Environmental Assessment

Terminal High-Altitude Area Defense (THAAD)
Permanent Stationing in Guam

94th Army Air and Missile
Defense Command

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This Environmental Assessment (EA) documents the potential environmental impacts associated with the current expeditionary (temporary) placement and operation of a THAAD ballistic missile defense battery at Andersen Air Force Base in Guam, and from the proposed permanent stationing of the THAAD battery at its current location on Northwest Field (NWF). As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam, this EA also analyzes the potential impacts from the expansion of the NWF cargo drop zone training area that was encumbered by THAAD operations.

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DRAFT FINDING OF NO SIGNIFICANT IMPACT
TERMINAL HIGH-ALTITUDE AREA DEFENSE (THAAD)
PERMANENT STATIONING IN GUAM
ENVIRONMENTAL ASSESSMENT

AGENCY: United States Army

ACTION: Finding of No Significant Impact

BACKGROUND: The United States (U.S.) Army prepared an Environmental Assessment (EA) to evaluate the potential environmental impacts associated with the current expeditionary (temporary) placement and operation of a U.S. Army Terminal High-Altitude Area Defense (THAAD) ballistic missile defense battery in Guam, and from the proposal to maintain the THAAD battery permanently at its current location on Northwest Field (NWF) of Andersen Air Force Base (AFB). As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam, the EA also analyzes the potential impacts from the expansion of the NWF cargo drop zone (CDZ) training area that was encumbered by THAAD operations. The attached THAAD Permanent Stationing in Guam EA, which is hereby incorporated by reference, was prepared in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations Parts 1500–1508), and the Department of the Army Procedures for Implementing NEPA (32 Code of Federal Regulations Part 651).

Under Title 10 of the United States Code (U.S.C.), the Department of Defense has a mandate to protect the U.S. homeland against impending threats, whether foreign or domestic. In accordance with Title 10 U.S.C., the purpose of the Proposed Action is to provide long-term protection for Guam residents and the U.S. forces in Guam from the threat of ballistic missile attacks. The Proposed Action to permanently station a THAAD battery in Guam is needed because of existing and emerging missile threats in the region.

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES: The Proposed Action is to maintain the THAAD battery permanently in Guam. The current battery has been operating as an expeditionary (temporary) mission at Andersen AFB since its deployment in April 2013. In order to maintain an enduring THAAD battery presence in Guam, two alternatives are considered under the Proposed Action. For analysis purposes, both alternatives include the activities that occurred during the emergency deployment and subsequent adaptations of the THAAD battery, along with proposed modifications and improvements for long-term system operations. The No Action Alternative was also evaluated. All three alternatives are described below.

Alternative 1: Permanent Stationing of Expeditionary THAAD System. Under this alternative, the THAAD battery expeditionary mission would continue at its current location on NWF with minimal site improvements or changes in operations. During the emergency deployment of the expeditionary THAAD battery in April 2013, approximately 35.7 acres (14.4 hectares) of limestone forest and perennial scrub were cleared to accommodate radar and missile launcher requirements. Other emplacement actions included temporary fencing and guard towers, constructing several concrete pads, and establishment of a motor pool.

Approximately 200 support personnel originally were deployed in support of the THAAD mission. The personnel are housed in military transient quarters on Andersen AFB and are deployed on a rotational basis. Because the emplacement site has no electrical service, the ongoing THAAD battery activities require continuous operation of numerous generators. For improved power generation efficiency, most of the system tactical generators would be replaced with fewer and more efficient portable generators.

THAAD battery operations require an exclusion zone in front of the radar to avoid injury to personnel and damage to equipment from electromagnetic radiation (EMR) emissions. For aircraft, a Temporary Flight Restriction (TFR) area was established on the northern end of Guam starting in April 2013. Under Alternative 1, the TFR would continue to be used during THAAD radar operations.

Because the THAAD battery currently encumbers the CDZ and use of the NWF South Runway, the airborne training activities and exercises that previously occurred there would continue operations elsewhere in the region.

Alternative 2 (Preferred Alternative): THAAD System Permanent Stationing and CDZ Expansion. Permanently stationing the THAAD battery at NWF would require various site improvements and operational changes made to the current expeditionary mission, including installation of perimeter fencing; replacing most of the system tactical generators with fewer and more efficient portable generators; running a fiber optic line to the site and installing a communication (cable) trough; installation of a drainage system; grading and leveling previously disturbed areas; replacing guard towers; and constructing four new buildings. Total THAAD personnel numbers would increase from the current 200 to about 225. In addition, all or most of the approximate 168 military dependents moving to Guam would be placed in existing or future installation housing. To facilitate THAAD radar operations long-term, the U.S. Army would request that the Federal Aviation Administration establish a special use airspace (SUA) Restricted Area to replace the current TFR.

Additionally, the U.S. Army, in collaboration with the U.S. Air Force (USAF), would expand the current CDZ by shifting the drop zone assets from the NWF South Runway to the North Runway and adjacent areas. A total of 55.5 additional acres (22.5 hectares) of forest and perennial scrub vegetation would be cleared for the expanded CDZ and proposed fiber optic line, all located outside of the original drop zone area.

No Action Alternative. The THAAD battery, including equipment and supporting personnel, would cease expeditionary operations on Guam. The associated equipment, temporary facilities, and infrastructure would be removed from the current expeditionary emplacement site and motor pool area at NWF. The TFR that was established for radar operations would no longer be needed. In addition, the THAAD battery and associated 200 mission support personnel would be removed from Guam.

The 35.7 acres (14.4 hectares) of forest and perennial scrub previously cleared for the emplacement site would be allowed to revegetate. Because of the THAAD expeditionary mission-related actions and activities that have already occurred, analysis of the No Action Alternative included those prior actions identified under Alternative 1. With the removal of THAAD battery operations from NWF, the existing CDZ would no longer be encumbered. Thus, airborne training operations would be able to resume at the NWF South Runway.

ENVIRONMENTAL EFFECTS: In assessing environmental impacts of the Proposed Action, the U.S. Army identified potential effects to the following resource areas, which are analyzed in the attached EA: air quality, noise, water resources, biological resources, cultural resources, airspace management, hazardous materials and wastes, human health and safety, socioeconomics, and utilities and transportation infrastructure. A review of the analysis for the Proposed Action (Alternatives 1 and 2) is provided below.

Short-term, negligible, adverse effects on air quality occurred from the site preparation and construction activities associated with the initial deployment of the expeditionary THAAD battery. For either alternative, the increase in air emissions from the site preparation and construction activities would be below applicable significance criteria. Long-term, moderate, adverse effects on air quality would occur from continuous operation of the power generators. Under either alternative, the U.S. Army would obtain

an appropriate Guam Environmental Protection Agency Air Pollution Source Construction Permit and a Title V operating permit.

There are no sensitive noise receptors within the region of influence for the THAAD emplacement site. Under Alternative 1, aircraft noise from prior CDZ training operations at NWF has been reduced. For Alternative 2, aircraft-related noise would resume with the return of airborne training operations to NWF at the proposed shifted CDZ. Noise impacts from CDZ operations would be similar to that of prior operations, with the exception that flight paths would shift to align with the NWF North Runway instead of the South Runway.

There are no surface waters on or near the THAAD emplacement site. For either alternative, the potential for contamination of stormwater runoff or groundwater from construction and operations is minimized through the implementation of appropriate best management practices (BMPs). No flooding downstream is expected. To minimize the potential for increase in salinity intrusions into the groundwater aquifer, there would be no new groundwater wells installed and no new potable water service connections for the THAAD mission and facilities. Andersen AFB and the DoD would implement strategies to minimize groundwater withdrawals.

Initial clearing and site preparation for the THAAD emergency deployment on NWF included the loss of approximately 35.7 acres (14.4 total hectares) of forested and perennial scrub, which contributes to the cumulative loss of available habitat for several protected species on Guam. Under Alternative 2, an additional 55.5 acres (22.5 hectares) of forest and perennial scrub vegetation would be cleared outside of the original CDZ area. No designated critical habitats are affected by either alternative. Because of the availability of suitable habitat elsewhere on the island, the clearing of potential habitat is expected to have less-than-significant effects in the short term and on the survivability of special status species in the area. Long-term operation of the THAAD battery would further reduce the availability of nearby habitat because of high levels of noise and lighting at night at the emplacement site. To minimize effects to wildlife, all security lighting would be shielded and pointed down to reduce light levels. Long-term operations are expected to have less-than-significant effects on the survivability of special status species in the area. Under both alternatives, development of a fenced conservation area adjacent to the THAAD emplacement site would, over time, increase the availability of habitat for some species.

Although there are no previously identified archaeological sites within the project area that have been recommended eligible for listing in the National Register of Historic Places (NRHP), the clearing and construction activities would alter character-defining elements of the NWF historic airfield property that contribute to its eligibility for listing in the NRHP. The NWF airfield, however, has been documented to Historic American Engineering Record standards, and any alterations to the airfield pavement would be repaired in kind with like material. Any adverse effects to NRHP-eligible archaeological properties caused by the Proposed Action would be addressed in compliance with Section 106 of the NHPA through avoidance, minimization, or mitigation of adverse effects. These steps would include pedestrian surveys of the areas that would be subject to vegetation clearance or ground disturbance and that have not been previously surveyed for cultural resources. Also, subsurface archaeological testing would be conducted along portions of the proposed underground fiber optic line and conservation area fence line in areas where subsurface soils have not been previously disturbed by construction of NWF and other activities. If archaeological resources are inadvertently discovered during ground-disturbing activities, then the standard operating procedures (SOPs) contained in the Andersen AFB Integrated Cultural Resource Management Plan would be followed, as well as all appropriate Federal and state regulations and guidelines. As appropriate, data recovery and mitigation measures would be conducted for any newly discovered archaeological resources that could not be avoided by project-related activity. With mitigation and best practice measures negotiated for and memorialized under a Section 106 Memorandum of Agreement between the U.S. Army and the Guam State Historic Preservation Office, the impact under

NEPA of the THAAD emplacement on NWF under either alternative would be reduced to less than significant.

Guam International Airport and Andersen AFB units are impacted by the current TFR, which would continue to be used under Alternative 1. Aircraft are rerouted to avoid the TFR area when it is active. Under Alternative 2, the proposed SUA Restricted Area would replace the current TFR, resulting in continued disruptions to the existing flow of air traffic to and from Andersen AFB and the Guam International Airport. Air traffic having to avoid the Restricted Area would require procedural changes for some approach and departure flight paths, and add several minutes of flight time. Joint Service access to the new Restricted Area, to include NWF, the landing zone, and the expanded CDZ would be coordinated through development of an inter-service agreement, as well as a letter of procedure with the Federal Aviation Administration as appropriate.

The use of hazardous material and generation of hazardous waste during site preparation and construction activities has not been substantial, consisting primarily of equipment-related fuels and lubricants. On rare occasions during operations, it is possible for the THAAD motor pool satellite accumulation area to exceed hazardous waste storage limits. Andersen AFB is in the process of establishing a 90-day hazardous waste accumulation site on NWF in accordance with Federal regulations. Thus, the potential for a hazardous waste storage violation at the THAAD motor pool will be significantly reduced. The new storage facility is expected to be in place later in 2015. All hazardous materials and wastes are handled and disposed of in accordance with applicable Federal, Air Force, and Guam regulations.

During site preparation and construction, worker safety risks have been minimized through the application of standard safety procedures and use of personal protection equipment. During radar operations, personnel work in accordance with the established SOPs for the THAAD system, thereby controlling and minimizing health and safety risks from EMR.

Site preparation and construction-related activities require a small workforce. For long-term operations, the THAAD-related increase in population would have a small beneficial impact on local businesses and on Guam's overall economy, although insignificant. Effects on local housing demands and on public services would be minimal.

The increase in population from either alternative would not place substantial demands on existing utilities or cause major increases in local roadway use. Potable water capacities would not be exceeded. The THAAD mission and facility requirements do not include any new service connections for sewer or water. Nearly all THAAD personnel and military dependents would be placed in existing installation housing or in future Joint Region Marianas housing. The additional THAAD personnel, however, add to the cumulative demand for wastewater collection and treatment at the Northern District Wastewater Treatment Plant (WWTP), which is currently unable to meet the new secondary treatment discharge limits. The fiscal year 2014 Consolidated Appropriations Act provided funding for civilian water and wastewater improvements on Guam and is expected to include repairs and improvements to the WWTP and wastewater collection systems. Such improvements are anticipated to bring the WWTP into compliance.

Under the No Action Alternative, initial site preparation and construction activities, and operations to date, for the THAAD battery would have the same effects as for Alternative 1. Little or no impacts would be expected from removal of the THAAD battery and related infrastructure from NWF. In the long-term, NWF would, in general, return to THAAD pre-deployment conditions.

In terms of cumulative impacts, the Proposed Action and No Action Alternative were analyzed for air quality, water resources, terrestrial biological resources, airspace management, and utilities and transportation infrastructure. Following review of the THAAD alternative actions in combination with

other past, present, and reasonably foreseeable future actions at NWF, the U.S. Army determined that either no cumulative impacts or no significant cumulative impacts would occur.

CONCLUSION: The environmental analysis in the THAAD Permanent Stationing in Guam EA, determined that implementation of either Proposed Action alternative, or the No Action Alternative, will not have a significant environmental impact on the human and natural environment, either by themselves or cumulatively with other actions. After thoroughly considering the facts herein, the undersigned finds that the Proposed Action is consistent with existing environmental policies and objectives set forth in NEPA and its implementing regulations. Preparation of an Environmental Impact Statement, therefore, is not required.

PUBLIC REVIEW AND COMMENT: The EA, including the Draft FNSI, are available for a 30-day public review and comment period. A Notice on Availability (NOA) of this document was published in the *Pacific Daily News* and the *Marianas Variety* (Guam Edition). As identified in the published NOA, copies of this document are available at two Guam libraries for public access. The EA, including the Draft FNSI, also is available over the Internet at http://www.THAADGuamEA.com through the end of the comment period.

DEADLINE FOR RECEIPT OF WRITTEN COMMENTS: July 9, 2015

POINT OF CONTACT: Submit written comments to Mr. Mark Hubbs at the address below or on the project website at http://www.THAADGuamEA.com.

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APPROVED:

ERIC L. SANCHEZ
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Date

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Executive Summary

Introduction

This Environmental Assessment (EA) documents the potential environmental impacts associated with the current expeditionary (temporary) placement and operation of a United States (U.S.) Army Terminal High-Altitude Area Defense (THAAD) ballistic missile defense battery in Guam, and from the proposal to maintain the THAAD battery permanently at its current location on Northwest Field (NWF) of Andersen Air Force Base (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, this EA also analyzes the potential impacts from the expansion of the NWF cargo drop zone (CDZ) training area that was encumbered by THAAD operations. The EA was prepared in compliance with the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] § 4321, as amended), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations Parts 1500–1508, July 1, 1986), and the Department of the Army Procedures for Implementing NEPA (32 Code of Federal Regulations Part 651).

Background

In response to the evolving security environment in the Pacific region and through a series of negotiations with the Government of Japan, a realignment initiative was developed in 2006 to relocate a portion of the U.S. forces from Okinawa to Guam. To support the build-up of U.S. forces on Guam, the U.S. Joint Guam Program Office prepared an Environmental Impact Statement (EIS) that was completed in 2010. As part of the Proposed Action analyzed in the 2010 Final EIS, the U.S. Army was to establish and operate an Air and Missile Defense Task Force (AMDTF) on Guam that included a THAAD system. At the time of the issuance of the EIS Record of Decision in September 2010, the Department of Defense (DoD) had not decided to establish and operate an AMDTF on Guam.

In April 2013, the U.S. Secretary of Defense directed the Army to deploy a THAAD battery immediately to Guam on an emergency basis in response to potential North Korean missile launch activity. Under the command of the 94th Army Air and Missile Defense Command (AAMDC), the expeditionary placement and operation of the THAAD battery by Task Force Talon in Guam began on April 25, 2013. The DoD's order to the U.S. Army to deploy an expeditionary THAAD battery to Guam precluded preconstruction surveys and consultation with regulators. Further, because the requirement was commenced as a result of an emergent threat, the Executive responsibility to protect the homeland obviated the need for traditional NEPA analysis prior to the emergency deployment. While this emergency action was not addressed in the 2010 Final EIS, the associated Final EIS planning and analysis helped guide decision makers in deploying the THAAD battery to its current emplacement location, which falls within the general area of the AMDTF Preferred Alternative identified in the 2010 document.

Since the temporary deployment of the THAAD battery in 2013, the DoD validated the enduring requirement for a THAAD battery in Guam to ensure continued defense of the homeland against existing and emerging missile threats by potentially hostile states in the region, as mandated in Title 10 of the U.S.C., *Armed Forces*. In response, the DoD proposes to maintain the THAAD battery permanently at Andersen AFB.

Prior to the emergency emplacement of the U.S. Army's THAAD battery in April 2013, the NWF South Runway area served as Andersen AFB's key asset for the aircraft assault landing-departure zone and CDZ involving extensive personnel and cargo parachute operations (airborne training). The THAAD battery currently occupies a portion of the South Runway and the southern edge of the current CDZ, which forced airborne training activities and exercises to other locations in the region, primarily Tinian North Field and

the Andersen AFB main runway. To address training operational deficiencies and compensate for the loss of use of the CDZ on NWF now encumbered by THAAD operations, the 94th AAMDC, in cooperation with 36th Wing at Andersen AFB, proposes to expand the area used for the CDZ so as to restore critical cargo drop training capability on NWF.

Purpose and Need

Under Title 10 of the U.S.C., the DoD has a mandate to protect the U.S. homeland against impending threats, whether foreign or domestic. In accordance with Title 10 U.S.C., the purpose of the Proposed Action is to provide long-term protection for Guam residents and the U.S. forces in Guam from the threat of ballistic missile attacks. The Proposed Action to permanently station a THAAD battery in Guam is needed because of existing and emerging missile threats in the region. The long-term placement and operation of a THAAD battery in Guam would provide the U.S. Pacific Command with a proven ground-based ballistic missile defense capability and a flexible option for deterring hostile actions in the region.

As part of the Proposed Action, expanding the existing NWF CDZ at Andersen AFB would restore critical CDZ training capability that was hampered by the emergency placement of the THAAD battery and its proposed permanent stationing. Restoring cargo drop training capability on NWF is needed in order to eliminate conflicts with normal flight operations conducted at Andersen AFB and with the approaches to Saipan International Airport caused by the relocation of airborne training operations to the Andersen AFB main runway and Tinian North Field, respectively. It would also enhance airborne training operations by allowing both personnel and cargo parachute drop operations to occur at one location, while minimizing transportation and other logistical support requirements.

Proposed Action and Alternatives Considered

Proposed Action

The Proposed Action evaluated in this EA is to maintain the THAAD battery permanently in Guam. The current battery has been operating as an expeditionary (temporary) mission at Andersen AFB since its deployment in April 2013. In order to maintain an enduring THAAD battery presence in Guam, two alternatives are considered under the Proposed Action. For analysis purposes, both alternatives include the activities that occurred during the emergency deployment and subsequent adaptations of the THAAD battery, along with proposed modifications and improvements for long-term system operations.

Alternative 1: Permanent Stationing of Expeditionary THAAD System. Under this alternative, the THAAD battery expeditionary mission would maintain a permanent presence at its current location on NWF with minimal site improvements or changes in operations. During the emergency deployment of the expeditionary THAAD battery in April 2013, the battery occupied a 237.4-acre (96.1-hectare) emplacement area on the eastern end of the NWF airfield, which included the clearing of approximately 35.7 acres (14.4 hectares) of limestone forest and perennial scrub to accommodate radar and missile launcher requirements. Within the cleared original expeditionary emplacement site, additional changes were made in 2014 that included compressing the THAAD emplacement perimeter to an 82.0-acre (33.2-hectare) area to allow for improved operational flexibility. Other emplacement actions included temporary fencing and guard towers, constructing several concrete pads, and establishment of a motor pool.

Approximately 200 support personnel originally were deployed in support of the THAAD mission. The personnel are housed in military transient quarters on Andersen AFB and are deployed on a rotational basis with each rotation lasting from several months to a year or more. Current expeditionary operations consist of radar surveillance, facility security, routine facility and equipment maintenance, and battle drills (i.e., computer simulations that do not include missiles being launched). Because the emplacement

site has no electrical service, the ongoing THAAD battery activities require continuous operation of numerous generators. For improved power generation efficiency at the THAAD battery site, most of the system tactical generators would be replaced with fewer and more efficient portable generators ranging from 420 kilowatts to 1.3 megawatts, along with installation of an associated grounding grid and two 10,000-gallon (37,854-liter) aboveground fuel pods.

THAAD battery operations require an exclusion zone in front of the radar to avoid injury to personnel and damage to equipment from electromagnetic radiation (EMR) emissions. For aircraft, a Temporary Flight Restriction (TFR) area was established on the northern end of Guam starting in April 2013. Under Alternative 1, the TFR would continue to be used during THAAD radar operations.

Because the THAAD battery currently encumbers the CDZ and use of the NWF South Runway, the airborne training activities and exercises that previously occurred there would continue operations elsewhere in the region.

***Alternative 2 (Preferred Alternative): THAAD System Permanent Stationing and CDZ* Expansion.** For Alternative 2, permanently stationing the THAAD battery at NWF would require various site improvements and operational changes made to the current expeditionary missions, which are described below. Without repeating prior discussions, Alternative 2 incorporates those expeditionary-related actions and activities that have already occurred under Alternative 1.

To permanently station the THAAD battery at its current location would require installing perimeter and motor pool fencing, security lighting, and a Giant Voice (also referred to as Big Voice) warning system; replacing most of the system tactical generators with fewer and more efficient portable generators, along with installation of an associated grounding grid and two 10,000-gallon (37,854-liter) aboveground fuel pods (same as for Alternative 1); running a fiber optic line to the site and installing a communication (cable) trough; installation of a drainage system; grading and leveling previously disturbed areas; improving roadways; replacing guard towers; and constructing four new buildings. Trenching along the corridor for the proposed fiber optic line would require clearing of an additional 2.3 acres (0.9 hectare) of forest and perennial scrub. Total THAAD personnel numbers would increase from the current 200 to about 225. In addition, all or most of the approximate 168 military dependents moving to Guam would be placed in existing or future installation housing. To facilitate THAAD radar operations, the U.S. Army would request the Federal Aviation Administration (FAA) to establish a special use airspace (SUA) Restricted Area.

As part of Alternative 2, the 94th AAMDC, in collaboration with the 36th Wing, would expand the current CDZ by shifting the drop zone assets from the NWF South Runway to the North Runway and adjacent areas. To comply with Air Force runway design specifications and airborne training requirements, additional vegetation clearing would be needed along the North Runway and north of the originally cleared CDZ and THAAD original expeditionary emplacement area. The combination of these areas to be cleared of forest and perennial scrub vegetation totals 53.2 acres (21.5 hectares) located outside of the original drop zone area. Within the original CDZ boundary, additional forest and perennial scrub areas that were not cleared of vegetation when the training area was established in 2001, would now require clearing for the proposed shifted CDZ training area.

No Action Alternative

Under the No Action Alternative, the THAAD battery, including equipment and supporting personnel, would cease expeditionary operations on Guam. The associated equipment, temporary facilities, and infrastructure (including temporary fencing and concrete pads), would be removed from the current, compressed expeditionary emplacement site and motor pool area at NWF. The TFR that was established for radar operations would no longer be needed. In addition, the THAAD battery and associated 200

mission support personnel would be removed from Guam. With the removal of the THAAD battery from Guam, the DoD would be required to consider the need for the mission and how it may otherwise be accomplished.

The 35.7 acres (14.4 hectares) of forest and perennial scrub that was previously cleared for the emplacement site would be allowed to revegetate. Because of the THAAD expeditionary mission-related actions and activities that have already occurred, analysis of the No Action Alternative includes those prior actions identified under Alternative 1.

With the removal of THAAD battery operations from NWF, the existing CDZ would no longer be encumbered. Thus, airborne training operations would be able to resume at the NWF South Runway.

Summary of Findings

The potential direct and indirect environmental impacts that might result from implementation of the Proposed Action and the No Action Alternatives are summarized in **Table ES-1** for each of the 10 resource topics analyzed in the EA.

Based on the assessment of other past, present, and reasonably foreseeable future actions at NWF and in the vicinity of Andersen AFB, the Proposed Action and No Action Alternatives also could result in potential cumulative impacts on air quality, water resources, terrestrial biological resources, airspace management, and utilities and transportation infrastructure when combined with other actions. A summary of the cumulative effects for these resource topics is provided in **Table ES-2**. *De minimis* cumulative impacts are anticipated for all other resources.

Table ES-1. Summary of Environmental Impacts

Resource	Alternative	Environmental Impacts
Air Quality (Section 4.1.1)	Alternative 1	*Site Preparation and Construction*: Short-term, negligible, adverse effects on air quality occurred from the site preparation and construction activities associated with the initial deployment of the expeditionary THAAD battery. The estimated amount of greenhouse gas (GHG) emissions from these actions is a small fraction (approximately 2.5 percent) of the meaningful reference point (25,000 metric tons per year [tpy] of carbon dioxide-equivalent emissions) established by the CEQ for when to consider GHG in NEPA analyses. In summary, the increase in air emissions from the site preparation and construction activities was below applicable significance criteria.
		Operations: Long-term, moderate, adverse effects on air quality would occur from continuous operation of the power generators as part of the THAAD expeditionary mission. All potential generator emissions are estimated to be below the Federal Prevention of Significant Deterioration (PSD) major source thresholds for all applicable pollutants. The THAAD mission would, therefore obtain an appropriate Guam Environmental Protection Agency (Guam EPA) Air Pollution Source Construction Permit, with review and approval required by the Guam EPA and U.S. Environmental Protection Agency (USEPA). Obtaining a construction permit would demonstrate conformance with the State Implementation Plan for air quality in Guam. The THAAD operations would also need to obtain a Title V operating permit because the potential emissions have been estimated at greater than 100 tpy for nitrogen oxides (NO_X). The estimated amount of GHG emissions from these actions is a fraction (less than 50 percent) of the meaningful reference point established by the CEQ for when to consider GHG in NEPA analyses. Thus, the overall impacts on air quality from operations would be less than significant.
	Alternative 2	*Site Preparation and Construction*: Alternative 2 includes the effects on air quality from the site preparation and construction activities as described for the initial deployment of the expeditionary THAAD battery under Alternative 1. For those site preparation and construction activities associated with the permanent stationing of the THAAD battery, similar short-term, minor, adverse effects on air quality would occur. Although overall air emissions from proposed (future) activities would exceed those from the initial expeditionary deployment, the emissions would occur over different years. Similar to Alternative 1, the estimated amount of GHG emissions from these actions is a small fraction (approximately 2.8 percent) of the meaningful reference point established by the CEQ for when to consider GHG in NEPA analyses. In summary, the increase in air emissions from the site preparation and construction activities would be below applicable significance criteria.
		Operations: Under Alterative 2, air emissions from the THAAD expeditionary mission (Alternative 1) that occurred to date are included. Overall generator emissions would be same. The only pertinent difference from Alternative 1 is that Alternative 2 includes approximately 25 additional military personnel and contractors, and 168 military dependents, relocating to Guam. These additional persons would generate air emissions from the operation of their personal vehicles. Identical air permitting implications would result for Alternative 2. The U.S. Army would obtain an appropriate Guam EPA Air Pollution Source Construction Permit, with review and approval required by the Guam EPA and USEPA, and a Title V operating permit. Just as for Alternative 1, the estimated amount of GHG emissions from these actions is a fraction (less than 50 percent) of the meaningful reference point established by the CEQ for when to consider GHG in NEPA analyses. Overall impacts on air quality from operations, therefore, would be less than significant.

