FINAL

ENVIRONMENTAL ASSESSMENT

for

Munitions Storage Igloos

at

Andersen Air Force Base, Guam

July 2020

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United States Department of Defense
FINDING OF NO SIGNIFICANT IMPACT – Environmental Assessment for Munitions Storage Igloos at Andersen Air Force Base, Guam

Introduction

Pursuant to the Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations Section 1500-1508) implementing procedural provisions of the National Environmental Policy Act (NEPA), and Department of the Navy (DON) NEPA regulations (32 CFR Part 775), the U.S. Air Force (USAF) gives notice that an Environmental Assessment (EA) has been prepared and an Environmental Impact Statement (EIS) is not required for the Munitions Storage Igloos at Andersen Air Force Base (AFB), Guam. This action will be implemented as set out in Alternative 1 (the Preferred Alternative).

Proposed Action

The USAF proposes to construct new munitions storage facilities and infrastructure upgrades in Munitions Storage Area (MSA) I on Andersen AFB, Guam. The Proposed Action includes construction of 48 new Hayman style earth covered magazines (ECMs), based on the Department of Defense (DOD) Explosives Safety Board-approved Hayman ECM for Guam. The Proposed Action would occur in multiple phases based on the availability of funds. The anticipated timeline for construction of the 48 igloos is between three and six years.

Purpose and Need

The purpose and need for the Proposed Action is to enable Andersen AFB to fulfill its mission of providing storage for a sufficient supply of new, highly sophisticated munitions deemed critical in the initial stages of any armed conflict in the region. To fully achieve this mission, 280,000 square feet of additional munitions storage capacity and associated infrastructure upgrades are needed. The Proposed Action is needed to enable the 36th Wing, a Pacific Air Forces wing at Andersen AFB, to perform its existing mission and ongoing military operations by providing adequate munitions storage.

Alternatives Considered

The EA analyzes the potential environmental impacts of the No Action Alternative, Alternative 1 (Preferred Alternative), and Alternative 2. Under the No Action Alternative, the Proposed Action would not occur. Construction of new munitions storage facilities and infrastructure upgrades would not occur, and no additional storage capacity would be gained. Alternative 1 includes construction of 48 new Hayman style ECMs near the existing 12 ECMs that were completed under Phase 1 in 2006. Alternative 2 includes demolishing 30 existing substandard ECMs and constructing 48 new Hayman style ECMs in their place. Alternative 1 is operationally preferred. Alternative 2 has substantial disadvantages including the demolition of 30 existing ECMs, temporarily reducing ammunition storage capacity, and potentially reducing munitions operations efficiency on base during construction. Other alternatives were considered but not carried forward for evaluation of potential effects to resources in this EA as they did not meet the purpose and need for the project and satisfy the reasonable alternative screening factors. These include alternative locations on base for munitions storage facilities; alternative designs for munitions storage facilities; and renovating, upgrading, or replacing existing munitions storage igloos.

Environmental Effects

No significant direct, indirect, or cumulative environmental impacts would occur from implementing the Proposed Action. Certain environmental resources were not analyzed in detail in this EA because implementation of the Proposed Action would not be likely to result in any potential environmental impacts on these resources or impacts would be negligible. This includes: land use, visual resources, airspace, socioeconomics, and environmental justice. Potential environmental impacts to other resources are summarized below.

Air Quality. The estimated emissions would be negligible and would not trigger a formal Conformity Determination under the Clean Air Act General Conformity Rule. The temporary and minor increases in construction and operation emissions would be negligible. The limited amount of emissions is not likely to contribute to global warming to any discernible extent. Therefore, the Proposed Action would not result in significant impacts to air quality.

Water Resources. No surface waters are located within or near the construction area, construction would not occur in flood zones, and construction stormwater runoff protection measures would also serve to protect groundwater quality. Andersen AFB personnel would comply with established plans and procedures to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles. Therefore, the Proposed Action would not result in significant impacts to water resources.

Geological Resources. Known sinkholes in the project area would be avoided. Potential structural damage or injuries during operations from seismic ground-shaking and fault rupture during an earthquake would be minimized by adherence to UFC 3-310-04, *Seismic Design of Buildings*, Change 1 dated June 20, 2016. Percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces. Therefore, the Proposed Action would not result in significant impacts to geological resources.

Cultural Resources. Analyses from an architectural survey in 2017 do not support a historic district made up of structures within MSA 1. The two architectural resources within Alternative 1 are both ineligible for listing in the National Register of Historic Places (NRHP), and these two facilities would not be demolished or modified. Three archaeological sites found within the footprint of Alternative 1 are eligible for listing in the NRHP. Two eligible sites would have adverse effects minimized through avoidance by altering plans to omit the igloo that coincides with that location and by altering the path of proposed utility lines. The eligible site that falls under the footprint of three igloos in Alternative 1 would have adverse effects minimized through archaeological data recovery. No eligible archaeological sites are located within the Alternative 2 footprint. The USAF initiated consultation under Section 106 of the National Historic Preservation Act (NHPA) in April 2018. The Guam State Historic Preservation Officer (SHPO) concurred with the Section 106 NHPA request on 3 May 2018, subject to an archaeological data recovery plan be put in place. Therefore, the proposed mitigation measure for cultural resources is a data recovery plan to be submitted to the Guam SHPO and the work executed prior to the onset of construction (see Section 3.4 and Appendix D of the EA). The USAF submitted the data recovery plan to the Guam SHPO and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D of the EA). Procedures for inadvertent discoveries or archaeological resources or human remains would be implemented during construction. Therefore, the Proposed Action would not result in significant impacts to cultural resources.

Biological Resources. Potential impacts to vegetation and wildlife are described below.

Section 7 ESA Consultation. The USAF submitted a Biological Assessment to the USFWS and requested formal consultation in October 2018 under Section 7 of the ESA regarding Alternative 1 (the Preferred Alternative). Formal consultation was initiated on 8 November 2018. The USAF submitted a revised Biological Assessment to the USFWS on 21 April 2020. The USFWS issued a signed Biological Opinion on 1 July 2020 concurring with the conclusions of the revised Biological Assessment and identifying best management practices (BMPs) and conservation measures to avoid and minimize potential effects to ESA-listed species (Appendix C of the EA). The Biological Opinion conclusion is that: a) the Proposed Action is not likely to jeopardize the continued existence of the Mariana fruit bat (*Pteropus mariannus mariannus*) and two plant species (*Cycas micronesica,* or *Tabernaemontana rotensis*), and b) there is no designated critical habitat within the action area, so there would be no effect to critical habitat.

Vegetation. USAF would follow biosecurity measures set forth in the Regional Biosecurity Plan for Micronesia and Hawaii to ensure the Proposed Action does not introduce invasive species through construction material and equipment potentially coming to Guam (DON, 2015c). Vegetation removal under the Proposed Action may affect, and is likely to adversely affect, *Cycas micronesica* and *Tabernaemontana rotensis* (ESA-listed vegetation species). Approximately 7,863 *Cycas micronesica* individuals occur throughout the entire MSA (473 in Alternative 1 and 55 in Alternative 2). Approximately 542 *Tabernaemontana rotensis* individuals occur throughout the entire MSA (22 in Alternative 1, 0 in Alternative 2). Habitat loss, fragmentation, and degradation are of concern to the species, as is the scale infestation that impacts tree health. However, the numbers of protected plants affected by Alternative 1 and Alternative 2 represent less than one percent of the *Cycas micronesica* population and *Tabernaemontana rotensis* population on Guam. In addition, proposed mitigation measures (the conservation measures in the Biological Opinion that are also incorporated into the EA, see Attachment 1) and BMPs would reduce impacts to *Cycas micronesica* and *Tabernaemontana rotensis*. To offset the loss of *Cycas micronesica* and *Tabernaemontana rotensis* within the preferred alternative, Andersen AFB will outplant 95 *Cycas micronesica* and 6 *Tabernaemontana rotensis*. The USFWS conclude in their Biological Opinion that Andersen AFB actions would not affect the continued existence of the species.

Wildlife. Short-term minor adverse effects to wildlife would be expected as a result of construction activity and noise. Ground disturbance and noise from vehicle use or construction could temporarily flush any foraging or resting native birds and fruit bats. However, USAF will conduct pre-construction surveys for nesting Migratory Bird Treaty Act (MBTA) birds to minimize potential impacts. In addition, wildlife are accustomed to noise-generating activities. Following construction, no adverse effects as a result of increased noise would be expected. The ESA-listed wildlife species in the Alternative 1 and Alternative 2 action areas are the Mariana fruit bat, the Guam Rail, and the Mariana crow. The Guam rail and Mariana crow are now extirpated from Guam and would not be directly impacted by the Proposed Action. Although no Mariana fruit bats have been observed roosting in the action area, they have been known to occur in the Andersen AFB area and to transit over the action area. Adverse effects on this species would be expected primarily as a result of construction activity and noise and secondarily as a result of habitat removal. Therefore, the action is likely to adversely affect the Mariana fruit bat. Proposed mitigation measures (the conservation measures in the Biological Opinion that are also incorporated into the EA) and proposed BMPs would avoid and reduce impacts to the Mariana fruit bats

and species listed in the MBTA. The USFWS concluded in their Biological Opinion that Andersen AFB actions would not adversely affect the continued existence of the Mariana fruit bat. Native tree snails and butterflies have not been found in the Alternative 1 or Alternative 2 action areas, so the Proposed Action would have less than significant impacts to tree snails and butterflies.

Noise. Since the construction site would be entirely on Andersen AFB property, and the nearest of the island's population resides several miles away from the proposed site, construction noise within the project area would not be audible to residents on base or off base. Once construction of the munitions storage igloos is completed, the ambient noise levels would return to their normal levels. Therefore, the Proposed Action would not result in significant noise impacts.

Infrastructure. There would be no impacts to utilities infrastructure. Stormwater systems would be constructed to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. Cleared vegetation would be transferred off base to a certified composter. The Proposed Action would have a negligible impact on the capacity of the Andersen AFB or off-base solid waste landfills. Therefore, the Proposed Action would not result in significant impacts to infrastructure.

Transportation. Potential increases in traffic volume associated with proposed construction activities would be temporary, and construction equipment and vehicles would be directed to roads and streets that have minimum traffic volume. Traffic delays or changes in level of service to Highway 1 and its intersections are also expected to be minimal. Ordnance vehicle transport trips would not change. Therefore, the Proposed Action would not result in significant impacts to transportation.

Public Health and Safety. The general public would be excluded from the construction zones. To reduce the potential hazards related to exposure to unexploded ordnance and munitions and explosives of concern, Explosives Safety Submission documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers and the public. The construction of new ECMs in MSA 1 would meet all the safety design standards for munitions storage facilities. Therefore, the Proposed Action would not result in significant impacts to public health and safety.

Hazardous Materials and Wastes. Construction and operations personnel would follow hazardous materials management and spill response procedures. Construction would not disturb contaminated soil or groundwater associated with Installation Restoration Program (IRP) sites, or interfere with IRP site cleanup and monitoring activities. Diesel fuel for the new back-up generator would be stored in a double-walled tank mounted on a concrete pad. Therefore, the Proposed Action would not result in significant impacts with respect to hazardous materials and hazardous waste.

Cumulative Impacts. Cumulative impacts can result from individually minor but collectively significant actions taken over a period of time. Potential impacts to cultural resources could occur. Should any cultural resources be uncovered during any construction, all findings would be handled in accordance with the Final Integrated Cultural Resource Management Plan for Andersen AFB and consultation with the Guam SHPO. For biological resources, cumulative impacts to vegetation and wildlife would occur, but these would be minimized through project-specific BMPs and conservation measures. In addition, the USFWS concluded there are no cumulative effects to ESA-listed species. For other resources, the Proposed Action, in combination with other present and reasonably foreseeable projects, would not result in significant impacts.

Mitigation Measures

Mitigation measures are proposed for cultural resources and biological resources to reduce impacts of the Proposed Action to less than significant. The proposed mitigation measures are included in Attachment 1.

Public Outreach

The USAF circulated the Draft EA for a 21-day public review in Guam from 31 January to 21 February 2020. The USAF published a Notice of Availability of the Draft EA for three consecutive days in the Pacific Daily News. The documents were available for review by interested parties on the Navy's public website and at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam. No public comments were received.

Finding

Based on the analysis presented in the EA, which has been prepared in accordance with the requirements of NEPA and DON policies and procedures (32 CFR Part 775), and in coordination with USAF, USFWS, Guam SHPO, and Guam Bureau of Statistics and Plans Coastal Zone Management Program, Commander, Joint Region Marianas finds that implementation of the Proposed Action, as set out in Alternative 1, will not significantly impact the quality of the human environment. Therefore, an EIS will not be prepared.

Electronic copies of this EA and Finding of No Significant Impact may be obtained by written request to Jeffrey Laitila, 36th Civil Engineer Squadron Environmental Flight Chief, NAVFAC IEPD, Andersen AFB, Guam. Email: jeffrey.laitila@us.af.mil.

9/10/2020
Date

J. V. Menoni
Rear Admiral, U.S. Navy
Commander, Joint Region Marianas

Attachment 1
Proposed Mitigation Measures

Below are proposed mitigation measures for cultural resources (Section 3.4 of the EA) and biological resources (Section 3.5 of the EA).

Cultural Resources Mitigation Measures

The proposed mitigation measure for cultural resources is a data recovery plan to be submitted to the Guam SHPO and the work executed prior to the onset of construction. The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D of the EA).

Biological Resources Mitigation Measures

The proposed mitigation measures for biological resources are the conservation measures in the Biological Opinion that would reduce the impacts to *Cycas micronesica* and *Tabernaemontana rotensis* so that significant impacts would not adversely affect the continued existence of the species (see Appendix C of the EA). The Proposed Action's conservation measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. Conservation measures are considered part of the Proposed Action and are vital to determining the scope of the Proposed Action. Implementation of conservation measures is required under the terms of the Proposed Action.

General conservation measures include:

1. An authorized biologist will conduct and oversee all plant conservation measures. The authorized biologist must have relevant experience at a comparable level of responsibility in projects of similar size, scope and complexity and must have the following minimum qualifications:
    a. A bachelor's degree with an emphasis in botany, horticulture, ecology, or a related science;
    b. At least 100 documented hours of experience conducting propagation, translocation, transplantation, pest control, and monitoring of the aforementioned species or a closely related species; and
    c. Applicant must provide contact information of three references familiar with their work related to b (above).
2. Prior to salvage, DON's natural resources will conduct surveys for ESA-listed plants to determine the health status of plants that cannot be avoided in the construction footprint. These additional surveys, referred to as pre-construction surveys, will verify the occurrence of federally listed species in the construction footprint and evaluate them for salvage and transplantation. An assessment will be conducted to determine how many individuals can be salvaged through either collection of seeds (*Cycas micronesica* and *Tabernaemontana rotensis*) or basal shoots (*Cycas micronesica*). DON's authorized biologist will pursue seed germination and plant division to meet transplanting success targets.

3. Plant propagation will occur at nurseries that follow the Hawaii Rare Plant Restoration Group "Phytosanitation Standards and Guidelines."

4. All salvaged plants will be transplanted in vegetation plots. Andersen AFB Environmental Flight will choose up to five vegetation plots for the transplantation of salvaged individuals. These vegetation plots will be mixed native limestone forest with an ungulate-proof fence and ungulate-free. Andersen AFB will choose transplanting locations within habitat suitable to support cycads. The sites must receive environmental approval from the 36 WG Commander prior to award of a contract to conduct the salvage and transplant activities. DON staff will submit the description of the locations to the USFWS once the sites are approved.

5. The DON will maintain the ungulate fences around these plots and conduct weed removal (mechanically, manually, or by herbicide) to enhance the existing native forest. Invasive species within a 20-foot radius around salvaged plants will be removed and maintained to ensure no more that 15 percent of vegetation is invasive species.

6. The DON will submit an annual report to the USFWS one year after the Biological Opinion is issued and each year thereafter until the project and associated conservation measures are complete. The conservation measures will be complete once the number of plants meeting the success criteria, defined in the DON's Biological Assessment, has been achieved. The report will summarize the type of activities (e.g., health status of plants, propagation, transplantation, etc.) conducted on each species and the status of transplantation efforts. It will include the number of cycad basal shoots and seeds collected from each healthy adult, mature cycad and the number of *Tabernaemontana rotensis* seeds collected, propagation methods (number seeds germinated), survival rate, and the number of plants meeting the success criteria. The DON will also include information on bat monitoring within line of sight (up to 492 feet) of construction activities.

7. If it is determined that a contractor has violated any of the Navy's proposed conservation measures, the DON will provide an on-site biological monitor during all further construction actions to ensure no further incidents occur.

The following conservation measures are specific to the action and promote the continued existence of *Cycas micronesica* and *Tabernaemontana rotensis*. These conservation measures are meant to offset the effects of forest clearing and removal of plants in the construction site. The DON has proposed the following methods for salvage, propagation, and outplanting of *Cycas micronesica*:

1. Efforts will be made to salvage as many cycad basal shoots as possible that are deemed healthy and suitable for salvage. Cycad basal shoot health is based on a variety of factors including extent of cycad aulacaspis scale (*Aulacaspis yasumatsui*). infestation/damage and current health condition of the parent plant.

2. Basal shoots that are approximately 1.7 inches in diameter (golf ball size) and larger will be considered for salvage (EA Engineering 2019).

3. Prior to salvage of the basal shoots, pesticides will be applied to treat cycad scale and *Chilades pandava* (cycad blue butterfly) larvae.

4. Cycads will be visually inspected for little fire ants before salvage and transplant. If little fire ants are observed, Little Fire Ant Management Procedures will be followed (see Appendix A in the Biological Assessment).

5. Basal shoots will be removed from the main trunk to maintain as much of the root mass as possible. All pups will be placed in an appropriate pot for the pup's size and promote drainage.
6. Basal shoots will be tagged prior to removal from the parent plant. The tags will consist of a unique alphanumeric aluminum tag, which will be secured to the individual pots.
7. A pressure washer may be used to remove any remaining debris, loose plant material, and pests (i.e. cycad scales).
8. During transportation, basal shoots will be covered for protection from sun and wind exposure.
9. Once transported to a nursery, commercial root-promoting hormone may be applied to the stem followed by the remaining treatments: fungicide and insecticide applied in accordance with label directions and applicable regulations and law.
10. Each basal shoot will be potted in plastic pots with well-drained potting media such as pumice, perlite or sand and/or soilless and placed in the nursery. Salvaged basal shoots will be processed and transplanted in the nursery within one week of salvage.
11. Cycads will be evaluated monthly or more frequently depending on the conditions of the plants to determine growth and status. Any disease outbreak or significant loss of individuals under nursery conditions should be reported to the USFWS to allow DON and the USFWS to work together to ensure the success of nursery propagation of cycads.
12. Salvaged cycad basal shoots/seeds will be propagated in a nursery until the lead biologist determines they are suitable for transplanting.
13. After transplantation, maintenance will include watering, weeding, fertilizer, pest control, support structures and/or plant protection will occur until the transplants shows stem growth of at least 0.4 inches as measured below the base of the existing leaves (fronds) since planting in the wild.
14. Salvaged cycads (basal shoots or seeds) will be monitored and maintained until a minimum of 95 genetically different individuals have been established in the wild, showing stem growth of at least 0.4 inches as measured below the base of the existing leaves (fronds) since planting in the wild and plants will be weaned of maintenance for a period of six months since planting for natural up take of nutrients and water.
15. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. The lead biologist will make the determination of "health."

The DON has proposed the following methods for the salvage, propagation, and transplanting of *Tabernaemontana rotensis*:

1. The DON has proposed to salvage and propagate enough *Tabernaemontana rotensis* seeds to ensure that a minimum of six genetically distinct individuals meet or exceed success criteria. This minimum number is based on the assumption that there will be at least six mature, adult *Tabernaemontana rotensis* trees producing seeds at the time of collection. If seeds cannot be collected from within the project footprint prior to being removed (i.e., if the trees do not produce seeds), plant cuttings will be collected from the project footprint or seeds will be collected from individuals within the action area. A seed collection site consisting of 53

Tabernaemontana rotensis trees has been identified outside the project footprint but within the action area.

2. Once collected, seeds of *Tabernaemontana rotensis* will be cultivated in a plant nursery for propagating and subsequent transplanting. An authorized biologist will determine when plants are ready for transplanting and plant them into the vegetation plots. Monitoring will be done monthly or more frequently depending on the conditions of the plants to record growth and health status. Maintenance will be conducted depending on the conditions and needs of the plants; these include watering, weeding, pest removal, and plant protection. The DON's success criteria for *Tabernaemontana rotensis* transplanting are that the plants must be between 2 and 3 feet tall, leaves remain turgid on the plant, individuals produce apical stem growth, and plants will be weaned of maintenance for a period of six months.

ABSTRACT

Designation:	Environmental Assessment
Title of Proposed Action:	Munitions Storage Igloos
Project Location:	Andersen Air Force Base (AFB), Guam
Lead Agency for the EA:	Headquarters Pacific Air Forces
Affected Region:	Guam
Action Proponent:	The 36th Wing, Andersen AFB, Guam
Point of Contact:	Jeffrey Laitila, United States Air Force (USAF) 36 CES/CEV Environmental Flight Chief NAVFAC IEPD Andersen AFB, Guam Email address: jeffrey.laitila@us.af.mil
Date:	July 2020

On behalf of the Headquarters Pacific Air Forces, a Major Command of the USAF, Naval Facilities Engineering Command Pacific has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations. Per the Joint Region Marianas (JRM) Memorandum of Agreement (2009) implementing the 2005 Base Realignment and Closure Commission's (BRAC) decisions and the 2011 JRM Memorandum of Agreement, Navy NEPA regulations are implemented at Andersen AFB. The Proposed Action is to construct an additional 48 Hayman style munitions storage igloos in Munitions Storage Area I at Andersen AFB in Joint Region Marianas, Guam to reduce the current existing munitions storage capacity shortfall and to enable 36th Wing's mission requirements under Title 10 U.S Code Section 8062. The new igloos would require lighting and electrical support, an intrusion detection system, ventilation, reinforced concrete foundations, rated 7-bar construction, floor slabs, columns, beams, and a lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons. The anticipated timeline for construction of the 48 igloos is approximately 3 to 6 years. This EA evaluates the potential environmental impacts associated with the two action alternatives, Alternative 1 (Preferred Alternative), Alternative 2, and the No Action Alternative. The environmental resource areas analyzed in this EA include: air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and wastes.

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Final Environmental Assessment
Munitions Storage Igloos
Andersen Air Force Base, Guam

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Abbreviations and Acronyms

Abbreviation/Acronym	Definition
36 WG	36th Wing
ACM	asbestos-containing material
AFB	Air Force Base
AFI	Air Force Instruction
AFMAN	Air Force Manual
APE	Area of Potential Effect
ATFP	Antiterrorism Force Protection
BMP	best management practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CES/CEV	Civil Engineer Squadron Environmental Flight
CFR	Code of Federal Regulations
CHH	cable handhole
CNEL	Community Noise Equivalent Level
CNMI	Commonwealth of the Northern Mariana Islands
CO	carbon monoxide
CO_2	carbon dioxide
CWA	Clean Water Act
DAWR	Division of Aquatic and Wildlife Resources
dB	decibel
dBA	A-weighted sound level
DNL	day-night average sound level
DOD	Department of Defense
DON	Department of the Navy
EA	Environmental Assessment
ECM	earth-covered magazine
EIS	Environmental Impact Statement
EO	Executive Order
EPP	Environmental Protection Plan
ESA	Endangered Species Act
ESS	Explosives Safety Submission
ESZ	explosive safety zone
ft^2	square feet
FY	Fiscal Year
GAR	Guam Administrative Rules and Regulations
GEPA	Guam Environmental Protection Agency
GHG	greenhouse gas
GovGuam	Government of Guam
HAP	hazardous air pollutant
IMD	inter-magazine distance
IRAA	Indoor Radon Abatement Act
IRP	Installation Restoration Program
ISR	Intelligence, Surveillance, and Reconnaissance
JRM	Joint Region Marianas
kV	kilovolt
LBP	lead based paint
LED	light-emitting diode
L_{eq}	equivalent sound level
LFTRC	live-fire training range complex
L_{max}	maximum A-weighted sound level
LOS	level of service
MBTA	Migratory Bird Treaty Act
MEC	Munitions and Explosives of Concern
MSA	Munitions Storage Area
NAAQS	National Ambient Air Quality Standards
NAVFAC	Naval Facilities Engineering Command
NAVFAC Pacific	Naval Facilities Engineering Command Pacific
NAVRAMP	Navy Radon Assessment and Mitigation Program
Navy	U.S. Navy
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NIPTS	Noise Induced Permanent Threshold Shift
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWF	Northwest Field
NWR	National Wildlife Refuge
O_3	ozone
OEIS	Overseas Environmental Impact Statement
OSHA	Occupational Safety and Health Administration
PACAF	Pacific Air Forces
Pb	lead

Abbreviation/Acronym	Definition	Abbreviation/Acronym	Definition
PCB	polychlorinated biphenyl	TCP	traditional cultural property
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter	THAAD	Terminal High-Altitude Area Defense
PM_{10}	particulate matter less than or equal to 10 microns in diameter	tpy	tons per year
		U.S.	United States
QD	quantity-distance	U.S.C.	U.S. Code
ROD	Record of Decision	UFC	Unified Facilities Criteria
ROI	region of influence	USACE	U.S. Army Corps of Engineers
SEIS	Supplemental Environmental Impact Statement	USAF	U.S. Air Force
		USEPA	U.S. Environmental Protection Agency
SEL	sound exposure level		
SHPO	State Historic Preservation Officer	USFWS	U.S. Fish and Wildlife Service
		USINDOPACOM	United States Indo-Pacific Command
SO_2	sulfur dioxide		
SWPPP	Stormwater Pollution Prevention Plan	UXO	unexploded ordnance
		VOC	volatile organic compound
TARRP	tactical air-munitions rapid response package	WW II	World War II

1 Introduction

The United States (U.S.) Air Force (USAF), Headquarters Pacific Air Forces (PACAF), 36thWing (36 WG), Andersen Air Force Base (AFB), Guam proposes to construct an additional 48 Hayman style munitions storage igloos in Munitions Storage Area (MSA) I at Andersen AFB in Joint Region Marianas (JRM), Guam. The new igloos would require lighting and electrical support, an intrusion detection system, ventilation, reinforced concrete foundations, rated 7-bar construction, floor slabs, columns, beams, and a lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons.

The action would increase munitions storage capacity and provide minor facility modifications to meet operational requirements. The anticipated timeline for construction of the 48 igloos is approximately 3 to 6 years. An increase in personnel is not anticipated.

The JRM military command on Guam oversees the partnership of Andersen AFB and Naval Base Guam (NBG) in accordance with the Joint Region Marianas Memorandum of Agreement (2009) implementing the 2005 Base Realignment and Closure Commission's (BRAC) decisions and the 2011 JRM Memorandum of Agreement. Per these agreements, Navy NEPA regulations are implemented at Andersen AFB. Under JRM, PACAF and the U.S. Navy (Navy) utilize shared resources and support services, including Navy support of environmental compliance documentation.

On behalf of the Headquarters Pacific Air Forces, a Major Command of the USAF, Naval Facilities Engineering Command Pacific (NAVFAC Pacific) has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] parts 1500–1508) and Navy procedures for implementing NEPA (32 CFR part 775), in accordance with the 2009 MOA. This EA evaluates the environmental consequences associated with the Proposed Action (Alternatives 1 and 2) and the No Action Alternative.

1.1 Background

Andersen AFB is a strategically located forward main operating base, positioned to support operations across the spectrum of conflict to include sustained combat operations. The 36 WG is host unit to USAF Active, Reserve, National Guard, and U.S. Naval forces and its mission is to provide the highest quality peacetime and wartime support from its strategic Pacific location on Guam. In addition, Guam serves as a stopping point for numerous aircraft enroute to Japan, Korea, and other Indo-Asia Pacific locations.

Andersen AFB has an existing total of 144 munitions storage igloos (126 igloos in MSA I and 18 igloos in MSA II). Within MSA I there are: 114 traditional earth-covered magazines (ECMs) that have been downgraded for nonstandard munitions storage; 12 Hayman style ECMs that were constructed in Fiscal Year (FY) 2008; numerous exterior storage pads and designated open storage areas; 10 aboveground magazines; and several maintenance, operations, and storage facilities.

In April 2002, the USAF Safety Center evaluated existing munitions magazines from the 1950s (USAF 2002, USAF 2005) accounting for a total of 263,000 ft^2 of storage capacity . A total of 132 igloos were determined to be improperly sited and had substandard storage capability. The magazines failed to meet the standard rating due to faulty door design. Additionally, the earth coverings on the magazines have deteriorated from age, typhoon winds, and rain. As a result of failing the safety rating, these munitions magazines were downgraded from storing 500,000 pounds of net explosive weight (NEW) to

250,000 pounds of NEW. The age and wear of these facilities have caused a shortfall in munitions storage that is needed to support the current mission. With this loss of storage capability, the 36 WG was challenged to meet the operational requirement.

Every functional munitions storage unit at Andersen AFB is currently in use and essential to meet the minimum storage capacity. The loss or temporary loss of a magazine will negatively impact the mission of Andersen AFB. A total of 60 additional munitions storage igloos were determined to be needed to provide adequate munitions storage (USAF 2005). A portion of that total amount (12 igloos) was completed as Phase 1 in FY08, with the remaining 48 igloos to be constructed in subsequent phases, subject to funding.

The 36 WG initially proposed to construct 60 munitions storage igloos in two phases: Phase 1 (12 munitions storage igloos) and Phase 2 (48 munitions storage igloos). In October 2005, the *Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam* was prepared to analyze the effects of siting all 60 munitions storage igloos within MSA I (USAF 2005). Phase 1 was constructed in FY 2008, with the remaining 48 igloos planned to be constructed in Phase 2, subject to funding. However, Phase 2 was not implemented due to constraints identified during agency review of the 2005 Draft EA. The U.S. Fish and Wildlife Service (USFWS) and Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (Guam DAWR) indicated that Phase 2 (the proposed construction of the 48 igloos) would encroach on biologically sensitive habitat. Areas north and west of Phase 1 possess limestone forest components that serve as important habitat to several endangered species on Guam. The 36 WG subsequently revised alternatives for the remaining 48 igloos to avoid and minimize potential effects on biologically sensitive habitat. These revised alternatives are analyzed in this EA.

The current munitions storage capability at Andersen AFB is 384,000 square feet (ft^2). The future operational floor space requirement is 664,000 ft^2, leaving the base with a storage capacity shortfall of 280,000 ft^2. There are no other anticipated storage capacity shortfalls currently identified for munitions storage at Andersen AFB.

1.2 Location

Guam is located approximately 3,700 miles west of Hawaii, 1,500 miles east of the Republic of the Philippines, and 1,550 miles south of Japan. The island of Guam is the westernmost territory of the U.S. and is the southernmost island of the Marianas chain. NBG is the primary military presence on Guam, occupying over 18,000 acres of land on seven noncontiguous sites located throughout the 212 square mile island. These sites include the main base, NBG Barrigada, NBG North Finegayan, NBG Munitions Site, Polaris Point, Tenjo Valley, and Sasa Valley.

Andersen AFB is located on the northern tip of the island and covers over 14,000 acres. The base hosts the largest MSA in the USAF and is a key base in the U.S. Indo-Pacific Command (USINDOPACOM) Area of Responsibility. The proposed munitions storage facilities would be constructed within MSA I, which is located northwest of the Andersen AFB airfield and southeast of the Northwest Field Training Area.

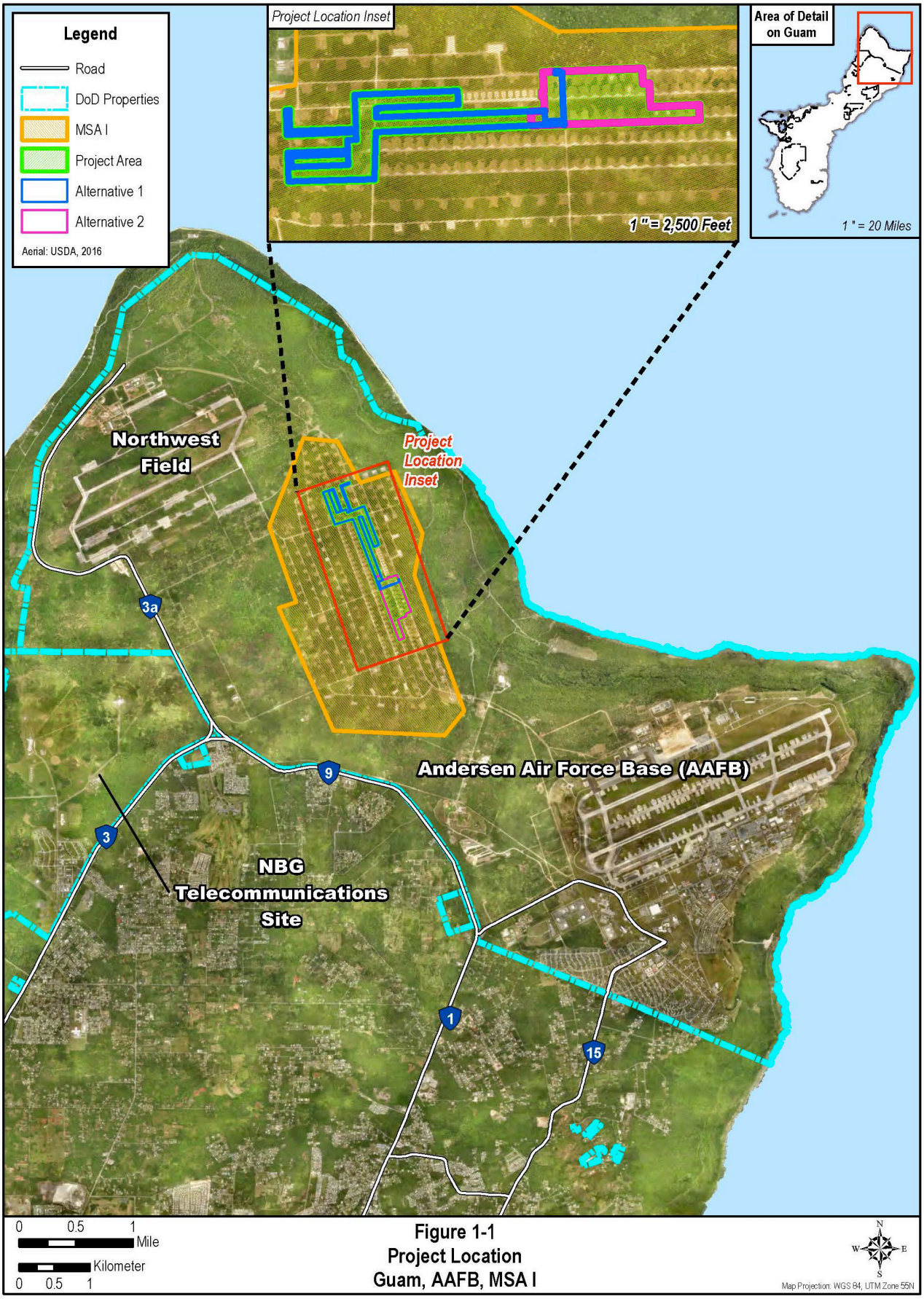

Figure 1-1
Project Location
Guam, AAFB, MSA I

MSA I is used exclusively for the receiving, storage, and maintenance of munitions. Figure 1-1 shows the location of the project within Andersen AFB.

The majority of Andersen AFB is within the Refuge Overlay Unit of the Guam National Wildlife Refuge (NWR). The Guam NWR was established in 1993 through a Memorandum of Understanding between the U.S. Fish and Wildlife Service (USFWS), Department of the Navy (DON), USAF, and the Government of Guam (GovGuam) (GovGuam et al., 1993). By way of cooperative agreements signed in 1994, the USAF, DON, USFWS, and the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources established the Refuge Overlay Units to provide a coordinated program for protecting threatened and endangered species and native flora and fauna, maintaining native ecosystems, and conserving biological diversity on Department of Defense (DOD) lands on Guam. Further detail on Overlay Refuge lands can be found in Section 3.5.1.

1.3 Purpose of and Need for the Proposed Action

The purpose of and need for the Proposed Action is to enable Andersen AFB to fulfill its mission of providing a sufficient supply of new, highly sophisticated munitions deemed critical in the initial stages of any armed conflict in the region. To fully achieve this mission, 280,000 ft^2 of additional munitions storage capacity and associated infrastructure upgrades are needed. The Proposed Action is needed to enable the 36 WG to perform its existing mission and ongoing military operations by providing adequate munitions storage.

The USAF has congressionally mandated roles and responsibilities under Title 10 U.S. Code (U.S.C.) Section 8062, which specifies that the USAF, "shall be organized, trained, and equipped primarily for prompt and sustained offensive and defensive air operations." By addressing the NEW storage shortfall, the Proposed Action supports the USAF's Title 10 U.S.C. Section 8062 directive to "form the basis for a complete and immediate mobilization for the national defense in the event of a national emergency."

1.4 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternatives and the No Action Alternative. The environmental resource areas analyzed in this EA include: air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and waste. The study area for each resource analyzed may differ due to how the Proposed Action and alternative actions interact with or impact the resource.

1.5 Key Documents

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

- *Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam*, October 2005 (USAF 2005). The EA analyzed the effects of siting 60 munitions storage igloos within MSA I (USAF 2005). A portion of that total amount (12 igloos) was completed as Phase 1 in FY 2008.

- *Joint Region Marianas Andersen Air Force Base Area Development Plan, MSA 1 Earth Covered Magazines Final Report, April 2017*. The report assessed existing facilities and infrastructure, developed and evaluated concepts for safely increasing munitions storage at Andersen AFB.
- *Final Supplemental Environmental Impact Statement (SEIS) Guam and Commonwealth of the Northern Marianas Islands (CNMI) Military Relocation (2012 Roadmap Adjustments), February 2015*. In September 2010, the DON signed a Record of Decision regarding the 2010 Final Environmental Impact Statement (EIS) for the Guam and CNMI Military Relocation. The Final SEIS analyzes the potential environmental impacts of a materially smaller and reconfigured Marine Corps force on Guam than was evaluated in the 2010 Final EIS.

1.6 Relevant Laws and Regulations

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

- NEPA (42 U.S.C. sections 4321–4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500–1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Clean Air Act (42 U.S.C. Section 7401 et seq.)
- Clean Water Act (33 U.S.C. Section 1251 et seq.)
- Coastal Zone Management Act (16 U.S.C. Section 1451 et seq.)
- National Historic Preservation Act (NHPA) (54 U.S.C. Section 300101 et seq.)
- Archaeological and Historic Preservation Act (1974) (54 U.S.C. Section 312102 et seq.)
- Archaeological Resources Protection Act (1979) (16 U.S.C. Section 470aa et seq.)
- Endangered Species Act (16 U.S.C. Section 1531 et seq.)
- Migratory Bird Treaty Act (16 U.S.C. Section 703–712)
- Comprehensive Environmental Response and Liability Act (42 U.S.C. Section 9601 et seq.)
- Emergency Planning and Community Right-to-Know Act (42 U.S.C. sections 11001–11050)
- Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. Section 136 et seq.)
- Resource Conservation and Recovery Act (42 U.S.C. Section 6901 et seq.)
- Toxic Substances Control Act (15 U.S.C. Sections 2601–2629)
- Executive Order (EO) 11988, Floodplain Management
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13834, Efficient Federal Operations

- Indoor Radon Abatement Act (IRAA) of 1988 (15 U.S.C. Section 53 et seq.)
- Defense Base Closure and Realignment Act of 1990 (Part A of Title XXIX of Public Law 101-510; 10 U.S.C. 2687 Note
- Department of Defense Initial Guidance for BRAC 2005 Joint Base Implementation, 22 January 2008
- Department of Defense Supplemental Guidance for Operating a Joint Base, April 15, 2008

A description of the Proposed Action's consistency with these laws, policies, and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Chapter 5 (Table 5-1).

1.7 Public and Agency Participation and Intergovernmental Coordination

CEQ Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1500-1508) require agencies to encourage and facilitate public involvement in decisions which affect the quality of the human environment (1500.2(d).

The USAF published a Notice of Availability of the Draft EA for three consecutive days in the Pacific Daily News (Appendix A). The Draft EA review period was 31 January to 21 February 2020. The notice described the Proposed Action, solicited public and agency comments on the Draft EA, provided dates of the open comment period, and announced that a copy of the EA would be available for review. The Draft EA was made available for review by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; and the Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam. The Draft EA was also made available on the following website: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information/environmental-assessments-availble-for-public-review.html. No public comments were received.

The USAF submitted a Biological Assessment to the USFWS and requested formal consultation in October 2018 under Section 7 of the ESA regarding Alternative 1 (the Preferred Alternative). Formal consultation was initiated on 8 November 2018. The USAF submitted a revised Biological Assessment to the USFWS on 21 April 2020. The USFWS issued a signed Biological Opinion on 1 July 2020 concurring with the conclusions of the revised Biological Assessment and identifying BMPs and conservation measures to avoid and minimize potential effects to ESA-listed species (see Appendix C). The Biological Opinion conclusion is that: a) the Proposed Action is not likely to jeopardize the continued existence of the Mariana fruit bat (*Pteropus mariannus mariannus*), *Cycas micronesica*, or *Tabernaemontana rotensis*, and b) there is no designated critical habitat within the project area, so there would be no effect to critical habitat.

The USAF consulted with the Guam State Historic Preservation Officer (SHPO) (Appendix D). The USAF submitted a Section 106 consultation package on 17 April 2018. The Guam Department of Parks and Recreation provided a letter on 3 May 2018 concurring with the "No Adverse Effect" conclusion based on provisions in the package for inadvertent discoveries as well as an archaeological data recovery plan is in place. The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D).

The USAF coordinated with the Guam Bureau of Statistics and Plans to ensure the Proposed Action is consistent with the Guam Coastal Management Program and is in compliance with the Coastal Zone Management Act to the maximum extent practicable. The USAF submitted a Negative Determination to the Guam Bureau of Statistics and Plans on 6 March 2020. The Bureau provided concurrence on 27 May 2020 that the proposal is consistent with the enforceable policies of the Guam Coastal Management Program. Appendix E includes the coastal consistency analysis and concurrence letter for the Proposed Action.

1.8 Organization of this Document

This EA is organized into eight chapters, not including appendices. Chapter 1 contains background information, a description of the purpose of and need for the Proposed Action, a description of the applicable regulatory requirements, and an introduction to the organization of the EA. Chapter 2 provides a detailed description of the Proposed Action, the action alternatives, the No Action Alternative, the alternatives not carried forward for analysis, and BMPs included in the project. Chapter 3 contains a general description of the baseline conditions that could potentially be affected by the Proposed Action or the No Action Alternative, and it presents an analysis of the environmental consequences. Chapter 4 includes an analysis of the potential cumulative impacts. Chapter 5 looks at other special considerations under NEPA. Chapter 6 lists the sources of information used in the preparation of the document. Chapter 7 lists the preparers of the document. Chapter 8 lists the federal, territorial, and other organizations to which the Draft EA was distributed.

Appendix A includes distribution letters sent during the public review period. Appendix B includes air emission calculations to support the Air Quality section. Appendix C includes information from the natural resource surveys and consultation documentation for the project (coordinated with USFWS). Appendix D includes information from the cultural resource surveys and consultation documentation for the project (coordinated with Guam SHPO). Appendix E includes information from the coastal consistency analysis for the Proposed Action (coordinated with Guam Bureau of Statistics and Plans). Appendix F contains the Munitions Storage Area Plant Survey Report.

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2 Proposed Action and Alternatives

2.1 Proposed Action

2.1.1 Baseline Conditions

MSA I contains facilities for the storage, receiving, and maintenance of munitions. The area is heavily vegetated. Surrounding development includes Northwest Field to the north and west, undeveloped jungle to the west and south, and a cliff line to the east. The area is moderately sloped, with an average slope of approximately 2.5 percent. Drainage within MSA I is mostly via surface runoff to the west.

The project area under consideration in this EA is located within MSA I and includes the footprints of Alternative 1 and Alternative 2. The project area is generally located between E Avenue and B Avenue and between 4th Street and 8th Street. Figure 2-1 shows an aerial look at existing conditions within MSA I and the project area. Figure 2-2 illustrates topography and drainage in the project area.

The transportation system within MSA I consists of a grid of paved and unpaved roads that provide access to the various munitions storage facilities. The primary entrance to MSA I is through a controlled gate near the intersection of B Avenue and 5th Street.

Utilities in the project area include electrical service and fiber optic communications cabling. Under existing conditions, the primary voltage at Andersen Air Force Base (AFB) is 13,800Y/7,970 volts. In 2008, an underground primary electrical feeder was installed to serve the first 12 ECMs in Phase 1 as well as future ECMs. This feeder extends from the east on the north side of 4th Street to a 4-way, pad-mounted 15-kilovolt (kV) switch near the intersection of 4th Street and C Avenue. From this switch, a radial feeder is extended to a new pad-mounted transformer located on the east side of ECM 8418. This transformer has a 13.8-kV primary winding and 480Y/277 volts secondary. A standby generator is located in a building near the transformer.

Communications infrastructure was expanded in the project area in 2008. An underground communications ductbank with 100-pair copper and 48-strand fiber optic cabling was installed to serve the first 12 ECMs in Phase 1 as well as future ECMs. The fiber optic cable originates in Building 23028 and the copper cable originates in Building 25008. This cable is extended to MSA I where the copper cable is terminated in a splice case in cable handhole (CHH) 123 and the fiber optic cable is terminated in a splice case in CHH 124. From these handholes, the cable is extended to the ECMs. Figure 2-3 shows existing facilities and utilities within the project area. This figure also shows explosives safety arcs within and adjacent to the study area that constrain development potential.

2.1.2 Site Development Considerations

The site planning process must consider factors that may have the potential to or will affect the planned laydown of program requirements.

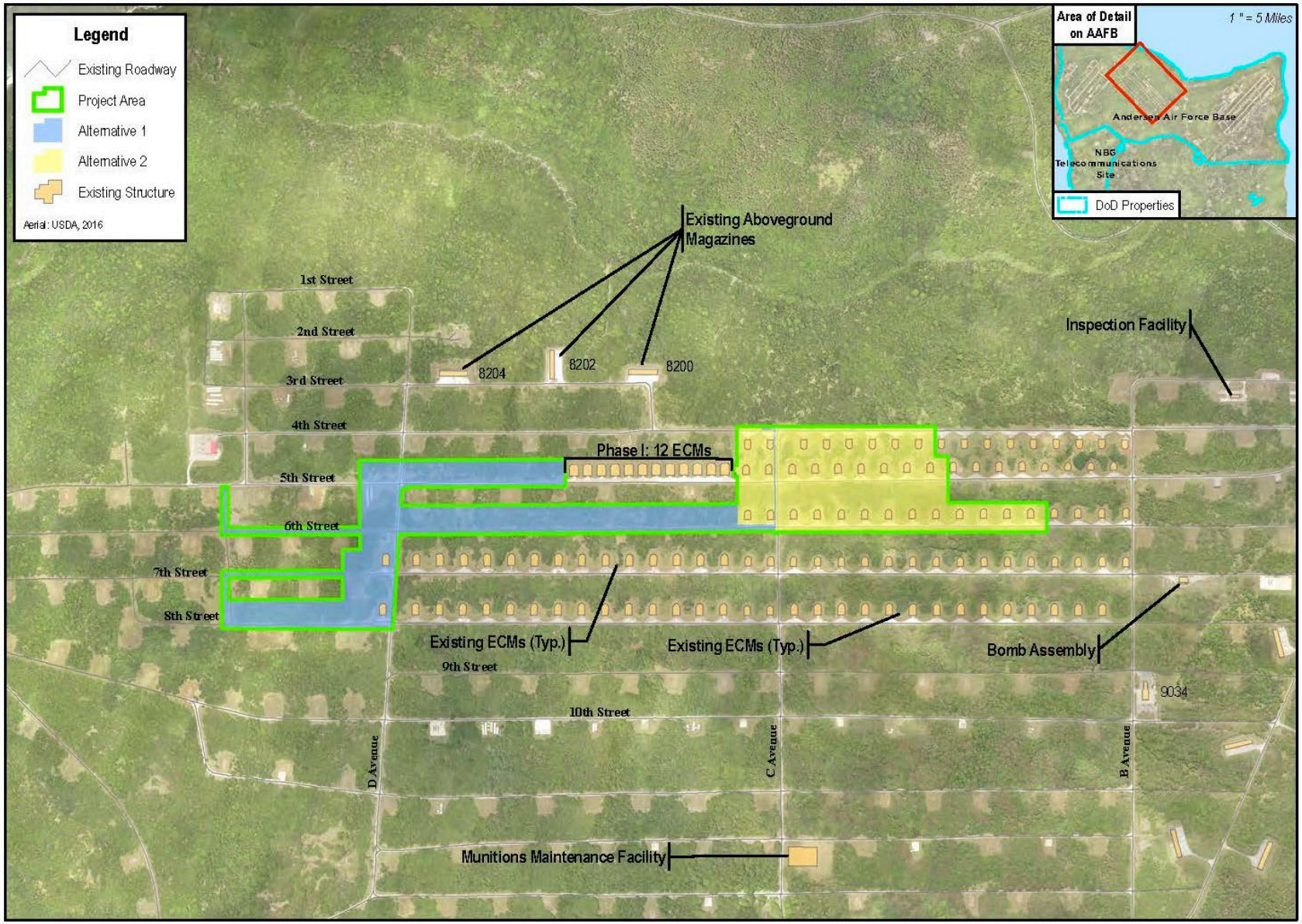


Figure 2-1
Existing Conditions (MSA I and Project Location)

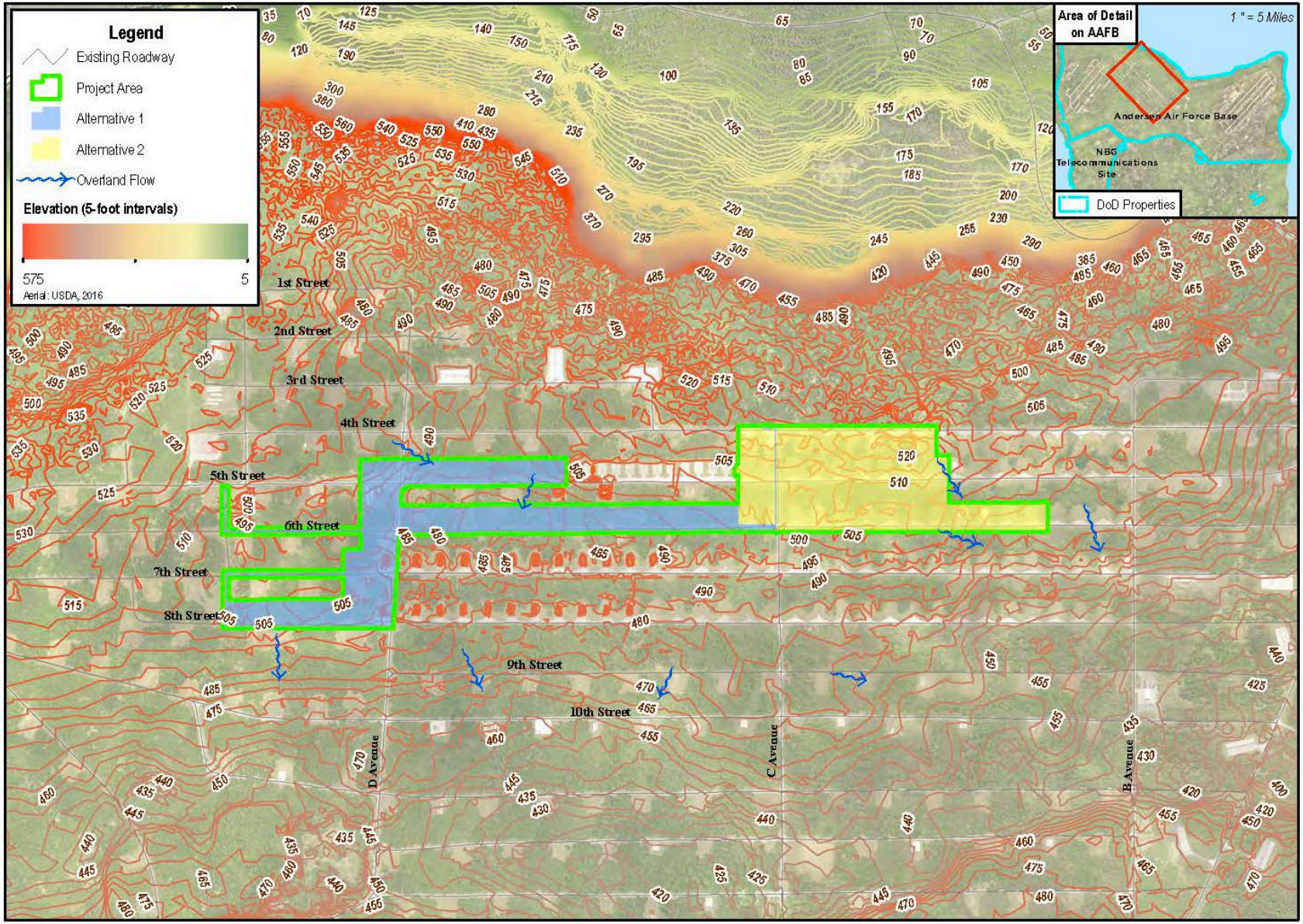


Figure 2-2
Topography and Drainage

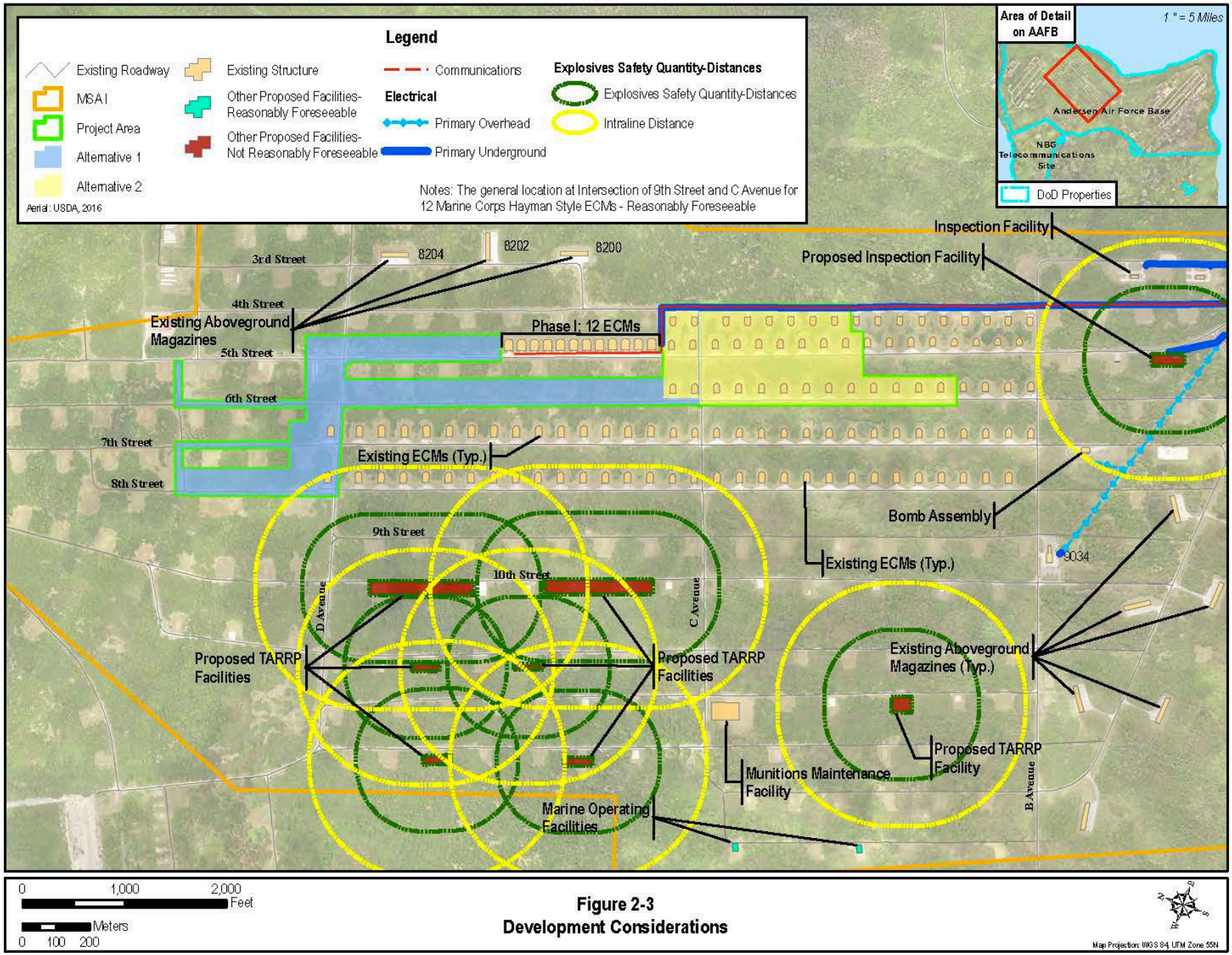


Figure 2-3
Development Considerations

2.1.2.1 Existing Facilities

Most existing facilities within MSA I must remain. Areas where new facilities could be constructed are limited. The primary existing facilities in the project vicinity are ECMs. There are two existing ECMs within the Alternative 1 footprint that would be retained. Alternative 2 would provide the option to demolish 30 existing ECMs to construct the proposed 48 new Hayman ECMs. Other existing facilities include: access roads, aboveground magazines, inspection facility, bomb assembly area, plus electrical and communications connections.

2.1.3 Explosives Safety

For existing storage facilities, the controlling constraint to siting new explosives storage facilities is the minimum inter-magazine distance that is based on the amount of munitions to be stored and the construction type of each storage facility. The inter-magazine distance (IMD), the distance from one magazine to another, for the existing ECMs and proposed Hayman style ECMs is approximately 100 feet for up to 500,000 pounds of hazard class/division (HC/D) 1.1 munitions. IMD arcs for existing ECMs are not depicted as a constraint in the summary constraints drawing that follows, but each alternative for new munitions storage facilities considered the minimum IMD from existing storage facilities. In addition to the IMD, each proposed facility must consider other explosives safety siting criteria including the minimum intra-line distance (the distance to related personnel or facilities), minimum public traffic route distance (the distance to unrelated public traffic routes), and the minimum inhabited building distance (the distance to unrelated facilities or personnel).

