ANG facilities. No chemical control methods for vertebrate pests are approved for use at the Puerto Rico ANG facilities.

7.11.2 Invasive Species

Non-native, invasive, and pest species have the potential to be a major contributor to ecosystem destabilization. Non-native species (also termed exotic), as the name indicates, are species from other regions of the world which have been artificially introduced to the region, primarily through human activities. Invasive species are those that, whether native or non-native, tend to become established in disturbed systems and competitively exclude native species. Invasive plant species should be monitored to prevent further spread and infestation. Information on invasive species in Puerto Rico can be found from USDA's Introduced, Invasive and Noxious Plants: https://plants.usda.gov/java/noxious.

EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*, requires all federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. Invasive plants are nonnative or native species that can thrive in areas beyond their natural range of dispersal. Noxious weeds are invasive species that are difficult to control or eradicate and have the ability to cause economic harm to the agricultural industry. Seventeen species of noxious plants are listed by USDA for Puerto Rico (USDA, 2020). Table 15 lists the invasive species currently identified at the Puerto Rico ANG facilities, and the IPM Plan details the control of invasive species.

Table 15. Noxious Weed Species Observed at the Puerto Rico ANG Facilities

Scientific Name	Common Name	Habitat Type(s) Observed In	Puerto Rico ANG Facility Observed At
Commelina benghalensis	Benghal dayflower, jio	Mowed, maintained areas; young, disturbed deciduous forest	Muñiz ANGB, Punta Salinas, Punta Borinquen
Melaleuca quinquenervia	Melaleuca, Punk tree	Mowed, maintained areas	Muñiz ANGB
Saccharum spontaneum	Wild sugarcane	Mowed, maintained areas; monotypic stands; rocky shores	Punta Salinas
Tridax procumbens	Coatbuttons	Mowed, maintained areas; disturbed deciduous forest	Muñiz ANGB, Punta Salinas, Punta Borinquen

Source: (PRANG, 2015; PRANG, 2017; PRANG, 2019b; PRANG, 2019c)

In addition to invasive plants, invasive fauna have been observed at the Puerto Rico ANG facilities, including: Afro-American house gecko, green iguana, and monk parakeet.

Invasive, non-native species, and noxious weeds have the capability to significantly impact native vegetation and wildlife. A key element of INRMP implementation is to ensure no net loss of military training capability. Management of undesirable species is necessary to maintain military lands and facilities in usable condition. In addition, uncontrolled animal pests can become health hazards, which could threaten the military mission.

The objectives of the IPM Plan are to establish and maintain safe, effective, and environmentally sound IPM practices to control pests that may adversely impact readiness of military operations by affecting the health of personnel or damaging structures, material, or property. Management strategies outlined for implementation of this INRMP are to ensure no net loss of military training capabilities. General management strategies are as follows:

- Control invasive and exotic species and noxious weeds through early detection and isolation of infested areas.

- Establish and maintain systematic and pest-specific surveillance and monitoring programs to determine the status of pest presence at the installation and if and when treatments are needed rather than by a predetermined schedule.
- Implement BMPs to minimize land disturbances that favor invasion of non-native species and re-vegetate disturbed areas with native species.
- If required, only use those pesticides approved for use in aquatic environments in and around wetlands and other surface waters.
- Do not use invasive, non-native species in landscaping.
- Implement judicious use of both non-chemical and chemical control techniques to achieve effective pest management that minimizes economic, health, and environmental risks. Emphasize the use of mechanical, biological, and cultural control techniques, using chemical techniques sparingly with caution. Use chemical controls only after careful consideration of alternative controls.
- Educate site users.
- Ensure all pest management operations involving the application of pesticides on the installation are performed by DoD or Commonwealth-certified pesticide applicators and by licensed commercial pest management companies.
- Ensure pesticides used at Puerto Rico ANG facilities are applied and stored in accordance with the product labels, their Material Safety Data Sheets, DoDI 4150.07, and federal, Commonwealth, and local regulations.
- Ensure the IPMC monitors contracts for pest management at the Puerto Rico ANG facilities.

7.11.3 Stormwater Management

The USEPA has legal authority to implement and enforce the provisions of the CWA. USEPA issued an NPDES industrial stormwater permit (Permit No. PPR053228) for industrial stormwater at Muñiz ANGB effective December 2015. There are no NPDES industrial stormwater permits issued for Punta Salinas or Punta Borinquen. The Puerto Rico ANG facilities operate under site-specific SWPPPs, which provide engineering and management strategies designed to improve the quality of stormwater runoff from the installation and thereby improve the quality of receiving waters (PRANG, 2018c; PRANG, 2013; PRANG, 2014). A Construction General Permit for discharge of stormwater and dewatering wastewaters from construction activities that disturb greater than 1 acre (0.7 ha) is required from the USEPA.

7.11.4 State Wildlife Action Plan

During the INRMP development process, the Puerto Rico ANG consulted with the DRNA to ensure INRMP goals, objectives, and strategies are consistent with Puerto Rico's overall Commonwealth and habitat-specific plans. The 2015 SWAP provides an essential foundation for the future of wildlife conservation through the identification of species of greatest conservation need and provides an opportunity for Commonwealth and federal agencies and other conservation partners to coordinate roles in conservation efforts across the Commonwealth (DRNA, 2015).

8.0 MANAGEMENT GOALS AND OBJECTIVES

Goals and objectives provide the framework for natural resources management programs. Goals provide a general guiding direction for each technical area and objectives are more specific actions that facilitate achieving those goals. The objectives then drive the development of specific activities and projects to achieve those objectives. Management goals and objectives for the INRMP were developed by a thorough evaluation of the natural resources present on the Puerto Rico ANG facilities in accordance with AFMAN 32-7003 and the principles of adaptive ecosystem management by an interdisciplinary team of biologists, planners, and environmental scientists. Goals and objectives should be revised over time to reflect evolving environmental conditions, adaptive management, and the completion of tasks as the INRMP is implemented.

GOAL – Natural Resources Program Management (PM): Manage resources in a manner that is compatible with and supports the military missions of the 156 AW, 140 ADS, and 141 ACS, while complying with applicable federal and Commonwealth laws, USAF regulations and policies.

- OBJECTIVE PM1: Ensure Environmental Management staff are trained in accordance with the requirements of AFMAN 32-7003. At a minimum, members of the Environmental Management Office must attend the CECOS Natural Resources Compliance Course as part of their training requirements for implementation of the INRMP. When feasible, members of the Environmental Management Office will attend the annual National Military Fish and Wildlife Association Training Workshop.
- OBJECTIVE PM2: Prepare a budget and identify project needs to implement the natural resources management program at the Puerto Rico ANG facilities. Project needs are to be submitted to the NGB/A4VN NRPM for budget and contracting.
- OBJECTIVE PM3: Conduct an annual INRMP review meeting with internal stakeholders. The Puerto Rico ANG EM will promote discussion with Installation Command, personnel, and pertinent internal stakeholders to identify operational needs relative to natural resources management. The EM will document, in writing, the discussions held and agreements made.
- OBJECTIVE PM4: Conduct an annual INRMP review meeting with the USFWS, NOAA, and DRNA. The Puerto Rico ANG EM will document, in writing, the discussions held and agreements made along with any changes to the goals and objectives of the INRMP and discussions regarding the projects to be undertaken in the coming year. The document will be submitted to the USFWS, NOAA, and DRNA for their concurrence and will serve as an annual update of the INRMP. The annual meeting can be conducted as an in-person meeting, via a teleconference, or it can be conducted via email.

GOAL – Fish and Wildlife Monitoring (FW): Establish a general wildlife and plant population trend monitoring program as a component of long-term ecological trend monitoring.

- OBJECTIVE FW1: Based on the results of the Final Flora and Fauna Surveys (PRANG, 2019b; PRANG, 2019c; PRANG, 2017), determine what additional surveys, and at what frequency, may be needed to gain an understanding of existing fish and wildlife habitat and the species utilizing Puerto Rico ANG facilities.
- OBJECTIVE FW2: Maintain an updated inventory of plants and animals present on the Puerto Rico ANG facilities.
- OBJECTIVE FW3: Support the ANG Safety Office and the USDA-Wildlife Specialist (WS) with implementation of the BASH plan.

- Attend quarterly BASH meetings to ensure natural resources compliance.

GOAL – Vegetative Management (VM): Establish survey and monitoring protocols to identify and address various vegetative communities on the installation.

- OBJECTIVE VM1: Based on the results of the Final Flora and Fauna Surveys (PRANG, 2019b; PRANG, 2019c; PRANG, 2017), determine what additional surveys may be needed to address the vegetative communities including the presence of non-native, invasive, and noxious species on the installation.
- OBJECTIVE VM2: Promote natural resources education and awareness.
  - Work with the base Public Affairs Office to develop information materials (i.e., pamphlets) to promote the positive aspects of Puerto Rico ANG facilities including management and preservation of natural resources.
  - Continue to develop activities and educational materials for outreach events.
  - Develop and promote natural resources public outreach events with local outdoor education groups (ex: Boy Scouts of America, Girl Scouts of the USA, 4-H groups, and school groups).

GOAL – Invasive Species (IN): Manage invasive, non-native, and noxious species at the Puerto Rico ANG facilities in accordance with municipality, Commonwealth, and federal laws and regulations

- OBJECTIVE IN1: Based on the results of the Final Flora and Fauna Surveys (PRANG, 2019b; PRANG, 2019c; PRANG, 2017) for the Puerto Rico ANG facilities, determine what additional surveys may be needed, and the actions warranted to address the presence of invasive, nonnative, and noxious species.
- OBJECTIVE IN2: Ensure pest management projects and invasive species projects undertaken by either the Pest Management Office or the Environmental Office are coordinated and provide mutual benefit.
- OBJECTIVE IN3: Monitor forested areas for any signs of disease or infestation and contact a certified forester and/or arborist if needed.
- OBJECTIVE IN4: Work with Ground Maintenance and CE Operations to determine the effectiveness of organic control methods for invasive and noxious weeds at the Puerto Rico ANG facilities.