Resource	Alternative	Environmental Impacts
	No Action	The effects on air quality include the site preparation and construction activities that already occurred, and the operational activities that have occurred to date, for the THAAD expeditionary mission (Alternative 1). Short-term, negligible, adverse effects on air quality would occur from the removal and demolition of the infrastructure constructed for the expeditionary mission. Once the THAAD battery ceases operations and the demolition activities are completed, air emissions on NWF would, in general, return to THAAD pre-deployment levels. No air permitting actions would be required. As such, the air emissions from the No Action Alternative would be below applicable significance criteria.
Noise (Section 4.1.2)	Alternative 1	*Site Preparation and Construction*: There are no sensitive receptors within region of influence for the THAAD emplacement site. The nearest residences are approximately 2 miles (3 kilometers) away. As a result, noise from construction activities would be approximately 48 A-weighted decibels and not discernable over ambient noise levels. Greater noise disturbance has occurred within and near the construction corridors, but the noise levels were temporary and intermittent. Therefore, no significant noise impacts have resulted from site preparation and construction activities.
		Operations: No noise impacts on sensitive receptors have resulted from the operation of generators, vehicles, and other equipment at the THAAD emplacement site. The nearest sensitive receptors (residences) are approximately 2 miles (3 kilometers) away. Noise resulting from additional vehicular traffic on local roadways has increased slightly; however, overall noise levels are not significant. In addition, aircraft noise from prior CDZ training operations at NWF has been reduced.
	Alternative 2	*Site Preparation and Construction*: Impacts would be similar to those described for Alternative 1. Under Alternative 2, there would be a greater area of land cleared and prepared (including the CDZ) and more substantial construction (e.g., perimeter fences and new buildings) than for Alternative 1.
		Operations: Noise-related impacts resulting from operation of the THAAD battery to date would be the same as that described for Alternative 1. For permanent stationing under Alternative 2, operational noise for the THAAD battery generally would be the same, with the exception of slightly greater traffic noise from the increase in military support personnel and dependents. With the return of airborne training operations to NWF at the proposed shifted CDZ, aircraft-related noise also would return. Noise impacts from CDZ operations would be similar to that of prior operations, with the exception that flight paths and landing exercises would shift to align with the NWF North Runway instead of the South Runway. The change in alignment likely would result in a negligible reduction in noise, as the receptors to the south would be further away. Overall noise levels would not be significant.
	No Action	Under the No Action Alternative, noise impacts to date for the THAAD expeditionary mission (Alternative 1) would be the same. Noise impacts resulting from removal of the THAAD equipment and infrastructure would be similar to those described for Alternative 1. Once the THAAD system and the associated support personnel are moved off the island, the long-term operational noise impacts would return to THAAD pre-deployment levels, as CDZ operations would resume at the NWF South Runway. In summary, short-term and long-term noise levels for the No Action Alternative would not be significant.
Water Resources (Section 4.1.3)	Alternative 1	*Site Preparation and Construction*: There are no surface waters on or near the THAAD emplacement site. The potential for contaminated stormwater runoff from the construction site is minimized through the development and implementation of a site-specific Erosion Control Plan (ECP) and a Spill Prevention, Control, and Countermeasure (SPCC) Plan. To help ensure that stormwater runoff from the emplacement site is free of contaminants, an Environmental Protection Plan (EPP) would be

Resource	Alternative	Environmental Impacts
		developed. Because of the implementation of appropriate best management practices (BMPs) at the THAAD emplacement site to contain contaminants and control stormwater runoff during the site preparation and construction phase, no significant impacts to the groundwater resources are expected.
		Operations: A site-specific Stormwater Pollution Prevention Plan (SWPPP) and SPCC Plan implements BMPs to eliminate/minimize potential for groundwater contamination from leaks and spills from stored fuels, motor pool wastes, and other materials used during operations. The additional military personnel and contractors have resulted in an estimated potable water increase demand of approximately 20,000 gallons (75,708 liters) per day. This increase in potable water demand is highly unlikely to result in substantial additional groundwater withdrawals with minimal increase in salinity intrusions into the groundwater aquifer. The U.S. Army would rely on existing Andersen AFB wells and other sources for the potable water. There would be no new groundwater wells installed, and no new potable water service connections for the THAAD mission and facilities. To mitigate potentially adverse effects on groundwater usage, Andersen AFB and the DoD are making further improvements to the existing DoD water distribution systems to reduce system leaks. The DoD would, as appropriate, adjust pumping rates at DoD wells if salinity (chloride) levels show an increase, and increase the use of surface water from Fena Reservoir to reduce overall withdrawals from the Northern Guam Lens Aquifer (NGLA). Thus, the projected increase in potable water demand for the THAAD mission is not expected to result in substantial additional groundwater withdrawals with minimal increase in salinity intrusions into the groundwater aquifer.
	Alternative 2	*Site Preparation and Construction*: Under Alternative 2, the effects on water resources during the initial site preparation and construction phase are the same as those described for Alternative 1. The additional grading and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ would have similar effects on groundwater resources. Just as for Alternative 1, impacts would be minimized through the implementation of site-specific BMPs, which would be described in an ECP, SPCC Plan, and EPP prepared for the project activities. Overall, site preparation and construction activities associated with Alternative 2 are not expected to cause significant impacts on groundwater resources.
		Operations: Beyond the initial operational effects described under Alternative 1, long-term THAAD operations under Alternative 2 would present similar impacts. The increase in impervious area for the new drainage system and new buildings would not be substantial, considering the extent of existing pavement on NWF. No flooding downstream or pollutant releases are expected. Impacts from operations would be minimized through the implementation of site-specific BMPs described in a site-specific SWPPP and SPCC Plan. Because of the increase in support personnel and the addition of military dependents, the daily potable water increase demand would double to about 40,000 gallons (151,416 liters) per day. Just as for Alternative 1, this alternative would rely on existing wells and other sources for the potable water. There would be no new groundwater wells installed and no new potable water service connections for the THAAD mission and facilities. The same mitigating actions would be implemented to reduce overall withdrawals from the NGLA. Therefore, no significant impacts to groundwater resources are expected to occur.
	No Action	The initial site preparation and construction phase of the THAAD battery emplacement would result in no significant impacts to groundwater resources, the same as those described for Alternative 1. Additionally, as with Alternative 1, the THAAD battery operational activities to date would not result in significant impacts. Removal of the THAAD battery, including ancillary equipment and related infrastructure, could result in potential fuel spillage and contamination of stormwater runoff. The implementation of site-specific BMPs, however, would ensure that no significant impacts to

Resource	Alternative	Environmental Impacts
		groundwater would occur. On a longer-term basis, the 200 THAAD mission support personnel to be removed from Guam would result in potable water usage and groundwater withdrawals being reduced, closer to THAAD pre-deployment levels.
Biological Resources (Section 4.1.4)	Alternative 1	*Site Preparation and Construction*: Clearing and site preparation of the THAAD emplacement site includes the loss of approximately 35.7 acres (14.4 total hectares) of forested and perennial scrub, which contributes to the cumulative loss of available habitat for several species on Guam. The deployment, however, has had no effect on designated critical habitats. As for impacts on special status species, a very small but unknown number of individuals of fadang, a federally proposed threatened plant, could have been destroyed during clearing of secondary limestone forest and that habitat is no longer available. The clearing of secondary forest could have caused the long-term loss of a small amount of habitat that might be used by the proposed endangered Mariana wandering butterfly if it were to be reintroduced or rediscovered on Guam. The Government of Guam endangered moth skink and Pacific slender-toed gecko occur in the secondary limestone forest on NWF; thus, the clearing of forest caused the long-term loss of potential habitat for these species and the possible killing of individuals. Three federally endangered forest and forest-edge dwelling birds, the Guam Micronesian kingfisher, Guam rail, and Mariana crow, have been extirpated from Guam. For all three of these species, the amount of habitat lost was substantially less than the amount of available habitat, and did not exceed the threshold of habitat remaining that would be required for recovery of the species. The clearing of forest and perennial scrub habitat could have caused the long-term loss of a small amount of habitat for the Government of Guam endangered Micronesian starling. For the Mariana fruit bat, which is federally listed as threatened and Guam-listed as endangered, the clearing of forested areas has caused a long-term, small loss of foraging habitat, and possibly roosting habitat. The noise and other disturbances during site preparation and clearing may also have affected foraging and roosting in the surrounding area. Because of the availability of suitable habitat elsewhere on the island, the clearing of potential habitat is expected to have less than significant effects in the short term and on the survivability of special status species in the area. In addition, development of a fenced conservation area (approximately 121 acres [49 hectares] in size) adjacent to the THAAD emplacement site would, over time, increase the availability of habitat for some species.
		Operations: Long-term operation of the THAAD battery would further reduce the availability of habitat for threatened and endangered species as these species are likely to avoid habitat surrounding the emplacement area, a source of high levels of noise and lighting at night. To minimize effects to wildlife, all security lighting would be shielded and pointed down to reduce light levels in surrounding areas. There also is a small risk for various bird species and Mariana fruit bats to be harmed if they were to fly across or along the EMR beam of the radar system when it is operating; however, such impacts are unlikely to occur. In summary, long-term operations under Alternative 1 are expected to have less than significant effects on the survivability of special status species in the area. Additionally, to prevent the spread of brown treesnakes and other non-native species, 100 percent of outbound equipment, supplies, household goods, personal equipment, and other materials associated with operation of the THAAD battery are, and will continue to be, inspected for brown treesnakes.
	Alternative 2	*Site Preparation and Construction*: Under Alternative 2, the effects on biological resources during the initial site preparation and construction phase are the same as those described for Alternative 1. The additional grading and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ would have similar effects. The clearing of an additional 55.5 acres (22.5 hectares) of forest and perennial scrub for the fiber optic line and CDZ expansion would have similar impacts on the following special status species: fadang, moth skink, Pacific slender-toed gecko, Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat. Similar to Alternative 1, however, suitable habitat is available elsewhere on the island; thus, the clearing of potential habitat is expected to have less than significant effects in

Resource	Alternative	Environmental Impacts
		the short-term and on the survivability of special status species in the area. In addition, development of a fenced conservation area (approximately 121 acres [49 hectares] in size) adjacent to the THAAD emplacement site would, over time, increase the availability of habitat for some species.
		Operations: Once the new THAAD facilities are constructed and other site improvements completed under Alternative 2, the daily operations for the THAAD battery are expected to have similar impacts as those described for Alternative 1.
	No Action	Under the No Action Alternative, the initial site preparation and construction phase of the THAAD would have the same effects on biological resources as described for Alternative 1. Additionally, as with Alternative 1, the THAAD battery operational activities to date would have less than significant effects on the survivability of special status species in the area. On a longer term basis, the THAAD battery would be removed and the site would be returned to near original conditions. Those areas cleared of vegetation for the THAAD emplacement would be allowed to revegetate. Over time, there would be a beneficial effect to most native flora and fauna, including the special status species that occurred there, as forest vegetation returns to the approximately 35.7 acres (14.4 hectares) of disturbed land located outside of the CDZ training area.
Cultural Resources (Section 4.1.5)	Alternative 1	*Site Preparation and Construction*: There are no previously identified archaeological sites within the project area that have been recommended eligible for listing in the National Register of Historic Places (NRHP) and that would be directly affected by the Proposed Action. The clearing and construction activities associated with the THAAD expeditionary emplacement site, however, do represent alterations to character-defining elements of the NWF historic airfield property that contribute to its eligibility for listing in the NRHP, and would be considered adverse effects under Section 106 of the National Historic Preservation Act (NHPA) and a significant, long-term impact under NEPA. The NWF airfield has been documented to Historic American Engineering Record standards, and any alterations to the pavement of the runways, taxiways, or service areas of NWF would be repaired in kind with like material. All future THAAD mission-related ground-disturbing activities would be conducted in keeping with the Andersen AFB Integrated Cultural Resources Management Plan. These steps would include pedestrian surveys of the areas that would be subject to vegetation clearance or ground disturbance and that have not been previously surveyed for cultural resources. Also, subsurface archaeological testing would be conducted along portions of the proposed underground fiber optic line and conservation area fence line in areas where subsurface soils have not been previously disturbed by construction of NWF and other activities. Any adverse effects to NRHP-eligible archaeological properties caused by the Proposed Action would be addressed in compliance with Section 106 of the NHPA through avoidance, minimization, or mitigation of adverse effects, including data recovery and mitigation as appropriate for cultural resources newly discovered as part of the proposed activity and that could not be avoided. If archaeological resources are inadvertently discovered during ground-disturbing activities, then the standard operating procedures (SOPs) contained in the Integrated Cultural Resource Management Plan would be followed, as well as all appropriate Federal and state regulations and guidelines. With mitigation and best practice measures negotiated for and memorialized under a Section 106 Memorandum of Agreement between the U.S. Army and the Guam State Historic Preservation Office (SHPO), the impact under NEPA of the THAAD expeditionary emplacement on NWF would be reduced to less than significant.
		Operations: Long-term operation of the THAAD battery on NWF would have no direct or indirect effects to cultural resources.
	Alternative 2	*Site Preparation and Construction*: For the permanent stationing of the THAAD battery under Alternative 2, the effects on cultural resources at NWF during the initial site preparation and construction phase are the same as those described for

Resource	Alternative	Environmental Impacts
		Alternative 1. The additional grading and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ would have similar effects. These actions affect the character and use of NWF, and collectively represent an adverse effect under Section 106 and a significant, long-term impact under NEPA. Just as for Alternative 1, mitigation and best practice measures would be memorialized under a Section 106 Memorandum of Agreement between the U.S. Army and the Guam SHPO. These measures would be essentially identical to those for Alternative 1. Thus, the impact of the THAAD permanent stationing under NEPA would be reduced to less than significant.
		Operations: Long-term operation of the THAAD battery on NWF would have no direct or indirect effects to cultural resources.
	No Action	Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would have the same impacts to cultural resources as those described for Alternative 1. Removal of the THAAD battery from NWF, including ancillary equipment and related infrastructure would have no significant direct or indirect effects on previously identified traditional cultural properties.
Airspace Management (Section 4.1.6)	Alternative 1	*Site Preparation and Construction*: There have been no impacts on airspace management during the site preparation and construction activities.
		Operations: Guam International Airport and Andersen AFB units are impacted by the current TFR used for the THAAD expeditionary mission. The TFR encroaches into some of the Guam International Airport initial approach areas and departures. Aircraft executing these procedures are rerouted to avoid the TFR area. Additionally, airborne training activities cannot occur on NWF when the TFR is active.
	Alternative 2	*Site Preparation and Construction*: No impacts on airspace management are expected.
		Operations: The proposed SUA Restricted Area, to be named R-XXXX, would replace the current TFR and is intended to be continuously active to enable THAAD operational response. Establishment of the Restricted Area would continue to disrupt the existing flow of air traffic to and from Andersen AFB and Guam International Airport. Air traffic having to avoid R-XXXX would require procedural changes for some approach and departure flight paths, and add several minutes of flight time. Joint Service access to R-XXXX, to include NWF, the landing zone, and the expanded CDZ would be coordinated through development of an inter-service agreement (e.g., memorandum of agreement, letter of authorization), as well as a letter of procedure with the FAA as appropriate. Shifting the CDZ to the NWF North Runway would reestablish airborne training capability at NWF. Thus, long-term impacts on airborne training operations are expected to be mitigable to minor.
	No Action	Under the No Action Alternative, the THAAD radar operations would cease and the current TFR would be removed. This change would allow airspace management on the northern end of Guam to return to THAAD pre-deployment status.
Hazardous Materials and Wastes (Section 4.1.7)	Alternative 1	*Site Preparation and Construction*: The use of hazardous material and generation of hazardous waste during site preparation and construction activities has not been substantial, consisting primarily of equipment-related fuels and lubricants. Should munitions or contamination/hazardous wastes be encountered as part of the construction activities, personnel would cease work and immediately report the finding to the appropriate installation hazardous material or ordnance disposal response group. Thus, no significant impacts are expected.
		Operations: Operational activities, particularly the motor pool, also require fuel storage and the generation of petroleum,

Resource	Alternative	Environmental Impacts
		oil, and lubricant (POL) wastes, coolant wastes, and related solid wastes. The POLs and combined solid wastes are destined for recycling or disposal as non-hazardous wastes. Only the contaminated coolant is managed as a hazardous waste. On rare occasions, it is possible for the THAAD motor pool satellite accumulation area to exceed hazardous waste storage limits, which also increases the risk for mishap. The 36th Wing is in the process of establishing a 90-day hazardous waste accumulation site on NWF in accordance with U.S. Environmental Protection Agency regulations. Thus, the potential for a hazardous waste storage violation at the THAAD motor pool satellite accumulation area will be significantly reduced. The new storage facility is expected to be in place later in 2015. All hazardous materials and wastes are handled and disposed of in accordance with applicable Federal, Air Force, and Guam regulations. Additionally, all herbicide applications for vegetation control are conducted in accordance with the Andersen AFB Pest Management Plan. As a result, no significant impacts are expected for hazardous materials and wastes.
	Alternative 2	*Site Preparation and Construction*: Impacts would be similar to those described for Alternative 1. Because Alternative 2 involves more clearing and construction, greater volumes of hazardous materials and wastes would be used or generated. As with Alternative 1, these would be handled and disposed of in accordance with applicable regulations. Thus, no significant impacts are expected.
		Operations: Impacts resulting from operation of the THAAD battery would be similar to those described for Alternative 1. There would be a long-term, minor increase in the use of hazardous materials and generation of hazardous wastes from the upkeep and maintenance of the security fences, roadways, and support buildings (e.g., paints, sealants, adhesives, and herbicides). Just as for Alternative 1, hazardous waste storage concerns at the THAAD motor pool will be resolved once the 90-day hazardous waste accumulation site is established on NWF. No significant impacts are expected for hazardous materials and wastes as a result of this alternative.
	No Action	Under the No Action Alternative, hazardous material and waste-related impacts to date for the THAAD expeditionary mission (Alternative 1) would be the same. Following removal of the THAAD battery, there would be no hazardous materials used or hazardous wastes generated from operational activities. No significant impacts would be expected.
Human Health and Safety (Section 4.1.8)	Alternative 1	*Site Preparation and Construction*: During site preparation and construction, worker safety risks have been minimized through the application of standard safety procedures and use of personal protection equipment. Due to the nature of the site preparation and construction activities, the risk of impacts on construction worker safety from implementation of Alternative 1 has been minimal. There have been no impacts to public health and safety from site preparation and construction because those activities have occurred entirely within the boundaries of Andersen AFB.
		Operations: During operations, personnel work in accordance with the established SOPs for the THAAD system, thereby controlling and minimizing health and safety risks. This includes a personnel exclusion zone of 328 feet (100 meters), +/- 90 degrees of the axis of orientation of the THAAD radar system to avoid injury to personnel from EMR. Because the THAAD battery radar operations do not affect any land or ocean surface areas outside of the installation boundary, no members of the public would be exposed to harmful EMR. The current TFR provides a safety measure to keep all aircraft from being adversely affected by the operation of the THAAD radar. Established explosive safety quantity distance (ESQD) arcs at the Andersen AFB Munitions Storage Area do not need to be modified. New ESQD arcs have been established for the THAAD missile launchers in accordance with DoD regulatory requirements; no areas outside the installation boundary are affected. As a result, no significant impacts on health and safety are expected.

Resource	Alternative	Environmental Impacts
	Alternative 2	*Site Preparation and Construction*: Impacts to health and safety would be similar to those described for Alternative 1.
		Operations: Impacts to health and safety would be similar to those described for Alternative 1.
	No Action	Impacts to health and safety would be similar to those describe for Alternative 1; however, additional minor impacts would arise from demolition activities. Following removal of the THAAD battery, there would be no operational impacts.
Socioeconomics (Section 4.1.9)	Alternative 1	*Site Preparation and Construction*: Site preparation and construction-related activities required a small workforce consisting of installation personnel and no more than 20 contract workers at any one time. These actions have had a temporary positive effect on the local economy through increased employment; however, such effects are insignificant. Because the activities required few temporary workers, there have been no adverse effects on public services or local housing.
		Operations: For long-term operations, the addition of approximately 200 support personnel has resulted in a 2.6 percent increase in the current population at Andersen AFB. This increase in personnel, and Federal spending in support of the THAAD mission, would have a small beneficial impact on local businesses and on Guam's overall economy, although insignificant. Because most of the military and contractor personnel live in existing billeting facilities on Andersen AFB, there are no significant impacts on housing demands on the installation and no impacts off the installation. The increase in island population also resulted in a minor increase in the use of public services, but no adverse effects are expected.
	Alternative 2	*Site Preparation and Construction*: Under Alternative 2, the effects on socioeconomics during the initial site preparation and construction phase would be the same as those described for Alternative 1. The proposed permanent stationing of the THAAD battery and expansion of the CDZ, however, would involve additional clearing and construction-related activities, requiring a small workforce consisting of military personnel and no more than 50 contract workers at any one time. These activities would have a temporary positive effect on the local economy through increased employment, although insignificant. Because the activities would require few temporary workers, there would be no adverse effects on public services or local housing.
		Operations: Beyond the initial operational effects described under Alternative 1, long-term THAAD operations for Alternative 2 would increase military personnel and contractors to about 225 (25 more than Alternative 1), and adds approximately 168 military dependents. The combined total of 393 people results in a 5 percent increase in the current population at Andersen AFB. Operational activities associated with the expansion of the CDZ would result in no additional permanent personnel, contractors, or dependents. The increase in military personnel and families, and Federal spending in support of the THAAD mission, would have a small beneficial impact on local businesses and on Guam's overall economy that is slightly greater than for Alternative 1, but still insignificant. Just as for Alternative 1, most of the military personnel would live in existing billeting facilities on Andersen AFB. In addition, all or most of the approximate 70 families moving to Guam would be placed in existing or future Joint Region Marianas (JRM) housing on the island. Thus, there would be no significant impacts on housing demands either on or off the installation. Overall, the permanent increase in island population would result in a minor increase in the use of public services, including public schools and health care facilities, but no adverse effects are expected.
	No Action	Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would result in the same minor beneficial socioeconomic effects as described for Alternative 1. The THAAD battery

Resource	Alternative	Environmental Impacts
		operational activities to date also would result in minor beneficial effects, similar to that of Alternative 1. Removal of the THAAD equipment, temporary facilities, and infrastructure would require a small, temporary workforce consisting of military personnel and no more than 20 contract workers at any one time. These activities would have a temporary beneficial effect on the local economy through increased employment, although insignificant. Because there would be few temporary workers, no adverse effects on public services or local housing would occur. On a longer-term basis, removal of the THAAD battery and the 200 support personnel from Guam would result in no effects from the return to THAAD pre-deployment socioeconomic conditions.
Utilities and Transportation Infrastructure (Section 4.1.10)	Alternative 1	*Site Preparation and Construction*: Utility demands during site preparation and construction activities have been temporary and minimal, and did not exceed existing capacities. Temporary increases in local traffic and roadway use have been minimal.
		Operations: Under Alternative 1, the addition of 200 military personnel and contractors has resulted in a 2.6 percent increase in the current population at Andersen AFB. Such a small increase in base population has not placed substantial demands on existing utilities or caused major increases in local roadway use. The THAAD mission and facility requirements do not include any new service connections for installation electrical power, potable water, or wastewater. All THAAD personnel have been placed in existing installation housing already permitted for sewer and water. Additionally, sewage collected from contractor operated portable latrines at the battery site on NWF would be taken to one of the existing Wastewater Treatment Plants (WWTPs) on Guam in a position for accepting and treating the wastes. Increases in wastewater resulting from the associated population increase are approximately 12,000 gallons (45,425 liters) per day. The Northern District WWTP is currently unable to meet the new secondary treatment discharge limits of the 2013 National Pollutant Discharge Elimination System (NPDES) permit. The fiscal year 2014 Consolidated Appropriations Act provided funding for civilian water and wastewater improvements on Guam and is expected to include repairs and improvements to the WWTP and wastewater collection systems. Such improvements are anticipated to bring the Northern District WWTP into compliance. As a result, THAAD-related activities are not expected to have a significant impact on the existing utility and transportation infrastructure.
	Alternative 2	*Site Preparation and Construction*: Under Alternative 2, the effects on utility and transportation infrastructure during the initial site preparation and construction phase are the same as those described for Alternative 1. The additional site preparation and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ would have similar effects. Thus, no impacts to utilities and transportation infrastructure would be expected.
		Operations: As with Alternative 1, the Alternative 2 THAAD mission and facility requirements do not include any new service connections for sewer or water. Nearly all THAAD personnel and military dependents would be placed in existing installation housing or in future JRM permitted housing (depending on when new housing becomes available). JRM would be responsible for obtaining sewer and water connection permits for the future housing. Sewage collected from contractor operated portable latrines at the battery site on NWF would be taken to one of the existing WWTPs on Guam in a position for accepting and treating the wastes. Following the initial operational effects described under Alternative 1, long-term THAAD operations for Alternative 2 would increase military personnel and contractors to about 225 (25 more than Alternative 1), and adds approximately 168 military dependents. The combined total of 393 people results in a 5 percent increase in the current population at Andersen AFB. This increase in installation population would not place substantial demands on existing utilities or cause major increases in local roadway usage. Increased wastewater generation resulting

Resource	Alternative	Environmental Impacts
		from the associated population increase would be approximately 23,600 gallons per day (89,336 liters per day) per day. Just as for Alternative 1, the Northern District WWTP is currently unable to meet the new secondary treatment discharge limits. Through use of fiscal year 2014 Consolidated Appropriations Act funding, repairs and improvements to the Northern District WWTP and wastewater collection systems are anticipated to bring the treatment plant into compliance. Overall, THAAD-related operational activities under Alternative 2 would not have a significant impact on the existing utility and transportation infrastructure. The proposed expansion of the CDZ would not impose any additional impacts on utility or transportation systems.
	No Action	Under the No Action Alternative, the utilities and transportation-related impacts to date for the THAAD expeditionary mission (Alternative 1) would be the same. Removal of the THAAD battery, including temporary facilities and infrastructure, also would result in no significant impacts. On a longer-term basis, removal of the THAAD battery and the 200 mission support personnel from Guam would result in no effects from the return to THAAD pre-deployment conditions for utilities and transportation infrastructure.

Table ES-2. Summary of Cumulative Impacts

Resource	Alternative	Cumulative Impacts
Air Quality (Section 4.2.3.1)	Alternative 1	The proposed clearing and construction-related activities would generate air pollutant emissions that are temporary and typical for such activities; however, the cumulative emissions would not cause or contribute to a violation of any National Ambient Air Quality Standards or State Ambient Air Quality Standards and would represent a small percentage of the overall air emissions in Guam. Potential annual emissions from the generators are estimated to be below the PSD major source thresholds for all applicable pollutants. The THAAD installation would therefore require an appropriate Guam EPA Air Pollution Source Construction Permit, with review and approval required by the Guam EPA and USEPA, and a Title V operating permit because the potential emissions have been estimated at greater than 100 tpy for NO_X. Obtaining and operating within the conditions of these permits ensures the Guam State Implementation Plan is being followed and ambient air quality standards are being met. Thus, the proposed operational emissions when considered cumulatively with the other local projects would impose a less than significant, long-term adverse impact to air quality.
	Alternative 2	This alternative would result in cumulative impacts similar to that of Alternative 1.
	No Action	Impacts from removal of the THAAD battery under the No Action alternative would result in similar non-significant cumulative impacts during the removal of temporary facilities and demolition work. Following removal of the THAAD battery, there would be no long-term operational cumulative impacts from generator operations.
Water Resources (Section 4.2.3.2)	Alternative 1	No stormwater-related cumulative impacts are expected from the Proposed Action. Stormwater BMPs would be implemented for all construction and other ground disturbance areas. The approximate 200 THAAD personnel add to the cumulative demand of potable water from the NGLA, which could potential lead to increased salinity intrusions into the groundwater aquifer. THAAD Alternative 1 requirements do not include any new groundwater wells being installed or new potable water service connections for facilities and operations. To mitigate potentially adverse effects on groundwater usage, Andersen AFB and the DoD are making further improvements to the existing DoD water distribution systems on Guam to reduce system leaks. The DoD also would, as appropriate, adjust pumping rates at DoD wells if salinity (chloride) levels show an increase, and increase the use of surface water from Fena Reservoir to reduce overall withdrawals from the NGLA.
	Alternative 2	Just as for Alternative 1, Alternative 2 would not include any new groundwater wells being installed or new potable water service connections for facilities and operations. This alternative would require additional stormwater management actions, and increases the number of THAAD-related personnel and military dependents to a total of approximately 393; however, the overall cumulative impacts on water resources would be similar to that of Alternative 1.
	No Action	Removal of the THAAD battery and personnel from Guam would have no long-term cumulative impacts on water resources.

Resource	Alternative	Cumulative Impacts
Biological Resources (Section 4.2.3.3)	Alternative 1	No designated critical habitat would be affected. There would, however, be a cumulative loss of primary recovery habitat on NWF for several listed species (Micronesian kingfisher, Guam rail, Mariana crow, and Mariana fruit bat) when the Proposed Action is combined with the habitat loss required for the proposed U.S. Marine Corps (USMC) live-fire training range complex (LFTRC). Because sufficient recovery habitat would remain following the forest/scrub clearing actions, no significant cumulative impacts on these species would be expected. In addition, development of a fenced conservation area (approximately 121 acres [49 hectares] in size) adjacent to the THAAD emplacement site would, over time, increase the availability of habitat for some species.
	Alternative 2	This alternative would result in cumulative impacts similar to that of Alternative 1.
	No Action	Under the No Action Alternative, the THAAD emplacement site would be returned to near original conditions. Over time, there would be a beneficial effect to most native flora and fauna, including the special status species that occurred there, as forest vegetation returns to the approximately 35.7 acres (14.4 hectares) of disturbed land located outside of the original CDZ training area.
Airspace Management (Section 4.2.3.4)	Alternative 1	Under Alternative 1, the Letter of Agreement for the current THAAD TFR would need to be rewritten to include the USMC and account for the proposed SUA Restricted Area needed to operate the future LFTRC. Thus, no cumulative impacts would be expected.
	Alternative 2	For Alternative 2, operational impacts of THAAD would combine with operational impacts from the proposed LFTRC, resulting in minor long-term beneficial cumulative impacts. The proposed Restricted Area, R-XXXX, that would be used for THAAD would encompass the USMC proposed Restricted Area for the LFTRC. This action would result in one SUA Restricted Area that meets the needs of both THAAD and LFTRC.
	No Action	Under the No Action Alternative, there would be no long-term cumulative impacts from THAAD mission-related airspace restrictions. The THAAD radar would cease operations and the current TFR would be removed. Prior CDZ-related operations at NWF would no longer be encumbered. The proposed LFTRC would still require a SUA, but that area would not include the additional Restricted Area required for THAAD radar operations.
Utilities and Transportation Infrastructure (Section 4.2.3.5)	Alternative 1	Alternative 1 is not expected to result in significant cumulative impacts on utilities and roadway use. The THAAD Alternative 1 requirements do not include any new service connections for sewer or potable water. All THAAD personnel have been placed in existing installation housing already permitted for sewer and water. Additionally, portable latrines provided at the THAAD battery site require periodic emptying by contractors, with the sewage then taken to one of the existing WWTPs on Guam in a position for accepting and treating the wastes. The approximate 200 THAAD personnel add to the cumulative demand for wastewater collection and treatment at the Northern District WWTP, which is currently unable to meet the new secondary treatment discharge limits of the 2013 NPDES permit. Any additional strain on the existing system could cause increases in sanitary sewer overflows, which then could potentially have an adverse effect on near-shore waters. The fiscal year 2014 Consolidated Appropriations Act (Public Law No. 113-76), provides funding for civilian water and wastewater improvements on Guam and is expected to include repairs and improvements to the Northern District WWTP and wastewater collection systems. Such improvements are anticipated to bring the WWTP into compliance.

Resource	Alternative	Cumulative Impacts
	Alternative 2	This alternative increases the number of THAAD-related personnel and military dependents to a total of approximately 393; however, the overall cumulative impacts on utilities and roadway use, including wastewater treatment, would be similar to that of Alternative 1.
	No Action	Removal of the THAAD battery and personnel from Guam would have no long-term cumulative impacts on utilities and transportation infrastructure.

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ENVIRONMENTAL ASSESSMENT FOR TERMINAL HIGH-ALTITUDE AREA DEFENSE (THAAD) PERMANENT STATIONING IN GUAM

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ACRONYMS AND ABBREVIATIONS

µg/m^3	micrograms per cubic meter
AAMDC	Army Air and Missile Defense Command
ACM	asbestos-containing material
AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AGL	above ground level
AMDTF	Air and Missile Defense Task Force
ARSTRAT	Army Forces Strategic Command
AST	aboveground storage tank
ATC	air traffic control
BA	Biological Assessment
BMP	best management practice
CAA	Clean Air Act
CD	compact disc
CDZ	cargo drop zone
CEQ	Council on Environmental Quality
CERAP	Center Radar Approach
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNMI	Commonwealth of the Northern Mariana Islands
CO	carbon monoxide
CO_2	carbon dioxide
CRE	Cultural Resource Evaluation
CZMA	Coastal Zone Management Act
dBA	A-weighted decibel
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DoN	Department of the Navy
EA	Environmental Assessment
ECF	Entry Control Facility
EIS	Environmental Impact Statement
EMR	electromagnetic radiation
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
ESQD	Explosive Safety Quantity Distance
FAA	Federal Aviation Administration
FDC	Fire Direction Center
FEIS	Final Environmental Impact Statement
FL	flight level
FNSI	Finding of No Significant Impact
FR	Federal Register
GBSP	Guam Bureau of Statistics and Plans
GCMP	Guam Coastal Management Program
GHG	greenhouse gas
GHMP	Guam Hazard Mitigation Plan
GMP	Guam Master Plan
GWA	Guam Waterworks Authority
HAER	Historic American Engineering Record
HAP	hazardous air pollutants
HMMP	Hazardous Material Management Process
HWMP	Hazardous Waste Management Plan
IBD	Inhabited Building Distance
IRP	Installation Restoration Program
IT/COMM	information technology/communications
JGPO	Joint Guam Program Office
JP-8	Jet Propellant-8
JRM	Joint Region Marianas
kW	kilowatt(s)
LBP	lead-based paint
LFTRC	live-fire training range complex
LID	low-impact development
LOA	letter of authorization
mg/m^3	milligrams per cubic meter

MMRP	Military Munitions Response Program
MOU	memorandum of understanding
MSA	Munitions Storage Area
msl	mean sea level
MW	megawatt(s)
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NGLA	Northern Guam Lens Aquifer
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NOA	Notice of Availability
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New Source Review
NWF	Northwest Field
O_3	ozone
PACAF	Pacific Air Forces
Pb	lead
PCB	polychlorinated biphenyl
pCi/L	picocuries per liter
PM_{10}	particulate matter with an aerodynamic size less than or equal to 10 microns
$PM_{2.5}$	particulate matter with an aerodynamic size less than or equal to 2.5 microns
POL	petroleum, oil, and lubricant
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
ROI	Region of Influence
SCC	Security Control Center
SFC	surface
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SLAMRAAM	Surface-Launched Advanced Medium-Range Air-to-Air Missile
SO_2	sulfur dioxide
SOP	standard operating procedure
SPCC	Spill Prevention, Control, and Countermeasure
SUA	special use airspace
SWPPP	Stormwater Pollution Prevention Plan
TEMF	Tactical Equipment Maintenance Facility
TFR	Temporary Flight Restriction
THAAD	Terminal High-Altitude Area Defense
TOC	total organic compounds
tpy	tons per year
TSCA	Toxic Substances Control Act
UFC	United Facilities Criteria
U.S.	United States
USAF	United States Air Force
USMC	United States Marine Corps
USASMDC	United States Army Space and Missile Defense Command
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UXO	unexploded ordnance
VOC	volatile organic compound
WWTP	Wastewater Treatment Plant

1. Purpose and Need for Proposed Action

1.1 Introduction

National defense is exclusively the function of the Federal government, as Article II of the United States (U.S.) Constitution establishes the President as the "Commander in Chief of the Army and Navy of the United States…." and Article IV requires the Federal government to protect the nation. Article IV, Section 4, states that "The United States shall guarantee to every State in this Union a republican form of government, and shall protect each of them against invasion..." This authority was codified by Congress in Title 10 of the United States Code (U.S.C.), *Armed Forces*. Pursuant to the inherent authority to protect the nation, a decision was made by the National Command Authority to deploy a Terminal High-Altitude Area Defense (THAAD) ballistic missile defense battery to Guam to protect the homeland of the United States from an immediate and emergent threat of a missile attack from North Korea. In accordance with Title 10 U.S.C., the U.S. Secretary of Defense directed the U.S. Army in early April 2013 to deploy the THAAD battery to Guam immediately on an emergency basis as a precautionary move to strengthen the U.S. regional defense posture against the North Korean missile threat.