In addition to existing facilities, proposed facilities also impose siting constraints due to their explosives safety spacing requirements. See Section 4.3.3 for a list of Present and Reasonably Foreseeable Actions. Based on preliminary explosives site plans approved by the DOD Explosives Safety Board, proposed projects near the study area have the following explosives safety spacing requirements (USAF 2017):

- The proposed Marine Operation Locations have an approximate IMD of 680 feet
- Proposed tactical air-munitions rapid response package (TARRP) facilities have the following IMD:
    - Aboveground magazines have an approximate IMD of 680 feet
    - Operations pads have an approximate IMD of 694 feet
    - The T-2 pad has an approximate IMD of 694 feet
- The proposed Munitions Inspection Facility has an approximate IMD of 337 feet

2.1.4 Design Standards

Basic design standards for construction in northern Guam, munitions storage facilities in general, and munitions storage igloos specifically would be followed. Geotechnical conditions would be investigated and integrated into project design. Design standards specific to munitions storage facilities include the following:

- Air Force Handbook 32-1084, Facility Requirements
- Air Force Instruction 32-1021, Planning and Programming Military Construction Projects
- Air Force Manual (AFMAN) 91-201, Explosives Safety Standards

- Technical Manual 5-1300, Structures to Resist the Effects of Accidental Explosives
- DOD Manual 5100.76-M, Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives
- DOD Standard 6055.9-STD, DOD Ammunition and Explosives Safety Standards

2.1.5 Description of Proposed Action

The USAF 36WG proposes to construct new munitions storage facilities and infrastructure upgrades in MSA I on Andersen AFB, Guam. The Proposed Action would help the 36 WG reduce its munitions storage capacity deficit. The Proposed Action would include two action alternatives and one No Action alternative. Each action alternative proposes construction of 48 new Hayman style ECMs, based on the DOD Explosives Safety Board-approved Hayman ECM for Guam. The program requirement for munitions storage is guided by AFMAN 32-1084 *Earth Covered Magazines* (CC 422-264), AFMAN 91-201, Unified Facilities Criteria (UFC) 4-420-01. Figure 2-4 depicts a standard Hayman style ECM design. Figure 2-5 shows photographs of existing munitions storage igloos on Andersen AFB.

The igloos would be constructed with reinforced concrete floors and roof slabs. Their interior dimensions would be approximately 25 feet wide and 80 feet long. Excavation depth would vary from at least 2 feet below the planned igloo footings to a depth of at least 5 feet beyond footing limits (DON, 2018a). The walls and roof are designed to be covered in a minimum of 24 inches of fill with a topping of shotcrete to prevent plant growth and erosion. Each new ECM would have approximately 2,000 square feet (ft^2) of floor space for munitions storage. Access to the storage area would be provided through a pair of blast resistant structural steel access doors of 7-bar construction that provides an 11-foot clear height and a 24-foot clear width opening. The doors are required to be secured with high security hasps and an intrusion detection system. Each igloo would have a concrete apron at the igloo door.

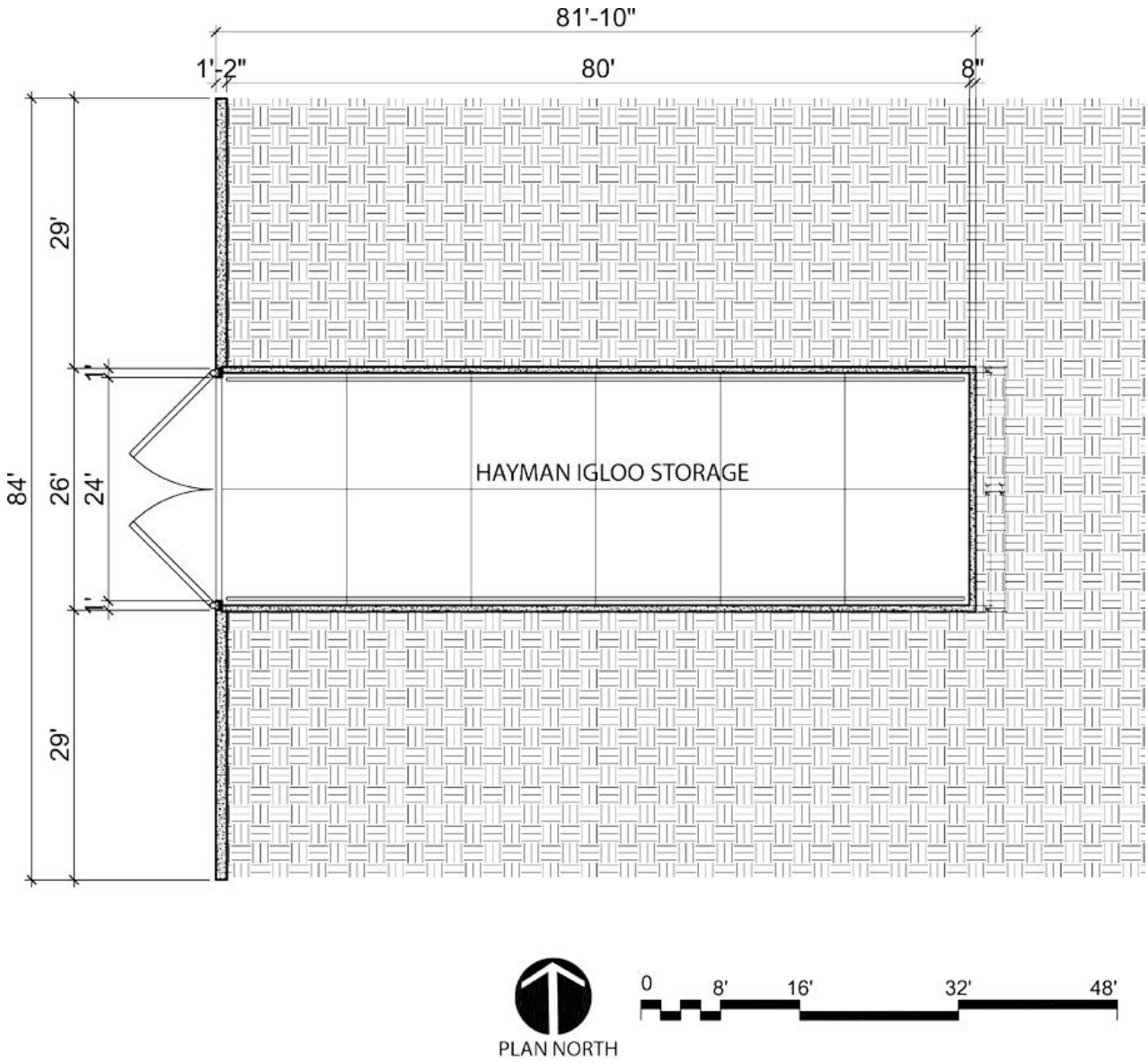
Each igloo would include electrical outlets, standard fluorescent lighting, and exterior lighting. Flood lights over the igloo doors would be hooded to avoid disturbing bats. Primary power would require 13.8 kV, and secondary power would require 480 volts and 120/208 volts. Each storage ECM would be lightning and surge protected and would have a grounding system.

No water or sewer infrastructure would be included for the igloos. Shotcrete erosion control of the exterior and waterproofing of the interior would also be included. For moisture drainage, the interior floor slab would be ridged in the center, parallel with the long direction, and sloped down 1 inch to a gutter. The space requires mechanical ventilation in two places, one in the side wall near the front entry, and one in the rear wall.

Construction fill material would be obtained from an established borrow location on Andersen AFB.

2.1.6 Timeline

The Proposed Action would occur in multiple phases based on the availability of funds. The anticipated timeline for construction of the 48 igloos is approximately 3 to 6 years.



Source: DON, 2018a.

Figure 2-4 Typical Hayman Style ECM Design

Figure 2-5 Photographs of Existing Munitions Storage Igloos, Andersen AFB

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally Proposed Action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis.

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

- Operational Readiness: Operational readiness must be preserved so the 36 WG is able to meet their USAF-assigned missions. Operational readiness is the capability of a unit/formation, aircraft, weapon system, or equipment to perform the missions or functions for which it is organized or designed.
- DOD Explosives Safety Board Approval: Proposed improvements must satisfy NEW square footage requirements and receive DOD Explosives Safety Board approval.
- Safety Requirements: The individual igloos must be sited in accordance with all regulatory guidance to ensure the safe working environment for munitions and other installation personnel. The igloo configurations are as close together as safety setback distances allow. This (1) helps maintain quantity-distance (QD) setback arcs within MSA 1 and prevent unnecessary exposure to habitable spaces outside the MSA; and (2) minimizes logistical and maintenance requirements due to a more compact project area footprint.

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, two action alternatives were identified and will be analyzed within this EA. The No Action Alternative is also described below.

2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. Construction of new munitions storage facilities and infrastructure upgrades would not occur, and no additional storage capacity would be gained. There would be no site disturbance due to construction activities and utilities would not be extended or upgraded. The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA. The No Action Alternative will be used to analyze the consequences of not undertaking the Proposed Action, not simply conclude no impact. It will serve to establish a comparative baseline for analysis and a determination of the significance of any effect.

2.3.2 Alternative 1 (Preferred Alternative)

Alternative 1 (the Preferred Alternative) proposes construction of 48 new Hayman style ECMs directly south and west of the existing 12 ECMs that were completed under Phase 1 in FY2008. Alternative 1 is operationally preferred. Alternative 2 has substantial disadvantages including the demolition of 30 existing ECMs, temporarily reducing ammunition storage capacity, and potentially reducing munitions operations efficiency on base during construction. Alternative 1 would be constructed in Phases 2 through 4. The number of igloos constructed in each phase may be adjusted, but the total number of new igloos remains 48. Initial plans call for the following number of igloos in each phase:

- Phase 2: Construction of up to 16 Hayman style storage ECMs.
- Phase 3: Construction of up to 20 Hayman style storage ECMs.
- Phase 4: Construction of the remaining balance of Hayman-style storage ECMs to meet a total of 48.

Figure 2-6 depicts the proposed site plan for Alternative 1. Constructing 48 new Hayman style ECMs would result in a net increase of approximately 97,392 ft^2 of munitions storage capacity, reducing the operational storage capacity deficit at Andersen AFB from 280,000 ft^2 to approximately 182,600 ft^2. The Preferred Alternative would have the least amount of operational impact to existing ECMs, and the 48 new ECMs would be constructed without the need to demolish existing storage facilities, resulting in immediate storage capacity increase.

2.3.2.1 Existing Conditions

The site selected for Alternative 1 is currently undeveloped space and demolition of existing facilities would not be required. The site is heavily overgrown and would require vegetation clearance.

2.3.2.2 Site Disturbance

Construction and implementation of Alternative 1 would involve disturbance of 51 acres, 19 acres of which would be new impervious surface. Areas of the Proposed Action are detailed in Table 2-1.

Table 2-1 Alternative 1 Areas of Proposed Action

Alternative 1	***Acres***
Impervious Surface (Igloos, Pavement)	19.3
Pervious Construction Area (Grading, LID)	21.6
Pervious Utility Corridor	3.5
Construction Staging Area	1.6
Existing Igloo Site	1.25
Non-Impacted Pervious Surface	3.8
TOTAL	51.05

Key: LID = Low Impact Development.

2.3.2.3 Access

Existing access roads within the Alternative 1 footprint are in poor condition and improvements would be needed. New roads would be 24 feet wide with 2-foot wide shoulders and constructed of asphaltic concrete. Roads would be crowned to drain.

A paved apron between an adjacent road and the access doors would be required for each ECM. Each apron would consist of two separate elements: an asphaltic concrete transition approximately 26.5 feet long and 127 feet wide, and a Portland cement concrete apron centered on the ECM doors and approximately 24 feet long and 26 feet wide. It is assumed that excavation depths would be similar those described earlier for construction of the igloos (2-5 feet).

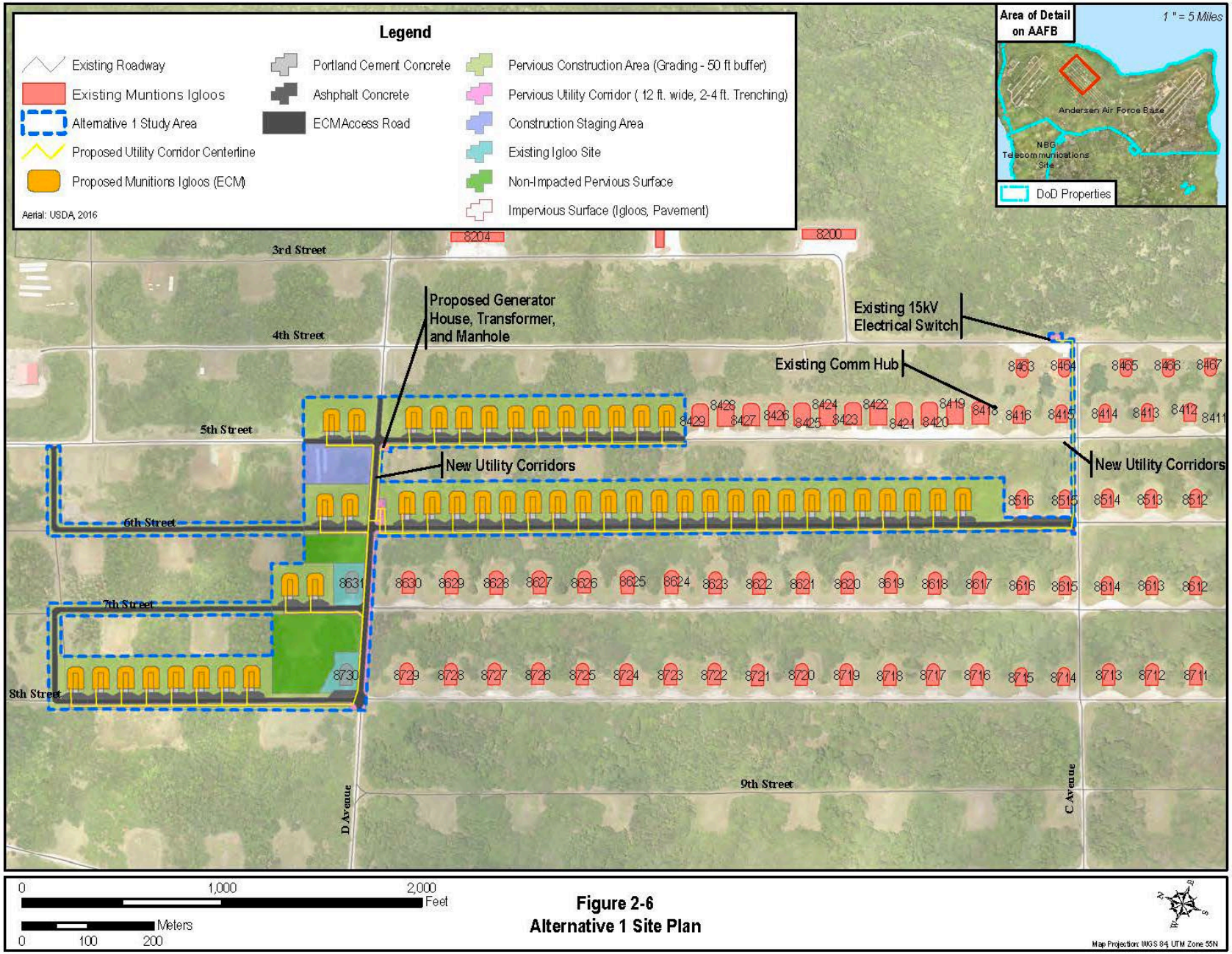


Figure 2-6
Alternative 1 Site Plan

2.3.2.4 Utilities

New electrical and communications services would be provided for Alternative 1. New electrical facilities would consist of a new radial feeder extended from the pad-mounted switch installed in Phase 1, to a new pad-mounted transformer and enclosure located near the intersection of 6th Street and D Avenue. A new building would be constructed adjacent to the transformer enclosure to house a new standby generator, which would serve the additional 48 ECMs. An automatic transfer switch would be provided from the new pad-mounted transformer and the standby generator to provide redundant electrical sources for the new ECMs. A distribution panel supplied from the automatic transfer switch would provide secondary service to the ECMs. Primary and secondary electrical service would be distributed to the ECMs via new utility corridors with ductbanks and intermediate handholes.

A new air-conditioned communications equipment building would be provided as well as a new standby generator building. Existing fiber optics would be extended from the communications equipment room and connected to serve the ECMs. New communications infrastructure housing would be located in the new utility corridors.

Storm drainage would be managed with percolation basins and meet the requirements of UFC 3-210-10, *Low Impact Development*. Potable water and sewer services are not required to serve the project area.

2.3.2.5 Antiterrorism Force Protection

In October 2006, the DOD issued Instruction Number 2000.16, *DOD Antiterrorism Standards*, requiring all DOD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats. The intent of these building standards is to integrate greater resistance to a terrorist attack into all inhabited buildings. That philosophy affects the general practice of designing inhabited buildings. Antiterrorism Force Protection (ATFP) standards consist of restrictions for onsite planning, including standoff distances, building separation, unobstructed space, drive-up and drop-off areas, access roads, and parking; structural design; structural isolation; and electrical and mechanical design. The igloos, Generator Building, and Telecom Building are considered low occupancy per UFC 4-010-01 as they are not routinely inhabited by 11 or more DOD personnel; therefore, they are exempt from the minimum ATFP standards. ATFP standards would be incorporated into the design of the project, where applicable.

2.3.3 Alternative 2

Alternative 2 proposes demolishing 30 existing substandard ECMs and constructing 48 new Hayman style ECMs in their place. The Alternative 2 project area is located east of the Phase 1 ECMs between 4th Street and 6th Street. Facilities that could be demolished include:

- ECMs 8463 through 8470 (8 total)
- ECMs 8408 through 8416 (9 total)
- ECMs 8504 through 8516 (13 total)

Demolishing the existing 30 ECMs would result in a loss of approximately 50,000 ft^2 of storage capacity. The proposed 48 ECMs would add approximately 47,392 ft^2 of munitions storage capacity. Alternative 2 would reduce the operational storage capacity deficit at Andersen AFB from 280,000 ft^2 to approximately 232,600 ft^2.

Figure 2-7 depicts the proposed Alternative 2 site plan.

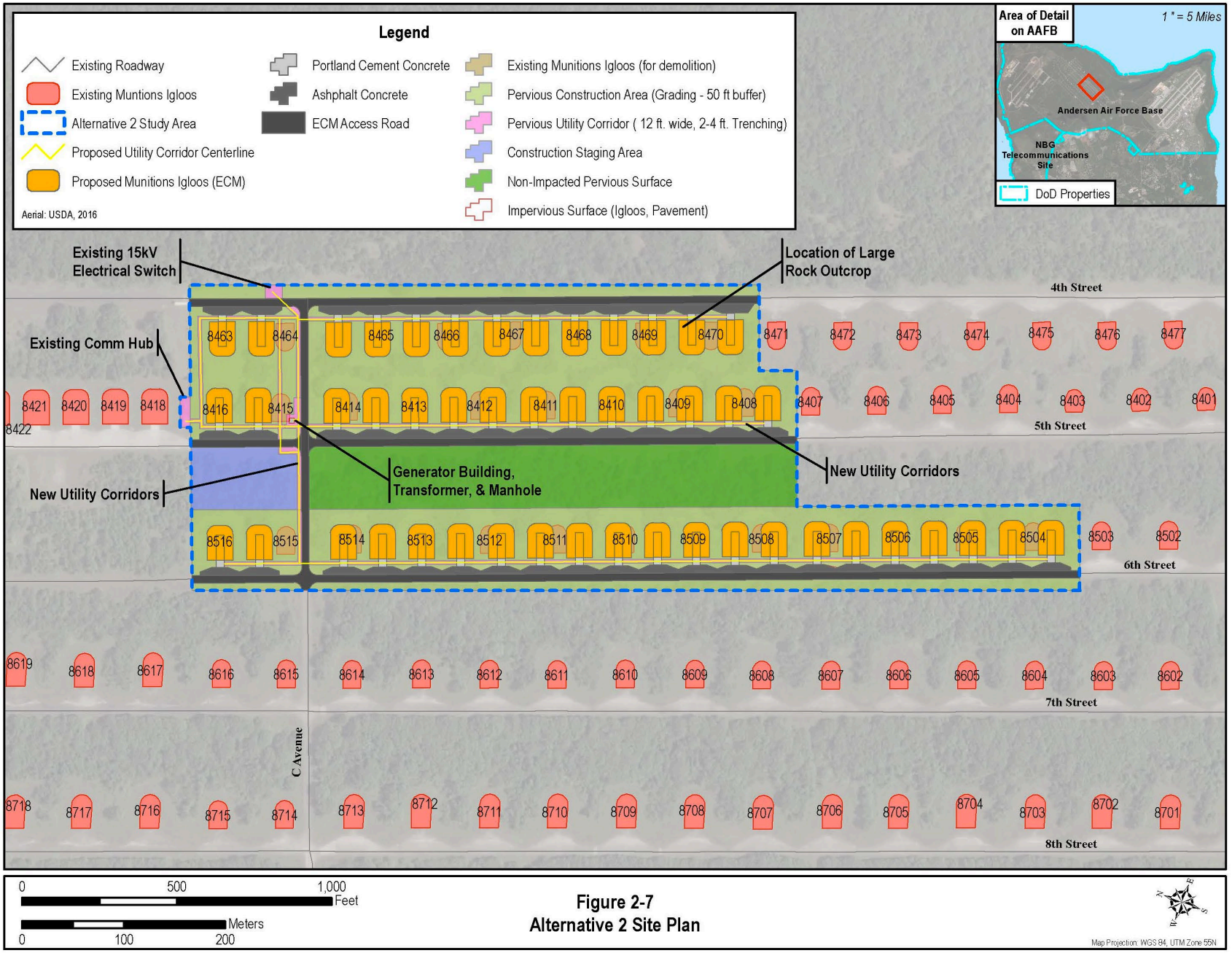


Figure 2-7
Alternative 2 Site Plan

2.3.3.1 Existing Conditions

There are 30 existing ECMs located within the Alternative 2 project area. The magazines were constructed in the 1950s and have since been rated as substandard due to their limited capacity for ordnance storage. The area proposed for construction has been previously disturbed so less existing vegetation would be cleared.

2.3.3.2 Site Disturbance

Construction and implementation of Alternative 2 would involve disturbance of 50 acres, 18 acres of which would be impervious surface. Areas of the Proposed Action are detailed in Table 2-2.

Table 2-2 Alternative 2 Areas of Proposed Action

Alternative 1	*Acres*
Impervious Surface (Igloos, Pavement)	18.2
Pervious Construction Area (Grading, LID)	20.3
Pervious Utility Corridor	2
Construction Staging Area	1.6
Non-Impacted Pervious Surface	7.4
TOTAL	49.5

Key: LID = Low Impact Development.

2.3.3.3 Access

Existing access roads are already improved and would only require minor patching to repair construction damage under Alternative 2.

2.3.3.4 Utilities

The electrical distribution for Alternative 2 would be the same as that described for Alternative 1 with the exception that the pad-mounted transformer and generator building would be located at the intersection of 5th Street and C Avenue. The electrical distribution plans and stormwater management for Alternative 2 would also be the same as Alternative 1.

2.3.3.5 Antiterrorism Force Protection

The same ATFP requirements listed under Alternative 1 would also apply to Alternative 2.

2.3.4 Alternatives Comparison

A comparison of alternatives is presented in Table 2-3.

Table 2-3 Alternatives Comparison

Metric	*Alternative 1*	*Alternative 2*
Total Acres	51.05 acres	49.5 acres
Total Impervious Surface	19.3 acres	18.2 acres
Total Pervious Surface	21.6 acres	20.3 acres
Demolition	No demolition	Demolition of 30 existing ECMs
Safety	Constrained by ESQD arcs	Constrained by ESQD arcs
Operational	None	Mission-critical short-term operational impacts to remove 30 ECMS from use during construction
Net Increase in Munitions Storage Capacity	97,392 ft^2	47,392 ft^2
Residual Storage Capacity Deficit	182,608 ft^2	232,608 ft^2
Biological	More vegetation removal than Alternative 2; potentially sensitive habitat	Majority of site was previously disturbed; less potentially sensitive habitat compared with Alternative 1
ROM Cost	No demolition costs; may include mitigation costs	Includes demolition costs

Key: ESQD = Explosive Safety Quantity Distance; ROM = Rough Order Magnitude.

2.4 Alternatives Considered but not Carried Forward for Effects Evaluation

The following alternatives were considered, but not carried forward for evaluation of potential effects to resources in this EA as they did not meet the purpose and need for the project and satisfy the reasonable alternative screening factors presented in Section 2.2.

2.4.1 Alternative Locations on Base for Munitions Storage Facilities

According to munitions siting criteria in AFMAN 91-201, *Explosives Safety Standards*, munitions storage facilities can only be constructed within an MSA. There are two MSAs on Andersen AFB: MSA I and MSA II (refer to Figure 1-2). MSA I is the primary MSA and is used to store large quantities of munitions (114 igloos), whereas MSA II, just north of the airfield, is much smaller (18 igloos) and cannot be adequately expanded to accommodate 48 additional munitions storage igloos. In addition, MSA II cannot be expanded to accommodate additional munitions storage igloos because it is constrained by topography and the airfield; safety setbacks and munitions siting criteria prohibit an increase in storage capacity. Furthermore, it is not operationally feasible or safe to store only a portion of the munitions shortfall in MSA II. It would not be safe or practical to transport munitions between MSA I and MSA II, or between the MSAs and other more distant locations, with the frequency needed to support the existing mission. Only MSA I would have adequate space for the proposed munitions storage igloos. Therefore, locations outside of MSA I on Andersen AFB were eliminated from detailed evaluation. Alternative configurations within MSA I were considered but are not being carried forward for detailed analysis in the EA because they do not meet operational or safety requirements.

2.4.2 Alternative Designs for Munitions Storage Facilities

Munitions storage facilities are used to store munitions explosives material, inert components, and equipment used for the operating requirements of the USAF. Table 2-4 presents a description of various types of munitions storage facilities and the basis for analysis or elimination. As indicated in Table 2-4, storage igloos were found to be the only reasonable munitions storage facility for the Proposed Action.

Table 2-4 Munitions Storage Facility Alternatives

Type of Munitions Storage Facility	***Description and Most Appropriate Use***	***Basis for Analysis or Elimination***
Storage Igloo	Aboveground, covered with a minimum of 24 inches of earth. Preferred storage facility type for all explosives.	The storage igloo is the preferred storage facility type and meets the 36 WG's munitions storage needs. This alternative is analyzed in this EA.
Aboveground Magazine Storage	Aboveground, similar to storage igloo but not earth-covered. Requires large QD setbacks to ensure proper protection.	While similar in size and function to igloos, the QD arc for the aboveground magazines would encroach on habitable buildings outside MSA I. This is not a safe alternative. Therefore, this alternative was eliminated.
Multi-cubicle Magazine Storage	Aboveground, used to store small quantities of explosives. Ideal for segregating incompatible explosive groups.	The 36 WG needs to increase munitions storage space. Multi-cubicle magazines are designed for storing small quantities of munitions. Therefore, this alternative was eliminated.
Segregated Magazine Storage	Aboveground, similar to multi-cubicle magazine storage. Ideal for segregating incompatible explosive groups. Each cubicle is akin to a small locker with a door width of 36 inches.	The 36 WG needs to increase munitions storage space. Segregated magazines are designed for storing small quantities of munitions. Therefore, this alternative was eliminated.
Rocket Check Out and Assembly Storage	Serves as an operating location to accommodate the assembly, disassembly, and electrical checkout and provides a site to store built-up rockets.	Rocket checkout and assembly facilities are designed for the assembly and storage of rockets. This capability is beyond the scope of the 36 WG's needs. Therefore, this alternative was eliminated.
Module Barricaded Storage	Provides field storage for large quantities of explosives in constrained land uses. Maximum NEW permitted is 250,000 pounds. Locations for use must be specifically approved under AFMAN 91-201.	Module barricaded storage supports less NEW than storage igloos. Furthermore, this would be an expensive venture to accommodate the munitions storage required. Therefore, this alternative was eliminated.
Inert Spares Storage	Stores inert munitions components, materials, and support equipment.	The 36 WG needs to store live munitions. Therefore, this alternative was eliminated.
Ancillary Explosives Facility	Used in pads, locations, revetments, and facilities primarily for munitions holding, inspection, loading, and unloading.	The 36 WG needs permanent munitions storage. This alternative is for the temporary storage of munitions. Therefore, this alternative was eliminated.

Source: Based on munitions facilities identified in the *Air Force Munitions Facilities Standards Guide Volume I* (Air Force Center for Engineering and the Environment, 2004).

As defined in Air Force Handbook 32-1084, *Facility Requirements*, storage igloos are used to store all types of explosives and are the preferred facility where moisture condensation is not a factor. They would be either concrete or steel arch-type construction (see Figure 2-4). The typical munitions storage module is 24 feet by 80 feet long and no wider than 30 feet; however, length can vary in 66-foot increments to provide greater mission-specific flexibility. Of the various types of munitions storage facilities, the storage igloo was found to be the only reasonable alternative. Alternative designs for munitions storage facilities were considered but eliminated from detailed analysis in this EA because they did not meet operational or safety requirements.

2.4.3 Renovate, Upgrade, or Replace Existing Munitions Storage Igloos

The existing munitions storage igloos are rated to store only nonstandard-type munitions (i.e., limited to 250,000 pounds NEW capacity). The 36 WG could theoretically meet the storage shortfall by replacing the nonstandard doors and eroded earthen covering, or demolishing all 114 existing nonstandard storage igloos in MSA I and constructing enough 7-bar-rated replacement storage igloos to meet the shortfall (i.e., 117 storage igloos).

These alternatives were eliminated from detailed evaluation due to the current 36 WG munitions storage capacity deficit. In order to upgrade or replace any of the existing storage igloos, the munitions in that existing igloo (and possibly surrounding igloos) would have to be temporarily relocated for safety purposes. There is no other location on Andersen AFB that could safely accommodate a temporary relocation of munitions from the existing igloos. The only safe option would be to temporarily store munitions at an installation other than Andersen AFB during renovation or construction periods. The 36 WG would not be able to meet their current mission requirements if their existing capabilities were further reduced by temporarily storing munitions at other installations. Therefore, this alternative was eliminated from detailed evaluation. This alternative was considered but is not being carried forward for detailed analysis in the EA because it does not meet operational requirements.

2.5 Best Management Practices Included in Proposed Action

This section presents an overview of the BMPs that are incorporated into the Proposed Action in this document. BMPs are existing policies, practices, and measures that the Air Force would adopt to reduce the environmental impacts of designated activities, functions, or processes. Although BMPs mitigate potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from potential mitigation measures because BMPs are (1) existing requirements for the Proposed Action, (2) ongoing, regularly occurring practices, or (3) not unique to the Proposed Action. In other words, the BMPs identified in this document are inherently part of the Proposed Action and are not potential mitigation measures proposed as a function of the NEPA environmental review process for the Proposed Action. Table 2-5 includes a list of BMPs. Mitigation measures are discussed separately in the respective resource section of Chapter 3, and they are summarized in Section 3.11. Cultural resources mitigation measures include an archaeological data recovery plan to be put in place in accordance with the Guam

SHPO Section 106 NHPA concurrent letter (see Section 3.4 and Appendix D). The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D). Biological resources BMPs are summarized in the table; details are provided in Section 3.5 and Appendix C. Biological resources mitigation measures include conservation measures in Section 3.5, Biological Resources, that were identified in the signed Biological Opinion as part of Section 7 ESA consultation (see Section 3.5 and Appendix C).

Table 2-5 Best Management Practices

BMP	*Description*	*Impacts Reduced/Avoided*
Air Quality	Properly maintain vehicles and construction equipment.	Reduce/minimize gaseous and particulate pollutant emissions during construction.
Air Quality	Water exposed soil for dust suppression.	Minimize fugitive dust associated with soil disturbance during construction.
Water Quality	Comply with Program and Site-Specific Stormwater Pollution Prevention Plans and use measures such as diversion dikes and swales, gravel/sand bag berms, and fiber rolls.	Reduce/minimize off-site transport of stormwater runoff and sediment.
Water Quality	Comply with Clean Water Act Section 401 Water Quality Certification: prepare and implement Environmental Protection Plan and use measures such as diversion dikes and swales, gravel/sand bag berms, and fiber rolls.	Reduce/minimize off-site transport of stormwater runoff and sediment during construction.
Water Quality	Equip all vehicles with on-board spill containment kits, park on paved surfaces where possible, and place drip pans beneath parked vehicles.	Prevent/minimize potential for construction vehicle fuel to enter surface and groundwater.
Water Quality	In the event of an accidental release of fuel, follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the Guam Environmental Protection Agency *Spill Prevention Control Countermeasure Program.*	Prevent/minimize potential for construction vehicle fuel to enter surface and groundwater.
Water Quality	Construct percolation basins between the new ECMs according to the requirements of Unified Facilities Criteria (UFC) 3-210-10, *Low Impact Development*.	Prevent erosion and sediment mobilization into stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs.
Water Quality	Following completion of construction and utility line trenching replant exposed soil with native vegetation.	Prevent long-term soil erosion in the areas disturbed during construction.
Geological Resources	Use drainage diversion and control to divert stormwater away from the construction area.	Prevent increased erosion, compaction, and soil loss from physical disturbance during construction activity.
Geological Resources	Limit the size of the unstabilized disturbed areas for each project phase to less than 20 acres during construction.	Prevent increased erosion, compaction, and soil loss from physical disturbance during construction activity.
Geological Resources	Implement standard soil erosion control practice construction practices.	Minimize soil erosion during clearing, grubbing, grading, embankment or filling, excavation, stockpiling, or other earthmoving operations.

Table 2-5 Best Management Practices

BMP	*Description*	*Impacts Reduced/Avoided*
Geological Resources	Construct percolation basins between the new ECMs according to the requirements of UFC 3-210-10, *Low Impact Development*.	Prevent erosion and sediment mobilization into stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs.
Geological Resources	Construct ECMs in accordance with UFC 3-310-04, *Seismic Design of Buildings* dated June 1, 2013 (U.S. Army Corps of Engineers [USACE], 2013).	Minimize potential for seismic safety hazards at the new ECMs.
Biological Resources	Details on the Biological Resources BMPs are provided in Section 3.5 and Appendix C.	
Biological Resources	Conduct plant assessments and collection of plant material before any vegetation clearing or site preparation.	Prevent environmental stressors on the listed plants.
Biological Resources	Flag ESA-listed plants within 10 feet of the construction perimeter.	Prevent any unnecessary disturbance from construction.
Biological Resources	Mark construction perimeter during site preparation and prior to any clearing and grubbing of surface vegetation.	Prevent encroachment into adjacent areas with ESA-listed plants.
Biological Resources	Use silt fences or straw wattles, and use dust screens at the project boundary if ESA-listed plants are within 10 feet from the project boundary.	Prevent soil erosion into adjacent areas with ESA-listed plants; and shield protect, screen, and create a buffer for the ESA-listed plants.
Biological Resources	Implement a contractor education program to ensure contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements in the project area. See Appendix C for pamphlets and natural resource training material related to coconut rhinoceros beetle (*Cocos nucifera*) and little fire ant (*Wasmannia auropunctata*).	Minimize effects to biological resources, in particular: *Cycas micronesica*, *Tabernaemontana rotensis*, and Mariana fruit bat (*Pteropus mariannus mariannus*).
Biological Resources	Survey within line of sight (up to 492 feet) of construction activities for bats, prior to the start of a day's construction activities. Postpone construction work generating noise, light or human activity above the ambient levels until the bat(s) has left the area.	Minimize effects to Mariana fruit bat.
Biological Resources	Examine the condition of listed plant species within 10 feet of the construction perimeter and document any adverse effects to the plants within that buffer. Inspect the contractors work to ensure that these BMPs are implemented for the entire duration of the project.	Minimize effects to ESA-listed plant species.
Biological Resources	Provide project specific work plans to the USFWS for inclusion in the consultation file.	Minimize effects to ESA-listed plant and wildlife species.

Table 2-5 Best Management Practices

BMP	*Description*	*Impacts Reduced/Avoided*
Biological Resources	Monitor Mariana fruit bat population status on Andersen AFB to maintain and identify habitat relationships. If changes in roost locations, colony size, or movement are detected, investigate potential threats or stressors that may be causing disturbance.	Minimize effects to Mariana fruit bat.
Infrastructure	Locate and mark existing underground fire suppression, electrical, and communications lines and avoid them during construction activities.	Prevent damage to existing utility infrastructure in the project area.
Infrastructure	Recycle all project municipal solid waste, including concrete demolition debris, to the maximum extent possible. Mulch cleared vegetation for landscaping.	Divert project-related solid waste from the Andersen AFB to minimize impacts to the landfill capacity.
Public Health and Safety	Comply with DOD Directive 6055.9-STD (DOD Ammunition and Explosive Safety Submission [ESS]) and prepare ESS documentation.	Outline specific measures that would be implemented to ensure the safety of workers and the public.
Public Health and Safety	Have qualified unexploded ordnance (UXO) personnel perform surveys to identify and remove potential UXO and munitions and explosives of concern (MEC) items prior to the initiation of ground-disturbing activities.	Prevent/minimize potential UXO and MEC hazards before construction begins.
Public Health and Safety	Have the Andersen AFB Explosive Ordnance Disposal Unit present at the work site during all active groundbreaking and clearing activities.	Prevent/minimize potential UXO and MEC hazards during construction.
Public Health and Safety	Provide UXO awareness training to construction personnel involved in grading and excavations prior to and during ground-disturbing activities that would occur in previously disturbed areas that have a high probability of UXO.	Prevent/minimize potential UXO and MEC hazards to workers during construction.
Hazardous Materials and Waste	Conduct ongoing radon gas monitoring in the new ECMs and maintain the ventilations following construction (U.S. Navy 2017).	Minimize potential impacts of radon gas accumulation inside the ECMs.

2.6 Decision to be Made and Identification of the Preferred Alternative

The 36 WG will make one of the following decisions:

- Take no action as described in Section 2.3.1
- Implement Alternative 1 as the Preferred Alternative as described in Section 2.3.2
- Implement Alternative 2 as described in Section 2.3.3

3 Affected Environment and Environmental Consequences

This chapter presents a description of the environmental resources and baseline conditions that could be affected from implementing any of the alternatives and an analysis of the potential direct and indirect effects of each alternative.

All potentially relevant environmental resource areas were initially considered for analysis in this Environmental Assessment (EA). In compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and the Department of the Navy's "Procedures for Implementing NEPA (32 CFR Part 775), Secretary of the Navy Instruction (SECNAVINST) 50906.A, *Environmental Planning for Department on the Navy Actions,* and Office of the Chief of Naval Operations Instruction (OPNAVINST) M-5090.1 Chapter 10 , the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

"Significantly," as used in NEPA, requires considerations of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (e.g., human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of a Proposed Action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant. Mitigation measures are discussed separately in the respective resource section of Chapter 3, and they are summarized in Section 3.11.

This chapter includes air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and wastes.

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

Land Use: Both alternatives are located on Andersen Air Force Base (AFB) within Munitions Storage Area (MSA) 1 (land already designated for munitions storage). The entire territory of Guam lies within the Coastal Zone. Neither Alternative 1 nor Alternative 2 would alter or modify the existing land use designations; therefore, this resource has been excluded from further detailed analysis. The USAF coordinated with the Guam Bureau of Statistics and Plans. The Bureau concurred that the Proposed Action is consistent with the Guam Coastal Management Program and is in compliance with the Coastal Zone Management Act to the maximum extent practicable. Appendix E includes information from the coastal consistency analysis for the Proposed Action (coordinated with Guam Bureau of Statistics and Plans).

Visual Resources: Both alternatives would be located on Andersen AFB within MSA 1 (land already designated for munitions storage). This area cannot be accessed or seen by anyone other than Andersen AFB personnel. Multiple earth-covered magazines (ECMs) resembling those that would be constructed with either Alternative 1 or Alternative 2 are already present in MSA 1. Neither Alternative 1 nor

Alternative 2 would change the visual characteristics of MSA 1; therefore, this resource has been excluded from further detailed analysis.

Airspace: Both alternatives are located on Andersen AFB, within MSA 1 (land already designated for munitions storage). With either alternative, there would be no changes to airspace. Therefore, this resource has been excluded from further detailed analysis.

Socioeconomics: Neither Alternative 1 nor Alternative 2 would involve any activities that would contribute to changes in socioeconomic conditions at Andersen AFB or on the island of Guam. There would be no change in the number of personnel assigned to Andersen AFB, and, therefore, there would be no changes in area population or associated demands for housing and support services. There would be short-term minor beneficial economic impacts from the local purchase of goods and services during construction of either alternative. Neither alternative would pose any adverse or disproportionate environmental health or safety risks to children living on or in the vicinity of Andersen AFB. Therefore, this resource has been excluded from further detailed analysis.

Environmental Justice: Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations in the vicinity of a proposed action. Short-term direct minor beneficial impacts on the local economy through increased employment and purchase of goods and services would be expected as a result of construction activities. Both alternatives are located entirely within MSA 1, an area designated for munitions storage that is only accessible to Andersen AFB munitions personnel. Neither Alternative 1 nor Alternative 2 would pose any adverse or disproportionate environmental health or safety risks to the population living on or in the vicinity of Andersen AFB. Therefore, this resource has been excluded from further detailed analysis.

3.1 Air Quality

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

Most air pollutants originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires.

3.1.1 Regulatory Setting

3.1.1.1 Criteria Pollutants and National Ambient Air Quality Standards

The principal pollutants defining the air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). CO, SO_2, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. O_3, NO_2, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) (40 Code of Federal Regulations [CFR] part 50) for

these pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires local air quality management agencies to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These implementation plans are developed by local air quality management agencies and submitted to USEPA for approval.

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants (HAPs), which are regulated under Section 112(b) of the 1990 CAA Amendments. The *National Emission Standards for Hazardous Air Pollutants* regulate HAP emissions from stationary sources (40 CFR part 61). Because the Proposed Action does not involve any new stationary sources of emissions, HAPs are not discussed further in this section.

3.1.1.2 General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a federal action must be supported by a conformity determination. This is typically done by quantifying applicable direct and indirect emissions that are projected to result due to implementation of the federal action. Indirect emissions are those emissions caused by the federal action and originating in the region of interest, but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable. The federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the federal agency. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. The location of such emissions is known and the emissions are quantifiable, as described and documented by the federal agency based on its own information and after reviewing any information presented to the federal agency. If the results of the applicability analysis indicate that the total emissions would not exceed the *de minimis* emissions thresholds, then the conformity evaluation process is completed. *De minimis* threshold emissions are presented in Table 3-1.

Table 3-1 General Conformity *de minimis* levels

Pollutant	*Area Type*	*tpy*
Ozone (VOC or NO_x)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon monoxide, SO_2 and NO_2	All nonattainment and maintenance	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$ Direct emissions, SO_2, NO_x (unless determined not to be a significant precursor), VOC or ammonia (if determined to be significant precursors)	All nonattainment and maintenance	100
Lead (Pb)	All nonattainment and maintenance	25

Key: NO_x = nitrogen oxide; VOC = volatile organic compound.

3.1.1.3 Greenhouse Gases

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

USEPA issued the Final *Mandatory Reporting of Greenhouse Gases Rule* on September 22, 2009. GHGs covered under the Final *Mandatory Reporting of Greenhouse Gases Rule* are carbon dioxide (CO_2), methane, nitrogen oxide (NO_x), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. The equivalent CO_2 rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of mobile sources and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions as CO_2e are required to submit annual reports to USEPA.

3.1.2 Affected Environment

Guam has been designated as Air Quality Control Region No. 246. Guam is in attainment of the NAAQS for all criteria pollutants, with the exception of the areas within a 3.5-mile radius of the Piti and Tanguisson Power Plants. These areas are in nonattainment of the NAAQS for SO_2, however, Andersen

AFB is outside of these nonattainment areas (USEPA, 2017). Because the project area is in attainment of the NAAQS, Conformity Applicability Requirements do not apply to the Proposed Action; however, as explained in Section 3.1.3 below, estimates of potential air quality emissions have been provided for planning purposes.

3.1.3 Environmental Consequences

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The region of influence (ROI) for assessing air quality impacts is the air basin in which the project is located. Guam has been designated as Air Quality Control Region No. 246.

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations. Although the ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply, emissions estimates are provided and are compared with *de minimis* thresholds of 100 tpy for criteria pollutants (i.e., *de minimis* threshold for a basic nonattainment area), for planning purposes only.

3.1.3.1 Approach to Analysis

The air quality analysis estimated the magnitude of emissions that would occur from proposed construction activities. Construction-related activities would include clearing vegetation and grading to prepare the site, paving the igloo pads, constructing the additional 48 Hayman style munitions storage igloos and infrastructure upgrades, and architectural coating. The impact analysis assumes that the construction would occur over 3 years.

Operational emissions from maintenance and repair activities would be minor and infrequent and are, therefore, evaluated only briefly and qualitatively.

3.1.3.2 Emissions Evaluation Methodology

Air quality impacts from construction activities proposed under each action alternative would primarily occur from combustive emissions due to the use of fossil fuel-powered equipment and fugitive dust emissions (PM_{10} and $PM_{2.5}$) from the operation of equipment on exposed soil. Construction emissions were estimated using CalEEMod (Version 2016.3.1), which is an industry accepted comprehensive air quality modeling tool for quantifying air quality emissions from land use projects. Assumptions were made regarding the total number of days each piece of equipment would be used, and the number of hours per day each type of equipment would be used. Assumptions and model inputs are located within the modeling calculations presented in Appendix B.

3.1.3.3 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline air quality. Therefore, no significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.

3.1.3.4 Alternative 1

Impacts

Construction of 48 new Hayman style ECMs under Alternative 1 would be divided over the three-year construction period and would include clearing vegetation, grading to prepare the site, paving the ECM pads, construction of the ECMs and supporting structures (standby generator building, telecommunications building, and transformer enclosure), and architectural coating. Since phasing of the projects could potentially change, it is assumed for the air quality analysis that the amount of construction would be roughly equal for each of the three years. These activities would generate minor amounts of air emissions and dust, which would have the potential to migrate off-site, depending on wind and soil conditions and the intensity of surface disturbance on any given day. Construction activities would be temporary.

Table 3-2 presents a summary of the annual estimated air quality emissions associated with construction activities at Andersen AFB under Alternative 1. Because the potential emissions from construction activities would occur over the course of three years, they are not additive. As shown in Table 3-2, construction emissions would be below the *de minimis* thresholds of a basic nonattainment area. As previously discussed, the ROI is in attainment of the NAAQS for all criteria pollutants and even if the ROI was located in a basic nonattainment area, the estimated emission would not trigger a formal Conformity Determination under the CAA General Conformity Rule.

Table 3-2 Alternative 1 – Construction Emissions at Andersen AFB with Evaluation of Conformity

Approximate Calendar Year	*Emissions (tons/year)*					
	VOCs	*NO_x*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
Year 1 – Phase 2	9.06	4.37	3.25	0.01	0.77	0.42
Year 2 – Phase 3	9.09	4.53	3.48	0.01	0.84	0.45
Year 3 – Phase 4	8.93	3.15	2.54	0.01	0.56	0.27
Conformity *de minimis* Limits *(for a basic nonattainment area)*[1]	100	100	100	100	100	100
Exceeds Conformity *de minimis* Limits?[1]	No	No	No	No	No	No

Note: [1] The ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply; however, emission estimates have been provided and are compared with the *de minimis* thresholds of a basic nonattainment area, for planning purposes only.

The estimated emissions presented in Table 3-2 would be negligible and would not trigger a formal Conformity Determination under the CAA General Conformity Rule. Standard BMPs such as proper maintenance of vehicles and construction equipment and dust suppression methods (watering of exposed soil) would be implemented by the construction contractor as needed to minimize and further reduce air quality impacts.

General Conformity

The General Conformity rule applies to federal actions proposed within areas designated as either nonattainment or maintenance areas for a NAAQS for any of the criteria pollutants. Emissions of pollutants for which an area is in attainment are exempt from conformity analyses. As such, a Record of Non-Applicability for CAA conformity is not required for this project.

Because the ROI is in attainment of all criteria pollutants, the *de minimis* thresholds for General Conformity Applicability analysis do not apply. The temporary and minor increases in construction and

operation emissions would be negligible (as shown in Table 3-2), would not trigger a formal Conformity Determination under the CAA General Conformity Rule, and would not be considered significant.

Greenhouse Gases

Implementation of Alternative 1 would contribute a nominal amount of emissions of GHGs from the combustion of fossil fuels from construction and operational activities. Total emissions for all constituents in the maximum construction year for Alternative 1 is 18 tons (see Table 3-2), and only a subset of these are considered GHG emissions. Therefore, due to the relatively small project scale, the annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons. The limited amount of emissions would not likely contribute to global warming to any discernible extent. Therefore, implementation of Alternative 1 would not result in significant impacts to air quality.

3.1.3.5 Alternative 2

Impacts

Air quality impacts under Alternative 2 would be similar as described for Alternative 1, except that emissions associated with construction activities would be slightly higher during Phase 2 when compared to Alternative 1. This is because the proposed demolition of 30 existing ECMs is assumed to occur in Phase 2, before construction of the new ECMs. Emission estimates would be slightly lower for Phase 3 and Phase 4 when compared to Alternative 1, due to a slightly smaller construction footprint proposed under Alternative 2. However, since phasing of the projects could potentially change, it is assumed for the air quality analysis that the amount of construction would be roughly equal for each of the three years. Table 3-3 presents a summary of the estimated annual emissions associated with construction activities at Andersen AFB under Alternative 2.

Table 3-3 Alternative 2 – Construction Emissions at Andersen AFB with Evaluation of Conformity

Approximate Calendar Year	*Emissions (tons/year)*					
	VOCs	*NO_x*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
Year 1 – Phase 2	9.12	6.44	4.32	0.01	1.14	0.67
Year 2 – Phase 3	8.98	4.86	3.86	0.01	0.81	0.44
Year 3 – Phase 4	8.80	3.42	2.82	0.01	0.57	0.28
Conformity *de minimis* Limits *(for a basic nonattainment area)*[1]	100	100	100	100	100	100
Exceeds Conformity *de minimis* Limits?[1]	No	No	No	No	No	No

Note: [1] The ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply; however, emission estimates have been provided and are compared with the *de minimis* thresholds of a basic nonattainment area, for planning purposes only.

Total emissions for all constituents in the maximum construction year for Alternative 2 is less than 22 tons (see Table 3-3), and only a subset of these are considered GHG emissions. Therefore, due to the relatively small project scale, the annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons. Similar to Alternative 1, the estimated emissions in Table 3-3 for Alternative 2 would be temporary and minor and would not trigger a formal Conformity Determination under the CAA General Conformity Rule. As stated for Alternative 1, a Record of Non-Applicability for CAA conformity is not required for this project. The temporary and minor increases in construction and operation emissions would be negligible (as shown in Table 3-3), would not trigger a formal Conformity Determination under the CAA General Conformity Rule, and would not be considered significant. The

annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons, so the limited amount of emissions would not likely contribute to global warming to any discernible extent. Therefore, implementation of Alternative 2 would not result in significant impacts to air quality.

3.2 Water Resources

This discussion of water resources includes groundwater, surface water, wetlands, and floodplains. This section only discusses the physical characteristics of wetlands. Related wildlife and vegetation are addressed in Section 3.5, Biological Resources. The project location is inland. No runoff from construction or operational activities will reach cliff edges and flow offshore, thereby ensuring that coral reefs will not be affected. Measures to avoid and minimize runoff at the project site are discussed in Section 3.2.3, Environmental Consequences.

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

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

Wetlands are jointly defined by USEPA and U.S. Army Corps of Engineers (USACE) at 40 CFR 232.2 as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include “swamps, marshes, bogs, and similar areas.”

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

3.2.1 Regulatory Setting

The Safe Drinking Water Act is the federal law that protects public drinking water supplies throughout the U.S. and Guam. Under the Safe Drinking Water Act, the USEPA sets standards for drinking water quality. Groundwater quality and quantity are regulated under several statutes and regulations, including the Safe Drinking Water Act.

The Clean Water Act (CWA) establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES) program, on the amounts of specific pollutants that can be discharged into surface waters to restore and maintain the chemical, physical, and biological integrity of the water. The

NPDES program regulates the discharge of point (i.e., end of pipe) and nonpoint sources (i.e., stormwater) of water pollution.

The Guam Coastal Management Program requires consistency with its Erosion and Siltation development policy for applicable federal activities on Guam. The policy states that "development shall be limited in areas of 15 percent or greater slope by requiring strict compliance with erosion, sedimentation, and land use regulations, as well as other related land use guidelines for such areas." The Guam Environmental Protection Agency (GEPA) administers portions of federal statutes via a Memorandum of Agreement with the USEPA Region 9. In addition to compliance with the USEPA NPDES program, federal projects must also comply with local requirements (e.g., "respecting the control and abatement of water pollution") per Section 313(a) of the CWA.

Construction or demolition that necessitates an individual permit also requires preparation of a Notice of Intent to discharge stormwater and a Stormwater Pollution Prevention Plan (SWPPP) that is implemented during construction. As part of the 2010 Final Rule for the CWA, titled *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category*, activities covered by this permit must implement non-numeric erosion and sediment controls and pollution prevention measures.

CWA Section 401 Water Quality Certification issuance identifies that construction or operation of a proposed project or facility would be conducted in a manner consistent with Guam Water Quality Standards. As part of a Water Quality Certification, an Environmental Protection Plan (EPP) is required. EPPs describe the methods, practices, and equipment to be used on site; expected or anticipated environmental problems during and after construction; and the methods, practices, and equipment that may be used to avoid, mitigate, or control potential adverse effects on the environment. EPPs are specifically identified in 22 Guam Administrative Rules and Regulations (GAR), Division II, Chapter 10, § 10103.C.5 (d). For work occurring within or affecting surface waters, a USACE permit applicant must prepare a Water Quality Monitoring Plan that describes measures to maintain Guam Water Quality Standards. These measures typically include procedures for monitoring, corrective actions, reporting, and recordkeeping. The local requirement for a Water Quality Monitoring Plan is usually incorporated by the USACE or GEPA in their permit programs regulating activities affecting surface water or wetlands.

Section 438 of the Energy Independence and Security Act establishes stormwater design requirements for development and redevelopment projects. Under these requirements, federal facility projects larger than 5,000 square feet (ft^2) must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

3.2.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under water quality resources at MSA 1 on Andersen AFB.

3.2.2.1 Surface Water

There are no surface water resources in the Andersen AFB area. Sinkholes and depressions in the porous limestone bedrock (karst) covering the northern portion of Guam, including Andersen AFB channel surface runoff downward into the bedrock. The direction of overland surface water runoff in MSA 1 is generally westward to several sinkholes and depressions.

3.2.2.2 Groundwater

Andersen AFB overlies the northern portion of three groundwater basins: the Finegayan Basin under the western third of the base, the Agafa-Gumas Basin under the central portion of the base, and the Andersen Basin under the eastern portion of the base. The Andersen AFB SWPPP protects against groundwater contamination from recharge of stormwater runoff via approximately 100 dry wells that were drilled to facilitate the flow of stormwater into the underlying groundwater.

3.2.2.3 Wetlands

As described above in Section 3.2.2.1, surface water percolates downward into the bedrock in the Andersen AFB area. In addition, Andersen AFB and MSA 1 are located on an elevated bedrock platform with a very gentle slope. The physical setting at MSA 1 does not support the formation of wetlands, thus, none are found at MSA 1.

3.2.2.4 Floodplains

Andersen AFB and MSA 1 are not located within either the 100-year or the 500-year flood zones (Department of the Navy [DON], 2015).

3.2.3 Environmental Consequences

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

3.2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline water resources. Therefore, no significant impacts to water resources would occur with implementation of the No Action Alternative.

3.2.3.2 Alternative 1

The study area for the analysis of effects to water resources associated with Alternative 1 includes Andersen AFB MSA 1.

Construction activities under Alternative 1 would result in the removal of vegetation and soil disturbance, which could increase potential for short-term increases in stormwater runoff and erosion.

No surface waters are located within or near the Alternative 1 construction area. The Program SWPPP, a site-specific SWPPP, and EPP would require the use of potential construction BMPs such as diversion dikes and swales, gravel/sandbag berms, and fiber rolls to control erosion and reduce runoff. Through implementation of the BMPs required in the SWPPPs and the EPP, off-site transport of stormwater runoff, sediment, or other pollutants would be unlikely. Project design would include components to withstand and minimize potential effects of typhoon-level events. No construction activities would occur in the 100-year or 500-year flood zones. Therefore, construction activities associated with Alternative 1

would have minimal effect on surface waters, and no construction-associated runoff would reach cliff edges and flow offshore.

Stormwater percolates rapidly in the Andersen AFB limestone karst bedrock. Construction vehicles and equipment have the potential to leak fuel or other hazardous materials, which could have adverse effects on the aquifer due to rapid infiltration. The construction contractor would be responsible for ensuring that their equipment is in good operating condition, and following BMPs to prevent/minimize accidental releases of fuels and hazardous materials, such as equipping all vehicles with on-board spill containment kits, parking on paved surfaces where possible, and placing drip pans beneath parked vehicles. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the GEPA *Spill Prevention Control Countermeasure Program.*

The Alternative 1 construction stormwater runoff protection measures would also serve to protect groundwater quality. The Proposed Action would be implemented in compliance with the Program SWPPP, a site-specific SWPPP, EPP, and BMPs associated with addressing site- and activity-specific water resource protection requirements. Therefore, there would be a reduction in stormwater pollutant loading potential, and thus a reduction in pollution loading potential to the groundwater basins underlying Andersen AFB.

Percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs. The percolation basins would meet the requirements of Unified Facilities Criteria (UFC) 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. The percolation basins and replanted vegetation would avoid mobilization of soil in runoff into surface and groundwater. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given the use of stormwater protection measures and BMPs to minimize soil transport and accidental release of hazardous materials during construction, the incorporation of stormwater management in project design and construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, Alternative 1 would not result in significant impacts to water resources.

3.2.3.3 Alternative 2

The study area for the analysis of effects to water resources associated with this alternative includes Andersen AFB MSA 1.

Construction activities under Alternative 2 would result in the removal of vegetation and soil disturbance, which could increase potential for short-term increases in stormwater runoff and erosion. However, vegetation removal would be less than under Alternative 1 since 30 existing ECMs would be demolished before construction of the 48 new ECMs.

No surface waters are located within or near the Alternative 2 construction area. Through implementation and compliance with the Program SWPPP, a site-specific SWPPP, and EPP, off-site

transport of stormwater runoff, sediment, or other pollutants would be unlikely. Project design would include components to withstand and minimize potential effects of typhoon-level events. No construction activities would occur in the 100-year or 500-year flood zones. Therefore, construction activities associated with Alternative 2 would have minimal effect on surface waters, and no construction-associated runoff would reach cliff edges and flow offshore.

Similar to Alternative 1, under Alternative 2 the construction contractor would be responsible for ensuring that their equipment is in good operating condition, and following BMPs to prevent/minimize accidental releases of fuels and hazardous materials, such as equipping all vehicles with on-board spill containment kits, parking on paved surfaces where possible, and placing drip pans beneath parked vehicles. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the GEPA *Spill Prevention Control Countermeasure Program.*

Compliance with the same plans described for Alternative 1 would be required for Alternative 2. Similar to Alternative 1, implementation of stormwater runoff protection measures during construction would also serve to protect groundwater quality under Alternative 2. Thus under Alternative 2, the effect on groundwater would be similar to that of Alternative 1, i.e., there would be a reduction in pollution loading potential to the groundwater basins underlying Andersen AFB.