GOAL – Threatened and Endangered Species (TE): Identify the presence of federally and Commonwealth threatened and endangered species and species of greatest conservation need identified in Puerto Rico's SWAP.

- OBJECTIVE TE1: Based on the results of the Final Flora and Fauna Surveys (PRANG, 2019b; PRANG, 2019c; PRANG, 2017) for the Puerto Rico ANG facilities, as well as Commonwealth and federal information sites identifying Commonwealth- and federally listed species, determine what additional surveys may be needed to protect and conserve sensitive species and the survey timing.
- OBJECTIVE TE2: Annually review Commonwealth and federal lists of endangered, threatened, and species of concern with potential to occur on the Puerto Rico ANG facilities. Maintain current lists of federal- and Commonwealth-listed species.

- OBJECTIVE TE3: Maintain compliance with USFWS, NOAA, and DRNA laws and regulations concerning special status species.
    - Conduct floral surveys targeting arana (*Shoepfia arenaria)* and cobana negra (*Stahlia monosperma*). Surveys may be conducted at any time of the year, preferably during the flowering or fruiting season of these species.
    - Conduct amphibian and reptile surveys, to include but not be limited to the Puerto Rican boa and the coquí frog at Muniz ANGB and at Punta Salinas and Punta Borinquen to determine presence, habitat, locations, and populations.
- OBJECTIVE TE4: Collaborate with the Manatee Conservation Center, USFWS, NOAA, DRNA, and non-profit organizations to support conservation of federally and Commonwealth-listed species, including but not limited to the West Indian manatee and sea turtles.

GOAL – Grounds Maintenance and Landscaping (GM): Manage vegetative cover, forested areas, and soil to minimize sediment loss and erosion, while protecting water quality.

- OBJECTIVE GM1: Improve effectiveness of grounds maintenance to the overall ecosystem.
    - Develop natural resources plan/grounds maintenance plan that contains an evaluation of improved and semi-improved lands with potential for conversion to unimproved. The plan should also include a list of suitable native plants for on base landscape projects.
    - Mow natural grassland vegetation restoration areas annually to control woody vegetation growth.
    - Maximize the use of regional native plant species and avoid introductions of invasive and exotic species in re-vegetation and landscaping activities.
    - Work with Ground Maintenance and CE Operations to test the effectiveness of organic weed control methods for invasive and noxious weeds.
- OBJECTIVE GM2: Maintain the safety and security of base personnel while improving the effectiveness of grounds maintenance to the overall ecosystem. Maintain trees and shrubs to avoid impacts to buildings and infrastructure.
    - Annually inventory trees and shrubs to identify trees that need pruning, replacement, or removal, to ensure they are not impacting buildings and base infrastructure.
    - As feasible, replace dead trees with suitable native tree species.

GOAL – Water Resource Protection (WA): Manage water resources to prevent potential degradation of water quality while ensuring no net loss of acreage, functions, and values.

- OBJECTIVE WA1: Ensure all NPDES permits are current and all conditions of those permits, including water quality monitoring, are implemented in accordance with the permits.
- OBJECTIVE WA2: Minimize nonpoint source pollution through implementation of BMP protocols to avoid and/or minimize impacts that may occur as the result of petroleum, oil, and lubricants or hazardous material spills.

- OBJECTIVE WA3: Implement and maintain Commonwealth erosion and sediment control BMPs during all phases of construction and maintenance projects to prevent disturbed soils from entering into water resources onsite and adjacent to the base.
- OBJECTIVE WA4: Implement the SWPPP and manage stormwater runoff to reduce nutrients and contaminants from entering onsite and adjacent stream and wetland systems.

GOAL – Waters of the US/Wetland Management and Protection (WT): Ensure the jurisdictional determinations (JDs) for onsite WOTUS and wetlands remain current.

- OBJECTIVE WT1: Ensure the boundaries of WOTUS, wetlands, and floodplains identified on and adjacent to the installation are shown in a GIS data layer for Muniz ANGB, Punta Salinas, and Punta Borinquen and shown in all installation development, comprehensive plans, and educational materials developed for installation personnel, leadership, and visiting personnel.
- OBJECTIVE WT2: Ensure the JDs for WOTUS including wetlands remain current.
- OBJECTIVE WT3: Educate key installation and visiting personnel on the processes for conducting the mission in and adjacent to delineated and mapped WOTUS, wetlands, and floodplains.
- OBJECTIVE WT4: Review all land disturbing projects including but not limited to demolition, construction, and maintenance projects to determine if the projects will impact WOTUS including wetlands and/or floodplains.
    - If impacts will occur, determine what type of Section 404 permit and Section 401 WQC will be required. Work with the NGB/A4VN NRPM to prepare the applications necessary to obtain Section 404 permits from the USACE and Section 401 WQC from the DRNA.
    - Ensure all projects at the Puerto Rico ANG facilities are in compliance with CZM laws and regulations.

GOAL – Public Outreach (PO): Promote natural resources education and awareness.

- OBJECTIVE PO1: Conduct annual Earth Day outreach events with the public.
    - Work with the Muñiz ANGB Public Affairs Office to develop information materials (i.e., pamphlets) to promote positive natural resources management.
    - Determine if educational materials from DRNA, NOAA, USFWS, and the Manatee Conservation Center can be shared with the public as part of the Earth Day outreach events, and if these agencies can assist the ANG Environmental Manager in implementing these annual events.

GOAL – Climate Change (CC): Contact the LMMIAP Airfield Manager, the ANGB Safety Office, and the USDA Wildlife Services Specialist regarding the climate change studies they will be conducting at LMMIAP.

- OBJECTIVE CC1: Determine the feasibility of one or more of the Puerto Rico ANG facilities participating in the climate change studies they will be conducting at LMMIAP.
- OBJECTIVE CC2: Determine what aspects of the climate change studies may be supported by the Puerto Rico ANG facilities and incorporated into the INRMP.

9.0 ANNUAL WORK PLANS

The INRMP Annual Work Plans contain projects listed by FY. For each project, a specific timeframe for implementation is provided (as applicable), as well as the Office of Primary Responsibility (OPR), funding sources, and priority for implementation (see Table 16 through 20) Priorities are defined as follows:

- High: The INRMP signatories assert that if the project is not funded the INRMP is not being implemented and the USAF is non-compliant with the Sikes Act; or that it is specifically tied to an INRMP goal and objective and is part of a "Benefit of the Species" determination necessary for ESA Sec 4(a)(3)(B)(i) critical habitat exemption.
- Medium: Project supports a specific INRMP goal and objective, and is deemed by INRMP signatories to be important for preventing non-compliance with a specific requirement within a natural resources law or by EO 13112, *Invasive Species.* However, the INRMP signatories would not contend that the INRMP is not being implemented if not accomplished within the programmed year due to other priorities and/or funding shortfalls.
- Low: Project supports a specific INRMP goal and objective, enhances conservation resources or the integrity of the installation mission, and/or supports long-term compliance with specific requirements within natural resources law; but is not directly tied to specific compliance within the programmed year.

Table 16. Work Plans FY 2021

Project	Objective	Frequency	OPR	Funding Source	Priority Level
Prepare budget to implement the natural resources management program at Puerto Rico ANG facilities.	PM2	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with Puerto Rico ANG installation stakeholders.	PM3	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with USFWS, DRNA, and NOAA.	PM4	Annual	156 CES/EM	PRANG	High
Annually review federal and Commonwealth listings for threatened and endangered and species of concern to maintain current lists of federal and Commonwealth species that potentially could be on or near Puerto Rico ANG facilities.	TE2	Annual	156 CES/EM	NGB	High
Organic Weed Applications –Work with Ground Maintenance and CE Operations to test the effectiveness of organic control methods for invasive and noxious weeds.	IN4, GM1	Ongoing	156 CES Grounds Maintenance	PRANG	High
Ensure all activities (e.g., construction projects, mission changes, service contracts, etc.) at Puerto Rico ANG facilities are reviewed by the EM to identify any environmental permit required.	PM3	Ongoing	156 CES/EM	NGB	High
Annually review federal and Commonwealth listings of invasive and noxious flora and fauna species to maintain current lists of species that potentially could be on or near Puerto Rico ANG facilities, and to determine which ones may pose a threat to the facilities.	IN1	Annual	156 CES/EM	NGB	High
Support BASH Program by attending quarterly meetings to ensure natural resources compliance.	FW3	Ongoing	156 CES/EM	NGB	High
Ensure demolition, construction and renovation projects use native grasses in unimproved areas and/or with a suitable seed mix as part of the project design plan.	GM1	Ongoing, as needed	156 CES/EM	PRANG	Medium
Follow up on the request submitted to the USACE to extend the WOTUS JD for the Muñiz ANGB for an additional 5 years.	WT2	Every five years	156 CES/EM Contractors	NGB	High
Develop activities and educational materials for Earth Day events, as feasible.	VM2, PO1	Annual	156 CES/EM	NGB	Low
Collaborate with the Manatee Conservation Center, the USFWS, NOAA, and DRNA regarding working with those agencies to support conservation efforts and the use of a sea pen in La Playita at Punta Salinas.	VM2, TE4	Ongoing, as needed	156 CES/EM	NGB	Low
Consult with the LMMIAP in regards to their development of climate change studies to determine feasibility of Puerto Rico ANG facilities participating in those studies.	CC1	Ongoing	156 CES/EM	NGB	High