Under the command of the 94th Army Air and Missile Defense Command (AAMDC), the emergent mission for the expeditionary (temporary) placement and operation of a THAAD battery in Guam began on April 25, 2013. Due to the continuation of existing and emerging missile threats by potentially hostile states, the Department of Defense (DoD) has determined a need for the enduring presence of a THAAD battery on Guam to meet the requirements of Title 10 U.S.C. by providing homeland defense against these types of threats. In response, the DoD is proposing the permanent stationing of a THAAD battery on Northwest Field (NWF) at Andersen Air Force Base (AFB) on the northern end of Guam (**Figure 1-1**).

The emergency deployment of the THAAD battery on NWF required occupation of the same runway area used by Andersen AFB for personnel and cargo parachute drop training. The THAAD encumbrance of the current cargo drop zone (CDZ) training area prevents such training from occurring at NWF. As a result, CDZ training and related military exercises are being conducted at other less suitable DoD facilities in the region, which has resulted in joint training deficiencies. In order to restore critical cargo drop training capability on NWF, the 94th AAMDC, in cooperation with 36th Wing at Andersen AFB, is also proposing to expand the current CDZ. This would allow a shifting of previous training operations from the area occupied by the THAAD emplacement to an adjacent, unencumbered site on NWF. Although unrelated to the THAAD mission, this expansion of the CDZ training area represents a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam.

In support of the 94th AAMDC, the U.S. Army Space and Missile Defense Command (USASMDC)/Army Forces Strategic Command (ARSTRAT) determined that an Environmental Assessment (EA) is required to assess the potential environmental effects that may arise from the permanent stationing of the THAAD battery in Guam and from the expansion of the Andersen AFB CDZ on NWF. This Environmental Assessment (EA) documents the environmental and socioeconomic analysis of the Proposed Action and was prepared in compliance with the National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq., as amended); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (Title 40 Code of Federal Regulations [CFR] Parts 1500–1508, July 1, 1986); and the U.S. Department of the Army Procedures for Implementing NEPA (32 CFR Part 651).

Figure 1-1. Guam Location Map

1.2 Background

1.2.1 Deployment of the THAAD System to Guam

In response to the evolving security environment in the Pacific region and through a series of negotiations with the Government of Japan, a realignment initiative was developed in 2006 to relocate a portion of the U.S. forces from Okinawa to Guam. This initiative is described in the document *U.S.-Japan Roadmap for Realignment Implementation* (U.S.-Japan Security Consultative Committee 2006). To support the build-up of U.S. forces on the island of Guam, the U.S. Joint Guam Program Office (JGPO) prepared the Final Environmental Impact Statement (FEIS) for the *Guam and CNMI Military Relocation; Relocating Marines from Okinawa; Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force*, which was completed in 2010 (JGPO 2010). The FEIS Record of Decision (ROD) (77 Federal Register [FR] 60438-60440, September 30, 2010) documented the U.S. Department of the Navy (DoN) and U.S. Department of the Army decisions to implement the following actions:

- **Relocate a portion of U.S. Marine Corps (USMC) forces from Okinawa, Japan, to Guam.** This action involved the development and construction of facilities and infrastructure to support approximately 8,600 Marines and their 9,000 dependents, along with the development and construction of facilities and infrastructure to support training and operations. The DoN elected to defer selection of a specific site for the construction and operation of a live-fire training range complex pending further studies and consultations.[1]
- **Construct a new deep-draft wharf with shore side infrastructure.** The proposed waterfront improvements would allow a transient aircraft carrier to berth within Apra Harbor for extended visits to Guam. The DoN elected to defer selection of a specific site for the construction and operation of a transient aircraft carrier berth within Apra Harbor for the near term. The analysis presented in the FEIS provided sufficient information to allow the DoN to make a programmatic decision to locate a transient aircraft carrier berth generally within Apra Harbor.
- **Establish and operate an Air and Missile Defense Task Force (AMDTF).** Although the FEIS included an AMDTF Preferred Alternative to protect against the threat of missile attacks on Guam, the DoD elected in the ROD to defer the decision to deploy a missile defense component. The Preferred Alternative included the development of facilities and infrastructure to permanently station and operate an AMDTF containing three missile components: the THAAD system, Patriot Missiles, and the Surface-Launched Advanced Medium-Range Air-to-Air Missile (SLAMRAAM). It also included the relocation of approximately 750 military and civilian personnel, and 950 service member dependents, to Guam.
- **Implement utility and roadway improvements.** To support the increased demand associated with the growth in DoD and civilian populations caused by the buildup of U.S. forces, additional capacity for power, water, and wastewater systems would be added on and off the installation. Improvements also would be made to off-installation roads, bridges, and intersections to better accommodate the increased traffic.

At the time of the issuance of the ROD in September 2010, the DoD had not yet decided to establish and operate an AMDTF on Guam. The ROD noted that the decision regarding whether to assign this mission

[1] In 2012, the DoD adopted a new posture in the Pacific providing for a smaller and reconfigured force in Guam. Current plans now call for the relocation of approximately 5,000 Marines with approximately 1,300 dependents from Okinawa to Guam. The revised facility and infrastructure requirements for the cantonment and family housing, along with changes to proposed training and operation requirements, are described and analyzed in the Draft Supplemental Environmental Impact Statement (EIS) for the *Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments)* (JGPO 2014).

to the Army would be made pending the results of ongoing regional and global Ballistic Missile Defense architecture and capability studies. The decision would also be based in part on the 2010 FEIS with Guam as one site under consideration for an AMDTF mission.

In the early months of 2013, the DoD deployed a THAAD ballistic missile defense system to Guam as a precautionary move to strengthen the U.S. regional defense posture against the emergent North Korean regional ballistic missile threat. The DoD's order to the U.S. Army to deploy an expeditionary THAAD system immediately to Guam precluded preconstruction surveys and consultation with regulatory agencies. Further, because the requirement was commenced as a result of an emergent threat, the Executive responsibility to protect the homeland obviated the need for traditional NEPA analysis prior to the emergency deployment.[2] While this emergency action was not addressed in the 2010 FEIS, the associated FEIS planning and analysis helped guide decision makers in deploying the THAAD battery at its current emplacement location, which falls within the general area of the AMDTF Preferred Alternative identified in the 2010 document. The THAAD system emplacement is just one of several AMDTF components analyzed in Volume 5 of the 2010 FEIS (JGPO 2010).

Since the temporary deployment of the THAAD battery in 2013, the DoD validated the enduring requirement for a THAAD battery in Guam to ensure continued defense of the homeland as mandated in Title 10 of the U.S.C. The U.S. Army proposes to satisfy this requirement by permanently stationing a THAAD battery in Guam at NWF. The current THAAD battery emplacement and the proposal for permanent stationing require several site modifications, facility and infrastructure improvements, and added airspace restrictions for long-term system operations. Additionally, while the emergency deployment did not allow for ground clearing best management practices (BMPs) to mitigate potential impacts on terrestrial resources, this EA describes the actions and analyzes the after-the-fact effects of the 2013 expeditionary (temporary) placement and operation of the THAAD battery in Guam, along with the proposed modifications and improvements required for long-term system operations.

1.2.2 Cargo Parachute Drop Training at Andersen AFB

Title 10 of the U.S.C. provides for each of the Services to be organized, trained and equipped. Military training, also called readiness training, must be as realistic as possible to provide the experiences so important to success and survival. NWF provides a variety of training venues including realistic unimproved expeditionary runways, landing zones, and CDZs to practice austere location cargo and personnel delivery methods. Prior to the emergency emplacement of the Army's THAAD battery, the NWF South Runway area served as Andersen AFB's key asset for the C-130 and C-17 aircraft assault landing-departure zone, monthly Contingency Response Group Exercises, Contingency Response Group Assessment Team training, and quarterly multi-national exercises, which involve extensive personnel and cargo parachute operations (airborne training). The establishment of the NWF CDZ for these critical activities was previously analyzed in the 2000 *Environmental Assessment: Andersen Air Force Base Cargo Parachute Drop Zone* (USAF 2000); hereafter referred to as the CDZ EA.

The THAAD battery currently occupies a portion of the NWF South Runway and the southern edge of the CDZ. Since deployment of the battery in April 2013, the airborne training activities and exercises have been moved to other locations, primarily Tinian North Field and the Andersen AFB main runway. Both of these sites are less suitable, and the use of these alternative sites has negatively impacted other airfield activities and missions. At the Andersen AFB main runway, for example, normal aircraft operations cannot be conducted simultaneously with parachute drop training because of safety considerations on the

[2] U.S. Army regulations for NEPA implementation (32 CFR § 651.11[b]) state that "In the event of an emergency, the Army will, as necessary, take immediate actions that have environmental impacts, such as those to promote national defense or security or to protect life or property, without the specific documentation and procedural requirements of other sections of this part."

ground and within nearby airspace. At Tinian North Field, parachute drop training and other contingency response training conflicts with the approach to Saipan International Airport, and thus does not meet training requirements due to commercial air safety concerns. Additionally, the shifting of some aircraft training operations to the Orote Point Airfield and parachute training to a civilian drop zone on Guam also has resulted in use conflicts.

To address these operational deficiencies and compensate for the loss of use of the CDZ training area on NWF now encumbered by THAAD operations, the 94th AAMDC, in cooperation with 36th Wing, proposes to expand the area used for the CDZ. Expansion of the CDZ on NWF would involve the same purpose and need for the training site previously analyzed in the CDZ EA (USAF 2000). Most training activities and landing zone exercises utilizing the cleared CDZ would merely shift from the NWF South Runway to the North Runway. The types and frequency of airborne training activities and exercises conducted at the site, as previously analyzed in the CDZ EA, are not expected to change. Thus, this EA only analyzes the environmental effects of vegetation clearing and other site improvements required to expand the CDZ training area on NWF. Although unrelated to the THAAD mission, expansion of the CDZ represents a secondary, connected action to the THAAD battery emplacement and its long-term operation.

1.3 Purpose of the Proposed Action

Under Title 10 of the U.S.C., the DoD has a mandate to protect the U.S. homeland against impending threats, whether foreign or domestic. In accordance with Title 10 U.S.C., the purpose of the Proposed Action is to provide long term protection for Guam residents and the U.S. forces in Guam from the threat of ballistic missile attacks. The Proposed Action would be accomplished through the permanent stationing of the THAAD battery in Guam, including facility and infrastructure improvements and added airspace restrictions that support system operations and personnel requirements.

As part of the Proposed Action, expanding the existing NWF CDZ on Andersen AFB would restore critical CDZ training capability that was hampered by the emergency placement of the THAAD battery and its proposed permanent stationing. The expanded CDZ would be used to support various military units in the region requiring airborne training.

1.4 Need for the Proposed Action

Guam is a critically important U.S. military hub in the Pacific region. Current DoD programming assures its continuation as a strategic location for forward deployment of U.S. military assets in the western Pacific. Because of existing and emerging missile threats in the region, the U.S. Army has determined that permanent stationing of the THAAD battery in Guam is needed to fulfill a vital role in protecting Guam residents and the U.S forces based there from potential ballistic missile attacks. The long-term placement and operation of a THAAD battery in Guam would provide the U.S. Pacific Command with a proven ground-based ballistic missile defense capability and a flexible option for deterring hostile actions in the region.

Restoring cargo drop training capability on NWF is needed in order to eliminate conflicts with normal flight operations conducted at Andersen AFB and with the approaches to Saipan International Airport caused by the relocation of airborne training operations to the Andersen AFB main runway and Tinian North Field. It would also enhance airborne training operations by allowing both personnel and cargo parachute drop operations to occur at one location, while minimizing transportation and other logistical support requirements.

1.5 Interagency Coordination, Consultations, and Decisionmaking Responsibilities

Interagency coordination is integral to the NEPA process and to the preparation of this EA. As part of the analysis process, the 94th AAMDC closely coordinated with various agencies to ensure that the Proposed Action would fully comply with applicable Federal, state, local, and DoD regulatory and statutory requirements.

1.5.1 Cooperating Agencies

The following Federal agencies—having either jurisdiction or technical expertise for certain components of the Proposed Action or for a potentially affected resource—have accepted the 94th AAMDC's invitation to participate as cooperating agencies (40 CFR § 1501.6) (refer to **Appendix A** for relevant correspondence) in the preparation of this EA:

- Department of the Air Force (Andersen AFB)
- DoN (JGPO/Joint Region Marianas [JRM])
- Federal Aviation Administration (FAA)

For the Department of the Air Force, the 36th Wing at Andersen AFB oversees the activities and operations occurring on the installation, including NWF. In support of the Proposed Action, the 36th Wing is working with the U.S. Army on the proposed expansion of the existing CDZ on NWF now encumbered by THAAD operations.

Within the DoN, the JRM provides executive level installation management support to all DoD components and tenants through assigned regional installations on Guam and the Northern Mariana Islands, including Andersen AFB. Part of JRM's support to the installations is to ensure compliance with all applicable environmental laws and regulations. Also within the DoN, the JGPO has the lead to coordinate planning efforts among the DoD and other stakeholders to consolidate, optimize, and integrate the existing DoD infrastructure capabilities on Guam. The JGPO is the action proponent for the EIS process covering the rebasing of USMC assets from Okinawa to Guam (JGPO 2010, 2014).

The FAA is assigned responsibilities pursuant to 49 USC 40101 et seq., for civil aviation and regulation of air commerce in the interests of aviation safety and efficiency. The FAA is a cooperating agency on this EA, in accordance with 40 CFR § 1501.6(a)(1), since it has special expertise and jurisdiction by law to approve proposed special use airspace (SUA) for the THAAD mission in Guam. As a cooperating agency on this project, FAA will use the EA documentation to comply with its own requirements under NEPA.

1.5.2 Agency Consultations and Coordination

Consultations with the U.S. Fish and Wildlife Service (USFWS)

Beginning in May 2013, representatives from the JRM entered into consultation discussions with the USFWS on Guam because of the potential environmental effects from the emergency deployment of the THAAD system at Andersen AFB that began in April 2013. In addition to a site visit by the USFWS to the THAAD expeditionary emplacement at NWF on May 30, 2013, the JRM corresponded with the USFWS in August 2013 and February 2014 to clarify and determine the status of the emergency consultation process.

In early September 2014, the USASMDC/ARSTRAT (on behalf of the 94th AAMDC) met with the USFWS on Guam to discuss the expeditionary deployment of the THAAD battery on NWF, proposed permanent stationing and operation of the battery, and plans for consultation on this project in accordance

with Section 7 of the Endangered Species Act (ESA). Also in September 2014, the U.S. Air Force (USAF) submitted a Biological Assessment (BA) to the USFWS that described the effects of modifying the existing CDZ training area on listed species and species proposed for listing, and requested re-initiation of Section 7 formal consultation (Andersen AFB 2014a). The USFWS responded in October 2014 and concurred that the proposed CZM modifications were not likely to adversely affect the Guam rail or Mariana fruit bat, and requesting additional information about effects to recovery habitat for the Mariana crow and Guam Micronesian kingfisher.

Because the proposed CDZ modification (expansion) represents a secondary, connected action to the THAAD mission in Guam, the 94th AAMDC (with 36th Wing and USASMDC/ARSTRAT support) made the decision in November 2014 to prepare a single BA to support three separate but related consultations: (1) consultation on the emergency deployment and expeditionary operation of the THAAD battery, (2) consultation and conference on proposed modifications and improvements for permanent stationing and long-term system operations of the THAAD battery, and (3) consultation and conference on the proposed expansion of the CDZ. The BA was prepared because of the potential for these actions to affect federally listed species, proposed species, and designated critical habitats. The 94th AAMDC submitted the BA to the USFWS on March 30, 2015 with a request for concurrence of the conclusions in the document regarding potential effects on listed and proposed species (see correspondence in **Appendix A**).

Consultations with the Guam State Historic Preservation Office (SHPO)

In September 2014, the USASMDC/ARSTRAT (on behalf of the 94th AAMDC) entered into pre-consultation discussions with the Guam SHPO. The USASMDC/ARSTRAT met with the agency to discuss the potential effects of the THAAD expeditionary deployment and the proposed permanent stationing of the battery on historic resources at Andersen AFB. From these discussions and through the preparation of this EA, it was determined that the emplacement of the THAAD system, along with expansion of the CDZ, potentially would have adverse effects to historic properties as defined by Section 106 of the National Historic Preservation Act (NHPA). In particular, the THAAD battery would be within the boundaries of the NWF site, a World War II-era airfield determined eligible for listing in the National Register of Historic Places (NRHP).

The 94th AAMDC and USASMDC/ARSTRAT expect that Section 106 consultation may be needed due to the NRHP-eligible status of NWF and the potential for adverse effects to NWF and other historic properties. As part of coordination, the USASMDC/ARSTRAT submitted a request for assistance to the SHPO in October 2014, followed by an updated request for assistance in January 2015 to identify previously recorded historic properties in and near the project area. The request for assistance also serves as an informal notification that the 94th AAMDC and USASMDC/ARSTRAT may enter into Section 106 consultation with the SHPO.

In support of consultations, the 94th AAMDC prepared a Cultural Resource Evaluation (CRE) to document the potential for adverse effects on historic properties, as specified by 36 CFR 800.11(e). The 94th AAMDC submitted the CRE to the Guam SHPO in early April 2015 to formally initiate Section 106 consultations. The Guam SHPO responded on May 5, 2015 in a letter that specified steps to avoid, minimize, and mitigate potential adverse effects to cultural resources (see relevant correspondence in **Appendix A**). Currently, the 94th AAMDC is in the process of responding to the Guam SHPO with an outline of specific measures in accord with the SHPO request. These measures are described in **Section 4.1.5** of this EA.

Coordination for Consistency with the Guam Coastal Management Program (GCMP)

The entire island of Guam has been designated a "coastal zone" under the Federal Coastal Zone Management Act (CZMA) of 1972. The CZMA requires that all construction and operational activities be

consistent, to the maximum extent practicable, with the GCMP policies to guide the use, protection, and development of land and ocean resources within Guam's coastal zone (GBSP 2011).

In accordance with the CZMA, the 94th AAMDC (with USASMDC/ARSTRAT support) will coordinate with the Guam Bureau of Statistics and Plans (GBSP) to ensure the Proposed Action is consistent with the policies of the GCMP. Because the Proposed Action is expected to comply with all applicable GCMP policies, the 94th AAMDC will prepare and submit a CZMA Consistency Determination to the GBSP requesting their review and concurrence.

1.5.3 Federal and Guam Agency Decisionmaking Responsibilities

This section summarizes agency decisionmaking responsibilities associated with the Proposed Action.

- **Federal Aviation Administration (FAA).** Approval of the proposed establishment of SUA in Guam in accordance with FAA Joint Order 7400.2, *Procedures for Handling Airspace Matters*.
- **U.S. Fish and Wildlife Service (USFWS).** Consultation under Section 7 of Endangered Species Act for potential adverse effects on special status species.
- **U.S. Environmental Protection Agency (USEPA).** Air emissions permitting for THAAD system equipment in accordance with Federal regulations under the Clean Air Act.
- **Guam Historic Preservation Office (Guam SHPO).** Consultation under Section 106 of the National Historic Preservation Act for potential adverse effects on historical, archaeological, and traditional cultural resources.
- **Guam Environmental Protection Agency (Guam EPA).** Stormwater management permitting and plan approval, as appropriate, in accordance with Guam regulations and policies. Also, air emissions permitting for THAAD system equipment in accordance with Federal and state regulations under the Clean Air Act.
- **Guam Bureau of Statistics and Plans (GBSP).** Review of the Proposed Action for consistency with the enforceable policies of the GCMP and Federal consistency regulations under 15 CFR Part 930.

1.6 Public Notification and Review

In accordance with the CEQ and DoD regulations for implementing NEPA, the 94th AAMDC is soliciting comments on this EA and the Draft Finding of No Significant Impact (FNSI) from interested and affected parties. A Notice of Availability (NOA) for the EA and Draft FNSI will be published in the following newspapers.

- *Pacific Daily News* (Guam)
- *Marianas Variety* (CNMI).

Copies of the EA and Draft FNSI were placed in local repositories for public access and are available over the Internet at http://www.THAADGuamEA.com. Those agencies, organizations, and repositories that were directly notified about the NOA or received a copy of the document are listed in **Chapter 8**. Comments on the EA and Draft FNSI can be submitted on the project website at http://www.THAADGuamEA.com or mailed to the following address:

U.S. Army Space and Missile Defense Command/Army Forces Strategic Command
Attention: SMDC-ENE (Mark Hubbs)
Post Office Box 1500
Huntsville, AL 35807-3801

As identified in the published NOA, the 94th AAMDC will hold two public information meetings near Andersen AFB, Guam, to explain the scope of the Proposed Action and describe the potential environmental consequences that may arise from its implementation. Written comments on the EA and Draft FNSI will also be accepted at the meetings.

Following the public review period (as specified in the newspaper notice), the 94th AAMDC will decide whether to sign the FNSI, which would allow the Proposed Action to be implemented, or to prepare an EIS. If the 94th AAMDC decides to sign the FNSI, the Final EA will include both the written comments (i.e., letters and electronic messages received) and their resolutions. Availability of the Final EA and the signed FNSI will be publicized in the newspapers listed earlier and the document will be accessible on the Internet at http://www.THAADGuamEA.com.

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2. Description of Proposed Action and Alternatives

2.1 Proposed Action

The Proposed Action evaluated in this EA is to maintain the THAAD battery permanently in Guam. The current battery has been operating as an expeditionary (temporary) mission at Andersen AFB since its deployment in April 2013. In order to maintain an enduring THAAD battery presence in Guam, two alternatives are considered under the Proposed Action. Alternative 1 would involve a continuation of the THAAD battery expeditionary mission at its current location on NWF with minimal site improvements or changes in operations. Under this alternative, CDZ training and related military exercises—conducted on the NWF South Runway prior to the THAAD encumbrance—would continue to occur at other DoD facilities in the region. Under Alternative 2, the Preferred Alternative, the U.S. Army would permanently station the THAAD battery at its current location by implementing facility and infrastructure improvements, and added airspace restrictions, to support long-term system operations and personnel requirements. As part of Alternative 2, the 94th AAMDC, in collaboration with the 36th Wing, would expand the existing CDZ to include the NWF North Runway so as to restore critical CDZ training capability on Andersen AFB.

For analysis purposes, the descriptions of Alternatives 1 and 2 presented in this section include the activities that occurred during the emergency deployment and subsequent adaptations of the THAAD system, along with proposed modifications and improvements for long-term system operations, all in relation to the AMDTF Preferred Alternative identified in the 2010 FEIS (JGPO 2010) and summarized in **Section 2.3** of this EA.

Although the proposed AMDTF described and analyzed in the 2010 FEIS included a combination of THAAD and other defensive weapon systems, only the action of maintaining a THAAD system in Guam is analyzed under the Proposed Action in this EA. Should the DoD and the U.S. Army decide to deploy other defensive weapon systems to Guam in the future, supplemental NEPA analyses beyond this EA would be prepared as necessary.

2.1.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

In April 2013, a THAAD battery was deployed to Guam on an emergency basis in response to potential North Korean missile launch activity. As of the date of this EA, the THAAD battery is still in place at Andersen AFB and operating as an expeditionary (temporary) mission. Under Alternative 1, the THAAD battery would continue to operate indefinitely at its current location on NWF with minimal site improvements.

Because the THAAD battery currently encumbers the CDZ and use of the NWF South Runway, the airborne training activities and exercises that previously occurred there would continue operations elsewhere in the region, primarily at Tinian North Field and the Andersen AFB main runway. The environmental effects of conducting airborne training at Tinian North Field and the Andersen AFB main runway were previously analyzed in the Draft EIS/Overseas EIS for *Mariana Islands Training and Testing Activities* (DoN 2013b) and are not further discussed in this EA.

2.1.1.1 Current Facilities Configuration

On Andersen AFB, the THAAD battery (equipment and support facilities) was placed at NWF in an area surrounding the east end of the North and South Runways. The site is partly located within the area previously identified as the Preferred Alternative for weapons emplacement in the 2010 FEIS. A variance to the 2010 proposed location, however, was required to adjust to current threats and physical security

requirements. The basic components that make up the THAAD system are described below. A conceptual configuration of the THAAD battery and related support equipment is shown in **Figure 2-1**.

- *Fire Control and Communication* – This system component exercises direct control and management of the missile battery, providing the human interface of the automated system functions.
- *Radar Unit* – The radar provides a broad range of surveillance services that perform target search, acquisition, identification, and tracking functions.
- *Interceptor* – The interceptor missile intercepts an incoming hostile missile threat.
- *Launch Platform/Fire Unit* – The truck-mounted launchers transport, aim, and launch the interceptor missiles. The THAAD launcher carries a missile round pallet that contains up to eight missiles.

During the initial deployment of the expeditionary THAAD system in April 2013, a 237.4-acre (96.1-hectare) emplacement area was occupied by Task Force Talon (**Figure 2-2**). Prior to the deployment, approximately 145.4 acres (58.84 hectares) of the emplacement area between and to the east of the NWF runways were maintained as low, mixed herbaceous scrub for safe operation and use of the CDZ training area. An additional 68.3 acres (27.6 hectares) are paved runways, taxiways, and other developed land. The remaining 35.7 acres (14.4 hectares) of limestone forest and perennial scrub were cleared of all vegetation using heavy equipment operated by the U.S. Army 84th Engineer Battalion. These areas were grubbed and graded, and the tree and other vegetation debris piled around the site perimeter. In addition to emplacement of the expeditionary THAAD battery, temporary fencing was placed around the site and temporary wooden guard towers were erected within the cleared areas. Within the emplacement site, temporary gravel roads were graded along the fence line in order to provide adequate vehicular access.

For THAAD equipment maintenance and storage, a motor pool was established south of the emplacement area opposite Area 50[3] on an additional 12.0 acres (4.9 hectares) of existing pavement (**Figure 2-2**). No activities or disturbances occurred within Area 50. Within the motor pool, one office container (8 feet [2.4 meters] × 40 feet [12.2 meters]), one portable AirBeam shelter (40 feet [12.2 meters] × 56 feet [17.1 meters]), and other storage containers were installed. Other existing buildings within the Andersen AFB cantonment area have been repurposed to support the THAAD battery and mission-related personnel. The old base post office, for example, serves as headquarter for Task Force Talon and existing billeting (Tinian Hall) provides housing for the task force's soldiers. Additionally, for munitions storage, the THAAD mission is using existing bunkers located in the Munitions Storage Area (MSA) 1 just south of the motor pool. No changes to existing Explosives Safety Quantity Distance (ESQD) arcs are required.

Within the cleared emplacement area, additional changes were made in 2014 for improved system operations during the expeditionary mission. These changes have included compressing the THAAD emplacement perimeter into an 82.0-acre (33.2-hectare) area to allow for improved operational flexibility. The boundary for this compressed expeditionary emplacement falls entirely within the original expeditionary emplacement area and is also shown on **Figure 2-2**. Within the new fence line, additional temporary wooden guard towers have been erected.

To provide a more stable foundation for the primary THAAD equipment, several individual concrete pads have been added for the launchers and radar placement, for a total pad area of approximate 28,200 square feet (2,620 square meters). Additional grading within the compressed expeditionary emplacement area was required prior to constructing some of these pads. No other clearing or construction is proposed under this alternative.

[3] Area 50 was fenced in 1991-1992 for conservation of and research on threatened and endangered species.

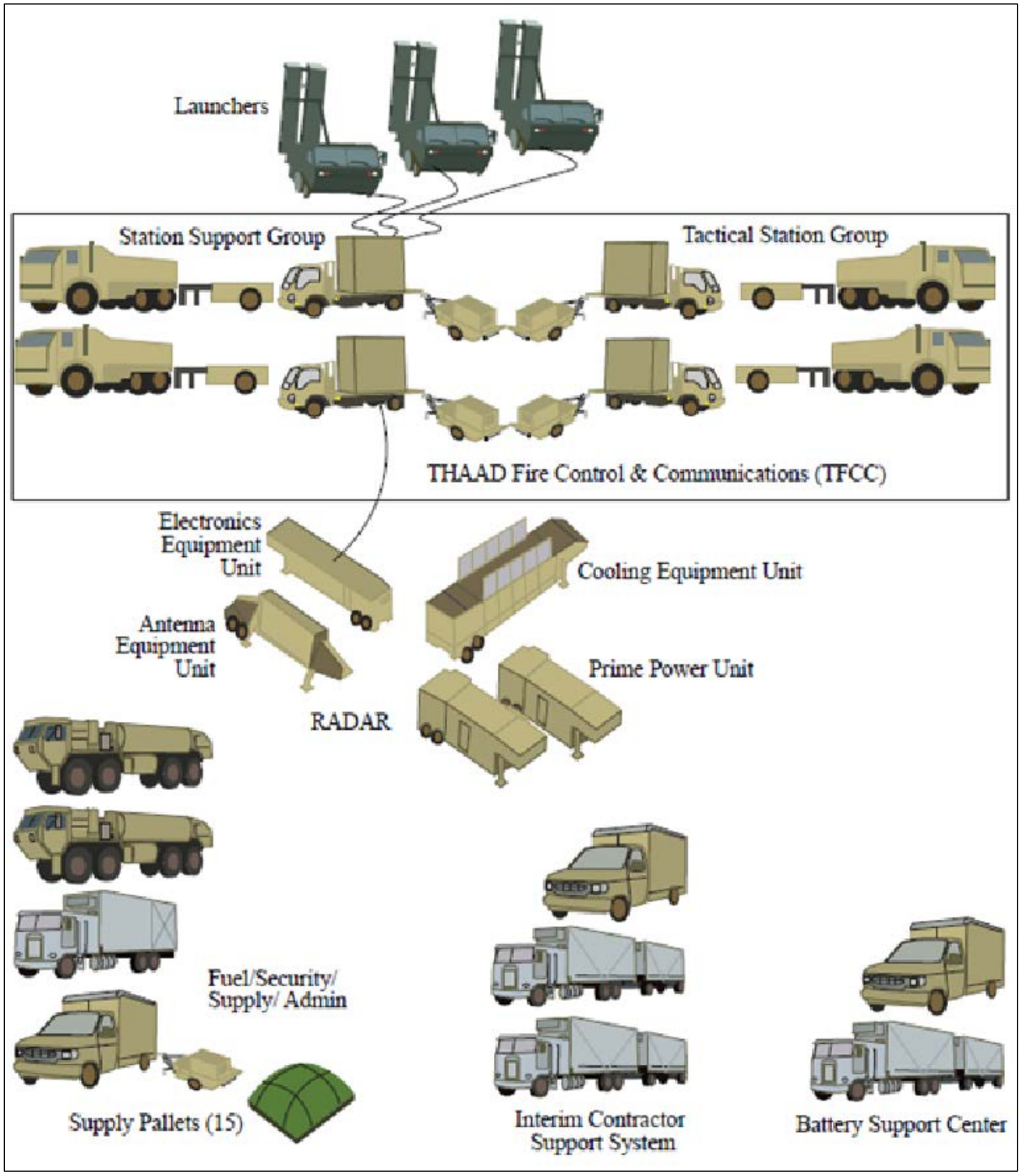

Figure 2-1. THAAD Conceptual Configuration

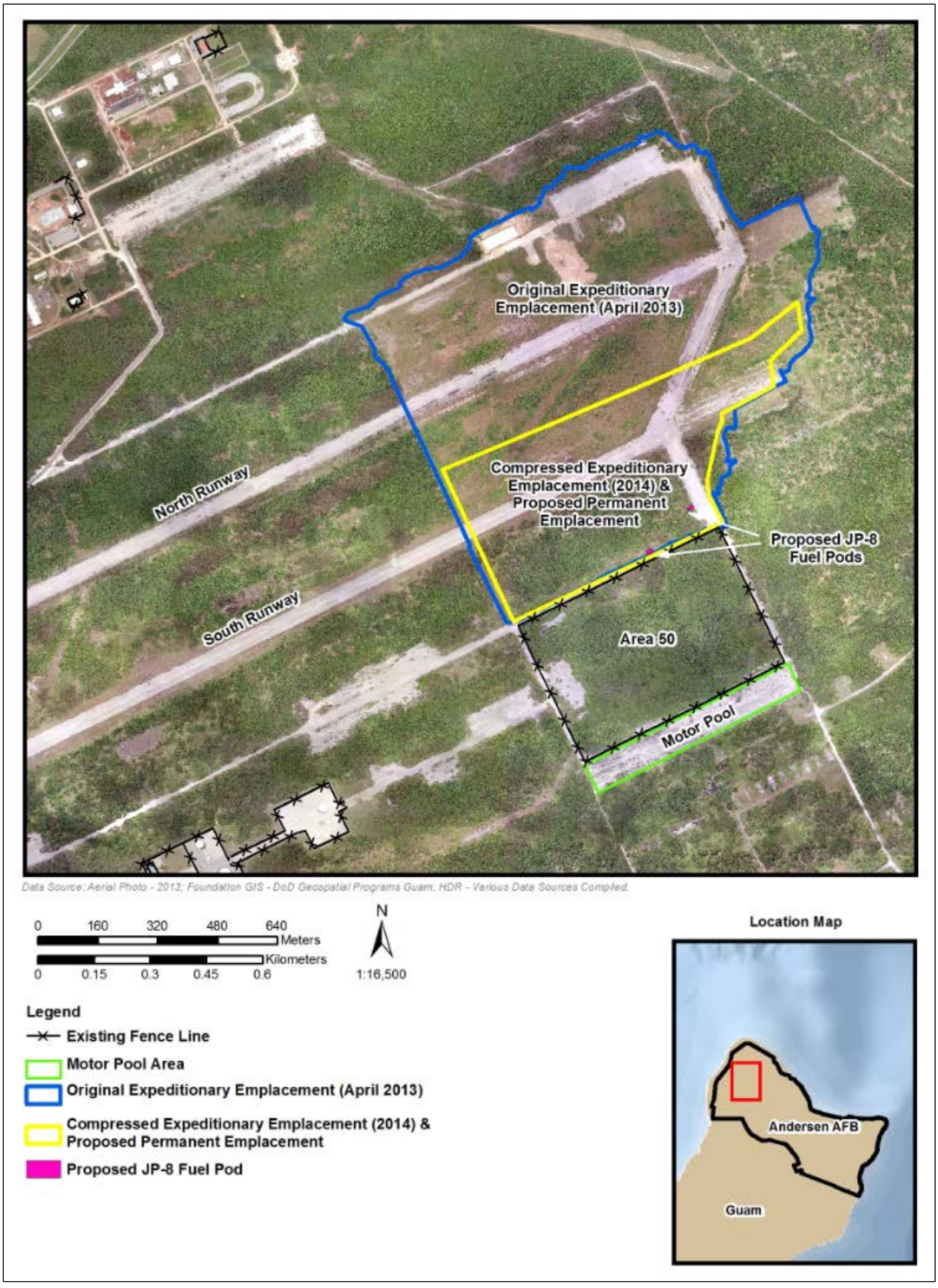

Figure 2-2. Original and Compressed Expeditionary Emplacement of the THAAD System

2.1.1.2 Ongoing Operations

Approximately 190 military and 10 civilian support personnel originally were originally deployed in support of the expeditionary THAAD mission. The personnel are housed in military transient quarters on Andersen AFB and are deployed on a rotational basis with each rotation lasting from several months to a year or more. Current expeditionary operations consist of radar surveillance, facility security, routine facility and equipment maintenance, and battle drills (i.e., computer simulations that do not include missiles being launched). Operations are in shifts, which include a mix of approximately 60 contract personnel, military police, and soldiers out of the 200 personnel that were deployed. Government vehicles are used to travel to and from the battery site.