Under Alternative 2, the same percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs as for Alternative 1. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion. Operations following construction of Alternative 2 would be the same as described for Alternative 1.

Given the use of stormwater protection measures and BMPs to minimize soil transport and accidental release of hazardous materials during construction, the incorporation of stormwater management in project design and construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 2 would not result in significant impacts to water resources.

3.3 Geological Resources

This discussion of geological resources includes topography, geology, and soils of a given area. Topography is typically described with respect to the elevation, slope, and surface features found within a given area. The geology of an area may include bedrock materials, mineral deposits, and fossil remains. The principal geological factors influencing the stability of structures are soil stability and seismic properties. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material. Soil structure, elasticity, strength, shrink-swell potential, and erodibility determine the ability for the ground to support structures and facilities. Soils are typically described in terms of their type, slope, physical characteristics, and relative compatibility or limitations regarding types of land use and particular construction activities.

3.3.1 Regulatory Setting

Consideration of geologic resources extends to prime or unique farmlands. The Farmland Protection Policy Act was enacted in 1981 in order to minimize the loss of prime farmland and unique farmlands as a result of federal actions. The implementing procedures of the Farmland Protection Policy Act require

federal agencies to evaluate the adverse effects of their activities on farmland, which includes prime and unique farmland and farmland of statewide and local importance, and to consider alternative actions that could avoid adverse effects.

3.3.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under geological resources at MSA 1 at Andersen AFB, Guam.

3.3.2.1 Topography

MSA 1 is located at the top of a broad, near-level plateau that slopes gently downward towards the west. Surface elevations in the proposed project area range from approximately 505 to 480 feet above mean sea level.

3.3.2.2 Geology

The island of Guam is located on a volcanic arc adjacent to the Mariana subduction boundary and comprises a volcanic core partially overlain with limestone (karst). The entire island is a potentially active seismic area. Geologic hazards on Guam include the potential for earthquakes that can cause liquefaction (loss of soil cohesiveness and stability in response to earthquake ground motion) and tsunamis, steep slopes where landslides can occur due to earthquakes or heavy rainfall, and sinkholes associated with the limestone karst.

Andersen AFB is located on the northeastern portion of Guam's uplifted limestone (karst) plateau. There are no earthquake fault zones within Andersen AFB. However, there is a minor earthquake fault zone approximately 1 mile west of the proposed project area in MSA 1 (DON, 2015a). MSA 1 is located in an area with low landslide potential and is not located in an area subject to tsunamis (DON, 2015a). Basic design standards for construction in northern Guam, munitions storage facilities in general, and munitions storage igloos specifically would be followed. Geotechnical conditions would be investigated and integrated into project design (see Section 2.1.4, *Design Standards*).

3.3.2.3 Soils

The soil in MSA 1 is classified by the U.S. Department of Agriculture as "Urban Land Complex" due to previous disturbance for military purposes. Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils best suited to producing food, seed, forage, fiber and oilseed crops, are favorable for economic production and sustained high yield, and require minimal inputs of energy and result in the least damage to the environment (DON, 2015a). The soil underlying MSA 1 is not identified as prime farmland by the U.S. Department of Agriculture (DON, 2015a).

3.3.3 Environmental Consequences

Geological resources are analyzed in terms of drainage, erosion, prime farmland, land subsidence, and seismic activity. The analysis of topography and soils focuses on the area of soils that would be disturbed, the potential for erosion of soils from construction areas, and the potential for eroded soils to become pollutants in downstream surface water during storm events. The analysis also examines potential impacts related to seismic events. BMPs are identified to minimize soil impacts and prevent or control pollutant releases into stormwater. The potentially affected environment for geological resources is limited to lands that would be disturbed by any proposed facility development or demolition.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline geology, topography, or soils. Therefore, no significant impacts to geological resources would occur with implementation of the No Action Alternative.

3.3.3.2 Alternative 1

The study area encompasses the proposed construction and ground disturbance areas related to Alternative 1.

As listed in Table 2-1, Alternative 1 would involve disturbance of 51 acres. Under existing conditions, there are 19.3 acres of impervious surfaces in the Alternative 1 Project area. Upon completion, there would be 38.6 acres of impervious surface in the project area. With Alternative 1, construction of the new Hayman style ECMs and associated support facilities would include clearing and grubbing, grading, roadway improvements, excavation, utility line trenching, and landscaping. Construction fill material would be obtained from an established borrow location on Andersen AFB.

The near-level limestone plateau where the work would occur does not have substantial grade changes such as steep hills or canyons that would be leveled or filled. In addition, cut and fill volumes generated during construction would be relatively balanced. For these reasons, only relatively minor changes in grade are anticipated to provide a buildable surface to construct the ECMs and improve the roadways associated with Alternative 1. The limestone karst underlying Andersen AFB is subject to the formation of sinkholes. Known sinkholes in the project area would be avoided. Construction of Alternative 1 would not involve major elevation changes, substantially alter the surrounding landscape, affect important geologic features, or diminish slope stability.

The potential geologic hazards associated with slope instability and liquefaction are minimal at Andersen AFB MSA 1. Potential structural damage or injuries during operations from seismic ground-shaking and fault rupture during an earthquake would be minimized by adherence to UFC 3-310-04, *Seismic Design of Buildings*, Change 1 dated June 20, 2016 (USACE, 2016). Therefore, impacts with respect to seismic hazards would be less than significant.

There is a potential for increased erosion, compaction, and soil loss from physical disturbance during construction activity. However, project design and construction would incorporate engineering controls as BMPs to minimize erosion. Examples of such engineering controls include:

- Use of drainage diversion and control to direct stormwater flow away from construction sites
- Limiting the size of the unstabilized disturbed areas for each project phase to less than 20 acres during construction

Percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. The percolation basins would meet the requirements of UFC 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

There is no prime farmland in the Alternative 1 project area, so implementation of Alternative 1 would have no impact on prime farmland.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. There would be no further soil disturbance or other effects on geological resources.

Given the minimal changes to topography, the use of engineering controls and BMPs to minimize erosion during construction, the incorporation of stormwater management in project design and construction, implementation of the Alternative 1 would not result in significant impacts with respect to seismic hazards and geological resources.

3.3.3.3 Alternative 2

The study area encompasses the proposed construction and ground disturbance areas related to the Alternative 2.

As listed in Table 2-2, Alternative 2 would involve disturbance of 50 acres, 18 acres of which would be existing impervious surface. Under existing conditions, there are 17.9 acres of impervious surfaces in the Alternative 2 Project area. Upon completion, there would be 36.1 acres of impervious surface in the project area.

Similar to Alternative 1, only relatively minor changes in grade are anticipated to provide a buildable surface for construction of the ECMs and roadway improvements with Alternative 2. Construction fill material would be obtained from an established borrow location on Andersen AFB. In addition, cut and fill volumes generated during construction would be relatively balanced. Localized high karst outcrops would be avoided in the project design phase. Because construction activities under Alternative 2 would not involve major elevation changes, Alternative 2 would not substantially alter the surrounding landscape, affect important geologic features, or diminish slope stability. Under Alternative 2, similar construction activities would take place as under Alternative 1, in similar geologic, soil, and seismic conditions. However, new ground disturbance would be less than under Alternative 2 since 30 existing ECMs would be demolished before construction of the 48 new ECMs. No prime farmland is identified within the Alternative 2 project footprint, thus there would be no impact to prime farmland soil.

As described for Alternative 1, project design and construction for Alternative 2 would incorporate engineering controls as BMPs to minimize erosion. The same construction BMPs described for Alternative 1 would be implemented for Alternative 2.

As with Alternative 1, percolation basins would be constructed between the new ECMS to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. The percolation basins would meet the requirements of UFC 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

Potential structural damage or injuries during operations from seismic ground-shaking and fault rupture during an earthquake would be minimized by adherence to UFC 3-310-04, *Seismic Design of Buildings*, with Change 1, dated June 2016 (USACE 2016). Therefore, impacts with respect to seismic hazards would be less than significant.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. There would be no further soil disturbance or other effects on geological resources.

Given the minimal changes to topography, the use of engineering controls and BMPs to minimize erosion during construction, the incorporation of stormwater management in project design and construction, implementation of Alternative 2 would not result in significant impacts with respect to seismic hazards and geological resources.

3.4 Cultural Resources

Cultural resources include prehistoric or historic archaeological sites, buildings, structures, districts, or other places or objects considered important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources can be divided into three major categories:

- Archaeological sites are locations where past human activity measurably altered the earth, left deposits of physical remains, or created measurably modified landscapes.
- Architectural resources include standing buildings, structures, l, and other built-environment resources of historic significance.
- Traditional cultural properties may include archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that traditional Chamorro or other groups consider essential for the preservation of traditional culture.

3.4.1 Regulatory Setting

Cultural resources are protected and identified under several federal laws and executive orders. Federal laws include the NHPA (1966), the Archaeological and Historic Preservation Act (1974), and the Archaeological Resources Protection Act (1979). Cultural resources may also be covered by state, local, and territorial laws.

Federal agencies' responsibility for protecting significant cultural resources is defined primarily by sections 106 and 110 of the NHPA. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties. Historic properties are defined by 36 CFR § 800.16 as any prehistoric or historic district, site, building, structure, or object (per Part 800) included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). Section 110 of the NHPA requires federal agencies to establish—in conjunction with the Secretary of the Interior—historic preservation programs for the identification, evaluation, and protection of historic properties.

Program comments are an alternate method for federal agencies to meet their Section 106 obligations. The *Program Comment for World War II and Cold War Era (1939-1974) Ammunitions Storage Facilities* (Advisory Council on Historic Preservation, 2006:1) "provides the Department of Defense (DoD) and its Military Departments with an alternative way to comply with their responsibilities under Section 106 of the National Historic Preservation Act with regard to the effect of the following management actions on World War II and Cold War Era ammunition storage facilities that may be eligible for listing on the National Register of Historic Properties ongoing operations, maintenance and repair, rehabilitation, renovation, mothballing, cessation of maintenance, new construction, demolition, deconstruction and salvage, remediation activities, and transfer, sale, lease, and closure of such facilities." Under the Program Comment, Section 106 review is considered to be complete for ammunition storage facilities built from 1939-1974 that are identified by a DOD Category Group (2 digit) code of 42, Ammunition Storage. The Program Comment does not apply to ammunition storage facilities in historic districts "where the ammunition storage facility is a contributing element of the district and the proposed undertaking has the potential to adversely affect such historic district. This third exclusion does not

apply to historic districts that are made up solely of ammunition storage facility properties" (Advisory Council on Historic Preservation, 2006:4).

3.4.2 Affected Environment

The area of potential effect (APE) for cultural resources is the geographic area or areas within which an undertaking (project, activity, program, or practice) may directly or indirectly cause alterations in the character or use of historic properties (§800.16(d). The APE is influenced by the scale and nature of the undertaking and may be different for various kinds of effects caused by the undertaking. For the Proposed Action, the APE is the potential Munitions Storage Area historic district that includes the footprint of the project area on Andersen AFB. The potential Munitions Storage Area historic district is made up of MSA 1 and MSA 2, totaling approximately 1,372 acres. MSA 1 contains the footprints for Alternative 1 and Alternative 2.

The Navy has conducted nine cultural resource inventories within MSA 1 (Davis, 1983; Dixon and Walker, 2011; Dixon et al., 2017; Hokanson et al., 2008; Hunter-Anderson and Moore, 2003; Defant and Leon Guerrero, 2006; Mason Architects, Inc., 2004; Yee et al., 2004). One archaeological survey (Defant and Leon Guerrero, 2006) partially overlapped the Alternative 1 footprint. Dixon et al. (2017) conducted an intensive archaeological survey of the remaining portions of the Alternative 1 footprint and all of the Alternative 2 footprint. The other previous surveys covered areas adjacent to but not within the footprints of Alternative 1 and 2. A 2004 architectural survey (Mason Architects, Inc., 2004) covered most of MSA 1 and 2, but focused on architectural resources only. In 2017, a survey of architectural resources within MSA 1 and MSA 2 (Dixon et al., 2017) was conducted in order to provide data for this analysis.

3.4.2.1 Archaeological Resources

NRHP criteria to categorize sites are listed below:

- A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history
- B = eligible because they are associated with the lives of significant persons
- C = eligible because they embody the distinctive characteristics of a type, period, or method of construction
- D = eligible for potential to yield information important in prehistory or history

Sixteen archaeological sites are located within MSA 1 (Table 3-4). These sites include Latte Period ceramic scatters, Latte Period artifact scatters, Post World War II (WW II)/Second American Territorial artifact scatters, Post WW II/Second American Territorial Period concrete curbs and slabs, and a Spanish Colonial Period oven. Of these 16 sites, 11 are eligible for listing in the NRHP under Criterion D (have yielded or may be likely to yield, information important in history or prehistory) (Aguon, 2005; Defant and Leon Guerrero, 2006; Dixon and Walker, 2011; Hokanson et al., 2008; Dixon et al., 2017). One (Site 66-08-2728) is eligible for listing in the NRHP under Criteria A, C, and D (Yee et al., 2004).

Of the sites within MSA 1, three are located within the project footprints. Three eligible sites (66-08-2101, 66-08-2102, 66-08-2922) are located within the Alternative 1 footprint. No eligible sites are located within the Alternative 2 footprint. One eligible archaeological site (66-08-2921) is located adjacent to Alternative 2 but outside the construction footprint.

Table 3-4 Archaeological Resources Located in MSA 1

Site Number	*Site Age*	*Description*	*Reference*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
66-08-2096	Post WW II/Second American Territorial	Concrete Slab	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	No
66-08-2097	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	No
66-08-2098	Post WW II/Second American Territorial	Concrete curb	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	No
66-08-2099	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	No
66-08-2100[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	Alternative 1
66-08-2101[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	Alternative 1
66-08-2102[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	Alternative 1
66-08-2103[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	Alternative 1
66-08-2155	Latte	Artifact Scatter	Hokanson et al., 2008	Eligible under D	No
66-08-2156	Latte	Artifact Scatter	Hokanson et al., 2008	Eligible under D	No
66-08-2728	Spanish Colonial	Spanish Oven	Yee et al., 2004	Eligible under A,C,D	No
66-08-2913	Latte	Ceramic Scatter	Dixon and Walker, 2011	Eligible under D	No
66-08-2914	Latte, Post WW II/Second American Territorial	Artifact Scatters	Dixon and Walker, 2011	Eligible under D	No
66-08-2915	Latte	Ceramic Scatter	Dixon and Walker, 2011	Eligible under D	No
66-08-2921	Latte	Ceramic Scatter	Dixon et al., 2017	Eligible under D	No
66-08-2922	Latte	Ceramic Scatter	Dixon et al., 2017	Eligible under D	Alternative 1

Notes: * NRHP criteria for significance contained in Federal Regulation 36 CFR 60.4: A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history; B = eligible because they are associated with the lives of significant persons; C = eligible because they embody the distinctive characteristics of a type, period, or method of construction; D = eligible for potential to yield information important in prehistory or history.

3.4.2.2 Architectural Resources

The APE for architectural properties includes the entire potential MSA Historic District (MSA 1 and MSA 2). This potential historic district was first identified by Mason Architects, Inc. (2004) and recommended eligible for listing in the NRHP under Criterion A and C. The 2004 study defined the district as including "the various types of storage igloos" on MSA 1 and MSA 2. Because this project has the potential to impact buildings that are part of this district, the entire proposed district was considered in this analysis. A 2017 architectural history study of MSA 1 and MSA 2 (Dixon et al., 2017) assessed the conditions and significance of 174 architectural resources located within MSA 1 and MSA 2, including all architectural resources in Alternative 1 and Alternative 2 (Table 3-5). All of the architectural resources in Alternatives 1 and 2 were evaluated as not eligible for listing in the NRHP. The study also found that none of the facilities in MSA 1 met any NRHP criteria and were not individually eligible for the NRHP. MSA 1 was analyzed as a historic district, and the study found that a district comprising MSA 1 facilities did not meet any NRHP criteria and was not eligible for the NRHP. In accordance with the *Program Comment for World War II and Cold War Era (1939 – 1974) Ammunition Storage Facilities* (Advisory Council on Historic Preservation, 2006), the Air Force/Navy has no further obligations under Section 106 regarding the igloos in Alternatives 1 and 2.

In MSA 2, the same study found the igloos (Types 4 and 5) and Facility 51150 to be eligible for the NRHP under Criterion A for their associations with Strategic Air Command's Cold War era nuclear program. Type 4 igloos and Facility 51150 are also eligible under NRHP Criterion C for their specialized designs that were specific to their direct roles in supporting Strategic Air Command's program. Furthermore, a historic district comprising the individually eligible structures and secondary supporting structures is eligible under NRHP Criterion A. The boundary of the district encompasses the fenced area of MSA 2, which historically encompassed the Ordnance Storage Area.

3.4.2.3 Traditional Cultural Properties

No traditional cultural properties (TCPs) are found within the project area (Welch and Prasad, 2006).

3.4.3 Environmental Consequences

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment that contribute to the importance of the resource, introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting), or neglecting the resource to the extent that it deteriorates or is destroyed.

3.4.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to cultural resources. Therefore, no significant impacts to cultural resources would occur with implementation of the No Action Alternative.

Table 3-5 Architectural Resources in the Area of Potential Effects

Facility Number	*Type*	*Date*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
8200, 8202, 8204	Storage Magazine	1955	Not eligible	Yes
8400-8403	Storage Igloo 87.6 square meters (943 square feet) (TYPE 1)	1953	Not eligible	Yes
8404, 8405, 8406, 8407, 8408-8416[2]	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1953	Not eligible	Yes
8463-8470[2], 8471-8479	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1953	Not eligible	Yes
8500-8503 8504-8516[2]	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8600-8616	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8617-8630, 8631[1]	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1954	Not eligible	Yes
8700-8713	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1954	Not eligible	Yes
8714-8715	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8716-8729 8730[1]	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1955	Not eligible	Yes
9000	Munitions Maintenance Administration Building	1952	Not eligible	Yes
9001/66-08-2923	Munitions Production Mobility and Training	1955	Not eligible	Yes
9002	36th Munitions Squadron Building	1955	Not eligible	Yes
9020, 9022, 9024, 9026, 9028, 9030, 9032	Storage Magazine	1954	Not eligible	Yes
9034/66-08-2924	Storage Building (Surveillance and inspection Building)	1953	Not eligible	Yes
9040	Fabrication Shop (Renovation Shop Building)	1953	Not eligible	Yes
9041/66-08-2925	Inert Storage (Renovation Shop Building)	1953	Not eligible	Yes
51000/66-08-2926	Sentry House	1953	Contributor to MSA 2 Historic District	Yes
51104	WRM Storage Facility	1953	Not eligible	Yes
51110	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes
51112	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes

Table 3-5 Architectural Resources in the Area of Potential Effects

Facility Number	*Type*	*Date*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
51114	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes
51150	Munitions Support Equipment Maintenance	1953	Eligible (A and C); Contributor to MSA 2 Historic District	Yes
51175/66-08-2927	Station 7	1948	Not eligible; Noncontributing to MSA 2 Historic District	Yes
51250, 51254, 51265	Storage Igloo 70.6 square meters (760 square feet) (TYPE 4)	1953	Eligible under A and C; Contributor to MSA 2 Historic District	Yes
51253, 51255, 51257, 51259, 51261	Storage Igloo 200.2 square meters (2,155 square feet) (TYPE 5)	1956	Eligible under A; Contributor to MSA 2 Historic District	Yes
51256, 51258, 51260, 51262, 51264	Storage Igloo 200.2 square meters (2,155 square feet) (TYPE 5)	1953	Eligible under A; Contributor to MSA 2 Historic District	Yes

Notes: Structures less than 50 years old are not eligible except under specific circumstances.
* NRHP criteria for significance contained in Federal Regulation 36 CFR 60.4: A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history; B = eligible because they are associated with the lives of significant persons; C = eligible because they embody the distinctive characteristics of a type, period, or method of construction; D = eligible for potential to yield information important in prehistory or history.
[1] Within Alternative 1.
[2] Within Alternative 2.

3.4.3.2 Alternative 1

Alternative 1 would involve the disturbance of 51 acres, 19 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. Depth of construction is anticipated to vary between 2 to 5 feet below ground surface for road and facility construction. Vegetation is dense in the undeveloped space and would require clearance. Existing access roads within Alternative 1 would be removed and replaced, and new utilities would be constructed. No demolition of existing facilities would be required.

Analyses from the architectural survey in 2017 (Dixon et al., 2017) do not support a historic district made up of structures within MSA 1. In accordance with the *Program Comment for World War II and Cold War Era (1939 – 1974) Ammunition Storage Facilities* (Advisory Council on Historic Preservation,

2006), the Air Force/Navy has no further obligations under Section 106 regarding the igloos in Alternatives 1 and 2. In addition, only two architectural resources (Facilities 8631 and 8730) are located within Alternative 1. Both are ineligible, for listing in the NRHP, and these two facilities would not be demolished or modified. Therefore, no impacts would occur either to eligible architectural resources or to historic properties made up of either individual structures or a historic district.

Three archaeological sites found within the footprint of Alternative 1 (66-08-2101, 66-08-2102, 66-08-2922) are Latte Period ceramic scatters eligible for listing in the NRHP, and one (66-08-2103) is a Latte Period ceramic scatter ineligible for listing in the NRHP. These sites would be disturbed by vegetation clearance and the construction of the munitions storage facilities. Though Site 66-08-2103 is ineligible for listing in the NRHP, the provision of the Final Integrated Cultural Resource Management Plan (ICRMP) for Andersen AFB would be followed (Andersen AFB, 2003) if inadvertent discoveries occur during construction. Sites 66-08-2100 (ineligible), 66-08-2101, and 66-08-2922 would have adverse effects minimized through avoidance by altering plans to omit the igloo that coincides with that location and by altering the path of proposed utility lines. Site 66-08-2102, which falls under the footprint of three igloos, would have adverse effects minimized through archaeological data recovery. The proposed mitigation measure is a data recovery plan to be submitted to the Guam SHPO and the work executed prior to the onset of construction (see Appendix D). The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D). If archaeological resources are inadvertently discovered during ground-disturbing activities, then the ICRMP Standard Operating Procedures would be followed, as well as the provisions of the 36 CFR 800.13 Post Review Discovery. Human remains encountered during these excavations or in association with any of the project's construction activities would trigger ICRMP Standard Operating Procedures and would require further consultation with the Guam SHPO.

The Air Force initiated consultation under Section 106 of NHPA in April 2018 (Andersen AFB, 2018). This consultation indicated that Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the NRHP and that there would be no adverse effect to these sites if proposed measures are followed. The Guam SHPO concurred with the Section 106 request on 3 May 2018, subject to an archaeological data recovery plan (see Appendix D). The USAF submitted the data recovery plan to the Guam SHPO addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D). Implementation of Alternative 1 would result in no adverse effect to historic properties, so impacts would be less than significant.

3.4.3.3 Alternative 2

Alternative 2 would involve the disturbance of 50 acres, 18 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. Thirty existing ECMs would be demolished as part of this action. The 30 existing ECMs were constructed in the 1950s and are not considered to be eligible for listing in the NRHP. These structures are also covered under the *Program Comment for World War II and Cold War Era Ammunitions Storage Facilities* (Advisory Council on Historic Preservation, 2006). Analyses from the architectural survey in 2017 (Dixon et al., 2017) do not support a historic district made up of structures within MSA 1. Therefore, no impacts would occur to historic properties made up of either individual structures or a historic district.

No eligible archaeological sites are located within the Alternative 2 footprint. One eligible archaeological site (66-08-2921) is located adjacent to Alternative 2, but outside of the construction footprint, and would be avoided. The procedures for inadvertent discoveries of archaeological resources or human

remains specified for Alternative 1 would be implemented for Alternative 2. Implementation of Alternative 2 would result in no adverse effects to archaeological sites.

Therefore, implementation of Alternative 2 would not result in a significant direct impact to historic properties consisting of archaeological resources, architectural properties, or TCPs.

3.5 Biological Resources

Biological resources include native and naturalized plant and animal species and the habitats in which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

Within this EA, biological resources are divided into two major categories: (1) terrestrial vegetation and (2) terrestrial wildlife. Special-status species, including threatened and endangered species, are discussed within the corresponding sections.

3.5.1 Regulatory Setting

Special-status species, for the purposes of this assessment, are those species listed as threatened or endangered under the Federal ESA and Guam ESA, and species afforded federal protection under the Migratory Bird Treaty Act (MBTA) (Title 16 U.S.C. Section 703).

The purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. It is administered by the U.S. Fish and Wildlife Service (Service) for terrestrial and freshwater organisms. Section 7 of the federal ESA requires federal agencies to use their legal authorities to promote the conservation purposes of the ESA and to consult with the USFWS or National Oceanic and Atmospheric Administration (NOAA) Fisheries, as appropriate, to ensure that effects of actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of designated critical habitat. The USAF submitted a Biological Assessment to the USFWS and requested formal consultation in October 2018 under Section 7 of the ESA regarding Alternative 1 (the Preferred Alternative). Formal consultation was initiated on 8 November 2018. The USAF submitted a revised Biological Assessment to the USFWS on 21 April 2020. The USFWS issued a signed Biological Opinion on 1 July 2020 concurring with the conclusions of the revised Biological Assessment and identifying BMPs and conservation measures to avoid and minimize potential effects to ESA-listed species (see Appendix C). The Biological Opinion conclusion is that: a) the Proposed Action is not likely to jeopardize the continued existence of the Mariana fruit bat (*Pteropus mariannus mariannus*), *Cycas micronesica,* or *Tabernaemontana rotensis*, and b) there is no designated critical habitat within the action area, so there would be no effect to critical habitat. The Biological Opinion also supports the DOD's compliance with Section 102 of NEPA mandating that appropriate consideration be given to environmental resources impacted by the Preferred Alternative presented in this EA.

The Guam National Wildlife Refuge (NWR) was established in 1993 by a Memorandum of Understanding between the USFWS, Navy, USAF, and GovGuam (GovGuam et al., 1993). Cooperative Agreements were signed in 1994 to establish the Overlay Refuge and define the management, administrative roles, and responsibilities (DON and USFWS, 1994; Air Force and USFWS, 1994) (Figure 3-1). The 1994 Cooperative Agreements provide a commitment by the Navy, Air Force, and USFWS for a coordinated program centered on the protection of threatened and endangered species and other native flora and fauna,

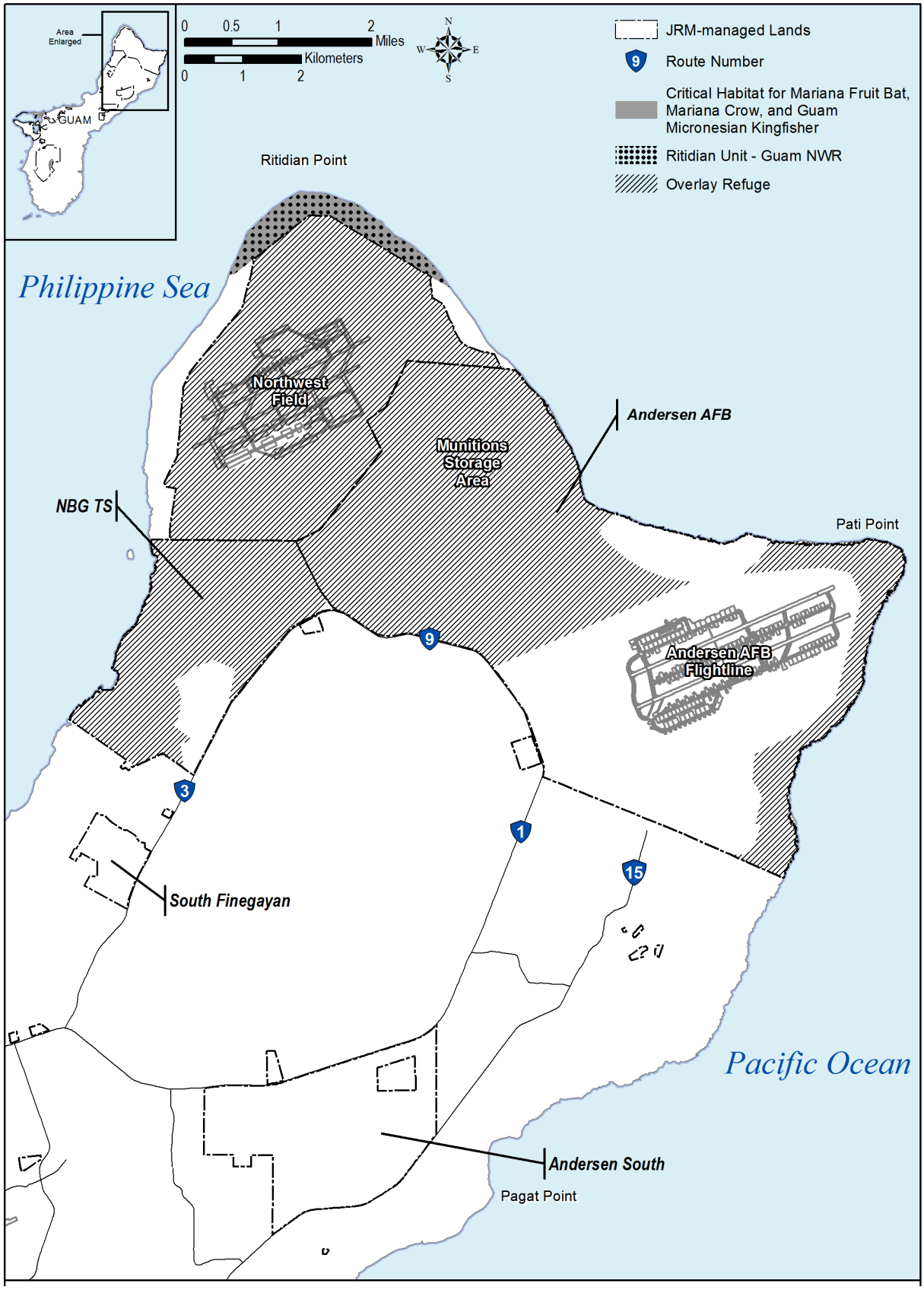


Figure 3-1 Overlay Refuge Lands and Critical Habitat – Northern Guam

maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR), recognizing that the primary purpose of lands within the Overlay Refuge is to support the national defense missions of the Navy and Air Force. Excess military land at Ritidian Point was then transferred to USFWS under the federal excess property regulations for inclusion in the Guam NWR as the Ritidian Unit.

The Guam NWR is comprised of three units: the Ritidian Unit, the Andersen AFB Overlay Unit, and the Navy Overlay Unit. The Ritidian Unit is located on the northern tip of Guam and encompasses 1,217 acres, including 385 acres of terrestrial lands and 832 acres of submerged lands (USFWS, 2009b). The Andersen AFB and Navy overlay units are collectively referred to as Overlay Refuge lands and total 21,693 acres. The Andersen AFB Overlay Unit covers approximately 10,159 acres and the Navy Overlay Unit covers approximately 11,534 acres (see Figure 3-1).

In 2004, the USFWS designated 376 acres of land as critical habitat under the ESA for the Guam Micronesian kingfisher (*Todiramphus cinnamominus*), Mariana crow (*Corvus kubaryi*), and Mariana fruit bat on the Ritidian Unit of the Guam NWR (USFWS, 2004). Overlay Refuge lands were excluded from this designation in northern and southern Guam. Air Force lands were excluded under Section 4(a)(3) of the ESA based on the Air Force's 2003 INRMP for Andersen AFB. The DON lands were excluded under Section 4(b)(2) of the ESA based on a determination by the Secretary of the Interior that the benefits of excluding these lands, including benefits to national security and existing management plans and conservation efforts, outweighed the benefits of designating them as critical habitat. The 376 terrestrial acres of the Guam NWR (Ritidian Unit) is the only designated critical habitat on Guam.

Birds, both migratory and most native resident species, are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. Under the MBTA (Title 16 U.S.C. Section 703), it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess migratory birds or their nests or eggs at any time, unless permitted by regulation.

The 2003 National Defense Authorization Act (50 CFR 21) gives the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from incidentally taking migratory birds during authorized military readiness activities. In this Act, congress defined military readiness activities as all training and operations of the armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (a) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (b) the operation of industrial activities; and (c) the construction or demolition of facilities used for a purpose described in a or b (50 CFR 21). The 2003 National Defense Authorization Act includes a requirement that the DOD must confer with the USFWS while developing and implementing appropriate conservation measures to minimize or mitigate the adverse effects of a military readiness activity, if the activity is predicted to have a significant adverse effect on a population of migratory birds. The Proposed Action addressed in this EA, however, is not a military readiness activity. Migratory bird conservation relative to military activities not necessary for military readiness is addressed separately in a 2006 Memorandum of Understanding developed in accordance with EO 13186.

Biosecurity measures described in the Regional Biosecurity Plan for Micronesia and Hawaii are designed to reduce the risk of introducing invasive species on Guam (DON, 2015c). These accidental but inevitable introductions have the potential to impact terrestrial resources on Guam.

3.5.2 Affected Environment

The following paragraphs provide a description of the existing conditions for each of the categories under biological resources at Andersen AFB MSA I. Threatened and endangered species are discussed within the corresponding sections. The action area for biological resources (called "project area" in other sections of this EA) is defined as all areas that may be affected directly or indirectly and not merely the immediate area involved in the action. It encompasses the geographic extent of environmental changes (i.e., the physical, chemical and biotic effects) that may result directly and indirectly from the Proposed Action. The action area is the area within which the action is likely to produce stressors that have direct or indirect effects to ESA-listed species.

Navy-funded ESA-listed plant surveys were conducted from November 2016 to January 2017 in the entire MSA with focus on the action area for Alternatives 1 and 2. The plant survey targeted ESA-listed plants as well as *Maytenus thompsonii*, the host plant for the endangered and extirpated Mariana wandering butterfly (*Vagrans egistina*), and *Procris pedunculata* and *Elatostema calcareum*, the host plants for the Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*). ESA-listed plants and *Maytenus thompsonii* were flagged and GPS points of their locations were collected. Health of plants was documented and plant life stage (adult or seedling) was noted. Neither *Procris pedunculata* nor *Elatostema calcareum* were observed.

Biologists conducted fauna surveys for species listed under federal ESA, the Guam ESA, and MBTA in the Alternative 2 action area in December 2016 (DON, 2017b). Target species included federal and Guam ESA-listed reptiles and tree snails, federal ESA-listed butterflies, associated tree snail and butterfly host plants, and birds listed under the MBTA. Biologists conducted tree snail surveys from July-September 2019 in the Alternative 1 action area (DON, 2019b). Observations during the November 2016 to January 2017 plant survey in the Alternative 1 action area and other existing data were used to characterize wildlife in that location. Although fauna surveys were not conducted in the Alternative 1 action area, this action area is similar in habitat and adjacent to the Alternative 2 action area and have the same forest composition. These two locations are also contiguous; the Alternative 1 action area, however, contains native limestone forest than the Alternative 2 action area and is less fragmented.

3.5.2.1 Terrestrial Vegetation

Overview

The action area on Andersen AFB consists of old Hayman style munition storage bunkers surrounded by maintained grassy fields and other forested vegetation. The Alternative 1 action area consists of Limestone Degraded Forest, *Vitex* Forest, Developed land, and a very small portion of Coconut Forest, and the Alternative 2 action area consists of *Vitex* Forest and Developed Land (Figure 3-2). However, surveys conducted within the action areas found that the forested vegetation consists of fragmented, degraded limestone forest, with small patches of native limestone forest restricted to areas of tower karst. These two dominant forest types found within the action area are described below. Feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) have highly impacted the forest understory, leaving little to no vegetation, and rooting by pigs has further produced large areas of rutted topsoil.

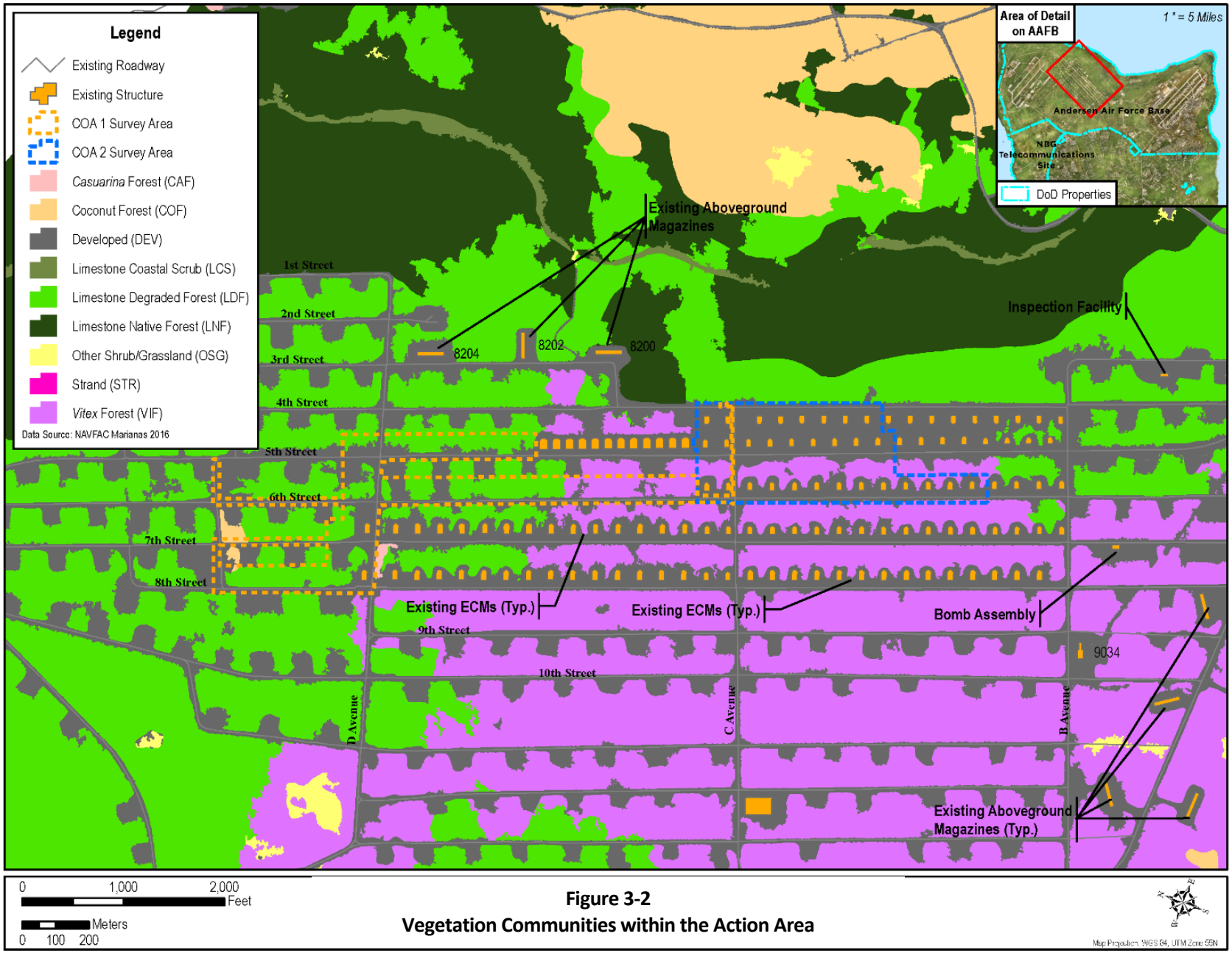


Figure 3-2
Vegetation Communities within the Action Area

MSA I is located at the edge of the northern Guam limestone plateau. The original native limestone vegetation was largely composed of *Artocarpus mariannensis*, *Pandanus tectorius*, and *Ficus* spp., among others. The plateau has historically been impacted by extensive agricultural and military use, which began in the early 1800s, continued during WW II, and continues today (Mueller-Dombois and Fosberg, 1998). Vegetation mapping was conducted on Andersen AFB lands in 2015, which relied on a combination of desktop mapping, aerial imagery, and ground-truthing (DON, 2016). Based on the results of this recent vegetation mapping, the action area is composed of 10.4 acres of *Vitex* forest and 38.9 acres of developed land (see Figure 3-2).

Plants common to limestone degraded forests include *Artocarpus mariannensis*, *Artocarpus altilis*, ironwood (*Casuarina equisetifolia*), *Pandanus tectorius*, *Ochrosia oppositifolia*, *Scaevola sericea*, *Morinda citrifolia*, *Hibiscus tiliaceus*, *Elaeocarpus joga*, *Ficus prolixa*, *Aglaia mariannensis*, *Guamia mariannae*, and *Cycas micronesica*. Native terrestrial ferns are present in the forest understory and include tongue fern (*Pyrrosia lanceolata*), shoestring fern (*Vittaria incurvata*), galak (*Pteris tripartita*), scaly sword fern (*Nephrolepis hirsutula*), and crested elk horn fern (*Polypodium punctatum*) (36 CES/CEVN, 2003). The canopy found in the limestone degraded forests within the two alternative action areas varies from full closure to intermediate with some rock outcrops.

Numerous non-native plant species have become established throughout Guam, including Andersen AFB, and are out-competing native plant species. Invasive non-native species are characterized by rapid growth and rapid seed production. Disturbed areas in MSA I are colonized by introduced species such as bittervine (*Mikania micrantha*), *Momordica charantia*, and wild passion flower (*Passiflora suberosa*). Introduced weedy herbs such as *Chromolaena odorata*, comb bushmint (*Hyptis pectinata*), light blue snakeweed (*Stachytarpheta jamaicensis*), tropical whiteweed (*Ageratum conyzoides*), and romerillo (*Bidens alba*) are frequent as well (36 CES/CEVN, 2003). *Vitex parviflora* is a large, non-native tree that dominates much of the canopy in the action area, out-competing native species that normally colonize limestone soils.

The plant surveys conducted in MSA I found native and degraded limestone forest vegetation types within the Alternative 1 action area (shown in Figure 2 of Appendix F [DON, 2017a]). The native limestone forest was described as generally dense forest dominated by *Guamia mariannae*, *Aglaia mariannensis*, *Eugenia reinwardtiana*, *Eugenia thompsonii*, and *Macaranga thompsonii*. The upper canopy occasionally consisted of natives such as *Ficus prolixa*, *Artocarpus mariannensis*, *Intsia bijuga*, *Elaeocarpus joga* and *Tristiropsis obtusangula*, while the mid-canopy often consisted of natives such as *Premna serratifolia*, *Cynometra ramiflora*, and *Psychotria mariana*. Other native trees occasionally encountered within the Alternative 1 action area included *Guettarda speciosa*, *Dendrocnide latifolia*, *Polyscias grandifolia*, *Drypetes dolichocarpa* and *Maytenus thompsonii*. The degraded limestone forest contained many of the same species as found in native limestone forest, but was described as having a slightly more open canopy cover and was dominated by native trees that are commonly found in disturbed areas (*Guamia mariannae*, *Hibiscus tiliaceus*, and *Ochrosia oppositifolia*). Seven federally and Guam-listed plant species have the potential to occur within the MSA and action area (Table 3-6), but only *Cycas micronesica* and *Tabernaemontana rotensis* were observed within the Alternative 1 action area (Appendix C) (Figure 3-3) (DON, 2017a).

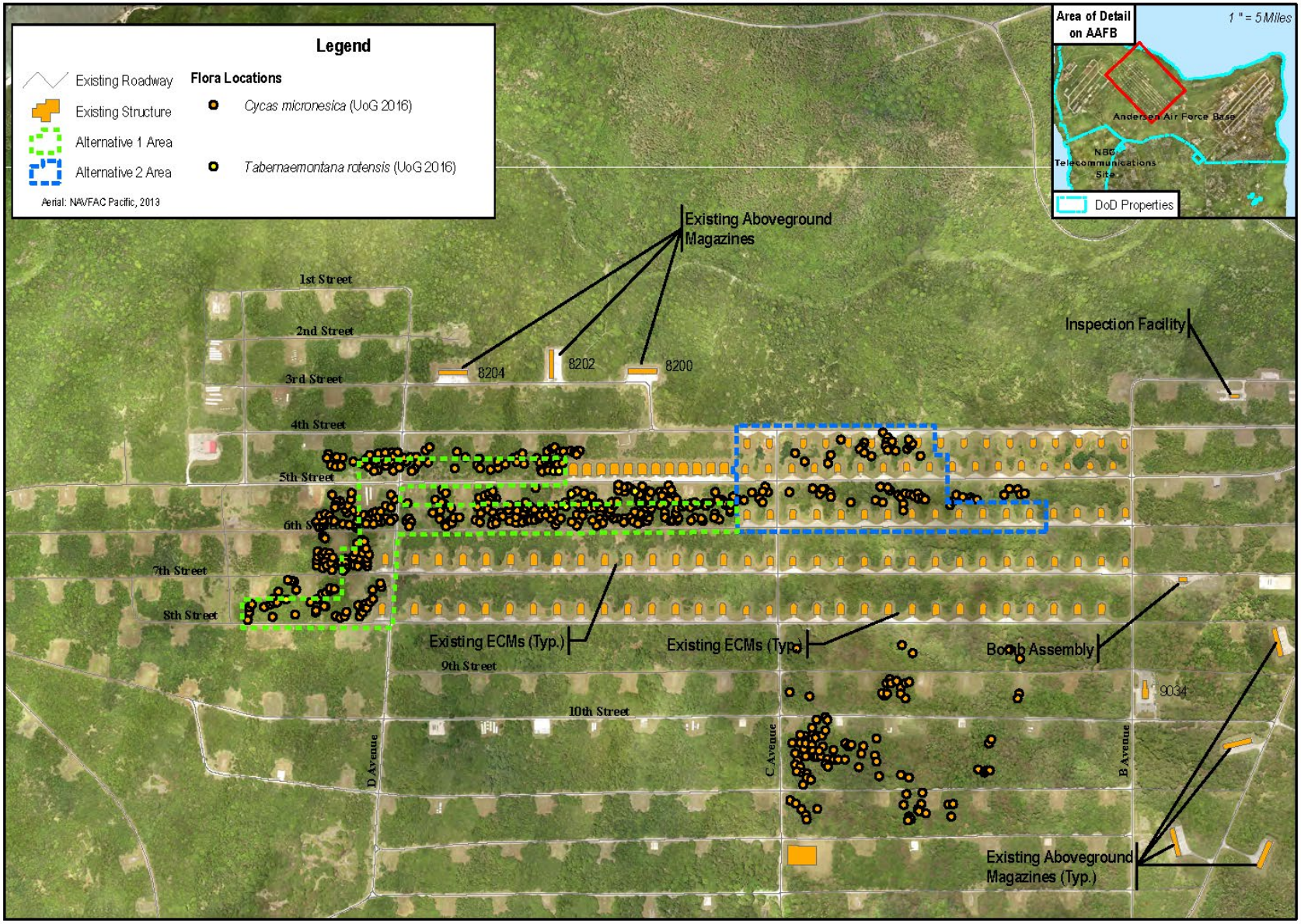


Figure 3-3
Population Counts of Federally Threatened Plant Species Found in the Action Area

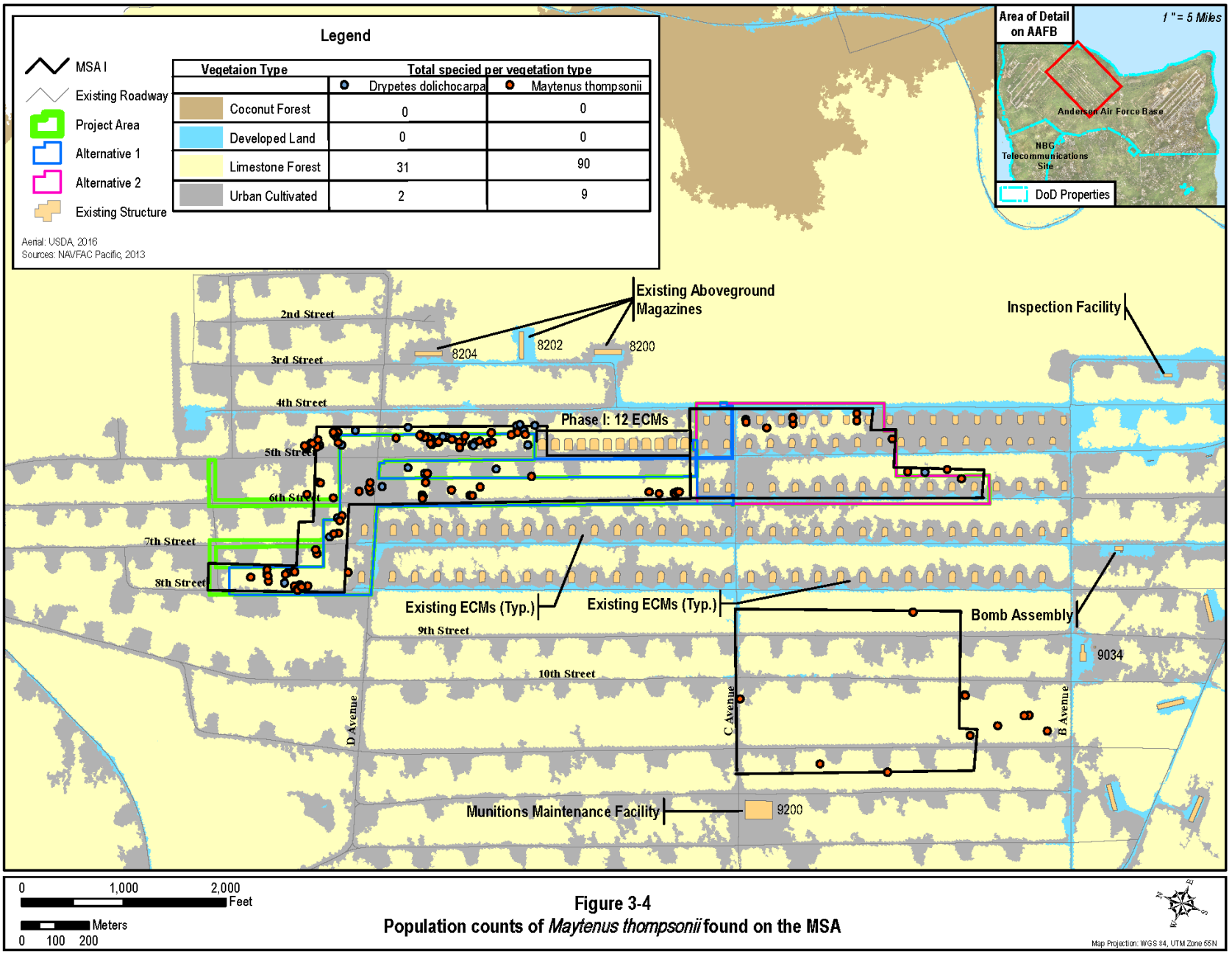


Figure 3-4
Population counts of *Maytenus thompsonii* found on the MSA

Table 3-6 Federally and Guam ESA-listed Species Potentially Occurring within the MSA

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status[2]*	*GovGuam Status[3]*	*Status of Action Area Population[2, 4, 5]*	*Habitat[2, 4, 6, 7]*
Plants					
Fire tree/hayun lago	*Serianthes nelsonii*	E	E	Not present.	Native limestone and ravine forest; edge species.
None/siboyas halumtanu	*Bulbophyllum guamense*	T	--	Not present.	Native forests, especially along clifflines and slopes. Epiphytic.
None/none	*Tuberolabium guamense*	T	--	Not present.	Native forests. Epiphytic.
None/none	*Dendrobium guamense*	T	--	Not present.	Native forests. Epiphytic and lythohytic.
None/Ufa halumtano	*Heritiera longipetiolata*	E	E	Not present.	Limestone cliffs and plateaus.
Cycad/fadang	*Cycas micronesica*	T	T	7,863 individuals occur throughout the entire MSA[8] (473 in Alternative 1, 55 in Alternative 2).	Clay, sand, and limestone soils.
None/none	*Tabernaemontana rotensis*	T	T	542 individuals occur throughout the entire MSA[8] (22 in Alternative 1, 0 in Alternative 2).	Limestone forests.
None/none	*Eugenia bryanii*	E	--	Not present.	Limestone forests.
Mammals					
Mariana fruit bat/fanihi	*Pteropus mariannus mariannus*	T	E	Few individuals known to transit over action area.	Limestone forest, coastal forest, and coconut plantations. Critical habitat on the Ritidian Unit of the Guam NWR. No critical habitat has been designated on DODD lands.
Birds					
Guam rail/ko'ko'	*Gallirallus owstoni*	E	--	Not observed during fauna survey, no longer known to exist in the wild in Guam.	In captivity on Guam, small introduced population on Cocos, introduced population on Rota.
Mariana crow/aga	*Corvus kubaryi*	E	--	Not observed during fauna survey, no longer known to exist in the wild in Guam.	Critical habitat on the Ritidian Unit of the Guam NWR. No critical habitat has been designated on DOD lands.

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status[2]*	*GovGuam Status[3]*	*Status of Action Area Population[2, 4, 5]*	*Habitat[2, 4, 6, 7]*
Micronesian starling/såli	*Aplonis opaca*	--	E	Primarily occurs in urban areas, Andersen AFB, and Cocos Island.	Cavity nester; all habitats but prefers forest.
Reptiles					
Moth skink/ guali'ek kanton tåsi	*Lipinia noctua*	--	E	Not present.	Native limestone forest.
Pacific slender-toed gecko/guali'ek	*Nactus pelagicus*	--	E	Not present.	Forest edge.
Invertebrates					
Humped tree snail/akaleha	*Partula gibba*	E	E	Not present.	Coastal backstrand limestone forest.
Guam tree snail/akaleha	*Partula radiolata*	E	E	Not present.	Coastal backstrand limestone forest.
Fragile tree snail/akaleha	*Samoana fragilis*	E	E	Not present.	Coastal backstrand limestone forest.
Mariana eight-spot butterfly/ababbang	*Hypolimnas octocula marianensis*	E	--	Not observed during fauna survey.	Coastal backstrand limestone forest.

Sources: [1]Chamorro names are from USFWS, 2015a and GovGuam, 2009; [2]USFWS, 2015a; [3]Government of Guam, 2009; [4]Guam Department of Agriculture DAWR, 2015; [5]JRM, 2013; [6]DON, 2015b; [7]Raulerson and Rinehart, 1991; [8]DON, 2017a.

Degraded limestone forest and mixed scrub community were the two vegetation types found within the Alternative 2 action area (DON, 2017a, see Appendix F). Mixed scrub community was described as open and disturbed habitat dominated by the shrubs *Cestrum diurnum* and *Wikstroemia elliptica*. No native limestone forest was found within this area. Seven federally and Guam-listed plant species have the potential to occur within the MSA and the Alternative 2 action area (see Table 3-6), but only *Cycas micronesica* was observed within the action area (Appendix C) (Figure 3-3). Unlike the Alternative 1 action area, *Tabernaemontana rotensis* was not found in the Alternative 2 action area (DON, 2017a, b). Many *Cycus micronesica* found in the Alternative 2 action area were in poor condition, either ravaged by scale and / or found dead (DON, 2017b). While the ESA-listed butterfly host plants *Procris pedunculata* and *Elatostema calcareum* were not seen in the action area, several *Maytenus thompsonii,* the host for the Mariana wandering butterfly, were found to occur within the action area (Figure 3-4).

Summary of Occurrence of ESA-Listed Plant Species

The occurrence of ESA-listed plant species within the MSA is summarized below (DON, 2018b):

- *Cycas micronesica* (threatened). On Guam, there are approximately 516,000 individuals that occur from the shoreline to limestone cliffs (USFWS, 2015b). Vegetation surveys in support of this project identified 7,863 *Cycas micronesica* within the MSA. Approximately 473 *Cycas micronesica* are located within the Alternative 1 action area (UOG, 2017), and 55 *Cycas micronesica* are located within the Alternative 2 action area. Locations of the trees are identified in Figure 3.1. Trees varied in heath with some having damage to the crown and others being healthy.
- *Tabernaemontana rotensis* (threatened). There are seven known locations of this species on Guam and Rota, totaling 22,375 individuals. There are 9 known individuals in one location on Rota, and 6 locations on Guam where the species occur, equaling a range-wide total of 22,384

individuals (DON, 2017a). Vegetation surveys in support of this project identified 542 *Tabernaemontana rotensis* within the MSA, including 22 plants in the Alternative 1 action area (0 individuals were identified in the Alternative 2 action area). Seedlings (44 plants) and mature plants (39 plants) were found in the Alternative 1 action area (UOG, 2017).

3.5.2.2 Terrestrial Wildlife

Wildlife includes all animal species (i.e., mammals, reptiles, birds, and invertebrates) focusing on the species and habitat features of greatest importance or interest.

Mammals

Mariana fruit bat or fanihi (*Pteropus mariannus mariannus*) is the only native mammal species that occurs on Andersen AFB (DON, 2015b; DON, 2017d). As a result of overhunting, habitat loss, and predation by the brown treesnake (*Boiga irregularis*), fruit bat population numbers have substantially decreased since the 1930s (DON, 2017c; USFWS, 2009a).

Introduced feral ungulates, such as the Philippine deer and feral pig, limit recovery of native forest. Feral ungulates impact native vegetation by grazing and rooting, which (1) kills or clears vegetation, (2) prevents native vegetation recolonization, (3) spreads the seeds of introduced plant species, and (4) disturbs soils. Four rodent species are present on base; this includes *Mus musculus* (House mouse) and three introduced rat species (*Rattus norvegicus*, *Rattus diardii*, and *Rattus exulans*). Rodents also have a very detrimental effect on island birds and affect native ecosystems in their consumption of native tree seeds, thus reducing native plant recruitment.

While only a few small mammal surveys have been conducted on Andersen AFB, it is likely that the musk shrew (*Suncus murinus*) occurs within the MSA (Wiles 2005; Wiewel et al. 2009). Feral populations of domesticated animals such as dogs (*Canis lupus familiaris*) and cats (*Felis catus*) occur on Andersen AFB and occur within the MSA. (NAVFAC Marianas 2017a).

Reptiles and Amphibians

Table 3-7 summarizes reptiles and amphibians at Andersen AFB. The brown treesnake was inadvertently introduced to Guam shortly after WW II, probably in cargo and materials. They are a major nocturnal predator of native birds and reptiles on Guam and are thought to be responsible for the near total extinction of the island's forest-dwelling avifauna, as well as severe reductions or extirpation of native reptile species (USFWS, 1990a; Wiles et al., 2003). The introduced and native skinks and geckos, as well as the potentially recent introduction of frog species, sustain the high brown treesnake population levels.