Table 17. Work Plans FY 2022

Project	Objective	Frequency	OPR	Funding Source	Priority Level
Prepare budget to implement the natural resources management program at Puerto Rico ANG facilities.	PM2	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with Puerto Rico ANG installation stakeholders.	PM3	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with USFWS, DRNA, and NOAA.	PM4	Annual	156 CES/EM	PRANG	High
Annually review federal and Commonwealth listings for threatened and endangered species and species of concern to maintain current lists of federal and Commonwealth species that potentially could be on or near Puerto Rico ANG facilities.	TE2	Annual	156 CES/EM	NGB	High
Organic Weed Applications –Work with Ground Maintenance and CE Operations to test the effectiveness of organic control methods for invasive and noxious weeds.	GM1, IN4	Ongoing	156 CES Grounds Maintenance	PRANG	High
Ensure all activities (e.g., construction projects, mission changes, service contracts, etc.) at Puerto Rico ANG facilities are reviewed by the EM to identify any environmental permit required.	PM3	Ongoing	156 CES/EM	NGB	High
Annually review federal and Commonwealth listings of invasive and noxious flora and fauna species to maintain current lists of species that potentially could be on or near Puerto Rico ANG facilities, and to determine which ones may pose a threat to the facilities	IN1	Annual	156 CES/EM	NGB	High
Support BASH Program by attending quarterly meetings to ensure natural resources compliance.	FW3	Ongoing	156 CES/EM	NGB	High
Ensure demolition, construction, and renovation projects use native grasses in unimproved areas and/or with a suitable seed mix as part of the project design plan.	GM1	Ongoing, as needed	156 CES/EM Contractors	NGB	Medium
Develop activities and educational materials for Earth Day events, as feasible.	VM2, PO1	Annual	156 CES/EM	NGB	Low
Collaborate with the Manatee Conservation Center, the USFWS, NOAA, and DRNA regarding working with those agencies to support conservation efforts and the use of a sea pen in La Playita at Punta Salinas.	VM2, TE4	Ongoing	156 CES/EM	NGB	Low
In cooperation with the grounds maintenance personnel and any other landscape personnel, the Safety Office and the USDA WS, develop a native plant species list (with low-maintenance species) for use at all three Puerto Rico ANG facilities including the flightline at Muniz ANGB.	GM1	Ongoing	156 CES Grounds Maintenance 156 CES/EM	NGB	Medium
Ensure any climate change studies determined to be feasible for the ANG are funded, contracted for, and included in the annual INRMP review with federal agencies and DRNA.	WT1	Ongoing	156 CES/EM	NGB	High
Conduct an urban forest inventory at the Puerto Rico ANG facilities to identify tree and shrub species, to conduct health assessments, to develop a pruning schedule and to identify need for replacement or removal and to ensure there are no impacts to buildings and base infrastructure at the Puerto Rico ANG facilities.	GM2	Once	156 CES/EM Contractors	NGB	Medium

Table 18. Work Plans FY 2023

Project	Objective	Frequency	OPR	Funding Source	Priority Level
Prepare budget to implement the natural resources management program at Puerto Rico ANG facilities.	PM2	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with Puerto Rico ANG installation stakeholders.	PM3	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with USFWS, DRNA, and NOAA.	PM4	Annual	156 CES/EM	PRANG	High
Annually review federal and Commonwealth listings for threatened and endangered species and species of concern to maintain current lists of federal and Commonwealth species that potentially could be on or near Puerto Rico ANG facilities. species.	TE2	Annual	156 CES/EM	NGB	High
Organic Weed Applications –Work with Ground Maintenance and CE Operations to test the effectiveness of organic control methods for invasive and noxious weeds.	IN4, GM1	Ongoing	156 CES Grounds Maintenance	PRANG	High
Ensure all activities (e.g., construction projects, mission changes, service contracts, etc.) at Puerto Rico ANG facilities are reviewed by the EM to identify any environmental permit required.	PM3	Ongoing	156 CES/EM	NGB	High
Annually review federal and Commonwealth listings of invasive and noxious flora and fauna species to maintain current lists of species that potentially could be on or near Puerto Rico ANG facilities, and to determine which ones may pose a threat to the facilities.	IN1	Annual	156 CES/EM	NGB	High
Support BASH Program by attending quarterly meeting to ensure natural resources compliance.	FW3	Ongoing	156 CES/EM	NGB	High
Submit requests to the USACE to extend the existing JDs for Punta Salinas and Punta Borinquen for an additional 5 years. The requests must be submitted before October 2023.	WT2	Every five years	156 CES/EM Contractors	NGB	High
Ensure demolition, construction, and renovation projects use native grasses in unimproved areas and/or with a suitable seed mix as part of the project design plan for improved areas.	GM1	Ongoing, as needed	156 CES/EM	PRANG	Medium
Develop activities and educational materials for Earth Day events, as feasible.	VM2, PO1	Annual	156 CES/EM	NGB	Low
Collaborate with the Manatee Conservation Center, the USFWS, NOAA, and DRNA regarding working with those agencies to support conservation efforts and the use of a sea pen in La Playita at Punta Salinas.	VM2, TE4	Ongoing	156 CES/EM	NGB	Low
Ensure the approved native plant species list is incorporated in all Grounds Maintenance contractors and the actions to be undertaken as the result of the inventory and health assessments are implemented at the Puerto Rico ANG facilities.	GM1	Ongoing	156 CES Grounds Maintenance	GM1	Ongoing
Conduct a detailed survey of invasive plant species (Benghal dayflower, punk tree, coatbuttons) on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities to identify control measures.	IN1	Review every five years	Contractors	NGB	Medium
Conduct a detailed survey of invasive and exotic reptile and amphibian species (tropical house gecko, green iguana, boas, pythons, caimans), and their impact on natural areas on and near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities and develop a species management control plan. Study should tie in the effectiveness of existing control measures for the BASH program with control of the iguana population in the natural areas outside the vicinity of the airfield.	IN1	As needed	156 CES/EM Contractors	NGB	Medium
Conduct a detailed survey of native amphibians and reptile species (Puerto Rican boa, common coquí frog and any other reptiles present) on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities.	FW1, TE3	As needed	156 CES/EM Contractors	NGB	Medium

Table 19. Work Plans FY 2024

Project	Objective	Frequency	OPR	Funding Source	Priority Level
Prepare budget to implement the natural resources management program at Puerto Rico ANG facilities.	PM2	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with PR ANG installation stakeholders.	PM3	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with USFWS, DRNA, and NOAA.	PM4	Annual	156 CES/EM	PRANG	High
Annually review federal and Commonwealth listings for threatened and endangered species and species of concern to maintain current lists of federal and Commonwealth species that potentially could be on or near Puerto Rico ANG facilities.	TE2	Annual	156 CES/EM	NGB	High
Organic Weed Applications –Work with Ground Maintenance and CE Operations to test the effectiveness of organic control methods for invasive and noxious weeds.	IN4, GM1	Ongoing	156 CES Grounds Maintenance	PRANG	High
Ensure all activities (e.g., construction projects, mission changes, service contracts, etc.) at Puerto Rico ANG facilities are reviewed by the EM to identify any environmental permit required.	PM3	Ongoing	156 CES/EM	NGB	High
Annually review federal and Commonwealth listings of invasive and noxious flora and fauna species to maintain current lists of species that potentially could be on or near Puerto Rico ANG facilities, and to determine which ones may pose a threat to the facilities.	IN1	Annual	156 CES/EM	NGB	High
Support BASH Program by attending quarterly meeting to ensure natural resources compliance.	FW3	Ongoing	156 CES/EM	NGB	High
Ensure demolition, construction, and/or renovation projects use native grasses in unimproved areas and/or with a suitable seed mix as part of the project design plan for improved areas.	GM1	Ongoing, as needed	156 CES/EM	PRANG	Medium
Develop activities and educational materials for Earth Day events, as feasible.	VM2, PO1	Annual	156 CES/EM	NGB	Low
Collaborate with the Manatee Conservation Center, the USFWS, NOAA, and DRNA regarding working with those agencies to support conservation efforts and the use of a sea pen in La Playita at Punta Salinas.	VM2, TE4	Ongoing	156 CES/EM	NGB	Low
Conduct a fisheries inventory at the Punta Salinas lagoon (located between the Main Radar Site and the East Island).	FW1	As needed	156 CES/EM Contractors	NGB	
Investigate control methods for the invasive lionfish at Punta Salinas and feasibility of implementation.	IN2	As needed	156 CES/EM Contractors	NGB	
Monitor progress of previous years' surveys of invasive plant species (Benghal dayflower, punk tree, coatbuttons) on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities to identify control measures.	IN1	Review every five years	Contractors	NGB	Medium
Monitor progress of previous years' surveys of invasive and exotic reptile's species (tropical house gecko, green iguana, boas, pythons), and their impact on natural areas on and near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities, to develop an invasive species management plan. Study should tie in the effectiveness of existing control measures for the BASH program with control of the iguana population in the natural areas outside the vicinity of the airfield.	IN1	As needed	156 CES/EM Contractors	NGB	Medium
Monitor progress of previous years' surveys of native amphibians and reptile's species (Puerto Rican boa, common coqui frog and any other reptiles present) on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities.	FW1, TE3	As needed	156 CES/EM Contractors	NGB	Medium