Just as for the original expeditionary emplacement, all areas within and along the outer fence line of the compressed expeditionary emplacement area require periodic mowing for security purposes; approximately once a week during the rainy season and less often during the dry season. In some instances, approved selective and non-selective herbicides (such as glyphosate) are being used to control vegetation growth in areas that are inaccessible to mowing equipment. All herbicide applications are being conducted in accordance with the installation's Pest Management Plan (Andersen AFB 2014b).

Equipment associated with the current THAAD expeditionary emplacement at NWF has included several generator sets ranging from 3 kilowatts (kW) to 1.3 megawatts (MW), several powered light sets, three 3,000-gallon (11,356-liter) jet propellant-8 (JP-8) fuelers on spill containment systems with spill kits, satellite communications and other command center support equipment, patrol vehicles, and contractor operated portable latrines. The generators run continuously to provide power to the weapons system, temperature control systems, lights, computers, and motor pool.

For improved power generation efficiency at the THAAD battery site, most of the system's tactical generators would be replaced with fewer and more efficient portable generators ranging from 420 kW to 1.3 MW. To improve fuel storage requirements for the generators, two 10,000-gallon (37,854-liter) JP-8 above-ground fuel pods would be placed on site (see **Figure 2-2**) and a grounding grid installed. Each pod would be double walled with built-in spill sensors. All power distribution at the emplacement site would continue to be via above-ground cables and conduits.

Wastes generated per quarter as a result of THAAD motor pool operations include approximately 450 gallons (1,703 liters) of used petroleum, oil, and lubricants (POLs), ten 55-gallon (208-liter) drums of combined solid waste (oily rags/oil filters/fuel filters), and 50 gallons (189 liters) of contaminated (used) coolant. The POLs and combined solid waste drums are destined for recycling or disposal as non-hazardous wastes. The contaminated coolant, however, is managed as a hazardous waste. On rare occasions, THAAD equipment maintenance operations have the potential to generate up to 400 gallons (1,514 liters) of contaminated coolant at one time. All hazardous and non-hazardous wastes are collected by a contractor and disposed of in accordance with installation regulations and BMPs.

Operation of the THAAD battery requires the following exclusion zones along +/- 90 degrees of the axis of orientation of the THAAD radar system to avoid injury to personnel and damage to equipment from electromagnetic radiation (EMR) emitted from that radar: 328 feet (100 meters) for personnel, 1,640 feet (500 meters) for equipment, and 3.4 miles (5.5 kilometers) for aircraft. An earthen berm in front of the radar further reduces the ground-level EMR exposure risks. For aircraft, a Temporary Flight Restriction (TFR) was established for the THAAD expeditionary mission starting in April 2013. The airspace coordination procedures for this flight restriction were documented in a Letter of Agreement between the Army, USAF, FAA, and Guam Air Route Traffic Control Center. Under Alternative 1, the TFR would continue to be used during THAAD radar operations.

2.1.2 Alternative 2 (Preferred Alternative): THAAD System Permanent Stationing and Cargo Drop Zone Expansion

Under Alternative 2, permanently stationing the THAAD battery at NWF would require various site improvements and operational changes made to the current expeditionary mission. These actions are described in detail in the subsections that follow. Without repeating prior discussions, Alternative 2 incorporates those expeditionary-related actions and activities that have already occurred under Alternative 1 and described in **Section 2.1.1**.

As a secondary, connected action to permanently stationing the THAAD battery, the 94th AAMDC, in collaboration with the 36th Wing, also would expand the existing CDZ to include the NWF North Runway and areas that are adjacent. This expansion would allow previous airborne training activities to shift from the South Runway to the adjacent North Runway and restore CDZ training capability at NWF. As part of Alternative 2, a description of the vegetation clearing requirements and other site improvements for the expanded CDZ is included in the discussions that follow. Because the airborne training activities and exercises at NWF would not change from those originally analyzed in the CDZ EA (USAF 2000), personnel and cargo parachute operations are not further described or analyzed as part of Alternative 2 with the exception of the noise impacts discussed in **Section 4.1.2**. For discussions on potential cumulative effects from combined THAAD and CDZ operations, refer to **Section 4.2** in this EA.

2.1.2.1 THAAD Facility Requirements and Site Improvements

For the permanent stationing of the THAAD battery at NWF, the following facility and site improvements would be needed to meet operational and security protection requirements. The site improvement projects are expected to begin in 2015 and most should be completed before the end of 2016.

- **Dual Perimeter Chain-link Security Fences.** Along the western, northern, and eastern perimeters of the proposed permanent emplacement site (same area as the compressed expeditionary emplacement), two security fences would be installed, each approximately 7 feet (2.1 meters) tall and spaced approximately 30 feet (9.1 meters) apart (**Figure 2-3**). No new fences would be installed on the southern perimeter bordering Area 50. Intrusion detection systems would be installed along the fence line. Lighting systems that are shielded and facing downward would also be placed along the fence line.
- **Motor Pool Fence.** The motor pool and roadway along the eastern side of Area 50 would be secured by a single chain-link fence, approximately 7 feet (2.1 meters) tall, as shown on **Figure 2-3**. This new single fence would be separate from the dual perimeter fence securing the emplacement site.
- **Concrete Guard Towers.** The current temporary guard towers within the proposed permanent emplacement site would be replaced with four concrete guard towers measuring approximately 20 to 25 feet (6.1 to 7.6 meters) in height. The new towers would be designed to withstand a 170 knot typhoon and a seismic zone 4 earthquake.
- **Entry Control Facility (ECF).** As part of the perimeter security system, an ECF building would be constructed towards the western end of the motor pool to control entry to authorized personnel and vehicles. The one story building would measure approximately 160 square feet (14.9 square meters) in area.

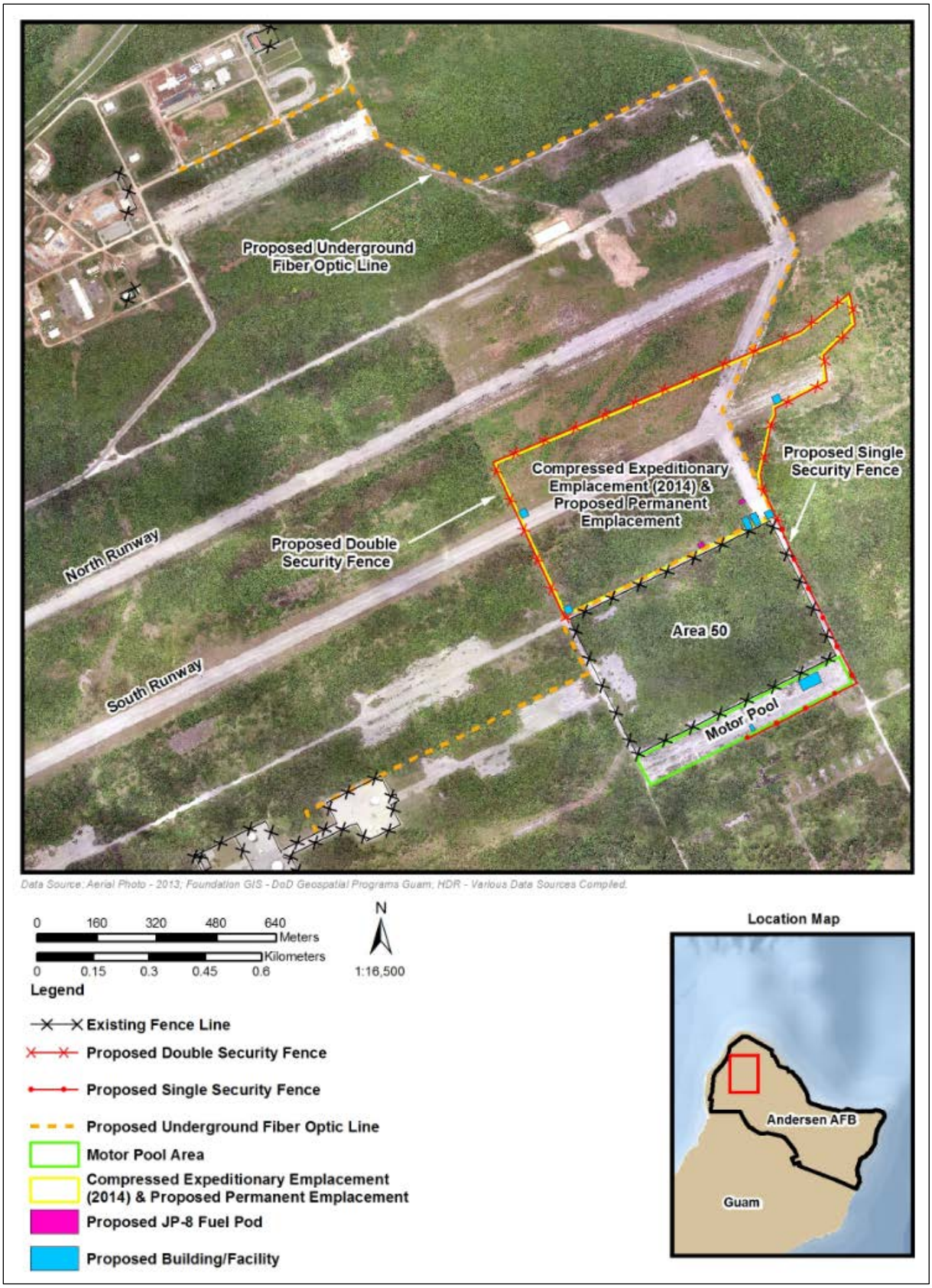

Figure 2-3. Proposed Permanent Emplacement of the THAAD System

- **Power Generators.** Just as for Alternative 1 (**Section 2.1.1.2**), permanent stationing and operation of the THAAD battery would require replacement of most of the current tactical generators with fewer and more efficient portable generators ranging from 420 kW to 1.3 MW, which would be needed to power the emplacement site at all times. To fuel the generators, two 10,000-gallon (37,854-liter) JP-8 above-ground fuel pods would be placed nearby (**Figure 2-3**) and a grounding grid installed. Each pod would be double walled with built-in spill sensors. All power generation at the emplacement site would continue to be distributed via above-ground cables and conduits.
- **Utilities.** A fiber optic communications line would be trenched from the Rapid Engineer Deployable Heavy Operational Repair Squadron Engineer (RED HORSE) Squadron installation on NWF to the emplacement site and other facilities just to the west (**Figure 2-3**). The communication line would be located along existing roadways, paved surfaces, or other previously disturbed areas wherever possible.
- **Giant Voice System.** The installation of a Giant Voice system (also referred to as Big Voice) would give the THAAD battery a means to warn personnel of an incoming missile attack or weather advisories. The system would include speakers mounted on a single pole and it would be linked to the phone system to announce warnings at the THAAD emplacement site. The system would be audible out to approximately 6,560 feet (2,000 meters).
- **Roadways.** Within the compressed expeditionary emplacement site, grading for additional gravel roads would occur in order to provide adequate vehicular access along the fence line. Additionally, pavement improvements to existing roadways leading to the site may be needed. All roadway improvements would be conducted within the existing emplacement area or within previously paved areas.
- **Fire Direction Center (FDC).** As part of permanent stationing, an FDC building for the THAAD battery would be constructed at the southern end of the current emplacement site for operations and administrative support. The single-story, reinforced concrete building would measure approximately 20 feet (6.1 meters) × 50 feet (15.2 meters) in size.
- **Communication Trough.** Between the THAAD radar and the FDC, a communication trough would be excavated to run cables. The trough would measure up to 4 feet (1.2 meters) deep and be constructed of concrete.
- **Drainage System.** To channel stormwater away from THAAD equipment at the southern end of the emplacement site, a combination of concrete drainage culverts and underground piping would be installed. The stormwater would be funneled to a ravine at the east side of the site. The drainage system also would include installation of an asphalt pad measuring approximately 12,800 square feet (1,190 square meters) in area located behind the radar to redirect stormwater towards the culvert and piping.
- **Security Control Center (SCC).** A new SCC building would be constructed at the southern end of the current emplacement site for security force use. The single-story, reinforced concrete building would measure approximately 20 feet (6.1 meters) × 50 feet (15.2 meters) in size.
- **Tactical Equipment Maintenance Facility (TEMF).** Within the next 3 to 5 years, the current AirBeam shelter in the motor pool area would be replaced with a permanent reinforced concrete, open bay warehouse building of larger size (measuring approximately 70 feet [21.3 meters] × 107 feet [32.6 meters] in area). The new TEMF would be used to provide space and equipment storage for maintaining THAAD mission-related vehicles and associated equipment for all levels of maintenance below depot level. Typical operations in the facility would include inspection, lubrication, preventive maintenance, diagnostic analysis, welding, and replacement of major components.

For permanent stationing of the THAAD battery, uneven terrain and piled debris within the proposed permanent emplacement area and along some perimeters would be leveled for improved security. Trenching along the corridor for the proposed fiber optic line would require clearing of an additional 2.3 acres (0.9 hectares) of forest and perennial scrub. There are no plans to clear or otherwise disturb additional native forest vegetation at the emplacement site, as the only additional disturbance would be on or adjacent to existing disturbed areas and along established roads, runways, or taxiways of NWF. It is expected that most earthwork activities would be conducted by military engineers located in the Pacific region. For facility construction, no more than 50 contractors would be on site at any one time.

For the long-term, permanent stationing of the THAAD battery on NWF, additional site improvements may be considered for mission support. For these future projects to be implemented, however, they would first require supplemental environmental analyses and consultations, as necessary, beyond this EA. Such future projects may include replacement of the site generator power with island commercial power, and bringing potable water and wastewater service lines to the emplacement site as a replacement for water being trucked to the site and the use of portable latrines.

2.1.2.2 Expansion of the Cargo Drop Zone Training Area

As part of Alternative 2, the 94th AAMDC, in collaboration with the 36th Wing, would expand the current CDZ that was evaluated for airborne training in the CDZ EA (USAF 2000) by shifting the drop zone assets from the NWF South Runway to the North Runway and adjacent areas (**Figure 2-4**). To comply with the USAF's runway design specifications for C-130 and C-17 aircraft assault landing zone exercises, all vegetation along both shoulders of the North Runway and within the west glide slope area of the runway would be cleared using heavy equipment operated by military engineers located in the Pacific region. Additional vegetation clearing would be needed north of the originally cleared CDZ and THAAD original expeditionary emplacement area. The combination of these areas to be cleared of forest and perennial scrub vegetation totals 53.2 acres (21.5 hectares) located outside of the original 248-acre (100-hectare) drop zone area evaluated in the CDZ EA. These areas would be grubbed and graded, and the tree and other vegetation debris piled around the cleared perimeters. It is estimated that it would take about 3 months to complete the vegetation removal.

Within the original CDZ boundary (**Figure 2-4**), there are some forests and perennial scrub areas that were not cleared of vegetation when the training area was established in 2001. Some of these forest/scrub areas—including a 22.4-acre (9.1-hectare) forest tract located north of the east glide slope in the northeast corner of the original CDZ—would now require clearing for the proposed shifted CDZ training area. Other smaller vegetated areas within the original CDZ also might need to be cleared. All of these areas to be cleared within the original CDZ boundary were previously analyzed in the CDZ EA (USAF 2000) and approved for vegetation clearing and airborne training activities.

In summary, a total of 53.2 acres (21.5 hectares) of forest and perennial scrub vegetation located outside of the original 248-acre (100-hectare) CDZ, and 22.4 acres (9.1-hectare) or more within the original CDZ evaluated in the CDZ EA (USAF 2000), would be cleared in order to utilize the NWF North Runway for landing zone exercises and establish the shifted CDZ training area. In addition to the vegetation clearing, pavement improvements to the North Runway and to existing roadways leading to the reconfigured CDZ site may be needed. All such improvements would be conducted within previously paved areas.

2.1.2.3 Long-Term Operations

Once the new THAAD facilities are constructed and other site improvements completed, daily operations and training activities for the THAAD battery are expected to be similar to that of the expeditionary mission described in **Section 2.1.1.2**. These activities would include vegetation maintenance within and

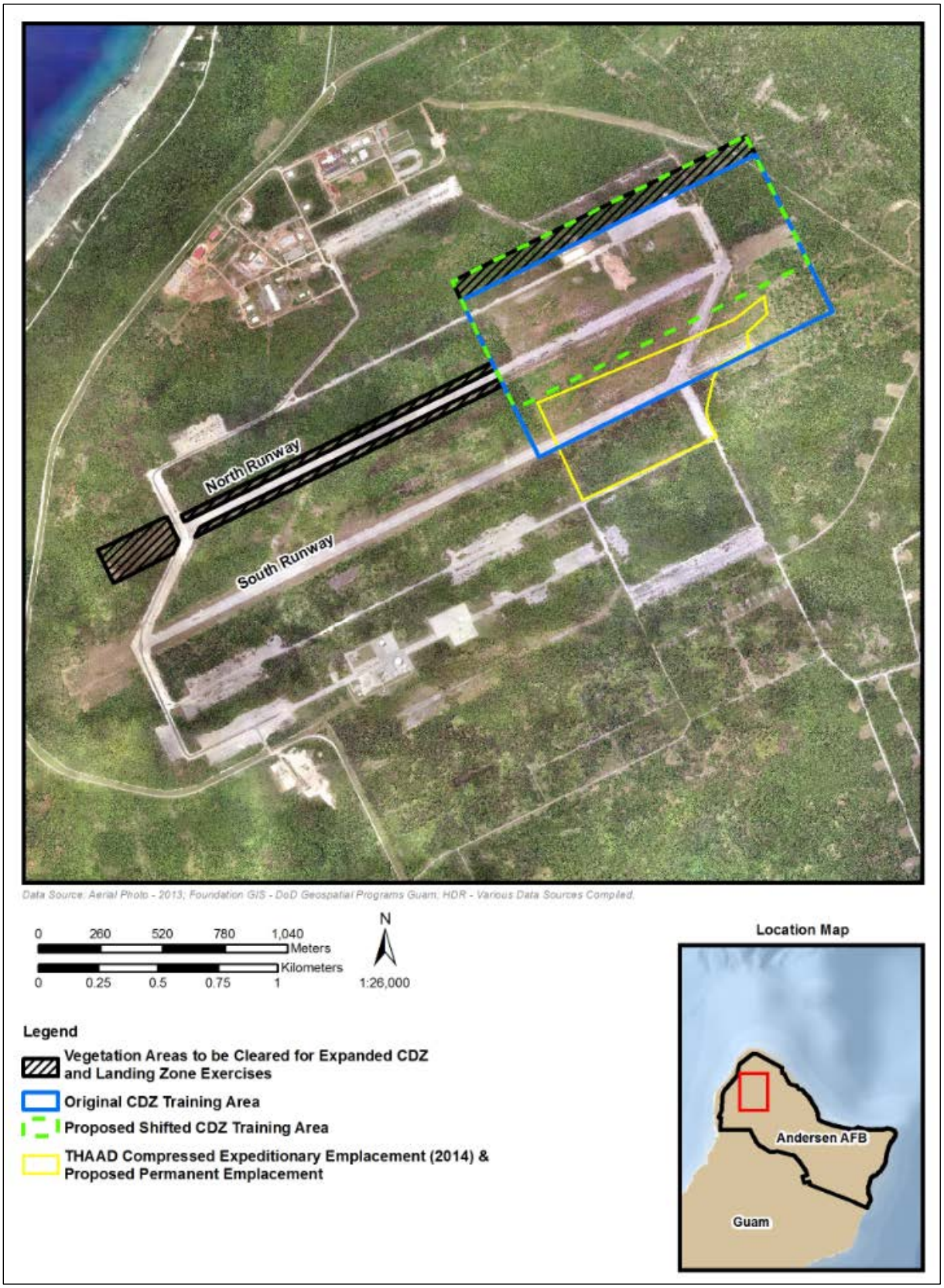

Figure 2-4. Proposed CDZ Expansion Areas

along the outer fence line of the proposed permanent emplacement site. Mowing would occur approximately once a week during the rainy season and less often during the dry season. Approved selective and non-selective herbicides (such as glyphosate) also would continue to be used to control vegetation growth in areas that are less accessible. All herbicide applications are conducted in accordance with the installation's Pest Management Plan (Andersen AFB 2014b). For the expanded CDZ at the NWF North Runway, similar vegetation maintenance activities would occur.

During permanent stationing, total THAAD personnel numbers would increase from the current 200 to approximately 225. In addition, all or most of the approximate 70 families (about 168 family member dependents of THAAD personnel) moving to Guam would be placed in existing or future JRM housing on the island (depending on when new housing becomes available). Required support facilities for military personnel and their dependents would be provided through the JRM installations on Guam. No additional facilities, beyond the facilities within the JRM quality of life support structure, have been identified.

To facilitate THAAD radar operations, the U.S. Army would request the FAA to establish an SUA Restricted Area to support permanent stationing of the THAAD battery. Restricted Areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature, or limitations imposed upon aircraft operations that are not a part of those activities, or both. Restricted Areas denote the existence of unusual, often invisible, hazards to aircraft (FAA 2014). The proposed Restricted Area, designated as R-XXXX, is shown on **Figure 2-5** and is described as follows:

- **Boundaries:** Beginning at coordinates 13º38'54"N/144º47'57"E; to 13º41'35"N/144º53'21"E; to 13º38'24"N/144º54'57"E; to 13º35'45"N/144º49'34"E; to the point of the beginning. The altitude would be from the surface up to 22,000 feet (6,706 meters) above mean sea level (msl), but minus altitudes from surface to 3,000 feet (914 meters) above ground level for the coordinates starting at 13°40'50"N/144°51'51"E; to 13°41'21"N/144°52'53"E; to 13°40'59"N/144°53'38"E; to 13°40'29"N/144°53'54"E; to 13°40'50"N/ 144°51'51"E; to the point of beginning.
- **Designated Altitudes:** Surface to 22,000 feet (6,706 meters) msl (FL220)
- **Time of Designation:** Continuous
- **Controlling Agency:** FAA, Guam Center Radar Approach Control (CERAP)
- **Using Agency:** U.S. Army

The general location of R-XXXX is similar to that of the Restricted Area originally proposed for the Army AMDTF Preferred Alternative that was analyzed in the 2010 FEIS (see **Figure 2-6**). The boundaries of R-XXXX, however, have been modified as a result of changes to the THAAD emplacement site layout, changes to ballistic missile threat risks, and to avoid overlap with an adjacent Restricted Area being developed by the USMC.

2.2 No Action Alternative

Pursuant to 40 CFR § 1502.14(d), the No Action Alternative is evaluated in this EA. Under No Action, the THAAD battery, including equipment and supporting personnel, would cease expeditionary operations on Guam. The associated equipment, temporary facilities, and infrastructure (including temporary fencing), would be removed from the current, compressed expeditionary emplacement site and motor pool area at NWF (**Figure 2-2**). The TFR that was established for radar operations would no longer be needed. The concrete pads built specifically for the expeditionary mission, a total of approximately

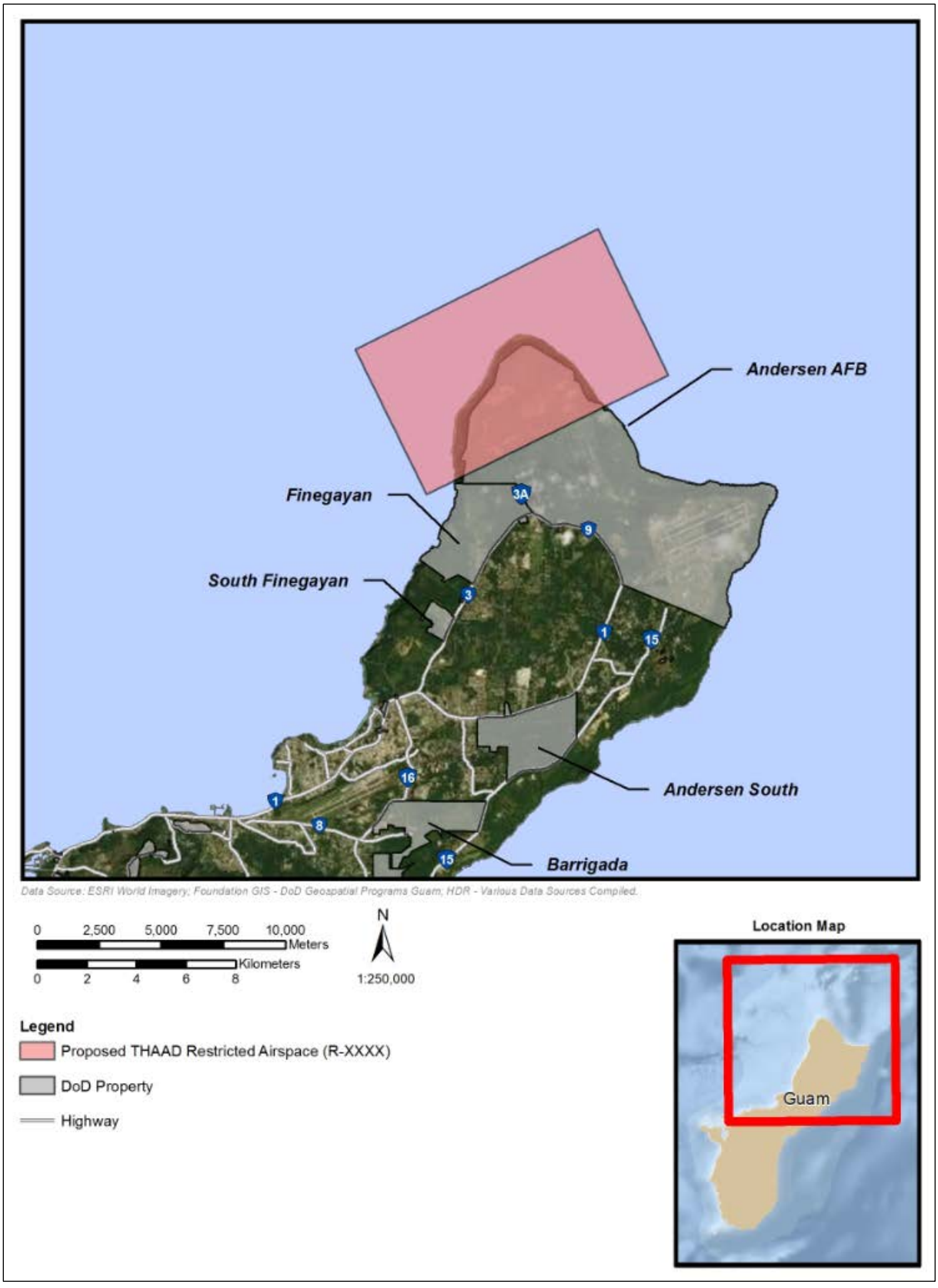

Figure 2-5. Proposed SUA Restricted Area R-XXXX

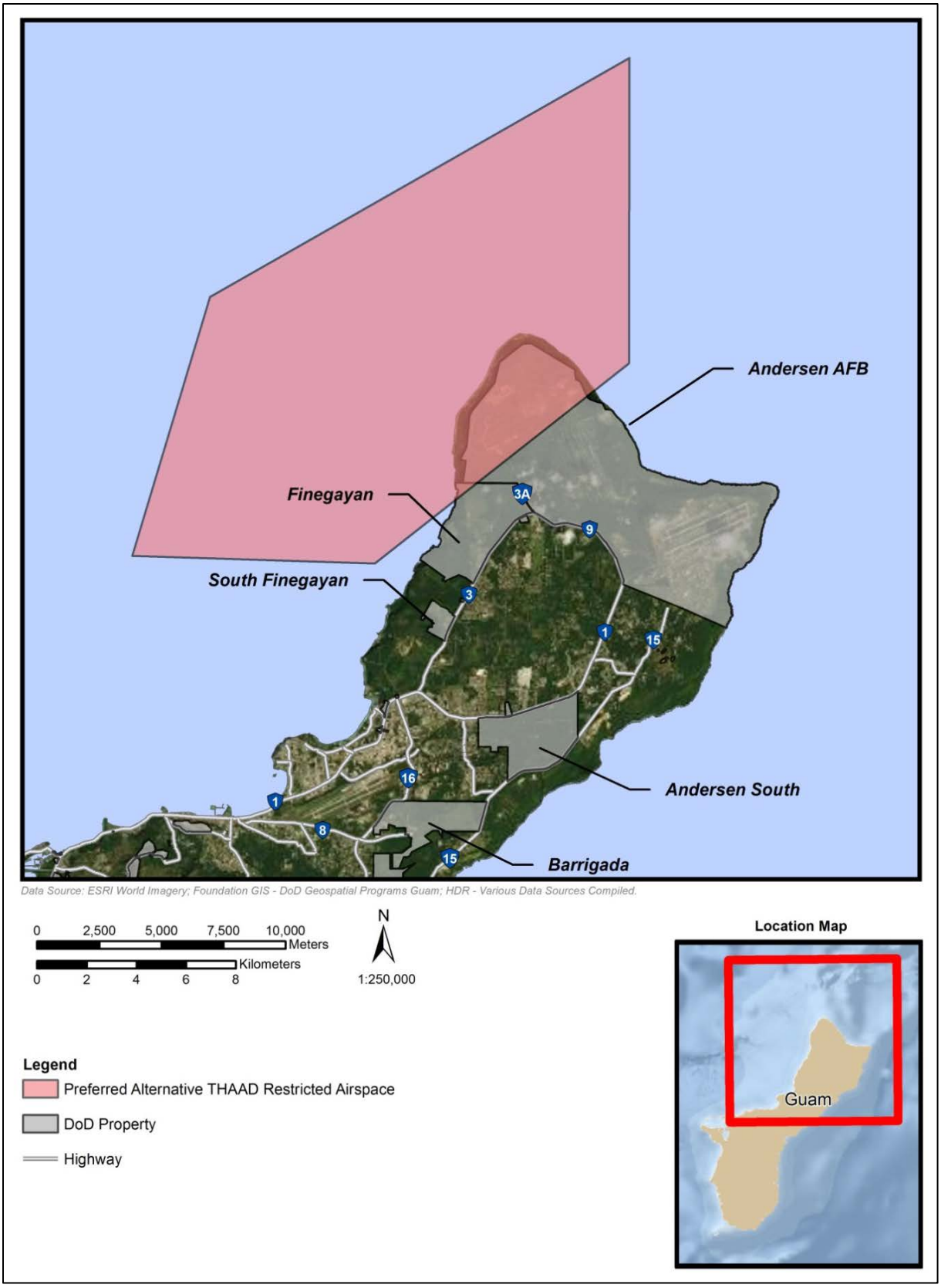

Figure 2-6. Army AMDTF Restricted Area Requirements

28,200 square feet (2,620 square meters), would be demolished and the waste concrete removed for proper disposal. In addition, the THAAD battery and associated 200 mission support personnel would be removed from Guam. With the removal of the THAAD battery from Guam, the DoD would be required to consider the need for the mission and how it may otherwise be accomplished.