Wildlife surveys conducted in the action area for Alternative 2 at Andersen AFB in December 2016 did not detect any listed wildlife species (DON, 2017b). Two species of skinks and three species of gecko were observed:

- non-native curious skink (*Carlia ailanpalai*)
- native Pacific blue-tailed skink (*Emoia caeruleocauda*)
- native mutilating gecko *(Gehyra mutilata*)
- native mourning gecko (*Lepidodactylus lugubrus*)
- non-native house gecko (*Hemidactylus frenatus*)

- **Table 3-7 Reptiles and Amphibians at Andersen AFB**

Common Name/Chamorro Name[1]	*Scientific Name*	*Residence Status*
Brown treesnake/Kulepbla	*Boiga irregularis*	Non-native
Marine toad or Cane toad/Kairo	*Rhinella* (=*Bufo*) *marina*	Non-native
Curious skink/Gualiek halumtano	*Carlia ailanpalai*	Non-native
Green turtle/Haggan	*Chelonia mydas*	Native
Greenhouse frog/Kairo	*Eleutherodactylus planirostris*	Non-native
Gunther's amoy frog	*Rana guentheri*	Non-native
Pacific blue-tailed skink/Gualiek halumtano	*Emoia caeruleocauda*	Native
Hawksbill turtle/Haggan karai	*Eretmochelys imbricata*	Native
Mutilating gecko/Achiak	*Gehyra mutilata*	Native
House gecko/Achiak	*Hemidactylus frenatus*	Non-native
Mourning gecko/Achiak	*Lepidodactylus lugubris*	Native
Moth skink/Gualiek halumtano	*Lipinia noctua*	Native
Brahminy blind snake/Ulo attilong	*Ramphotyphlops braminus*	Non-native
Monitor lizard/Hilitai	*Varanus tsukamotoi*	Native

Notes: [1] Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clark (2015), Topping et al. (1975), and USFWS (2015a).
Source: DON (2010).

The non-native Brahminy blind snake (*Indotyphlops braminus*) (DON, 2017b) and the naturalized Pacific monitor lizard (*Varanus tsukamotoi*) were also observed.

Birds

Table 3-8 shows bird species recorded at Andersen AFB. Although the forests of Andersen AFB once supported the federally and Guam-listed endangered Mariana crow, Guam Micronesian kingfisher, and Guam rail (*Gallirallus owstoni*), avian populations on Guam were significantly affected by the introduction of the brown treesnake. While the Mariana crow was extirpated from Guam, the Guam rail and the Guam Micronesian kingfisher were extirpated from the wild (DON, 2015b). Captive-bred Guam rail have been introduced to Cocos Island, immediately southwest of Guam, and the CNMI island of Rota (JRM, 2013).

No federal or Guam ESA-listed birds were observed during recent surveys of the Alternative 2 action area (DON, 2017b). Three non-native resident bird species (black drongo [*Dicrurus macrocerus*], island collared dove [*Streptopelia bitorquata*] and black francolin [*Francolinus francolinus*]) and three MBTA-listed species (Pacific golden plover [*Pluvialis fulva*], Pacific reef heron [*Egretta sacra*], and yellow bittern [*Ixobrychus sinensis*]) were recorded (DON, 2017b). White-throated ground dove (*Gallicolumba xanthonura*) have also been sighted occasionally in the action areas (DON, 2017e).

Table 3-8 Bird Species Recorded on Andersen AFB

Common Name/Chamorro Name[1]	*Species*	*Residence Status*	*Listed under MBTA?*
Micronesian starling/Sali	*Aplonis opaca*	Uncommon native breeding resident	N
Yellow bittern/Kakkak	*Ixobrychus sinesis*	Common breeding resident	Y
Ruddy turnstone/Dulili	*Arenaria interpres*	Common non-breeding visitor	Y
Tattler spp.[2]	*Tringa spp.*	Common non-breeding visitor	Y
Wood sandpiper/Dulili	*Tringa glareola*	Common non-breeding visitor	Y
Sharp-tailed sandpiper/Dulili	*Calidris acuminata*	Common non-breeding visitor	Y
Pacific golden plover/Dulili	*Pluvialis fulva*	Common non-breeding visitor	Y
White tern/Chunge	*Gygis candida*	Common breeding resident	Y
Eastern cattle heron/Chuchuko	*Bubulcus coromandus*	Common non-breeding visitor	Y
Pacific reef heron, reef egret/Chuchuko atilong[3]	*Egretta sacra*	Common native breeding resident	Y
Little egret/Chuchuko	*Egretta garzetta*	Uncommon non-breeding visitor	Y
Whimbrel/Kalalang	*Numenius phaeopus*	Uncommon non-breeding visitor	Y
Black-winged stilt/None	*Himantopus himantopus*	Uncommon non-breeding visitor	Y
Ruff/None	*Calidris pugnax*	Uncommon non-breeding visitor	Y
Island collared dove/Palumat	*Streptopelia bitorquata*	Common introduced breeding resident	N
Mariana fruit dove	*Ptilinopus roseicapilla*	Uncommon native visitor	Y
White-throated ground dove	*Gallicolumba xanthonura*	Uncommon native visitor	Y
Black drongo/Salin Taiwan	*Dicrurus macrocercus*	Common introduced breeding resident	N
Black noddy/Fahang Dikike'	*Anous minutus*	Common breeding resident	Y
Brown noddy/Fahang Dankolo	*Anous stolidus*	Common breeding resident	Y
Eurasian tree sparrow/Gagapale	*Passer montanus*	Common introduced breeding resident	N
Great frigate bird/Payaya	*Fregata minor*	Occasional non-breeding resident	Y
Black francolin/None	*Francolinus francolinus*	Common introduced breeding resident	N

Notes: [1] Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clark (2015), Topping et al. (1975), and USFWS (2015a).
[2] Wandering and grey tattlers were combined into one category since they are indistinguishable from each other in non-breeding plumage.
[3] The Pacific reef egret is uncommon.
Sources: NAVFAC Marianas 2013b; DON 2015a.

Invertebrates

Despite the presence of plants commonly associated with tree snails, no native tree snails were observed or are known to occur in the action area. Non-native tree snails observed included the Asian land snail (*Satsuma* sp.) and tropical American lined tree snail (*Drymaeus multilineatus*), as well as weathered white shells of the giant African snail (*Achatina fulica*) and the invasive predator rosy wolf

snail (*Euglandina rosea*). Also seen was the invasive flatworm *Platydemus manokwari*, a known predator of native tree snails on Guam (DON, 2017b).

The coconut rhinoceros beetle (*Oryctes rhinoceros*) was first detected on Guam in the Tumon Bay area 2007 and spread island-wide by 2010 (DON, 2019a). This large scarab beetle is a serious pest to palm trees, including coconut and betelnut, and screwpine trees. The little fire ant (*Wasmannia auropunctata*) was confirmed on Guam in November 2011 (DON, 2019a). However, it is not yet known to occur on Andersen AFB.

Although *Maytenus thompsonii*, the host plant for the endangered and extirpated Mariana wandering butterfly (*Vagrans egistina*) was observed during project surveys, no Mariana wandering butterflies, larvae, or pupae were observed during surveys conducted in December 2016 (see Figure 3-4) (DON, 2017b). Neither the Mariana eight-spot butterfly nor its host plants (*Procris pedunculata* and *Elatostema calcareum*) were observed during surveys of the Alternative 2 action area. The non-native black citrus swallowtail (*Papilio polytes*) and common eggfly (*Hypolimnas bolina*) were abundant in the action area (DON, 2017b).

Summary of ESA-listed Wildlife Species

The ESA-listed wildlife species are summarized below from the DON (2018) Biological Assessment:

- Mariana Fruit Bat (*Pteropus mariannus mariannus*) (threatened). The Guam population of the Mariana fruit bat was listed as endangered in August 1984 (USFWS, 1984) and critical habitat was designated. A Revised Recovery Plan was completed for the species bat in 2009 (USFWS, 2009a) and in 2005, the USFWS down-listed it from endangered to threatened. This decision was based on research indicating that *Pteropus mariannus* is not a subspecies endemic to Guam but is instead endemic to the Mariana archipelago (USFWS, 2005). The Mariana fruit bat is medium-sized compared to other fruit bats, weighing 11.6-20.3 ounces and with a wingspan of 34-42 inches; males are slightly larger than females. The underside is black to brown with interspersed gray hair creating a grizzled appearance. The shoulders and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown (DON, 2017c). Andersen AFB has been conducting base-wide surveys for bats since 2010 using fixed stations, including ones within the MSA (see Appendix C for details). Sightings of bats within the MSA were of individuals transiting through the area; no bats were observed roosting or foraging.

3.5.3 Environmental Consequences

This analysis focuses on wildlife and vegetation types that are important to the function of the ecosystem or are protected under federal or state law or statute. This section presents an analysis of potential direct and indirect effects from implementation of the Proposed Action. Direct effects are the direct or immediate effects on the species or its habitat. Indirect effects are those that are caused by the Proposed Action and would manifest themselves at a later time, but which are still reasonably certain to occur. All direct and indirect project effects have been further classified and evaluated based on their anticipated longevity (i.e., temporary or permanent effects).

As they relate to the federally listed species and suitable habitat considered in this EA, direct and indirect effects from proposed activities within the action area have been evaluated herein based upon: (1) an understanding of the methods and equipment that would be used during construction and operation of facilities, (2) knowledge of the potential for such methods and equipment to disturb the

natural resources on which the subject species depend, and (3) awareness of the types of effects that have resulted from similar actions in the past.

3.5.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no significant impacts to biological resources would occur with implementation of the No Action Alternative.

3.5.3.2 Alternative 1

Alternative 1 would involve the disturbance of 51 acres, 19 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. During site preparation, surface vegetation would be cleared and grubbed (i.e., roots and stumps extracted), and the ground would be excavated for the storage unit flooring. Ground disturbance during construction would include site grading to establish positive drainage control and a perimeter mound to control runoff. Existing access roads within Alternative 1 would be removed and replaced, and new utilities would be constructed, impacting an additional 3.5 acres of pervious surface. Vegetation in this area and in parts of the degraded limestone forest is dense and would require clearance, with approximately 12 acres of currently undisturbed land listed as native limestone forest.

Vegetation

All DON and Air Force construction and operational activities are conducted in accordance with the biosecurity measures in the Regional Biosecurity Plan for Micronesia and Hawaii (DON, 2015c). The DON will follow these measures to ensure the Proposed Action does not introduce invasive species through construction material and equipment potentially coming to Guam. The DON's contractor will develop a Hazard Analysis Critical Control Point plan to ensure that invasive species are not moved or introduced in association with salvage and transplantation efforts. The plan must be approved by the DON prior to the commencement of fieldwork or the field assessment.

Regarding potential impacts to vegetation, short-term adverse effects (during construction) and long-term adverse effects (those lasting into post-construction phase) would be expected. Though parts of Alternative 1 would take place in areas that have been previously modified, the native and degraded limestone forest habitat is considered to be of high habitat value since it contains federally and Guam-listed plant species and provides habitat suitable for listed animal species. Loss of this habitat would result in adverse effects to protected species that are known to inhabit the proposed area of construction.

Habitat loss, fragmentation, and degradation are of concern to the vegetation and wildlife species, as is the scale infestation that impacts tree health. Past land management practices and the introduction of invasive species has contributed towards forest degradation. This holds true for the Andersen AFB MSA and proposed project site, where historical use of the MSA has significantly lowered the quality of habitat for *Cycas micronesica* and *Tabernaemontana rotensis*. Alternative 1 would involve the construction of 48 igloos north and west of Phase 1 along 5th, 6th, 7th, and 8th streets (all north of C Avenue) (see Figure 3-2). A maximum of 56.1 acres of vegetation would be removed for Alternative 1 construction (less than 0.5 percent of the total vegetated area of the Guam NWR overlay). Based on data collected during the plant surveys (Appendix F) (DON, 2017a), it is anticipated that up to 22 of the federally threatened *Tabernaemontana rotensis* and 473 of the federally threatened *Cycas micronesica*, as well as 76 *Maytenus thompsonii* trees associated with the federally listed Mariana wandering

butterfly, would be removed during construction under Alternative 1 (see Figures 3-3 and 3-4). Vegetation removal represents 0.094 percent of the *Tabernaemontana rotensis* population on Guam, 0.068 percent of the *Cycas micronesica* population across its native range on Guam, and 0.14 percent of the cycads on Guam (see Appendix C). The DON has proposed to replace a minimum of six genetically distinct *Tabernaemontana rotensis*, grown from seeds or cuttings and planted in up to five vegetation plots on Andersen AFB. Accounting for the replacement of these six individuals the population-wide reduction is reduced to 0.070 percent. Considering just the cycads in good condition on Guam, the population-wide reduction is reduced to 0.067 percent.

Trees that are identified in the Native Forest Birds of Guam and Rota Recovery Plan (USFWS, 1990a) and the Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan (USFWS, 1990b) as trees associated with protected species that could be removed include *Aglaia mariannensis*, *Ficus microcarpa*, and *Ficus prolixa* (USFWS, 1990a,b; USFWS, 2009a). Removal of native vegetation in the area designated for Alternative 1 construction would have a direct adverse effect on the habitat used by Guam's endangered species by reducing forest habitat available for roosting and foraging.

The Alternative 1 action may affect, and is likely to adversely affect, *Cycas micronesica* and *Tabernaemontana rotensis*. The proposed mitigation measures are the conservation measures in the Biological Opinion that would reduce the impacts to *Cycas micronesica* and *Tabernaemontana rotensis* so that significant impacts would not adversely affect the continued existence of the species (see Appendix C). The Biological Opinion also includes BMPS to avoid and minimize impacts to ESA-listed species. The USAF shared these analyses and conclusions during formal consultation with the USFWS under Section 7 of the Endangered Species Act regarding the Preferred Alternative (Appendix C). The USFWS concurred with these conclusions in the signed Biological Opinion.

Terrestrial Wildlife

Terrestrial wildlife has not been recently surveyed in the area located within Alternative 1. This site would be disturbed by vegetation clearance and the construction of the munitions storage facilities. Proposed construction activities would remove vegetative habitat, as previously discussed. Wildlife habitat is fragmented due to previous modifications. All proposed construction and operational activities would be conducted in accordance with the biosecurity measures in the Regional Biosecurity Plan for Micronesia and Hawaii (DON, 2015c). However, construction under Alternative 1 would result in moderate impacts to terrestrial wildlife as a result of the loss of native limestone forest habitat. This native limestone forest makes the Alternative 1 action area better suited to maintaining native wildlife since this native habitat often provides foraging and sheltering conditions important to the survival of native wildlife. Non-native plants may or may not provide this same benefit, and they often allow the establishment of non-native wildlife.

Despite the presence of plants commonly associated with tree snails, native tree snails have not been found in the Alternative 1 action area. Favorable vegetation for Partulid tree snails has been identified, but much of this vegetation is common in degraded limestone forest present across Guam. Therefore, Alternative 1 would have less than significant impacts to tree snails.

Short-term minor adverse effects to wildlife would be expected as a result of construction activity and noise. Ground disturbance and noise from vehicle use or construction is likely to temporarily flush any foraging or resting native birds and fruit bats. However, the DON will conduct pre-construction surveys for nesting MBTA birds. If an active nest is present, vegetation clearing will be kept 100 feet away until birds have fledged or abandoned the nest on their own accord. In addition, as discussed in Section 3.6.5,

the ambient noise environment is characterized by aircraft overflights as well as regular vehicle and operational activities within the MSA, so wildlife are accustomed to noise-generating activities in the Alternative 1 action area. Following construction, no adverse effects would be expected as a result of increased noise.

Management of natural resources on Andersen AFB is covered under the Joint Region Marianas Integrated Natural Resources Management Plan (DON, 2013; DON, 2019a). Components of this plan and the updated revised plan include controlling introduced wildlife species on Andersen AFB for the benefit of native species, particularly protected species. Andersen AFB has depredation programs in place within the MSA and will continue to manage feral ungulates in the area.

Although no Mariana fruit bats have been seen roosting within MSA I, they have been known to occur in the Andersen AFB area and to transit over the action area. Habitat loss and degradation are considered one of the most serious threats to fruit bats in Guam. Adverse effects on this species would be expected primarily as a result of construction activity and noise and secondarily as a result of habitat removal. All the current *Vitex* and limestone forest within the project footprint is considered fruit bat habitat that is poor quality due to past historical impacts and ongoing operations. The impact to 28.7 acres of suitable habitat represents less than 0.09 percent of suitable habitat lost (USFWS 2010). The overall remaining 29,279 acres of bat suitable habitat is large enough to support the remaining population of Mariana fruit bats on Guam, so the reduction in suitable habitat would not reduce the likelihood for recovery of the species. To date, the recovery plan for the species has not been updated to reflect the criteria for determining habitat suitability for recovery of the species.

Noise levels associated with the construction of the 48 new ECM would cause short-term impacts to the species. Typical construction noise is associated with the construction equipment and increased truck and vehicle access to the location. Construction of the ECMs would be done using concrete casting and heavy construction equipment. Construction noise will impact the action area and be audible in the adjacent forest. It is anticipated that Mariana fruit bats would avoid the action area and adjacent sites during construction because of noise disturbance.

Based on these effects, the action is likely to adversely affect the Mariana fruit bat in the form of disturbing foraging bats according to ESA take definitions. The proposed mitigation measures are the conservation measures in the Biological Opinion; implementation of these conservation measures would reduce the impacts to the Mariana fruit bat so that significant impacts would not adversely affect the continued existence of the species. The Biological Opinion also includes BMPs to avoid and minimize impacts to ESA-listed species (see the following subsection and Appendix C for a full list of conservation measures and BMPs identified in the Biological Opinion). Andersen AFB will conduct pre-construction surveys to determine if Mariana fruit bats are present in the project site before construction. If bats are present, construction will be delayed until they have left the site. After construction, noise disturbance will result from ongoing operations at the MSA. As stated above, the impact to suitable habitat represents less than 0.09 percent of suitable habitat lost (USFWS 2010); the overall remaining bat suitable habitat is large enough to support the remaining population of Mariana fruit bats on Guam. Therefore, reduction of suitable habitat would not reduce the likelihood for recovery of the species. The USAF shared these analyses and conclusions during formal consultation with the USFWS under Section 7 of the ESA regarding the Preferred Alternative (Appendix C). The USFWS concurred with these conclusions in the signed Biological Opinion.

Best Management Practices and Conservation Measures

Best Management Practices

Andersen AFB has identified BMPs and designed conservation measures to avoid or minimize impacts to ESA-listed species. These BMPs are typically process improvement activities and are described below and in the Biological Opinion (see Appendix C).

1. To prevent environmental stressors on the listed plants, plant assessments and collection of plant material will be conducted before any construction related vegetation clearing or site preparation. Once all the (plant) material is collected, the DON will approve the site for vegetation clearing or site preparation.
2. ESA-listed plants will be clearly flagged to prevent any unnecessary disturbance from construction within 10 feet of the construction perimeter.
3. During site preparation and prior to any clearing and grubbing of surface vegetation, the construction perimeter will be clearly marked to prevent encroachment into adjacent areas with ESA-listed plants.
4. Silt fences or straw wattles will be used to prevent soil erosion into adjacent areas with ESA-listed plants. Dust screens will be installed at the project boundary if ESA-listed plants are within 10 feet from the project boundary. The dust screens will be used to shield protect, screen, and create a buffer for the ESA-listed plants.
5. DON will implement a contractor education program to ensure contractor personnel are informed of the biological resources in the action area, including invasive species, special-status species, avoidance measures, and reporting requirements in the action area. DON staff will provide the contractors a natural resources orientation with special focus on *Cycas micronesica*, *Tabernaemontana rotensis*, and Mariana fruit bat to ensure construction personnel are aware of these species and avoid inadvertent impacts due to lack of awareness of resource presence, sensitivities, and protective measures (see Appendix C for pamphlets and natural resource training material related to coconut rhinoceros beetle and little fire ant.
6. In areas where noise, light or human activity from construction of the Proposed Action would result in excessive noise, light or human activity above the ambient level, construction contractor personnel will be required to survey within line of sight (up to 492 feet) of construction activities for bats, prior to the start of a day's construction activities. Construction work generating noise, light or human activity above the ambient levels will be postponed until the bat(s) has left the area. The construction contractor will document bat surveys in the daily logs.
7. DON staff will examine the condition of listed plant species within 10 feet of the construction perimeter and document any adverse effects to the plants within that buffer. DON will contact USFWS if new information reveals effects of the action that may adversely affect the listed plants in a manner or to an extent not previously considered. DON will inspect the contractors work to ensure that these BMPs are implemented for the entire duration of the project. DON staff will conduct random, unannounced inspections monthly and document the results in a log.
8. The DON will provide project specific work plans to the USFWS for inclusion in the consultation file.

9. The DON will implement systematic searches for Mariana fruit bat colonies in all areas of suitable habitat within the action area. If a maternity colony is found, the DON will notify the USFWS.

DON will conduct pre-construction surveys for nesting MBTA birds. If an active nest is present, vegetation clearing will be kept 100 feet away until birds have fledged or abandoned the nest on their own accord.

Guam rail and Guam Micronesian kingfisher were not observed during the fauna survey (see Appendix C) and are no longer known to exist in MSA I. With the minimization measures described for reducing and compensating for loss of habitat, Alternative 1 could potentially have minor adverse effects on the future plans for releasing captive-bred Guam rail and Guam Micronesian kingfisher in MSA I.

Conservation Measures to Avoid or Minimize Project Impacts

The Proposed Action's conservation measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. Conservation measures are considered part of the Proposed Action and are vital to determining the scope of the Proposed Action. Implementation of conservation measures is required under the terms of the Proposed Action; they are described below and in the Biological Opinion (see Appendix C).

General Conservation Measures include:

1. An authorized biologist will conduct and oversee all plant Conservation Measures. The authorized biologist must have relevant experience at a comparable level of responsibility in projects of similar size, scope and complexity and must have the following minimum qualifications:
    a. A bachelor's degree with an emphasis in botany, horticulture, ecology, or a related science;
    b. At least 100 documented hours of experience conducting propagation, translocation, transplantation, pest control, and monitoring of the aforementioned species or a closely related species; and
    c. Applicant must provide contact information of three references familiar with their work related to b (above).
2. Prior to salvage, DON's natural resources will conduct surveys for ESA-listed plants to determine the health status of plants that cannot be avoided in the construction footprint. These additional surveys, referred to as pre-construction surveys, will verify the occurrence of federally listed species in the construction footprint and evaluate them for salvage and transplantation. An assessment will be conducted to determine how many individuals can be salvaged through either collection of seeds (*Cycas micronesica* and *Tabernaemontana rotensis*) or basal shoots (*Cycas micronesica*). DON's authorized biologist will pursue seed germination and plant division to meet transplanting success targets.
3. Plant propagation will occur at nurseries that follow the Hawaii Rare Plant Restoration Group "Phytosanitation Standards and Guidelines."
4. All salvaged plants will be transplanted in vegetation plots. Andersen AFB Environmental Flight will choose up to five vegetation plots for the transplantation of salvaged individuals. These

vegetation plots will be mixed native limestone forest with an ungulate-proof fence and ungulate-free. Andersen AFB will choose transplanting locations within habitat suitable to support cycads. The sites must receive environmental approval from the 36 WG Commander prior to award of a contract to conduct the salvage and transplant activities. DON staff will submit the description of the locations to the USFWS once the sites are approved.

5. The DON will maintain the ungulate fences around these plots and conduct weed removal (mechanically, manually, or by herbicide) to enhance the existing native forest. Invasive species within a 20-foot radius around salvaged plants will be removed and maintained to ensure no more that 15 percent of vegetation is invasive species.
6. The DON will submit an annual report to the USFWS one year after the Biological Opinion is issued and each year thereafter until the project and associated conservation measures are complete. The conservation measures will be complete once the number of plants meeting the success criteria, defined in the DON's Biological Assessment, has been achieved. The report will summarize the type of activities (e.g., health status of plants, propagation, transplantation, etc.) conducted on each species and the status of transplantation efforts. It will include the number of cycad basal shoots and seeds collected from each healthy adult, mature cycad and the number of *Tabernaemontana rotensis* seeds collected, propagation methods (number seeds germinated), survival rate, and the number of plants meeting the success criteria. The DON will also include information on bat monitoring within line of sight (up to 492 feet) of construction activities.
7. If it is determined that a contractor has violated any of the Navy's proposed conservation measures, the DON will provide an on-site biological monitor during all further construction actions to ensure no further incidents occur.

The following conservation measures are specific to the action and promote the continued existence of *Cycas micronesica* and *Tabernaemontana rotensis*. These conservation measures are meant to offset the effects of forest clearing and removal of plants in the construction site.

The DON has proposed the following methods for salvage, propagation, and outplanting of *Cycas micronesica*:

1. Efforts will be made to salvage as many cycad basal shoots as possible that are deemed healthy and suitable for salvage. Cycad basal shoot health is based on a variety of factors including extent of cycad aulacaspis scale (*Aulacaspis yasumatsui*). infestation/damage and current health condition of the parent plant.
2. Basal shoots that are approximately 1.7 inches in diameter (golf ball size) and larger will be considered for salvage (EA Engineering 2019).
3. Prior to salvage of the basal shoots, pesticides will be applied to treat cycad scale and *Chilades pandava* (cycad blue butterfly) larvae.
4. Cycads will be visually inspected for little fire ants before salvage and transplant. If little fire ants are observed, Little Fire Ant Management Procedures will be followed (see Appendix A in the Biological Assessment).
5. Basal shoots will be removed from the main trunk to maintain as much of the root mass as possible. All pups will be placed in an appropriate pot for the pup's size and promote drainage.

6. Basal shoots will be tagged prior to removal from the parent plant. The tags will consist of a unique alphanumeric aluminum tag, which will be secured to the individual pots.
7. A pressure washer may be used to remove any remaining debris, loose plant material, and pests (i.e. cycad scales).
8. During transportation, basal shoots will be covered for protection from sun and wind exposure.
9. Once transported to a nursery, commercial root-promoting hormone may be applied to the stem followed by the remaining treatments: fungicide and insecticide applied in accordance with label directions and applicable regulations and law.
10. Each basal shoot will be potted in plastic pots with well-drained potting media such as pumice, perlite or sand and/or soilless and placed in the nursery. Salvaged basal shoots will be processed and transplanted in the nursery within one week of salvage.
11. Cycads will be evaluated monthly or more frequently depending on the conditions of the plants to determine growth and status. Any disease outbreak or significant loss of individuals under nursery conditions should be reported to the USFWS to allow DON and the USFWS to work together to ensure the success of nursery propagation of cycads.
12. Salvaged cycad basal shoots/seeds will be propagated in a nursery until the lead biologist determines they are suitable for transplanting.
13. After transplantation, maintenance will include watering, weeding, fertilizer, pest control, support structures and/or plant protection will occur until the transplants shows stem growth of at least 0.4 inches as measured below the base of the existing leaves (fronds) since planting in the wild.
14. Salvaged cycads (basal shoots or seeds) will be monitored and maintained until a minimum of 95 genetically different individuals have been established in the wild, showing stem growth of at least 0.4 inches as measured below the base of the existing leaves (fronds) since planting in the wild and plants will be weaned of maintenance for a period of six months since planting for natural up take of nutrients and water.
15. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. The lead biologist will make the determination of "health."

The DON has proposed the following methods for the salvage, propagation, and transplanting of *Tabernaemontana rotensis*:

1. The DON has proposed to salvage and propagate enough *Tabernaemontana rotensis* seeds to ensure that a minimum of six genetically distinct individuals meet or exceed success criteria. This minimum number is based on the assumption that there will be at least six mature, adult *Tabernaemontana rotensis* trees producing seeds at the time of collection. If seeds cannot be collected from within the project footprint prior to being removed (i.e., if the trees do not produce seeds), plant cuttings will be collected from the project footprint or seeds will be collected from individuals within the action area. A seed collection site consisting of 53 *Tabernaemontana rotensis* trees has been identified outside the project footprint but within the action area.

2. Once collected, seeds of *Tabernaemontana rotensis* will be cultivated in a plant nursery for propagating and subsequent transplanting. An authorized biologist will determine when plants are ready for transplanting and plant them into the vegetation plots. Monitoring will be done monthly or more frequently depending on the conditions of the plants to record growth and health status. Maintenance will be conducted depending on the conditions and needs of the plants; these include watering, weeding, pest removal, and plant protection. The DON's success criteria for *Tabernaemontana rotensis* transplanting are that the plants must be between 2 and 3 feet tall, leaves remain turgid on the plant, individuals produce apical stem growth, and plants will be weaned of maintenance for a period of six months.

3.5.3.3 Alternative 2

Alternative 2 would involve the disturbance of 50 acres, 18 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. During site preparation, surface vegetation would be cleared and grubbed (i.e., roots and stumps extracted), and the ground would be excavated for the storage unit flooring. Ground disturbance during construction would include site grading to establish positive drainage control and a perimeter mound to control runoff. Thirty existing ECMs are in a developed area and would be demolished as part of this action. Existing access roads within Alternative 2 would require minor patches, and new utilities would be constructed, impacting an additional 2 acres of pervious surface.

Types of impacts, such as tree trimming and vegetation clearing, would be similar under Alternative 2 as under Alternative 1, but the area impacted under Alternative 2 would be smaller (20.3 acres of pervious surface for Alternative 2 compared to 21.6 acres of pervious surface for Alternative 1). In addition, the impacts to terrestrial biological resources would be reduced since the habitat in Alternative 2 includes no native limestone forest and is much more fragmented than the habitat in Alternative 1.

Vegetation

Short-term adverse effects (during construction) and long-term moderate adverse effects (effects lasting into post-construction phase) would be expected. Though Alternative 2 would take place in areas that have been previously modified, areas of the Mixed Limestone Forest/Secondary habitat is considered to be of high habitat value. Clearing of this habitat would result in adverse effects on protected species that are known to inhabit the proposed area of construction.

A maximum of 49.5 acres of vegetation would be removed for Alternative 2 construction (less than 0.5 percent of the total vegetated area of the GNWR overlay). Based on data collected during the plant surveys (Appendix F) (DON, 2017a), it is anticipated that none of the federally threatened *Tabernaemontana rotensis* and 55 of the federally threatened *Cycas micronesica*, as well as 12 *Maytenus thompsonii* trees associated with the federally listed Mariana wandering butterfly, would be removed during construction under Alternative 2 (see Figures 3-3 and 3-4). The removal represents less than one percent of the *Cycas micronesica* population on Guam. Habitat loss, fragmentation, and degradation are of concern to the species, as is the scale infestation that impacts tree health. Past land management practices and the introduction of invasive species have contributed towards forest degradation. This holds true for the Andersen AFB MSA and proposed project site, where historical use of the MSA has significantly lowered the quality of habitat for *Cycas micronesica* and *Tabernaemontana rotensis*.

Effects on trees that are federally protected or associated with protected species under Alternative 2 are similar to those described for Alternative 1. The number and density of protected species found within the Alternative 2 action area are fewer, however, and the habitat is much more fragmented. Therefore, the impacts to vegetation would be less than those in Alternative 1. Native trees that could be removed under Alternative 2 include *Aglaia mariannensis*, *Elaeocarpus joga*, and *Ficus prolixa*. Removal of native vegetation in the proposed area for Alternative 2 construction would have a direct adverse effect on the habitat used by Guam's endangered species.

The Alternative 2 action is not likely to adversely affect *Tabernaemontana rotensis* since no individuals are located in the action area. The Alternative 2 action may affect, but is not likely to adversely affect, *Cycas micronesica*, but the impact would be smaller than in Alternative 1 since the habitat is more fragmented and fewer cycads were found in the Alternative 2 action area. Implementation of the proposed BMPs and conservation measures discussed below would lessen the severity of impacts to Alternative 2 action area.

Terrestrial Wildlife

Minor adverse effects to wildlife species would be expected. Proposed construction activities would remove vegetative habitat, as previously discussed; wildlife habitat is fragmented, however, due to previous modifications and fragmentation. Construction under Alternative 2 would result in effects similar to those described under Alternative 1; the effects resulting from loss of habitat, however, would be less adverse because the habitat found in Alternative 1 consists of native and degraded limestone forest, which is of higher quality than the fragmented degraded limestone forest and mixed scrub community found in Alternative 2.

Despite the presence of plants commonly associated with tree snails, no native tree snails are known to occur in the Alternative 2 action area. However, favorable vegetation for Partulid tree snails has been identified. Much of this vegetation is common in degraded limestone forest present across Guam. Therefore, Alternative 2 would have less than significant impacts to tree snails.

Short-term minor adverse effects on wildlife would be expected as a result of construction activity and noise. Ground disturbance and noise from vehicle use or construction is likely to temporarily flush any foraging or resting native birds and fruit bats. As discussed in Section 3.6.2, however, the ambient noise environment is characterized by aircraft overflights, so wildlife are accustomed to noise-generating activities in the Alternative 2 action area. Following construction, no adverse effects as a result of increased noise would be expected.

Management of natural resources on Andersen AFB is covered under the Joint Region Marianas Integrated Natural Resources Management Plan (DON, 2019a). Components of this plan and the updated revised plan include controlling introduced wildlife species on Andersen AFB for the benefit of native species, particularly protected species. Andersen AFB has depredation programs in place within the MSA and will continue to manage feral ungulates in the area.

Although no Mariana fruit bats have been seen roosting within MSA I, they have been known to occur in the Andersen AFB area and transit over the action area. Adverse effects under Alternative 2 would be similar to Alternative 1; the effects resulting from loss of habitat, however, would be less adverse because the habitat found in Alternative 1 consists of higher quality habitat better suited for the Mariana fruit bat.

Minimization measures associated with protected species habitat would reduce and compensate for adverse effects but not eliminate them altogether. To reduce the potential for adverse effects resulting from construction activity or noise, the following minimization measures described below would be implemented.

Best Management Practices and Conservation Measures

BMPs and conservation measures identified for Alternative 1 also apply for Alternative 2.

3.6 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors in the human environment. Noise in relation to biological resources and wildlife species is discussed in Section 3.5, Biological Resources.

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

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

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

3.6.1 Basics of Sound and A-Weighted Sound Level

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second, or Hertz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit in order to identify that the measurement has been made with this filtering process (dBA). In this document, the dB unit refers to A-weighted sound levels. Table 3-9 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table 3-9 Subjective Responses to Changes in A-Weighted Decibels

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

Key: dB = decibel.

Figure 3-5 (Cowan, 1994) provides a chart of A-weighted sound levels from typical noise sources. Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

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

3.6.2 Noise Metrics

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

3.6.2.1 Day-Night Average Sound Level

The DNL metric is the energy-averaged sound level measured over a 24-hour period, with a 10-dB penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). DNL values are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The DNL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. DNL is the standard noise metric used by the U.S. Department of Housing and Urban Development, Federal Aviation Administration, USEPA, and DOD. Studies of community annoyance in response to numerous types of environmental noise show that DNL correlates well with impact assessments; there is a consistent relationship between DNL and the level of annoyance. Most people are exposed to sound levels of 50 to 55 DNL or higher on a daily basis.

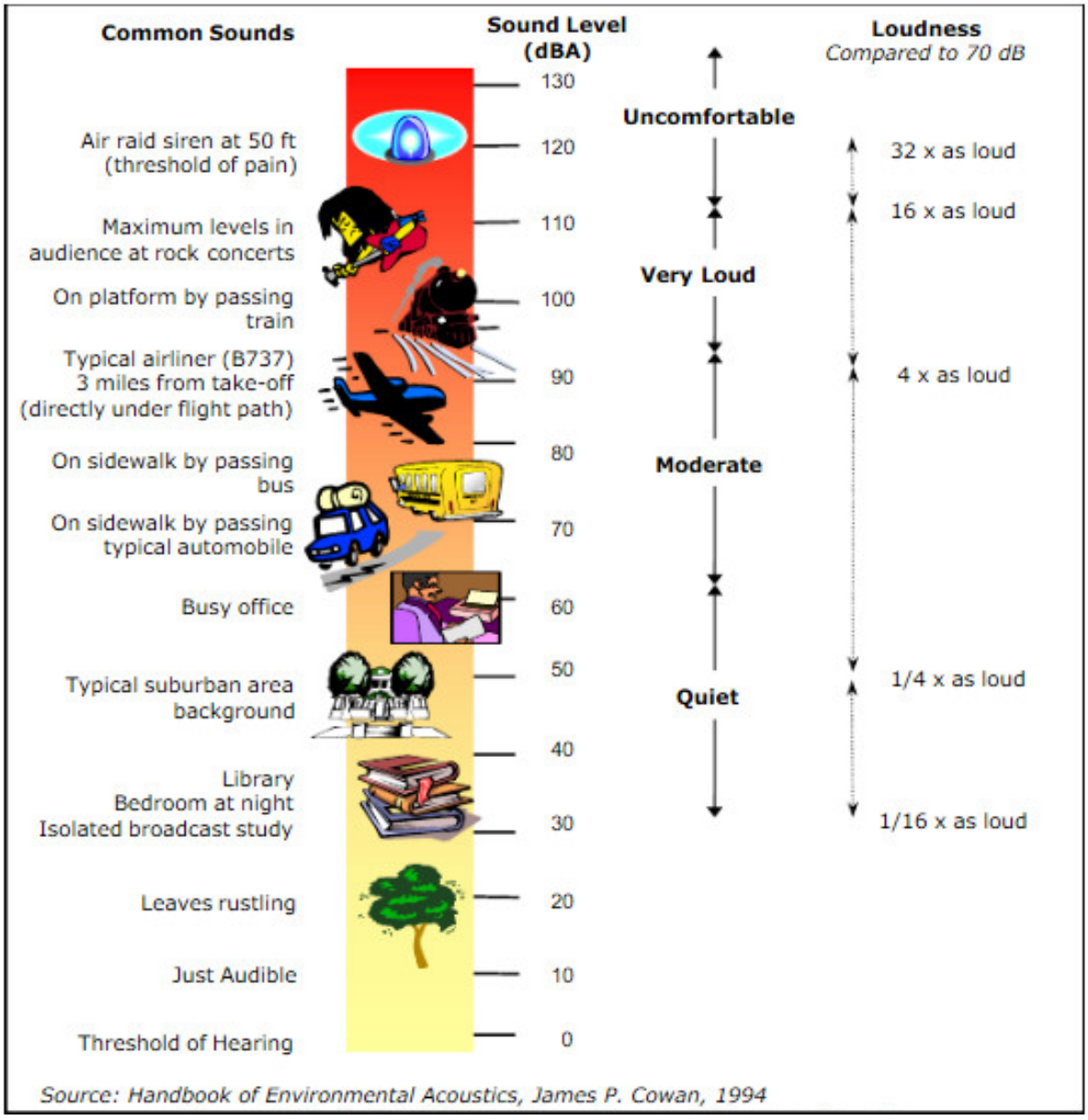


Figure 3-5 A-Weighted Sound Levels from Typical Sources

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

Building construction, modification, and demolition work can cause noise emissions well above ambient sound levels. A variety of sounds come from cranes, cement mixers, welding, hammering, boring, and other work processes. Table 3-10 lists noise levels associated with common types of construction equipment that might be used to build various buildings and other structures. Construction equipment usually exceeds the ambient sound levels by 20 to 25 dBA in an urban environment and up to 30 to 35 dBA in a quiet suburban neighborhood.

Table 3-10 Predicted Noise Levels for Construction Equipment

Construction Category and Equipment	*Predicted Noise Level at 50 feet (dBA)*
Clearing and Grading	
Bulldozer	80
Grader	80–93
Truck	83–94
Roller	73–75
Excavation	
Backhoe	72–93
Jackhammer	81–98
Building Construction	
Concrete mixer	74–88
Welding generator	71–82
Pile driver	91–105
Crane	75–87
Paver	86–88

Source: USEPA, 1974.

3.6.2.2 Community Noise Equivalent Level

CNEL is a noise metric adopted as a standard by the state of California. The CNEL metric is similar to the DNL metric and is also an energy-averaged sound level measurement. DNL and CNEL provide average noise levels taking into consideration and applying penalties for annoyance from intrusive events that occur during evening and nighttime hours. Both DNL and CNEL are measures of cumulative noise exposure over a 24-hour period, with adjustments to reflect the added intrusiveness of noise during certain times of the day. However, while DNL considers one adjustment period, CNEL reflects two adjustment periods. DNL includes a single adjustment period for night, in which each aircraft noise event at night (defined as 10 p.m. to 7 a.m.) is counted 10 times. CNEL adds a second adjustment period where each aircraft noise event in the evening (defined as 7 p.m. to 10 p.m.) is counted three times. The nighttime adjustment is equivalent to increasing the noise levels during that time interval by 10 dB. Similarly, the evening adjustment increases the noise levels by approximately 5 dB.

3.6.2.3 Equivalent Sound Level

A cumulative noise metric useful in describing noise is the Equivalent Sound Level (L_{eq}). L_{eq} is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy. The same calculation for a daily average time period such as DNL or CNEL but without the penalties is a 24-hour equivalent sound level, abbreviated $L_{eq}(24)$. Other typical time periods for L_{eq} are 1 hour and 8 hours.

3.6.2.4 Sound Exposure Level

The Sound Exposure Level (SEL) metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric

represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds, such as aircraft overflights, and is the recommended metric for sleep disturbance analysis (DOD Noise Working Group, 2009). In this EA, SEL is used in aircraft comparison and sleep disturbance analyses.

3.6.2.5 Maximum Sound Level

The highest A-weighted sound level measured during a single event where the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level (L_{max}). During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. L_{max} defines the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second (American National Standards Institute, 1988). For sound from aircraft overflights, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the L_{max} occurs instantaneously. In this EA, L_{max} is used in the analysis of aircraft comparison and speech interference.

3.6.2.6 Number of Events above a Threshold Level

The "Number of Events Above a Threshold Level" metric provides the total number of noise events that exceed a selected noise level threshold during a specified period of time (DOD Noise Working Group, 2009). In this EA, an L_{max} threshold is selected to analyze speech interference and an SEL threshold is selected for analysis of sleep disturbance.

3.6.3 Noise Effects

An extensive amount of research has been conducted regarding noise effects including annoyance, speech interference, sleep disturbance, noise-induced hearing impairment, nonauditory health effects, performance effects, noise effects on children, effects on domestic animals and wildlife, property values, structures, terrain, and archaeological sites. These effects are summarized below.

3.6.3.1 Annoyance

As previously noted, the primary effect of aircraft noise on exposed communities is long-term annoyance, defined by USEPA as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response and there is a consistent relationship between DNL/CNEL and the level of community annoyance (Federal Interagency Committee on Noise, 1992).

3.6.3.2 Potential Hearing Loss

People living in high noise environments for an extended period of time (40 years) can be at risk for hearing loss called Noise Induced Permanent Threshold Shift (NIPTS). The NIPTS defines a permanent change in hearing level, or threshold, caused by exposure to noise (USEPA, 1982). According to USEPA (1974), changes in hearing level of less than 5 dB are generally not considered noticeable. There is no known evidence that an NIPTS of less than 5 dB is perceptible or has any practical significance for the individual affected. Furthermore, the variability in audiometric testing is generally assumed to be plus or minus 5 dB. The preponderance of available information on hearing loss risk is from the workplace with continuous exposure throughout the day for many years.

Based on a report by Ludlow and Sixsmith (1999), there were no major differences in audiometric test results between military personnel, who as children, had lived in or near installations where fast jet operations were based, and a similar group who had no such exposure as children. Hence, for the purposes of this EA, the limited data are considered applicable to the general population, including children, and are used to provide a conservative estimate of the risk of potential hearing loss.

DOD policy directive requires that hearing loss risk be estimated for the at-risk population, defined as the population exposed to DNL greater than or equal to 80 dB (DOD, 2009). However, it should be recognized that characterizing noise exposure in terms of DNL and CNEL overestimates hearing loss risk but suffices when nighttime operations are 5 percent or less than the total operations. When nighttime operations are greater than 5 percent, $L_{eq}(24)$ is recommended for calculating potential hearing loss since hearing loss is a physical phenomenon due to the sound level and independent of annoyance. Thus, the additional penalties applied by CNEL for evening and nighttime operations do not accurately portray the NIPTS.

3.6.3.3 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. Speech interference can cause disruption of routine activities, such as enjoyment of radio or television programs, telephone use, or family conversation, giving rise to frustration or irritation. In extreme cases, speech interference may cause fatigue and vocal strain to individuals who try to communicate over the noise. In this EA, speech interference is measured by the number of daily indoor events (from 7 a.m. to 10 p.m.) that exceed 50 dB L_{max} at selected locations. This metric also accounts for noise level reduction provided by buildings with windows open or closed.

3.6.3.4 Classroom Criteria and Noise Effects on Children

Research suggests that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of school children. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DOD Noise Working Group, 2009).

Analyses for school-aged children are similar to speech interference by using the indoor number of events exceeding 50 dB L_{max}, but also has the added restriction of using an outdoor equivalent noise level of 60 dB L_{eq} (9 hour). This represents a level that a person with normal hearing can clearly hear a speaker (teacher) speaking at a level of 50 dB indoors in a classroom setting.

3.6.3.5 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. In this EA, sleep disturbance uses the SEL noise metric and calculates the probability of awakening from single aircraft overflights. These are based upon the particular type of aircraft, flight profile, power setting, speed, and altitude relative to the receptor. The results are then presented as a percent probability of people awakening (USEPA, 1974).

3.6.3.6 Workplace Noise

In 1972, the National Institute for Occupational Safety and Health (NIOSH) published a criteria document with a recommended exposure limit of 85 dBA as an 8-hour time-weighted average. This exposure limit was reevaluated in 1998 when NIOSH made recommendations that went beyond conserving hearing by focusing on the prevention of occupational hearing loss. Following the reevaluation using a new risk assessment technique, NIOSH published another criteria document in 1998, which reaffirmed the 85 dB recommended exposure limit (National Institute for Occupational Health and Safety, 1998).

3.6.4 Regulatory Setting

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

3.6.5 Affected Environment

The federal government supports conditions free from noise that threaten human health and welfare and the environment. Response to noise varies, depending on the type and characteristics of the noise, distance between the noise source and whoever hears it (the receptor), receptor sensitivity, and time of day. A noise-sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Sensitive receptors may also include noise-sensitive cultural practices, some domestic animals, or certain wildlife species. The nearest sensitive receptors are private residences on Route 9 outside the boundary of Andersen AFB, which are located approximately 1.3 miles from the project site. These private residences are also outside the aircraft operations noise boundaries associated with operations at Andersen AFB (DON, 2015a). Potentially noise-sensitive wildlife species are discussed in Section 3.5.

3.6.5.1 Aircraft Noise

In the vicinity of Andersen AFB, noise contours extend off-base to the south and west, and there are populated areas currently within the noise contours up to 70 dB DNL as described in the 2013 Andersen AFB Air Installation Compatible Use Zone Study (DON, 2015a). Along the Andersen AFB boundary, noise levels range from approximately 65 to 75 dB DNL in line with the end of the runway and dropping back down to below 65 dB DNL near both on- and off-base housing east of the Route 15 family housing gate.

3.6.5.2 Installation Noise Environment

Many components may generate noise and warrant analysis as contributors to the total noise impact. Regular vehicle and operational activities within the MSA generate noise. Andersen AFB has two parallel runways, each approximately 2 miles long, as well as fuel and munitions storage facilities. Consequently, the noise environment around Andersen AFB is characterized primarily by military aircraft and the regular vehicle and operational activities within the MSA.

3.6.6 Environmental Consequences

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

3.6.6.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline noise levels. Therefore, no significant impacts due to the noise environment would occur with implementation of the No Action Alternative.

3.6.6.2 Alternative 1

The study area for noise for Alternative 1 includes Andersen AFB MSA 1, Andersen AFB military family housing, and areas within 1 mile from MSA 1.

Short-term direct minor adverse effects would be expected. Construction activities would cause an increase in the surrounding noise levels in the project area. The noise levels from construction equipment would be louder than 50 to 55 dBA. Consequently, short-term direct minor adverse effects on the noise environment near the construction sites could result from the use of heavy equipment. Night time construction is not anticipated; however, construction equipment would be maintained to the manufacturers' specifications to minimize noise impacts.

Since the construction site would be entirely on Andersen AFB property, and the majority of the island's population resides several miles away from the proposed site, construction noise within MSA I would not be audible to residents on base or off base. Construction traffic on off-base roadways would be audible to residents. However, construction traffic would not increase substantially, so construction traffic noise would be similar to typical traffic noise levels. Therefore, the short-term increase in ambient noise levels from Alternative 1 would not cause significant adverse impacts on the surrounding populations. Potential construction noise effects on biological resources are presented as appropriate in Section 3.5.3.

Once the construction of the munitions storage igloos are completed, the ambient noise levels would return to their normal levels. No long-term effects would occur as a result of Alternative 1. Therefore, implementation of Alternative 1 would not result in significant impacts to the noise environment.

3.6.6.3 Alternative 2

Alternative 2 would construct the same 48 new ECMs, but in a different location. The only difference between Alternative 1 and Alternative 2 with respect to noise is the facility demolition activities that would occur prior to construction of new ECMs. Noise associated with facility demolition is consistent with noise associated with new construction, so this difference between alternatives would not result in a significant difference in the surrounding noise environment during construction. There is no operational difference between the alternatives following construction, so operational noise would be the same for each alternative. Therefore, implementation of Alternative 2 would not result in significant impacts to the noise environment.

3.7 Infrastructure

This section discusses infrastructure such as utilities (including potable water service, sanitary sewer service, storm water management, solid waste management, fire suppression, and electrical and communications service). Transportation systems and traffic are addressed separately in Section 3.8.

3.7.1 Regulatory Setting

Resource Conservation and Recovery Act (RCRA) 42 U.S.C. Section 6902 et seq., Subtitle C regulates management and disposal of hazardous waste. Federal facilities must have programs in place to reduce the volume or quantity of their hazardous waste to the degree determined by the generator to be economically practicable. Additionally, the proposed method of treatment, storage, or disposal is the practicable method available to the generator that minimizes the present and future threat to human health and the environment. RCRA Subtitle D regulates management and disposal of municipal solid waste. Federal facilities must also comply with the requirements of RCRA Subtitle D, which include proper siting, construction, inspection, and closure of municipal solid waste landfills, as well as restrictions on the type and volume of waste that landfills may accept.

Antiterrorism Force Protection Standards have been adopted by the DOD through DOD Instruction 2000.16 dated October 2006. The standards require all DOD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats.

3.7.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under infrastructure at Andersen AFB MSA 1.

Potable Water

There is no potable water service within MSA 1.

Fire Suppression

A system of underground water lines provides water for fire suppression in the developed portions of MSA 1. Fire hydrants are positioned on nearly every block of the MSA where there are existing munitions storage facilities and other structures. Andersen AFB firefighters and munitions operations personnel use the underground water supply for fire suppression, in combination with firefighting vehicles and other equipment as needed should a fire occur as a result of an accidental munitions discharge. Immediate containment and suppression of fire is necessary to preclude the possibility of successive explosion.

Wastewater

There is no sanitary sewer service within MSA 1.

Stormwater

Drainage within MSA 1 is typically surface sheet flow. Culverts are minimal and they are normally placed at road intersections to convey runoff from the upslope side of the intersection to the downslope side, preventing erosion of the roadway (DON, 2018a).

Solid Waste Management

The USAF solid waste disposal facility includes a recycling center and a lined solid waste landfill. However, it is under closure and is no longer being used. The main landfill has surrounding areas that are capable of disposing construction and demolition debris, scrap metal, and wood and green waste (Grooms et al., 2008). Solid waste generated on the installation is disposed of in a permitted landfill. The solid waste management plan at Andersen AFB calls for diverting as much waste or refuse from the landfill as possible through recycling, reuse, or recovery.

Electrical Service

Andersen AFB receives electrical power through the Guam Power Authority. Under existing conditions, the primary voltage at Andersen AFB is 13,800Y/7,970 volts. All electrical utility lines in MSA 1 are underground. In 2008, an underground primary electrical feeder was installed to serve the first 12 ECMs in Phase 1 as well as the future ECMs. This feeder extends from the east on the north side of 4th Street to a 4-way, pad-mounted 15-kilovolt (kV) switch near the intersection of 4th Street and C Avenue. From this switch, a radial feeder is extended to a new pad-mounted transformer located on the east side of ECM 8418. This transformer has a 13.8-kV primary and 480Y/277V secondary. A standby generator is located in a building near the transformer.

Communications

Communications infrastructure was also expanded in the project area in 2008. An underground communications ductbank with 100-pair copper and 48-strand fiber optic cabling was installed to serve the first 12 ECMs in Phase 1 as well as the future ECMs. The fiber optic cable originates in Building 23028 and the copper cable originates in Building 25008. This cable is extended to MSA I where the copper cable is terminated in a splice case in CHH 123 and the fiber optic cable is terminated in a splice case in CHH 124. From these handholes, the cable is extended to the ECMs (refer to Figure 2-3).

3.7.3 Environmental Consequences

This section analyzes the magnitude of anticipated increases or decreases in public works infrastructure demands considering historic levels, existing management practices, and storage capacity, and evaluates potential impacts to public works infrastructure associated with implementation of the alternatives. Impacts are evaluated by whether they would result in the use of a substantial proportion of the remaining system capacity, reach or exceed the current capacity of the system, or require development of facilities and sources beyond those existing or currently planned.

3.7.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to the existing infrastructure of MSA 1. Therefore, no significant impacts to utilities infrastructure would occur with implementation of the No Action Alternative.

3.7.3.2 Alternative 1

The study area for infrastructure for Alternative 1 is Andersen AFB.

No potable water or sanitary sewer infrastructure would be constructed for Alternative 1, thus there would be no impacts to these two utilities with Alternative 1.

No fire suppression infrastructure would be constructed for Alternative 1. Existing fire suppression water lines would be located, marked, and avoided during construction, so there would be no impacts to fire suppression water supply lines in MSA 1 and the fire suppression system on Andersen AFB.

Stormwater systems would be constructed to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. Shallow ground depressions would be constructed at the sides and rear of each ECM for stormwater collection and infiltration. Stormwater run-offs will be directed to a shallow grass swale that would serve as stormwater collection and infiltration area. The depressions and swales would meet the requirements of UFC 3-210-10, *Low Impact Development*. Thus, there would be no significant impact with respect to stormwater infrastructure. New access roads would be crowned to drain, and intersection culverts may be added or improved as needed.

Municipal solid waste resulting from construction activities would consist of a negligible amount of building materials, such as solid pieces of concrete and lumber. Municipal solid waste would be recycled to the maximum extent possible in accordance with Andersen AFB policies to avoid impacting the capacity of the waste disposal facility. Non-recyclable solid waste would disposed of in a permitted landfill. Cleared vegetation would be transferred off base to a certified composter within two weeks of clearing to divert municipal solid waste from landfills. Due to the reduced volume of solid waste, implementation of Alternative 1 at Andersen AFB would have a negligible impact on permitted landfill capacity.

The proposed ECMs would have electrical outlets, light-emitting diode (LED) lighting, and exterior LED lighting. Primary power would require 13.8 kV, and secondary power would require 480 volts and 120/208 volts. The lighting for the ECMs would be hooded and directed not to shine on forest habitat. These additional demands for electricity would be negligible compared with total base usage. Alternative 1 would not significantly increase electricity demand at Andersen AFB.

Communications infrastructure was also expanded in the Alternative 1 project area in 2008. An underground communications ductbank with copper and fiber optic cabling was installed to serve the first 12 ECMs in Phase 1 as well as the ECMs proposed for Alternative 1. These communications lines would be located, marked, and avoided during construction activities. Sufficient communications infrastructure to support the Alternative 1 ECMs already exists and would not be extended during construction.

During the operational phase, the volume of municipal solid waste (green waste and other types of solid waste) associated with munitions handling and maintaining the Alternative 1 project area would be the same as they are for MSA 1 overall, i.e., no change from existing conditions.

Therefore, implementation of Alternative 1 would not result in significant impacts to infrastructure.

3.7.3.3 Alternative 2

The study area for infrastructure for Alternative 2 is Andersen AFB.

Alternative 2 would construct the same 48 new ECMs, but in a different location. Existing underground utility infrastructure in the Alternative 2 project area would be located, marked, and avoided during construction. As with Alternative 1, LED fixtures would be used to provide interior and exterior lighting. The exterior lighting for the ECMs would be hooded and directed not to shine on forest habitat. Construction and operation of the Alternative 2 ECMs would have the same impacts to potable water,

sanitary sewer, fire suppression, stormwater, electrical, and communications infrastructure as Alternative 1.

The only difference between Alternative 1 and Alternative 2 with respect to infrastructure is the amount and type of municipal solid waste that would result from the demolition activities. With Alternative 1, more vegetation would be removed, so there would be a larger volume of green waste to be mulched than with Alternative 2. Alternative 2 would generate less green waste and more concrete and asphalt debris than Alternative 1. However, with Alternative 2, concrete and asphalt debris would be re-used/recycled for use in other construction projects to the maximum extent possible in accordance with Andersen AFB policies to avoid impacting the capacity of the waste disposal facility. Non-recyclable solid waste would disposed of in a permitted landfill. Given green waste mulching and concrete and asphalt debris reuse and recycling, it is anticipated that implementation of Alternative 2 at Andersen AFB would not have a significant impact on the capacity of the Andersen AFB solid waste landfill.

Therefore, implementation of Alternative 2 would not result in significant impacts to infrastructure.

3.8 Transportation

This discussion of transportation includes land routes with the means of moving passengers and goods.

Traffic is commonly measured through average daily traffic and design capacity. These two measures are used to assign a roadway with a corresponding level of service (LOS). The LOS designation is a professional industry standard used to describe the operating conditions of a roadway segment or intersection. The LOS is defined on a scale of A to F that describes the range of operating conditions on a particular type of roadway facility. LOS A through LOS B indicates free flow travel. LOS C indicates stable traffic flow. LOS D indicates the beginning of traffic congestion. LOS E indicates the nearing of traffic breakdown conditions. LOS F indicates stop-and-go traffic conditions and represents unacceptable congestion and delay.

3.8.1 Regulatory Setting

EO 13834 encourages government agencies to meet energy and environmental performance statutory requirements in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment.

3.8.2 Affected Environment

Primary vehicular access to Andersen AFB is provided by Highway 1 (Marine Drive). The main gate is located at the junction of Highways 1 and 9 and has guarded entry. Traffic volumes entering and exiting the base are relatively low, but short delays are possible at the main gate because USAF personnel screen incoming vehicles. MSA I has serviced a grid of paved and unpaved two-lane roads. The primary entrance to MSA I is through a controlled gate near the intersection of B Avenue and 5th Street. MSA I is a secured area of the base; vehicles entering MSA I are screened at this location.

The Guam climate (typhoons and earthquakes) can degrade pavement rapidly (Andersen AFB, 1998). The majority of the roads on Andersen AFB were constructed following the end of WW II and are generally in good condition.

3.8.3 Environmental Consequences

Impacts to ground traffic and transportation are analyzed by considering the possible changes to existing traffic conditions and the capacity of area roadways from proposed increases in construction traffic and munitions transport operations associated with the new ECMs.

3.8.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to transportation. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.8.3.2 Alternative 1

The study area for Alternative 1 is Andersen AFB and Highway 1 (Marine Drive).

The construction phase of Alternative 1 would involve delivery of materials to and removal of debris from construction sites. Potential increases in traffic volume associated with proposed construction activities would be temporary. Construction schedules would be coordinated with MSA operations to avoid impacting MSA activities. All road and lane closures would be coordinated with USAF prior to commencing construction activities and would be temporary; therefore, traffic delays or changes in LOS to roadway segments and intersections within Andersen AFB are anticipated to be minimal.

Outside Andersen AFB, construction equipment and associated trucks transporting material to and from the construction site would be directed to roads and streets that have minimum traffic volume. Construction traffic would compose a small percentage of the total existing traffic and many of the vehicles would be driven to and kept onsite for the duration of construction activities, resulting in relatively few additional trips. Traffic delays or changes in LOS to Highway 1 and its and intersections are also expected to be minimal.