Table 20. Work Plans FY 2025

Project	Objective	Frequency	OPR	Funding Source	Priority Level
Prepare budget to implement the natural resources management program at Puerto Rico ANG facilities.	PM2	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with Puerto Rico ANG installation stakeholders.	PM3	Annual	156 CES/EM	PRANG	High
Complete annual review of INRMP with USFWS, DRNA, and NOAA.	PM4	Annual	156 CES/EM	PRANG	High
Annually review federal and Commonwealth listings for threatened and endangered species and species of concern to maintain current lists of federal and Commonwealth species that potentially could be on or near Puerto Rico ANG facilities.	TE2	Annual	156 CES/EM	NGB	High
Organic Weed Applications –Work with Ground Maintenance and CE Operations to test the effectiveness of organic control methods for invasive and noxious weeds.	IN4,	Ongoing	156 CES Grounds Maintenance	PRANG	High
Ensure all activities (e.g., construction projects, mission changes, service contracts, etc.) at Puerto Rico ANG facilities are reviewed by the EM to identify any environmental permit required.	PM3	Ongoing	156 CES/EM	NGB	High
Annually review federal and Commonwealth listings of invasive and noxious flora and fauna species to maintain current lists of species that potentially could be on or near Puerto Rico ANG facilities, and to determine which ones may pose a threat to the facilities.	IN1	Annual	156 CES/EM	NGB	High
Support BASH Program by attending quarterly meeting to ensure natural resources compliance.	FW3	Ongoing	156 CES/EM	NGB	High
Ensure demolition, construction, and/or renovation projects use native grasses in unimproved areas and/or with a suitable seed mix as part of the project design plan for improved areas.	GM1	Ongoing, as needed	156 CES/EM	PRANG	Medium
Develop activities and educational materials for Earth Day events, as feasible.	VM2, PO1	Annual	156 CES/EM	NGB	Low
Collaborate with the Manatee Conservation Center, the USFWS, NOAA, and DRNA regarding working with those agencies to support conservation efforts and the use of a sea pen in La Playita at Punta Salinas.	VM2, TE4	Ongoing	156 CES/EM	NGB	Low
Conduct a survey to identify presence of arana and Cobana negra on or near Muñiz ANGB. Surveys may be conducted any time of the year, preferably during flowering or fruiting seasons.	VM1, TE3	Once	156 CES/EM Contractors	NGB	Medium
Monitor progress of previous years' surveys of invasive plant species (Benghal dayflower, punk tree, coatbuttons) on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities to identify control measures.	IN1	Review every five years	Contractors	NGB	Medium
Monitor progress of previous years' surveys of invasive and exotic reptile's species (tropical house gecko, green iguana, boas, pythons), and their impact on natural areas on and near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities and development of the invasive species management plan.	IN1	As needed	156 CES/EM Contractors	NGB	Medium
Monitor progress of previous years' surveys of reptiles and amphibians on or near Muñiz ANGB, Punta Salinas, and Punta Borinquen facilities.	FW1, TE3	As needed	156 CES/EM Contractors	NGB	Medium

10.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

10.1 INRMP Implementation

In accordance with AFMAN 32-7003, an INRMP is considered implemented if an installation:

- Actively requests, receives, and uses funds for "must fund" projects and activities as defined by Chapter 4 of AFI 32-7001, *Environmental Quality Programming and Budgeting*.
- Executes all "must fund" projects and activities in accordance with specific time frames identified in the INRMP.
- Prepares the INRMP in cooperation with appropriate stakeholders. Notifies stakeholders when a new or revised INRMP will be prepared, and solicits participation and input to the INRMP development and review process.
- Ensures that sufficient numbers of professionally trained natural resources management personnel are available to perform the tasks required by the INRMP.
- Ensures INRMP has been approved in writing by the appropriate representative from each cooperating agency within the past 5 years.
- Reviews the INRMP annually and coordinates annually with cooperating agencies.
- Establishes and maintains regular communications with the appropriate federal and Commonwealth agencies for the region where the installation is located.
- Documents specific INRMP action accomplishments undertaken each year.
- Ensures INRMP updates and reviews are conducted in cooperation with the USFWS, DRNA, and NOAA, where applicable.
- Ensures the INRMP implements ecosystem management on ANG installations by setting goals for attaining a desired land condition.

Natural resource and land use management issues are not the only factors contributing to the development and implementation of this INRMP. Facility management and other seemingly unrelated issues affect implementation. It is important to the implementation of this INRMP that Puerto Rico ANG personnel take ownership of this INRMP to provide the necessary resources (e.g. personnel and equipment), and to utilize the appropriate funding allocated by the ANG NGB/A4VN NRPM to implement this INRMP. It is extremely important that the INRMP Working Group continue to participate in the implementation of this INRMP. The INRMP Working Group is made up of key Puerto Rico ANG personnel, representatives from the USFWS, DRNA, NOAA, and the USDA-WS. It has an oversight role to ensure the effective implementation of this INRMP. Top and middle-level management representation, as well as representation from individuals with day-to-day on-site experience will provide the INRMP Working Group with the leadership and structure necessary for the successful implementation of this INRMP.

10.1.1 Monitoring INRMP Implementation

10.1.1.1 *Puerto Rico INRMP Implementation Analysis*

Implementation of this INRMP will be monitored for meeting the legal requirements of the Sikes Act as well as for other mission and biological measures of effectiveness. The ultimate successful implementation of this INRMP is realized in no net loss in the capability of the Muñiz ANGB training lands, including its two GSUs, to support the military mission while at the same time providing effective natural resources management.

In order to monitor and evaluate the effectiveness of the INRMP implementation, the following will be reviewed, as applicable, and discussed within the context of the annual review and/or a formal review of operation and effect:

- Impacts to and from military mission
- Conservation program budget
- Staff requirements
- Program budget
- Compliance with regulatory requirements
- Program and project implementation
- Feedback from military trainers, the USFWS, DRNA, and others
- Trends in species and habitat diversity as evidenced by recurring biological surveys, land use changes, and opinions of natural resource experts

Some of these areas may not be reviewed every year due to lack of data or pertinent information. The effectiveness of this INRMP as a mission enabling conservation tool will be decided by mutual agreement of the USFWS, NOAA, DRNA, and Puerto Rico ANG during annual reviews and/or reviews for operation and effect.

10.1.1.2 *USAF and DoD INRMP Implementation Monitoring*

The USAF uses the Defense Environmental Programs Annual Report to Congress (DEPARC) to monitor Sikes Act compliance. DEPARC is the automated system used to collect installation environmental information for reporting to DoD and Congress. Established to fulfill an annual requirement to report the status of DoD's Environmental Quality program to Congress, DEPARC collects information on enforcement actions, inspections, and other performance measures for high-level reports and quarterly reviews. DEPARC also helps the USAF track fulfillment of DoD measures of merit requirements. The Deputy under Secretary of Defense's (DUSD) Updated Guidance for Implementation of the Sikes Act also includes an updated section, Conservation Metrics for Preparing and Implementing INRMPs. Progress toward meeting these measures of merit is reported in the annual report to Congress.

10.1.2 Priorities and Scheduling

The Office of Management and Budget considers funding for the preparation and implementation of this INRMP, as required by the Sikes Act, to be a high priority. However, the reality is that not all of the projects and programs identified in this INRMP will receive immediate funding. Therefore, projects need to be funded consistent with timely execution to meet future deadlines. Projects are generally prioritized with respect to compliance. Highest priority projects are projects related to

recurring or current compliance, and these are generally scheduled earliest. The prioritization of the projects is based on need, legal drivers, and ability to further implement the INRMP.

Current compliance includes projects and activities needed because an installation is currently or will be out of compliance if projects or activities are not implemented in the current program year. Examples include:

- Environmental analyses, monitoring, and studies required to assess and mitigate potential effects of the military mission on conservation resources
- Planning documents
- Baseline inventories and surveys of natural resources (historical and archaeological sites)
- Biological assessments (BAs), surveys, or habitat protection for a specific listed species
- Mitigation to meet existing regulatory permit conditions or written agreements
- Wetland delineations in support of subsequent JDs
- Efforts to achieve compliance with requirements that have deadlines that have already passed

Maintenance requirements include those projects needed that are not currently out of compliance but shall be out of compliance if projects are not implemented in time to meet an established deadline beyond the current program year. Examples include:

- Compliance with future requirements that have deadlines
- Conservation and GIS mapping to be in compliance
- Efforts undertaken in accordance with non-deadline specific compliance requirements of leadership initiatives
- Wetlands enhancement, in order to achieve the executive order for no net loss or to achieve enhancement of existing degraded wetlands
- Public education programs that explain the importance of protecting natural resources

Lower priority projects include those that enhance conservation resources of the installation mission, or are needed to address overall environmental goals and objectives, but are not specifically required under regulation or executive order, and are not of an immediate nature. These projects are generally funded after those of higher priority are funded. Examples include:

- Community outreach activities such as Earth Day and Historic Preservation Week activities
- Educational and public awareness projects such as interpretive displays, nature trails, wildlife checklists, and conservation teaching materials
- BAs, biological surveys, or habitat protection for a non-listed species
- Restoration or enhancement of natural resources when no specific compliance requirement dictates a course or timing of action
- Management and execution of volunteer and partnership programs

10.1.3 Funding

Implementation of this INRMP is subject to the availability of annual funding. Funding for specific projects can be grouped into three main categories by source: federal ANG or NGB funds, other federal funds, and non-federal funds. When projects identified in the plan are not implemented due to lack of funding, or other compelling circumstances, the installation will review the goals and objectives of this INRMP to determine whether adjustments are necessary. Funding options include:

- The Legacy Resource Management Program provides financial assistance to DoD efforts to conserve natural and cultural resources on federal lands. Legacy projects could include regional ecosystem management initiatives, habitat preservation efforts, archeological investigations, invasive species control, and/or flora or fauna surveys. Project proposals are submitted to the Legacy program during their annual funding cycle (https://www.denix.osd.mil/legacy/home).
- Grant and assistance programs are administered by other federal agencies that could be accessed for natural resources management at the Puerto Rico ANG facilities. Examples include funds associated with the CWA and endangered species.
- Other non-federal funding sources that could be considered include The Public Lands Day Program, which coordinates volunteers to improve the public lands they use for recreation, education, and enjoyment, and the National Environmental Education and Training Foundation, which manages, coordinates, and generates financial support for the program (https://www.neefusa.org/npld).
- The Puerto Rico ANG facilities may also consider entering into cooperative or mutual aid agreements with Commonwealth agencies, local governments, non-governmental organizations, and other individuals.