The 35.7 acres (14.4 hectares) of limestone forest and perennial scrub that was previously cleared for the emplacement site, most of which was located between the NWF South Runway and Area 50, would be allowed to revegetate. Because of the THAAD expeditionary mission-related actions and activities that have already occurred, the No Action Alternative includes in its description those prior actions described under Alternative 1 without repeating the discussions provided in **Section 2.1.1**.

With the removal of THAAD battery operations from NWF, the existing CDZ would no longer be encumbered. Thus, airborne training operations would be able to resume at the NWF South Runway. Because the types and tempo of airborne training activities and exercises at NWF would not change from what was originally analyzed in the CDZ EA (USAF 2000), the impacts associated with operations are not further described or analyzed with the exception of noise, as discussed in **Section 4.1.2**.

2.3 Review of the 2010 Final Environmental Impact Statement Preferred Alternative for Permanent Stationing of an Army AMDTF

As mentioned in **Section 1.2.1**, the 2010 FEIS (JGPO 2010) included a Proposed Action to permanently establish and operate a land-based AMDTF in Guam. This section summarizes the Army AMDTF Preferred Alternative that was analyzed in the FEIS and compares it to the Proposed Action alternatives addressed in this EA. Although the proposed AMDTF included a combination of THAAD and other defensive weapon systems, only the action of maintaining a THAAD system in Guam is analyzed under the Proposed Action in this EA. Should the DoD and the U.S. Army decide to deploy other defensive weapon systems to Guam in the future, supplemental NEPA analyses beyond this EA would be prepared as necessary. The entire FEIS is accessible for download from the Internet at: *http://www.guambuildupeis.us/archived-documents*.

The proposed Army AMDTF, as analyzed in the 2010 FEIS, would have required the development of supporting facilities and infrastructure, and the relocation of Army and dependent personnel to Guam. The 2010 FEIS included several categories of facilities needed to support the AMDTF: (1) administration/headquarters and maintenance facilities, (2) munitions storage, (3) weapons emplacement sites, and (4) enlisted barracks, family housing, and quality of life facilities. The locations of the facilities proposed under the FEIS AMDTF Preferred Alternative are shown in **Figure 2-7**. As depicted in the figure, three emplacement sites for the THAAD and other defensive missile launchers and support facilities (i.e., a readiness building, personnel operations area, tractor pads, and parking areas) were proposed to be constructed in NWF. Under the FEIS Preferred Alternative, establishment of the emplacement sites in NWF would have required the clearing of nearly 190 acres (77 hectares) of forest habitat. Of the AMDTF alternatives that were evaluated in the 2010 FEIS for weapons emplacement, the FEIS Preferred Alternative involved the least amount of construction in previously undisturbed areas.

For AMDTF munitions storage, two proposed magazines would have been constructed within the Habitat Management Unit of Andersen AFB at the site of two existing magazines being used for inert munitions storage (**Figure 2-7**). A third magazine would have been built just east of the Habitat Management Unit next to the other new magazines. The two existing inert storage facilities would have required demolition prior to the new construction. The existing MSA 1 ESQD arcs would have been expanded approximately 400 feet (121.9 meters) to the north to accommodate the new munitions storage facilities. The proposed magazines would have been used to store Army missiles and provide storage for system launchers during inclement weather.

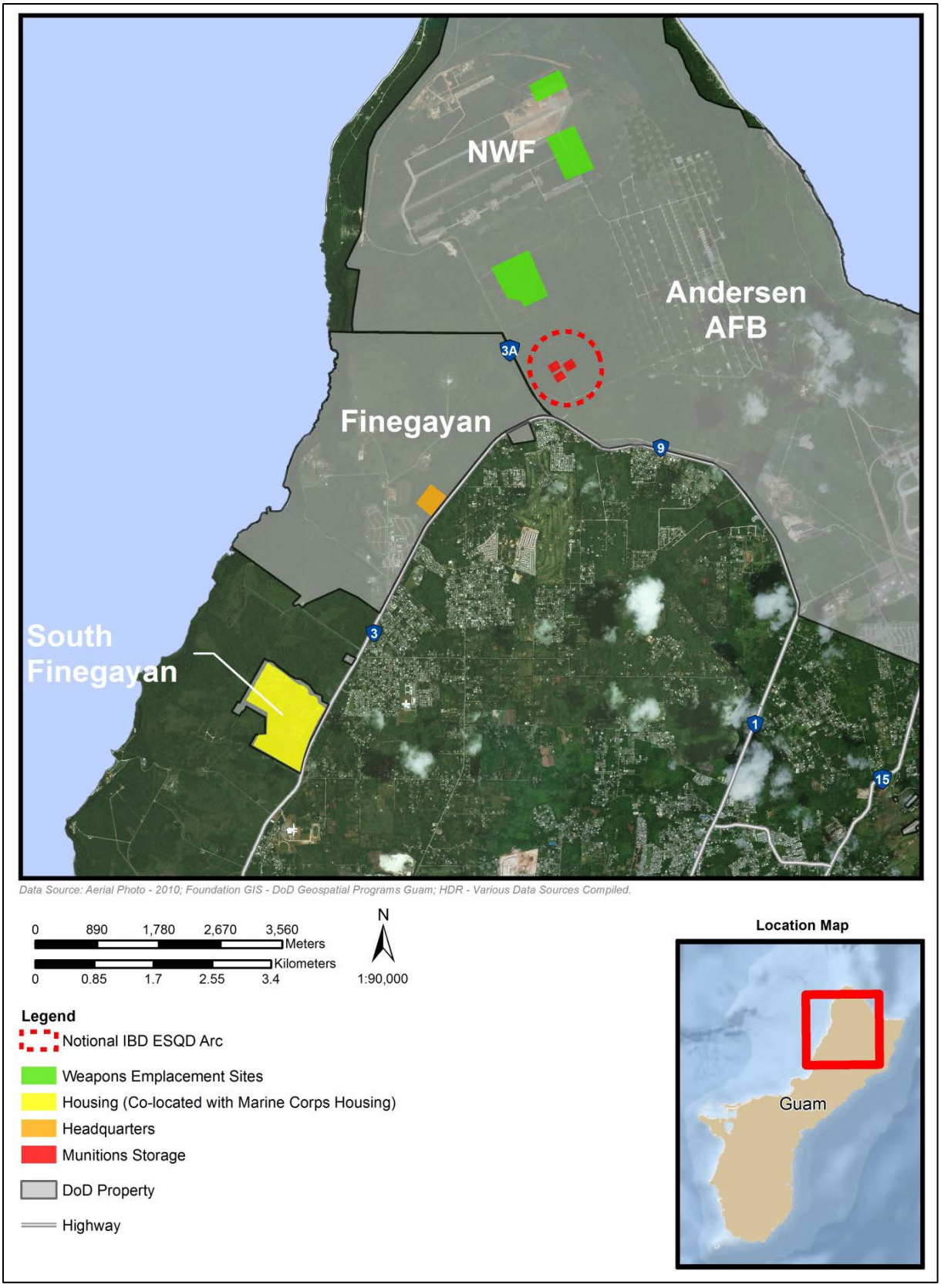

Figure 2-7. Army AMDTF Preferred Alternative Facility Locations

The proposed Army AMDTF would have required approximately 126 civilian personnel, 630 soldiers, and 950 Army service member dependents to be relocated to Guam. Enlisted barracks, family housing, and quality of life facilities would have been constructed to accommodate the increase in military personnel and their dependents (approximately 1,580 people). Under the Preferred Alternative, the housing and quality of life facilities would have been co-located with the USMC Main Cantonment housing areas in South Finegayan (**Figure 2-7**).

Operation of the AMDTF system radars would have posed a potential hazard to military and civilian aircraft. Therefore, a SUA Restricted Area would have been established along the northern end of Guam. The proposed Restricted Area would have ranged from the surface up to 22,000 feet (6,706 meters) above msl. The Restricted Area would have been activated in accordance with FAA approved airspace periods required for system maintenance, training, certification, and contingency operations. As depicted in **Figure 2-6**, the proposed boundary for the new SUA Restricted Area would have started at coordinates 13^{0}34'20"N/144^{0}43'00"E; to 13^{0}40'00"N/144^{0}44'41"E; to 13^{0}45'18"N/144^{0}54'00"E; to 13^{0}38'38"N/144^{0}54'03"E; to 13^{0}34'13"N/144^{0}48'25"E; and back to the point of beginning.

For comparison purposes, several key characteristics of the Army AMDTF Preferred Alternative in the FEIS are shown in **Table 2-1** along with the Proposed Action alternatives analyzed in this EA. As the numbers in the table show, the current Proposed Action alternative requirements for personnel, clearing of vegetation, and building/facility construction have been scaled back considerably from the 2010 FEIS proposal.

Table 2-1. Comparison of the Army AMDTF Preferred Alternative to the Proposed Action Alternatives

Characteristics	Proposed Action		Army AMDTF Preferred Alternative (2010 FEIS)
	Alternative 1	Alternative 2	
Defensive Weapon Systems	THAAD	THAAD	THAAD Patriot SLAMRAAM
New Personnel	190 military 10 civilian	225 military & civilian 168 dependents	630 military 126 civilian 950 dependents
Forest/Perennial Scrub Vegetation Clearing	35.7 acres (14.4 hectares) [1]	91.2 acres (36.9 hectares) [1]	189.3 acres (76.6 hectares)[2]
New Building/Facility Construction Footprint	28,200 square feet (2,620 square meters)	52,250 square feet (4,854 square meters)	230,080 square feet (21,375 square meters)
New Airspace Restrictions	Yes	Yes	Yes

[1] Includes clearing for the THAAD emplacement, fiber optic line, and CDZ expansion. Does not include acreage inside the original CDZ boundary that was cleared or would be cleared under the Proposed Action.

[2] Does not include the Army AMDTF headquarters and housing areas that would be co-located with the proposed USMC cantonment.

2.4 Alternatives Eliminated from Further Consideration

In addition to the AMDTF Preferred Alternative described in **Section 2.3**, sets of other alternative facilities and locations for each AMDTF component (i.e., headquarters/housing, munitions storage, and weapons emplacement) were presented and evaluated in Volume 5 of the 2010

FEIS (JGPO 2010). The entire FEIS is accessible for download from the Internet at: http://www.guambuildupeis.us/archived-documents. These other alternatives, which were not selected in the FEIS, are eliminated from further consideration in this EA. No other alternatives to the Proposed Action have been identified.

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3. Affected Environment

This chapter describes the environmental conditions in Guam that could be affected by the Proposed Action and No Action Alternatives. The information and data presented are commensurate with the importance of the potential impacts in order to provide the proper context for evaluating such impacts. Sources of data used and cited in the preparation of this chapter include the 2010 FEIS (JGPO 2010), other EAs and EISs, related environmental studies, installation and facility personnel, and regulatory agencies. Because the THAAD battery was initially deployed to Guam on an emergency basis in April 2013, the affected environment described in this chapter includes information on the conditions of the emplacement site prior to the expeditionary deployment.

Ten broad areas of environmental consideration were assessed during the preparation of this EA. These areas are air quality, noise, water resources, biological resources, cultural resources, airspace management, hazardous materials and wastes, human health and safety, socioeconomics, and utilities and transportation infrastructure. Three additional resource topics were not analyzed further for the following reasons: (1) impacts on geology and soil resources 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; (2) there would be no adverse effects on the use or ownership of land or submerged land because the proposed activities would occur entirely within Andersen AFB, would comply with installation master planning requirements, and would not affect land areas off the installation; and (3) the THAAD project area is on a plateau about 500 feet (152.4 meters) above sea level and more than 1.4 mile (2.3 kilometers) from the coast. No project activities would occur near the coast and lights at the THAAD site would not be visible from the shore. Project activities therefore have not and would not affect the coastal or marine environment, and related biological resources.

The information contained in this chapter serves as the baseline against which the predicted effects of the actions can be compared. The potential environmental effects of the Proposed Action and No Action Alternatives are discussed in **Chapter 4**.

3.1 Air Quality

Air quality is measured by the concentration of criteria pollutants in the atmosphere. The air quality in a region is a result not only of the types and quantities of atmospheric pollutants and pollutant sources in an area, but also surface topography, the size of the topological "air basin," and the prevailing meteorological conditions in that region.

National Ambient Air Quality Standards (NAAQS). The Clean Air Act (CAA), as amended, requires the USEPA to set NAAQS for pollutants considered harmful to public health and the environment. The USEPA characterizes ambient air quality in terms of compliance with the primary and secondary NAAQS. Primary NAAQS provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary NAAQS provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The USEPA has established NAAQS for six criteria pollutants:

- Carbon monoxide (CO)
- Lead (Pb)
- Nitrogen dioxide (NO_2)

- Ozone (O_3), which is represented as the precursor pollutants nitrogen oxides [NO_X] and volatile organic compounds [VOC]
- Sulfur dioxide (SO_2)
- Particulate matter (with an aerodynamic size less than or equal to 10 microns [PM_{10}] and with an aerodynamic size less than or equal to 2.5 microns [$PM_{2.5}$]).

States and territories may either adopt the NAAQS or establish their own more stringent standards.

Attainment Versus Nonattainment and General Conformity. The USEPA classifies the air quality in a region according to whether the concentrations of criteria pollutants in ambient air exceed the NAAQS. Areas are therefore designated as either "attainment," "nonattainment," "maintenance," or "unclassified" for each of the six criteria pollutants. Attainment means that the air quality is better than the NAAQS; nonattainment indicates that criteria pollutant levels exceed NAAQS; maintenance indicates that an area was previously designated nonattainment but is now attainment; and an unclassified air quality designation means that there is not enough information to appropriately classify an area, so the area is considered attainment.

The General Conformity Rule applies only to significant Federal actions in nonattainment or maintenance areas. This rule requires that any Federal action meet the requirements of a State Implementation Plan (SIP) or Federal Implementation Plan. More specifically, CAA conformity is ensured when a Federal action does not cause a new violation of the NAAQS; contribute to an increase in the frequency or severity of violations of NAAQS; or delay the timely attainment of any NAAQS, interim progress milestones, or other milestones toward achieving compliance with the NAAQS.

Federal Prevention of Significant Deterioration. Federal Prevention of Significant Deterioration (PSD) regulations apply in attainment areas to a major stationary source (i.e., source with the potential to emit 250 tons per year [tpy] of any regulated pollutant), and a significant modification to a major stationary source (i.e., change that adds 10 to 100 tpy to the major stationary source's potential to emit depending on the pollutant). Additional PSD major source and significant modification thresholds apply for GHGs, as discussed later for greenhouse gas emissions. Prevention of Significant Deterioration regulations also define ambient air increments, limiting the allowable increases to any area's baseline air contaminant concentrations, based on the area's class designation (40 CFR § 52.21[c]).

Title V and Other CAA Requirements. Title V of the CAA Amendments of 1990 requires states and local agencies to permit major stationary sources. A Title V major stationary source has the potential to emit regulated air pollutants and hazardous air pollutants (HAPs) at levels equal to or greater than Major Source Thresholds. Major Source Thresholds vary depending on the attainment status of an area. For Guam, the criteria pollutant thresholds are 100 tpy for CO, NO_X, VOC, $PM_{2.5}$, PM_{10}, and SO_2. The purpose of the Title V operating permit rule is to establish regulatory control over large, industrial-type activities and monitor their impact on air quality.

Section 111 of the CAA lists stationary source categories that are subject to new source performance standards if the applicable equipment is constructed, reconstructed, or modified after specified dates. Section 112 of the CAA lists HAPs and identifies stationary source categories that are subject to emissions control or work practice requirements.

Greenhouse Gas (GHG) Emissions. GHGs are gaseous emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Human-caused GHGs are produced primarily by the burning of fossil fuels and through industrial and biological processes.

There are no regulatory thresholds of significance for GHG emissions; however, the CEQ has released the *Revised Draft Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas*

Emissions and the Effects of Climate Change in NEPA Reviews (CEQ 2014), which suggests that 25,000 metric tpy of CO_2-equivalent is a meaningful reference point for when to consider GHG emissions in NEPA documentation. CO_2 emissions are provided in this EA for information and comparison purposes.

The regulation of GHG emissions under the PSD and Title V permitting programs was initiated by a USEPA rulemaking issued on June 3, 2010, known as the GHG Tailoring Rule (75 FR 31514). For GHG emissions to be regulated, a new source must trigger PSD permitting thresholds for a pollutant other than a GHG. The USEPA then would apply the PSD Best Available Control Technology requirements to the GHG emissions if their potential to emit is 75,000 tpy or greater. The 75,000 tpy GHG threshold would also apply to a PSD modification, if a PSD major modification is first triggered by a non-GHG pollutant.

Coastal Zone Management. As previously mentioned, the entire island of Guam has been designated a "coastal zone" under the CZMA. The GCMP's policy on air quality states that "all activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality." The GBSP is responsible for reviewing federally authorized projects for consistency with the GCMP.

3.1.1 Region of Influence

The (ROI) for air quality varies greatly depending on the pollutant. For criteria pollutants, the ROI is local, specifically the area surrounding NWF of Andersen AFB. For GHG, the ROI is the global atmosphere. Note also that the ROI for direct and indirect effects to air quality, and for the other nine resources described in this chapter, are not necessarily the same because of the different nature of effects to various types of resources and resource attributes.

3.1.2 Existing Conditions

As mentioned above, air quality is described by the concentration of various pollutants in the atmosphere. The significance of a pollutant concentration is determined by comparing the concentration in the atmosphere to applicable national, state, and/or territory ambient air quality standards. These standards represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety. **Table 3-1** lists the primary and secondary NAAQS and Guam ambient air quality standards.

The portion of Guam where the Proposed Action would occur is designated attainment/unclassifiable for all criteria pollutants (USEPA 2014). Because the General Conformity Rule applies only to significant Federal actions in nonattainment or maintenance areas, it is not applicable to this air quality analysis. Therefore, neither an applicability analysis nor a conformity determination is required.

Andersen AFB's potential to emit for each criteria pollutant is summarized in **Table 3-2**. The installation's potential to emit exceeds 250 tpy for two pollutants and is therefore a PSD major source. A facility emitting more than 250 tpy of any one criteria pollutant is classified as a major source of air pollution and its permit requires review and approval by both the Guam Environmental Protection Agency (Guam EPA) and the USEPA.

Andersen AFB holds a Title V Operating Permit (Permit Number FO-001) issued in November 2009 for a 5-year period. The current permit is in effect until the application for renewal (submitted to the Guam EPA) is approved or denied.

Table 3-1. National and Guam Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard
		Federal	Guam	
CO	8-hour (1)	9 ppm (10 mg/m^3)	Same as Federal	None
	1-hour (1)	35 ppm (40 mg/m^3)	Same as Federal	None
Pb	Rolling 3-Month Average (2)	0.15 µg/m^3 (3)	Same as Federal	Same as Primary
NO_2	Annual (4)	53 ppb (5)	Same as Federal	Same as Primary
	1-hour (6)	100 ppb	None	None
PM_{10}	24-hour (7)	150 µg/m^3	Same as Federal	Same as Primary
	Annual	None	50 µg/m^3	Same as Primary
$PM_{2.5}$	Annual (8)	12 µg/m^3	None	15 µg/m^3
	24-hour (6)	35 µg/m^3	None	Same as Primary
O_3	8-hour (9)	0.075 ppm (10)	None	Same as Primary
SO_2	1-hour (11)	75 ppb (12)	None	None
	3-hour (1)	None	None	0.5 ppm
	24-hour	None	365 µg/m^3	None
	Annual mean	None	80 µg/m^3	None

Sources: USEPA 2012a, Guam EPA 2014

Notes: Parenthetical values are approximate equivalent concentrations.

1. Not to be exceeded more than once per year.
2. Not to be exceeded.
3. Final rule signed October 15, 2008. The 1978 standard for Pb (1.5 µg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved. The USEPA designated areas for the new 2008 standard on November 8, 2011.
4. Annual mean.
5. The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of cleaner comparison to the 1-hour standard.
6. 98th percentile, averaged over 3 years.
7. Not to be exceeded more than once per year on average over 3 years.
8. Annual mean, averaged over 3 years.
9. Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
10. Final rule signed March 12, 2008. The 1997 O_3 standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, USEPA revoked the 1-hour O_3 standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour O_3 standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.
11. 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
12. Final rule signed June 2, 2010. The 1971 annual (0.3 ppm) and 24-hour (0.14 ppm) SO_2 standards were revoked in that same rulemaking. These standards, however, remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Key: ppm = parts per million; ppb = parts per billion; mg/m^3 = milligrams per cubic meter; µg/m^3 = micrograms per cubic meter

Table 3-2. Potential to Emit for Andersen AFB

	NO_X (tpy)	**VOC (tpy)**	**SO_2 (tpy)**	**PM_{10} (tpy)**	**CO (tpy)**	**Pb (tpy)**
Potential to Emit	801	47.5	525	49.6	184	0.000603

Source: Guam EPA 2009

Regarding GHGs, the most common GHGs emitted from human activities include carbon dioxide (CO_2), methane, and nitrous oxide; however, because CO_2 emissions account for approximately 92 percent of all energy-related GHG emissions in the United States, they are used for analyses of GHG emissions in this assessment. The U.S. Department of Energy, Energy Information Administration estimates that 2011 gross CO_2 emissions in Guam and the United States were 1 million metric ton and 5,491 million metric tons, respectively (U.S. EIA 2014).

3.2 Noise

Sound is defined as a particular auditory effect produced by a given source, for example the sound of rain on a rooftop. Noise and sound share the same physical aspects, but noise is considered a disturbance while sound is defined as an auditory effect. Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies. It can be readily identifiable or generally nondescript. Human response to increased sound levels varies according to the source type, characteristics of the sound source, distance between source and receptor, receptor sensitivity, and time of day. How an individual responds to the sound source will determine if the sound is viewed as music to one's ears or as annoying noise. Affected receptors are specific (e.g., schools, churches, or hospitals) or broad (e.g., nature preserves or designated districts) areas in which occasional or persistent sensitivity to noise above ambient levels exists.

Noise Metrics and Regulations. For purposes of assessing human response, sound is measured in units of A-weighted decibels (dBA). "A-weighted" denotes the adjustment of the sound levels in certain frequencies to account for how the average human ear senses the sound. The threshold of audibility is generally within the range of 10 to 25 dBA for normal hearing. Noise levels below this range are undetectable by most people. The threshold of pain occurs at the upper boundary of audibility, which is normally in the region of 135 dBA (USEPA 1981). **Table 3-3** compares common sounds and shows how they rank in terms of the effects of hearing. As shown, a whisper is normally 30 dBA and considered to be very quiet while an air conditioning unit 20 feet (6.1 meters) away is considered an intrusive noise at 60 dBA. To the human ear, each 10-dBA increase seems twice as loud (USEPA 1981).

Table 3-3. Sound Levels and Human Response

Noise Level (dBA)	Common Sounds	Effect
10	Just audible	Negligible*
30	Soft whisper (15 feet)	Very quiet
50	Light auto traffic (100 feet)	Quiet
60	Air conditioning unit (20 feet)	Intrusive
70	Noisy restaurant or freeway traffic	Telephone use difficult
80	Alarm clock (2 feet)	Annoying
90	Heavy truck (50 feet) or city traffic	Very annoying Hearing damage (8 hours)
100	Garbage truck	Very annoying*
110	Pile drivers	Strained vocal effort*
120	Jet takeoff (200 feet) or auto horn (3 feet)	Maximum vocal effort
140	Carrier deck jet operation	Painfully loud

Source: USEPA 1981 and *HDR extrapolation

A noise sensitive receptor is any property where frequent exterior human use occurs and where a lowered noise level would be beneficial. Examples of sensitive receivers may include residential homes, parks, hospitals, nursing homes, educational facilities, and libraries. Sensitive noise receptors could also include supporting habitat for certain wildlife species or noise-sensitive cultural practices.

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

DoD Instruction 6055.12, Hearing Conservation Program, requires that new equipment being considered for purchase have the lowest sound emissions levels that are technologically and economically feasible, and compatible with performance and environmental requirements, in order to protect personnel audible safety.

Air Force Occupational Safety and Health (AFOSH) Standard 48-20 (Occupational Noise and Hearing Conservation Program) describes the U.S. Air Force (USAF) Hearing Conservation Program procedures used at Andersen AFB. USAF standards require hearing protection whenever a person is exposed to steady-state noise of 85 dBA or more, or impulse noise of 140 dB sound pressure level or more, regardless of duration. Personal noise protection is required when using noise-hazardous machinery or entering hazardous noise areas.

3.2.1 Region of Influence

The ROI for potential noise impacts from site preparation and construction would be within 2,000 feet (609.6 meters) of the Proposed Action. This area was selected because noise from site preparation and construction activities would not likely exceed 60 dBA outside of this distance. The ROI for potential noise impacts from operation activities would be the area immediately bordering the installation fence line.

3.2.2 Existing Conditions

The predominant source of noise in the ROI has been aircraft operations from Andersen AFB and NWF. Noise modeling for aircraft operations is not required by Air Force directives if the noise contours do not extend beyond the installation boundary, or if there are fewer than 10 jet or 25 propeller-driven aircraft operations per day (Air Force Handbook 32-7084, *AICUZ Program Manager's Guide*). The level of aircraft operations at NWF has been well below these thresholds (JGPO 2010). Prior to the THAAD expeditionary deployment to Guam, the South Runway at NWF was used for fixed-wing aircraft operations, which included operations at the CDZ on the eastern end of the runway. The North Runway has been used for helicopter operations, which also included operations at the existing CDZ training area. Other noise sources in and around NWF include vehicle traffic and other ground-training activities.

3.3 Water Resources

For this analysis, water resources include all land-based sources of water available for human consumption (domestic, agriculture, industrial, etc.) and environmental needs. On Guam as a whole, the two main categories of land-based water sources are surface waters (stormwater, lakes, ponds, rivers, streams and impoundments) and groundwater (any source of water beneath the ground surface). In Guam,

natural precipitation is the primary source of replenishment of both surface and groundwater sources. Annual rainfall on the island averages between 85 and 115 inches (216 and 292 centimeters), much of which falls during the rainy season from July to December.

As previously mentioned, the entire island of Guam has been designated a "coastal zone" under the CZMA, and it includes the coastal waters extending seaward to a distance of 3 nautical miles (5.6 kilometers). The CZMA requires that all construction and operational activities be consistent, to the maximum extent practicable, with the GCMP policies to guide the use, protection, and development of land and ocean resources within Guam's coastal zone (GBSP 2011). The GCMP's policy on water quality states that "safe drinking water shall be assured and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuaries, reef, and aquifer areas."

3.3.1 Region of Influence

The ROI of the Proposed Action is limited to NWF of Andersen AFB and the adjacent areas. The majority of the activities related to construction and operation under the Proposed Action and No Action Alternatives would occur in and around the THAAD emplacement site, which is more than 0.5 mile (0.8 kilometer) from the island's coastline. Existing conditions of the land-based water resources within the ROI are summarized below.

3.3.2 Existing Conditions

Andersen AFB is located on the limestone formations of Guam's northern plateau. The karst geology of the area allows rainwater to easily percolate through the porous limestone (Gingerich 2003). Therefore the installation does not have any perennial surface water resources. Impervious areas on the base cover 1,766 acres (714.7 hectares); storm runoff from these impervious surfaces is directed via concrete lined culverts to underground injection control wells, which are permitted and regulated by Guam EPA (Andersen AFB 2008). Approximately 105 dry wells were drilled on the installation to facilitate the flow of stormwater into the underlying basins. While this method has the potential to cause groundwater contamination from stormwater runoff, proper implementation of the Andersen AFB Stormwater Pollution Prevention Plan (SWPPP) Guam Underground Injection Control permit requirements in conjunction with drainage basin and well head modifications has prevented extensive groundwater contamination (JGPO 2010).

Rainwater quickly infiltrates into the subsurface recharging the fresh groundwater lens that floats on top of the underlying saltwater. The body of rock "holding" the fresh water lens is known as the Northern Guam Lens Aquifer (NGLA). The boundary between the fresh and salt water bodies is not sharp but rather a gradual transition that begins at a depth determined by the rate of diffusion of salts into the freshwater and the mixing between the two bodies as the water flows laterally toward discharge points at the coast (Gingerich 2003).

From a water resources perspective, that portion of the basal lens from the water table down to the top of the transition zone (often referred to as the basal freshwater lens) is most important as it serves as the main source of potable water supply that can be harvested for human use.

The NGLA has been designated by USEPA as a Sole Source Aquifer under the Safe Drinking Water Act. It supplies drinking water to at least 50 percent of the area residents; approximately 40,200 people draw drinking water from wells located within a 4-mile (6.4-kilometer) radius of the site. The NGLA is currently being considered by Guam EPA for designation as groundwater under direct influence of surface water (JGPO 2010). This designation would mean that drinking water extracted from the aquifer would be subject to the same level of treatment as surface water.

Overall, the groundwater quality within the NGLA is considered good, but the aquifer is highly vulnerable to contamination from chlorides due to over pumping the aquifer at production wells, and from raw sewage leaking from sewer systems, leaking septic systems, leach fields, and unpermitted cesspools. Bacteria, nutrients, chlorides, and toxic contaminants have been detected in groundwater from the NGLA at various Installation Restoration Program (IRP) wells located at or near contaminated IRP sites. Groundwater sampling by the Air Force indicates the presence of VOCs in the groundwater, though no water wells currently produce water from contaminated areas (JGPO 2010).

3.4 Biological Resources

Native or naturalized vegetation, wildlife, special-status plant and animal species, and the habitats in which they occur are collectively referred to as biological resources. Special-status species include species classified as endangered, threatened, proposed, or candidates under the Federal ESA and species classified as threatened or endangered by the Guam ESA.