Heavy vehicles frequently use base roads; therefore, the vehicles necessary for construction would not be expected to have an adverse impact on base roads. Roadway improvements in the project area are included as part of Alternative 1 construction.

Construction workers and construction-related vehicle trips would have different trip origins and destinations compared to the Air Force personnel and their dependents. Consequently, short-term and intermittent impacts may occur during construction in locations that would not be impacted after construction, when the new ECMs are in use. No significant increase in ordnance vehicle transport trips is anticipated to result from the increased munitions storage capacity that Alternative 1 would provide during the operational phase.

Therefore, implementation of Alternative 1 would not result in significant impacts to transportation.

3.8.3.3 Alternative 2

The study area for Alternative 2 is Andersen AFB and Highway 1 (Marine Drive).

Alternative 2 would construct the same 48 new ECMs as Alternative 1, as well as the demolition of 30 ECMs. This would result in higher volumes of construction materials and demolition debris for Alternative 2 and, consequently, a higher number of construction vehicle trips. Despite the higher volume of anticipated construction traffic, the Alternative 2 project area is adjacent to the Alternative 1 project area, so construction vehicles and workers would access the Alternative 2 site using the same Andersen AFB roads and off-base roadways as Alternative 1.

Construction schedules would be coordinated with MSA operations to avoid impacting MSA activities. All road and lane closures would be coordinated with USAF prior to commencing construction activities and would be temporary; therefore, traffic delays or changes in LOS to roadway segments and intersections within Andersen AFB are anticipated to be minimal with Alternative 2.

Alternative 2 would direct construction traffic outside Andersen AFB to roads and streets that carry minimum vehicles. Traffic delays or changes in LOS to Highway 1 and its and intersections are expected to be minimal.

Heavy military vehicles frequently use base roads; therefore, the vehicles necessary for construction would not be expected to have an adverse impact on base roads. Roadway improvements in the project area are included as part of Alternative 2 construction.

Construction workers and construction-related vehicle trips would have different trip origins and destinations compared to the Air Force personnel and their dependents. Consequently, short-term and intermittent impacts may occur during construction in locations that would not be impacted after construction, when the new ECMs are in use. No significant increase in ordnance vehicle transport trips is anticipated to result from the increased munitions storage capacity that Alternative 2 would provide during the operational phase.

Therefore, implementation of Alternative 2 would not result in significant impacts to transportation.

3.9 Public Health and Safety

This discussion of public health and safety includes consideration for any activities, occurrences, or operations that have the potential to affect the safety, well-being, or health of members of the public. A safe environment is one in which there is no, or optimally reduced, potential for death, serious bodily injury or illness, or property damage. The primary goal is to identify and avoid potential accidents or impacts on the general public. Public health and safety within the context of this EA includes information pertaining to community emergency services, construction activities, potential accidental explosives discharge, and operations following construction.

Community emergency services are organizations that ensure public safety and health by addressing different emergencies. The three main emergency service functions include police, fire and rescue service, and emergency medical service.

Public health and safety during construction, demolition, and renovation activities is generally associated with construction traffic, as well as the safety of personnel within or adjacent to the construction zones.

Operational safety may refer to the actual use of the facility or built-out proposed project, or training or testing activities and potential risks to inhabitants or users of adjacent or nearby land and water parcels. Safety measures are often implemented through designated safety zones, warning areas, or other types of designations.

3.9.1 Regulatory Setting

Explosive Safety Zones (ESZs) are required for areas where ordnance is stored or handled. ESZs are typically determined based upon the NEW of the ordnance to be stored or handled and the blast resistance properties of the magazine. Quantity-distance (QD) setback arcs that delineate the extents of each ESZ are determined. In accordance with Air Force Manual (AFMAN) 91-201, Explosives Safety

Standards, munitions storage igloos can only be constructed within a designated MSA that meets all the safety and explosives standards of AFMAN 91-201. Air Force Handbook 32-1081, *Facility Requirements*, defines storage igloos as the preferred facility to store munitions where moisture condensation is not a safety factor. Such facilities can be earth-covered, concrete, or steel-reinforced structures. Additional standards that must be considered for the storage of munitions in igloos are as follows:

- Technical Manual 5-1300, *Structures to Resist the Effects of Accidental Explosives*
- DOD Manual 5100.76-M, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*
- DOD Standard 6055.9-STD, *DOD Ammunitions and Explosives Safety Standards*

In addition, the Air Force follows strict guidance for the transport and handling of ordnance, to minimize the potential for accidental discharge of munitions. All munitions operations personnel are trained and certified in munitions handling. Munitions are transported and stored in a dis-armed state, and without fuses, to preclude inadvertent explosions. Should an accidental explosion occur, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result.

Unexploded ordnance (UXO) is any munitions, weapon delivery system, or ordnance item that contains explosives, propellants, and chemical agents. UXO consists of munitions that (1) are armed or otherwise prepared for action; (2) are launched, placed, fired, or released in a way that they cause hazards; or (3) remain unexploded either through malfunction or design. UXO presents both an immediate safety danger (from explosion) and a long-term health threat (from toxic contamination).

Construction site safety is largely a matter of adherence to regulatory requirements imposed for the benefit of employees and implementation of operational practices that reduce risks of illness, injury, death, and property damage. The health and safety of onsite military and civilian workers are safeguarded by numerous DOD and USAF regulations designed to comply with standards issued by OSHA and NIOSH. These standards specify the amount and type of training required for industrial workers, the use of protective equipment and clothing, engineering controls, and maximum exposure limits for workplace stressors.

3.9.2 Affected Environment

Munitions at Andersen AFB are presently being stored in earthen-covered igloos.

Guam's history in WW II increases the potential of finding UXO within areas proposed for development. The project site is located in a moderate probability area for Munitions and Explosives of Concern (MEC). A Munitions and Explosives of Concern (MEC) investigation is required prior to the start of project activities. The MEC investigation must be preceded by an Explosives Safety Submission (ESS). The ESS must also be approved by the appropriate authorities before work begins (see DOD 6055.9 STD, DOD *Ammunition and Explosives Safety Standards*). The ESS is designed to provide an assessment of the explosives hazards likely to be encountered during the implementation of the MEC investigation and any resulting response action. All personnel working on site must complete MEC/UXO Awareness Training before starting work.

3.9.3 Environmental Consequences

The safety and environmental health analysis contained in the respective sections addresses issues related to the health and well-being of military personnel working in MSA 1, as well as military personnel and civilians living on or in the vicinity of Andersen AFB MSA 1. Specifically, this section provides information on potential UXO and MEC in the project area; construction site safety; and operational safety.

3.9.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to public health and safety. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.9.3.2 Alternative 1

The study area for Alternative 1 is Andersen AFB MSA 1. MSA 1 is a secure location within Andersen AFB that is only accessible to Andersen AFB munitions personnel. Construction areas would be fenced and appropriately marked with signs and placards to ensure that construction activities do not interfere or conflict with munitions operations. Outside Andersen AFB, construction equipment and associated trucks transporting material to and from the construction site would be directed to appropriate roads and streets to ensure traffic safety. During all phases of construction, safety standards required by OSHA and NIOSH would be followed. Workers would be required to wear protective gear such as ear protection from sound, steel- toed boots, hard hat, gloves, and other appropriate safety gear for the proposed igloo construction. No adverse safety effects related to traffic and construction site safety would be expected during the construction of the proposed ECMs.

The Alternative 1 construction site lies outside the portion of MSA 1 where munitions operations currently take place. As stated above, Andersen AFB munitions operations personnel would coordinate with the construction contractor to ensure that munitions handling activities do not conflict or take place concurrently (as feasible) with construction activities. In the unlikely event of an accidental explosion in MSA 1, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result. Therefore, no adverse safety effects related to explosives handling and fire are anticipated during the construction of the proposed ECMs.

The project site is located in a moderate probability area for MEC, so excavation for building foundations, roads, underground utilities, and other infrastructure could encounter UXO and MEC. Exposure to UXO and MEC could result in death or injury to workers. The general public would be excluded from the construction zones. To reduce the potential hazards related to the exposure to UXO and MEC, in accordance with DOD Directive 6055.9-STD (DOD Ammunition and Explosive Safety Standards), ESS documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers and the public. Construction will require MEC screening for all excavation and earthwork. To ensure construction site safety, the Andersen AFB Explosive Ordnance Disposal Unit would be present to conduct MEC screening for all excavation and earthwork during all active groundbreaking and clearing activities. If UXO is found, exclusion zones will be required. UXO identified during construction of facilities that requires open detonation in-place would require an emergency permit from GEPA. UXO that is safe to transport would be taken to the Andersen AFB Hazardous Waste Management Facility - Andersen AFB Explosive Ordnance Disposal Permitted Facility

to be safely detonated. BMPs that would be implemented include having qualified UXO personnel perform surveys to identify and remove potential MEC items prior to the initiation of ground-disturbing activities. Additional safety precautions would include providing UXO awareness training to construction personnel involved in grading and excavations prior to and during ground-disturbing activities that would occur in previously disturbed areas that have a high probability of UXO. Potential safety hazards from encounters with UXO would be minimized because UXO would be identified and removed prior to initiating construction activities and construction personnel would be trained as to the hazards associated with unexploded military munitions.

The construction of new ECMs in MSA I would meet all the safety requirements of the regulations and standards listed in Section 2.1.4. The new ECMs would be constructed in accordance with the highest strength classification for munitions storage igloos, the 7-bar rating. This rating would ensure more than adequate explosion safety for 500,000 pounds of NEW anticipated for each ECM. The 48 new ECMs would have vertical concrete walls, reinforced concrete floor and roof slabs, and blast resistant structural steel access doors. Thus, the design and construction of the new ECMs would minimize potential explosives safety hazards.

The ECMs would be situated in MSA I and would have the appropriate distance between ECMs and the required safety explosive QD of 3,969 feet for ECMs containing 500,000 pounds NEW with respect to the inhabited building distance. The closest inhabited building to the new ECMs would be outside the 3,969 feet QD (AFMAN 91-201). This would not affect any inhabited buildings or pose unacceptable safety risks.

The new ECMs would meet USAF safety standards for 7-bar construction. Following construction of the new ECMs, Andersen AFB munitions operations personnel would continue to transport munitions in MSA 1 according to all applicable DOD requirements. Therefore, implementation of Alternative 1 would not result in significant impacts to public health and safety.

3.9.3.3 Alternative 2

The study area for Alternative 2 is Andersen AFB MSA 1. Under Alternative 2, the same construction safety standards described for Alternative 1 would be followed. The same procedures would be followed to ensure that construction activities would not interfere or conflict with munitions operations. No adverse safety effects related to traffic and construction site safety would be expected during the construction of the proposed ECMs under Alternative 2.

The Alternative 2 construction site lies inside the portion of MSA 1 where munitions operations currently take place. All explosives would be removed and transported elsewhere for proper storage prior to the demolition of ECMs. As described for Alternative 1, Andersen AFB munitions operations personnel would coordinate with the construction contractor to ensure that munitions handling activities do not conflict or take place concurrently (as feasible) elsewhere in MSA 1 with construction activities. In the unlikely event of an accidental explosion in MSA 1, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result. Therefore, no adverse safety effects related to explosives handling and fire are anticipated during the construction of the proposed ECMs.

The Alternative 2 project area has the same potential for the presence of UXO and MEC. The same procedures described for Alternative 1 would be required for Alternative 2 to minimize potential safety hazards associated with UXO and MEC.

With Alternative 2, the construction of new ECMs in MSA I would meet all the safety requirements of the regulations and standards listed in Section 2.1.4. The new ECMs would be constructed in accordance with the highest strength classification for munitions storage igloos, the 7-bar rating. This rating would ensure more than adequate explosion safety for 500,000 pounds of NEW anticipated for each ECM. The 48 new ECMs would have vertical concrete walls, reinforced concrete floor and roof slabs, and blast resistant structural steel access doors. Thus, the design and construction of the new ECMs would minimize potential explosives safety hazards.

The ECMs would be situated in MSA I and would have the appropriate distance between ECMs and the required safety explosive QD of 3,969 feet for ECMs containing 500,000 pounds NEW with respect to the inhabited building distance. The closest inhabited building to the new ECMs would be outside the 3,969 feet QD (AFMAN 91-201). This would not affect any inhabited buildings or pose unacceptable safety risks.

The new ECMs would meet USAF safety standards for 7-bar construction. Following construction of the new ECMs, Andersen AFB munitions operations personnel would continue to transport munitions in MSA 1 according to all applicable DOD requirements. Therefore, implementation of Alternative 2 would not result in significant impacts to public health and safety.

3.10 Hazardous Materials and Wastes

This section discusses hazardous materials, hazardous waste, toxic substances, and contaminated sites.

3.10.1 Regulatory Setting

Hazardous materials are defined by 49 CFR Section 171.8 as “hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table, and materials that meet the defining criteria for hazard classes and divisions in 49 CFR part 173.” Transportation of hazardous materials is regulated by the U.S. Department of Transportation regulations.

Hazardous wastes are defined by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments, as: “a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.” Certain types of hazardous wastes are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These are called universal wastes and their associated regulatory requirements are specified in 40 CFR part 273. Four types of waste are currently covered under the universal wastes regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps, such as fluorescent light bulbs.

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing material (ACM), polychlorinated biphenyls (PCBs), lead-based paint (LBP), and radon gas. USEPA is given authority to regulate special hazard substances by the Toxic Substances Control Act. Asbestos is also regulated by USEPA under the CAA, and the Comprehensive Environmental Response, Compensation, and Liability Act.

The DOD established the Defense Environmental Restoration Program to facilitate thorough investigation and cleanup of contaminated sites on military installations (active installations, installations subject to Base Realignment and Closure, and formerly used defense sites). The Installation Restoration Program (IRP) and the Military Munitions Response Program are components of the Defense Environmental Restoration Program. The IRP requires each DOD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The Military Munitions Response Program addresses nonoperational rangelands that are suspected or known to contain UXO, discarded military munitions, or munitions constituent contamination.

3.10.2 Affected Environment

To protect habitats and people from inadvertent and potentially harmful releases of hazardous substances, the DOD has required that all facilities develop and implement Hazardous Material Emergency Planning and Response Plans or Spill Prevention, Control, and Countermeasure Plans. These plans and programs, in addition to established legislation effectively form the "safety net" intended to protect the ecosystems on which most living organisms depend.

Air Force Policy Directive 32-70, *Environmental Quality*, establishes the policy that the USAF is committed to the following environmentally sound practices:

- Cleaning up environmental damage resulting from its past activities
- Meeting all environmental standards applicable to its present operations
- Planning its future activities to minimize environmental impacts
- Responsibly managing the irreplaceable natural and cultural resources it holds in public trust
- Eliminating pollution from its activities wherever possible

Air Force Policy Directive 32-70 and the Air Force Instruction (AFI) 32-7000 series incorporate the requirements of all federal regulations, other AFIs, and DOD Directives for the management of hazardous materials, hazardous wastes, and special hazards.

3.10.2.1 Hazardous Materials and Hazardous Waste

Andersen AFB has enacted programs to ensure adherence to federal environmental regulations regarding hazardous materials and waste management. Standards and procedures for emergency responses for fuel spills are contained in Andersen AFB's Oil and Hazardous Substance Contingency Plan, which conforms to AFI 32-4002, *Facility Hazardous Emergency Planning and Response*; and federal laws and regulations.

3.10.2.2 Special Hazards (Asbestos-Containing Materials, Lead-Based Paint, Polychlorinated Biphenyls and Radon Gas)

Electrical transformers and other exterior electrical equipment in the project area were installed as part of construction and maintenance projects that began in 2006; thus, exterior electrical equipment in the project area is not likely to contain PCBs. There are no structures in the Alternative 1 project area where asbestos-containing materials and lead based paint could be present. However, it is possible that the 30 ECMs in the Alternative 2 project area may have PCBs in interior electrical equipment, as well asbestos-containing materials and lead based paint. Radon gas is a concern on Guam because of its relatively high natural levels. Radon gas originates from the natural decay of uranium and thorium in soil, rock, and

water. MSA I has a porous karst topography, which allows radon gas to easily rise to open air areas, and possibly leak into buildings or other enclosed structures.

3.10.2.3 Installation Restoration Program

On October 14, 1992, USEPA placed Andersen AFB on the National Priorities List. The USAF subsequently entered into a Federal Facility Agreement with USEPA and GEPA to coordinate the IRP effort at Andersen AFB.

There are 4 IRP sites near the Alternative 1 project area in MSA I (Figure 3-6). IRP Site 3, inside MSA I, is near the corner of 2nd Street and E Avenue, approximately 1,000 feet north of the Alternative 1 site boundary, but it is located at a lower elevation than Alternative 1 and thus would not affect surface water, groundwater, or soil conditions at Alternative 1. IRP Site 5, outside MSA 1 is about 1,680 feet northwest of the Alternative 1 site boundary. IRP Site 21, also outside MSA 1 is about 2,120 feet west of the Alternative 1 site boundary. Similar to IRP Site 3, Sites 5 and 21 are at lower elevations than Alternative 1, and would not affect conditions at the Alternative 1 project area.

3.10.3 Environmental Consequences

The hazardous materials and wastes analysis contained in the respective sections addresses issues related to the use and management of hazardous materials and wastes as well as the presence and management of specific cleanup sites at Andersen AFB.

3.10.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change associated with hazardous materials and wastes. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.10.3.2 Alternative 1

The study area for Alternative 1 is MSA 1. Short-term localized minor adverse effects would be expected. Construction activities associated with Alternative 1 would require the use of certain hazardous materials such as paints, welding gases, solvents, preservatives, and sealants. Construction equipment that would be used contain fuel, lubricating oils, hydraulic fluid, and coolants that could be regulated hazardous substances if spilled or leaked on the construction site. During project activities, contractors would be required to minimize the potential for a release of hazardous substances from all construction equipment, including daily inspection of equipment to ensure that there are no discharges, maintaining appropriate spill containment material onsite, and storage of all fuels and other materials in appropriate containers. Equipment maintenance activities would not be conducted on the construction site.

It is anticipated that the quantity of products containing hazardous materials used during the construction activities would be minimal. Contractors would be responsible for the management of hazardous materials, which would be handled in accordance with federal regulations. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan.*

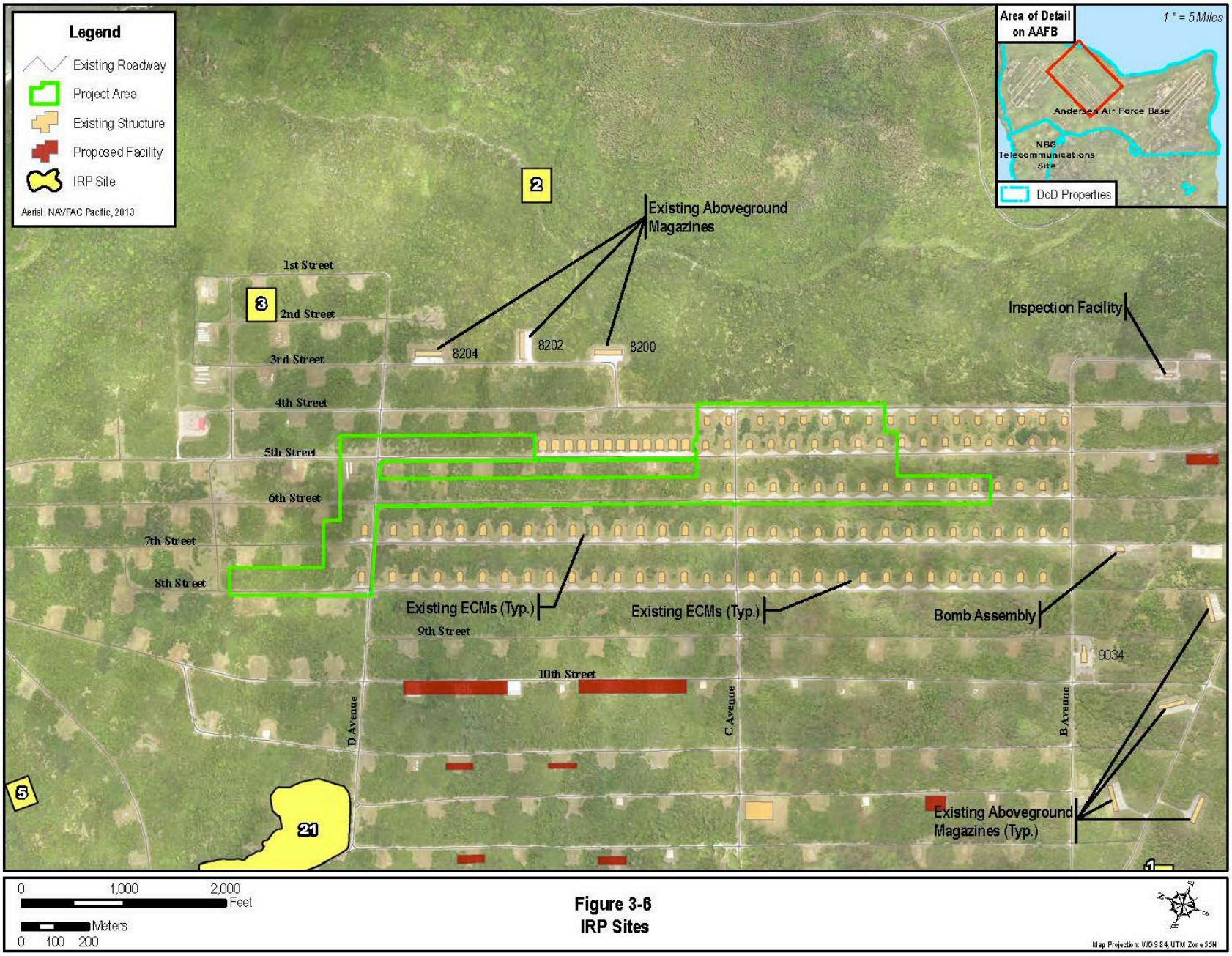


Figure 3-6
IRP Sites

Hazardous wastes resulting from construction activities are expected to be minimal. Construction contractors would be required to manage and dispose all hazardous waste in compliance with all federal regulations and USAF requirements. Hazardous waste collection facilities on Andersen AFB are anticipated to have sufficient capacity to accept the waste resulting from Alternative 1 construction activities.

There are no IRP sites, contaminated soils, or known hazardous materials in or immediately adjacent to the Alternative 1 project area, so construction of Alternative 1 would not disturb contaminated soil or groundwater associated with IRP sites, or interfere with IRP site cleanup and monitoring activities. If contaminated soils were encountered, such material would be managed in accordance with federal guidelines and regulations.

New transformers, electrical switchgear, and lighting equipment installed for Alternative 1 would be specified to be non-PCB (DON, 2018a). No LBP or ACMs would be used in construction of the ECMs. Diesel fuel for the new back-up generator would be stored in a double-walled tank mounted on concrete pad, in accordance with all federal regulations and USAF requirements.

In recognition of the public health hazard presented by indoor radon, the U.S. Congress passed the Indoor Radon Abatement Act (IRAA) of 1988. In response to IRAA, the Navy created the Navy Radon Assessment and Mitigation Program (NAVRAMP) to manage radon at Navy/Marine Corps installations worldwide. Radon is a naturally occurring, odorless, colorless, radioactive gas that is released from rock, soil, and water as part of the natural decay of uranium. According to USEPA, long-term exposure to elevated indoor radon levels is the second leading cause of lung cancer in the U.S. and the number one cause among non-smokers. New Navy/Marine Corps construction projects, as well as certain types of renovation projects (particularly those involving housing and occupied facilities), may be subject to radon abatement measures. With respect to the Proposed Action, the only proposed construction is for munitions storage facilities and supporting infrastructure, which would not require radon abatement measures since the concern is over human health risks. The proposed construction included in the Proposed Action would comply with NAVRAMP as applicable. Potential long-term adverse effects associated with radon gas could occur if radon accumulated in the ECMs. However, radon would be monitored over time to ensure that no adverse effects would occur. The ECMs would be equipped with ventilation systems that would minimize accumulation of radon gas inside the structures.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given compliance with federal, GEPA and USAF hazardous materials and waste management regulations and requirements during construction, exclusion of LBP, ACMs, and PCBs from new construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 1 would not result in significant impacts with respect to hazardous materials and hazardous waste.

3.10.3.3 Alternative 2

The study area for Alternative 2 is MSA 1. The 30 existing ECMs were constructed in the 1950s, thus, it is possible that they may contain LBP, ACMs, and PCBs. Maintenance records for these ECMs would be reviewed, and if necessary, surveys for LBP, ACMs, and PCBs would be conducted prior to demolition. If

any of these hazardous materials are determined to be present in the 30 existing ECMs, prior to demolition they would be removed/abated by licensed technicians according to all applicable federal, GEPA, and USAF requirements, and properly disposed as hazardous waste.

There are no IRP sites or contaminated soils, in or immediately adjacent to the Alternative 2 project area, so construction of Alternative 2 would not disturb contaminated soil or groundwater associated with IRP sites, or interfere with IRP site cleanup and monitoring activities. If contaminated soils were encountered, such material would be managed in accordance with federal guidelines and regulations. The only difference between Alternative 1 and Alternative 2 with regard to hazardous materials and wastes is the potential need to identity, abate/remove, and properly dispose LBP, ACMs, and PCBs in the existing ECMs to be demolished. Otherwise, the same construction activities would take place with Alternative 2 as those described for Alternative 1. Construction contractors would be required to manage and dispose all hazardous waste in compliance with all federal Resource Conservation and Recovery Act regulations and DOD requirements. Hazardous waste collection facilities on Andersen AFB are anticipated to have sufficient capacity to accept the waste resulting from Alternative 2 demolition and construction activities, including any LBP, ACMs, and PCBs that may be removed from the existing ECMs.

New transformers, electrical switchgear, and lighting equipment installed for Alternative 2 would be specified to be non-PCB (DON, 2018a). No LBP or ACMs would be used in construction of the ECMs. Diesel fuel for the new back-up generator would be stored in a double-walled tank mounted on concrete pad, in accordance with all federal regulations and USAF requirements.

If radon is identified as a potential concern during design of the project, suitable measure could be implemented to ensure it is not a safety hazard during construction or during operations. Potential long-term adverse effects associated with radon gas could occur if radon accumulated in the ECMs. However, radon would be monitored over time to ensure that no adverse effects would occur. The ECMs would be equipped with ventilation systems that would minimize accumulation of radon gas inside the structures.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given compliance with federal and USAF hazardous materials and waste management regulations and requirements during construction, exclusion of LBP, ACMs, and PCBs from new construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 2 would not result in significant impacts with respect to hazardous materials and hazardous wastes.

3.11 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative and impact avoidance and minimization measures are presented in Table 3-11. Mitigation measures are discussed in Chapter 3. Cultural resources mitigation measures include an archaeological data recovery plan to be put in place in accordance with the Guam SHPO Section 106 NHPA concurrent letter (see Section 3.4 and Appendix D). The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D). Procedures for inadvertent discoveries of archaeological resources or human remains would be implemented during construction. Biological resources mitigation measures include conservation measures in Section 3.5, Biological Resources, that were identified in the signed Biological Opinion as part of Section 7 ESA consultation to avoid and minimize impacts to ESA- and MBTA-listed species (see Section 3.5 and Appendix C). The Biological Opinion also includes BMPs to avoid and minimize impacts to ESA-listed species.

Table 3-11 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Alternative 1*	*Alternative 2*
Air Quality	No Significant Impacts	No Significant Impacts	No Significant Impacts
Water Resources	No Significant Impacts	No Significant Impacts	No Significant Impacts
Geological Resources	No Significant Impacts	No Significant Impacts	No Significant Impacts
Cultural Resources	No Significant Impacts	No Significant Impacts Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the NRHP. Mitigation Measure: there would be no adverse effect to these sites with implementation of a data recovery plan, per SHPO concurrence on 3 May 2018 (see Appendix D). The USAF submitted the data recovery plan to the Guam SHPO with work to be executed prior to construction and addressed Guam SHPO comments in a letter dated 14 July 2020 (see Appendix D).	No Significant Impacts
Biological Resources	No Significant Impacts	Less than Significant Impacts BMPs and conservation measures include Contractor Education Program (*Cycas micronesica*, *Tabernaemontana rotensis*, and Mariana fruit bats), pre-construction surveys and hooded lighting (Mariana fruit bats), biosecurity protocols (invasive species), pre-construction surveys and salvage/transplanting for ESA-listed plants, and annual reporting to adaptively manage ESA-listed species. These procedures will be executed to minimize impacts to a level where they are not significant to the environment and ESA- and MBTA-listed species existence. The USFWS issued a signed Biological Opinion on 1 July 2020 concurring with BMPs and conservation measures to avoid and	Less than Significant Impacts BMPs and conservation measures identified for Alternative 1 also apply for Alternative 2. These procedures will be executed to minimize impacts to a level where they are not significant to the environment and species existence.

Table 3-11 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Alternative 1*	*Alternative 2*
		minimize potential effects to ESA-listed species (see Appendix C). Mitigation Measures: incorporation of conservation measures to reduce impacts to ESA-listed species.	
Noise	No Significant Impacts	No Significant Impacts	No Significant Impacts
Infrastructure	No Significant Impacts	No Significant Impacts	No Significant Impacts
Transportation	No Significant Impacts	No Significant Impacts	No Significant Impacts
Public Health and Safety	No Significant Impacts	No Significant Impacts	No Significant Impacts
Hazardous Materials and Wastes	No Significant Impacts	No Significant Impacts	No Significant Impacts

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4 Cumulative Impacts

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

4.1 Definition of Cumulative Impacts

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

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

In addition, CEQ and the U.S. Environmental Protection Agency (USEPA) have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ, 2005) and Consideration of Cumulative Impacts in EPA Review of NEPA Documents (USEPA, 1999). CEQ guidance entitled Considering Cumulative Impacts Under NEPA (CEQ, 1997) states that cumulative impact analyses should "…determine the magnitude and significance of the environmental consequences of the Proposed Action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

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

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

4.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area will include those areas previously identified in Chapter 3 for the respective resource areas. This study area is primarily Andersen AFB because the effects of the Proposed Action are localized, but it also includes the island of Guam for the context of biological resources impacts. The time frame for cumulative impacts centers on the timing of the Proposed Action.

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

4.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects at and near the Proposed Action locale. In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable action. Specifically, using the first fundamental question included in Section 4.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ, 2005), these actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making. Projects included in this cumulative impacts analysis are listed in Table 4-1 and briefly described in the following subsections.

4.3.1 Past Actions

The 2005 EA addressed the full proposed action identified at that time (i.e., 60 munitions storage igloos within the MSA), and Phase 1 (12 igloos) was implemented following completion of that EA. However, plans for the remaining 48 igloos were subsequently revised, requiring development of revised alternatives to be addressed in this EA. Therefore, Phase 1 is considered a past action for this cumulative impacts analysis.

4.3.2 Present and Reasonably Foreseeable Actions

Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation (2012 Roadmap Adjustments): In September 2010, the Department of the Navy (DON) signed a ROD regarding the 2010 Final EIS for the *Guam and CNMI Military Relocation*. In April 2012, the U.S.-Japan Security Consultative Committee jointly announced an adjustment to the previous plans for the Guam military relocation. In accordance with these "2012 Roadmap Adjustments," the Department of Defense adopted a new force posture in the Pacific providing for a materially smaller and reconfigured Marine Corps force on Guam.

Table 4-1 Cumulative Action Evaluation

Action	*Level of NEPA Analysis Completed*
Past Actions	
Construction of 12 munitions storage igloos in FY2008	EA
Present and Reasonably Foreseeable Future Actions	
Mariana Island Training and Testing	Supplemental EIS
Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments)	Supplemental EIS
Two Marine Operation Locations: Sites 15B-4 and 15B-g	Supplemental EIS
Marine Corps Earth-covered Magazines	Supplemental EIS
Beddown of Training and Support Initiatives at Northwest Field	EA
Construction of a Brown Treesnake Barrier at the Habitat Management Unit, and Construction of Five Well Sites, Andersen Air Force Base, Guam	EA
Parachute Cargo Drop Training at Northwest Field on Andersen Air Force Base	EA
Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam	EA
Chemical Applications for Control of Brown Treesnakes	EA

The DON prepared a Final SEIS for the purpose of supplementing portions of the 2010 Final EIS regarding the establishment on Guam of a live-fire training range complex (LFTRC), a cantonment area, a family housing area, and associated infrastructure to support the relocation of a substantially reduced number of Marines and dependents than was previously analyzed (DON, 2015a). The Final SEIS analyzes the potential environmental impacts of five action alternatives for the cantonment/family housing component of the Proposed Action and five action alternatives for the LFTRC component, plus a No Action Alternative. The DON's preferred alternative is to construct and operate the proposed cantonment at the Naval Base Guam (NBG), Telecommunications Site at Finegayan (hereinafter "Finegayan"), the proposed family housing on Andersen AFB, and the proposed LFTRC at Northwest Field (NWF) on Andersen AFB.

Mariana Island Training and Testing: The DON conducts training and testing activities at the existing Mariana Islands Range Complex land-based training areas located on Guam, Saipan, Tinian, and Rota. This includes training activities at Andersen AFB, primarily aircraft activities at the airfield. The Final Supplemental EIS assessed the potential environmental impacts associated with ongoing military readiness activities (DON, 2020).

Two Marine Operation Locations: Sites 15B-4 and 15B-g in Munitions Storage Area (MSA) 1 have been identified as potential Marine operating locations and are sited for up to 250,000 pounds of hazard class/division (HC/D) 1.1 munitions. The proposed Marine operating locations have an approximate inter-magazine distance (IMD) of 680 feet that would impose siting constraints due to their explosives safety spacing requirements on the Proposed Action.

Marine Corps Earth-covered Magazines (ECMs): Three potential structure designs and location for six new ECMs for Marine Corps hazard class/division 1.1 munitions have been created with a total storage capacity of 110,500 pounds of NEW. Depending on a final decision for the location, number, and structure type, these facilities may have an effect on siting new munitions storage facilities. However, a preferred site and type of structure for this request has not been determined, and explosives safety distances for these facilities have not been considered a current constraint.

Beddown of Training and Support Initiatives at Northwest Field: This project establishes the relocation of a Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer of mobile engineering forces, the Pacific Air Force Commando Warrior training program, the Pacific Air Force SILVER FLAG training program, and a Combat Communication Squadron and its training program at the same location (USAF, 2006).

Construction of a Brown Treesnake Barrier at the Habitat Management Unit, and Construction of Five Well Sites, Andersen Air Force Base, Guam: The USAF proposes construction of a brown treesnake barrier at the Habitat Management Unit on Andersen AFB, as well as the construction of five well sites on base (USFWS, 2009).

Parachute Cargo Drop Training at Northwest Field on Andersen Air Force Base: A 248-acre parachute cargo drop training zone would be established at Area 2 of Northwest Feld (USAF, 2001). This would involve clearing approximately 165 acres of vegetation. Area 2 is in a designated military training area, and this would be an extension of the personnel drop zone training operations. USFWS and assisted in the selection process for Area 2 to avoid significant impacts to ESA-listed species.

Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam: The U.S. Army proposes to maintain its THAAD ballistic missile defense battery in Guam permanently at its current temporary location on NWF of Andersen AFB near the northern end of the island. As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam, the U.S. Army also proposes to expand the NWF cargo drop zone training area that was encumbered by THAAD operations. The THAAD Permanent Stationing in Guam also includes expansion of the Andersen AFB hazardous waste storage area to accommodate new hazardous waste volume associated with the THAAD operations. An EA was completed for this proposed project in March 2017 and the public comment period for the draft Finding of No Significant Impact ended on April 17, 2017.

Chemical Applications for Control of Brown Treesnakes: This project involves use of chemicals to help minimize and control the brown treesnake population on Guam. The method used would be the aerial application of acetaminophen-treated baits.

The following two projects have been proposed for MSA 1, but as of 2017 are not considered reasonably foreseeable.

Multiple Tactical Air-Munitions Rapid Response (TARRP) Facilities: Proposed TARRP facilities have been sited near the study area. Their proposed locations and explosives safety distance requirements limit the potential locations for new Hayman ECMs within the study area. Up to four aboveground magazines, two operations pads, a wood shop, an equipment storage facility, and a T-2 facility are proposed within MSA I. The proposed TARRP facilities have the following IMD:

- Aboveground magazines have an approximate IMD of 680 feet
- Operations pads have an approximate IMD of 694 feet
- The T-2 pad has an approximate IMD of 694 feet

Munitions Inspection Facility: A new munitions inspections and surveillance facility is proposed in the southeast corner of MSA I. The proposed facilities also impose siting constraints due to their explosives safety spacing requirements.

4.4 Cumulative Impact Analysis

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available and a qualitative analysis was undertaken. In addition, where an analysis of potential environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA where possible. The analytical methodology presented in Chapter 3, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

4.4.1 Air Quality

Cumulatively, short-term minor adverse effects on air quality would occur for all projects and the Proposed Action. Air emissions from construction equipment and activities would be short-term and would last only during active construction. Andersen AFB is in attainment for all criteria pollutants. Overall impacts on air quality during the operational phases of all projects, including the Proposed Action, would not be significant. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to air quality.

4.4.2 Water Resources

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam include requirements to obtain permits and prepare SWPPPs and EPPs to avoid and minimize impacts to water resources during construction and operations. It is assumed that the other present and reasonably foreseeable projects involving construction (Two Marine Operation Locations: Sites 15B-4, 15B-g Six Marine Corps Earth-covered Magazines, Beddown of Training and Support Initiatives at Northwest Field, Construction of a Brown Treesnake Barrier at the Habitat Management Unit, and Construction of Five Well Sites) would comply with federal guidance and regulations and include similar water resource protection measures. The Parachute Cargo Drop Training at Northwest Field is an addition to existing training in an established training area west of the MSA and would not require those water resource protection measures. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to water resources.

4.4.3 Geological Resources

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) include requirements to obtain permits and prepare SWPPPs and EPPs to avoid and minimize impacts to geological resources during construction and operations. Impacts to geological resources with the proposed THAAD Permanent Stationing in Guam project would be minimal because clearing and construction activities would be limited to surface disturbances and shallow excavations, include implementation of standard erosion control BMPs, and comply with applicable building standards for seismic risks and sinkholes associated with limestone karst. It is assumed that the other present and reasonably foreseeable projects involving construction would comply with federal regulations and include similar soil, bedrock, and seismic hazard protection measures. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to geological resources.

4.4.4 Cultural Resources

Potential impacts to cultural resources could occur for the additional projects and the Proposed Action. The DON will conduct appropriate consultations with Guam SHPO. Additionally, should any cultural resources be uncovered during any construction, all findings would be handled in accordance with the Final ICRMP for Andersen AFB (Andersen AFB, 2003) and consultation with the SHPO. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to cultural resources.

4.4.5 Biological Resources

Construction for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) LFTRC would be within NWF but away from the Proposed Action area. The USFWS determined that the action is not likely to appreciably reduce the survival and recovery of the Mariana eight-spot butterfly, *Dendrobium guamense*, *Tuberolabium guamense*, *Tabernaemontana rotensis*, *Heritiera longipetiolata*, *Cycas micronesica*, and *Bulbophyllum*. Impacts to biological resources with the proposed THAAD Permanent Stationing in Guam project would be minimal because clearing and construction activities would be limited to surface disturbances and shallow excavations. The other present and reasonably foreseeable projects construction would also involve clearing and construction activities. However, the cumulative vegetation removal would represent less than one percent of the *Tabernaemontana rotensis* and *Cycas micronesica* population on Guam. Furthermore, Section 7 ESA consultation with USFWS for the Proposed Action concluded there would be no significant cumulative effects to these species (see Appendix C). For the cargo parachute drop project at Northwest Field, the USFWS concurred that the prior disturbed areas of secondary limestone forest were not preferred or exclusive foraging habitat for ESA-listed species. USFWS assisted in the selection process for Area 2 to avoid significant impacts to ESA-listed species. Aerial application of acetaminophen for Brown treesnake control in the Habitat Management Unit would occur on Andersen AFB. DOD determined that the action may affect, but would not be likely to adversely affect *Cycas micronesica*, *Bulbophyllum guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Partula gibba*, *Partula radiolata*, and *Samoana fragilis*. The Proposed Action is likely to adversely affect the Mariana fruit bat. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would result in cumulative impacts to vegetation and wildlife. However, individual project impacts would be minimized through project-specific BMPs and conservation measures. In addition, the USFWS issued the Biological Opinion concluding the Proposed Action in this EA would not have cumulative effects to ESA-listed species (see Appendix C).

4.4.6 Noise

Construction for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) LFTRC would be within NWF and away from any sensitive human receptors. Construction areas along the access road to the LFTRC would be approximately 0.25 mile from the nearest receptors, a distance that is far enough from the source of temporary construction noise that there would be minimal noise effects on receptors. The LFTRC would be located at the remote northern tip of the Guam. Noise from LFTRC operations would not be audible in inhabited areas on or off Andersen AFB. Noise from other projects involving training at Northwest field (Beddown of Training and Support Initiatives and Parachute Cargo Drop Training) would be consistent with existing training activities conducted in that area and would not change the noise environment. Noise from the THAAD Permanent Stationing in Guam construction activities would not be discernable over ambient noise levels. Thus, there would be no significant noise

impacts from temporary site preparation and construction activities associated with this project. The THAAD operating location is about two miles from the nearest inhabited areas, so noise associated with THAAD operations would not be perceptible to sensitive receptors. The Proposed Action would have a temporary increase in ambient noise levels during construction that would not cause significant adverse impacts on the surrounding populations. Following construction of the Proposed Action, the ambient noise levels would return to their normal levels. No long-term noise impacts effects would occur as a result of the Proposed Action. The other present and reasonably foreseeable projects involving construction are located near the Proposed Action within MSA 1 and would involve similar types of construction activities and construction noise. Thus, it is assumed that these two projects would have noise impacts similar to those described for the Proposed Action, i.e., short-term increases in ambient noise levels that would not cause significant impacts on surrounding populations, followed by a return to normal ambient noise levels. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant noise impacts.

4.4.7 Infrastructure

Installation of new or modifications to existing electrical and potable water supply, sanitary sewer/portable latrines, storm drainage, and communications systems are included as part of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam projects. It is assumed that the other present and reasonably foreseeable projects involving construction would include electrical and telecommunications utilities if needed and implement standard construction measures to avoid damage to any existing utilities in their respective project areas. There would be no adverse effects on infrastructure associated with the Proposed Action. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to infrastructure.

4.4.8 Transportation

The Guam and CNMI Military Relocation (2012 Roadmap Adjustments) project would result in potential short-term traffic delays on Andersen AFB roadways during the construction phase. The delays would be minimized with appropriate construction work zone traffic management strategies and BMPs. This project includes a new Andersen AFB main gate and new Commercial Vehicle/Tactical Vehicle Gate on Route 3A to relieve congestion at the existing main gate at the junction of Highways 1 and 9. However, there would still be multiple significant impacts to traffic on off-base roadways and intersections associated with the operational phase of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) project. The project includes potential mitigation measures to minimize these impacts. The THAAD Permanent Stationing in Guam would have minimal short-term traffic localized traffic delays during construction. Following construction, the THAAD mission would include the existing workforce of 200 military personnel, and an additional small workforce comprising more military personnel and no more than 50 contract workers at any one time. Thus, the increase in vehicle trips that the THAAD Permanent Stationing would add would not cause major increases to on base or off base roadway use. The Proposed Action would cause temporary, minimal traffic delays during the construction phase, which would cease upon completion of construction. The other present and reasonably foreseeable projects involving construction are located near the Proposed Action within MSA 1 and would involve similar types of construction activities. Thus, it is assumed that these two projects would have traffic impacts similar to those described for the Proposed Action, i.e., short-term increases traffic delays that would cease upon completion of construction. Impacts to transportation associated with the Proposed

Action would be negligible in comparison to those from the Guam and CNMI Military Relocation (2012 Roadmap Adjustments). However, the project includes widening two segments of Route 1, three segments of Route 3, and one segment of Route 28 as mitigation. Additional traffic mitigation for this project includes improvements at two intersections on Route 3 and at nine intersections on Route 1. Therefore, implementation of the Proposed Action, in combination with other present and reasonably foreseeable projects would not result in significant impacts to transportation.

4.4.9 Public Health and Safety

According to completed NEPA documentation, the construction and operational phases of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam would have no significant impacts to public health and safety. For the reasons described in Section 3.9 of this EA, the Proposed Action is not anticipated to result in significant impacts to public health and safety. It is assumed that the other present and reasonably foreseeable projects involving construction would incorporate Occupational Safety and Health Administration worker health and safety protection, and UXO/MEC avoidance measures similar to those included in the Proposed Action. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to public health and safety for all projects and the Proposed Action.

4.4.10 Hazardous Materials and Wastes

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and THAAD Permanent Stationing in Guam would not disturb or interfere with investigation/cleanup activities at IRP sites within MSA 1 and NWF. Construction activities for these two projects would involve the use of fuels, hydraulic fuels, and solvents, similar to the Proposed Action. However, similar to the Proposed Action these two reasonably foreseeably projects are required to comply with federal regulations for the storage, management, and disposal of hazardous materials and waste. The Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam include multiple plans, BMPs, and procedures to avoid and minimize potential hazardous materials and hazardous waste impacts during construction and operations. It is assumed that the other present and reasonably foreseeable projects involving construction (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would not disturb IRP sites, and would comply with federal regulations and include hazardous materials and waste impact minimization measures. The projects at Northwest Field involving training would not introduce new types of activities to this existing training area; no effects involving hazardous materials and wastes are associated with these activities. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts with respect to hazardous materials and waste for all projects and the Proposed Action.

5 Other Considerations Required by NEPA

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

In accordance with 40 Code of Federal Regulations (CFR) Section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 5-1 identifies the principal federal laws and regulations that are applicable to the Proposed Action and describes briefly how compliance with these laws and regulations would be accomplished.

5.2 Irreversible or Irretrievable Commitments of Resources

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

The irreversible environmental changes that would result from implementation of the Proposed Action involve the consumption of energy resources, biological habitat, and human resources. The use of these resources is permanent. For the Proposed Action, consumption of energy and human resources are not significant. The potential loss of low-quality non-native biological habitat would be an irreversible and irretrievable commitment of resources. Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that use of these resources will have on future generations. Irreversible effects primarily result from use or destruction of a specific resource that cannot be replaced within a reasonable timeframe (e.g., energy and minerals).

5.3 Unavoidable Adverse Impacts

While some aspects of the Proposed Action would result in adverse effects, most of the anticipated environmental effects are associated with construction and would be short-term. Construction activities would comply with federal regulations and ordinances, including BMPs, which would reduce the potential for adverse effects. However, this Environmental Assessment (EA) has determined that the alternatives considered may result in significant impacts to natural resources. The loss of high-value native and low-value non-native biological habitat would be considered unavoidable adverse impacts.

5.4 Relationship between Short-Term Use of the Environment and Long-Term Productivity

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

Table 5-1 Principal Federal Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	***Status of Compliance***
National Environmental Policy Act (NEPA); Council on Environmental Quality NEPA implementing regulations; Navy procedures for Implementing NEPA	Complies (EA prepared)
Clean Air Act	Complies (does not exceed *de minimis* levels)
Clean Water Act	Complies
Rivers and Harbors Act	Not applicable
Coastal Zone Management Act	Complies (based on coastal consistency analysis, see Appendix E)
National Historic Preservation Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Archaeological and Historic Preservation Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Archaeological Resources Protection Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Endangered Species Act	Complies (based on Section 7 ESA consultation, see Section 3.5)
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	Not applicable
Marine Mammal Protection Act	Not applicable
Migratory Bird Treaty Act	Complies
Bald and Golden Eagle Protection Act	Not applicable
Comprehensive Environmental Response and Liability Act	Complies
Emergency Planning and Community Right-to-Know Act	Complies
Federal Insecticide, Fungicide, and Rodenticide Act	Complies
Resource Conservation and Recovery Act	Complies
Toxic Substances Control Act	Complies
Farmland Protection Policy Act	Not applicable
Executive Order (EO) 11988, Floodplain Management	Complies
EO 12088, Federal Compliance with Pollution Control Standards	Complies
EO 12114, Environmental Effects Abroad of Major Federal Actions (Department of Navy implementing regulation 32 CFR part 287)	Not applicable
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	Complies
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	Complies
EO 13089, Coral Reef Protection	Not applicable
EO 13175, Consultation and Coordination with Indian Tribal Governments	Not applicable
EO 13834, Efficient Federal Operations	Complies

For the Proposed Action, construction-related effects are minor and would not result in loss of long-term productivity. The long-term use of MSA I will continue to be for munitions storage and operations. The Proposed Action has the potential to result in long-term adverse effects on sensitive species habitat and potentially to sensitive archaeological and historic resources. However, the BMPs and conservation measures identified in this EA would support the long-term use of MSA I military operations and biological habitat. The construction and operation of proposed ECMs would not significantly impact the long-term natural resource productivity of the area. Therefore, the Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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8 Distribution List

The Draft EA was distributed to the agencies listed below.

8.1 Department of Defense

Andersen Air Force Base (AFB), Guam

Chief of Naval Operations, N45

Commonwealth of the Northern Mariana Islands Joint Region Marianas (JRM) Coordination Office

Naval Facilities Engineering Command (NAVFAC) Marianas, Guam

NAVFAC Headquarters

NAVFAC Pacific

Pacific Air Forces (PACAF)

8.2 Government Agencies

Guam Bureau of Statistics and Plans

Guam Department of Agriculture

Guam Department of Land Management

Guam Department of Parks and Recreation, Historic Resources Division

Guam Department of Public Works

Guam Division of Aquatic and Wildlife Resources (DAWR)

Guam Environmental Protection Agency

Guam Water Works Authority

U.S. Fish and Wildlife Service (USFWS)

8.3 Libraries

Dededo Public Library

Nieves M. Flores Memorial Library

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Appendix A
Public and Agency Participation

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The U.S. Air Force published a Notice of Availability of the Draft Environmental Assessment (EA) for three consecutive days in the Pacific Daily News. An example newspaper advertisement is shown on the following page. The Draft EA review period was 31 January to 21 February 2020. The notice described the Proposed Action, solicited public and agency comments on the Draft EA, provided dates of the open comment period, and announced that a copy of the EA would be available for review. The Draft EA was made available for review by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; and the Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam. The Draft EA was also made available on the following website: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information/environmental-assessments-availble-for-public-review.html

No public comments were received.

Pacific Daily News - 01/31/2020 Copy Reduced to 77% from original to fit a4 page

Lifestyle

40-Year-Old

Continued from Page 28

TV. I got a job. Someone had seen a play of mine and they hired me to adapt a book. And I got fired off the job. And I was kind of devastated and felt a little powerless and just decided, you know what? (Expletive) it. I'm going to make a web series so that I'm in charge. No one can fire me. About two weeks before we were going to shoot the first two episodes, my mom passed away and it pretty much devastated my life. Like we were like Dorothy and Sophia domestically, as a viewer of "The Golden Girls." We shared the same birthday and she's the person who nurtured all these storytelling seeds in me. I was probably going to quit anything creative because my biggest champion and friend was now gone. I was going to go back to school and become a social worker. I'm glad I didn't. I probably saved more children by not becoming a social worker.

AP: Is your protagonist you?

Blank: It's me but a heightened version. She is who I wish I could be all the time. She tells it like it is. What we have in common is how we use rejection to fuel an idea. My character, the idea of her becoming a rapper is a joke until she starts rhyming. And for me, when I first decided I wanted to shoot this in black and white. Everyone was like, why would you do that? It's a matter of trusting your impulses.

AP: How does it feel to be making your filmmaking debut at this stage in your life?

Blank: "Auteurs" are reserved for older filmmakers. And groundbreaking, fresh films seems to be associated with young filmmakers. I'm somewhere in the middle. I've been telling and crafting stories for over 20 years. When it came time to make the film, I knew exactly what it is I wanted to say. For people who know me and know my work, it was just a matter of time before I got here. It's kind of this idea that we never stop learning about who you are. You can have revelations about yourself and what you should be doing at any age.

Radha Blank wrote, directed and stars in her debut film, "The 40-Year-Old Version," which is premiering at the Sundance Film Festival. TAYLOR JEWELL/INVISION/AP

AP: And that includes rapping for you. But you bring a different perspective to hip-hop.

Blank: It's all of the bravado of hip-hop but it's from a person whose body is changing. There's some hot flashes in there. AARP is sending me (expletive) in the mail. I know a lot of people who feel that way, I just don't see it reflected in mainstream culture. Especially with hip-hop. I love this culture. I am the same age as hip-hop culture. Some of the culture is over-sexualized and over-saturated and so loud. That's part of why I wanted to film it in black and white. Black and white cools it down.

AP: Before Sundance, a lot of the conversation was disappointment in the homogeneity of the filmmakers being celebrated at the Oscars.

Blank: I was disappointed but I wasn't surprised. To me, it fluctuates very much like mainstream culture. Whatever is decided to be the thing is the thing. For one year, the thing was diversity. I don't know that it is now. When I think about some of the performances I saw in film, like "The Last Black Man in San Francisco" or Adam Sandler. Wait, Adam Sandler doesn't get it? If Adam Sandler doing his best work isn't getting acknowledged, then maybe we need to create new platforms of recognition and stop giving the Oscars so much power. It's kind of like my protagonist. This is about a person who just has to pivot their head and realize there are other kinds of success. It might be time to look in other directions to find that.

NOTICE OF AVAILABILITY OF THE PUBLIC DRAFT ENVIRONMENTAL ASSESSMENT FOR MUNITIONS STORAGE IGLOOS AT ANDERSEN AIR FORCE BASE, GUAM

Pursuant to the Council on Environmental Quality regulations (40 Code of Federal Regulations Parts 1500-1508) implementing the National Environmental Policy Act (NEPA), the United States (U.S.) Air Force gives notice that a Draft Environmental Assessment (EA) has been prepared for the proposed munitions storage igloos at Andersen Air Force Base (AFB) and is available for public review and comment.

The purpose of and need for the Proposed Action is to enable Andersen AFB to fulfill its mission of providing a sufficient supply of new, highly sophisticated munitions deemed critical in the initial stages of any armed conflict in the region. To fully achieve this mission, 280,000 square feet of additional munitions storage capacity and associated infrastructure upgrades are needed. The Proposed Action is needed to enable the 36th Wing (36 WG) at Andersen AFB to perform its existing mission and ongoing military operations by providing adequate munitions storage. New earth-covered magazines (ECMs) would be constructed to meet this need.

The public is invited and encouraged to participate in the NEPA process by reviewing and commenting on the Draft EA. The Draft EA is available for public comment at: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/draft_ea.html. It may also be reviewed by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street, Hagatna, Guam; and Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam.

Written comments may be provided by email to NFPAC-Receive@navy.mil or by mail to: Naval Facilities Engineering Command Pacific, Building 258 Makalapa Drive, Suite 100, JBPHH, HI 96860-3134, Attn: EV21 Andersen AFB Munitions Storage Igloos EA Project Manager. Comments on the Draft EA must be received or postmarked by February 21, 2020 to be considered in the final draft of the EA.

Appendix B
Air Quality Methodology and Calculations

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Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2020
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase for Phase 2 will be less than needed for Phase 3, but more than Phase 4.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	9.0652	4.3694	3.2548	8.0600e-003	0.5767	0.1886	0.7653	0.2392	0.1763	0.4155	0.0000	739.0186	739.0186	0.0987	0.0000	741.4858
Maximum	**9.0652**	**4.3694**	**3.2548**	**8.0600e-003**	**0.5767**	**0.1886**	**0.7653**	**0.2392**	**0.1763**	**0.4155**	**0.0000**	**739.0186**	**739.0186**	**0.0987**	**0.0000**	**741.4858**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	9.0652	4.3694	3.2548	8.0600e-003	0.4073	0.1886	0.5959	0.1478	0.1763	0.3241	0.0000	739.0183	739.0183	0.0987	0.0000	741.4854
Maximum	**9.0652**	**4.3694**	**3.2548**	**8.0600e-003**	**0.4073**	**0.1886**	**0.5959**	**0.1478**	**0.1763**	**0.3241**	**0.0000**	**739.0183**	**739.0183**	**0.0987**	**0.0000**	**741.4854**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.37**	**0.00**	**22.14**	**38.23**	**0.00**	**22.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2018	1/2/2018	5	2	
2	Building Construction	Building Construction	1/1/2018	8/14/2018	5	162	
3	Demolition	Demolition	1/1/2018	1/1/2018	5	1	
4	Grading	Grading	1/1/2018	1/12/2018	5	10	
5	Paving	Paving	1/1/2018	1/5/2018	5	5	
6	Site Preparation	Site Preparation	1/1/2018	2/9/2018	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2021
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase for Phase 3 will be more than needed for Phase 2 and Phase 4.

Off-road Equipment - Assumption: Slightly more equipment will be needed for the construction of 20 igloos.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	9.0878	4.5316	3.4798	8.7600e-003	0.6450	0.1905	0.8355	0.2728	0.1785	0.4513	0.0000	795.8609	795.8609	0.1088	0.0000	798.5810
Maximum	**9.0878**	**4.5316**	**3.4798**	**8.7600e-003**	**0.6450**	**0.1905**	**0.8355**	**0.2728**	**0.1785**	**0.4513**	**0.0000**	**795.8609**	**795.8609**	**0.1088**	**0.0000**	**798.5810**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	9.0878	4.5316	3.4798	8.7600e-003	0.4458	0.1905	0.6363	0.1650	0.1785	0.3435	0.0000	795.8605	795.8605	0.1088	0.0000	798.5806
Maximum	**9.0878**	**4.5316**	**3.4798**	**8.7600e-003**	**0.4458**	**0.1905**	**0.6363**	**0.1650**	**0.1785**	**0.3435**	**0.0000**	**795.8605**	**795.8605**	**0.1088**	**0.0000**	**798.5806**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**30.88**	**0.00**	**23.84**	**39.52**	**0.00**	**23.89**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2019	1/3/2019	5	3	
2	Building Construction	Building Construction	1/1/2019	8/26/2019	5	170	
3	Demolition	Demolition	1/1/2019	1/1/2019	5	1	
4	Grading	Grading	1/1/2019	1/17/2019	5	13	
5	Paving	Paving	1/1/2019	1/10/2019	5	8	
6	Site Preparation	Site Preparation	1/1/2019	2/18/2019	5	35	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	2	8.00	46	0.45

Trips and VMT

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos as compared to the other two phases.