10.1.4 Cooperative Agreements

The DoD and subcommand entities have MOUs, Memorandums of Agreement (MOAs), and other cooperative agreements with other federal agencies, conservation and special interest groups, and various state or Commonwealth agencies in order to provide assistance with natural resources management at installations across the US. Generally, these agreements allow installations and agencies, or conservation and special interest groups to obtain mutual conservation objectives. The DoD agreements applicable to the Puerto Rico ANG facilities include:

- MOU between DoD and USFWS/International Fund for Animal Welfare (IFAW) to promote the conservation of migratory birds (2011).
- MOU between DoD and USFWS/IFWA for a Cooperative Integrated Natural Resource Program associated with the ecosystem-based management of fish, wildlife, and plant resources on military lands (2006).
- MOU between the DoD and USEPA to form a working partnership to promote environmental stewardship by adopting IPM strategies to reduce the potential risks to human health and the environment associated with pesticides (2012).
- MOA for federal Neotropical Migratory Bird Conservation Program and addendum (Partners in Flight-Aves De Las Americas) among DoD, through each of the Military Services, and over 110 other federal and state or Commonwealth agencies and non-governmental organizations (1991).

- MOU between the DoD and Ducks Unlimited, Inc. to provide a foundation for cooperative development of selected wetlands and associated uplands in order to maintain and increase waterfowl populations and to fulfill the objectives of the North American Waterfowl Management Plan, within the context of DoD's environmental security and military missions (2006).
- MOU between DoD and NRCS to promote cooperative conservation, where appropriate (2006).
- MOU with Watchable Wildlife Incorporated (2002).
- MOU between the DoD and Bat Conservation International to identify, document, and maintain bat populations and habitats on DoD installations (2011).
- MOA between the FAA, USAF, US Army, USEPA, USFWS, and USDA to address aircraft-wildlife strikes (2003).

For a further list of cooperative agreements and MOUs please visit:

https://www.denix.osd.mil/nr/partnerships/mousandmoas/

10.1.5 Consultation Requirements

The Puerto Rico ANG facilities have multiple natural resources consultation requirements in addition to the INRMP development and review requirements as identified in the Sikes Act. Federally listed species management requires ESA Section 7 consultation with the USFWS. Commonwealth-listed species management requires consultation with DRNA. EFH consultation and aquatic species management requires coordination with NOAA. Actions that fall under the jurisdiction of Section 401 of the CWA necessitate permitting from the PREQB, while Section 404 actions necessitate permitting from the USACE.

The USFWS has updated the way federal agencies may consult on the effects of their actions on the northern long-eared bat. In 2016, the USFWS developed the optional streamlined Section 7 consultation framework for the northern long-eared bat. The framework was part of the USFWS' January 5, 2016 biological opinion on their issuance of a 4(d) rule for the species. Agencies can use the online determination key available through the USFWS Information Planning and Consultation website (https://ecos.fws.gov/ipac/).

10.2 Annual INRMP Review and Coordination Requirements

Per DoD policy, the Puerto Rico ANG will review the INRMP annually in cooperation with the USFWS, DRNA, and NOAA. On an annual basis, the EM will invite the USFWS Regional Office, the USFWS local field office, the DRNA, and NGB/A4VN NRPM to attend a meeting or participate in a conference call to review previous year INRMP implementation and discuss implementation of upcoming programs and projects. Invitations will be either by letter or email. Attendance is at the option of those invited, but at minimum the USFWS local field office and a representative from NOAA and DRNA are expected to attend. The meeting will be documented with an agenda, meeting minutes, and sign-in roster of attendees.

At this annual meeting the need for updates or revisions will be discussed. If updates are needed, the Puerto Rico ANG will initiate the updates and, after agreement of all four parties, they will be incorporated in the INRMP. If it is determined that major changes are needed, all four parties will provide input and an INRMP revision will be initiated with the Puerto Rico ANG acting as the lead coordinating agency. The annual meeting will be used to expedite the more formal review for

operation and effect and, if all parties agree and document their mutual agreement, it can fulfill the requirement to review the INRMP for operation and effect.

If not already determined in previous annual meetings, by the fourth year annual review a determination will be made jointly to continue implementation of the existing INRMP with updates or to proceed with a revision. If the parties feel that the annual reviews have not been sufficient to evaluate operation and effect and they cannot determine if the INRMP implementation should continue or be revised, a formal review for operation and effect will be initiated. The determination on how to proceed with INRMP implementation or revision will be made after the parties have had time to complete this review.

As part of the annual review, the Puerto Rico ANG will specifically:

- Invite feedback from USFWS, NOAA, and DRNA on the effectiveness of the INRMP.
- Inform USFWS, NOAA, and DRNA which INRMP projects are required to meet current natural resources compliance needs.
- Document specific INRMP action accomplishments from the previous year and demonstrate that the INRMP has been implemented appropriately.

10.3 INRMP Update and Revision Process

10.3.1 Review for Operation and Effect

Not less than every 5 years, the INRMP will be reviewed for operation and effect to determine if the INRMP is being implemented as required by the Sikes Act and contributing to the management of natural resources at the Puerto Rico ANG facilities. The review will be conducted by the cooperating parties to include the Commander responsible for the INRMP, the Supervisor of the USFWS Caribbean Ecological Field Office, and representatives from the DRNA and NOAA. While these are the responsible parties, technical representatives generally are the personnel who actually conduct the review.

The review for operation and effect will either conclude that the INRMP is meeting the intent of the Sikes Act and only needs an update and implementation can continue; or that it is not effective in meeting the intent of the Sikes Act and it must be revised. The conclusion of the review will be documented in a jointly executed memorandum, meeting minutes, or in some way that reflects mutual agreement.

If only updates are needed, they will be completed in a manner agreed to by all parties. The updated INRMP will be reviewed by the local USFWS Caribbean Ecological Field Office, NOAA, and DRNA. Once concurrence letters or signatures are received, the update of the INRMP will be complete and implementation will continue. Generally, the environmental impact analysis will continue to be applicable to updated INRMPs, and a new analysis will not be required.

If a review of operation and effect concludes that an INRMP must be revised, there is no set time to complete the revision. The existing INRMP remains in effect until the revision is complete and USFWS, NOAA, and DRNA concurrence on the revised INRMP is received. The Puerto Rico ANG will endeavor to complete such revisions within 18 months, depending upon funding availability. Revisions to the INRMP will go through a detailed review process similar to development of the initial INRMP to ensure Puerto Rico ANG military mission, USFWS, NOAA, and DRNA concerns are adequately addressed, and the INRMP meets the intent of the Sikes Act.

APPENDIX A. REFERENCES

Aerostar Airport Holdings LLC . (2013). *Luis Muñoz Marin International Airport Wildlife Hazard Management Plan.*

ANG. (2020). *Puerto Rico*. Retrieved September 9, 2020, from https://www.goang.com/locations/puerto-rico.html

Bailey, R. G. (1995, March). *Description of the Ecoregions of the United States.* Retrieved from https://www.fs.fed.us/land/ecosysmgmt/

Bernstein, B. (2008). *Sustaining life: How human health depends on biodiversity.* Oxford University Press.

Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of Wetlands and Deepwater Habitats of the United States.* Retrieved March 23, 2020, from https://www.fws.gov/wetlands/documents/Classification-of-Wetlands-and-Deepwater-Habitats-of-the-United-States.pdf

Discover Puerto Rico. (2020, August 20). *Ruinas Faro Punta Borinquen - Aguadilla*. Retrieved from https://www.discoverpuertorico.com/profile/ruinas-faro-punta-borinquen-aguadilla/8044

DoD. (2018). *Department of Defense Achieving Response Complete at Installation Restoration Program Sites.* Retrieved August 26, 2020, from https://www.denix.osd.mil/derp/home/documents/installation-restoration-program-report-to-congress-january-2018/IRP%20Report%20to%20Congress%202018.pdf

DRNA. (2015). *Puerto Rico State Wildlife Action Plan - Ten Year Review.*

DRNA. (2016). *Reglamento para regir las especies vulnerables y en peligro de extinción en el Estado Libre Asociado de Puerto Rico.*

Ewel, J. J., & Whitmore, J. L. (1973). *The Ecological Life Zones of Puerto Rico and the U.S. Virgin Islands.* US Forest Service, Institue of Tropical Forestry. Retrieved August 14, 2020, from https://www.srs.fs.usda.gov/pubs/rp/rp_itf018.pdf

FEMA. (2020). *National Flood Hazard Layer Viewer*. Retrieved August 21, 2020, from FEMA Flood Map Service Center: https://msc.fema.gov/portal/home

Miller, G. L., & Lugo, A. E. (2009). *Guide to the Ecological Systems of Puerto Rico.* USDA Forest Service. Retrieved from https://www.fs.fed.us/global/iitf/pubs/IITF_gtr35.pdf

Miller, J. A., Whitehead, R. L., Gingerich, S. B., Oki, D. S., & Olcott, P. G. (1999). *Ground Water Atlas of the United States, Segment 13: Alaska, Hawaii, Puerto Rico and the U.S. Virgin Islands.* US Geological Survey. Retrieved July 30, 2020, from https://pubs.usgs.gov/ha/730n/report.pdf