Under the Federal ESA, an "endangered species" is defined as any species that is in danger of extinction throughout all or a significant portion of its range. A "threatened species" is defined as any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. "Proposed species" are those that are undergoing review for listing as threatened or endangered. The USFWS defines a "candidate species" as those plants and animals that have been studied and the Service has concluded that they should be proposed for addition to the Federal endangered and threatened species list.

The ESA of Guam (5 Guam Code Annotated 63208, P.L. 15-36) provides authorization to conserve and manage threatened and endangered species to achieve the purposes of the Federal ESA. It provides for the creation of a local endangered and threatened species list, and extends local protection to all federally listed species. Under the ESA of Guam, an "endangered species" is defined as any species which is in danger of extirpation on Guam and has been so designated by the Guam Department of Agriculture or that has been determined to be an endangered species pursuant to the Federal ESA. A "threatened species" is defined as any species of plant or wildlife which appears likely, within the foreseeable future, to become endangered and which has been so designated by the Guam Department of Agriculture or that has been determined to be a threatened species pursuant to the Federal ESA.

3.4.1 Region of Influence

The ROI for the analysis of effects to biological resources includes all areas that were cleared of vegetation or otherwise disturbed for the deployment of the THAAD battery; areas that are proposed to be disturbed for THAAD permanent stationing (e.g., fiber optic line) and CDZ expansion; and surrounding areas where wildlife could be adversely affected by noise, lights, and EMR. This region is entirely within NWF of Andersen AFB.

3.4.2 Existing Conditions

Vegetation

Prior to World War II, the uplands of northern Guam, including NWF, were vegetated with primary limestone forest adapted to the shallow and excessively drained soils. That forest had a tall, closed canopy. Dominant trees included dugdug or native breadfruit (*Artocarpus mariannensis*) and nunu or banyan (*Ficus sp.*). Openings created by high winds were dominated by ferns, herbaceous vegetation, and shrubs (Fosberg 1960, JGPO 2010).

During initial development of NWF in 1944, much of the ROI and surrounding land, with the exception of a portion of Area 50 (**Figure 3-1**), was cleared of vegetation (USAF 2000). Much of NWF was re-cleared of vegetation during the Korean War era. Since then, vegetation has been cleared periodically from paved surfaces and the edges of runways for operational safety of training and other uses of the area (USAF 2000), but much of the rest of NWF has naturally revegetated with secondary limestone forest.

The most recent classification and map of vegetation communities on Andersen AFB was documented in 2008 (e^2M 2008), and is shown on **Figure 3-1** for the THAAD original expeditionary emplacement and surrounding area. The following description of vegetation communities within or near the THAAD emplacement area is from that report and the Joint Region Marianas Integrated Natural Resource Management Plan (JRM 2013).

Casuarina Forest. Near pure stands of gago or ironwood (*Casuarina equisetifolia*) forests occur on Andersen AFB on the terrace bordering the native strand community and within the strand, and in numerous smaller areas on the plateau. Ironwood is one of the most successful colonizers of denuded areas and will rapidly develop dense tall stands.

Eugenia Forest. Eugenia forest occurs in several small patches within the mixed limestone forest primary near the edge of the plateau to the northeast of NWF. Vegetation in the Eugenia forest is characterized by a dominance of A'abang (*Eugenia reinwardtiana*).

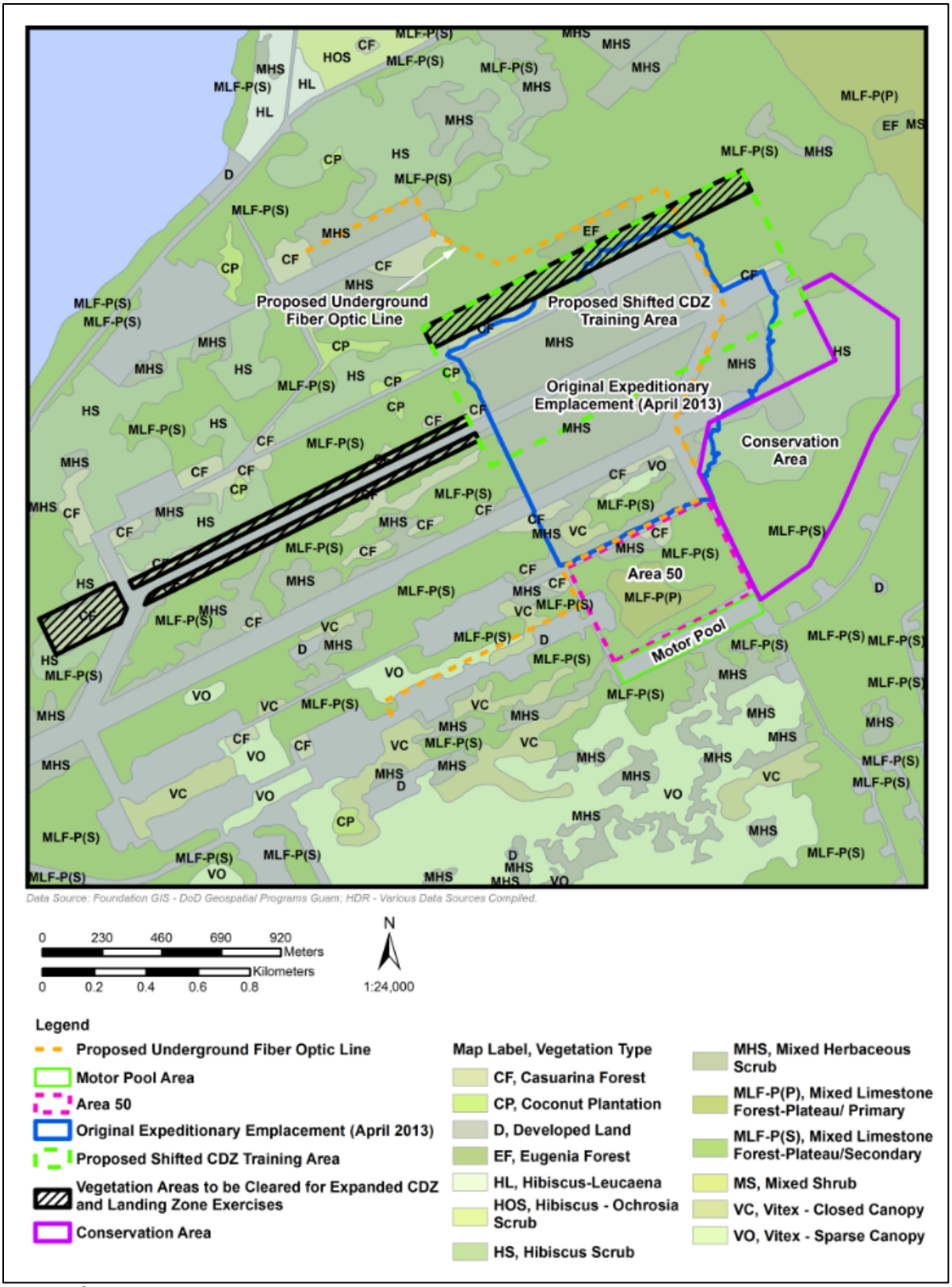
Hibiscus Scrub. The *Hibiscus* scrub community occurs on the plateau in the area of NWF and is characterized by a dominance of pago or sea hibiscus (*Hibiscus tiliaceous*). The scrub community occurs in varying heights and densities that might be a response to extreme salt spray, to dryness resulting from excessive drainage, to excessive transpiration due to exposure to winds, or to any combination of these and other factors. The native shrub community is generally of a lower stature than secondary growth mixed limestone forest.

Mixed Herbaceous Scrub. Mixed herbaceous scrub occurs on the plateau and terrace in association with developed land and is typically characterized by a dominance of *Stachytarpheta jamaicensis*. This native scrub community occurs in historically cleared areas on the plateau in the area of NWF.

Mixed Limestone Forest-Plateau/Secondary. Secondary growth mixed limestone forest occurs in areas that were once cleared of mature growth and are presumably returning to the climax successional stage. This forest type is common at NWF and is typified by an open canopy of low to moderate stature. Dominant flora include ironwood, kafu or screwpine (*Pandanus tectorius*), fagot (*Neisosperma oppositifolia*), nanaso or half flower (*Scaevola sericea*), lada or Indian mulberry (*Morinda citrifolia*), sea hibiscus, joga or blue marble tree (*Eleaocarpus joga*), fadang or cycad (*Cycas micronesica*), chopak (*Mammea odorata*), and breadfruit.

Vitex-Closed/ Vitex-Sparse Canopy. Closed canopy and sparse-canopy stands dominated by the medium-sized tree lagundi (*Vitex parviflora*) occurs in several smaller stands on the plateau. *Vitex*-closed canopy is characterized by a dense overstory of Vitex. *Vitex*-sparse canopy typically occurs in association with the *Vitex*-closed canopy, but is more open and is characterized primarily by Vitex, paipai (*Guamia mariannae*), and mapunyao (*Aglaia mariannensis*).

Forested areas on NWF have been substantially altered by feral pigs (*Sus scrofa*) and Philippine deer (*Cervus mariannus*). These species disturb the soil and reduce forest canopy cover, causing an increase in light penetration and a change in soil structure and moisture, temperature, and other factors. This has led to a decrease in the reproduction of native forest trees, and an increase in faster growing non-native species (JRM 2011, 2013). Feral pig density in NWF was estimated at 55.4 pigs per square mile (21.4 pigs/square kilometer) in 2006 (Parsons 2006). At this density, the 4,400-acre (17.8-square kilometer) NWF is estimated to hold approximately 381 feral pigs.



Source: e^{2}M 2008

Figure 3-1. Vegetation Communities Within and Surrounding the Original Expeditionary Emplacement

Fauna

Birds. Native forest bird species, such as the Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*) and Mariana crow (*Corvus kubaryi)*, are either extinct or have been extirpated from Guam due to predation by, or competition with, introduced species.

During surveys of the CDZ in 2000, including portions of the THAAD project site, the only four species observed were common, non-forest-dwelling species or non-native species: yellow bittern (*Ixobrychus sinesis*, native), Philippine turtle dove (*Streptopelia dusumieri*, non-native), black francolin (*Francolinus francolinus*, non-native), and red junglefowl (*Gallus gallus*, non-native) (Raulerson and Witteman 2000). Other birds known or likely to occur within or near NWF include the Pacific golden plover (*Pluvialis fulva*, migratory), ruddy turnstone (*Arenaria interpres*, migratory), white tern (*Gygis alba*, non-native), Micronesian starling (*Aplonis opaca guami*, native), black drongo (*Dicrurus macrocercus harterti*, non-native), Eurasian tree sparrow (*Passer montanus*, non-native), and island collared dove (*S. bitorquata*, non-native) (NAVFACPACIFIC 2010, HDR 2013).

Mammals. The only native terrestrial mammal species that occurs on Andersen AFB is the Mariana fruit bat (*Pteropus mariannus mariannus*), which is federally listed as threatened and Guam-listed as endangered. There are fewer than 25 fruit bats remaining on northern Guam. They occur primarily along the eastern and northern cliff line of Andersen AFB, and are observed infrequently in the area surrounding the THAAD emplacement (SWCA 2012). The Mariana fruit bat is further discussed later in this section under Special Status Species. Two feral ungulates, Philippine deer (*Cervus mariannus*) and pigs (*Sus scrofa*), are common throughout NFW, as are non-native rats (*Rattus spp.*), feral cats (*Felis catus*), and feral dogs (*Canis familiaris*).

Reptiles and Amphibians. One species of amphibian, the marine toad (*Rhinella marina*); two geckos, house gecko (*Hemidactulus frenatus*) and mourning gecko (*Lipidodactylus lugubris*); two skinks, four-toed skink (*Carlia fusca*) and Pacific blue-tailed skink (*Emoia caeruleocauda*); one lizard, the monitor lizard (*Varanus indicus*); and two snakes, Brahminy blind snake (*Ramphotyphlops braminus*) and brown treesnake (*Boiga irregularis*) were documented during surveys of the CDZ, including portions of the THAAD project site, in 2000 (Raulerson and Witteman 2000). Other species that might occur there include greenhouse frog (*Eleutherodactylus planirostris*), mutilating gecko (*Gehyra mutilata),* Pacific slender-toed gecko (*Nactus pelagicus*), and moth skink (*Lipinia noctua)* (Christy et al. 2007, NAVFACPACIFIC 2010). Of these, the mourning gecko, Pacific blue-tailed skink, monitor lizard, mutilating gecko, and Pacific slender-toed gecko are native or long-term residents of Guam. The remaining reptile and amphibian species mentioned are not native to the island.

Invertebrates. Endemic and indigenous tree and land snails, once abundant on the island, are in a state of serious decline and are disappearing from their former ranges. Causes of the decline include habitat loss to agriculture and development, pesticides, wildland fires, competition with introduced species, and predation by introduced predatory snails and the predatory Manokwar flatworm (*Platydemus manokwari*) (USAF 2009). Shells of the introduced giant African snail and both live individuals and shells of the introduced land snail (*Satsuma mercatoria*) were observed during 2009 tree snail surveys. Additionally, live introduced Manokwar flatworms were also observed (NAVFACPACIFIC 2010). A total of 49 live Guam tree snails were recorded during surveys of Andersen AFB conducted in 2011 (HDR 2013).

Six butterfly species were documented within forested areas on Andersen AFB during 2009–2011 butterfly surveys: lemon migrant (*Catopsilia pomona*), monarch (*Danaus plexippus*), blue-banded king crow (*Euploea eunice*), blue moon (*Hypolimnas bolina*), guardian (*Hypolimnas anomala*) and common Mormon (*Paplio polytes*) (NAVFACPACIFIC 2010, HDR 2013). These species are fairly well distributed throughout Guam and portions of the Mariana Islands. Additional butterfly species documented on Andersen AFB in previous surveys include Mariana eight-spot (*Hypolimnas octocula*

marianensis) , cycad blue butterfly or plains cupid (*Chilades pandava*), three-spot grass yellow (*Eurema blanda*), and tiny grass blue (*Zizula hylax*) (Schreiner and Nafus 1997, USAF 2009, HDR 2013).

Other terrestrial invertebrates that occur at Andersen AFB include the native land hermit crab (*Coenobita brevimanus*) and the coconut crab (*Birgus latro*).

Special Status Species

The USFWS (2014a) lists 19 species classified under the Federal ESA as threatened and endangered species on and around Guam, including six species of cetaceans, two terrestrial mammals, eight birds, two sea turtles, and one plant. One mammal, the little Mariana fruit bat (*Pteropus tokudae*) and one bird, Guam bridled white-eye (*Zosterops conspicillatus conspicillatus*), are presumed to be extinct, and three Guam endemic birds, Guam Micronesian kingfisher, Guam rail (*Rallus owstoni*), and Mariana crow (*Crovus kubaryi*) have been extirpated from Guam, but survive on other islands (including an introduced population of Guam rails on Cocos Island off the southern coast of Guam) or in zoos. The Guam ESA lists 37 species as endangered and one species as threatened (GDAWR 2005).

On October 1, 2014, the USFWS proposed to list 23 plant and animal species from the Mariana Islands as threatened or endangered (79 FR 59364). Critical habitat has not been proposed for any of these species.

- Two of the proposed plant species, fadang and *Tabernaemontana rotensis*, are found on NWF and are described below.
- Two of the proposed species, the Rota blue damselfly (*Ischnura luta*) and Langford's tree snail (*Partula langfordi*), are not native to Guam.
- Three species, the Mariana wandering butterfly (*Vagrans egistina*), Slevin's skink (*Emoia slevini*), and Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*), have been extirpated from Guam.
- Ten plant species are known to occur on Guam but not within or near NWF: *Eugenia bryanii*, Paudedo (*Hedyotis megalantha*), looking glass tree (*Heritiera longipetiolata*), *Maesa walkeri*, *Nervilia jacksoniae*, *Plyllanthus saffordii*, Aplokating-palaoan (*Psychotria malaspinae*), Berenghenas halomtano (*Solanum guamense*), *Tinospora hornosepala*, and *Tuberolabium gumense*. Two other plant species, the orchids *Bulbophyllum guamense* and *Dendrobium guamense* also are rare on Guam, but these species have been observed on Andersen AFB (D. Janeke, HDR, personal communication) and have the potential to occur in well-developed native forests such as within Area 50.
- Four invertebrates that occur on Guam do not occur in the second growth forests and scrub vegetation on NWF. The fragile tree snail (*Samoana fragilis*) is known from only two locations on Guam, one at Pugua Point (Smith et al. 2009) and one at Lost Pond in Hilaan (Curt Fiedler, University of Guam, personal communication). The humped tree snail (*Partula gibba*) occurs on the Haputo Ecological Reserve Area on the Navy Communications Site, but does not occur on Andersen AFB. The Guam tree snail (*Partula radiolata*) and the Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*) occur on Andersen AFB (JGPO 2010, HDR 2013), but do not occur on NWF. The Guam tree snail has been found only in the Tarague Basin, and it was not found during surveys of NWF in 2000 (Smith 2000). The eight-spot butterfly and its host plants are restricted to tower karst and other rugged topography in Tarague Basin and the northern and eastern plateau (HDR 2013, NAVFAC 2014).

Special status species that have the potential to occur at NWF or the surrounding region are listed in **Table 3-4** and discussed below. The three federally listed endangered birds that have been extirpated from Guam also are listed in the table because loss or degradation of their potential habitat could affect the success of future reintroductions and ultimate recovery of these species. The Proposed Action would not affect any marine or coastal resources and species restricted to those environments, therefore none of these species are listed in **Table 3-4** or further described in this EA.

Plants

Serianthes nelsonii. *Serianthes nelsonii* is classified as endangered under the Federal ESA and by the Government of Guam. It is one of the largest native trees in the Mariana Islands. As of 2012, one mature tree plus three saplings in a fenced site, all on Andersen AFB, were the only individuals of this species known to occur on Guam (USFWS 2012a). This tree species also occurs on Rota. Surveys for this species have been conducted on Andersen AFB, including comprehensive surveys of the CDZ on NWF in 2000 (Raulerson and Witteman 2000) and surveys to map vegetation on the installation in 2007 (e^2M 2008). It is therefore very unlikely that any unknown individuals of this species existed within the THAAD emplacement area.

Cyathea lunulata. *Cyathea lunulata* is a tree fern native to Guam. It occurs on volcanic clay soils in southern Guam, typically near the edge of ravine forest and savanna habitats. Mature ferns grow to 16 feet (5 meters) tall with 6.5-foot- (2-meter-) long fronds. *Cyathea lunulata* is listed as endangered by the Government of Guam. It is not common and has become increasingly rare due to savanna fires that kill the ferns and destroy their habitat. They have also been collected for planting as landscaping plants (Raulerson and Reinhart 1992).

Heritiera longipetiolata. Ufa (*Heritiera longipetiolata*) is a buttressed tree growing to a height of 40 feet (12 meters). It grows from limestone, often in the rough limestone terrain of terrace cliffs. This species achieves its greatest height where it occurs in a sheltered location, but typically they are wind-stunted or broken by typhoons (Raulerson and Reinhart 1991). *Heritiera* is endemic to the Mariana Islands and is an important canopy tree in limestone forests. This species is listed as endangered by the Government of Guam. Primary threats include deforestation and feral ungulate impacts on seeds and young trees.

Fadang. This large tree-like cycad occurs in closed forests throughout Guam, and also on Rota, Pagan, Palau, and Yap. Fadang was common on NWF and elsewhere on Guam prior to widespread mortality starting in 2003 and caused primarily by the cycad aulacaspis scale (JRM 2013). On Guam, over 500,000 individuals remain, but the abundance of this species is likely to continue to decline. During surveys conducted on Andersen AFB in 2012–2013, more than 12,770 live and 12,425 dead fadang were found. As of July 2013, the estimated population of this species on Andersen AFB was 257,604 living plants (Marler 2014). The fadang has been proposed for listing as threatened under the ESA (79 FR 59364).

Tabernaemontana rotensis. This small to medium-sized tree occurs on Guam and Rota on and near forested limestone terraces. Over 21,000 individuals were documented during a comprehensive survey of Andersen AFB prior to 2007. A small cluster of this species was found just north of the proposed NWF CDZ expansion (University of Guam 2007), but this species was not found during surveys of the NWF CDZ in 2000 (Raulerson and Witteman 2000). Mature trees have been documented in Area 50 (USAF 2000), but no *T. rotensis* were found within areas that have been cleared or would be cleared for activities considered in this EA. It is threatened by loss of habitat, habitat fragmentation, limited seed dispersal, and possibly by a non-native arthropod.

Table 3-4. Special Status Species that Could Occur on NWF

Common Name (Chamorro Name)*	Scientific Name	Federal Status	GovGuam/ CNMI Status	Habitat	Current Occurrence on Guam	Potential Occurrence at NWF
PLANTS						
Tree fern (Såtsa)	*Cyathea lunulata*	--	E	Native limestone forest	Present	Very unlikely, occurs on southern Guam
Fadang	*Cycas micronesica*	PT	--	Native limestone forest	Present	Present in forests
No common name (Ufa-halomtåno')	*Heritiera longipetiolata*	--	E	Native limestone forest	Present	Present in undisturbed forest
Fire Tree (Hayun lågo)	*Serianthes nelsonii*	E	E	Native limestone forest	Present	Present in undisturbed forest
No common name	*Tabernaemontana rotensis*	PT	--	Native limestone forest	Present	Present in forests
INVERTEBRATES						
Mariana eight-spot butterfly (Ababang)	*Hypolimnas octocula marianensis*	PE	--	Native limestone forest.	Present	Present in undisturbed forest
Humped tree snail (Akaleha')	*Partula gibba*	PE	E	Native limestone forest and ravine forest	Present	Unlikely
Guam tree snail (Akaleha')	*Partula radiolata*	PE	E	Native limestone and ravine forest, endemic to Guam.	Present	Unlikely
Fragile tree snail (Akaleha')	*Samoana fragilis*	PE	E	Native limestone and ravine forest.	Present	Unlikely
Mariana wandering butterfly (Ababang)	*Vagrans egistina*	PE	--	Native limestone forest.	Presumed Extirpated	Very unlikely

Common Name (Chamorro Name)*	Scientific Name	Federal Status	GovGuam/ CNMI Status	Habitat	Current Occurrence on Guam	Potential Occurrence at NWF
REPTILES and AMPHIBIANS						
Moth skink (Guali'ek halom tåno')	*Lipinia noctua*	--	E	Native limestone forest	Present	Possible
Pacific slender-toed gecko (Guali'ek)	*Nactus pelagicus*	--	E	Native limestone forest	Present	Possible
BIRDS						
Guam Micronesian kingfisher (Sihek)	*Todiramphus cinnamomina*	E	E	Native limestone forest	Occurs only in captivity	Extirpated from Guam
Guam rail (Ko'Ko')	*Gallirallus owstonii*	E	E	Edge and secondary growth	Extirpated	Extirpated from Guam
Mariana common moorhen (Pulattat)	*Gallinula chloropus guami*	E	E	Fresh and brackish wetlands	Present	No suitable habitat – very unlikely to occur
Mariana crow (Åga)	*Corvus kubaryi*	E	E	Native limestone forest	Extirpated	Extirpated from Guam
Micronesian starling (Såli)	*Aplonis opaca guami*	--	E	Native limestone forest	Present	Possible
Mariana swiftlet (Yayaguak)	*Aerodramus bartschi*	E	E	Mahlac Cave, Fachi Cave, and Maemong Cave	Present	Occurs only on southern Guam
MAMMALS						
Mariana fruit bat (fanihi)	*Pteropus mariannus*	T	E	Native limestone forest	Present	Present

Sources: USFWS 2014a, GDAWR 2005

Note: *Chamorro Names from Government of Guam, Department of Agriculture Endangered Species Regulation No. 8 (2003)

Key: E = Federal- or Guam-listed as endangered T = Federal- or Guam-listed as threatened PE = Proposed Endangered, PT = Proposed Threatened

Invertebrates

Mariana eight-spot and Mariana wandering butterflies. The Mariana eight-spot and Mariana wandering (*Vagrans egistina*) butterflies have been proposed for listing as endangered. These butterflies are endemic to the Micronesian Islands of Guam, Rota and Saipan. Although habitat requirements for these butterflies have not been described in detail, they are typically known to occur in forests and forest openings containing their respective host plant species (Schreiner and Nafus 1997, Campora and Lee 2009).

Results of surveys conducted in 1996 found adult Mariana eight-spot butterflies at 3 of 12 survey locations on Guam: Orote Point, Tweeds Cave, and the lower Pagat area. Two Mariana eight-spot butterflies were observed near Pati Point in 2006 (Parsons 2006). Surveys conducted in 2009 identified at least one adult Mariana eight-spot butterfly in limestone forest along Route 15 in the Pagat area (Campora and Lee 2009). The Mariana eight-spot butterfly was not observed on Andersen AFB during the 2009–2010 surveys. Seven adult butterflies, however, were observed and 38 percent of host plant patches were occupied in the Tarague Basin during surveys in 2011 (HDR 2013). The Mariana wandering butterfly, last recorded on Guam in 1979, is considered extirpated from the island (Schreiner and Nafus 1997).

Humped, Guam, and Fragile tree snails. The humped, Guam, and fragile tree snails have been proposed for listing as endangered. These three species are typically found in cool, shaded forested habitats (Crampton 1925).

While Crampton (1925) indicated that both the Guam and humped tree snails were widespread and common in 1920, a survey conducted by Hopper and Smith (1992) indicated an island-wide decline in both species. A 2000 survey of the CDZ on NWF at Andersen AFB yielded no observations of native tree snails (Smith 2000). No observations of the three candidate snails were made during surveys at Andersen AFB in 2006 (Parsons 2006).

Only two colonies of fragile tree snails are known to exist on Guam: one at Pugua Point (Smith et al. 2008) and one at Lost Pond in Hilaan (Fiedler 2014). The only known colony of tree snails on Andersen AFB is at Explosive Ordnance Disposal (EOD) Beach (HDR 2013). The native tree snails of Guam continue to decline and are threatened by deforestation, introduced predators, and alteration of the habitat by feral ungulates (Hopper and Smith 1992, Smith and Hopper 1994, Cowie 2000, Cowie and Cook 2001).

Reptiles and Amphibians

Moth skink. This species is found across much of the western Pacific, but Guam is the only location this species has been recorded in the Mariana Islands. It is found on the ground or low trees in native forest, often near *Pandanus* sp. The diet of this species consists primarily of ants. The moth skink is listed as an endangered species by the Government of Guam.

Pacific slender-toed gecko. The Pacific slender-toed gecko is nocturnal and terrestrial, preferring rocky areas, but will climb tree trunks (Vogt and Williams 2004). This species is entirely female, reproducing by parthenogenesis (essentially cloning itself). It is known to occur throughout the western Pacific, and in the Mariana Islands it has been recorded on Guam, Rota, Anatahan, Alamagan, and Sarigan. It is listed as an endangered species by the Government of Guam.

Birds

Guam Micronesian kingfisher. The Guam Micronesian kingfisher is classified as endangered under the Federal ESA and by the Government of Guam. Historically this subspecies was considered fairly common throughout Guam. Although kingfishers were collected and observed in southern Guam in 1945, their numbers decreased sharply over the next two decades. They were last observed in southern Guam in the 1970s and by 1985 only 30 were observed in the northern part of the island. The species was believed

extinct in the wild by 1988 (Wiles et al. 2003). In response to the widespread decline of Guam's native birds, in 1983 a captive breeding program was initiated. As of May 2008, the population consisted of 60 males, 37 females, and 4 unsexed chicks distributed among 17 captive propagation institutions in the mainland U.S. and Guam (USFWS 2008a, b).

This kingfisher utilized a wide variety of habitats on Guam including limestone forest, strand forest, ravine forest, agricultural forest, secondary forest, edge habitats, and forest openings. However, mature forests with appropriate nest sites may have been an important component for reproductive activities. The Guam Micronesian kingfisher is a cavity nester that requires large, standing dead trees for nesting and open understory or forest edges for foraging (Marshall 1989).

Approximately 376 acres (152 hectares) of critical habitat on Guam have been designated for the Guam Micronesian kingfisher (69 FR 62944). That critical habitat is located entirely on the Guam National Wildlife Refuge (see **Figure 1-1**), more than 1 mile (1.6 kilometer) north of the THAAD system emplacement site.

***Guam rail*.** The Guam rail is classified as endangered under the Federal ESA and by the Government of Guam. This species is endemic to Guam, and it was formerly distributed island-wide. It was believed to have been extirpated in the wild on Guam by 1987 and is now found in the wild as introduced populations on Cocos Island off of Guam and on Rota.

The Guam rail is believed to favor edge habitat, especially grassy or secondary vegetation areas, which provide good cover. All observations of breeding by wild individuals over the last decade have also been associated with edge habitats or secondary vegetation on Guam (USFWS 2009b). There have been two releases of rails on Guam since the species was listed. In 1998, 16 rails were released in Area 50 on NWF. Breeding was documented, although the small population was believed to have been extirpated by feral cats and other predators. In 2003, 44 rails were released onto the MSA of Andersen AFB. Neither of those releases was successful and no rails are believed to occur on Guam now (USFWS 2009b).

Mariana common moorhen. The Mariana common moorhen is classified as endangered under the Federal ESA and by the Government of Guam. This species occurs on Guam, Tinian, Rota, and Saipan in marshes, ponds, and other wetlands with emergent vegetation and open water. Moorhens could occur occasionally on artificial wetlands on Andersen AFB, but there are no wetlands or other suitable habitat on NWF (JRM 2013) and it is therefore very unlikely that it would occur on or near the THAAD system emplacement site.

***Mariana crow*.** The Mariana crow is classified as endangered under the Federal ESA and by the Government of Guam. This species was once widely distributed and abundant in limestone forests throughout Guam. It had disappeared from southern Guam by the 1960s, from central Guam by the 1970s, and by the 1980s only a small remnant population survived at the northernmost part of the island. The original Guam population has now been completely extirpated. The last crow of Guam origin is believed to have disappeared sometime in 2002 or 2003, and all crows on Guam following that time were from a release of birds from the population on Rota. As of 2004, there were about 10 crows in the wild on Guam (USFWS 2005), and by 2014, the Mariana crow was extirpated from Guam (USFWS 2014b).

Although Mariana crows were known to utilize secondary forest, coastline forest, ravine forests, agricultural forest, and coconut plantations, all evidence suggests that they were most abundant in primary or mature native limestone forests. Nests have been found exclusively in native tree species on Guam, and Mariana crows appear to forage primarily in native trees (USFWS 2005).

Approximately 376 acres (152 hectares) of critical habitat on Guam have been designated for the Mariana crow (69 FR 62944). That critical habitat is located entirely on the Guam National Wildlife Refuge, more

than 1 mile (1.6 kilometer) north of the THAAD system emplacement site. Additional critical habitat has been designated on Rota.

Mariana swiftlet. The Mariana swiftlet (*Aerodramus bartschi*) is classified as endangered under the Federal ESA and by the Government of Guam. Swiftlets nest and roost in limestone caves and their preferred foraging habitats include areas over forests, cliff lines, grassy hills, and grassy ravines (USFWS 1992, 2010a). Swiftlets currently occur on the islands of Guam, Aguiguan, and Saipan. They are locally extinct on Rota and Tinian. The Mariana swiftlet is currently known to nest in three caves on Guam (Mahlac, Maemong, and Fachi), all on the Naval Munitions Site in central and southern Guam. They do not occur, or are very rare, on northern Guam (USFWS 1992, 2010a).

Micronesian starling. The Micronesian starling is classified as endangered by the Government of Guam. This subspecies is endemic to the southern Mariana Islands of Guam, Rota, Tinian, and Saipan (Baker 1951, Jenkins 1983). The starlings use scrub, secondary growth, mixed woodland, and mature forest for habitat and feed primarily on the fruit and seeds of ripe papayas (Baker 1951, Jenkins 1983). They were often seen in urban areas, but are generally more abundant in forested areas (Jenkins 1983). Starlings are cavity nesters and have been found nesting in the cavities of trees and rocky cliffs. Predation by the brown treesnake has restricted them primarily to Cocos Island, Naval Base Guam Apra Harbor in buildings, Andersen AFB, parts of Hagatña and certain coastal areas in the south. On Andersen AFB they are most common in and around developed areas.