Off-road Equipment -

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Off-road Equipment -

Off-road Equipment -

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos as compared to the other two phases.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.9260	3.1496	2.5435	7.5500e-003	0.4455	0.1099	0.5554	0.1617	0.1033	0.2650	0.0000	687.7042	687.7042	0.0747	0.0000	689.5712
Maximum	**8.9260**	**3.1496**	**2.5435**	**7.5500e-003**	**0.4455**	**0.1099**	**0.5554**	**0.1617**	**0.1033**	**0.2650**	**0.0000**	**687.7042**	**687.7042**	**0.0747**	**0.0000**	**689.5712**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.9260	3.1496	2.5435	7.5500e-003	0.3589	0.1099	0.4688	0.1158	0.1033	0.2191	0.0000	687.7040	687.7040	0.0747	0.0000	689.5710
Maximum	**8.9260**	**3.1496**	**2.5435**	**7.5500e-003**	**0.3589**	**0.1099**	**0.4688**	**0.1158**	**0.1033**	**0.2191**	**0.0000**	**687.7040**	**687.7040**	**0.0747**	**0.0000**	**689.5710**

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2020	1/1/2020	5	1	
2	Building Construction	Building Construction	1/1/2020	9/1/2020	5	175	
3	Demolition	Demolition	1/1/2020	1/1/2020	5	1	
4	Grading	Grading	1/1/2020	1/7/2020	5	5	
5	Paving	Paving	1/1/2020	1/3/2020	5	3	
6	Site Preparation	Site Preparation	1/1/2020	1/21/2020	5	15	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	1	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	2	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	1	8.00	130	0.42
Paving	Rollers	1	8.00	80	0.38
Demolition	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	1	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2020
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment -

Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	8.9115	4.3474	3.2395	8.0000e-003	0.5740	0.1882	0.7622	0.2385	0.1760	0.4145	0.0000	733.7142	733.7142	0.0982	0.0000	736.1702
Maximum	**8.9115**	**4.3474**	**3.2395**	**8.0000e-003**	**0.5740**	**0.1882**	**0.7622**	**0.2385**	**0.1760**	**0.4145**	**0.0000**	**733.7142**	**733.7142**	**0.0982**	**0.0000**	**736.1702**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	8.9115	4.3474	3.2395	8.0000e-003	0.4046	0.1882	0.5928	0.1470	0.1760	0.3230	0.0000	733.7138	733.7138	0.0982	0.0000	736.1699
Maximum	**8.9115**	**4.3474**	**3.2395**	**8.0000e-003**	**0.4046**	**0.1882**	**0.5928**	**0.1470**	**0.1760**	**0.3230**	**0.0000**	**733.7138**	**733.7138**	**0.0982**	**0.0000**	**736.1699**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.51**	**0.00**	**22.23**	**38.35**	**0.00**	**22.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2018	1/2/2018	5	2	
2	Building Construction	Building Construction	1/1/2018	8/15/2018	5	163	
3	Demolition	Demolition	1/1/2018	12/31/2017	5	20	
4	Grading	Grading	1/1/2018	1/12/2018	5	10	
5	Paving	Paving	1/1/2018	1/5/2018	5	5	
6	Site Preparation	Site Preparation	1/1/2018	2/9/2018	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2021
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	8.8639	4.0041	3.0560	7.9100e-003	0.5740	0.1651	0.7391	0.2385	0.1543	0.3928	0.0000	722.1191	722.1191	0.0959	0.0000	724.5172
Maximum	**8.8639**	**4.0041**	**3.0560**	**7.9100e-003**	**0.5740**	**0.1651**	**0.7391**	**0.2385**	**0.1543**	**0.3928**	**0.0000**	**722.1191**	**722.1191**	**0.0959**	**0.0000**	**724.5172**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	8.8639	4.0041	3.0560	7.9100e-003	0.4046	0.1651	0.5697	0.1470	0.1543	0.3014	0.0000	722.1187	722.1187	0.0959	0.0000	724.5169
Maximum	**8.8639**	**4.0041**	**3.0560**	**7.9100e-003**	**0.4046**	**0.1651**	**0.5697**	**0.1470**	**0.1543**	**0.3014**	**0.0000**	**722.1187**	**722.1187**	**0.0959**	**0.0000**	**724.5169**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.51**	**0.00**	**22.92**	**38.35**	**0.00**	**23.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2019	1/2/2019	5	2	
2	Building Construction	Building Construction	1/1/2019	8/15/2019	5	163	
3	Demolition	Demolition	1/1/2019	12/31/2018	5	20	
4	Grading	Grading	1/1/2019	1/14/2019	5	10	
5	Paving	Paving	1/1/2019	1/7/2019	5	5	
6	Site Preparation	Site Preparation	1/1/2019	2/11/2019	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Off-road Equipment -

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Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterExposedAreaPM10PercentReduction	55	61
tblConstDustMitigation	WaterExposedAreaPM25PercentReduction	55	61
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	40	0
tblConstructionPhase	NumDays	20.00	1.00
tblConstructionPhase	NumDays	300.00	166.00
tblConstructionPhase	NumDays	20.00	10.00
tblConstructionPhase	NumDays	30.00	5.00
tblConstructionPhase	NumDays	20.00	3.00
tblConstructionPhase	NumDays	10.00	15.00
tblConstructionPhase	PhaseEndDate	12/31/2019	1/1/2020
tblConstructionPhase	PhaseEndDate	12/31/2019	8/19/2020

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.7659	3.0999	2.4676	7.2900e-003	0.4535	0.1093	0.5629	0.1609	0.1028	0.2637	0.0000	664.2059	664.2059	0.0736	0.0000	666.0448
Maximum	**8.7659**	**3.0999**	**2.4676**	**7.2900e-003**	**0.4535**	**0.1093**	**0.5629**	**0.1609**	**0.1028**	**0.2637**	**0.0000**	**664.2059**	**664.2059**	**0.0736**	**0.0000**	**666.0448**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.7659	3.0999	2.4676	7.2900e-003	0.3425	0.1093	0.4518	0.1077	0.1028	0.2105	0.0000	664.2057	664.2057	0.0736	0.0000	666.0445
Maximum	**8.7659**	**3.0999**	**2.4676**	**7.2900e-003**	**0.3425**	**0.1093**	**0.4518**	**0.1077**	**0.1028**	**0.2105**	**0.0000**	**664.2057**	**664.2057**	**0.0736**	**0.0000**	**666.0445**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**24.49**	**0.00**	**19.73**	**33.06**	**0.00**	**20.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2020	1/1/2020	5	1	
2	Building Construction	Building Construction	1/1/2020	8/19/2020	5	166	
3	Demolition	Demolition	1/1/2020	1/14/2020	5	10	
4	Grading	Grading	1/1/2020	1/7/2020	5	5	
5	Paving	Paving	1/1/2020	1/3/2020	5	3	
6	Site Preparation	Site Preparation	1/1/2020	1/21/2020	5	15	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	1	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
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Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	1	8.00	130	0.42
Paving	Rollers	1	8.00	80	0.38
Demolition	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
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Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	1	8.00	132	0.36
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Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Appendix C
Endangered Species Act Documentation

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122,
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2019-F-0012

Captain D.P. Turner
Civil Engineer Corps, U.S. Navy
Regional Engineer
Joint Region Marianas
PCS 455, Box 211
FPO AP 96540-1000

Subject: Formal Section 7 Consultation for the Construction of Munition Storage Igloos on Andersen Air Force Base, Guam

Dear Captain Turner:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of the Department of the Navy's (DON) October 10, 2018 letter and enclosure requesting formal section 7 consultation to address potential impacts to federally listed species due to the actions associated with the construction of Munitions Storage Area (MSA) Igloos on Andersen Air Forces Base, Guam pursuant to 50 CFR §402.14 of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended. Your request for formal consultation addresses potential adverse effects to two threatened plants *Cycas micronesica* and *Tabernaemontana rotensis*, the endangered Guam tree snail (*Partula radiolata*), humped tree snail (*Partula gibba*), and fragile tree snail (*Samoana fragilis*) due to clearing and construction of 48 new munition storage units and associated utilities as a result of mission related storage deficits. You also requested concurrence that the proposed project may affect, but is not likely to adversely affect the following federally listed species: the threatened Mariana fruit bat (*Pteropus marianannus mariannus*), the endangered Guam rail (*Gallirallus owstoni*), and Mariana crow (*Corvus kubaryi*).

We appreciate recent discussions we have had with the DON regarding this, and other, consultations in the Marianas, and look forward to closely working with your staff on the consultation for this project. The information necessary to initiate formal consultation for the MSA Igloos project was included in your October 10 letter and enclosure (*Biological Assessment for the Construction of 48 Munition Storage Igloos at Andersen AFB, Guam* (Biological Assessment) or discussed during an in-person meeting in Hawaii on October 24, 2018. However, a few clarifications to the information provided in the Biological Assessment are needed for the Service to proceed with the Biological Opinion. We will proceed with the consultation, based on

the information that has already been provided, but we may need to suspend the consultation if the clarifying information is not provided in a timely fashion. The Service typically has 135 days to prepare and finalize out Biological Opinion, which based on your initiation request dated October 10, 2018, the due date would be February 22, 2019. You have requested that we expedite the consultation and provide the Biological Opinion to you by January 31, 2018. The Service will attempt to expedite delivery of the Biological Opinion by that date, but we cannot guarantee it will be completed by that date.

Please add/clarify the following detail to your revised BA:

- When construction is anticipated to start and how long it is anticipated to take;
- How long before construction "pre-construction surveys" will be done;
- Throughout- "DoD approved native plant nurseries" should be revised to "a plant nursery that meets the Hawaii Rare Plant restoration guidelines in accordance with the requirements of a valid 10(a)(1)(A) permit";
- A long-term management plan or at least specific conditions with sufficient detail to describe the potential translocation sites (i.e. Tarague Basin) is needed since both plants and all snails are proposed to be translocated to this (or another) site;
- Rather than 50% survival for translocated individuals, we need an absolute number;
- In **2.3 Best Management Practices, (2) Mariana Fruit Bat**, you state that "If a fruit bat moves into the project footprint while work is ongoing, work may continue to proceed." The Service believes that this practice is likely to adversely affect the species. Therefore, we recommend that this sentence be removed to reflect that work will halt if a fruit bat enters the selected site. Alternatively, the consultation can be revised to formally consult on Mariana fruit bats;
- In **Conservation Measures**
    - You state that these conservation measures are meant to "off-set the effects of forest clearing and removal of plants in the construction site". You are only collecting a commensurate number of *T. rotensis* seeds and have not explicitly stated that more than one cycad pup will when possible be detached, salvaged and translocated. Is it possible to add language to detail that you will collect the maximum number of *T. rotensis* seeds and cycad pups as possible? If there is only a 50% survival of a commensurate number of seed, this by definition cannot offset the action.
- In **Specific information for *Cycas micronesica***
    - Please provide more detail about cycad pup salvage. If pups are detached, is the goal to take as many as possible?
    - Please clarify in the sentence "All cycads suitable for salvage…" that this refers to whole plants and as many pups as possible.
    - By providing a specific number of individuals that would survive translocation, the following statement is not necessary. If the DON decides to include it, we recommend modifying as follows; "The DON will translocate as many cycads and *T. rotensis* as possible, however the number of individuals salvaged will be

dependent on the health of the plant and whether or not it would survival transplantation."In **Specific information for *Tabernaemontana rotensis***
    - Mirror detail provided for Cycads (i.e. define survivorship, how long will maintenance and monitoring be done-or when it will stop, etc.)
- In **Specific information for Partulid Snail Species**
    - The translocation site needs to be identified, or if it cannot be identified in advance, the habitat characteristics that will be present at the translocation recipient site must be described, because it is part of the action.
    - The biologist must have a 10(a)1(A) permit, therefore statements of qualifications are not necessary
- In **Potential Direct and Indirect Effects to *Cycas micronesica***
- In **Annual Reporting of Propagation/Translocation Activities**
    - Provide more detail about the information that will be included in annual reports and the timing of those reports.

As a reminder, the ESA requires that after initiation of formal consultation, the Federal action agency may not make any irreversible or irretrievable commitment of resources that limits future options. This practice ensures agency actions do not preclude the formulation or implementation of reasonable and prudent alternatives that avoid jeopardizing the continued existence of endangered or threatened species or destroying or modifying their critical habitats.

We appreciate your efforts to protect listed species and can offer any assistance in your effects determinations and development of avoidance, minimization and mitigation measures. If you have questions regarding our response or require our technical assistance, please contact Toni Mizerek (toni_mizerek@fws.gov, 671-989-6746).

Sincerely,

for

Jacqueline Flores
Island Team Manager
Mariana Islands

cc: Celestino Aguon, Guam Department of Agriculture, Division of Wildlife and Aquatic Resources

Biological Opinion for MSA Igloos

Photo Credit: United States Navy

June 30, 2020
(01EPIF00-2019-F-0012)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2019-F-0012

June 30, 2020

Jeffrey Laitila
36 CES/CEV Flight Chief
Andersen AFB Guam
Unit 14007
APO AP 96543-4007

Dear Mr. Laitila:

This document transmits the U.S. Fish and Wildlife Service's (USFWS or Service) biological opinion (BiOp) based on our review of the U.S. Department of the Navy (DON) proposed construction and operation of 48 earth-covered magazines (ECMs), also referred to as munition storage igloos, within the Munition Storage Area (MSA) I located on Andersen Air Force Base (AAFB), Guam, and its effects on the threatened Mariana Fruit bat (*Pteropus mariannus mariannus*), *Cycas micronesica*, and *Tabernaemontana rotensis* (Table 1) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Your Biological Assessment (BA), containing sufficient information for the Service to complete this formal consultation was received on April 21, 2020.

This BiOp is based on information provided in the April 21, 2020 BA, previous correspondence between the Service, Air Force and DON, and information in Service files. A complete consultation record is on file at the Pacific Islands Fish and Wildlife Office (PIFWO).

Table 1: Species considered in this biological opinion.

Common Name	Latin Name	Listing Status	Critical Habitat	Effect Determination
Mariana Fruit Bat	*Pteropus mariannus mariannus*	T	NA	Likely to adversely affect
NA	*Cycas micronesica*	T	NA	Likely to adversely affect
NA	*Tabernaemontana rotensis*	T	NA	Likely to adversely affect

Consultation History

10/10/2018. USFWS received BA and request for formal consultation via email.

10/25/2018. DON and USFWS meet to discuss BA. USFWS to send comments on BA.

11/8/2018. USFWS sent a letter acknowledging the information necessary to initiate formal consultation was included in the October 10 letter and BA. Letter identified information requested to add/clarify the detail in the BA. Consultation number 01EPIF00-2019-F-0012 assigned to the project.

11/29/2018. DON submitted revised BA to USFWS with the requested information from the 11/8/2018 USFWS letter via email.

12/12/2018. USFWS-DON teleconference to discuss outstanding issues and BA revision.

12/13/2018. DON provides Mariana fruit bat (fanihi) survey methodology for Habitat Management Unit (HMU) via email.

12/14/2018. USFWS reviews and approves fanihi survey methodology via email.

12/19/2018. USFWS sends clarification regarding 10(a)(1)(A) permit requirement for potential handling of snails via email.

1/31/2019. USFWS-DON teleconference to discuss outstanding issues.

2/7/2019. USFWS provides DON with a draft snail survey protocol via email.

2/8/2019. DON seeks direction from AAFB leadership on whether to pause consultation until snail surveys are completed (email).

2/21/2019. USFWS sends email pausing consultation retroactive to 2/8/2019 (see above).

3/6/2019. DON acknowledges receipt of 2/21/2019 email and indicates AAFB is pursuing modification of University of Guam (UOG) contract for snail surveys (telephone conversation). Pending funding process, surveys expected to be completed by the end of April.

4/25/2019. USFWS requests clarification on status of consultation and use of Tarague Triangle fence via email.

6/26/2019. USFWS requests update on status of consultation.

7/15/2019. USFWS requests update on status of consultation.

7/15/2019. DON reports that snail and cycad survey contract have been awarded and are about to begin.

9/16/2019. DON email states cycad and snail surveys near completion and revised BA is expected by the end of the month.

9/20/2019. DON email requests call or meeting with USFWS.

10/2019. DON submits revised BA with snail survey report submitted to USFWS (version 3).

11/20/2019. USFWS provides comments on BA (version 3).

1/27/2020. DON submits revised BA (version 4).

2/25/2020. USFWS provides comments on BA (version 4).

3/23/2020. USFWS provides recommendations for cycad pup collection, nursery growth, and outplanting.

4/09/2020. DON and USFWS teleconference to discuss updates to draft BA.

4/21/2020. DON submits final BA for USFWS review.

4/28/2020. USFWS letter acknowledging initiation of formal consultation with DON.

BIOLOGICAL OPINION

Description of Proposed Action

The 36th Wing (WG) Commander proposes to construct new munitions storage facilities and infrastructure upgrades in MSA I. The action incudes building 48 ECMs within a 51-acre construction footprint. The ECMs will be arranged side by side along 5th to 8th Streets between C Avenue and E Avenue. The DON has chosen this arrangement because it reduces operational impacts to existing ECMs and does not require the need to demolish operating munitions storage units.

Other alternatives have been analyzed and eliminated from detailed evaluation in the Draft Environmental Assessment (EA) due to the current 36th WG munitions storage capacity deficit (DON 2018). Natural resources including protected species are just one environmental media analyzed in the DON's Draft EA. Demolishing ECMs that are operational without immediate replacement would cause a storage shortfall. In order to upgrade or replace any one of the existing storage magazines, the munitions in that existing magazine (and possibly surrounding magazines) would have to be temporarily relocated for safety purposes. No other location on AAFB can safely accommodate a temporary relocation of munitions from the existing ECMs. The only safe option would be to temporarily store munitions at an installation other than AAFB during renovation or construction periods. The 36th WG would not be able to meet their current mission requirements if their existing capabilities were further reduced by temporarily storing munitions at other installations.

Layout of the Munition Storage Facilities

The magazine storage area consists of ECMs arranged in rows linked together by a network of roads. A grassy buffer area approximately 20 feet surrounds each magazine. The area beyond the buffer is highly fragmented forest that separates rows of munitions magazines. The land area

shows signs of past land grading. Historically, the area was impacted by agroforestry, small-scale agriculture, and military use during World War II (Cardno 2017).

The proposed Hayman-style ECMs would be used to store up to 500,000 pounds of munitions. The 48 ECMs would be arranged in various clusters with 8 ECMs along 8th Street, 2 along 7th Street, 25 along 6th Street, and 13 along 5th Street. Each magazine would be 81 feet long by 25 feet wide for an area of 2,400 square feet. The walls and roof are designed to be covered in a minimum of 24 inches of fill with a topping of shotcrete to prevent plant growth and erosion. Access to the storage area would be provided through a pair of blast-resistant structural steel access doors. Each ECM would have a concrete apron connecting it to the roadway. Spacing between each ECM would be approximately 50 feet, and a buffer area of 50 feet will be spaced around each cluster. This buffer area will be cleared of vegetation, graded for water drainage, and managed for grass cover. The total area to be cleared to create a grassy buffer zone will be 21 acres. Total area of impact for all the construction will be 51 acres.

Existing access roads from 5th to 8th Streets are in poor condition and will be improved with pavement. New roads will be 24 feet wide with 2 foot shoulders and constructed of asphaltic concrete. Concrete aprons 24 feet long and 26 feet wide will connect the ECMs to the road. A staging area to hold equipment and materials for the construction phase is also planned. It will clear 1.6 acres of previously disturbed shrub and grassy area near the northern corner of 5th Street and D Avenue.

A utility connection line will provide communication and electrical service to all of the storage units. The line will connect each ECM and other clusters of magazines by underground utility corridor duct banks or trench. The duct banks would be 2 to 4 feet (60 to 122 m) deep and 6 feet (1.8 m) wide with a cleared area of 6 feet (1.8 m) for back hoe. Total width of the corridor will be a 12 feet (3.6 m) wide path. Some of these lines are sited through forest along Avenue D and will require clearing. A pad-mounted transformer and new building with standby generator will be constructed at the intersection of 5th Street and D Avenue.

Site Preparation and Construction Activities

During site preparation, surface vegetation will be cleared and grubbed (i.e., roots and stumps extracted), and the ground will be excavated for the storage unit flooring. Ground disturbance during construction will include site grading to establish positive drainage control and creation of a perimeter mound to control runoff. Best management practices for soil erosion and sedimentation control will be implemented in accordance with project-specific drainage and erosion control plans. ECMs is planned to be constructed in three phases starting with 20 ECMs roughly along D Avenue, 16 ECM along 5th and 6th Street, and 12 ECMs along 6th Street. Project construction is planned to begin in March 2021.

Night construction will not occur as part of this project and all noise generating construction will end approximately 30 minutes before sunset.

Best Management Practices

DON will implement the following efforts as best management practices (BMP) to avoid and minimize impacts to ESA-listed species that occur within the project footprint.

1. To prevent environmental stressors on the listed plants, plant assessments and collection of plant material will be conducted by an authorized biologist before any construction related vegetation clearing or site preparation. Once all the (plant) material is collected, the DON will approve the site for vegetation clearing or site preparation.
2. ESA-listed plants within 10 feet of the construction perimeter will be clearly flagged to prevent any unnecessary disturbance from construction.
3. During site preparation and prior to any clearing and grubbing of surface vegetation, the construction perimeter will be clearly marked to prevent encroachment into adjacent areas with ESA-listed plants.
4. Silt fences or straw wattles will be used to prevent soil erosion into adjacent areas with ESA-listed plants. Dust screens will be installed at the project boundary if ESA-listed plants are within 10 feet from the project boundary. The dust screens will be used to shield protect, screen, and create a buffer for the ESA-listed plants.
5. DON will implement a contractor education program to ensure contractor personnel are informed of the biological resources in the project area, including invasive species, special-status species, avoidance measures, and reporting requirements in the project area. DON staff will provide the contractors a natural resources orientation with special focus on *C. micronesica*, *T. rotensis*, and Mariana fruit bat to ensure construction personnel are aware of these species and avoid inadvertent impacts due to lack of awareness of resource presence, sensitivities, and protective measures (see Appendix A in the BA for pamphlets and natural resource training material related to coconut rhinoceros beetle (*Cocos nucifera*) (CRB) and little fire ant (*Wasmannia auropunctata*) (LFA).
6. In areas where noise, light or human activity from construction of the proposed action would result in excessive noise, light or human activity above the ambient level, construction contractor personnel will be required to survey within line of sight (up to 150 m) of construction activities for bats prior to the start of a day's construction activities. If a fruit bat is present within the 150 meter buffer, construction work generating noise, light or human activity above the ambient levels will be postponed until the bat(s) has left the area and the DON will be notified to assess the situation. The construction contractor will document bat surveys in the daily logs.
7. DON staff will examine the condition of listed plant species within 10 feet of the construction perimeter during construction activities and document any adverse effects to the plants within that buffer. DON will contact the Service if new information reveals effects of the action that may adversely affect the listed plants in a manner or to an extent not previously considered. DON will inspect the contractors work to ensure that these BMPs are implemented for the entire duration of the project. DON staff will conduct random, unannounced inspections monthly and document the results in a log.
8. The DON will provide project specific work plans to the Service for inclusion in the consultation file.

Conservation Measures-General

The project's Conservation Measures are designed to avoid or minimize project effects to listed species and their habitats or to contribute to the recovery of a listed species. Conservation Measures are considered part of the proposed action and are vital to determining the scope of the proposed action. Implementation of Conservation Measures is required under the terms of the proposed action.

1. An authorized biologist will conduct and oversee all plant Conservation Measures. The authorized biologist must have relevant experience at a comparable level of responsibility in projects of similar size, scope and complexity and must have the following minimum qualifications:
    a. A bachelor's degree with an emphasis in botany, horticulture, ecology, or a related science;
    b. At least 100 documented hours of experience conducting propagation, translocation, transplantation, pest control, and monitoring of the aforementioned species or a closely related species; and
    c. Applicant must provide contact information of three references familiar with their work related to b (above).
2. Prior to salvage DON's authorized biologist will conduct surveys for ESA-listed plants to determine the health status of plants that cannot be avoided in the construction footprint. These additional surveys, referred to as pre-construction surveys, will verify the occurrence of federally listed species in the construction footprint and evaluate them for salvage and transplantation. An assessment will be conducted to determine how many individuals can be salvaged through either collection of seeds (*C. micronesica* and *T. rotensis*) or basal shoots (*C. micronesica*). DON's authorized biologist will pursue seed germination and plant division to meet transplanting success targets.
3. Plant propagation will occur at nurseries that follow the Hawaii Rare Plant Restoration Group "Phytosanitation Standards and Guidelines."
4. All salvaged plants will be transplanted in vegetation plots. AAFB Environmental Flight will choose up to five vegetation plots for the transplantation of salvaged individuals. These vegetation plots will be mixed native limestone forest with an ungulate-proof fence and ungulate-free. DON's authorized biologist will choose transplanting locations within habitat suitable to support cycads. The sites must receive environmental approval from the 36th Wing Commander prior to award of a contract to conduct the salvage and transplant activities. DON will submit the description of the locations to the Service once the sites are approved.
5. The DON will maintain the ungulate fences around these plots and conduct weed removal (mechanically, manually, or by herbicide) to enhance the existing native forest. Invasive species within a 20-foot radius around salvaged plants will be removed and maintained to ensure no more that 15 percent of vegetation is invasive species within the plots.

6. The DON will submit an annual report to the Service one year after the BiOp is rendered and each year thereafter until the project and associated conservation measures are complete. The conservation measures will be complete once the number of plants meeting the success criteria, defined in the DON's BA, has been achieved. The report will summarize the type of activities (e.g., health status of plants, propagation, transplantation, etc.) conducted on each species and the status of transplantation efforts. It will include the number of cycads basal shoots and seeds collected from each healthy adult, mature cycad and the number of *T. rotensis* seeds collected, propagation methods (number seeds germinated), survival rate, and the number of plants meeting the success criteria. DON will also include information on bat monitoring within line of sight (up to 150 m) of construction activities.
7. If it is determined that a contractor has violated any of the DON's proposed conservation measures, the DON will provide an on-site biological monitor during all further construction actions to insure no further incidences occur.

Conservation Measures for Specific Species

Cycas micronesica

The DON has proposed the following methods for salvage, propagation, and outplanting (transplanting from the nursery to a conservation site) of *C. micronesica*:

1. Efforts will be made to salvage as many cycad basal shoots as possible that are deemed healthy and suitable for salvage. An authorized biologist with the qualifications described above would make the determination of "health." Cycad basal shoot health is based on a variety of factors including extent of cycad aulacaspis scale (*Aulacaspis yasumatsui*) infestation/damage and current health condition of the parent plant.
2. Basal shoots that are approximately 1.7 inches in diameter (golf ball size) and larger will be considered for salvage (EA Engineering 2019).
3. Prior to salvage of the basal shoots, pesticides will be applied to treat cycad scale and cycad blue butterfly (*Chilades pandava)* larvae.
4. Cycads will be visually inspected for LFA before salvage and transplant. If LFA are observed, LFA Management Procedures will be followed (See Appendix A in BA).
5. Basal shoots will be removed from the main trunk to maintain as much of the root mass as possible. All pups will be placed in an appropriate pot for the pup's size and promote drainage.
6. Basal shoots will be tagged prior to removal from the parent plant. The tags will consist of a unique alphanumeric aluminum tag, which will be secured to the individual pots.
7. A pressure washer may be used to remove any remaining debris, loose plant material, and pests (i.e. cycad scale).
8. During transportation, basal shoots will be covered for protection from sun and wind exposure.
9. Once transported to a nursery, commercial root-promoting hormone may be applied to the stem followed by the remaining treatments: fungicide and insecticide applied in accordance with label directions and applicable regulations and law.

10. Each basal shoot will be potted in plastic pots with well-drained potting media such as pumice, perlite or sand and/or soilless and placed in the nursery. Salvaged basal shoots will be processed and transplanted in the nursery within one week of salvage.
11. Cycads will be evaluated monthly or more frequently depending on the conditions of the plants to determine growth and status. Any disease outbreak or significant loss of individuals under nursery conditions should be reported to the Service to allow DON and the Service to work together to ensure the success of nursery propagation of cycads.
12. Salvaged cycad basal shoots/seeds will be propagated in a nursery until an authorized biologist determines they are suitable for transplanting.
13. After transplantation, maintenance will include watering, weeding, fertilizer, pest control, support structures and/or plant protection until the plants show stem growth of at least 1.0 cm as measured below the base of the existing leaves (fronds) since planting in the wild.
14. Salvaged cycads (basal shoots or seeds) will be monitored and maintained until a minimum of 95 genetically different individuals have been established in the wild, showing stem growth of at least 1.0 cm as measured below the base of the existing leaves (fronds) since planting in the wild, and plants will be weaned of maintenance for a period of six months since planting for natural up take of nutrients and water.
15. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. An authorized biologist will make the determination of "health."

Tabernaemontana rotensis

1. The DON has proposed to salvage and propagate enough *T. rotensis* seeds to ensure a minimum of six genetically distinct individuals meet or exceed success criteria described in #2 below. This minimum number is based on the assumption that there will be at least six mature, adult *T. rotensis* trees producing seeds at the time of collection. If seeds cannot be collected from within the project footprint prior to being removed (i.e., if the trees do not produce seeds), plant cuttings will be collected from the project footprint or seeds will be collected from individuals within the action area. A seed collection site consisting of 53 *T. rotensis* trees has been identified outside the project footprint but within the action area.
2. Once collected, seeds of *T. rotensis* will be cultivated in a plant nursery for propagating and subsequent transplanting. An authorized biologist will determine when plants are ready for transplanting and plant them into the vegetation plots. Monitoring will be done monthly or more frequently depending on the conditions of the plants to record growth and health status. Maintenance will be conducted depending on environmental conditions and plant needs, these include watering, weeding, pest removal, and plant protection. The DON's success criteria for *T. rotensis* transplanting is the plants must be between 2 and 3 feet tall, leaves remain turgid on the plant, individuals produce apical stem growth, and plants will be weaned of maintenance for a period of six months.

Action Area

The action area is defined at (50 CFR 402.02) as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The DON has determined that the action area for this project is AAFB, which is located on the northern tip of Guam on a limestone plateau occupying approximately 14,000 acres. The Service has reviewed this proposed action area and determined that since it includes areas where no effects to listed species are expected to occur the action area is, instead, the project footprint with an additional buffer of 150 meters. This accounts for possible bat disturbance, edge effects, and all five proposed outplanting sites (Achae Point, Tarague Basin, Tarague Triangle, Palms Golf Course, and 3A Outplanting). The entire action area is a total of 274 acres, including the project footprint, 150 meter buffer, and outplanting sites each totaling 51, 216, and 7 acres, respectively. The proposed ECMs would be constructed within MSA I, which is located northwest of AAFB's airfield and southeast of Northwest Field. The project footprint is within MSA I and includes a 51-acre construction footprint of 48 ECMs and related construction activities (Figure 1). No designated critical habitat occurs within the action area.

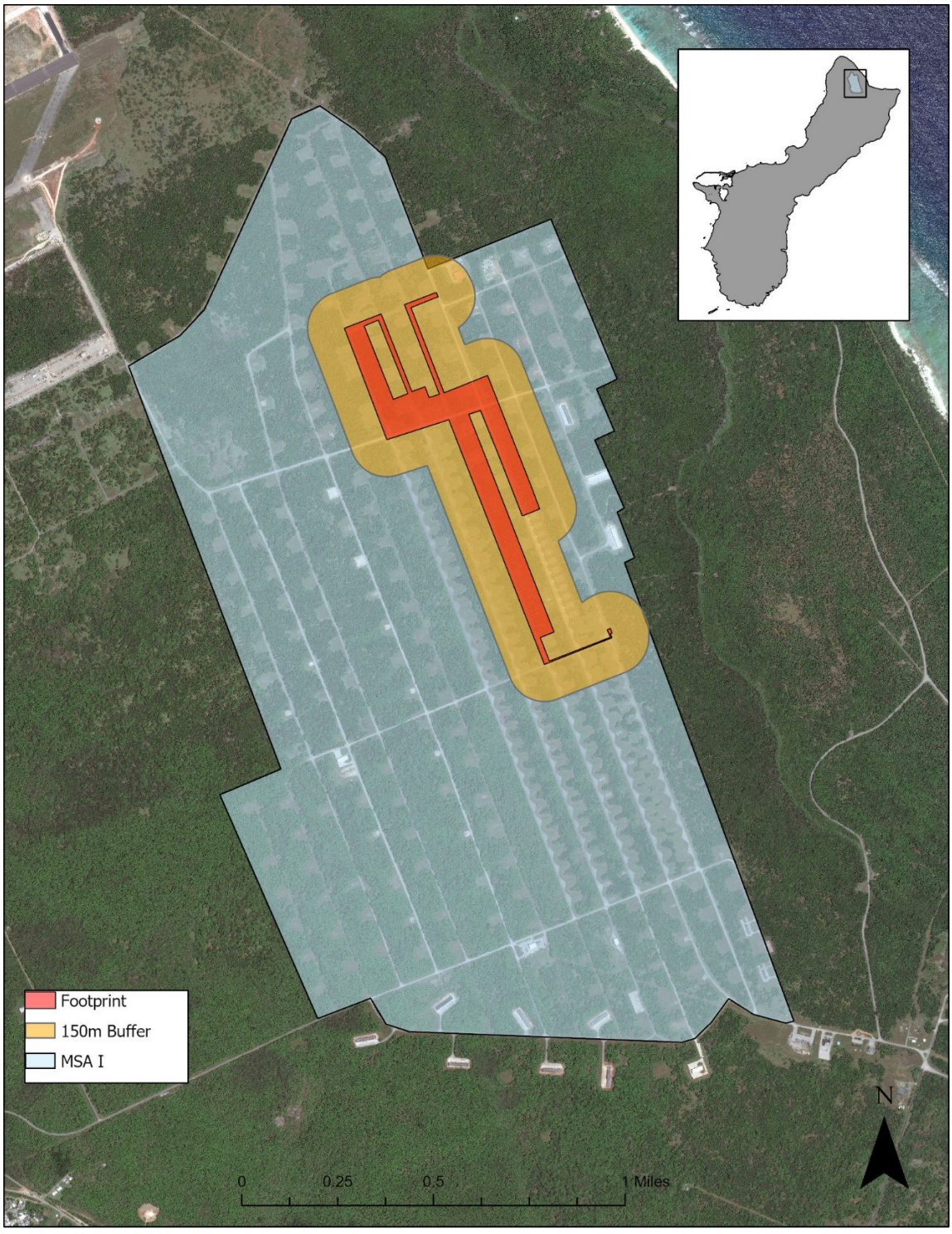

Figure 1: Layout of the Igloo site including MSA I, project footprint, and 150 meter action area buffer. Figure does not include proposed outplanting sites.

Analytical Framework for the Jeopardy/Adverse Modification Analysis

Jeopardy Analysis Framework

In accordance with regulation (see 84 FR 44976), the jeopardy determination in this BiOp relies on the following four components:

1. The *Status of the Species*, which evaluates the species' current range-wide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; its survival and recovery needs; and explains if the species' current range-wide population is likely to persist while retaining the potential for recovery or is not viable;
2. The *Environmental Baseline*, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species;
3. The *Effects of the Action*, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery role of the action area for the species; and
4. *Cumulative Effects*, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery role of the action area for the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the action area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role and the continued existence (i.e., survival) of the species.

Status of the Species

Status of Mariana Fruit Bat

Species Description

The Mariana fruit bat was listed as endangered in 1984, but was reclassified to threatened on January 6, 2005, when it was determined that all fruit bats on Guam and throughout the Commonwealth of the Northern Mariana Islands (CNMI) comprise a single subspecies (70 FR 1190). The Mariana fruit bat is the only fruit bat species under U.S. jurisdiction. In 2004, critical

habitat for the fruit bat was designated at the Guam National Wildlife Refuge (GNWR) in the Ritidian Unit (69 FR 62944).

The Mariana fruit bat is a medium-sized fruit bat in the family Pteropodidae, and weighs between 0.73 lb to 1.27 lb (331 g to 577 g). Male Mariana fruit bats are slightly larger than females. The underside (abdomen) is black to brown with gray hair interspersed that creates a grizzled appearance. The shoulders (mantle) and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown. The well-formed, rounded ears and large eyes give the face a canine appearance (USFWS 2010).

The paleotropical genus *Pteropus* is represented by approximately 63 species distributed across the Indian Ocean, Southern Asia, Australia, and in Oceania as far east as the Cook Islands (Almeida et al. 2014 p. 83). Most species in the genus *Pteropus* occur on islands or in coastal areas (Almeida et al. 2014 p. 84). Four species in the genus *Pteropus* are extinct and 38 species (60 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the IUCN (IUCN 2017). One of the four extinct species, *P. tokudae*, occurred only on Guam and has not been detected since 1968 (Bonaccorso et al. 2008; USFWS 2010).

Flannery (1995) and Simmons (2005) consider the Mariana fruit bat as one of two subspecies of fruit bats restricted to the Mariana Archipelago, with the Mariana fruit bat inhabiting the islands from Guam to Saipan and *P. mariannus paganensis* occurring on Pagan and Alamagan islands. However, subsequent genetic analysis conducted by Brown et al. (2011) indicate no genetic differentiation among islands within the Mariana Archipelago and that the bats on these islands, currently classified as two subspecies, should be managed as a single subspecies, *P. mariannus mariannus* (p. 940). In addition to the Mariana fruit bat, there are several other subspecies of *P. mariannus* endemic to other archipelagos, including the Caroline Islands and the Palau Archipelago (Brown et al. 2011 p. 934).

Life History

Mariana fruit bats, similar to other bats in the Pteropodidae family, do not use laryngeal echolocation, instead relying primarily on vision and smell to avoid obstacles and locate food sources (Almeida et al. 2014). Mariana fruit bats vocalize readily within colonies and when roosting. The diet of the Mariana fruit bat is comprised of fruits, nectar, pollen, and some leaves from at least 45 different plant species (Mildenstein & Johnson 2017). Rapid digestion and metabolism of food makes these animals reliant on forest habitat with diverse food resources available throughout the year (USFWS 2010). Mariana fruit bats use several forest types for foraging, roosting, and breeding, including native primary and secondary limestone forest, volcanic (or ravine) forest, old coconut plantations, and groves of *Casuarina equisetifolia* (Rice & Taisacan 1988; Worthington et al. 2001 p. 137; Wiles & Johnson 2004 p. 589, 591). Most Mariana fruit bats roost during the day in maternity colonies at sites to which they show a high level of fidelity (unless disturbed). A small proportion of Mariana fruit bats, usually males, roost alone or in small groups called bachelor colonies. Within colonies, Mariana fruit bats typically group themselves into harems (one male and 2-15 females) or bachelor groups (predominantly males) (Wiles 1987a).

Population Dynamics

Population demographic information for the Mariana fruit bat is limited. Based on three years of field observations on Guam similar to other Pteropodidae species, female Mariana fruit bats rear up to one pup annually (USFWS 2010) and likely have a gestation period of approximately 4.6 to 6.3 months (Pierson & Rainey 1992 pp. 1–17). Many *Pteropus* species typically do not give birth until 18 months of age (Pierson & Rainey 1992 pp. 1–17; McIlwee & Martin 2002 p. 76). Lifespan of substantially larger species, *P. alecto*, in Australia is four to five years, with a maximum of eight years (Vardon & Tidemann 2000).

Based on this demographic information, several authors have suggested that *Pteropus* bats have a low maximum population growth rate and thus a slow rate of recovery when a population is diminished (Pierson & Rainey 1992 p. 76; McIlwee & Martin 2002). Table 1 provides current population estimates per island and other demographic data (Mildenstein & Johnson 2017 p. 20).

Table 2: Mariana fruit bat population estimates and density by island

Island	Forest Habitat (ha)	No. of Bats	Density
Andersen, N. Guam	25,711	45	0.00
Rota	6,663	4,149	0.62
Aguiguan	302	50	0.17
Tinian	6,481	< 25	0.00
Saipan	5,355	< 50	0.01
Farallon de Medinilla	< 1	< 5	--
Anatahan	N/A	150	--
Sarigan	169	157	0.93
Guguan	170	226	1.33
Alamagan	485	86	0.18
Pagan	1,971	1,017	0.52
Agrihan	2,336	858	0.37
Asuncion	316	573	1.81
Maug	48	11[1]	

[1]Insufficient data available

Status and Distribution

The Mariana fruit bat is endemic to the Mariana Archipelago. The Mariana Archipelago extends across 459 nautical miles (nm) and is comprised of the U.S. Territory of Guam and 14 islands constituting the CNMI. The Mariana fruit bat is found on all 15 islands within the Marianas, except for Uracas, the northernmost island (Wiles et al. 1989 p. 69). The Mariana fruit bat is currently thought to be extirpated from Tinian (USFWS 2014). A single Mariana fruit bat was photographed on Farallon de Medinilla on two occasions, in 1996 and in 2008 (DON 2013 pp. 4–123).

Mariana fruit bats in general are strong fliers and highly mobile and small groups have been observed flying over the ocean between islands (Wiles & Glass 1990 p. 2; Wiles & Johnson

2004 p. 593). Distances between are: Guam to Rota, 32.3 NM; Rota to Aguijan, 42.1 NM; Aguijan to Tinian, 4.9 NM; Tinian to Saipan, 2.7 NM; Saipan to Farallon de Medinilla, 45.9 NM; and Saipan to Anatahan, 64.3 NM. In the remaining northern Marianas, interisland distances range from 15.7 NM to 54.0 NM. All islands have a maximum elevation ranging from 551 feet to 3,166 feet with the exception of Farallon de Medinilla, which has a maximum elevation of 266 ft. All islands are visible in clear weather from the tops of adjacent islands (Wiles & Glass 1990 p. 1).

Distribution of occupied Mariana fruit bat roost sites have fluctuated sharply in the southern islands. Fluctuations are attributed to variations in survey methods, coverage, and movements of Mariana fruit bats between islands (USFWS 2010). Initial observations of Mariana fruit bats in the southern islands (Aguiguan, Tinian, and Saipan) in 1983 and 1984 revealed populations of less than 25 to 50 Mariana fruit bats on each island. Mariana fruit bat numbers increased to about 75 to 100 individuals on Saipan in 1986 and to about 300 individuals on Aguiguan by 1988 (Wiles & Glass 1990 p. 2). Mariana fruit bats on Rota are believed to move periodically among the southern islands, and thus Rota is considered to be important to the long-term stability of the species in the southern part of the Marianas (Wiles & Glass 1990 p. 2; Wiles et al. 1995).

Historic numbers of Mariana fruit bats on Guam have been between 400 and 800 since 1984, but have since been decreasing. By the early 1980s nearly all Mariana fruit bats on Guam lived in Northern Guam in a single colony, which occasionally divided into several smaller aggregations (Wiles & Glass 1990 p. 2; Mildenstein & Johnson 2017 p. 25).

Survey data in the northern islands (Anatahan, Sarigan, Guguan, Alamagan, Pagan, and Agrihan; excluding Asuncion and Maug, which were not surveyed during this time period), indicate a 40 percent decline in Mariana fruit bat numbers between 1983 and 2000 (USFWS 2010). In the Service's 2014 5-year review, Mariana fruit bats were found to be stable or declining throughout most of their range; the only exception being on Rota where populations were increasing since 2008 due to increased enforcement of wildlife regulations (USFWS 2014).

Threats

Illegal hunting, loss of native forest, predation by the brown tree snake (*Boiga irregularis*) (BTS) on Guam, and the increased risk of extirpation or extinction of small, fragmented populations are the most significant threats to the survival of the Mariana fruit bat (USFWS 2014). These current known and potential threats are discussed below.

Threats:

- Loss or Degradation of Habitat:
    - Human development is a factor in habitat loss on all inhabited southern islands and on northern islands with military activity.
    - Feral ungulates and Philippine sambar deer (*Rusa marianna*) degrade habitat on many of the islands in the Marianas Archipelago. The successful eradication of feral ungulates from Sarigan and Anatahan suggests that similar projects may succeed on other islands. However, once grazing and browsing pressure is

removed, the potential invasion of native forest by non-native plants may be a more difficult and long-term recovery issue.

- Human Disturbance:
    - Illegal hunting is a threat to Mariana fruit bats throughout its range. Although law enforcement activity has increased since 2009 (CNMI -DLNR 2008; CNMI-DLNR 2009a, 2009b, 2010), illegal hunting of Mariana fruit bats on Rota continues and will likely resume to historical levels unless consistent, effective law enforcement efforts in tandem with education and outreach programs continue. Mariana fruit bats appear to be declining on Tinian, Saipan and Guam, and illegal hunting is thought to have greatly contributed to the decimation or decline of those populations (Wiles & Payne 1986; Wiles & Glass 1990; Sheeline 1991; Stinson et al. 1992; Esselstyn et al. 2006). As with Rota, recovery of the Mariana fruit bat on human-inhabited islands will not likely be possible without strong education programs combined with effective control of illegal hunting.
- Non-native Snake Predation:
    - BTS prey on non-volant young left at the roost during the night, thus preventing the recruitment of young bats into the breeding population. Effective control of BTS is among the actions that must be achieved before the Mariana fruit bat population on Guam can recover. The interdiction, control, and ultimate eradication of BTS on Guam are the focus of major, ongoing projects, and the Mariana fruit bat is likely to benefit from these efforts in the long term across the archipelago. This prognosis would change drastically if the BTS were to become established widely throughout the archipelago.
- Stochastic Events:
    - Typhoons and volcanic eruptions result in mortality, reduced population viability, and habitat loss. Natural disasters can be especially damaging to the viability of smaller Mariana fruit bat populations (e.g., on Guam, Saipan, Aguiguan, and Maug). The significant loss of habitat on Anatahan after the volcanic eruption in 2003 resulted in the loss of a substantial Mariana fruit bat population that has not yet recovered.

<u>Mariana Fruit Bat Recovery Criteria</u>

A draft revised recovery plan for the Mariana fruit bat (USFWS 2010) addressed actions needed for the survival and recovery needs of the Mariana fruit bat. New information indicates that, to meet recovery objectives, stable or increasing fruit bat subpopulations should, at a minimum, be distributed on the islands that currently have extant populations (USFWS 2010). Actions that reduce or eliminate the potential for self-sustaining populations of resident Mariana fruit bats on Guam may hamper or preclude recovery of the species. The reduction or elimination of this potential may take many forms: degradation or loss of habitat and resources required by the fruit bat for foraging, roosting, and reproduction; increased exposure of fruit bats to illegal hunting and other sources of human disturbance; and introduction of non-native predators that prey upon fruit bats. In order for the Mariana fruit bat's population to recover on Guam, sufficient amounts of functional habitat will need to be protected and restored on Guam (USFWS 2010).

Guam contains a large proportion of the remaining native limestone forest in the southern inhabited Mariana Islands, and most of that habitat is located within Department of Defense (DoD) lands. Habitat loss and degradation, illegal hunting, predation by non-native predators, and human disturbance currently impact fruit bats. If threat levels increase within Mariana fruit bat habitat, it may further inhibit the potential for the species to recover.

Survival and Recovery Needs

Before the Mariana fruit bat is considered for delisting, the Service proposes that stable or increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug (USFWS 2010). Of the six northern islands that require stable or increasing numbers, two of these must include Pagan, Anatahan, or Agrihan. Since publication of the draft revised recovery plan (USFWS 2010), new information on the Mariana fruit bat has resulted in changes to how we look at recovery for the species. We now consider recovery in terms of stable or increasing subpopulations of sufficient size distributed across Guam and the Mariana Islands. To meet recovery objectives, stable or increasing Mariana fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS 2010). The final version of the Mariana fruit bat recovery plan is currently in review, and recovery criteria stated here may change upon completion of the final plan.

Of the six northern islands, the only evidence for a possibly increasing population is on Asuncion (USGS 2010 p. 33). Of the five southern islands, only Rota has achieved an increasing population. Although a conservation area containing some important habitat for Mariana fruit bats was established on Rota (USFWS 2011 p. 1), there is not currently enough protected Mariana fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species (USFWS 2014).

Status of the *Cycas micronesica*

Species Description

Cycas micronesica (fadang in Chamorro) was federally listed as threatened under the ESA on October 1, 2015. No critical habitat has been designated for this species. A recovery plan for *C. micronesica* has not been completed.

Cycas micronesica is part of the Cycadaceae family, which contains only one genus, *Cycas*, a very ancient genus of trees dating back to the Jurassic period. Ninety-eight *Cycas* species are described, and 75 species (77 percent of the genus) are considered critically endangered, endangered, threatened, near threatened, or vulnerable under the definitions of the (IUCN 2017). All *Cycas* species are restricted to the equatorial regions.

Cycas micronesica is a palm-like plant, usually unbranched tree with a thick trunk. Adult stem lengths reach 8m, rarely to 12m, and 14-25 cm in diameter with pinnate leaves 150-180 cm long (Hill 1994).

Life History

Cycas micronesica is the only native gymnosperm in the Mariana Islands. Cycads are dioecious, and both sexes bear reproductive structures that are relatively massive amongst gymnosperms (e.g. conifers). *Cycas micronesica* occurs in limestone forests in Guam and Rota, with fewer occurrences in volcanic soils typical of southern Guam (Stone 1970 p. 65; Hill 1994). Few studies exist that describe cycad natural history and ecology in the Mariana Islands, and much of the current literature is focused on its decline and effects from introduced pests. However, *C. micronesica* (identified as *C. circinalis* at the time) is a food source for the Mariana fruit bat, which feed on its fruits (Wiles & Fujita 1992 p. 27), as well as for the Chamorro people, who process the fruits to rid the naturally-occurring toxins (Whiting 1963).

Cycas micronesica emits chemical cues to attract specialist insects for pollination (Schneider et al. 2002); however, there is also evidence of wind as a pollen vector in open areas or forested areas with some wind on Guam (Terry et al. 2009 p. 96; Hamada et al. 2015).

Population Dynamics

At the time of listing, there were fewer than 516,000 individuals on Guam (Marler 2013). This number does not distinguish between successfully reproducing adults and juveniles (Marler 2013), which, because of the effects of the cycad aulacaspis scale, implies that the number of extant individuals that can successfully reproduce is much lower.

Within Guam's AAFB, over 257,000 individuals were documented in July 2013; however, the population structure was dominated by adults with little recruitment and declining reproductive success (Marler 2014). In a separate survey, an unquantified number of *C. micronesica* individuals were found at 11 sites across Guam, some of which were on AAFB (Harrington et al. 2012). Between March 2015 and January 2017, natural resources personnel from the Marine Corps Activity Guam conducted surveys, which identified 19,852 mature individuals (DON 2017).

Status and Distribution

Cycas micronesica is known historically from Guam, Rota, Palau (politically the independent Republic of Palau) and Yap (geographically part of the Caroline Islands; politically part of the Federated States of Micronesia (Hill 2004; Hill et al. 2004) and has been outplanted on Tinian (NAVFACMAR 2016). In a 2002 forest inventory on Guam, prior to the introduction of *A. yasumatsui*, *C. micronesica* was the most abundant tree detected with over 1.5 million individuals counted on island (Donnegan et al. 2004 p. 16). In 2013 population estimates for Guam was down to 516,000 and 111,500 on Rota. Outside of the Marianas 300,000 were estimated on Yap, and 2,500 on Palau. Currently, there are no updated population numbers for Yap and Palau, but estimates for Guam and Rota are 344,000 and 52,000, respectively. These

estimates signify a decline of 33.3 percent on Guam and 53.4 percent on Rota, since 2013. As of February 2016, the total outplanted experimental population on Tinian was 903, half of which were small and required continued maintenance (NAVFACMAR 2016). The latest projections estimate a complete extirpation of *C. micronesica* from the island of Guam by 2032 if current rates of mortality continue unabated (Marler & Krishnapillai 2020).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat due to:
    - Development, urbanization, agriculture, as well as wild or incidental fire;
    - Non-native plants, trees, shrubs, and vines that compete with *C. micronesica* for space; and,
    - Non-native ungulates that degrade remaining forest habitats through herbivory and physical damage.
- Low population number from:
    - A lack of recruitment into the population on Guam that is currently dominated by adults increases the vulnerability of the species and challenges its ability to increase or maintain a population structure.
- Non-native pest species including:
    - *A. yasumatsui* which is an introduced cycad specialist armored scale insect that is the most significant threat and primary driver of mortality of all life stages (Marler & Muniappan 2006 p. 3, Marler & Krishnapillai 2020; Marler 2014). As of January 2013, *C. micronesica* mortality reached 92 percent on Guam, and cycads on Rota are experiencing a similar fate from the cycad aulacaspis scale (Marler 2013). *A. yasumatsui* has also invaded Palau; however the effects of the invasion on *C. micronesica* have not yet been determined. A specialist scale predator beetle, *Rhyzobius lophanthae*, was introduced purposefully to treat the *A. yasumatsui* outbreak with some positive results (Marler & Lawrence 2012 pp. 234–238). A number of other insects, including the cycad blue butterfly and a native longhorn beetle that bore cycad stems (*Dihammus marianarum*), also contribute to declining health and mortality in Guam cycad populations (Marler & Muniappan 2006 p. 3; Marler & Lawrence 2012 pp. 238–240).
- Reduction of resiliency if:
    - Unhealthy trees are not able to withstand or recover from damage caused by high winds and rains of typhoons (Hirsh & Marler 2002) if their natural resilience has decreased due to chronic *A. yasumatsui* damage.

Survival and Recovery Needs

In order to recover *C. micronesica*, individuals of this species need to be protected throughout its range. To promote population stability, *C. micronesica* populations should consist of a minimum 200 individuals and have age classes consisting of seedlings, juveniles, and adult plants (HPPRCC 2011). Expanded trials with biocontrol, especially targeting *A. yasumatsui*, should be

considered to help stabilize the population (Marler & Lawrence 2012 p. 240). In addition, future invasions from other pests must be prevented (Marler & Lawrence 2012 p. 240). Feral pigs and introduced deer are also threats through herbivory and physical damage, further compounding effects from insects (Marler & Lawrence 2012 p. 238); therefore, ungulate control and fencing restoration sites are also crucial steps in managing cycad populations.

Status of the *Tabernaemontana rotensis*

Species Description

Tabernaemontana rotensis (no common name) is currently listed as threatened (USFWS 2015). No critical habitat has been designated for this species. A recovery plan for *T. rotensis* has not been completed.

Tabernaemontana rotensis is in the dogbane family, Apocynaceae, which includes trees, shrubs, herbs, stem succulents, and vines. The family contains 366 genera, and the *Tabernaemontana* genus consists of 103 species (The Plant List 2013). *Tabernaemontana rotensis* is a small to medium-sized (8-10 m tall) tree with leaves that are thin, light green, opposite, and 15-30 cm long (Stone 1970). Flowers are white, elongate, slender, and branch from the tree. *Tabernaemontana rotensis* produce conspicuous orange fruit that are twinned or single and beaked (UOG 2007 p. 6; GPEPP 2015 p. 22).

Life History

Tabernaemontana rotensis occurs in forests with crevices of rough limestone (Raulerson & Rinehart 1991 p. 94) and are able to colonize sites that occur in full sun or in deep shade (UOG 2007 p. 16). The species has primarily been found in areas of little to no slope (<15 percent) (UOG 2007; JRM 2016). *Tabernaemontana rotensis* has been found in forest habitats most often co-occurring with *C. micronesica*; however, *T. rotensis* were not found in areas that were dominated by non-native tree species (UOG 2007).

Tabernaemontana rotensis populations typically flower in August through October, followed by the production of immature or orange fruit (UOG 2007 p. 23). During this time, 40 to 80 percent of trees were found to have at least some flowering occur every month (UOG 2007). The fruit of *T. rotensis* reaches full size of 1.6 inches, approximately 30 to 35 days after flowering. Fruit is mature after approximately 90 days, when it has turned from green to bright orange and splits open and exposes seeds (UOG 2007).

Seed dispersal of *T. rotensis* is dependent on birds and therefore a lack of frugivore bird species on Guam has resulted in limited spatial distribution of *T. rotensis*. Today, *T. rotensis* is generally found clumped within confined areas, as seedling establishment is restricted to within the vicinity of the parent tree (UOG 2007). This phenomenon does not support seedling recruitment, as seedlings develop in extreme competition with one other, and many of them become stunted and die (UOG 2007).

In typhoon conditions, *T. rotensis* develops a synchronized pulse of flowering about one month after the typhoon. This pulse of flowering leads to a mast seeding event about four months after a typhoon (UOG 2007 p. 29). This species may behave like a pioneer species since germination and seedling emergence have been shown to be maximized in full sun conditions (i.e., after typhoon damage) (UOG 2007).

Population Dynamics

In a study specific to AAFB, the species occurred in clumped patches within 256 sites across the base (UOG 2007). The population structure of over 21,000 individuals included emerging seedlings, young juveniles, and reproductive mature individuals with an extensive canopy size. The species was observed in northern Guam in the following areas: Ritidian Point, Pati Point, the Habitat Management Unit (HMU), and central and southeast edge of AAFB (UOG 2007; JRM 2016). At least five individuals of *T. rotensis* also occur within the GNWR. At the time of listing, *T. rotensis* was known from six occurrences on Guam and nine individuals on Rota (80 FR 59423). Individuals on Rota varied in size between 0.5 m and 6 m (1.6 ft. to 19.7 ft.) spread across the western, southern, and eastern parts of the island (CNMI-DLNR 2015).

Since the time of listing, additional surveys have identified and tagged 196 total individuals (88 of which were mature) at two locations outside of DoD property (GPEPP 2015). A total of 23,325 individuals have been identified at six locations on DoD property, over 85 percent of which are on AAFB (DON 2017).

Status and Distribution

Tabernaemontana rotensis is endemic to Guam and Rota and was suggested to be restricted to limestone forest habitat (Stone 1970). It was originally noted as very rare needing seed cultivation or cuttings to assure the existence of the species (Stone 1970).

Threats

The following threats to the species contributed to its listing or were identified subsequent to listing and continue to be an issue in the ability of the species to recover.

- Loss or degradation of habitat due to:
    - Wildfire, urbanization, and agricultural development;
    - Non-native plants and non-native ungulates that further degrade remaining forest habitats;
    - Spatial distribution when many individuals are growing in close proximity throughout AAFB. This aggregated pattern increases the vulnerability of the population, especially at sites with less than 15 percent slope that are suitable for human development.
- Low population numbers and lack of recruitment and dispersal are due to:
    - Restrictions to the spatial extent and distribution of bird populations on Guam.
    - Clustered populations exhibit less genetic diversity, becoming less resilient to evolutionary changes (UOG 2007).

- Clustered populations are more vulnerable to stochastic events causing a disproportionate species effect (extreme events or disease), thus the become more prone to extinction pressures (UOG 2007).
- Forest degradation due to typhoons which may require multiple years to regenerate.
- The lack of a viable seed bank for natural regeneration.

Survival and Recovery Needs

In order to recover *T. rotensis*, the remaining individuals of this species need to be protected on Guam and Rota. *Tabernaemontana rotensis* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate and invasive species control should be implemented throughout its range. On Guam, restoring areas with this species' natural dispersers (e.g., native frugivore birds) would expand the distribution of the *T. rotensis* population into new habitat niches, niches that would have likely been naturally occupied by the *T. rotensis* population prior to the loss of seed dispersal on Guam. Outplanting or relocation of wild seedlings within protect areas would help increase their abundance and distribution on Guam and Rota.