Monroe, W. H. (1980). *Some Tropical Landforms of Puerto Rico.* Department of the Interior, US Geological Survey. Retrieved July 30, 2020, from https://pubs.usgs.gov/pp/1159/report.pdf

NMFS. (2020). *Puerto Rico: Threatened and Endangered Species and Critical Habitat Under NOAA Fisheries Jurisdiction*. Retrieved August 20, 2020, from https://www.fisheries.noaa.gov/southeast/consultations/puerto-rico

NOAA. (2018). *Comparative Climatic Data for the United States through 2018.* Retrieved July 27, 2020, from https://www.ncdc.noaa.gov/sites/default/files/attachments/CCD-2018.pdf

NOAA. (2019). *EFH Mapper*. Retrieved August 20, 2020, from NOAA National Marine Fisheries Service, Habitat Conservation: https://www.habitat.noaa.gov/protection/efh/efhmapper/

NOAA. (2020). *Isabela Substation, US*. Retrieved August 14, 2020, from Data Tools: 1981-2010 Normals: https://www.ncdc.noaa.gov/cdo-web/datatools/normals

NRCS. (2020). *Web Soil Survey*. Retrieved from https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

PRANG. (2010). *Draft Puerto Rico Air National Guard Integrated Cultural Resources Management Plan, 2010-2014.*

PRANG. (2010). *Draft Puerto Rico Air National Guard Integrated Cultural Resources Management Plan, 2010-2014.*

PRANG. (2013). *Stormwater Pollution Prevention Plan, 141st Air Control Squadron, Puerto Rico Air National Guard, Aguadilla, Puerto Rico.*

PRANG. (2014). *Stormwater Pollution Prevention Plan, 140th Air Defense Squadron, Puerto Rico Air National Guard, Toa Baja, Puerto Rico.*

PRANG. (2015). *Final Integrated Natural Resource Management Plan for the Muñiz Air National Guard Base, Puerto Rico.*

PRANG. (2016). *Final Wetland Determination Report for the Muñiz Air National Guard Base, Puerto Rico.*

PRANG. (2017). *Final Flora and Fauna Surveys, Air National Guard - 156th Airlift Wing, Muñiz, Puerto Rico* .

PRANG. (2018a). *Final Wetland Delineation Report, Air National Guard - 140th Support Squadron, Punta Salinas Radar Site, Toa Baja, Puerto Rico.*

PRANG. (2018b). *Final Wetland Delineation Report, Air National Guard - 141st Air Control Squadron, Punta Borinquen Radar Site, Aguadilla, Puerto Rico.*

PRANG. (2018c). *Muñiz Air National Guard Base, Storm Water Pollution Prevention Plan.*

PRANG. (2019a). *Final Coral, Seagrass, and Mangrove Surveys.*

PRANG. (2019b). *Final Flora and Fauna Surveys, Air National Guard - 140th Support Squadron, Punta Salinas Radar Site, Toa Baja, Puerto Rico.*

PRANG. (2019c). *Final Flora and Fauna Surveys, Air National Guard - 141st Air Control Squadron, Punta Borinquen Radar Site, Aguadilla, Puerto Rico.*

PRANG. (2019d). *Final Wetland Delineation Report, Air National Guard - 140th Support Squadron, Punta Salinas Radar Site, Toa Baja, Puerto Rico.*

PRANG. (2019e). *Final Wetland Delineation Report, Air National Guard - 141st Air Control Squadron, Punta Borinquen Radar Site, Aguadilla, Puerto Rico.*

PRANG. (2019f). *Integrated Pest Management Plan, 156 Airlift Wing, Muñiz Air National Guard Base, Puerto Rico Air National Guard.*

PRANG. (2019g). *Oil and Hazardous Substances Spill Prevention and Response Plan (OHS SPRP), Puerto Rico Air National Guard.*

PRANG. (2020). *156th Airlift Wing Bird Aircraft Strike Hazard (BASH) Plan 91-212.*

PRCCC. (2015). *Puerto Rico's State of the Climate, 2010-2013.* Retrieved July 27, 2020

Puerto Rico Endowment for the Humanities. (2020a, August 20). *Toa Baja Municipality*. Retrieved from Enciclopedia de Puerto Rico: https://enciclopediapr.org/en/encyclopedia/toa-baja-municipality/

Puerto Rico Endowment for the Humanities. (2020b, August 20). *Aguadilla Municipality*. Retrieved from Enciclopedia de Puerto Rico: https://enciclopediapr.org/en/encyclopedia/aguadilla-municipality/

Rivera, M. (2020). *Carolina*. Retrieved from Welcome to Puerto Rico: https://welcome.topuertorico.org/city/carolina.shtml

US Census Bureau. (2020a, August 12). *Total Population of Cangrejo Arriba barrio, Carolina Municipio, Puerto Rico*. Retrieved from American Community Survey: https://data.census.gov/cedsci/table?q=Cangrejo%20Arriba%20barrio,%20Carolina%20Municipio,%20Puerto%20Rico&tid=ACSDT5Y2010.B01003&hidePreview=false

US Census Bureau. (2020b, August 12). *ACS Demographic and Housing Estimates, Toa Baja Municipio, Puerto Rico*. Retrieved from American Community Survey: https://data.census.gov/cedsci/table?q=toa%20baja%20Municipio,%20Puerto%20Rico&tid=ACSDP1Y2018.DP05&hidePreview=false

US Census Bureau. (2020c, August 20). *ACS Demographic and Housing Estimates, Borinquen Barrio, Aguadilla Municipio, Puerto Rico*. Retrieved from American Community Survey: https://data.census.gov/cedsci/table?q=borinquen%20barrio,%20Aguadilla%20Municipio,%20Puerto%20Rico%20&tid=ACSDP5Y2018.DP05&hidePreview=false

USDA. (2020, October 22). *Federal Noxious Weeds*. Retrieved from Introduced, Invasive, and Noxious Plants: https://plants.usda.gov/java/noxious?rptType=Federal

USEPA. (2016). *Whate Climate Change Means for Puerto Rico.* Retrieved July 27, 2020, from https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-pr.pdf

USFWS. (2017a). *Caribbean Endangered Species Map.* Retrieved August 20, 2020, from https://www.fws.gov/southeast/pdf/map/caribbean-listed-species-2017.pdf

USFWS. (2017b). *Threatened and endangered species and critical habitats under the jurisdiction of the U.S. Fish and Wildlife Service, Puerto Rico and U.S. Virgin Islands.* Retrieved August 20, 2020, from https://www.fws.gov/southeast/pdf/fact-sheet/caribbean-listeed-species-2017-english.pdf

USFWS. (2020a). *Information for Planning and Consultation*. Retrieved August 20, 2020, from https://ecos.fws.gov/ipac/

USFWS. (2020b). *Wetlands Mapper*. Retrieved August 21, 2020, from National Wetlands Inventory: https://www.fws.gov/wetlands/data/mapper.html

USGCRP. (2018). *Fourth National Climate Assessment.* Retrieved July 27, 2020, from https://nca2018.globalchange.gov/chapter/20/

USGS. (2020a, August). *Geologic Unit: Aguada*. Retrieved from National Geologic Map Database: https://ngmdb.usgs.gov/Geolex/UnitRefs/AguadaRefs_27.html

USGS. (2020b, August). *Geologic Unit: Cibao*. Retrieved from National Geologic Map database: https://ngmdb.usgs.gov/Geolex/UnitRefs/CibaoRefs_1067.html

USGS. (2020c, August). *Geologic Unit: San Sebastian*. Retrieved from National Geologic Map Database: https://ngmdb.usgs.gov/Geolex/UnitRefs/SanSebastianRefs_3698.html

Vicente & Associates, Inc. (2017). *GTMO-PUERTO RICO SFOC PROJECT: ENVIRONMENTAL EVALUATION OF THE NEARSHORE BENTHIC RESOURCES OF THE.*

APPENDIX B. LAWS, REGULATIONS, POLICIES, AND EXECUTIVE ORDERS

Federal Laws

American Indian Religious Freedom Act of 1978 (Public Law 95-341; 42 USC §1196) – requires the United States, where appropriate, to protect and preserve religious rights of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

Animal Damage Control Act of 1931 (7 USC §426 et seq.) – provides broad authority for investigation, demonstrations, and control of mammalian predators, rodents, and birds.

Anti-Deficiency Act of 1982 (31 USC §1341 et seq.) – provides that no federal official or employee may obligate the government for the expenditure of funds before funds have been authorized and appropriated by Congress for that purpose.

American Antiquities Act of 1906 (Public Law 59-209; 16 USC §431-433) – authorizes the President to designate historic and natural resources of national significance, located on federal lands, as National Monuments for the purpose of protecting items of archeological significance.

Archeological and Historical Preservation Act of 1974 (Public Law 95-96; 16 USC §469 et seq.) – provides for the preservation of historical and archeological data, including relics and specimens, threatened by federally funded or assisted construction projects.

Archeological Resources Protection Act of 1979 (16 USC §470 et seq.) – prohibits the excavation or removal from federal or Indian lands any archeological resources without a permit.

Bald Eagle Protection Act of 1940 (Public Law 87-884; 16 USC §668a-d) – prohibits the taking or harming (i.e. harassment, sale, or transportation) of bald eagles or golden eagles, including their eggs, nests, or young, without appropriate permit.

Clean Air Act of 1970 (42 USC §7401 et seq.) – regulates air emissions from stationary, area, and mobile sources. This law authorizes the USEPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and the environment.

Clean Water Act of 1972 (Public Law 92-500; 33 USC §1251 et seq.) – aims to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Under Section 401, states have authority to review federal permits that may result in a discharge to wetlands or water bodies under state or Commonwealth jurisdiction. Under Section 404, a program is established to regulate the discharge of dredged or fill material into the nation's waters, including wetlands.