Mammals

Mariana fruit bat. The Mariana fruit bat is federally classified as threatened and by the Government of Guam as endangered. This species forages and roosts in native limestone forest and occasionally in coconut groves and strand vegetation (USFWS 2009a). They feed on a variety of plant material, but fruit makes up the majority of its diet (Wiles 1987a, USFWS 2009a). Surveys for fruit bats on Andersen AFB in 2010–2011 resulted in a count of only 10 fruit bats and an estimate of fewer than 25 individuals island-wide (SWCA 2012). In July 2014, ten potential sightings of fruit bats were recorded by 85 volunteers simultaneously searching for bats from 42 vantage points located throughout Andersen AFB (Andersen AFB 2014a).

Approximately 376 acres (152 hectares) of critical habitat on Guam have been designated for the Mariana fruit bat (69 FR 62944). That critical habitat is located entirely on the Guam National Wildlife Refuge, more than 1 mile (1.6 kilometer) north of the THAAD emplacement. Predation by the brown treesnake and losses from illegal hunting are the most significant threats to the survival of the Mariana fruit bat on Guam (Wiles 1987b, USFWS 2009a).

3.5 Cultural Resources

NEPA requires consideration of impacts to cultural resources (40 C.F.R. § 1508.8). “Cultural resources” is an umbrella term for many types of resources, including prehistoric and historic archaeological sites; historic buildings, structures, and districts; and physical entities and human-made or natural features important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources are typically subdivided into archaeological resources; architectural resources; or resources of traditional, religious, or cultural significance to Native Americans or other groups.

- *Archaeological resources* are prehistoric or historic sites where human activity has left physical traces such as artifacts, the remains of structures, or hearths, but no structures remain standing.
- *Architectural resources* are buildings or other structures or groups of structures, or designed landscapes that are of historic or aesthetic significance, such as standing buildings and bridges.

- *Resources of traditional, religious, or cultural significance* to Native Americans or other groups, including traditional cultural properties. These resources may include archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that Native Americans or other groups consider essential for the preservation of traditional culture.

Cultural resources are also governed by other Federal laws and regulations, including the NHPA of 1966, the Archeological and Historic Preservation Act (1974), the American Indian Religious Freedom Act (1978), the Archaeological Resources Protection Act (1979), and the Native American Graves Protection and Repatriation Act (1990). Federal agencies' responsibility for protecting historic properties 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 in accordance with 36 CFR Part 800. 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. Cultural resources also may be covered by state, local, and territorial laws.

Historic Properties and the National Register of Historic Places

NEPA covers a much broader array of cultural resources than NHPA. In practice, NEPA analyses focus on properties that are listed in, eligible for listing in, or potentially eligible for inclusion in the NRHP, the official listing of properties significant in U.S. history, architecture or engineering, or prehistory. The list was established under the NHPA and is administered by the National Park Service on behalf of the Secretary of the Interior. Cultural resources that are listed in or eligible for listing in the NRHP are "historic properties" as defined by the NHPA. The NRHP may include properties on both public and private land. Properties can be determined eligible for listing in the NRHP by Secretary of the Interior or by consensus of a Federal agency official and the applicable SHPO. A NRHP-eligible property has the same protections as a property listed in the NRHP.

To be eligible for listing in the NRHP, a resource must meet one or more NRHP evaluation criteria (36 CFR § 60.4) and retain integrity that conveys its significance. In most cases, resources must also be more than 50 years old. The NRHP evaluation criteria are:

- Criterion A, association with events that have made a significant contribution to the broad patterns of history.
- Criterion B, association with the lives of persons significant in the past.
- Criterion C, embodiment of the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D, potential to yield information important in prehistory or history.

3.5.1 Region of Influence

The ROI or the area of potential effect (APE) is defined as the geographical area or areas within which the Proposed Action may directly or indirectly cause alterations in the character or use of historic properties. Direct effects would include damage caused by site preparation and construction activities, and are limited to the area in which the proposed activity would take place. Indirect effects would result in changes later in time or as a result of the direct effects, and may include changes that may affect the character or use of a historic property or alterations to its setting or viewshed. The concept of APE is defined at 36 CFR § 800.16(d).

The expeditionary and permanent emplacement of the THAAD system and the expansion of the existing CDZ have been and would in the future be potential sources of direct effects on cultural resources. Those effects include, but are not limited to, vegetation clearance and related disturbance to underlying areas; trenching fiber optic lines; modifications of existing pavements to support the motor pool and fencing; grading for gravel roads and leveling areas for improved security; and construction of a drainage system, a Giant Voice warning system, a communications trough, concrete pads, new guard towers, and four new buildings.

In addition, the expeditionary and permanent THAAD system deployment and CDZ expansion have been and would in the future be potential sources of indirect effects, primarily modifications to the appearance of the area as it existed prior to the expeditionary THAAD system deployment due to vegetation removal and the introduction of new equipment, structures, and lighting.

For the purposes of cultural resources analyzed for this EA, the ROI or APE for direct effects is defined as the maximum combined extent of the THAAD original expeditionary emplacement (April 2013), the compressed expeditionary emplacement (2014)/proposed permanent emplacement, the fiber-optic communication line trench, and the proposed CDZ expansion area, including all associated components of the project as described in **Section 2.1**. The APE totals approximately 365.7 acres (148.0 hectares), as well as 11,759 feet (3,584 meters) of associated linear construction (proposed fences and fiber optic communication line trench) that is outside of the aforementioned 365.7 acre (148.0 hectare) area.

Because the THAAD system, the proposed guard towers, and the other elements of the system are shorter than the approximately 30-foot (10-meter) height of the surrounding jungle overstory in an area of essentially flat topography, visual effects to cultural resources would be constrained to a small area around the emplacement. The ROI or APE for indirect effects is therefore defined as the area within 0.6 mile (1 kilometer) of the outer edges of the THAAD emplacement site and CDZ expansion.

3.5.2 Existing Conditions

The Mariana Islands archipelago, composed of the Commonwealth of the Northern Mariana Islands and Guam to the south, have a rich history of human occupation. This existing conditions section is based on published literature, the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010), site survey reports and data from Andersen AFB and the Guam Historic Resources Division, the 2010 FEIS (JGPO 2010) and supporting research, records in the Library of Congress, and other sources.

The following summary of the islands' history, derived and updated from the 2010 FEIS (JGPO 2010), the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010), and the NWF Historic American Engineering Record (HAER) (Aaron et al. 2007), is intended to provide context for understanding the range of prehistoric and historic cultural resources that may be present in and near the proposed permanent THAAD site.

The Mariana Islands were settled by at least 1,500 years B.C. and possibly hundreds of years earlier, by colonists from southeast Asia, possibly the Philippine Islands or Taiwan. The modern-day indigenous population of the Marianas, known as the Chamorro people, descended from these prehistoric settlers. The Pre-Latte Period dates from the time of initial settlement to A.D. 1000. Pre-Latte period populations focused on exploiting marine food sources. Sites of the pre-Latte period are rare and are usually found on sandy embayments and in caves and rock overhangs near the shore. The Latte period (A.D. 1000–1521) is distinguished primarily by the appearance of *latte* sets or stone structures. Populations increased and settlements expanded to a broad range of shoreline and inland settings near permanent water or arable soils, where rice and tubers were grown and non-marine wild plant and animal foods were exploited. European contact began with Ferdinand Magellan's 1521 landing and the arrival of Spanish missionaries and soldiers in 1668. The Spanish imposed a policy of *reduccion*, a deliberate effort to gather indigenous

people of the Marianas into a few communities on Guam and Rota. Chamorro resistance to Spanish practices led to war which, combined with introduced disease, reduced the indigenous population of Guam from an estimated pre-contact level of between 20,000 and 40,000 to only 1,800 in 1690. Guam was ceded by Spain to the U.S. government in 1898.

In December 1941, only a few hours after the attack on Pearl Harbor, Japanese planes from Saipan bombed Guam. For the next 2 years, the Japanese Navy controlled the island and its economy and forced the local population to build defenses and feed soldiers. In 1944, the United States began air raids over Japan-occupied Saipan, Tinian, Rota, and Guam, and by August 10 controlled Guam. The U.S. military immediately began constructing facilities throughout the Marianas to support bombing attacks on Japan by the new B-29 Superfortress aircraft. On Guam, those facilities included NWF and North Field, both within the boundaries of what is today Andersen AFB. NWF was operational by early 1945. The airfield originally consisted of two paved runways and associated taxiways, hardstands, and service aprons for B-29 bombers and other aircraft, as well as a large number of buildings for aircraft maintenance, personnel housing, mission planning, and other purposes. The airfield supported long-range bombing missions against the Japanese mainland and other military operations until it was completely decommissioned in 1949. The neighboring North Field has continued to be used and has been expanded to support Cold War-era military aircraft operations.

During initial development of NWF in 1944, much of the ROI or APE and surrounding land was leveled and cleared of vegetation, a subject that will be addressed in additional detail below (USAF 2000). Vegetation clearance continued during the Korean War era, and vegetation has since been cleared periodically from paved surfaces and the edges of runways for operational safety of training and other uses of the area (USAF 2000). Most of the original buildings at NWF were wood frame structures with fabric or metal walls; a small number had concrete foundations or slabs. NWF no longer has any original standing buildings associated with it, and now consists of paved runways, taxiways, service aprons, hardstands, and building foundations (Grant et al. 2007). Any World War II-era buildings remaining after the airfield was decommissioned in 1949 were destroyed by typhoons or were later demolished by the U.S. military (Aaron et al. 2007).

Although NWF was nominated to the NRHP in 1997, but not officially listed in the NRHP, it was determined eligible for the NRHP by the Keeper of the National Register in November 1998 (reference no. 65009786). The property is significant under NRHP Criterion A for its contribution to history, specifically to U.S. efforts against Japan in World War II. It was used as an airfield for B-29B aircraft of the 315th Bomb Wing. These specialized bombers were stripped of most armament and equipped with improved AN/APQ-7 radar. They were also able to carry greater payloads than conventional B-29s (Olmo 1997). These modifications allowed the B-29Bs from NWF to conduct raids on mainland Japan that were critical in destroying that country's oil infrastructure. The 1997 nomination form also recommended NWF as eligible under NRHP Criterion C, but does not provide a justification or explanation for that recommendation. Northwest Field was the subject of HAER documentation in 2007 (Aaron et al. 2007) as mitigation of adverse effects of military action associated with the 554th RED HORSE squadron deployment to the installation under a Section 106 Memorandum of Agreement signed in October 2006 between Andersen AFB and the Guam Historic Resources Division. The HAER documentation of NWF is in the Library of Congress (HAER-GU-5). The boundaries of the NWF historic property were expanded in 1998 and are larger than the site boundary on the 1997 NRHP nomination, which included only the two runways and the paved areas south of the runways. The historic property now encompasses approximately 2,120 acres (858 hectares), including approximately 204 acres (83 hectares) of paved runways, taxiways, service aprons, and hardstands. Both the THAAD original expeditionary emplacement (April 2013) and the compressed expeditionary emplacement (2014)/proposed permanent emplacement fall entirely within the boundary of the NWF historic property. All but 2.2 acres (0.9 hectares) of the proposed CDZ expansion area are within the boundaries of the NWF historic property.

Since NWF was decommissioned as an airfield, the facility's taxiways, runways, and surrounding lands have been used for a variety of military purposes, including hosting the 554th RED HORSE civil engineering squadron. Much of the area was further leveled, cleared of vegetation, and kept clear of vegetation for use of the CDZ addressed in the CDZ EA (USAF 2000).

Andersen AFB was the subject of traditional cultural properties studies in 2004, which identified two such properties in or near Andersen AFB, both of which are significant to Guam's Chamorro population (JGPO 2010). The Tarague Historic District is a traditional property for which the 2009 study identified archaeological, legendary, and ethnographic associations (JGPO 2010). It is located approximately 1.3 miles (2.1 kilometers) southeast of the THAAD battery APE. The Jinapsan Complex is a traditional cultural property with archaeological and ethnographic associations (JGPO 2010). It is located approximately 1 mile (1.6 kilometer) east-northeast of the THAAD battery APE. Both traditional cultural properties are on the coastal plain about 460 feet (140 meters) below the limestone plateau on which NWF and the THAAD battery are located.

Based on the Andersen AFB geospatial data (Andersen AFB 2014), the 2010 FEIS (JGPO 2010), the archaeological survey report prepared in support of that FEIS (Dixon et al 2010), and the CDZ EA (USAF 2000), much of NWF had been surveyed for cultural resources prior to the THAAD system expeditionary deployment. These surveys were conducted over the course of three decades and varied in method and intensity of coverage. Of the approximately 365.7 acres (148.0 hectares) in the total THAAD emplacement and CDZ expansion APE, approximately 139.1 acres (56.3 hectares) had been surveyed for archaeological resources prior to the system's expeditionary deployment in April 2013 (see **Figures 3-2, 3-3, and 3-4**). Of the 11,759 feet (3,584 meters) of proposed linear fence and fiber optic line trench that is not contained within the previously mentioned 365.7-acre (148.0-hectare) area, 7,789 feet (2,374 meters) had been surveyed prior to the THAAD system's expeditionary deployment.

The original expeditionary emplacement area (April 2013) and the compressed expeditionary emplacement (2014)/proposed permanent emplacement area contain a small number of archaeological resources first identified after the THAAD system emergency deployment. An archaeological survey of the original expeditionary emplacement area was conducted by the Navy in May 2013 following the vegetation clearing for the expeditionary THAAD system deployment (Rogers 2013). The survey included the approximate 35.7 acres (14.4 hectares) of forest and perennial scrub vegetation that was cleared. According to the surveyor's field notes, the project identified seven prehistoric, Latte-period pot sherds scattered across a roughly 1,230 × 160-foot (375 × 50-meter) area south of the South Runway. The surveyor recorded these artifacts as isolated occurrences, not archaeological sites. However, the field notes report that the survey also identified an archaeological site consisting of 13 prehistoric pot sherds east of the south runway. The isolated artifacts and the site were in areas that had not been previously surveyed for archaeological resources. The surveyor's field notes concluded that the newly recorded isolated artifacts and newly recorded archaeological site lacked archaeological significance and integrity. He recommended the site and isolated occurrences as not eligible for listing on the NRHP. It is not possible to definitively determine whether these archaeological materials retained integrity prior to the vegetation clearance for expeditionary deployment of the THAAD system. As noted above, the NWF area has been subject to considerable modification of the landscape and vegetation beginning with the airfield's construction. Historic aerial photographs indicate that the THAAD battery APE was subject to extensive vegetation removal and earthwork during the site preparation, construction, and maintenance of the airfield. **Figure 3-5**, taken when the airfield was in service during World War II, shows a lack of vegetation in most of what is now the THAAD emplacement and CDZ expansion area, and an isolated pocket of vegetation in what is now Area 50. Construction of the airfield involved months of labor with the use of dynamite and jackhammers to smooth uneven ground (Aaron et al. 2007). Later, a portion of the original THAAD battery APE was used as a USAF CDZ training area and subject to vegetation clearance and ground leveling (USAF 2000). These activities likely affected the existence and integrity of

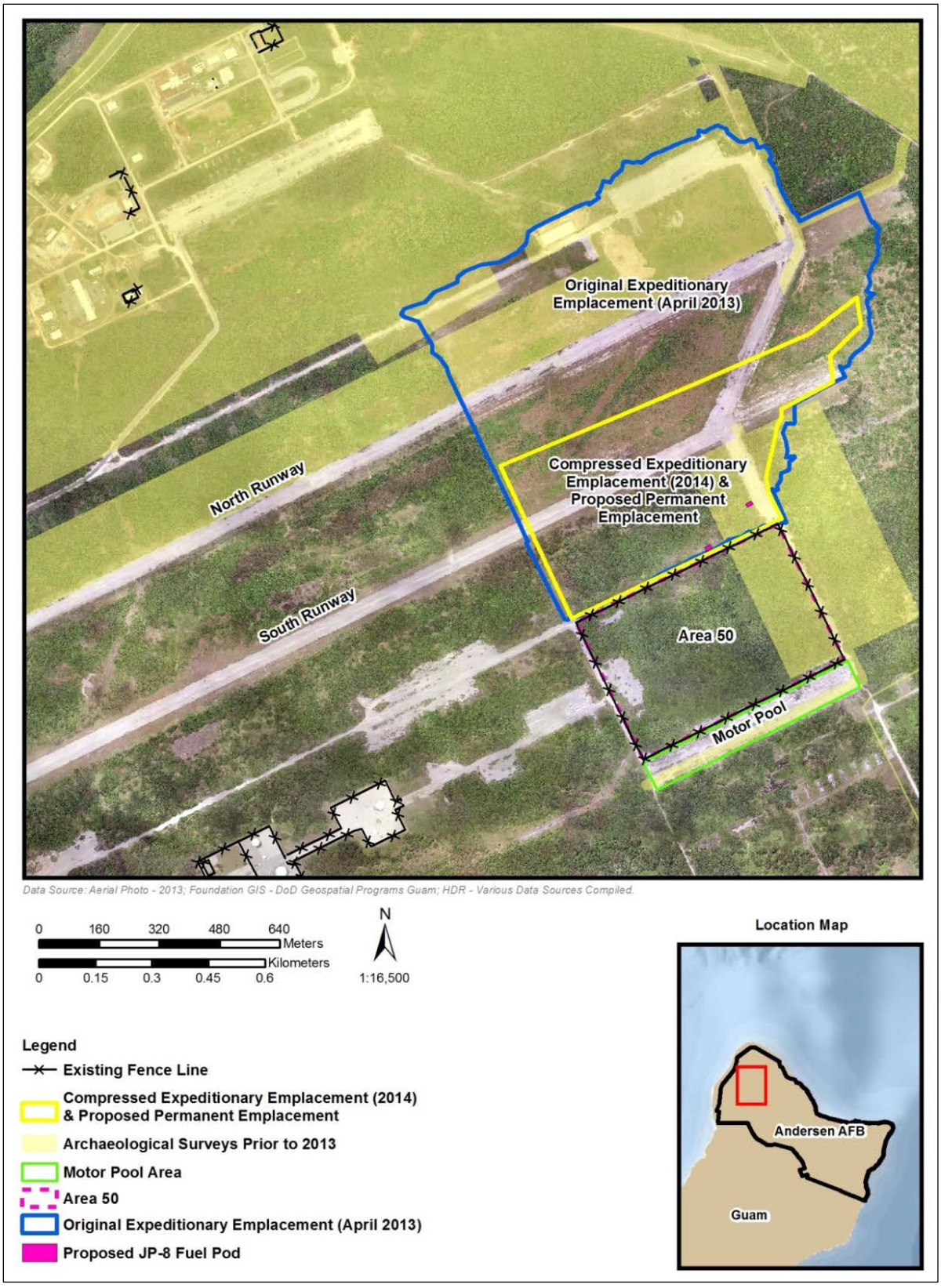


Figure 3-2. THAAD Emplacement Site for Alternative 1 in Relation to Prior Archaeological Surveys

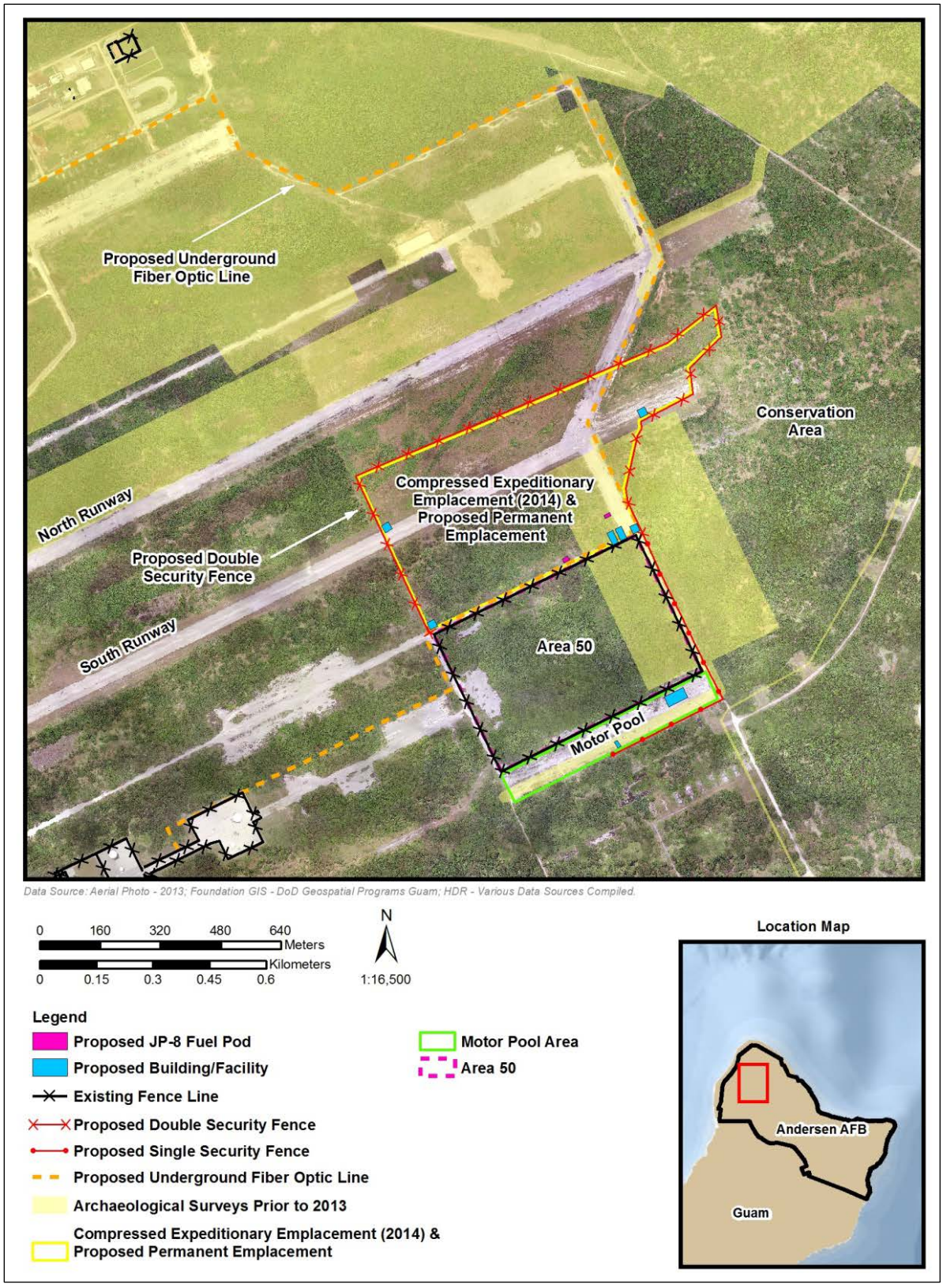


Figure 3-3. THAAD Emplacement Site for Alternative 2 in Relation to Prior Archaeological Surveys

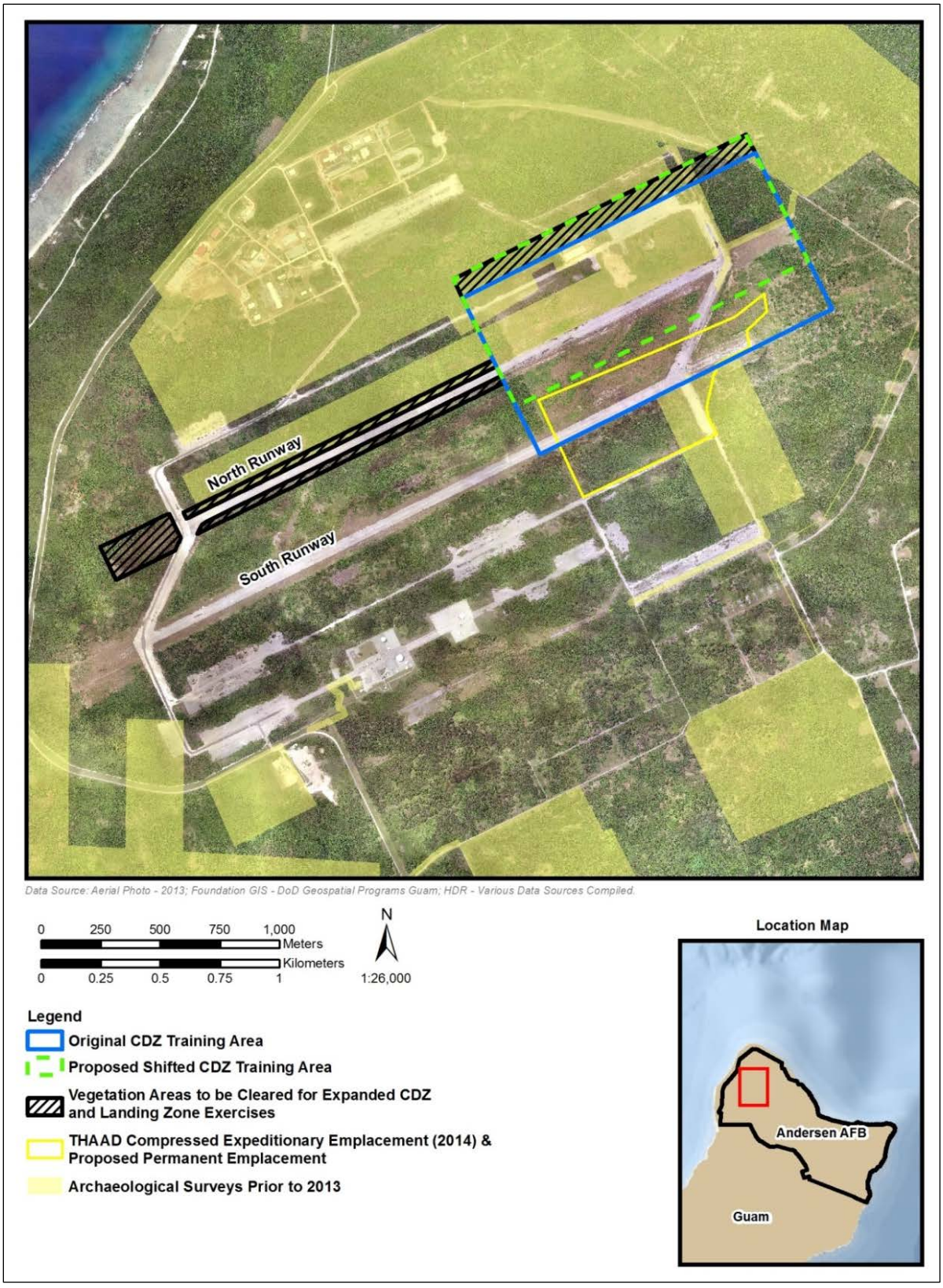


Figure 3-4. CDZ Expansion Area for Alternative 2 in Relation to Prior Archaeological Surveys

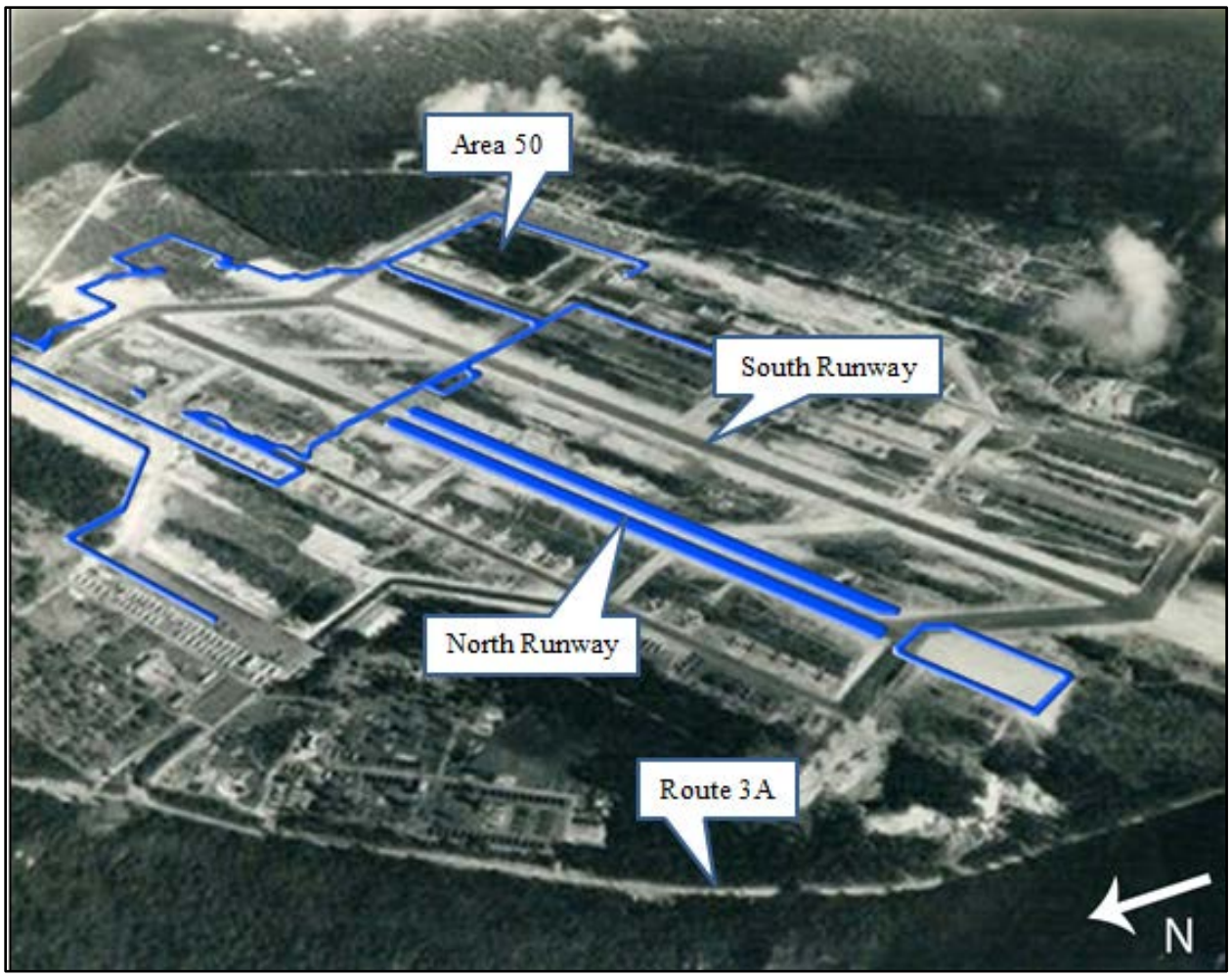


Figure 3-5. World War II-Era Aerial Photograph of Northwest Field Showing the Approximate Boundaries of the THAAD Emplacement and CDZ Expansion Area

any archaeological sites that may have been present in the THAAD system emplacement area and the CDZ expansion area prior to the construction of NWF.

Other archaeological sites have been identified close to but outside the THAAD original expeditionary emplacement and the proposed permanent emplacement areas, and the CDZ expansion area. These sites were recorded during an archaeological survey (Dixon et al. 2011) conducted as part of the 2010 FEIS (JGPO 2010). That survey recorded two prehistoric Latte-period sites outside the original and compressed THAAD system emplacement areas, but close to the proposed security fence around the existing Area 50. One of those sites, a scatter of Latte-period pot sherds, is approximately 490 feet (150 meters) from the proposed fence; the other site, a complex of cobble mounds and walls associated with Latte-period pot sherds, is approximately 82 feet (25 meters) from the proposed fence. Both of these prehistoric sites were recommended eligible for listing in the NRHP by Andersen AFB. The survey also recorded three World War II/Cold War-era archaeological sites that Andersen AFB recommended not eligible for listing in the NRHP. These sites include a scatter of World War II-era aircraft fragments and bottles, a scatter of Cold War-era automobile parts and other artifacts, and a complex of concrete pads dating to the World War II or Cold War eras. The two historic artifact scatters are approximately 300 feet (91 meters) or more from the APE for direct effects. The concrete pads are immediately adjacent to the motor pool. These three historic-period sites were recommended as not eligible for listing in the NRHP due to their lack of

integrity. The two prehistoric sites and the two historic artifact scatters were identified in areas that World War II-era photographs suggest were not disturbed by the construction of NWF.