Environmental Baseline

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated and/or ongoing impacts of all proposed federal projects in the action area that have undergone Section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Status of the Species within the Action Area

Mariana Fruit Bat

The habitat within the action area consists of both primary and secondary limestone forest and *Vitex* dominated forest as described by the Guam Plant Extinction Prevention Program (GPEPP) (2017). Limestone forest habitat contain trees suitable for bat roosting and feeding, namely *Elaeocarpus, Tristiropsis,* and *Artocarpus*. All are present within the action area (GPEPP 2017). *Vitex* dominated forest is less desirable, but may provide roosting habitat. Fruit bats are highly mobile and while they have been documented flying over the action area, there are no records of bats actively roosting or foraging in the action area. It is reasonable to assume that fruit bats have occasionally utilized the area to roost or feed.

Cycas micronesica

As of 2019, 473 *C. micronesica* were estimated to occur within the project footprint (DON 2020, GPEPP 2019). This number does not include cycad individuals growing immediately adjacent to,

but outside of, the project footprint. Within the five proposed outplanting sites (Achae Point, Tarague Basin, Tarague Triangle, Palms Golf Course, and 3A), there are at least 412 total cycads (GPEPP 2019). The proposed action is expected to remove the existing plants within the project footprint through land clearing. Surveys of the MSA by GPEPP (2017) showed the highest density of cycads within the MSA occurs within the project footprint (32.1 to 37.7 *C. micronesica* per acre) proposed for clearing. When considering *C. micronesica* counted in 2017, the action area includes an estimated minimum 481 additional *C. micronesica*, 86 of which are within the 10 foot buffer of the project footprint. Project BMP's recommend all listed plants within this buffer be protected during construction, but they will be further exposed to threats, such as typhoon damage, predation, and parasitism, once the project is complete (Laurance 2008, Marler 2020). The action will not physically remove any plants outside of this footprint, but they will be further fragmented, subjecting the remaining population to a likely decline in condition (Laurence 2008, Laurance & Curran 2008, Marler 2020). *C. micronesica* are generally considered adapted for consistent typhoons (Hintz & Marler 2002), but presence of introduced ungulates (e.g. deer and pigs) and novel predators such as cycad scale greatly reduce the survivability after storm impacts (Marler 2012). Of the *C. micronesica* within the project footprint, 2019 surveys estimated approximately 92 of the plants were classified as being in good condition, 285 in fair condition, and 96 in poor condition (DON 2020). No condition index was provided for plants outside of the footprint, surveyed in 2017 (GPEPP).

Tabernaemontana rotensis

In a 2019 survey of the project footprint, 22 *T. rotensis* were counted, most of which were seedlings (GPEPP 2019). Only the Tarague Basin and Golf Course proposed outplanting sites contain *T. rotensis*, each with about 50 trees, no information on age structure was provided (Diebel, pers. com. 2020). Specific numbers on adult and seedling plants were not provided in the survey, but a 2017 survey of a similar plot within the MSA showed roughly half (53 percent) of the *T. rotensis* in the plot were seedlings (GPEPP 2017). The proposed action will result in the removal of all 22 individuals from the project footprint and an overall population decline of 0.094 percent (DON 2020).

Factors affecting species environment within the action area

Habitat loss and degradation, predation by non-native predators, and human disturbance are the primary factors affecting Mariana fruit bats within the action area. Brown tree snakes can be found within every habitat type on the island of Guam and are present within the action area. If a bat roosted within the action area, it would be susceptible to predation by BTS. AAFB functions as one of the most active military airfields in the Western Pacific with an average of 21 daily take-off and landing events (Diebel, pers. com. 2020). Noise generated by these activities reduces the likelihood that Mariana fruit bats utilize the existing habitat for roosting and feeding, although the vegetation types preferred by the bats is present.

Several possible outplanting sites (Achae Point, Tarague Basin, and Palms Golf Course) currently function as study plots for a long-term cycad study performed by GPEPP on AAFB (GPEPP 2019). GPEPP biologists survey cycads within these plots regularly, as well as apply pesticides to control pest species. If *C. micronesica* are outplanted in study plots they must be

separated from the cycads in the GPEPP study and must not be included in cycad research data collected. If bats are roosting or feeding when biologists enter the study plots it may result in disturbance to the bats, but this disturbance is not expected to alter the bat's behavior enough to rise to the level of injury. Biologists are required to vacate the site if bats are seen in the study plots and they are prohibited from returning until the bats leave on their own volition.

The cycad scale and other cycad predators are present in every *C. micronesica* population on Guam, including the action area. The *C. micronesica* already present within the proposed outplanting sites are receiving treatments of pesticide to help alleviate scale infestations and increase recruitment of seedlings in the population. Those cycads proposed for clearing within the project footprint are receiving no treatment for scale. The site experiences little to no recruitment of seedlings and surveys show one-fifth of the population to be in poor condition.

Effects of the Action

Factors to be considered

Proximity of the Action

The proposed 48 new ECMs fall within the MSA on AAFB, located on the northernmost portion of Guam. AAFB is home to half of the remaining limestone forest on Guam. Native [limestone] forest is considered the preferred habitat type of the Mariana fruit bat, based on the availability of roosting and foraging habitat, *C. micronesica*, and *T. rotensis,* (USFWS 2014, Cibrian-Jaramillo 2010, UOG 2007). For analysis, the Service is using primary and secondary limestone forest types as a proxy for preferred habitat, although it should be noted that this is likely an overestimation of actual functional habitat for these species (Almeida-Gomes 2016). The action area comprises 151.7 acres of primary and secondary limestone forest, representing 1.2 percent of this habitat type on Guam and 2.3 percent on AAFB. Of the 151.7 acres contained in the action area, 31.1 acres falls within the project footprint and will be removed entirely. This represents 0.24 percent of the limestone forest on Guam and 0.47 percent of the limestone forest on AAFB.

Distribution

Fruit bats are occasionally observed as far south as the Naval Magazine, in central Guam, but most sightings occur in the north (USFWS 2014). The proposed munition igloos will be situated approximately 4.7 miles from Pati Point, the last known maternal fruit bat colony on Guam. Colony surveys at Pati Point have been in consistent decline since 2005 and have yielded low bat numbers, between 0 and 10, since 2009. Between 2015 and 2016 a colony of 112 fruit bats were observed in the HMU on AAFB, but since August of 2016, fruit bat aggregations have not been observed at this site.

Cycas micronesica occurs across Guam with the highest density on AAFB (USFWS 2014). Populations of *C. micronesica* occur across Guam, although the distribution and health of these populations is patchy (USFWS 2020, Cibrian-Jaramillo 2010).

The majority of *T. rotensis* on Guam exists within the borders of AAFB and approximately nine individuals are located on GNWR.

Timing

Once started, construction is expected to last for an estimated 42 months (March 2021-September 2024) and will start at 0600 hours and stop no later than 1800 hours, or 30 minutes prior to sunset, whichever comes first. After construction is complete, very little active disturbance is expected. Although the construction itself will result in the loss of *C. micronesica* and *T. rotensis* individuals, this will be restricted to the action of ground clearing during site preparation.

Nature of the Consequences

The action will remove 22 genetically distinct individuals of *T. rotensis* and 473 *C. micronesica* from the environment. If the individual plants are not replaced, the action will result in a population decline of 0.14 percent of the known population of *C. micronesica* and 0.1 percent for *T. rotensis* on the island of Guam (DON 2020). No take of Mariana fruit bats is expected, although activity and noise associated with the action would likely disturb bats in the action area.

Since the action results in clearing of the project footprint, that habitat will be lost to bats in the future.

Duration

1) Short-term (pulse) consequences: Construction activities will result in disturbance to bats present in the action area during construction. Bats may be disturbed by noise and subsequently discouraged from utilizing the area's resources. Once construction has completed these disturbances will no longer be present.
2) *C. micronesica* pups and both *C. micronesica* and *T. rotensis* seeds will be collected prior to habitat clearing. Once that is complete all *C. micronesica* and *T. rotensis* within the project footprint will be destroyed.
3) Long-term (press) consequence: Existing habitat within the project footprint for all listed species will be converted to cleared or developed area.
4) Permanent (threshold) Consequence: The clearing of *C. micronesica* and *T. rotensis* followed by construction of new permanent structures, leaves no opportunity for future recruitment of these species resulting in no replacement within the footprint. Since habitat will be completely lost, the action area is not likely to function as a roosting or feeding area for Mariana fruit bat, indefinitely.

Disturbance Frequency

The action will take place in five phases: the removal of *C. micronesica* pups and seeds and *T. rotensis* seeds, clearing and construction of the ECMs, propagation of the harvested pups and seeds, outplanting of the propagated material, and maintenance of outplanted material. Harvesting of the *C. micronesica* pups has potential to negatively impact the mother plant, but

since all individual *C. micronesica* will be destroyed during construction, this is not a concern. Clearing and construction will occur between March 2021 and April 2024. During this period, all plants will be removed and bats may be disturbed, if in the area. Plant propagation will continue until the pups and seeds are hardy enough to be outplanted in the wild (~1 year or more). Outplanting of the propagated material will be brief and will likely disturb topsoil in areas where plants are placed, but this will be a short-lived disturbance. Maintenance of the planted individuals will involve supplemental watering and applications of pesticide to control pests of *C. micronesica*. Maintenance activities are expected to continue until plants achieve the DON's proposed success criteria for each species after being outplanted, which is expected to take less than two years.

Analyses for consequences of the action

Beneficial consequences – The DON is proposing to collect *C. micronesica* seeds and pups, as well as *T. rotensis* seeds from the project footprint before habitat clearing occurs. The pups and seeds will be propagated under nursery conditions until an authorized biologist determines they are suitable for outplanting. The individuals will then be outplanted in at least one, and up to five, fenced, ungulate-free conservation sites. The DON will provide supplemental water and fertilizer to the outplanted individuals and apply pesticide to control pest invasions. The plants will be cared for and monitored until they achieve at least 1.0 centimeter of stem growth in the wild, as measured from the base of existing leaves (fronds). Removal of invasive species from the proposed outplanting sites will potentially result in an increase in use of the area(s) by the Mariana fruit bat. If the outplanted *C. micronesica* and *T. rotensis* reach sexual maturity, they will contribute to the genetic diversity and overall population numbers of each of these species.

Adverse consequences – The proposed action will likely result in the disturbance of all Mariana fruit bats that use the habitat within and immediately adjacent to the project footprint during construction. Fruit bats could also be disturbed during use of habitat adjacent to the project area once construction is complete. However, such disturbance during and after construction would be expected to be short term and intermittent and not likely to cause a significant disruption of their breeding, feeding, and sheltering behavior. Therefore, the disturbance of Mariana Fruit bats within the action area is not likely to rise to the level of injury to the bat and therefore would not meet the definition of harass.

Clearing of the project footprint will result in the destruction of all *C. micronesica* and *T. rotensis* within the project footprint. This will result in a reduction in the overall number of sexually mature individuals of each species by 377 of the good or fair *C. micronesica* and 22 *T. rotensis*. Genetic representation will also be reduced due to the removal of these individuals. A total of approximately 481 *C. micronesica* fall within the 150 meter buffer of the project footprint including 86 within the first 10 feet. The land clearing opens these individuals to future disturbance by typhoons as well as higher susceptibility to parasitism and predation.

Cycad pups and seeds collected and propagated/grown in the nursery environment, then outplanted into protected habitat may provide a replacement of up to 95 *C. micronesica* and 6 *T. rotensis.* However, there are already populations of *C. micronesica* within the five outplanting sites and two *T. rotensis* sites (Tarague Basin and Golf Course). In addition, the success criteria

of minimal growth of the outplanted individuals at the outplanting sites, rather than the replacement of sexually mature individuals, leaves significant uncertainty in whether the outplanted individuals will grow to a point that they contribute to the long-term recovery population or genetic diversity of the overall listed plant populations.

Species' response to the proposed action

Construction related disturbance and normal use of the project area post-construction is not expected to result in injury or death of any Mariana fruit bats.

As stated above, the proposed action would result in the direct loss of 473 *C. micronesica* and 22 *T. rotensis* from these species overall populations, and a possible 481 *C. micronesica* damaged or lost due to indirect (edge) effects. Some amount of genetic diversity would also be lost. The destruction of up to 473 cycads and 22 *T. rotensis*, plus the possible indirect effects to an additional 86 cycads, would not affect the growth and survival of individuals of these species outside of the project's action area. However, the population trend for *C. micronesica* is in steep decline in recent years due to the *A. yasumatsui* scale and other pest species. The combination of existing threats, plus projects such as the action, are pushing *C. micronesica* toward a point in which the species will no longer be recoverable. While the current impacts only represent a minimum 0.062 percent of the range-wide population of *C. micronesica*, continuing to impact this species without fully offsetting those impacts is not sustainable.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BiOp. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The Service is not aware of any future state, tribal, local, or private actions that are reasonably certain to occur within the action area at this time; therefore, no cumulative effects are anticipated.

Conclusion

After reviewing the current status of the threatened Mariana fruit bat (*Pteropus mariannus*), threatened *Cycas micronesica*, and threatened *Tabernaemontana rotensis*, the environmental baseline for the action area, the effects of the proposed construction and operation of 48 ECMs within MSA I, located on AAFB, Guam, and the cumulative effects, it is the Service's Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Mariana fruit bat, *C. micronesica*, or *T. rotensis.* There is no designated critical habitat within the action area; therefore, there will be no affect to critical habitat.

The Service reached this conclusion based on the following information described in the Effects of the Action section, above.

- Mariana fruit bats have not been observed roosting or feeding in the project footprint, where the clearing of land will occur, so it is assumed this is not a loss of functional habitat for the bats. No take of Mariana fruit bats is expected to occur because disturbance of the bat during and after construction is not expected to rise to the level of injury. The level of disturbance within the possible outplanting vegetation plots or transplantation of individuals is limited to biologists working in the forest plots.
- In areas where noise, light or human activity from construction of the proposed action would result in excessive noise, light or human activity above the ambient level, construction contractor personnel will be required to survey within line of sight (up to 150 m) of construction activities for bats prior to the start of a day's construction activities. Construction work generating noise, light or human activity above the ambient levels will be postponed until the bat(s) has left the area. The construction contractor will document bat surveys in the daily logs.
- Based on most recent estimates, the action is expected to remove 0.068 percent of the existing *C. micronesica* across its native range and 0.14 percent of the cycads on Guam. Considering just the cycads in good condition on Guam, 0.067 percent will be removed. Although this fraction seems minimal, *C. micronesica* has been in a state of decline since introduction of the *A. yasumatsui* scale in 2003. The current Guam population experienced an initial decline of 92 percent in the years following scale introduction. Between 2013 and 2020, cycad populations have declined by a further 33.3 percent. The continued loss of *C. micronesica* individuals from the population without adequate offset is likely to have significant consequences to the species as a whole and could result in the extirpation of the species on Guam within the next 15 years.
- An additional 481 *C. micronesica* fall within the 150-meter action area buffer and at least 86 of those are within the 10 foot BMP buffer of the cleared footprint. All of these plants will be subjected to increased fragmentation as a result of the action and a portion are expected to succumb to future stressors, such as typhoons, predation, and parasitism, because of increased exposure to the forest edge. When all of these plants are taken into account, the estimated loss to the population on Guam doubles from 0.14 to 0.28 percent. If just the 86 in the 10 foot buffer are added, 0.16 percent of the *C. micronesica* on Guam will be lost.
- The DON has proposed to salvage a minimum of 95 genetically unique individuals and ensure their survival in ungulate-proof fenced plots within AAFB. The 95 individuals is based on: (1) the health of the plants within the project footprint, (2) the ability to safely salvage the basal shoots or seeds, (3) whether or not the basal shoot would survive transplantation, or (4) whether the plant produces seed. The lead biologist will make the determination of "health." If these outplantings are successful, the reduction of *C. micronesica* will fall to 0.040 percent across their native range and 0.082 percent on Guam. The DON is not following nursery growth and outplanting recommendations provided by the Service on March 23, 2020, so outplanted individuals are not considered as an offset to the plants being removed.
- Outplantings will occur in up to five proposed vegetation plots on AAFB. These plots already contain a minimum 412 *C. micronesica*, which are maintained by the GPEPP as

*C. micronesic*a study sites. The addition of 95 new individuals is not expected to harm the plants already present across these plots, but the increase in individuals does not benefit the cycad populations at the outplant sites beyond increasing the genetic diversity. If outplanting is successful and the outplants reach sexual maturity, the result will be beneficial by providing increased local genetic diversity and support for the survival and recovery of the species.

- The proposed action will result in the removal of 22 *T. rotensis* from the project footprint, representing a range wide reduction of approximately 0.094 percent. The DON has proposed to replace a minimum of six genetically distinct *T. rotensis*, grown from seeds or cuttings and planted in up to five vegetation plots on AAFB. Accounting for the replacement of these six individuals the population wide reduction is reduced to 0.070 percent.
- Two of the five proposed outplanting plots, Tarague Basin and Golf Course, already contain a combined 100 *T. rotensis* (50 each), but if these sites are used, outplanting activities are not expected to harm existing trees. If outplanting is successful and the plants reach sexual maturity, the result will be beneficial by providing increased local genetic diversity.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the DON for the exemption in section 7(o)(2) to apply. The DON has a continuing duty to regulate the activity covered by this incidental take statement. If the DON: (1) fails to assume and implement the terms and conditions; or (2) fails to require contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the contract document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the DON must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)] Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to

possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

Amount or Extent of Take Anticipated

The Service does not anticipate the proposed action will incidentally take any Mariana fruit bats.

Effect of the take

In the accompanying BiOp, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Mariana fruit bat.

Reasonable and Prudent Measures

The Service has determined that no Reasonable and Prudent Measures are necessary to minimize the potential for Mariana fruit bat incidental take.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the DON must comply with the following reporting and monitoring requirements.

The DON must monitor the implementation of the project to a sufficient degree to ensure that disturbance of Mariana fruit bats does not rise to the level of harass or harm, resulting in injury or death through the alteration of normal feeding roosting, and breeding behaviors. The DON will implement systematic searches for Mariana fruit bat colonies in all areas of suitable habitat within the action area. If a maternity colony is found, the DON will notify the Service per the Reinitiation Notice.

Upon locating a dead or injured specimen, immediately notify the Service's Law Enforcement Office at 671-647-6064 and PIFWO's Marianas Field Office at 671-989-6743. Care must be taken in handling any dead or injured specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead or injured specimens does not imply enforcement proceedings pursuant to the ESA. This reporting requirement enables the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective.

The Service believes that no incidental take of the Mariana fruit bat will result from the proposed action. If, during the course of the action, non-intentional harassment of Mariana fruit bats utilizing habitat in the action area results in injury or death of one or more individual fruit bats, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The DON must immediately provide an

explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service recommends the DON continue to implement their comprehensive BTS interdiction program to ensure that military activities, including the transport of civilian and military personnel and equipment to and from Guam, do not contribute to the spread of the BTS to other islands or regions. The BTS interdiction requirements are specified in DoD instructions (i.e., *36 Wing Instruction 32-7004, BTS Control Plan and JTREGMARIANASINST 5090.10A, BTS Control and Interdiction*).

Reinitiation Notice

This concludes formal consultation on the action(s) outlined in this BiOp. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary DON involvement or control over the action has been retained or is authorized by law and: (1) if taking of a Mariana fruit bat occurs; (2) if new information reveals effects of the action that may affect listed species in a manner or to an extent not previously considered; (3) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the BiOp; or (4) if a new species is listed or critical habitat designated that may be affected by the identified action.

Sincerely,

KATHERINE MULLETT

Digitally signed by KATHERINE MULLETT
Date: 2020.07.01 07:15:40 -10'00'

Katherine Mullett
Field Supervisor

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ESA Listed Plant Species

Heritiera longipetiolata is a large to medium-sized tree. Leaves are large and oblong. The upper leaf surface is dark green and the lower leaf surface is bronze.

Eugenia bryanii is a multi-stemmed shrub. Leaves are small and leathery. Flowers are small, white with numerous thread-like stamens. Fruits are round and bright red.

What To Do If You Discover a Listed Plant Species on Jobsite

If protected plant species are found without a flag within your construction footprint:

1. Take note of location (GPS point if possible)
2. Place flag adjacent to the tree or plant
3. Inform supervisor
4. Supervisor will inform the Government Biologist

CONTACT INFORMATION

Environmental Flight Chief, 36th CES

Jeff Laitila – 671-366-2556 jeffery.laitila@us.af.mil

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FLORA

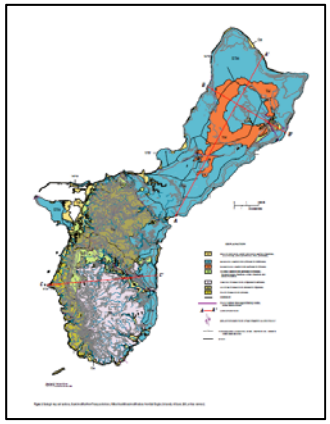
NAVFAC Naval Facilities Engineering Command

PACIFIC & MARIANAS

GUAM Natural Resources Contractor Education

AUGUST 2019

Guam is the southernmost and the largest island in the Mariana archipelago. The island is divided into two distinct physiogeographic provinces by the Pago-Adelup fault. The northern plateau is composed of limestone that were once coral reefs and are now fossilized. The southern hills are primarily composed of volcanic soils with uplifted limestone along the east coast and atop the Mt. Lamlam ridge.



In 2015 the US Fish and Wildlife Service (USFWS) listed 14 plant species under the Endangered Species Act (ESA). Seven of the listed species have been identified in pre-construction surveys on Marine Corps Buildup projects.

ESA Listed Plant Species

Tabernaemontana rotensis is a small to medium-sized tree. Leaves are large and light green. Flowers are white and occur in large clusters. Fruits are large and bright orange.

ESA Listed Plant Species

Bulbophyllum guamense occurs in large mat-like formations high on branches of large trees. Leaves are oblong shaped. Flowers are single, fleshy, and greenish-yellow in color.

Tuberolabium guamense grows on tree trunks and branches. Leaves are leathery and oblong shaped. Flowers are small, white and occur in clusters.

ESA Listed Plant Species

Dendrobium guamense grows on tree trunks and branches. Leaves are arranged on long stems in two opposite vertical rows. Flowers are small and white and occur at the base of the leaves.

Cycas micronesica is a small to medium sized unbranched tree with a thick trunk that looks like a palm tree. Leaf arrangement similar to palm fronds.

Listed Animal Species

Hypolimnas octocula mariannensis, Mariana eight-spot butterfly is a small-sized butterfly in the Nymphalidae family. Coloration is black with orange accents. Larvae are entirely black with red to red-orange spines

Adult

Larvae

Butterfly Host Plants

Procris pedunculata are large succulent plants with stems that hang down from the base that can grow to 3-4ft. long. Flowers are small and white.

Elatostema calcareum are medium sized, erect succulent plants that grow to 2ft. Flowers are small, white in the shape of a button on the stem.

What To Do If You Observe a Mariana Fruit Bat within 492ft from your Jobsite or Other Listed Animal Species on your Jobsite

1. Stop work in immediate area
2. Take note of location (GPS point if possible)
3. Inform supervisor
4. Inform Government Biological Monitor
5. Continue work in another area

CONTACT INFORMATION

Environmental Flight Chief, 36th CES

Jeff Laitila – 671-366-2556 jeffery.laitila@us.af.mil

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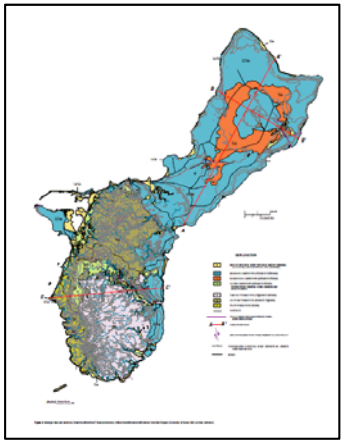
Fauna

NAVFAC Naval Facilities Engineering Command PACIFIC & MARIANAS

GUAM Natural Resources Contractor Education

AUGUST 2019

Guam is the southernmost and the largest island in the Mariana archipelago. The island is divided into two distinct physiogeographic provinces by the Pago-Adelup fault. The northern plateau is composed of limestone that were once coral reefs and are not fossilized. The southern hills are primarily composed of volcanic soils with remnant limestone along the east coast and atop the Mt. Lamlam ridge.



On Guam the US Fish and Wildlife Service (USFWS) has listed 18 animal species under the Endangered Species Act (ESA). Five of the listed species have been identified in pre-construction surveys on Marine Corps Buildup projects.

Listed Animals Species

Partula gibba, Humped Tree Snail. Shell coloration of whorl line consists of various shades of white or brown on a background of chestnut brown to whitish-yellow or purple. Snail size is comparable to that of a thumb tack.

Listed Animals Species

Partula radiolata, Guam Tree Snail. Shell coloration consists of dark axial rays and brown lines on a background of pale straw. Snail size is comparable to that of a thumb tack.

Samoana fragilis, Fragile Tree Snail. Shell coloration consists of dark maculations and whitish banding on a buff background. Snail size is comparable to that of a thumb tack.

Listed Animals Species

Pteropus mariannus mariannus, Mariana Fruit Bat (MFB) is a medium-sized fruit bat that varies from 0.73lb to 1.27lb. The MFB has a black to brown abdomen with pale or golden brown shoulders and necks. Head coloration varies from brown to dark brown.

Migratory Bird Species

Migratory Bird Treaty Act (MBTA) is a federal law designed to protect migratory birds against unlawful pursue, hunt, take, capture, kill, or sell.

Ixobrycus sinensis, Yellow Bittern

Pluvialis fulva, Pacific golden

Appendix D
National Historic Preservation Act Section 106 Documentation

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 36TH WING (PACAF)
ANDERSEN AIR FORCE BASE GUAM

14 July 2020

RECEIVED
JUL 14 2020
BY 10:35
GUAM HISTORIC RESOURCES DIVISION

Patrick Q. Lujan
State Historic Preservation Officer
Guam Historic Resources Division
490 Chalan Palasyo
Agaña Heights, Guam 96910

RE: Archaeological Data Recovery Plan for Site 66-08-2102 at Andersen Air Force Base, Guam, Mariana Islands (**RC2018-0610**)

Dear Mr. Lujan,

On behalf of Andersen Air Force Base, I thank you for your review of the above referenced document. Your close reading and salient comments are greatly appreciated and we will incorporate the necessary changes as they apply to the Data Recovery Plan. The one exception is that we will maintain use of 30cm diameter shovel tests as these are most appropriate to the task of both finding buried cultural deposits and defining boundaries. Should you provide us with scientific evidence (i.e. a peer reviewed paper as opposed to guidelines from some other jurisdiction) demonstrating that 30cm diameter shovel tests are ineffective for these purposes we will be glad to reconsider this position. We are in receipt of your letter dated May 3, 2018 concurring with our determination of "No Adverse Effect" and will proceed in accordance with 36 CFR §800.5(c)(1).

We thank you once again for your review.

Sincerely,

Richard K. Olmo
Archaeologist and CRM
Andersen Air Force Base, Guam

Eddie B. Calvo
Governor
Ray Tenorio
Lt. Governor

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo, Agana Heights, Guam 96910
Director's Office: (671) 475-6288
Parks Division: (671) 475-6291
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822

William N. Reyes
Director
John P. Taitano
Deputy Director

In reply refer to:
RC 2018-0610

May 3, 2018

Richard K. Olmo
Archaeologist/ CRM AAFB
36 Civil Engineers Squadron
Conservation Resources
Unit 14007
APO AP 96543-4007

Subject: Section 106 Review
Undertaking: Construct Forty-Eight Hayman Igloos Within MSA-1, Andersen Air Force Base, Guam (RCS 18-5001)

Dear Mr. Olmo,

We have reviewed your Section 106 request on the subject undertaking and agree that Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the National Register of Historic Places. We look forward to reviewing the draft archaeological data recovery plan. With an approved archaeological data recovery plan in place we will concur with the determination of "No Adverse Effect" and the provisions set forth for inadvertent discoveries.

Please do not hesitate to contact our office should you have any questions.

Sincerely,

William N. Reyes
Director

Lynda Bordallo Aguon
State Historic Preservation Officer

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 36TH WING (PACAF)
ANDERSEN AIR FORCE BASE GUAM

17 April 2018

36 Civil Engineer Squadron
Environmental Flight
Unit 14007
APO AP 96543-4007

Ms. Lynda Bordallo Aguon
State Historic Preservation Officer (SHPO)
Guam Historic Resources Division
Department of Parks and Recreation
490 Chalan Palasyo
Agaña Heights, Guam 96910

Subject: Section 106 Consultation—**Construct Forty-Eight Hayman Igloos within MSA-1** at Andersen Air Force Base, Guam, **RCS 18-5001**

Dear Ms. Aguon:

Andersen Air Force Base (AAFB) requests your review of a proposed project for the construction of forty-eight storage igloos within the Munitions Storage Area 1 (MSA-1) on Andersen Air Force Base (AAFB) [see Attachment 1]. Pursuant to Section 106 of the National Historic Preservation Act (NHPA), we have reviewed the proposed project scope and determined it is an undertaking as defined in 36 CFR 800.16(y).

Project Location and Description:

The igloos are to be located along 5th, 6th, 7th and 8th Streets in MSA 1 (see Attachment 2). They will be constructed with precast vertical concrete walls, reinforced concrete floor and roof slabs, and will measure approximately 25 feet wide and 81 feet long. The walls and roof are designed to be covered in a minimum of 24 inches of fill with a topping of shotcrete to prevent plant growth and erosion. Each new igloo would have approximately 2,025 square feet (ft^2) of floor space.

A paved apron between an adjacent road and the access doors would be required for each igloo. Each apron would consist of two separate elements: an asphaltic concrete transition approximately 26.5-feet deep and 127-feet wide and a Portland cement concrete apron centered on the entrance doors measuring approximately 24-feet deep and 26-feet wide. Approximately 8000 linear feet of new utility lines will be undergrounded in a trench 2 feet wide by 3 feet deep along the edge of the existing roadways and these will connect at the front of each igloo (see Attachment 3).

Area of Potential Effect:

The Area of Potential Effect (APE) for this project shows as the area within the gray dotted line in Attachment 2.

Identification of Historic Properties:

Archaeology:

The project is located in the munitions storage area of AAFB. The APE was partially surveyed by PHRI (DeFant and Leon Guerrero 2006), and was entirely surveyed by TEC-AECOM (Dixon et al. 2018). Five sites fall within the APE (see Attachment 2). Two sites, 66-08-2100 and 66-08-2103 were assessed as ineligible to the National Register of Historic Places (NRHP). Three sites were assessed as eligible: 66-08-2101, 66-08-2102 and 66-08-2922. These sites are the drivers for the mitigation actions discussed in the Determination of Project Effects section, below.

Site 66-08-2101 is a prehistoric sherd scatter identified along the margins of a cleared area approximately 70 m west of 7th Street and 75 m north of D Avenue. Three shovel tests were excavated in the site, two of which contained sherds, charcoal and shell fragments.

Site 66-08-2102 is a very small, yet relatively dense, scatter of prehistoric ceramics situated 30 m east of 6th Street and 300 m north of C Avenue. This site is located in a clearing just on the edge of dense vegetation. A shovel test in the site contained charcoal fragments, shell fragments and two sherds.

Site 66-08-2922 is a small Latte Period artifact scatter including prehistoric ceramics, fragments of a ground pumice tool and a broken *Tridacna* shell adze. A human bone fragment was also recovered from the site. Excavations revealed a low density, low diversity ceramic assemblage and a small refuse deposit.

Built Environment:

MSA-1 was assessed by an architectural historian and there are no eligible historic structures within the APE (Dixon et al. 2018).

Determination of Project Effect:

On 30 January 2018 Richard Olmo, Andersen Air Force Base Cultural Resources Manager met with State Archaeologist John Mark Joseph at the Historic Resources Division to discuss project impacts. As a result of this meeting and in a follow-up telephone conversation Mr. Joseph proposed that if we treated the sites in the following ways, we would achieve a finding of **No Adverse Effect** for the project.

Site 66-08-2103 (ineligible) will be "subject to inadvertent discovery" during the construction process. This follows the provisions of the *Final Integrated Cultural Resource Management Plan for Andersen AFB* (ICRMP) [SEARCH, 2015] and those of 36 CFR 800.13 Post Review Discovery.

The close proximity of the ineligible site 66-08-2100 and the eligible sites 66-08-2101 and 66-08-2922 suggests that these are portions of a single site that was disrupted during WWII construction. Sites 66-08-2100, 66-08-2101 and 66-08-2922 will have adverse effects mitigated through avoidance by

removing the igloo that coincides with that location and by altering the path of the proposed utility lines.

Site 66-08-2102, which falls under the footprint of three igloos will have adverse effects mitigated through archaeological data recovery. A data recovery plan shall be submitted to SHPO for approval, and the work executed prior to the onset of construction.

Human remains encountered during these excavations or in association with any of the project's construction activities will trigger ICRMP Standard Operating Procedures and Guam law, and require further consultation with the SHPO.

As noted above, mitigation actions outlined above are stipulated for this project. Consequently, Andersen Air Force Base determines that there will be **"no adverse effect"** by the proposed undertaking. Andersen Air Force Base respectfully requests concurrence from Guam SHPO with this determination. In accordance with 36 CFR 800.5(c) (1), if we receive no response from your office within 30 days of receipt of this letter we will assume no objections to the determination of project effect and site eligibility.

If archaeological resources are inadvertently discovered during ground-disturbing activities, then the Standard Operating Procedures contained with the *Final Integrated Cultural Resource Management Plan for Andersen AFB* (SEARCH, 2015) will be followed as well as the provisions of 36 CFR 800.13 Post Review Discovery.

We value your support in our efforts to continue carrying out the United States Air Force's responsibility regarding the management of its cultural resources. Should you have any questions or require additional information about this proposed project, please feel free to contact me via phone at (671) 366-1019 or e-mail at richard.olmo@us.af.mil.

Sincerely,

Richard K. Olmo
Archaeologist/CRM AAFB
Conservation Resources
Environmental Flight

Attachments:
1. Igloos sites Topo
2. Igloos Air Photo
3. Igloos Utilities

REFERENCES

DeFant, David and Lynn Leon Guerrero

2006 Archaeological Survey of Seven Parcels within the Munitions Storage Area, Andersen Air Force Base, Island of Guam. PHRI, Hilo.

Dixon, Boyd, Trina Meiser, Robert Jones and Isla Nelson

2018 Final Technical Report: Cultural Resources Investigations Within the Munitions Storage Area, Andersen Air Force Base, Yigo, Guam. Prepared by TEC-AECOM JV for NAVFAC Pacific

SEARCH

2015 *Integrated Cultural Resources Management Plan for Andersen Air Force Base, Joint Region Marianas*. Prepared for NAVFAC Marianas.

Appendix E
Coastal Zone Management Act Correspondence

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Lourdes A. Leon Guerrero
Governor of Guam

Joshua F. Tenorio
Lieutenant Governor

BUREAU OF STATISTICS & PLANS
SAGAN PLANU SIHA YAN EMFOTMASION
Government of Guam
P.O. Box 2950 Hagåtña, Guam 96932
Tel: (671) 472-4201/3
Fax: (671) 477-1812

Tyrone J. Taitano
Director
Matthew Santos
Deputy Director

MAY 27 2020

Todd T. Inouye
Lieutenant Colonel
36th Civil Engineer Squadron
Department of the Air Force
Unit 14007 APO AP 96543

RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for the proposed Construction of Munition Storage Igloos at Andersen Air Force Base, Guam *(GCMP FC No. 2020-0005)*

Hafa adai! The Guam Coastal Management Program of the Bureau of Statistics and Plans (Bureau) has completed its review of the Federal Consistency Determination by Department of the Air Force. The Department of the Air Force ("the federal agency") has submitted its consistency determination relative to the proposed Construction of Munition Storage Igloos at Andersen Air Force Base, Guam.

The Bureau coordinated this review with partnering agencies, provided Public Notice, and did not receive any comments. Furthermore, the Bureau hereby concurs with the federal agency's determination that the proposal is consistent with the enforceable policies of the Bureau's Guam Coastal Management Program (GCMP) and will be conducted in a manner consistent with the program. Our consistency concurrence, however, does not preclude the need for securing other federal and Government of Guam permits, clearances and approvals prior to the start of this project.

The proposed action shall be operated and completed as represented in the Coastal Zone Management (CZM) federal consistency determination. Significant changes to the subject proposal shall be submitted to the Bureau for review and approval and may require a full CZM federal consistency review, including publication of a public notice and provision for public review and comment. This condition is necessary to ensure that the proposed actions are implemented as reviewed for consistency with the enforceable policies of GCMP. Guam Land Use policies (E.O. 78-37), are the federally approved enforceable policies of GCMP that applies to this condition.

Please do not hesitate to contact Mr. Julian Janssen, Federal Consistency Coordinator at 475-9664 or email julian.janssen@bsp.guam.gov or Mr. Edwin Reyes, Coastal Program Administrator at 475-9672 or email edwin.reyes@bsp.guam.gov. *Si Yu'os Ma'åse'.*

Sincerely,

TYRONE J. TAITANO
Director

Cc: DoAgr-DAWR
DLM
DPR-SHPO
DPW
GEPA
NOAA-OCM

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 36TH WING (PACAF)
ANDERSEN AIR FORCE BASE GUAM

Mr. Tyrone J. Taitano
Director
Bureau of Statistics and Plans
P.O. Box 2950
Hagatna, Guam 96932

Subject: Negative Determination for the Proposed Construction of Munitions Storage Igloos at Andersen Air Force Base, Guam

Dear Mr. Taitano,

The United States Air Force (USAF), Headquarters Pacific Air Forces (PACAF), 36th Wing (36 WG), Andersen Air Force Base (AAFB), Guam proposes to construct an additional 48 Hayman-style munitions storage igloos in Munitions Storage Area I (MSA-I) at AAFB in Joint Region Marianas, Guam. The USAF determined that the proposed federal activity is a development project outside of Guam's defined coastal zone. This letter provides documentation that the USAF has determined that the proposed activity would not have foreseeable coastal effects to Guam's defined coastal zone per 15 CFR 930, Section 930.35.

The new munition igloos would require lighting and electrical support, an intrusion detection system, ventilation, reinforced concrete foundations, rated 7-bar construction, floor slabs, columns, beams, and a lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons. The action would increase munitions storage capacity and provide minor facility modifications to meet operational requirements. The anticipated timeline for construction, design and acquisition of the 48 igloos is approximately 3 years. An increase in personnel is not anticipated.

The purpose of the Proposed Action is to reduce the existing munitions storage capacity shortfall at Andersen AFB by constructing adequately sized, configured, sited, and protected munitions storage igloos. This would ensure sufficient supply of the new highly sophisticated munitions that will be critical in the initial stages of any armed combat missions. An additional 280,000 ft^2 of storage space and infrastructure upgrades are needed in MSA I so that Andersen AFB can continue to fulfill its mission.

The Proposed Action is needed to enable the 36 WG, a PACAF wing unit at Andersen AFB, to perform its existing mission and ongoing military operations by providing adequate munitions storage. In April 2002, the U.S. Air Force Safety Center evaluated existing munitions magazines from the 1950s. The magazines failed to meet the standard rating due to faulty door design. Additionally, the earth coverings on the magazines have deteriorated from age, typhoon winds, and rain. These munitions magazines were downgraded from 500,000 pounds of net explosive weight to 250,000 pounds of net explosive weight. The age and wear of these facilities have caused a shortfall in munitions storage that is needed to support the current mission.

Consultation with the U.S. Fish and Wildlife Service (USFWS) under section 7 of the Endangered Species Act (ESA) is underway to make the final determination of effect to ESA-listed species. The USAF conducted consultation under Section 106 of National Historic Preservation Act in April 2018. This consultation indicated that there would be no adverse effect to sites eligible for the National Register of Historic Places if proposed mitigation measures are followed. The Guam State Historic Preservation Officer (SHPO) concurred with the Section 106 request, with the provision that an approved archaeological data recovery plan be put in place.

The USAF prepared a draft Environmental Assessment (EA) (enclosed) and has completed an "effects" test per 15 CFR Part 930 Section 930.33(a)(1). The USAF assessed reasonably foreseeable direct and indirect effects on Guam's coastal use or resources, reviewed relevant management program enforceable policies, and determined that the project does not have foreseeable coastal effects to Guam's defined coastal zone per 15 CFR 930, Section 930.35. This notification of negative determination is based on:

1. The proposed federal activity is located entirely within federal property that by definition is excluded from Guam's coastal zone per 15 CFR 923, Section 923.33(a), and would not result in spillover effects extending into Guam's coastal zone per 15 CFR 923, Section 923(b).
2. The nearest coastal zone is located approximately 4,000 feet northeast and downslope from the nearest proposed federal activities in the construction footprint within the MSA. None of these proposed federal activities would spill-over to adjacent parcels of non-federal property.
3. The proposed federal development is consistent with existing land uses as military mission support. It is fully contained within an area on Andersen AFB currently used for munitions storage.
4. The use of Best Management Practices would be implemented to minimize potential environmental effects.
5. The proposed activities are similar to previous USAF activities that have been determined to have no coastal effects.

Per communications between and your staff (Julian Janssen and Edwin Reyes) and our consultant in January and February, we are hopeful that a response from Bureau of Statistics and Plans can occur within 30 days or less from receipt of this package. However, if no response is received from your office within 60 days, the USAF shall presume concurrence with the negative determination per 16 CFR Section 930.35(c). If you have questions or require additional information about the proposed project, please contact Jeffrey Laitila by email at jeffrey.laitila@us.af.mil.

Sincerely,

INOUYE.TODD.T.1179650017

Digitally signed by INOUYE.TODD.T.1179650017
Date: 2020.03.06 07:44:20 +10'00'

TODD T. INOUYE, Lt Col, USAF
Commander, 36th Civil Engineer Squadron

Enclosures: (1) Project Location Map
(2) Proposed Action Map
(3) Typical Munitions Storage Igloo Design
(4) Photographs of Existing Munitions Storage Igloos
(5) Draft EA of Proposed Munitions Storage Igloos, Andersen AFB, Guam

Enclosure 1: Project Location Map

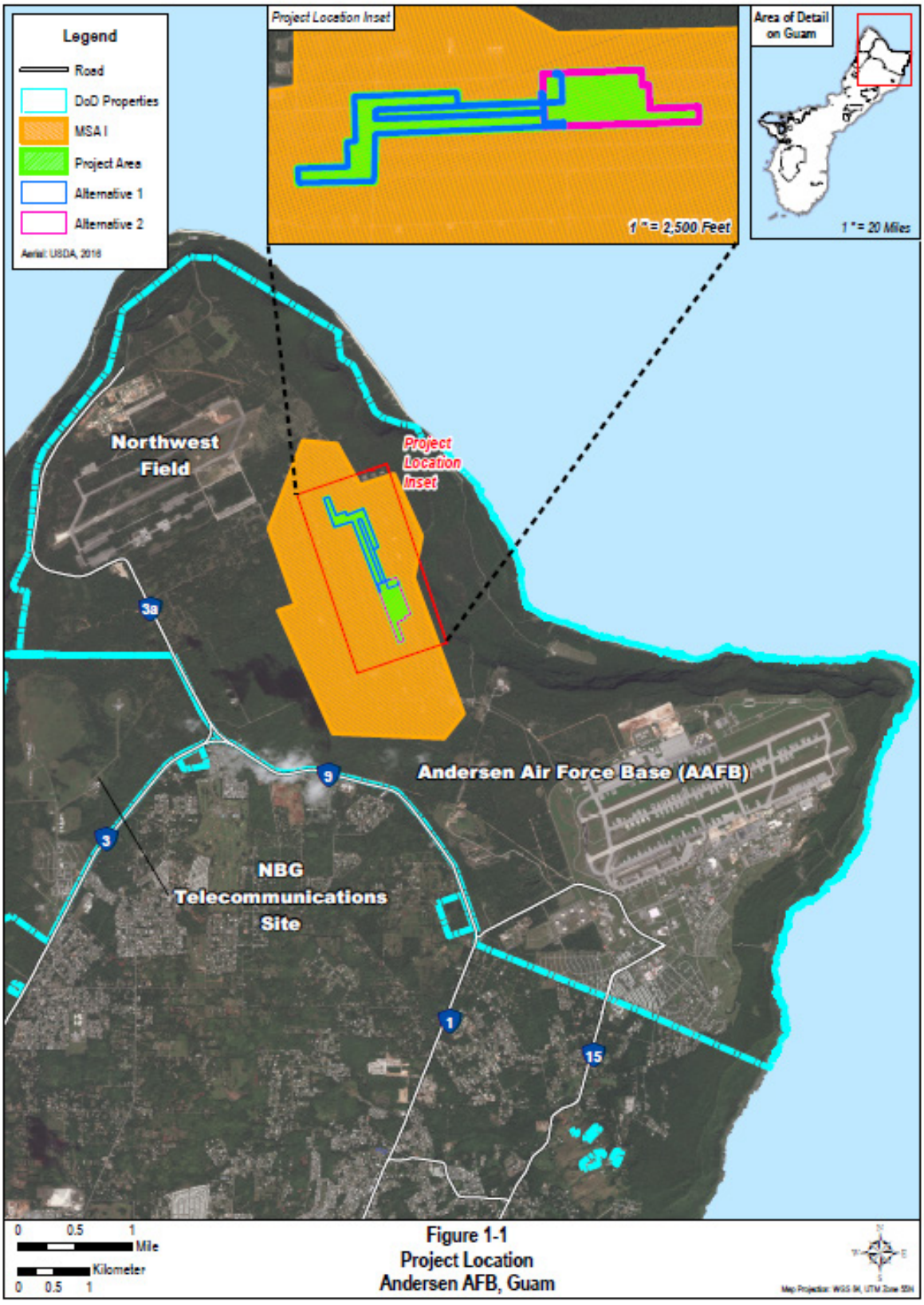


Figure 1-1
Project Location
Andersen AFB, Guam

Enclosure 2: Proposed Action Map

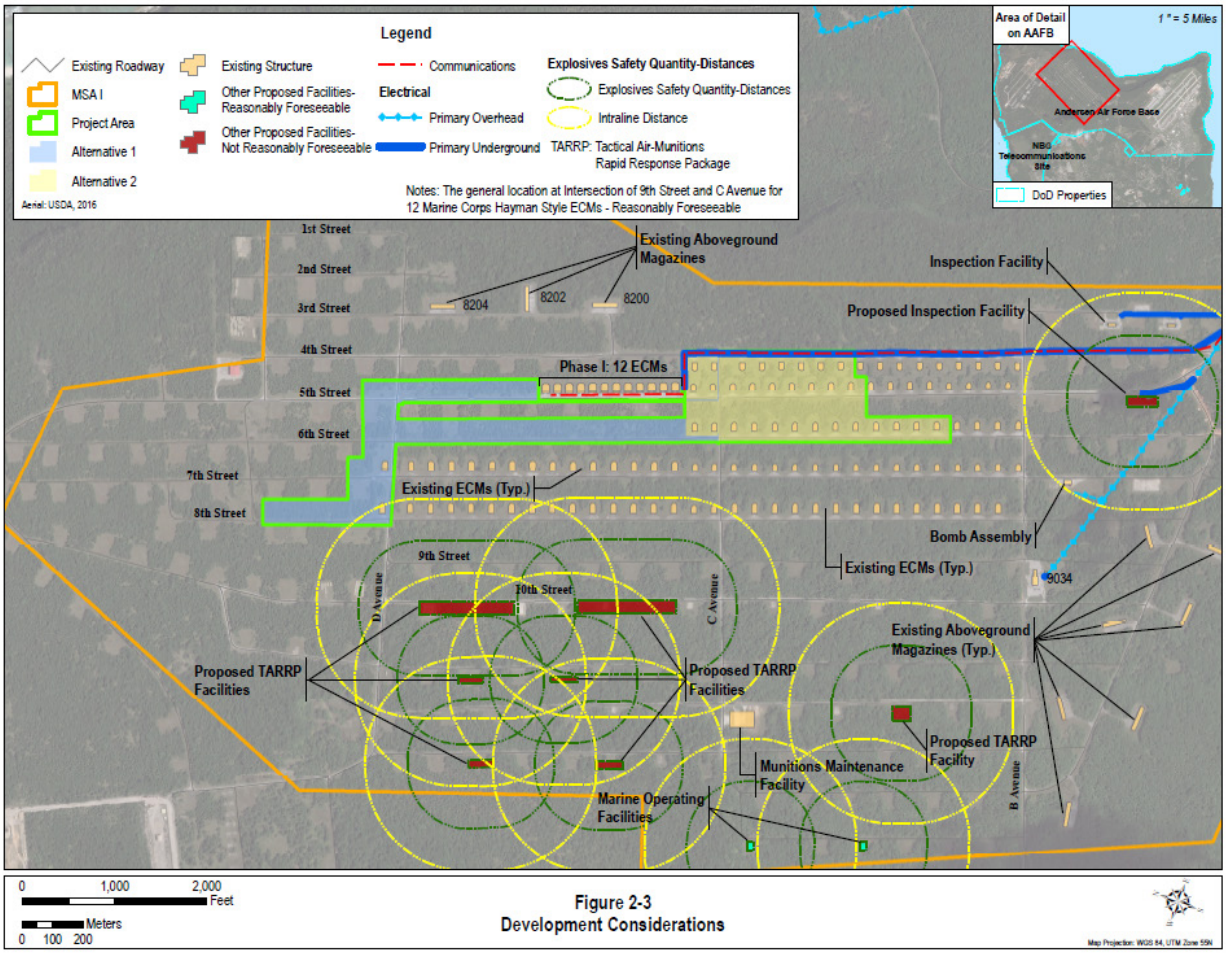
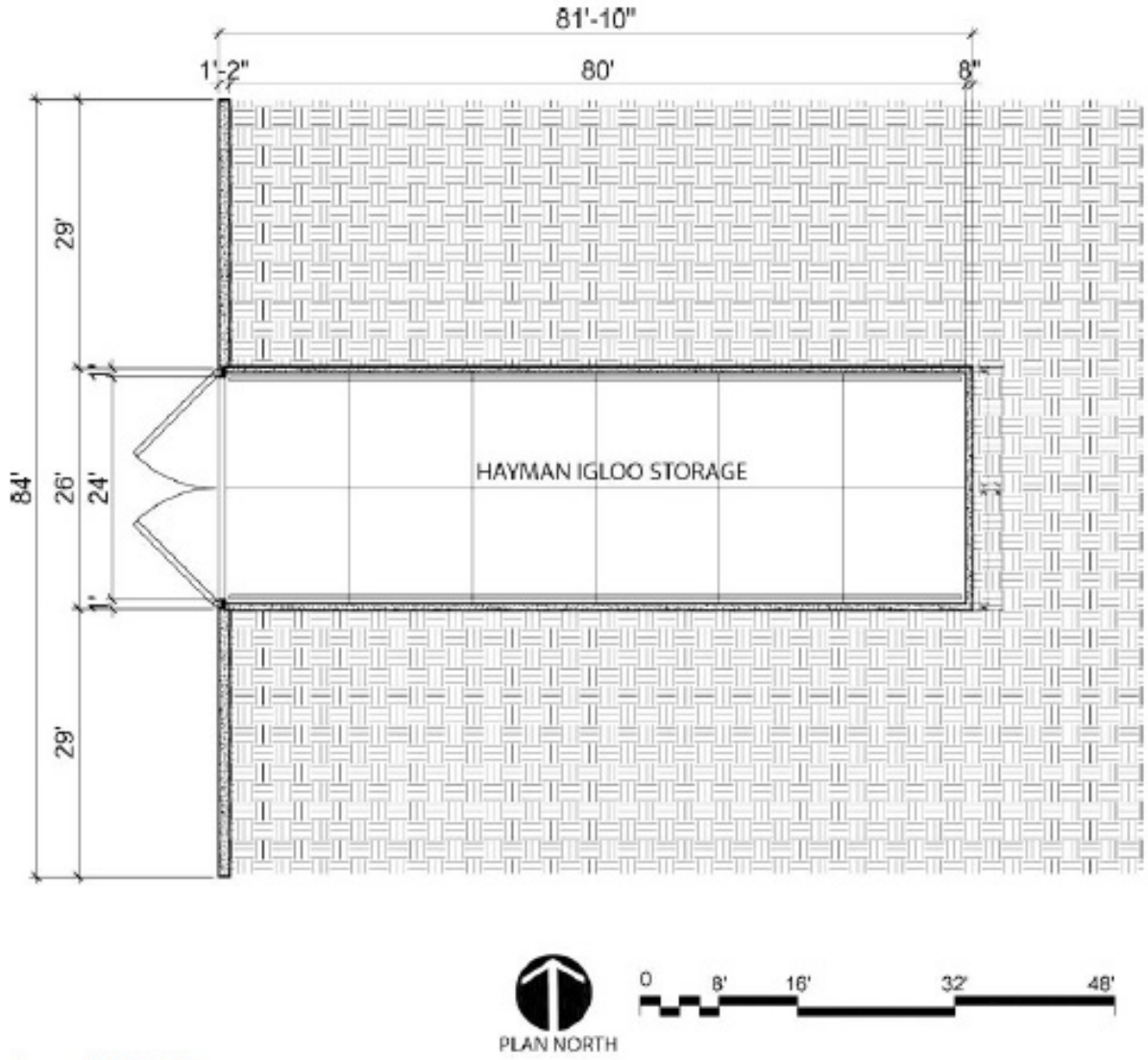


Figure 2-3
Development Considerations

Enclosure 3: Typical Munitions Storage Igloo Design



Source: PACAF, 2017.

Figure 2-4 Typical Hayman Style ECM Design

Enclosure 4: Photographs of Existing Munitions Storage Igloos

Source: 36 WG, 2009.

Figure 2-5 Photographs of Existing Munitions Storage Igloos, Andersen AFB

Appendix F
Munitions Storage Area Plant Survey Report

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Final

Natural Resources Survey Report in Support of the Environmental Assessment for Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Pacific
Joint Base Pearl Harbor-Hickam HI

Prepared by:

Honolulu HI

Prepared under: Contract N62742-11-D-1801, Task Order 0025

February 2017

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EXECUTIVE SUMMARY

Cardno biologists conducted surveys for species listed under the U.S. Endangered Species Act (ESA), Guam ESA, and Migratory Bird Treaty Act (MBTA) within the Munitions Storage Area (MSA) on Andersen Air Force Base (AAFB), Guam during December 12-16, 2016. These surveys were conducted in support of the Environmental Assessment (EA) for Proposed Munitions Storage Igloo Construction at AAFB. Per the Statement of Work, target species included Federal and Guam ESA-listed reptiles and tree snails, Federal ESA-listed butterflies, associated tree snail and butterfly host plants, and birds listed under the MBTA.

A team of three Cardno biologists conducted pedestrian surveys along a predetermined transect grid throughout all potential habitat for the target species in the project area. Since the MSA is characterized by patches of open, regularly mowed land alongside roads and wrapping around the circumference of munitions storage igloos, two general types of searches were employed during this project. The first set of surveys concentrated on the forested areas, and the second set focused on the surfaces of igloo structures.

Within the surveyed forested areas, there were only a few small isolated patches of tower karst containing native limestone forest habitat. The vast majority of the survey area, including the vegetated portions, consisted of flat, highly disturbed, closed-canopy degraded limestone forest with an open understory, with evidence of severe ungulate damage throughout.

The endemic Micronesian cycad (*Cycas micronesica*) was the only Federal and Guam ESA-listed species observed in the survey area. *Maytenus thompsonii*, the host plant for the Federal ESA-listed Mariana wandering butterfly (*Vagrans egistina*), was also observed throughout the survey area. No host plants for the Federal ESA-listed Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*) were observed within the survey area. Although numerous host plants for ESA-listed tree snails were observed, no ESA-listed tree snails were observed.

Three species of birds protected under the MBTA were observed: Pacific golden plover (*Pluvialis fulva*), Pacific reef heron (*Egretta sacra*), and yellow bittern (*Ixobrychus sinensis*). However, all were transient and no birds were observed nesting within the survey area.

Results of these surveys will be incorporated in the EA to support the evaluation of potential environmental impacts of the proposed action on biological resources. If applicable, results will also be incorporated into a Biological Assessment prepared in support of ESA section 7 consultation and will be used to develop measures to avoid, minimize, or mitigate potential impacts to ESA-listed species.

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Final
Natural Resources Survey Report in Support of the Environmental Assessment for Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam

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ACRONYMS AND ABBREVIATIONS

AAFB	Andersen Air Force Base
ac	acre(s)
DAWR	Division of Aquatic and Wildlife Resources
EA	Environmental Assessment
ESA	Endangered Species Act
ft	foot/feet
GovGuam	Government of Guam
GPS	Global Positioning System
ha	hectare(s)
km	kilometer(s)
m	meter(s)
mi	mile(s)
MATH	*Maytenus thompsonii*
MBTA	Migratory Bird Treaty Act
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Command
U.S.	United States
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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CHAPTER 1
INTRODUCTION

1.1 Overview

An Environmental Assessment (EA) is being prepared to assess the potential impacts from the proposed construction of munitions storage igloos at Andersen Air Force Base (AAFB), Guam. The proposed action includes the demolition of existing igloos and construction of 48 Hayman-style munitions storage igloos within the Munitions Storage Area (MSA). This report provides the results of biological surveys within the project area which will be incorporated into the EA to support the evaluation of potential environmental impacts of the proposed action on biological resources. If applicable, results will also be incorporated into a Biological Assessment prepared in support of Federal Endangered Species Act (ESA) section 7 consultation and will be used to develop measures to avoid, minimize, or mitigate potential impacts to ESA-listed species.

In accordance with the September 26, 2016 Statement of Work for Task Order 0025 (Naval Facilities Engineering Command [NAVFAC] Pacific 2016), the TEC-AECOM Joint Venture[1] team completed terrestrial biological resource surveys within the MSA on AAFB. Project tasks are as follows:

- Prepare a survey plan.
- Conduct surveys for butterflies, reptiles, and tree snails listed under the Federal ESA, Guam ESA, and Migratory Bird Treaty Act (MBTA), and host plant communities for ESA-listed butterflies and tree snails.
- Prepare a survey report (this document).

1.2 Natural Resources Team

The personnel involved in performing the project tasks are listed in Table 1-2. One subcontractor (Duenas, Camacho & Associates, Inc. [DCA]) assisted Cardno in the surveys.

Table 1-2. Natural Resources Team

Role	*Name*	*Organization*
Program Director	John Ford	Cardno
Project Manager	Peer Amble	Cardno
Quality Control	Rick Spaulding	Cardno
Survey Personnel	Brenden Holland, Lorraine Shaughnessy Claudine Camacho	Cardno DCA

1.3 Location

Guam is the largest and southernmost island within the Mariana Islands archipelago, approximately 1,550 miles (mi) (2,495 kilometers [km]) south of Japan and 1,620 mi (2,607 km) east of the Philippines (Figure 1-1). AAFB is located on the northeastern portion of Guam's limestone plateau and occupies approximately 15,360 acres (ac) (6,216 hectares [ha]). The MSA is located in the northwestern region of AAFB and occupies approximately 1,280 ac (518 ha). The project area for the proposed action is a 49-ac (20-ha) parcel located along the central eastern edge of the MSA (Figure 1-2).

[1]The TEC-AECOM Joint Venture is a contractual partnership between AECOM and Cardno, formerly TEC, Inc.