Coastal Zone Management Act of 1972 (Public Law 92-583; 16 USC §1451 et seq.) – provides incentives for coastal states to develop coastal zone management programs. Federal

actions that impact the coastal zone must be consistent to the maximum extent practicable with the state or Commonwealth program.

Conservation and Rehabilitation Program on Military and Public Lands (Public Law 93-452; 16 USC §670 et seq.) – provides for fish and wildlife habitat improvements, range rehabilitation, and control of off-road vehicles on federal lands.

Conservation Programs on Military Reservations (Public Law 90-465; 16 USC §670 et seq.) – requires each military department to manage natural resources and to ensure that services are provided which are necessary for management of fish and wildlife resources on each installation; to provide their personnel with professional training in fish and wildlife management; and to give priority to contracting work with federal and state or Commonwealth agencies that have responsibility for conservation or management of fish and wildlife. In addition it authorizes cooperative agreements (with states, local governments, non-governmental organizations, and individuals) which call for each party to provide matching funds or services to carry out natural resources projects or initiatives.

Endangered Species Act of 1973, as amended (16 USC §1531 et seq.) – provides for the identification and protection of threatened and endangered plants and animals, including their critical habitats. Requires federal agencies to conserve threatened and endangered species and cooperate with state or Commonwealth and local authorities to resolve water resources issues in concert with the conservation of threatened and endangered species. This law establishes a consultation process involving federal agencies to facilitate avoidance of agency action that would adversely affect species or habitat. Further, it prohibits all persons subject to US jurisdiction from taking, including any harm or harassment, endangered species.

Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (Public Law 92-516; 7 USC §136 et seq.) – governs the use and application of pesticides in natural resource management programs. This law provides the principal means for preventing environmental pollution from pesticides through product registration and applicator certification.

Federal Land Policy and Management Act of 1976 (43 USC §1701) – establishes public land policy and guidelines for its administration and provides for the management, protection, development, and enhancement of the public lands.

Federal Noxious Weed Act of 1974 (Public Law 93-629; 7 USC §2801) – provides for the control and eradication of noxious weeds and their regulation in interstate and foreign commerce.

Fish and Wildlife Conservation Act of 1980 (Public Law 96-366; 16 USC §2901 et seq.) – encourages management of non-game species and provides for conservation, protection, restoration, and propagation of certain species, including migratory birds threatened with extinction.

Fish and Wildlife Coordination Act of 1934 (16 USC §661 et seq.) – provides a mechanism for wildlife conservation to receive equal consideration and coordinate with water-resource development programs.

Land and Water Conservation Act of 1965 (16 USC §4601 et seq.) – assists in preserving developing, and assuring accessibility to outdoor recreation resources.

Migratory Bird Conservation Act of 1929 (16 USC §715 et seq.) – establishes a Migratory Bird Conservation Commission to approve areas recommended by the Secretary of the Interior for acquisition with Migratory Bird Conservation Funds.

Migratory Bird Treaty Act of 1918 (Public Law 65-186; 16 USC §703 et seq.) – provides for regulations to control taking of migratory birds, their nests, eggs, parts, or products without the appropriate permit and provides enforcement authority and penalties for violations.

National Environmental Policy Act of 1969 (Public Law 91-190; 42 USC §4321 et seq.) – mandates federal agencies to consider and document environmental impacts of proposed actions and legislation. In addition, it mandates preparation of comprehensive environmental impact statements where the Proposed Action is "major" and significantly affects the quality of the human environment.

Native American Graves Protection and Repatriation Act of 1990 (Public Law 101-601; 25 USC §§3001-3013) – addresses the recovery, treatment, and repatriation of Native American and Native Hawaiian cultural items by federal agencies and museums. It includes provisions for data gathering, reporting, consultation, and issuance of permits.

Resource Conservation and Recovery Act of 1976 (42 USC §6901 e 1860 t seq.) – establishes a comprehensive program which manages solid and hazardous waste. Subtitle C, Hazardous Waste Management, sets up a framework for managing hazardous waste from its initial generation to its final disposal. Waste pesticides and equipment/containers contaminated by pesticides are included under hazardous waste management requirements.

Sikes Act Improvement Act of 1997 (Public Law 105-85; 16 USC §670a et seq.) – amends the Sikes Act of 1960 to mandate the development of an INRMP through cooperation with the Department of the Interior (through the USFWS), DoD, and each state or Commonwealth fish and wildlife agency for each military installation supporting natural resources.

Soil Conservation Act of 1935 (16 USC §590a et seq.) – provides for soil conservation practices on federal lands.

Federal Regulations

40 CFR 1500-1508 – CEQ Regulations on Implementing NEPA Procedures
40 CFR 6 – USEPA Regulations on Implementation of NEPA Procedures
40 CFR 162 – USEPA Regulations on Insecticide, Fungicide, and Rodenticide Use

15 CFR 930 – Federal Consistency with Approved Coastal Management Programs
50 CFR 17 – USFWS List of Endangered and Threatened Wildlife
50 CFR 10.13 – List of Migratory Birds
32 CFR 190 – Natural Resources Management Program

Federal Executive Orders (EOs)

Environmental Safeguard for Activities for Animal Damage Control on Federal Lands (EO 11870) – restricts the use of chemical toxicants for mammal and bird control.

Exotic Organisms (EO 11987) – restricts federal agencies in the use of exotic plant species in any landscape and erosion control measures.

Energy Efficiencies and Water Conservation at Federal Facilities (EO 12902) – federal agency use of energy and water resources towards the goals of increased conservation and efficiency.

Floodplain Management (EO 11988) – specifies that agencies shall encourage and provide appropriate guidance to applicant to evaluate the effects of their proposals in floodplains prior to submitting applications. This includes wetlands that are within the 100-year floodplain and especially discourages filling.

Greening the Government through Leadership in Environmental Management (EO 13148) – requires the head of each federal agency to be responsible for ensuring that all necessary actions are taken to integrate environmental accountability into agency day-to-day decision making and long-term planning processes across all agency missions, activities, and functions.

Indian Sacred Sites (EO 13007) – provides for the protection of and access to Indian sacred sites.

Invasive Species (EO 13751) – directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

Protection and Enhancement of Environmental Quality (EO 11514) – provides for environmental protection of federal lands and enforces requirements of NEPA.

Protection of Wetlands (EO 11990) – directs all federal agencies to take action to minimize the destruction loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. This applies to the acquisition, management, and disposal of federal lands and facilities; to construction or improvements undertaken, financed, or assisted by the federal government; and to the conduct of federal activities and programs which affect land use.

Responsibilities of Federal Entities to Protect Migratory Birds (EO 13186) – directs all federal agencies taking actions that have a potential to negatively affect migratory bird populations to develop and implement a MOU with the USFWS by January 2003 that shall promote the conservation of migratory bird populations.

DoDI, AFI, & Air Force Pamphlets

DoDI 4715.03 – Natural Resources Conservation Program
DoDI 4165.57 – Air Installations Compatible Use Zones
DoDI 4150.07 – Pest Management Program

DoDI 6055.06 – Fire and Emergency Services Program
DoDI 4150.03 – Integrated Pest Management Program
DoDM 4715.03 – INRMP Implementation Manual
DoDM 4150.07 – DOD Pest Management Program Manual Volumes 1-3
AFI 32-7062 – Air Force Comprehensive Planning
AFMAN 32-1053 – Pest Management Program
AFMAN 32-7003 – Environmental Conservation
AFPAM 91-212 – BASH Techniques

Department of Defense Memoranda

Memorandum, Assistant DUSD (Environment, Safety and Occupational Health), 20 Sept 11, Subject: *Interim Policy on Management of White Nose Syndrome in Bats.*

Memorandum, Assistant DUSD (Environment, Safety and Occupational Health), 3 Apr 07, Subject: *Guidance to Implement the Memorandum of Understanding to Promote the Conservation of Migratory Birds.*

Memorandum, Assistant DUSD (Environment, Safety and Occupational Health), 14 Aug 06, Subject: *Integrated Natural Resource Management Plan (INRMP) Template*

Memorandum, Assistant DUSD (Environment, Safety and Occupational Health), 17 May 05, Subject: *Implementation of Sikes Act Improvement Amendments: Supplemental Guidance concerning Leased Lands*

Memorandum, Assistant DUSD (Environment, Safety and Occupational Health), 1 Nov 04, Subject: *Implementation of Sikes Act Improvement Amendments: Supplemental Guidance concerning INRMP Reviews*

Memorandum, DUSD (Installations and Environment), 10 Oct 02, Subject: *Implementation of Sikes Act Improvement Act: Updated Guidance*

Memorandum, Assistant DUSD (Environment), 5 Aug 02, Subject: *Access to Outdoor Recreation Programs on Military Installations for Persons with Disabilities*.