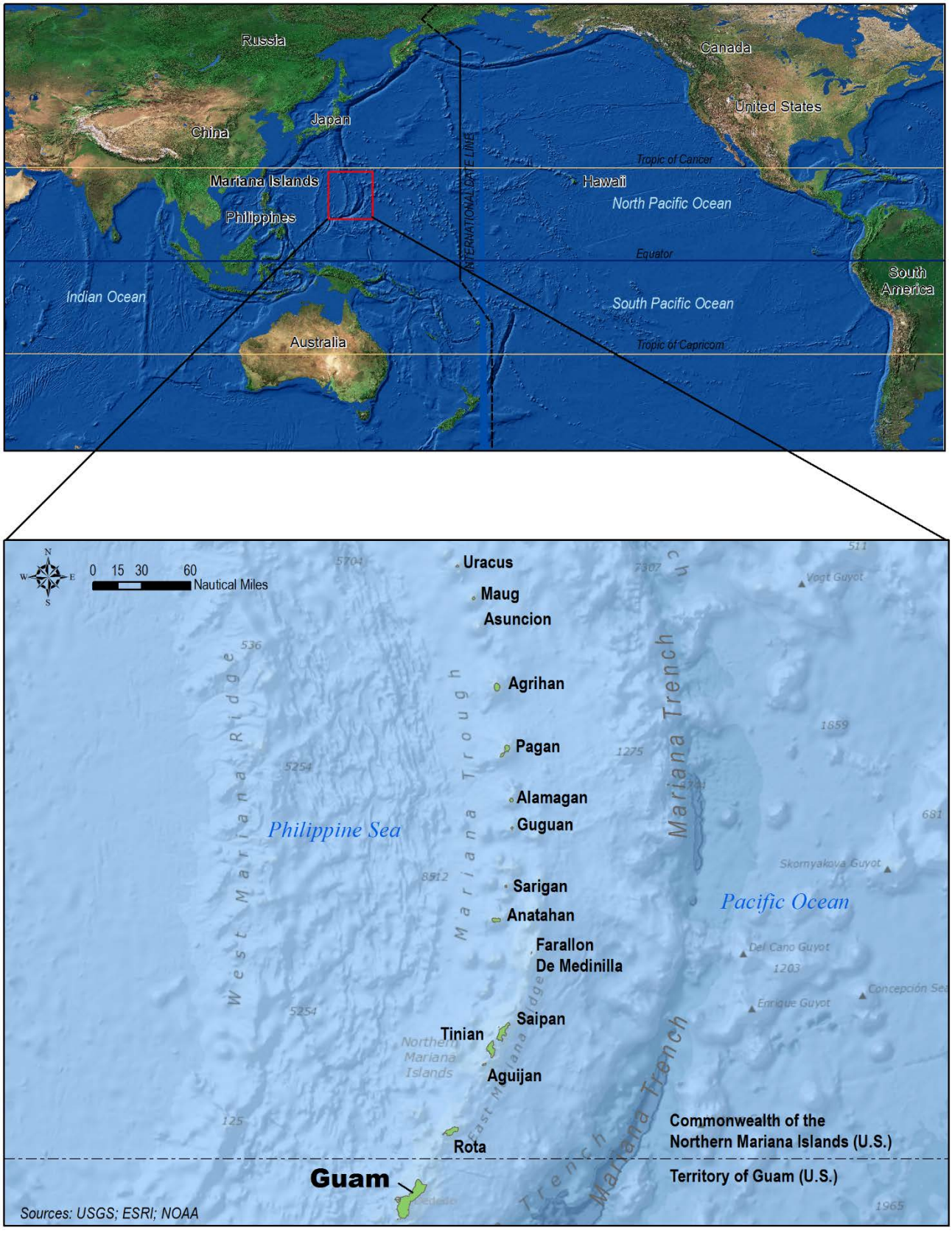

Figure 1-1. Location of Guam in the Western Pacific Region and the Mariana Islands

Figure 1-2. Project Area within the MSA, AAFB

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CHAPTER 2
VEGETATION COMMUNITIES AND TARGET SPECIES

2.1 Vegetation Communities

The MSA is located at the edge of the northern Guam limestone plateau. The original native limestone vegetation was largely composed of *Artocarpus marianensis*, *Pandanus* spp., and *Ficus* spp. among others. Historically, the plateau has been impacted by extensive agricultural and military use, which began in the early 1800s, continued during World War II, and continues today (Mueller-Dombois and Fosberg 1998). Vegetation mapping was conducted on AAFB lands in 2015 relying on a combination of desktop mapping, aerial imagery, and ground-truthing efforts (NAVFAC Marianas 2016). Based on this recent vegetation mapping, the project area is composed of 10.4 ac (4.2 ha) of *Vitex* forest and 38.9 ac (15.7 ha) of developed land (Figure 2-1).

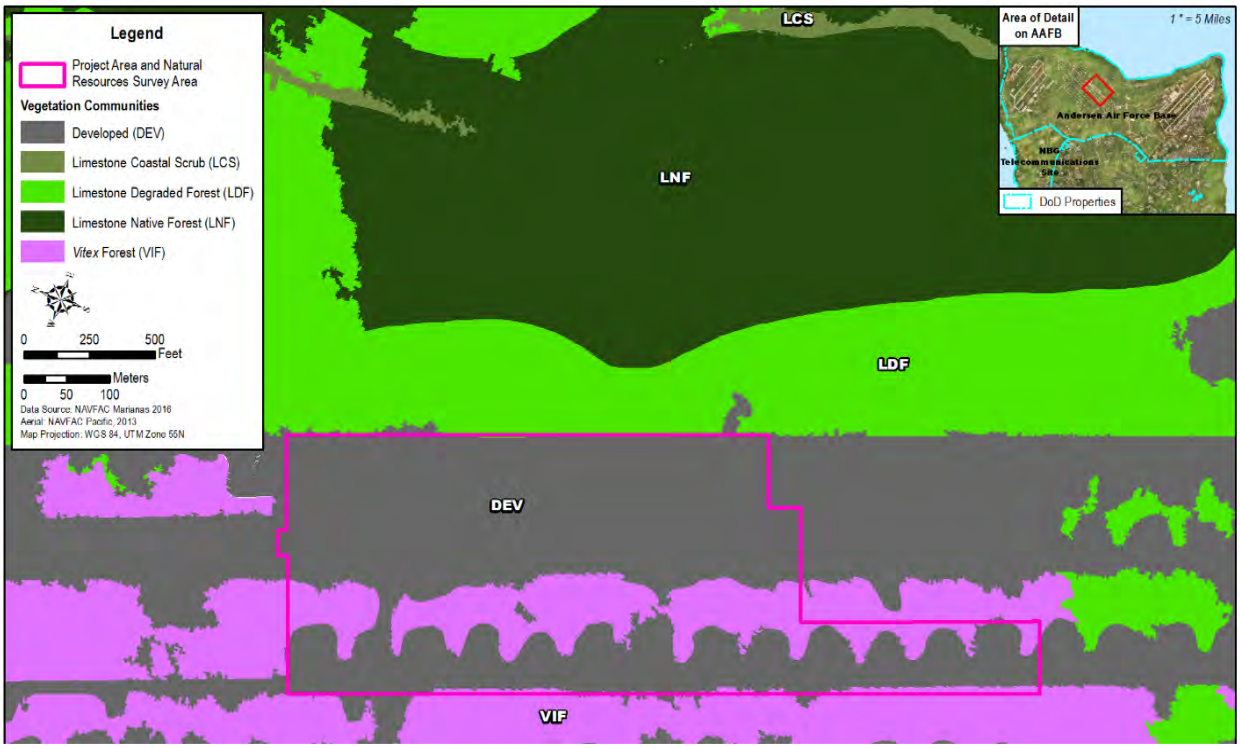

Figure 2-1. Vegetation Communities within the Project Area

Much of the land in the current project area is visibly graded (Figure 2-2). This disturbance to the limestone forest, in addition to continued ungulate activity that prevents recruitment and recovery of native flora, is what presumably allowed the non-native *Vitex parviflora* to overtake the canopy. However, a few small isolated patches of tower karst still exist within the project area (Figure 2-3). Despite considerable disturbance, some native flora such as *Ficus* spp., *Ochrosia oppositifolia,* and *Premna obtusifolia* persist. Within the larger strips of forested habitat there is closed canopy dominated by *Guamia mariannae*, although little or no understory and recruitment of new plants were observed. Throughout the forested areas there was fresh sign of ungulate activity, including Philippine deer (*Rusa marianna*) and feral pig (*Sus scrofa*) scat, and several small herds of deer were observed during the surveys.

Figure 2-2. Project Area with Visible Remnants of Past Limestone Grading

Figure 2-3. Small Patch of Tower Karst Located within the Project Area

2.2 Overview of Target Species

Natural resources surveys were conducted to detect the presence of species listed as endangered, threatened, proposed for listing, or a candidate for Federal ESA listing, as well as Guam-listed species. Species that had the potential to be detected during surveys are listed in Table 2-1, followed by detailed descriptions below. In addition, migratory birds protected under MBTA also have the potential to occur in the project area. Known host plants for ESA-listed tree snails and butterflies were also documented.

Table 2-1. Target Species for Biological Surveys Conducted in the MSA

*Common Name/ Chamorro Name**	*Scientific Name*	*Federal Status*[(a)]	*GovGuam Status*[(b)]	*Status of Guam Population*[(a, c)]	*Habitat*
Birds					
Micronesian starling/Såli	*Aplonis opaca*	--	E	Primarily occurs in urban areas and Cocos Island.	Cavity nester; all habitats but prefers forest.[(c)]
Reptiles					
Azure-tailed skink/ Guali'ek halom tåno'	*Emoia cyanura*	--	E	Extirpated	Dry open areas along the coast.[(c)]
Slevin's skink/ Guali'ek halom tåno'	*Emoia slevini*	E	E	Extirpated; only found on Cocos Island.	Forested areas.[(a)]
Moth skink/ Guali'ek kanton tåsi	*Lipinia noctua*	--	E	Very rare	Native limestone forest.[(c)]
Pacific slender-toed gecko/Guali'ek	*Nactus pelagicus*	--	E	Very rare	Forest edge.[(c)]
Micronesian gecko/ Guali'ek	*Perochirus ateles*	--	E	Extirpated	Native limestone and *Cocos* forests.[(c)]
Invertebrates					
Humped tree snail/Akaleha	*Partula gibba*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Guam tree snail/Akaleha	*Partula radiolata*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Fragile tree snail/Akaleha	*Samoana fragilis*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Mariana eight-spot butterfly/Ababbang	*Hypolimnas octocula marianensis*	E	--	Very rare	Coastal backstrand limestone forest.[(a, d)]
Mariana wandering butterfly/Ababbang	*Vagrans egistina*	E	--	Extirpated	Native limestone forest.[(a, d)]
Butterfly Host Plants					
None/Tapun ayuyu	*Elatostema calcareum*	--	--	Uncommon	Coastal backstrand limestone forest.[(a, d)]
None/Lulujut	*Maytenus thompsonii*	--	--	Common	Native limestone forest.[(a)]
None/None	*Procris pedunculata*[(b)]	--	--	Uncommon	Coastal backstrand limestone forest.[(a, d)]

Notes: *Chamorro names are from U.S. Fish and Wildlife Service (USFWS) (2015) and Government of Guam (GovGuam) (2009); [(a)]USFWS 2015; [(b)]GovGuam 2009; [(c)]Guam DAWR 2015; [(d)]NAVFAC Marianas 2015

2.2.1 Birds

The avifauna on Guam was significantly impacted after the introduction of the brown tree snake (*Boiga irregularis*) in the 1940s (Fritts and Rodda 1998; Wiles et al. 2003). The four remaining native species on the island include Micronesian starling and yellow bittern (*Ixobrychus sinensis*), and the Federally and Guam ESA-listed endangered Mariana swiftlet (*Aerodramus bartschi*) and Mariana common moorhen (*Gallinula chloropus guami*). Of these species, the Micronesian starling and the yellow bittern are found on AAFB.

2.2.1.1 Micronesian Starling

Micronesian starlings are social birds and are often found in groups. They build nests in the cavities of trees, limestone cliffs, and man-made structures (Vogt and Williams 2004). Their decline in the forest is a result of the introduction of and predation by the brown treensnake; however, their adaptability to urban development is likely one of the reasons it is one of the few surviving native bird species on Guam.

2.2.1.2 Migratory Birds

Species listed under the MBTA and that have the potential to occur on AAFB within the project area include Pacific golden plover (*Pluvialis fulva*) and yellow bittern. The Pacific golden plover is a seasonal migrant and the yellow bittern is a resident breeder (NAVFAC Marianas 2013).

2.2.2 Reptiles

2.2.2.1 Azure-tailed Skink

The azure-tailed skink is very similar to the Pacific blue-tailed skink (*Emoia caeruleocauda*) and is only discernable by specific characteristics found on the fourth toe. Historically, azure-tailed skinks occurred in southern Guam around the Geus River. Currently, the azure-tailed skink is considered extirpated from Guam (Guam DAWR 2015) but still occurs on Cocos Island (Kerr 2013a).

2.2.2.2 Slevin's Skink

Slevin's skink (*Emoia slevini*), or Mariana skink, is the only endemic reptile to the Mariana Islands. The historic range for Slevin's skink included Guam (including Cocos Island), Rota, Tinian, Sarigan, Guguan, Aguiguan, Alamagan, Pagan, Asuncion. Although never common on Guam and has not been verified in the wild on Guam since 1945, it still occurs on Cocos Island (USFWS 2015).

2.2.2.3 Moth Skink

The moth skink inhabits several Pacific islands, but in the Mariana Islands is only known to occur on Guam. It inhabits forested areas, and is thought to stay mainly on the ground or low on trunks of trees (Vogt and Williams 2004). The last recorded occurrence of this species on Guam was in 2009 at NBG Telecommunications Site, Naval Munitions Site, Cabras, and on AAFB, south of the MSA (NAVFAC Pacific 2010).

2.2.2.4 Pacific Slender-toed Gecko

The Pacific slender-toed gecko is nocturnal and unlike most geckos on Guam, is primarily ground dwelling within rocky terrain but occasionally can be found on the trunks of trees. It was observed on NBG Telecommunications Site and the Naval Munitions Site in 2009 (NAVFAC Pacific 2010) and southwest of the MSA within the Habitat Management Unit on AAFB (U.S. Geological Survey [USGS] 2013).

2.2.2.5 Micronesian Gecko

The Micronesian has not been seen on Guam since the 1970s, is thought to be extirpated as a result of the brown treesnake, and currently only occurs on Cocos Island (Rodda and Fritts 1992). It prefers undisturbed native limestone forests and large trees, but has also been seen on human structures and untended coconut groves (NAVFAC Pacific 2010).

2.2.3 Tree Snails

Three species of partulids, in two genera, are currently known to occur Guam: fragile tree snail, Guam tree snail, and humped tree snail. However, all three of these species have experienced massive range reductions, primarily due to habitat destruction and introduced predators. All three species were listed as endangered under the Federal ESA in October 2015 (USFWS 2015). Plants known to support partulid tree snails on Guam include but are not limited to: *Aglaia mariannensis*, *Artocarpus mariannensis*, *Asplenium nidus*, *Barringtonia asiatica*, *Carica papaya*, *Cocos nucifera*, *Erythrina variegata*, *Ficus tinctoria*, *Hernandia nymphaeifolia*, *Hernandia sonora*, *Mammea odorata*, *Merrilliodendron megacarpum*, *Ochrosia oppositifolia*, *Pandanus dubius*, *Piper guahamense*, and *Thelypteris* sp. (Hopper and Smith 1992; Smith et al. 2008).

2.2.3.1 Humped Tree Snail

The humped tree snail is endemic to the Mariana Islands and is the most widely distributed species of all Mariana tree snails and was once the most commonly encountered partulid on Guam (Smith et al. 2008; Kerr 2013b). To date, humped tree snails have not been observed on AAFB.

2.2.3.2 Guam Tree Snail

The Guam tree snail is endemic to Guam. It forms symbiotic relationships with several specific species of native plants, and is therefore generally found in native limestone forest. Guam tree snails have been observed within the Tarague basin east of the Combined Arms Training and Maintenance (CATM) Range (NAVFAC Marianas 2014, 2015).

2.2.3.3 Fragile Tree Snail

The fragile tree snail occurs in Guam and in Rota and is the only tree snail in the genus to occur outside of southeastern Polynesia. To date, fragile tree snails have not been observed on AAFB.

2.2.4 Butterflies

The Mariana eight-spot butterfly and the Mariana wandering butterfly are endemic to the Mariana Islands and both species were recently listed as endangered under the Federal ESA (USFWS 2015).

2.2.4.1 Mariana Eight-spot Butterfly

The Mariana eight-spot butterfly is one of two subspecies of *Hypolimnas octocula*, the second subspecies being found in Palau. It is considered rare, found in forest or forest clearings. On Guam, it has been found in forested areas where populations of its host plants, *Procris pedunculata* and *Elatostema calcareum*, are established. Both of these host plants, which larvae feed upon, are found only in karst substrates in native limestone forest (Schreiner and Nafus 1997; NAVFAC Marianas 2015; USFWS 2015). The Mariana eight-spot butterfly has been recently observed on AAFB east of the MSA within Tarague Basin east of the CATM Range and between the CATM Range and the AAFB flightline; north of the MSA at Ritidian Point and Northwest Field; and east of the MSA at Pati Point (NAVFAC Marianas 2014, 2015).

2.2.4.2 Mariana Wandering Butterfly

The Mariana wandering butterfly is endemic to the Mariana Islands and was known to occur on Guam and Rota (Schreiner and Nafus 1997). In the 1930s it was considered rare but widespread. Specimens of the butterfly were collected in the early 1970s; however, it has not been confirmed in the wild since 1979 and is considered extirpated from Guam (USFWS 2015).

The host plant for the wandering butterfly, *Maytenus thompsonii*, known as lulujut or luluhut in Chamorro, is a regionally endemic medium-sized tree commonly found in the understory of native limestone forest on Guam (Raulerson and Rinehart 1991). Its branches often grow in an irregular growth pattern from a central crown that is generally found 4 feet (ft) (1.5 meters [m]) off the ground to create a sprawling canopy layer in the understory. As a result, *M. thompsonii* branches are often entangled among the branches of other forest trees.

CHAPTER 3
METHODS

3.1 Survey Area

The survey area consisted of a 49-ac (20-ha) sector of the MSA at AAFB (Figure 3-1). Pedestrian surveys using visual searches for targeted species were carried out December 12-16, 2016 by a team of three Cardno biologists.

3.2 Survey Descriptions

Target species included ESA-listed geckos, skinks, butterflies, and tree snails, and host plants for tree snails and butterfly species (see Table 2-1 and Section 2.2 for detailed list of species and descriptions). While host plants are not protected, search for butterfly (species-specific) and partulid tree snail (more generalist) host plants enhanced probability of detection of cryptic target butterflies and tree snails.

Surveys were conducted with MSA escorts, and each biologist recorded their individual survey tracks with a Garmin 62s or eTrex 20 Global Positioning System (GPS) unit. Surveys focused on areas of suitable habitat and presence of host plants for habitat specialists, including butterflies and partulid tree snails (e.g., native limestone forest and suitable mixed forest with introduced and native vegetation and closed canopy). While none of the target species had been documented in this area in recent decades, access to the area is carefully controlled due to a high level of security, so that few surveys had been conducted in this area in some time, warranting careful and thorough search efforts for each of the target species.

Since the MSA is characterized by patches of open, regularly mowed land alongside roads and wrapping around the circumference of each munitions storage igloo, in order to cover all of the potential protected species habitat, two general types of searches were employed during this project. The first concentrated on vegetated areas, the second was conducted along the front surfaces of munitions storage igloos. For all survey efforts, in addition to recording GPS tracks and waypoints, photographs of relevant observations were taken when authorized and field notes included written descriptions of any observed target animal species or butterfly host plants.

3.2.1 Vegetated Area Surveys

For vegetated area survey methods, the transect design included a grid overlain on the entire project area. Transects were set through non-landscaped, vegetated forest strips of variable width with 2 running parallel to the roadways and 13 covering the shorter forest strips running perpendicular to the roads between existing igloo structures. The two roughly North-South lengthwise transects were located between 5th and 6th streets (Transect A, approx. 2,953 ft [900 m] long) and between 4th and 5th streets (Transect B, approx. 1,969 ft [610 m] long). The shorter East-West transects were between 328 ft [100 m] and 656 ft [200 m] in length (Transects 1-13). Together, they covered the extent of potential suitable habitat within the project area (Figure 3-1).

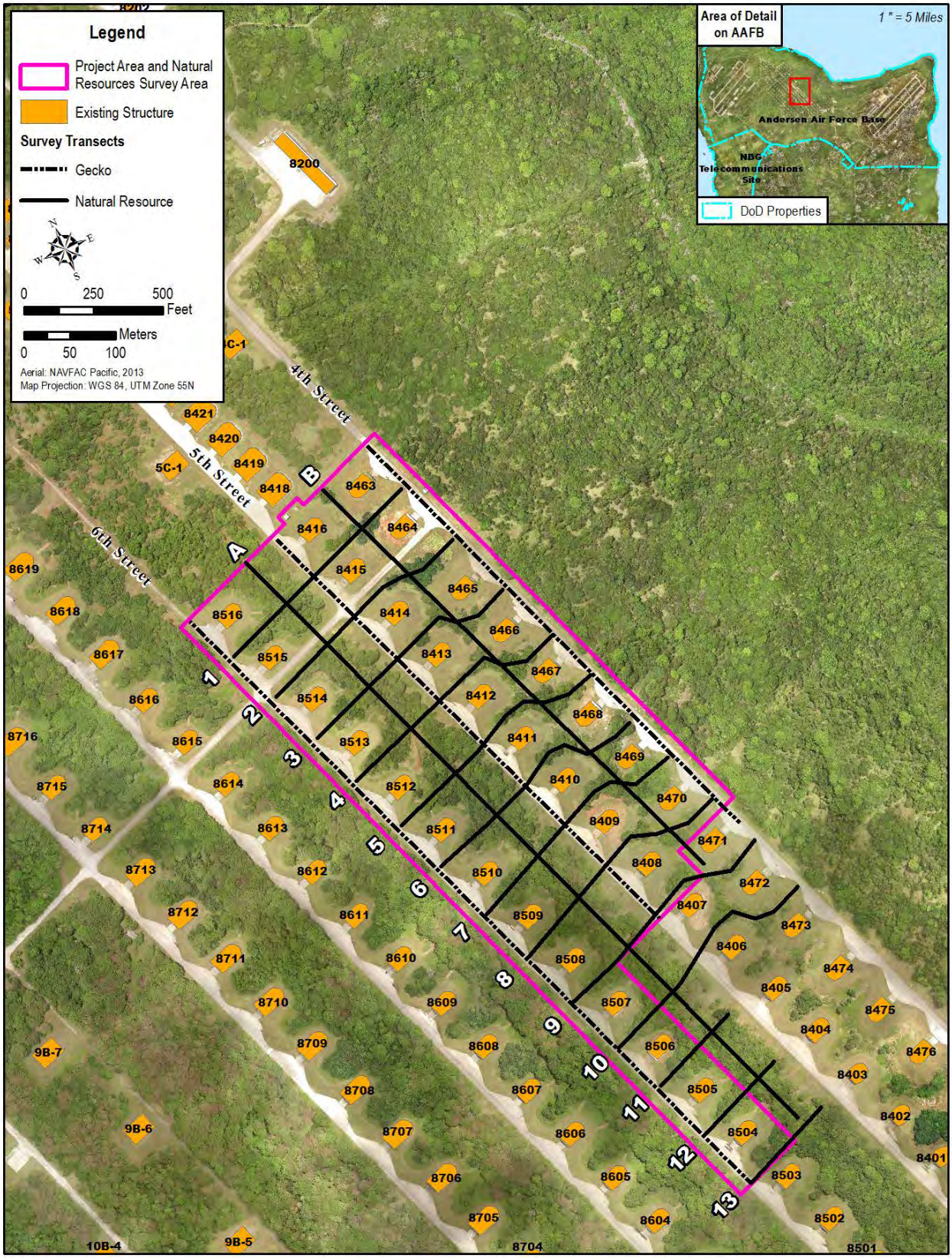

Figure 3-1. Survey Transect Grid Overlain on the Project Area

Visual search methods within the forest strips consisted of a roughly three-zone search approach, where surveyors continually scanned while moving forward, from low to high and back:

1) Ground-focused inspection of leaf litter, soil, low-lying rock and boulder surfaces (primarily for ground-dwelling skinks);
2) Above ground searches of shrubs, tree trunks, and vertical surfaces of karst pinnacles and large boulders (primarily for host plants and signs of butterfly life stages); and
3) Eye level and above searches using Nikon Monarch 10x42 binoculars of tree leaves, branches, vines, trunks, crevices, and sunlit clearings (primarily for tree snails, geckos, host trees, and flying adult butterflies).

Search methods also included timed (10-30 minutes), thorough team sub-searches of each butterfly host plant encountered and any tree harboring tree snails. Main objectives of butterfly host plant sub-searches were to identify evidence of any life stage of the two protected butterfly species and to include presence and condition of eggs, chrysalises, caterpillars, and caterpillar-caused leaf damage. Tree snails are generalists in terms of host plants, and any species with broad, smooth leaves are potential hosts; therefore, plants with these features were searched. The main objectives of potential tree snail host plant sub-searches (10-20 minutes) was to quantify the total number of ESA-listed tree snails present and the size class distribution if ESA-listed tree snails were found.

3.2.2 Munitions Storage Igloo Surface Surveys

The second general survey method was used in the open areas of the MSA, and employed use of hand-held flashlights to search the front of 48 munitions igloo structures, specifically targeting geckos. This method concentrated on manmade surface materials (concrete, fiberglass, and steel) that provided hiding places for geckos. Gecko transects ran along 4th, 5th, and 6th streets as seen in Figure 3-1. Five general areas were searched on each igloo structure: 1) steel screen vents covered by a rectangular louvered plate with eight slots, one vent per door; 2) stainless steel door hinges, each igloo door has three stainless steel hinges; 3) steel padlock housings on each pair of doors; 4) steel strips covering the top of door jams; and 5) space behind the fiberglass sign located to the right of the doors.

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CHAPTER 4
RESULTS

Weather conditions were variable during the surveys conducted December 12-16, 2016, with heavy, sustained precipitation occurring for the duration of Day 1, continuing into the early portion of Day 2, followed by 3.5 days of consistent hot and dry conditions. Cardno biologists traversed a total of 38.7 mi (62.3 km) searching for target species within the 49-ac (20-ha) project area (Figure 4-1).

4.1 Birds

No Federal or Guam ESA-listed birds were observed during the surveys. Three non-native resident species (black drongo [*Dicrurus macrocerus*], island collared dove [*Streptopelia bitorquata*] and black francolin [*Francolinus francolinus*]) and three MBTA-listed species (Pacific golden plover, Pacific reef heron [*Egretta sacra*], and yellow bittern) were observed during surveys. A number of black drongo were observed flying over the survey area and resting on tree tops. Island collared dove were seen and heard throughout the survey period. A pair of black francolin was observed feeding in the late afternoon on the edge of the forest. The three MBTA-listed species are described below.

Several Pacific golden plovers were seen along the road edges in the project area throughout the survey period. The Pacific golden plover is a medium-sized shorebird that breeds in Alaska and Siberia during the summer months and migrates to islands in the Pacific Ocean to winter (Johnson and Connors 2010). On Guam, it can often be found in open fields, pastures, shorelines, and mudflats.

One Pacific reef heron and several yellow bitterns were seen in flight passing overhead during surveys. The Pacific reef heron feeds both at night and during the day and can be seen hunting along the coast or in swampy areas. The bittern is a small wading bird and is common on all of the southern Mariana Islands (Vogt and Williams 2004). Bitterns can be observed in wetlands, forest edges, and scrub habitats. On Guam, they can often be seen in fields, parks, and on grassy edges along roads.

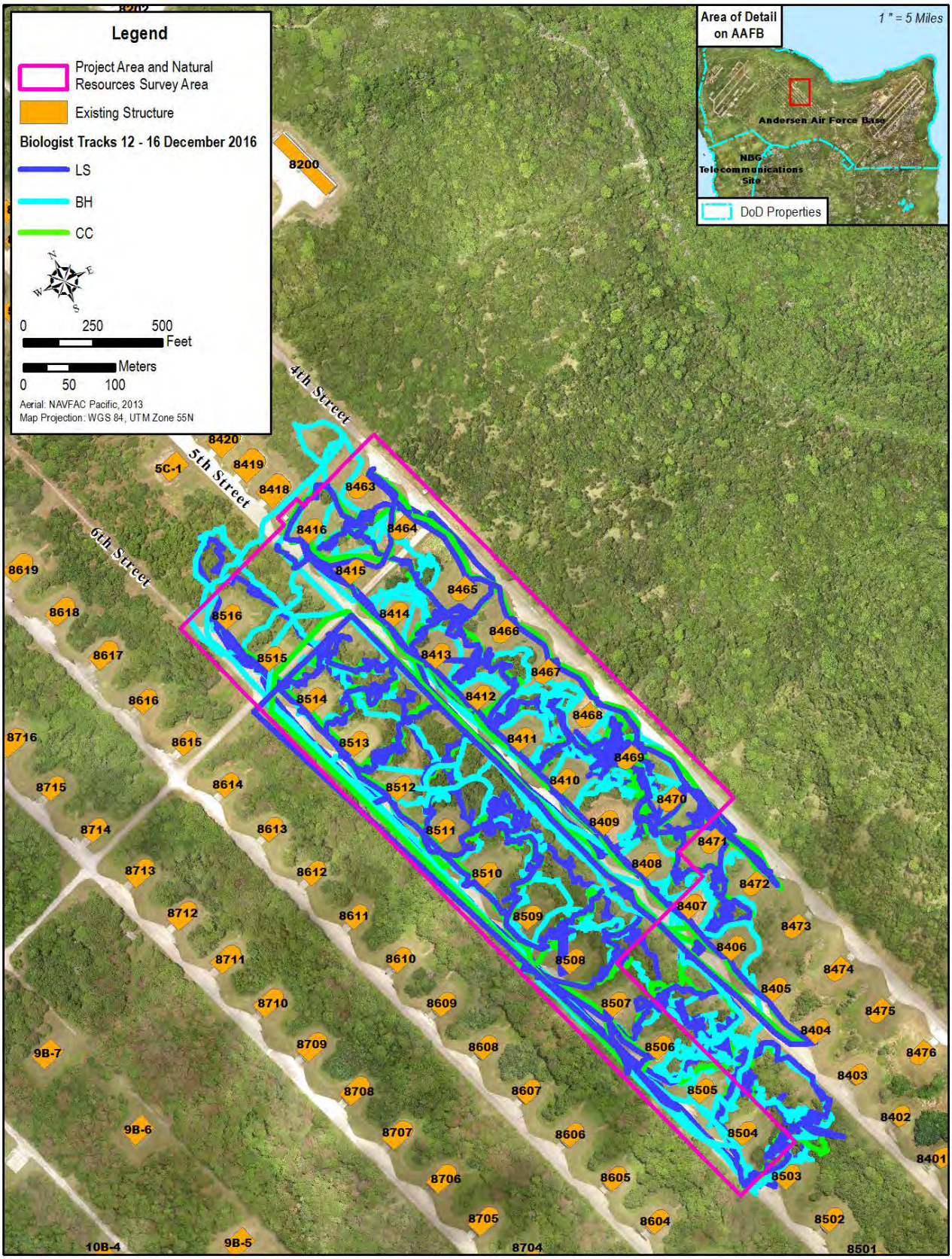

Figure 4-1. GPS Tracks of Survey Coverage within the Project Area

4.2 Reptiles

No listed species of reptiles were observed during the surveys. Two species of skink, three species of gecko, one Brahminy blind snake (*Indotyphlops braminus*), and one Pacific monitor lizard (*Varanus indicus*) were observed. The observed skinks include the non-native curious skink (*Carlia fusca;* Figure 4-2a) and the native Pacific blue-tailed skink (Figure 4-2b). Skink eggs were found throughout the survey area (Figure 4-2c). The curious skink was much more abundant than the Pacific blue-tailed skink; for example, in a timed survey effort, 73 curious skinks and 3 Pacific blue-tailed skinks were recorded during 12 person-hours.

Figure 4-2. Skinks Observed within the Project Area: (a) Curious Skink and (b) Pacific Blue-tailed Skink. (c) Skink Eggs.

Observed geckos include the native mutilating gecko (*Gehyra mutilata*) and mourning gecko (*Lepidodactylus lugubrus*; Figure 4-3a), and the non-native house gecko (*Hemidactylus frenatus*; Figure 4-3b). The mutilating gecko was observed on two occasions in the forest on trees hiding under peeling bark. Several mourning geckos and house geckos were observed during surveys of the front side of the munitions storage igloos. Geckos were found hiding in the vents, locks, and jambs of the igloo doors, behind door hinges and signs, as well as under the lip above the door. All life stages (juveniles and adults of both species, as well as females with eggs [Figure 4-3c]) were frequently observed.

Figure 4-3. Geckos Observed within the Project Area on Munition Igloos: (a) Mourning Gecko (b) House Gecko (c) Eggs within an Adult Gecko (delineated by green arrow).

4.3 Tree Snails

No native tree snails were observed during the surveys. However, two species of non-native arboreal gastropods were observed: east Asian land snail *Satsuma* sp. and tropical American lined tree snail (*Drymaeus multilineatus*) (Figures 4-4a and 4-4b, respectively). The occurrence of these species suggests that conditions within the forested areas of the MSA may be suitable for the persistence of tree snails. However, the invasive flatworm *Platydemus manokwari*, a known predator of tree snails, was observed to occur in high abundance (Figure 4-4c). No partulid shells or shell fragments were observed. Sun-bleached and weathered white shells of the giant African snail (*Achatina fulica*) were abundant throughout the

forested areas (Figure 4-4d). Less abundant, though apparently of about the same age, were shells of the invasive predator rosy wolf snail (*Euglandina rosea*), intentionally released several decades ago as a biocontrol for the giant African snail.

Figure 4-4. Non-Native Invertebrates Observed in the Project Area: (a) *Satsuma* sp.; (b) Lined Tree Snail; (c) *Platydemus manokwari;* and (d) Giant African Snail.

Table 4-1 provides a summary of common forest plants, including host plants for tree snails, seen throughout the transects. Several tree snail host plants were observed including *Ochrosia oppositifolia*, *Pandanus tectorius*, and *Cycas micronesica*.

Table 4-1. Summary of Observed Target Tree Snail Host Plant Species by Transect

	*Transect**														
Species	*A*	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Aglaia mariannensis	+	+	+	+	+	-	+	+	+	+	+	+	+	-	+
Alocasia macrorrhizos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annona reticulata	+	+	-	+	+	-	-	+	-	-	+	-	+	-	-
Artocarpus marianensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asplenium nidus	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+
Cocos nucifera	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Cordia subcordata	-	+	+	+	+	-	-	-	-	+	-	-	-	-	-
Cycas micronesica	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
Cynometra ramiflora	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Eugenia reinwardtiana	-	+	-	-	-	-	-	-	-	-	-	+	-	+	-
Ficus spp.	-	+	-	-	-	+	-	-	-	+	+	+	-	+	-
Flagellaria indica	+	+	-	-	-	-	-	+	-	-	+	-	-	+	-
Glochidion marianum	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Guamia mariannae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Guettarda speciosa	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Hernandia sonora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hibiscus tiliaceus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Intsia bijuga	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Ixora triantha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leucaena leucocephala	-	+	+	+	+	+	-	+	-	+	-	+	+	+	+
Macaranga thompsonii	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Mammea odorata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melanolepis multiglandulosa	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Merrilliodendron megacarpum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Morinda citrifolia	+	-	-	+	+	+	+	+	-	-	-	-	-	-	-
Ochrosia mariannensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ochrosia oppositifolia	+	+	+	+	+	+	-	+	-	-	+	+	-	+	+
Pandanus dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pandanus tectorius	+	+	-	+	-	-	-	+	-	+	+	+	+	+	+
Piper guahamense	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-

Table 4-1. Summary of Observed Target Tree Snail Host Plant Species by Transect

Species	*Transect**														
	A	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Pisonia grandis	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Premna obtusifolia	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
Pteris tripartita	+	+	-	-	+	-	+	+	+	-	+	+	-	+	+
Spathodea campanulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syngonium angustatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syzigium thompsonii	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+
Thelypteris opulenta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thespesia populnea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: * - = not observed; + = observed.

4.4 Butterflies

No native butterflies were observed during MSA surveys. While the butterfly host plants *Procris pedunculata* or *Elatostema calcareum* were not seen in the project area, several *Maytenus thompsonii* were seen (as discussed below). Despite dedicated timed searches on and around each individual *Maytenus* found, no sign of the Mariana wandering butterfly was observed. Several non-target butterfly species were seen. Black citrus swallowtail (*Papilio polytes*) and common eggfly (*Hypolimnas bolina*) were frequently seen on every transect.

Table 4-2 provides a summary of butterfly host plants seen throughout the transects. A total of 23 individual *Maytenus thompsonii* (MATH) trees were observed at 19 locations (Figure 4-5, Table 4-3, and Appendix A). Of the 23 trees found, 13 were observed flowering and 8 fruiting; no seedlings or saplings were observed.

Table 4-2. Summary of Observed Target Butterfly Host Plant Species by Transect

Species	*Transect*														
	A	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Elatostema calcareum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maytenus thompsonii	-	+	+	-	+	-	-	+	+	+	+	+	+	+	-
Procris pedunculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - = not observed; + = observed.

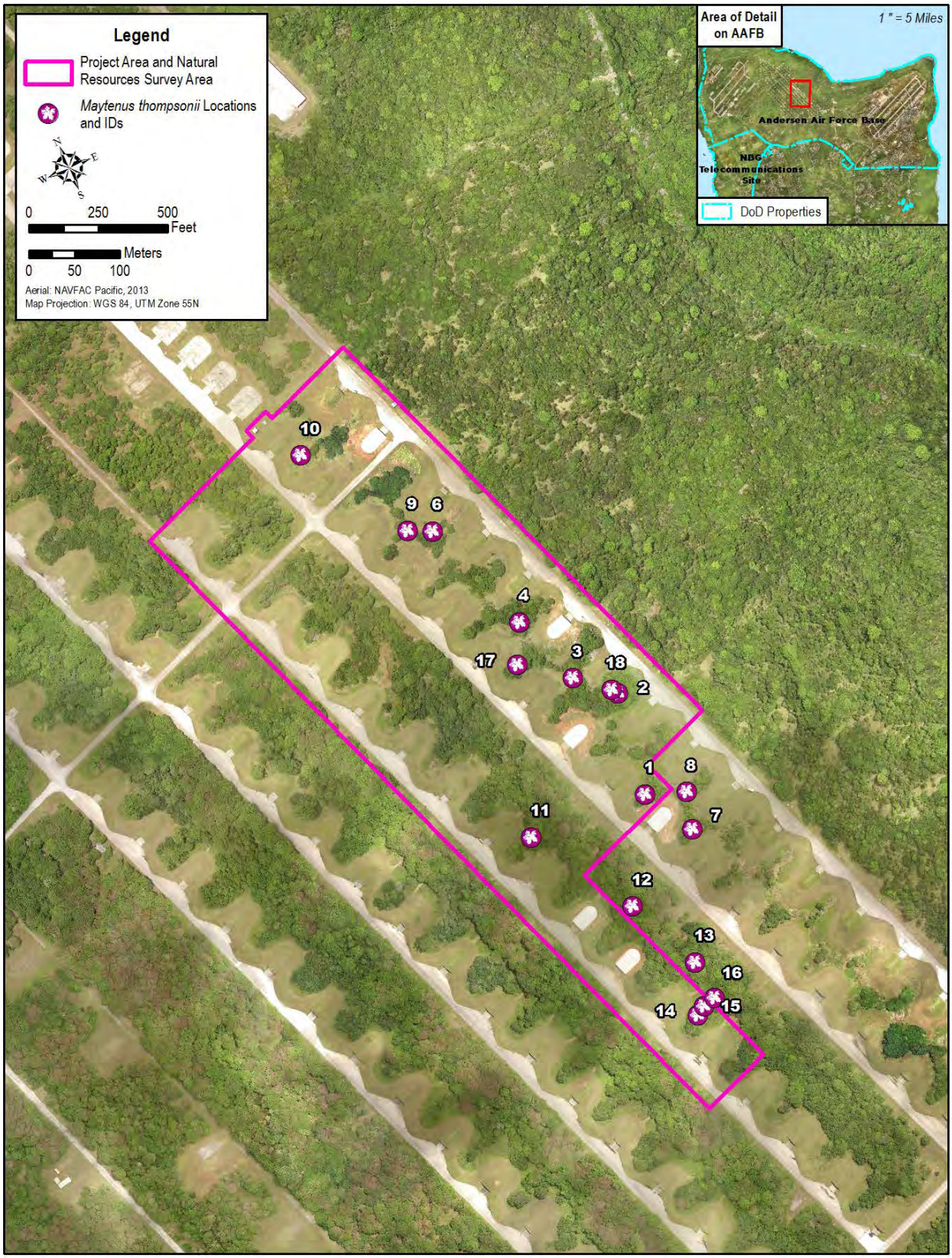

Figure 4-5. Locations of *Maytenus thompsonii* within and Adjacent to the Project Area

Table 4-3. Locations of *Maytenus thompsonii* Observed throughout the Project Area

Waypoint	*Latitude*	*Longitude*	*Date (2016)*	*Transect*	*No. of Trees*	*Light**	*Height (m)*	*Flower/ Fruit**	*Photo Record***	*Observations*
MATH 1	13.604929	144.889605	12/13	B	1	F	3.5	-/-	-	Live *Satsuma* sp. (introduced tree snail) observed on tree.
MATH 2	13.605953	144.889761	12/13	B	3	F	3-4.5	-/- -/- -/-	-	One *Guettarda speciosa* and several *Cycas micronesica* individuals in vicinity; *C. micronesica* fruiting; *Perperomia mariannensis* growing on *Guettarda speciosa*.
MATH 3	13.606268	144.889405	12/13	B	1	F	6.4	+/-	-	Large wasp nest located nearby; patch of tower karst located nearby with *Ficus* sp.; hawkmoth caterpillar observed on *Stictochardia tiliaefolia.*
MATH 4	13.606989	144.889130	12/13	B	1	F	4.8	-/-	-	Several *Hibiscus tiliaceus* in vicinity.
MATH 5	Not available†		12/13	B	1	F	5.6	+/-	-	MATH reaches up to canopy; trunk is decayed with loose bark; mutilating gecko (*Gehyra mutilata*) observed on trunk between bark; gecko eggs found in vicinity.
MATH 6	13.608158	144.888692	12/13	B	1	P/O	4	+/+	-	Several *Cocos nucifera* in vicinity forming canopy cover.
MATH 7	13.604424	144.889906	12/13	10	1	F	4.8	+/-	-	Long red petioles sprouting along branches; *Syzygium thompsonii* and a large downed tree (>2ft dbh) in vicinity.
MATH 8	13.604785	144.890004	12/13	9	1	F	4.8	+/-	-	Long red petioles sprouting along branches; five trunks observed splitting at the base.
MATH 9	13.608265	144.888464	12/13	3	1	P	4	+/+	-	Red petioles sprouting at the base of trunk.
MATH 10	13.609372	144.887772	12/13	1	1	F	6	-/-	-	*Satsuma* sp. observed alive on tree.
MATH 11	13.604983	144.888376	12/14	8	1	F	5.6	+/+	+	Several epiphytes observed on trunk; bleached *Pithia* sp. shell and skink eggs found near base; located near a *Cycas micronesica* and a fruiting *Melanolepus multiglandulosa*.
MATH 12	13.603955	144.889039	12/14	10	1	F	8.8	+/-	+	Marginal and central leaf damage observed.
MATH 13	13.603201	144.889392	12/14	11	2	P	8.8	+/+ +/+	+	Two MATH trees located side by side; marginal and central leaf damage observed on both.
MATH 14	13.602706	144.889202	12/15	12	1	F	6.8	-/-	+	Somewhat intact karst; marginal and central leaf damage observed; *Ficus* sp. nearby has engulfed neighboring windthrown *Premna obtusifolia* and is tangled around MATH.
MATH 15	13.602769	144.889300	12/15	12	1	F	7	+/+•	+	*Syzygium thompsonii* located in vicinity; marginal and central leaf damage observed.
MATH 16	13.602796	144.889433	12/15	12	1	P	7	+/+	+	Marginal and central leaf damage observed.
MATH 17	13.606607	144.888943	12/16	6	1	P	5.6	+/-	+	*Cycas micronesica* individuals in vicinity; *Ficus* sp. nearby is a potential threat.
MATH 18	13.606011	144.889718	12/16	7	1	P	6.4	-/+	+	*Cycas micronesica* individuals located in vicinity.
MATH 19	Not available†		12/15	12	2	P	4	-/- -/-	+	Two MATH trees located side by side; marginal and central leaf damage observed on both.

Notes: *- = not present; + = present; F = filtered; O = open; P = partial.

**Camera authorization for the MSA was not obtained until December 14.

†Due to technical problems with the GPS unit, waypoints for MATH locations 5 and 19 are not available.

•Reproductive structures observed were high in the canopy and appeared to be either small flower buds or fruits.

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CHAPTER 5
DISCUSSION

Of the target species, only birds protected under the MBTA and host plants for the Mariana wandering butterfly and tree snails were observed during the surveys. *Maytenus thompsonii*, the host plant for the Mariana wandering butterfly, was encountered at 19 locations throughout the project area, with a total of 23 individuals observed. Despite thorough searches of each tree encountered, no sign of the Mariana wandering butterfly was seen. Likewise, a variety of common plants known to serve as host plants for listed tree snails were observed within the survey area. However, no sign of ESA-listed tree snails was observed during the surveys. While several species of reptiles were seen (i.e., curious skink, house gecko, mourning gecko, and Pacific blue-tailed skink), no ESA-listed reptiles, such as Slevin's skink or azure-tailed skink, were observed. Observed MBTA-listed birds included Pacific golden plover, Pacific reef heron, and yellow bittern; no nests were seen in the survey area.

The brown tree snake and the western Pacific monitor lizard are both voracious predators, known to feed on ground and tree dwelling vertebrates during all life stages. The activity of one or both species and may have played a role in the extirpation of native skinks and geckos on Guam (Rodda and Fritts 1992), including within the MSA. Although no brown tree snakes were observed during the surveys, this is not surprising as this species is both nocturnal and highly cryptic. One juvenile monitor was observed during a MSA forest transect.

The reasons for the decline and scarcity of the Mariana wandering butterfly are presently unclear. The species has not been observed on Guam since 1979 and is considered extirpated (USFWS 2015). The habitat in the project area supports adult butterfly activity as evidenced by the conspicuous presence of non-listed butterfly species (e.g., adequate wind barriers and suitable nectaring opportunities). Unlike Mariana eight-spot butterfly, which seems limited primarily by host plant availability, the Mariana wandering butterfly's host plant, *Maytenus thompsonii*, is relatively common in native limetone habitat on Guam, including within the survey area. Many of the trees appear quite healthy and were over 20 ft (6 m) in height. However, there is some uncertainty surrounding the reliance of the Mariana wandering butterfly on *M. thompsonii*. The only documented evidence that *M. thompsonii* is a host plant was a single rearing of a wandering butterfly in captivity (Swezey 1942). Noted lepidopterists convey uncertainty that *M. thompsonii* is the sole host plant for this endangered butterfly (Moore 2017; Rubinoff 2017; Wright 2017). It is possible that a decline in an undocumented host plant played a role in its extirpation. In addition, it is possible that Mariana wandering butterfly populations have been disproportionately predated upon by an invasive species or other predator having a preference and/or expanded range (possibly invasive parasitoid wasps, orb weaving spiders, etc.).

In contrast, the Mariana eight-spot butterfly has recently been observed on AAFB in a number of locations where its host plants occurred (NAVFAC Marianas 2014, 2015), and it seems likely that host plant availability and connectivity may be factors in both its current distribution and challenges to its recovery. The host plants *Procris pedunculata* and *Elatostema calcareum* are highly susceptible to the impacts of introduced ungulates (e.g., browsing, trampling), and both are restricted to native limestone forest characterized by sharp edged tower karst terrain that impedes access by non-native deer and pig. Neither host plant was seen within the survey area.

In general, recent surveys have found that remaining suitable habitat for both butterflies and tree snails on Guam tends to be located along a band circumscribing the outer edges of the coastal escarpment, including coastal backstrand forest. Of primary concern in terms of impact and distribution of butterfly host plants

(*Procris/Elatostema*) is damage due to invasive ungulate herbivory and pest infestation. By far the most common and severe damage observed during previous host plant surveys was due to ungulate grazing and trampling by Philippine deer, which are abundant in the MSA, as well as rooting by feral pigs. In areas where ungulate activity has been observed, only those host plants that are afforded protection on shear tower karst tops tend to survive (NAVFAC Marianas 2014, 2015). This type of habitat was extremely rare during the current surveys, only two small patches were observed, and ungulate activity was high throughout the project footprint, perhaps explaining the absence of Mariana eight-spot butterfly and its host plants in the survey area.

The absence of partulid tree snails within the survey area may be related to land use history and deforestation of the area, combined with the lack of the natural ability of tree snails to recolonize areas where they experienced historical extirpation, despite subsequent return of host trees. The fact that non-native arboreal gastropods were observed in the survey area, namely the east Asian bradybaenid *Satsuma* sp. and the tropical American lined tree snail, suggests that conditions are suitable in the forested areas of the MSA for persistence of tree snails. However, ground searches in the area revealed two interesting observations: a lack of partulid shells, either fresh or fossil, and high abundance of the non-native predatory flatworm *Platydemus manokwari*. This, in addition to a nearly continuous swath of dead African giant snail shells, suggests that any snail moving along the ground would be subject to high risk of predation by flatworms. Therefore, the current habitat conditions would render recolonization by native partulid tree snails highly unlikely.

CHAPTER 6
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CHAPTER 7
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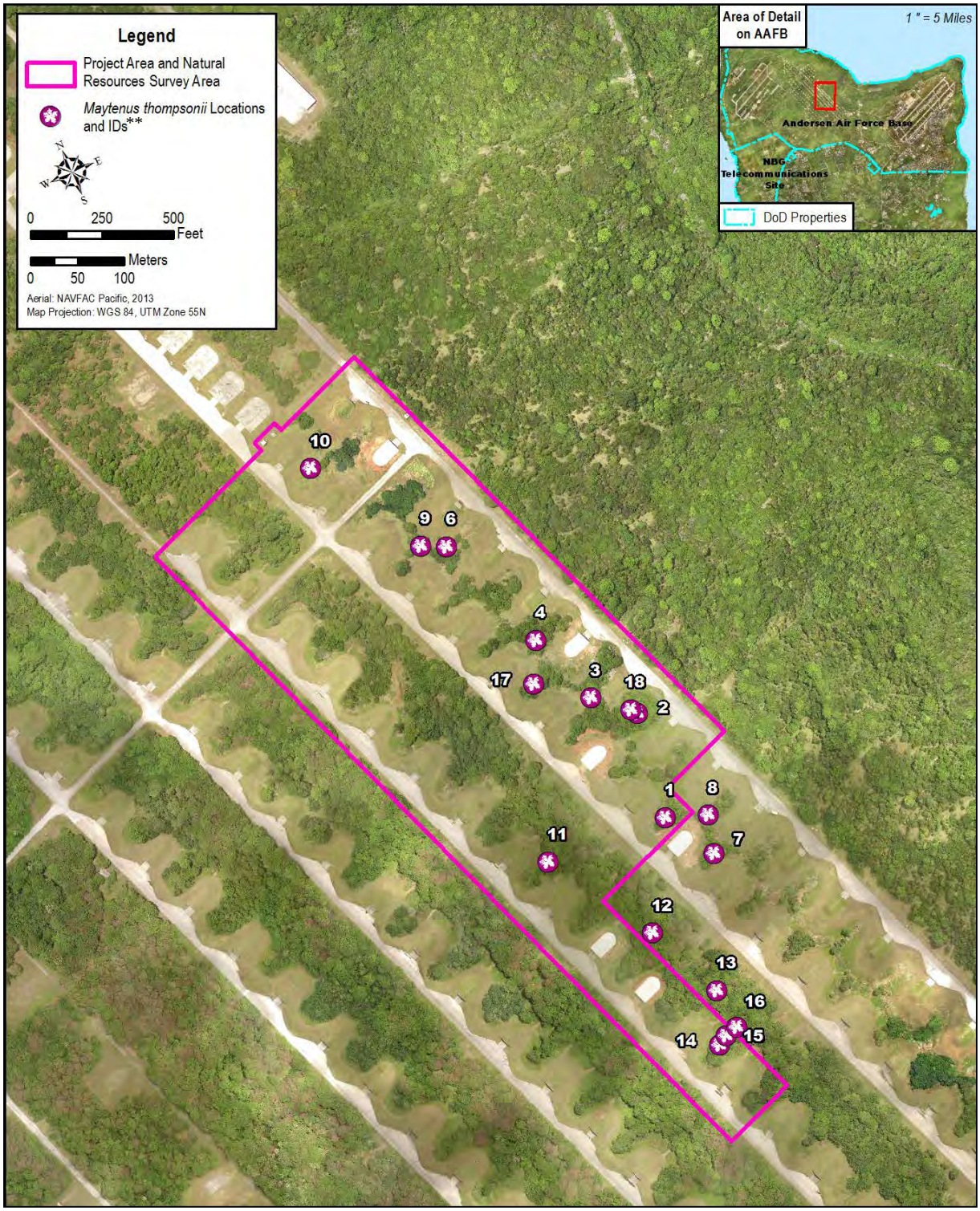
Maytenus thompsonii (MATH) Photo Log*



*Photos for *Maytenus thompsonii* locations 1 – 10 do not exist since camera authorization in the MSA was not granted until Wednesday, December 14.
**GPS points are not available for locations 5 and 19.

Number of trees: 1

Height: 3.5 m

Light Condition: Filtered

Reproduction: Flowering and fruiting

Light Condition: Windthrow; heavy ungulate rooting; bleached *Pithia* sp. shell and skink eggs found near base; located near a *Cycas micronesica* and a fruiting *Melanolepus multiglandulosa*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 11

Number of trees: 1

Height: 5.5 m

Light Condition: Filtered

Reproduction: Flowering

Observations: Windthrow; high ungulate activity; extensive leaf damage (holes in central portion of leaf).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 12

Number of trees: 2 (3 m apart)

Height: 5.5 m (branches intertwined in the canopy)

Light Condition: Partial

Reproduction: Only one tree was observed flowering, fruiting, and sprouting at the base.

Observations: Heavy ungulate rooting; extensive leaf damage (marginal and central); located near a *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 13

Number of trees: 1

Height: 6.8 m

Light Condition: Filtered

Reproduction: None observed

Observations: High ungulate activity; extensive leaf damage (marginal and central); *Ficus* sp. engulfed neighboring windthrown *Premna obtusifolia* and tangled around *Maytenus thompsonii*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 14

Number of trees: 1

Height: 7 m

Light Condition: Filtered

Reproduction: Possible flower buds or fruits seen high in canopy.

Observations: Windthrow; heavy ungulate rooting; extensive leaf damage (marginal and central); *Syzygium thompsonii* located 1.5 m away.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 15

Number of trees: 1

Height: 7 m

Light Condition: Partial

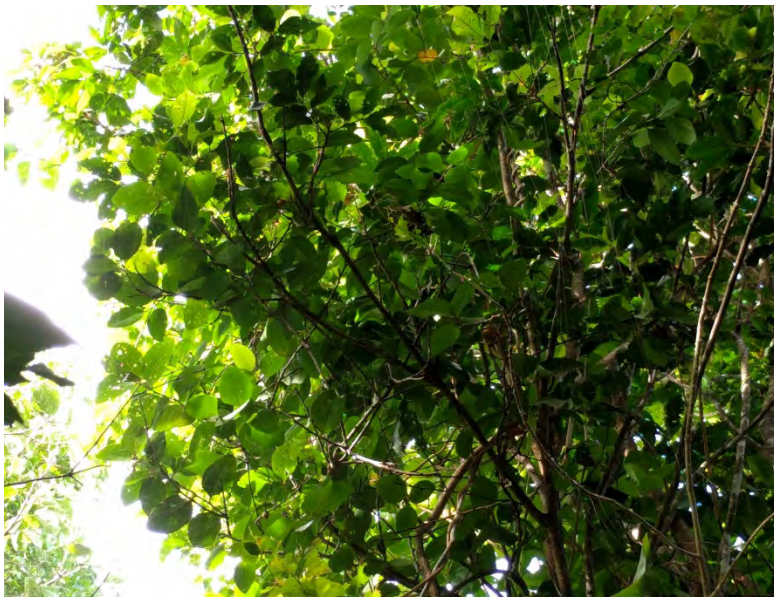
Reproduction: Flowering and fruiting

Observations: Windthrow; ungulate activity; extensive leaf damage (marginal and central).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 16



Number of trees: 1

Height: 3.5 m

Light Condition: Partial

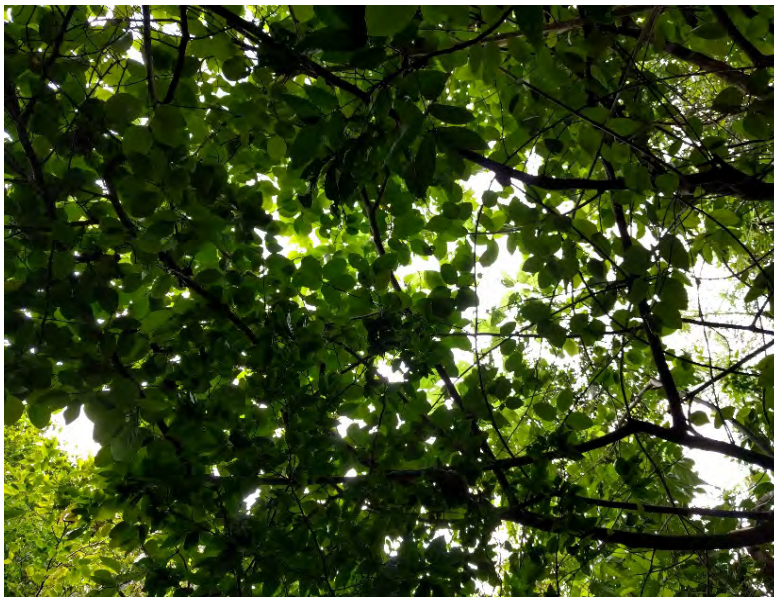
Reproduction: Flowering only

Observations: Windthrow; ungulate activity; located near a 2.5 m-tall *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 17



Number of trees: 1

Height: 4 m

Light Condition: Partial

Reproduction: Fruiting only

Observations: Windthrow; ungulate activity; located near a 2.5 m-tall *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 18

Number of trees: 2 (0.25 m apart)

Height: 4 m

Light Condition: Partial

Reproduction: None observed, sprouting at the base.

Observations: Windthrow; heavy ungulate rooting; extensive leaf damage (marginal and central).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

MATH 19