Memorandum, Assistant Secretary of Army (Environment, Safety and Occupational Health), Deputy Assistant Secretary of the Navy (Environment), Deputy Assistant Secretary of the Air Force (Environment, Safety and Occupational Health), 20 Sep 11, Subject: *Interim Policy on Management of White Nose Syndrome in Bats.*

Commonwealth and Local Statutes

Laws of Puerto Rico Annotated
Title 12 Conservation
- Subtitle 1: Protection of Game and Fish
- Subtitle 2: Forests
- Subtitle 2A: Natural Resources
- Subtitle 3: Water Protection

Subtitle 5: Environment

Puerto Rico Department of Natural and Environmental Resources regulations

APPENDIX C. LIST OF NATIVE SPECIES SUITABLE FOR LANDSCAPE PLANTINGS

Tree Type	Botanical Name	Common Name	Ornamental Flowers	Wildlife Attractant	Salt Tolerant	Drought Tolerant	Sun	Comments
Large Trees (over 45 ft [13.7 m] high)	*Anadenanthera peregrina*	Yopo	-	-	-	-	-	-
	Andira inermis	Cabbage tree	Yes	-	-	-	-	Large, hardy tree that tolerates a variety of conditions; suitable for roadside planting or a shade tree in parks and open spaces
	Buchenavia tetraphylla	Granadillo	-	-	-	-	-	Good tree for eroding soils, low nutrient sands
	Byrsonima spicata	Maricaco	Yes	Yes	-	-	-	-
	Calophyllum calaba	Maria	Yes	Yes	Yes	-	-	-
	Cecropia schreberiana	Pumpwood	Yes	-	-	No	-	-
	Ceiba pentandra	Kapok	No	-	Yes	Yes	-	Moderately wind and salt tolerant. This is a large, attractive shade tree.
	Cojoba arborea	Wild tamarind	Yes	-	-	-	-	Showy white flowers with conspicuous fruit
	Dacryodes excelsa	Tabonuco	No	-	No	-	-	Common native species of northern lower and middle slopes of mountains in Puerto Rico
	Genipa americana	Jagua	Yes	Yes	-	-	-	Continuously flowers and fruits from spring to fall
	Guarea guidonia	Guaraguao	Yes	-	-	-	Sun to partial shade	-
	Guazuma ulmifolia	Guácima	No	Yes	-	Yes	Full sun	-
	Hernandia sonora	Mago	No	-	-	-	Full sun	Often planted as a shade tree
	Hura crepitans	Sandbox tree	-	-	-	-	Full sun to partial sun, wet soil	Often planted as a shade tree
	Hyeronima clusioides	Cedro macho	No	-	-	-	-	Endemic to Puerto Rico
	Hymenaea courbaril	Stinking toe	Yes	-	-	No	Moist soil	Ornamental tree whose white showy flowers have a long flowering season. Suitable for shade tree, specimen tree, parking lot islands. Tolerant of urban conditions.
	Inga vera	Guaba	No	-	-	-	-	-
	Mammea americana	Mamey	No	-	-	-	-	Fragrant white flowers; edible fruit
	Manikara bidentata	Ausubo (Balatá)	-	-	-	-	-	-

Tree Type	Botanical Name	Common Name	Ornamental Flowers	Wildlife Attractant	Salt Tolerant	Drought Tolerant	Sun	Comments
	Melicoccus bijugatus	Quenepa (Spanish lime)	Yes	-	-	-	-	Popular ornamental tree with edible fruit
	Ochroma pyramidale	West Indian balsa	No	-	-	-	-	Medium sized tree; produces sweet, edible fruit
	Ocotea moschata	Nemoca	Yes	-	-	-	-	-
	Pouteria multiflora	Jácana (Bullytree)	-	-	-	Yes	Partial sun, shade	Wind resistant tree; plants well in groups; edible fruit
	Prunus occidentalis	Almendrón (Western cherry laurel)	Yes	-	-	-	-	-
	Sabal causiarum	Puerto Rico hat palm	No	Yes	Yes (med)	Yes (med)	Full sun	Easily maintained tree; characterized by large, smooth, gray trunk; makes an excellent ornamental as groups along roadways or as a solitary specimen
	Spondias mombin	Yellow mombin	Yes	-	-	No	Full sun	Well adapted to a variety of soil types and site conditions; showy white flowers and edible fruit
	Thespesia grandiflora	Maga	Yes	-	-	-	Sun to partial shade	The flower of the Maga tree is the national flower of Puerto Rico; the large showy flowers, dark green heart-shaped leaves, and moderate size make this an excellent ornamental tree
Medium Trees (30 to 45 ft [9.1 to 13.7 m])	*Bucida buceras*	Black olive (Ucar)	No	No	-	-	-	Wind resistant tree; showy fruit can cause litter problem
	Bursera simaruba	Gumbo-limbo	No	Yes	Yes	-	-	Wind tolerant, hardy tree; well suited to coastal conditions. Attractive, shiny bark. Suitable for screen plantings, specimen tree, small parking lot islands, or a lawn tree. Tolerates urban conditions.
	Cedrela odorata	Spanish cedar	No	-	-	-	-	Fast-growing, easily transplanted species with fragrant wood
	Chrysophyllum oliviforme	Satinleaf	No	No	-	-	-	The attractive leaves and showy bark make for attractive specimen trees or planted as a shrubbery border
	Conocarpus erecta	Button mangrove	Yes	Yes	Yes	Yes	Full sun	Open-sun, ornamental shrub that tolerates urban conditions such as compacted soil air pollution, poor drainage, and drought. Does well as a buffer around the edges of parking lots or median strips of roadways.
	Cordia rickseckeri	San Bartolomé	Yes	-	Yes	Yes	-	Showy, orange flowers with attractive foliage. Low maintenance native for roadside planting, use as a large hedge, or as a specimen tree.
	Guapira fragrans	Black mampoo	No	Yes	Yes	Yes	-	Dark green leaf canopy; tolerant of roadside conditions

Tree Type	Botanical Name	Common Name	Ornamental Flowers	Wildlife Attractant	Salt Tolerant	Drought Tolerant	Sun	Comments
	Myrciaria floribunda	Guavaberry	No	Yes	Yes (med)	Yes	-	Fragrant white flowers; edible fruit
	Petitia domingensis	Capá blanco	Yes	-	-	-	Full sun	-
	Rhizophora mangle	Red mangrove	No	Yes	Yes	-	Full sun	Wetland plant for use in coastal areas; showy surface roots
	Roystonea borinquena	Puerto Rico royal palm	No	Yes	Yes (med)	No	Full sun	Native palm of Puerto Rico; excellent for ornamental plantings as the plant tolerates air pollution, grows well in a variety of soil types, and roots do not damage sidewalks
	Tabebuia heterophylla	Pink trumpet tree	Yes	No	Yes (med)	Yes	Full sun	Very showy pink or white bell-shaped flowers; excellent ornamental as it does not attract wildlife, and there is no fruit/leaves litter problem
Small Trees and Shrubs (under 30 ft [9.1 m])	*Argusia gnaphalodes*	Sea lavender	Yes	-	Yes	Yes	-	Partially succulent, evergreen plant usually planted for its attractive blue-silver foliage and high tolerance to drought and salt spray. Tolerant of urban conditions
	Bourreria succulenta	Pigeon berry	Yes	Yes	Yes (med)	Yes	-	Fragrant white flowers and bright red berry cluster throughout the year. Beneficial to wildlife.
	Caesalpinia coriaria	Divi-Divi	No	No	Yes	Yes	-	Delicate, many-branched canopy. Tolerant of very dry and windy sites
	Capparis cynophallophora	Jamaican caper	Yes	-	Yes	Yes	-	Plant of the coastal scrub and beaches. Very showy white and purple flowers that bloom throughout the year.
	Chrysobalanus icaco	Coco plum	No	-	Yes	Yes	-	Medium-sized shrub with attractive foliage that naturally occurs in rocky and sandy beaches
	Citharexylum fruticosum	Fiddlewood	Yes	-	Yes	Yes	Partial shade/ partial sun	Outstanding ornamental; large shrub for partial shade/partial sun; does well in sandy soils
	Clusia rosea	Pitch apple	Yes	Yes	Yes	Yes	-	Widely planted ornamental tree with thick, leathery green leaves and year-round flowers
	Coccoloba uvifera	Seagrape	No	Yes	Yes	Yes	-	Picturesque shade tree or specimen planting; excellent seaside planting
	Cordia alba	Capá (Jamaican nettle tree)	No	Yes	-	-	-	Small, white flowers and red fruits occur throughout the year; naturally occurs in dry coastal forests of Puerto Rico
	Crescentia cujete	Calabash tree	Yes	No	No	Yes (med)	Full sun	Year-round production of showy fruit and flowers; fruit is not a litter problem

Tree Type	Botanical Name	Common Name	Ornamental Flowers	Wildlife Attractant	Salt Tolerant	Drought Tolerant	Sun	Comments
	Guaiacum officinale	Guayacán	Yes	No	Yes	Yes	Full sun, partial sun or partial shade	Extremely showy blue flowers, with attractive fruit. Not a litter problem. Plants will easily tolerate wet or dry soil, wind, and salt, making it an ideal choice, especially for seaside plantings
	Krugiodendron ferreum	Black ironwood	No	Yes	Yes (med)	Yes	-	Small tree with shiny, dark green leaves and black berries that attract birds
	Pilosocereus royenii	Royen's tree cactus	Yes	-	-	Yes	Full sun	Unique, low-maintenance landscape plant that is native to dry areas along the coast in Puerto Rico. The color and texture of this plant provide a striking plant for landscaping
	Pimenta racemosa	Bayrumtree	Yes	-	-	-	-	Fragrant leaves and flowers
	Plumeria alba	White frangipani	Yes	-	Yes	Yes	-	Large, fragrant flowers and succulent, linear branches give this small tree a unique and attractive appearance
	Tecoma stans	Yellow-elder	Yes	No	Yes (med)	Yes	Full sun	Very showy yellow flowers. Fruit does not attract wildlife. No litter problems
	Zanthoxylum flavum	Aceitillo (West Indian satinwood)	No	-	-	-	Full sun to partial shade	A medium-sized shrub/tree with attractive foliage; grows well in poor soils and urban conditions

- Information was not readily available.
* Note that this is a preliminary list of potential native landscape plants that are found in the region of Muñiz ANGB. Not all plants will be suited to planting in the immediate vicinity of the airfield.
** Plants are particularly well-suited to planting along coastal, sand beaches such as those found at Punta Salinas.