3.6 Airspace Management

Airspace management at Guam is described in this section in terms of its principal attributes: controlled and uncontrolled airspace, SUA, en route airways and jet routes, airports and airfields, and air traffic control.

3.6.1 Region of Influence

The ROI for airspace includes the airspace over and surrounding the island of Guam. **Figure 3-6** shows a view of the airspace within Guam to include the Class D Airspace for Andersen AFB and Guam International Airport.

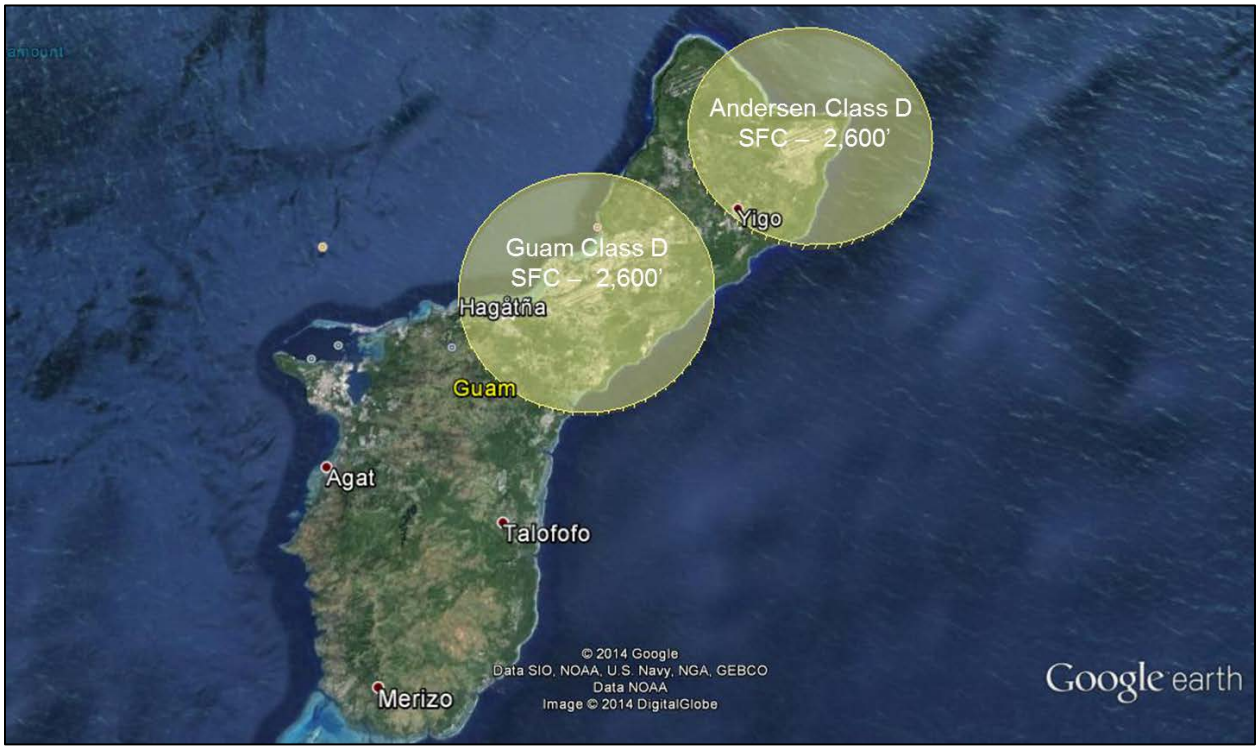


Figure 3-6. Guam International Airport and Andersen AFB Class D Airspace

3.6.2 Existing Condition

Guam International Airport

Guam International Airport is a primary regional airport serving passenger and cargo needs between Guam, the continental United States, Asia, Australia and various islands in the Pacific region. The airport is open 7 days a week, 24 hours a day. Guam International Airport is a public airport. Public airport means an airport that is owned by a political subdivision of this state or that is otherwise open to the public. Public airports are eligible for Federal funding.

Guam International Airport has Class D Airspace (see **Figure 3-6**), which only surrounds airports that have an operational control tower. Class D airspace is also tailored to meet the needs of the airport. The

Guam International Airport's Class D airspace extends from the surface upward to and including 2,600 feet (792.5 meters) msl within a 4.3-nautical mile radius of coordinates N13°29.04' / E144°47.83' (FAA 2012a). The FAA operates the air traffic control (ATC) tower through a SERCO contract at Guam International Airport. The ATC tower is responsible for the separation and efficient movement of aircraft and vehicles operating on the taxiways and runways of the airport itself, and aircraft within Guam's Class D Airspace.

Guam International Airport has 14 terminal instrument procedures (see **Table 3-5**) (SkyVector.com 2014). Terminal instrument procedures are a series of predetermined maneuvers for the orderly transfer of an aircraft under Instrument Flight Rules to initiate an approach to an aerodrome to a landing, or to a point from which a landing may be made visually.

Table 3-5. Guam International Airport Terminal Instrument Procedures

ILS or LOC RWY 06L	ILS or LOC RWY 06R	RNAV (RNP) Z RWY 06L
RNAV (RNP) Z RWY 06R	RNAV (RNP) Z RWY 24L	RNAV (RNP) Z RWY 24R
RNAV (GPS) Y RWY 06L	RNAV (GPS) Y RWY 06R	RNAV (GPS) Y RWY 24L
RNAV (GPS) Y RWY 24R	VOR/DME or TACAN RWY 06L	NDB/DME RWY 24R
VOR - A	TACAN 24R	

Andersen AFB

At Andersen AFB, the 36th Wing's mission is to provide support to deployed air and space forces of the USAF and foreign air forces, and to support tenant units assigned to the base. With an active military airfield, Andersen AFB provides basing and support to military aircraft. The airfield is open 7 days a week, 24 hours a day.

Andersen AFB has Class D Airspace (see **Figure 3-6**). Andersen Airfield's Class D airspace extends from the surface upward to and including 2,600 feet (792.5 meters) msl within a 4.3-nautical mile radius of coordinates N13°35.03' / E144°55.80' (FAA 2012a). The USAF operates the ATC tower at Andersen AFB. The ATC tower is responsible for the separation and efficient movement of aircraft and vehicles operating on the taxiways and runways of the airport itself, and aircraft within Andersen AFB Class D Airspace.

Andersen AFB Airfield has 14 terminal instrument procedures (**Table 3-6**).

Table 3-6. Andersen AFB Terminal Instrument Procedures

ILS or LOC/DME RWY 06R	ILS or LOC/DME RWY 06L
ILS or LOC/DME RWY 24R	ILS or LOC/DME RWY 24L
TACAN Z RWY 06L	TACAN Z RWY 06R
HI ILS or LOC/DME RWY 06L	HI TACAN Z RWY 06L
TACAN Z RWY 24L	TACAN Z RWY 24R
TACAN Y RWY 06L	TACAN Y RWY 06R
TACAN Y RWY 24L	TACAN Y RWY 24R

Northwest Field

NWF was constructed in 1944–45 on the northern end of Guam as a base for B-29 Super Fortresses to carry out the strategic bombing campaign against the Japanese. Today the airfield is all but abandoned, except for the runways, taxiways, and the CDZ that have been used by Andersen AFB units for airborne training purposes.

There are no terminal instrument procedures to NWF.

FAA Center Radar Approach Control (CERAP) on Guam.

Air traffic control services on and around Guam, except within Andersen AFB Class D Airspace, are provided by Guam's CERAP. Air traffic control services are provided for the purpose of safely transiting aircraft to and from airports and airfields, through controlled airspace, maneuvering aircraft within close proximity to each other and obstructions, and maintaining an orderly flow of air traffic.

Class E Airspace

Within 100 nautical miles of the Nimitz VHF Omnidirectional Radio (VOR), excluding Class G Airspace, Class E Airspace on Guam extends upward to the floor of Class A airspace. Between sunrise and sunset, Class E airspace extends up to but not including 20,000 feet (6,096 meters) msl (FL200). Between sunset and sunrise, Class E airspace extends up to but not including 5,500 feet (1,676 meters) msl (FAA 2003, 2012b).

3.7 Hazardous Materials and Wastes

Pursuant to 49 CFR § 171.8, hazardous materials include hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials designated as hazardous in the Hazardous Materials Table (49 CFR § 172.101), 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. These regulations are codified within 49 CFR Parts 105 to 180.

Hazardous waste is defined by the Resource Conservation and Recovery Act (RCRA) at 42 U.S.C. § 6903(5), 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. Several types of waste are currently covered under the universal wastes regulations: batteries, pesticides, and mercury containing equipment and lamps that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps.

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), and lead-based paint (LBP). The USEPA is given authority to regulate these special hazard substances by the Toxic Substances Control Act (TSCA) Title 15 U.S.C. Chapter 53. The USEPA has established regulations regarding asbestos abatement and worker safety under 40 CFR Part 763 with additional regulations concerning emissions under 40 CFR Part 61. Whether from lead abatement or other activities, depending on the quantity or concentration, the disposal of the LBP waste is regulated by RCRA at 40 CFR Part 260. The disposal of PCBs is addressed in 40 CFR Parts 750 and 761.

The DoD established the Defense Environmental Restoration Program (DERP) 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 IRP and the Military Munitions Response Program (MMRP) are components of the DERP. The Installation Restoration Program requires each DoD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The MMRP addresses nonoperational rangelands that are suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituent contamination.

Asbestos is regulated by the USEPA and the CAA; TSCA; and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). USEPA has established that any material containing more than 1 percent asbestos by weight is considered ACM. In 1989, the USEPA issued a final rule under Section 6 of TSCA banning most ACMs. In 1991, this rule was vacated and remanded by the Fifth Circuit Court of Appeals. As a result, most of the original ban on the majority of the ACMs originally covered in the 1989 final rule was overturned; however, specific ACMs remain banned and the final rule continues to ban the use of asbestos in products that have not historically contained asbestos, otherwise referred to as "new uses" of asbestos.

3.7.1 Region of Influence

The ROI for potential impacts related to hazardous materials and wastes would be the area of the Proposed Action within NWF of Andersen AFB.

3.7.2 Existing Conditions

Air Force Instruction (AFI) 32-7086 (*Hazardous Materials Management*) establishes procedures for the management of hazardous materials at all Air Force installations. AFI 32-7086 incorporates the requirements of Federal regulations, other AFIs, and DoD directives for reducing the use of hazardous materials. Andersen AFB has a Hazardous Material Management Process (HMMP) pursuant to AFI 32-7086 that is designed to guide and instruct all Air Force personnel involved in authorizing, procuring, using, managing, or disposing of hazardous materials. This plan specifically addresses hazardous materials management, transportation, spill/release control and containment, and clean up (JGPO 2010). Andersen AFB also has a Hazardous Waste Management Plan (HWMP) pursuant to AFI 32-7042 (*Waste Management*). The HWMP provides guidance for personnel regarding the proper handling, storage, and disposal of hazardous waste (JGPO 2010). The 36th Civil Engineering Squadron is responsible for overseeing the management of hazardous waste at Andersen AFB.

Hazardous Materials and Petroleum Products. Hazardous materials are managed by the installation's hazardous materials pharmacy. The Andersen AFB pharmacy reduces the need to store large quantities of hazardous materials elsewhere on base and allows these materials to be efficiently reordered on an as-needed basis. Routine operations at DoD installations require the storage, use, and handling of a variety of hazardous materials. Hazardous materials include POLs, cleaning agents, adhesives, and other products necessary to perform essential functions. Bulk quantities of fuels and other POLs are stored and distributed in aboveground storage tanks (ASTs) and underground storage tanks (USTs), pumps, and pipelines (JGPO 2010).

Numerous fueling operations to support aircraft, vehicle operation, and emergency power generation are performed at Andersen AFB. The majority of fuel handled at Andersen AFB is aviation fuel. The installation has the capacity to store approximately 66,000,000 gallons (249,837,178 liters) of aviation fuel (JGPO 2010). Fuel storage facilities on the installation have the primary and secondary containment and leak detection features required to contain unintended leaks, spills, and releases. Bulk jet fuel is sent

to Andersen AFB from fuel facilities at Apra Harbor via pipelines. Diesel and gasoline are delivered to the installation by tanker truck (JGPO 2010).

Hazardous and Petroleum Wastes. Andersen AFB is a Large Quantity Generator (40 CFR § 262.34 [d], [e], and [f]) of hazardous wastes with USEPA identification handler number GU6571999519. There are 21 (or up to 26 depending on operations) satellite accumulation areas (initial accumulation points) for hazardous waste on Andersen AFB and one 90-day hazardous waste accumulation site (Building 19017), located on the eastern side of the installation. Hazardous wastes originating from the NWF are not transported to the 90-day site because that would require transport through the secure installation MSA. The Defense Logistics Agency, Disposition Services arranges for all hazardous waste collection, transportation, and disposal via licensed contractors who ultimately dispose of the hazardous waste at permitted off-island disposal facilities (JGPO 2010).

Defense Environmental Restoration Program. Andersen AFB has 80 IRP sites located within six operable units (OUs). The OUs are based on geographical locations. There are no IRP sites within the Proposed Action area. The proposed underground fiber optic line does run along a short portion of IRP Site 53, Service Apron H and Quonset Huts. Polycyclic aromatic hydrocarbons and metals were found to be present in the soil. This site was remediated via soil excavation in 2010 and a Response Action Completed Report prepared in February of 2012. No further action is required at this site (DoN 2013a).

No MMRP sites are located within the ROI (DoN 2013a).

Special Hazards (ACM, LBP, PCB). There are no structures that would contain ACMs in the ROI. Potentially, there could be abandoned-in-place asbestos cement (transite) water pipes in the ROI (Clark 2014). There are no structures that would contain LBP within the ROI. There are no structures or utilities that would contain PCBs within the ROI.

Pesticides. In accordance with DoD policy on pest management, integrated pest management principles should be used to help minimize the use of pesticides. The objective of integrated pest management is to use ecologically, economically, and socially sound strategies to control or keep pests at tolerable levels. A full range of pest control options including biological, mechanical, and chemical may be employed after careful consideration of the pest's biology, the damage or infestation thresholds that require action, and the impacts each control alternative would have on the environment.

Any herbicide used at Andersen AFB must be on the installation's list of approved pesticides provided in the installation's Pest Management Plan (Andersen AFB 2014b). All installation pest management personnel who apply or supervise the application of pesticides must be trained and certified within 2 years of employment in accordance with the DoD Plan for the Certification of Pesticide Applicators of Restricted Use Pesticides.

Radon. Radon is a naturally occurring radioactive gas found in soils and rocks. Radon has the tendency to accumulate in enclosed spaces that are usually below ground and poorly ventilated (e.g., basements). Radon is an odorless, colorless gas that has been determined to increase the risk of developing lung cancer. In general, the risk increases as the level of radon and length of exposure increases.

Radon naturally occurs at high levels on Guam. USEPA has established a guidance radon level of 4 picocuries per liter (pCi/L) in indoor air for residences; however, there have been no standards established for commercial or industrial structures. Radon gas accumulation greater than 4 pCi/L is considered to represent a health risk to occupants. Northwest Field has a Zone 1 listing for radon. Zone 1 areas have a predicted average indoor radon screening level greater than 4 pCi/L (USEPA 2012b).

3.8 Human Health and Safety

Health and safety includes consideration of any activities, occurrences, or operations that have the potential to affect one or more of the following:

The well-being, safety, or health of workers—Workers are considered to be persons directly involved with the operation producing the effect or who are physically present at the operational site.

The well-being, safety, or health of members of the public—Members of the public are considered to be persons not physically present at the location of the operation, including workers at nearby locations who are not involved in the operation and the off-installation population.

Also included within this category are hazards to equipment and structures.

3.8.1 Region of Influence

The ROI for potential impacts to human health and safety would be the areas associated with the Proposed Action, including adjacent land uses and adjacent airspace. The population of concern for the Proposed Action consists of the people directly involved with the Proposed Action and its activities. This is because the Proposed Action would occur on a remote portion of a secure installation.

3.8.2 Existing Conditions

To help ensure the safe conduct of operations at Andersen AFB and other installations, the USAF has developed policies and procedures for implementing safety and health requirements. Air Force Policy Directive 91-2 (Safety Programs) establishes the USAF's key safety policies and also describes success-oriented feedback and performance metrics to measure policy implementation.

Contractors working on Andersen AFB follow applicable Occupational Safety and Health Administration regulatory requirements (29 CFR), except when DoD or USAF-specific requirements apply. Implementation of these regulatory requirements and procedures ensure that there is minimal risk to the health and safety of installation personnel and contractors, as well as to the general public, from installation operations.

Explosive safety quantity distance arcs have been established for NWF and the MSA. Explosives handling and storage is the primary function of the MSA. The area of the Proposed Action is within the MSA ESQD arc. All facility construction within an ESQD must comply with the requirements found in DoD Manual 6055.09-M and Air Force Manual 91-201. All facility construction or use within ESQD arcs requires review for compliance with explosives safety criteria and must have either an approved explosives safety site plan or an approved explosives safety deviation (DoD 2013).

See **Section 3.6** for a description of existing airspace conditions.

3.9 Socioeconomics

Socioeconomics describes a community by examining its social and economic characteristics. Several demographic variables are analyzed to characterize the Guam community, including population size and employment. In addition, socioeconomics analyzes the economic activity and the allocation of the assets of the community, such as housing and public services.

3.9.1 Region of Influence

The socioeconomic ROI for the Proposed Action is defined as the island of Guam, which covers 212 square miles (549 square kilometers). Because of the location of the Proposed Action, the geographic extent of the ROI includes characteristics on Andersen AFB and the northern portion of Guam.

3.9.2 Existing Conditions

Population. Guam's population as of the most recent full U.S. Census of 2010 was 159,358. The island's population has grown significantly since Guam became a U.S. Territory in 1950. From 1950 to 2000, Guam's population grew at an average rate of about 2.1 percent annually. However, population growth tapered off since then and is expected to stabilize over the next 20 years at around 1.5 percent per year. As of 2010, 42.5 percent of Guam's population lived in households in the island's northern region (GBSP 2014, JGPO 2014).

Guam's active duty military population has remained constant at about 6,200 from 2004 through 2011, but declined in 2012 and 2013 to approximately 4,750 personnel. The total active-duty population on Guam in 2013 was at the lowest level in the past 15 years, since 1998 (GBSP 2014, JGPO 2014). For Andersen AFB, the current active-duty population is about 2,334, while the total base population is approximately 7,770 (nearly 5 percent of Guam's total population) (DoD 2014).

Employment. From 2000 to 2011, as measured by the U.S. Bureau of Labor Statistics, Guam added 2,560 jobs (from 57,000 to 59,560), an increase of 4.5 percent. More recently, between 2011 and 2012, Guam's unemployment rate dropped from 13.3 percent to 11.8 percent in March of 2012, which was higher than the national rate of 8.2 percent at that time (GBSP 2014, JGPO 2014).

Income Sources. The DoD is a major source of revenue in Guam with $1.1 billion in total spending by the armed services in 2010. Additional non-defense Federal spending in 2010 was $0.9 billion. Tourism is another major source of revenue for the island, with over 1 million tourists per year visiting the island, primarily from Japan. The direct annual tourist spending in Guam is about $1 billion (USDOI 2014).

Housing. As of the 2010 Census there were approximately 50,560 housing units on Guam. Almost 17 percent of these units were vacant. In 2010, the northern region had a total of 18,716 housing units, which comprised 37 percent of the total number of housing units on Guam. Based on information from the Guam Department of Land Management, there was capacity to house approximately 4,200 temporary workers as of January 2013. Overall, Guam had a very high housing vacancy rate (15.2 percent in 2010, compared to the U.S. nationwide figure of 11.4 percent) (GBSP 2014, JGPO 2014). Andersen AFB currently has 1,225 family housing units and vacancy rates can vary from month-to-month (DoD 2014).

Public Services. In school year 2011–2012, the Guam Department of Education employed 3,377 full time equivalent teachers and staff positions. All primary and secondary schools during the fall of that school year had an enrollment of 40,262. The Guam Department of Education has identified the need to construct no less than four additional schools (two elementary schools, one middle school, and one high school) due to the growing island population (JGPO 2014).

As of 2011, Guam had one public hospital (Guam Memorial Hospital), 30 pharmacies, and 77 clinics. A new private hospital known as Guam Regional Medical City is expected to open in early 2015. There is also a U.S. Naval Hospital on Guam. Since 1988, Guam has been considered a Medically Underserved Area, demonstrating the island's difficulty in meeting its health care needs. Its remote location reduces access to specialized care and makes recruiting specialists from the U.S. mainland difficult (JGPO 2014).

Government agencies on Guam involved in law and traffic enforcement, fire prevention and suppression, emergency medical response, safety inspections, and civil and criminal litigation, justice, and corrections are all considered public safety agencies. In 2012, agency staffing included 303 sworn officers in the Guam Police Department, approximately 258 full time sworn personnel in the Guam Fire Department, and 214 full-time staff employed in the Guam Department of Corrections (JGPO 2014).

3.10 Utilities and Transportation Infrastructure

Utilities refers to what is typically public utilities that are provided to the general population for basic services, including electrical power, information technology/communications (IT/COMM), potable water, wastewater collection and treatment, and solid waste disposal. In the case of Andersen AFB, some utilities are serviced or supplied by utility systems on base, while others are provided by off-base DoD or public services. Utilities take into consideration distribution line accessibility, supporting infrastructure, and system capacities.

Transportation infrastructure in this case refers to roadways internal to Andersen AFB (on-installation roadways and intersections) and entry control facilities, but also takes into consideration local roadways and highways that are off the installation.

3.10.1 Region of Influence

For this analysis, the ROI for utilities and roadway transportation infrastructure focuses on Andersen AFB Main Base and the THAAD emplacement area of NWF, but it also includes outside infrastructure servicing the installation.

3.10.2 Existing Conditions

Electrical Power. The Guam Power Authority transmission and generation system provides all of the electrical power used on-island including Andersen AFB. The capacity of the installation main substation has been upgraded, and distribution lines are currently being installed and planned in order to provide power to new projects that are either under construction, or are in the design or planning stages. Thus, the on-installation distribution system is now, or soon will be, operating with excess capacity. The estimated excess capacity of the main substation is approximately 4 megavolt ampere over the combined present and estimated future loads. In cases of local or island-wide power outages, the installation has dedicated emergency (standby) generators to maintain power to critical facilities (JGPO 2014).

Within the THAAD emplacement area, there are no electrical utility lines and none are currently planned. The nearest power lines to the site consist of a DoD three-phase 13.8 kilovolt overhead power distribution system serving the installation RED HORSE Squadron facilities located approximately 0.7 mile (1.2 kilometer) to the northwest (JGPO 2014).

IT/COMM. The existing IT/COMM utilities at Andersen AFB includes existing DoD and commercial telecommunication duct banks, manholes/handholes, and connection buildings (JGPO 2014). For the THAAD emplacement site, there is no known IT/COMM infrastructure in the vicinity. The nearest IT/COMM connections are at the RED HORSE Squadron facilities located approximately 0.7 mile (1.2 kilometer) to the northwest.

Potable Water. Andersen AFB currently gets its water from seven wells at Andersen South and an additional five wells constructed on the southern portion of NWF. The well water produced is stored, disinfected, fluoridated, and then distributed. The existing on-base water distribution system includes a pump station, three storage tanks, and several hundred thousand feet of distribution lines. Unaccounted

for water loss in the distribution system (estimated at 50 percent in 2010) has been reduced to around 35 percent through water leak detection and repairs. Further improvements to reduce water loss are planned (JGPO 2014).

For the THAAD emplacement site, there are no water distribution lines in the vicinity. The nearest underground water lines are at the RED HORSE Squadron facilities located approximately 0.7 mile (1.2 kilometer) to the northwest. Potable water for these facilities is provided by one of the NWF wells (JGPO 2014).

Wastewater Collection and Treatment. The existing Andersen AFB wastewater collection system consists of a network of gravity sewer lines, with four major wastewater pump stations and force mains located on the south side of the Main Base. The system collects wastewater generated by the industrial and residential areas on-base and discharges wastewater off-base into the Guam Waterworks Authority (GWA) sewage collection system. This sewage flows through the GWA collection system to the Northern District Wastewater Treatment Plant (WWTP) for treatment and disposal.

The Northern District WWTP has a design capacity of 12 million gallons per day (45.4 million liters per day). Following the completion of upgrades at the WWTP in 2012, a capacity evaluation has shown that the plant has the capacity to treat up to 9 million gallons per day (34 million liters per day) of wastewater to primary treatment standards. The WWTP, however, is currently unable to meet the new secondary treatment discharge limits of the 2013 National Pollutant Discharge Elimination System (NPDES) permit; thus, the plant is currently in a state of noncompliance with the permit. To meet the new discharge requirements of the 2013 permit requires negotiations between the GWA and the USEPA (JGPO 2014).

For the THAAD emplacement site, there are no wastewater collection lines in the vicinity. The nearest sanitary sewer connections are at the RED HORSE Squadron facilities located over 3,750 feet (1,143 meters) to the northwest (JGPO 2014).

Solid Waste Disposal. The Andersen AFB landfill is no longer used for municipal solid waste disposal and is in the closure process now that the Government of Guam landfill at Layon is open and receiving solid waste. The base now operates a transfer station for sorting waste bound for the Layon landfill. Other waste not accepted at the landfill (e.g., construction and demolition waste) continues to be disposed of at either Andersen AFB or at the Naval Base Guam Apra Harbor facilities. Andersen AFB also continues to operate its recycling center. No capacity concerns have been identified for any of the current landfill operations (JGPO 2014).

Roadways. Andersen AFB Main Base has two access gates to the cantonment area off of Routes 1 and 15. NWF can be accessed via the Route 3A gate or using base internal roadways. All of the Andersen AFB roadways are two lanes (one lane in each direction), with additional separate turning lanes at major intersections. The installation's 2009 Traffic and Safety Engineering Study concluded that most of the on-installation intersections were operating at an acceptable Level of Service, with the exception of several intersections along Arc Light Boulevard in the base cantonment area (JGPO 2014).

In the vicinity of the THAAD emplacement site, former aviation operating surfaces comprise the paved network of roads, supplemented by unpaved connector roads and trails.

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4. Environmental Consequences

This chapter presents the potential environmental consequences of the Proposed Action and No Action Alternatives when compared to the 10 affected environment resource areas described in **Chapter 3**. **Section 4.1** provides a detailed analysis of the potential effects of implementing Alternative 1, Alternative 2, and the No Action Alternative under each resource topic. A cumulative impact analysis of the alternatives' incremental effects when added to other past, present, and reasonably foreseeable future actions is presented in **Section 4.2**. **Section 4.3** provides a summary of the overall environmental effects associated with the original AMDTF Preferred Alternative analyzed in the 2010 FEIS (JGPO 2010). This earlier analysis information is included for the purpose of comparing the AMDTF-related impacts to the potential effects of the Proposed Action analyzed in this EA. Additional analyses to address any concerns from Executive Order (EO) 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) and EO 13045 as amended by EO 13229 (Federal Actions to Address Protection of Children from Environmental Health Risks and Safety Risks) are discussed in **Sections 4.4** and **4.5**.

4.1 Environmental Consequences of the Proposed Action and No Action Alternatives

In determining whether the Proposed Action and No Action Alternatives could have a significant effect on the environment, this EA considered each phase of the action. Under each environmental consequence discussion for Alternatives 1 and 2 that follows, the impact analyses are arranged according to (1) the near-term site preparation and construction activities (including forest clearing, grubbing and grading, and soil stabilization) and (2) the long-term operation of the THAAD battery (including equipment maintenance and vegetation management within the emplacement site). The environmental consequences of removing the THAAD battery under the No Action Alternative are then discussed.

The amount of discussion presented in each section of the analysis is proportional to the potential for impacts and the complexity of those impacts. Both direct and indirect impacts[4] are addressed where applicable. Appropriate environmental management and monitoring actions and requirements are also included, where necessary. A list of all agencies and organizations consulted as part of this analysis is provided in **Chapter 6**.

4.1.1 Air Quality

The environmental consequences on local and regional air quality conditions from a proposed Federal action are determined based upon the increases or decreases in regulated air pollutant emissions and upon existing conditions and ambient air quality. The evaluation criteria are dependent on whether a proposed action is located in an attainment, nonattainment, or maintenance area for criteria pollutants.

For attainment areas, a proposed action would be considered significant if the net increases in pollutant emissions would result in any one of the following scenarios:

- Cause or contribute to a violation of any national or Guam ambient air quality standard
- Expose sensitive receptors to substantially increased pollutant concentrations
- Exceed any evaluation criteria established by a SIP
- Cause an increase of 250 tpy of any attainment criteria pollutant from mobile sources.

[4] *Direct* impacts are caused by the action and occur at the same time and place. *Indirect* impacts occur later in time or are farther removed in distance, but are still reasonably foreseeable.

Although the fourth bullet above (i.e., cause an increase of 250 tpy of any attainment criteria pollutant from mobile sources) is not a regulatory driven threshold, it is being applied as a conservative measure of significance in attainment areas. The rationale for applying this conservative threshold to mobile sources is that it is consistent with the threshold for a PSD major source (i.e., stationary source) in attainment areas.

While not a measure of significance under the NEPA, stationary source air emissions from a proposed action can be compared to the thresholds for Major New Source Review (NSR) air quality construction permitting and Title V operating permits to show the relative significance of an action compared to regulatory requirements. This comparison is not a measure of significance because obtaining these types of air permits demonstrates that the action is in conformance with the SIP.

With respect to the CZMA and GCMP, the Proposed Action would result in minor to moderate adverse effects on air quality from the addition of new stationary and mobile air emission sources to Guam. The Proposed Action, however, would comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality. Therefore, the Proposed Action would be consistent with the CZMA and GCMP policies. The 94th AAMDC will prepare and submit a CZMA Consistency Determination to the GBSP requesting their review and concurrence.

4.1.1.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.1.1.1 Site Preparation and Construction Activities

Short-term, negligible, adverse effects on air quality occurred from the site preparation and construction activities associated with the initial deployment of the expeditionary THAAD battery. Site preparation and construction activities generated air pollutant emissions from site-disturbing and the operation of construction equipment (mobile sources). Fugitive dust emissions resulted from ground-disturbing activities and from the combustion of fuels in construction equipment. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of activity. Construction workers commuting daily to and from the job site in their personal vehicles also generated regulated pollutant air emissions.

Site preparation and construction activities contributed directly to emissions of GHGs from the combustion of fossil fuels. The estimated emission of CO_2 from site preparation and construction activities associated with the initial deployment of the expeditionary THAAD battery is estimated to be 629 metric tpy, which is approximately 2.5 percent of the 25,000 metric tpy meaningful assessment reference point established by the CEQ (2014).

Emissions from site preparation and construction activities were produced only for the duration of construction activities which, for the purposes of this air quality analysis, was conservatively assumed to be 12 calendar months or 240 workdays. An air emissions analysis containing detailed calculations and assumptions was conducted for the site preparation and construction activities, which are summarized in **Table 4-1** and shown in detail in **Appendix B**. In summary, the increase in air emissions from the site preparation and construction activities was below applicable significance criteria.

4.1.1.1.2 Operational Activities

Long-term, moderate, adverse effects on air quality are occurring and would continue to occur from the operational activities associated with the initial deployment of the expeditionary THAAD system. Air emissions currently are produced and would continue to be produced from the operation of mowing equipment, light sets, patrol vehicles, and the personal and Government vehicles driven by the

Table 4-1. Summary of Site Preparation and Construction Air Emissions for Alternative 1

	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
Air Emissions							
Initial Deployment of the Expeditionary THAAD System	5.425	0.522	2.887	0.427	44.248	4.758	693.320
Significance Criteria Threshold for Mobile Sources							
Attainment Area Significance Criteria (250 tpy increase of any attainment criteria pollutant)	250	250	250	250	250	250	Not Applicable

Note: Emissions during site preparation and construction would be from mobile sources.

approximately 200 military and civilian personal currently supporting the THAAD mission. Additionally, air emissions currently are produced from the operation of generator sets with internal combustion engines ranging from 3 kW to 1.3 MW output and three 3,000-gallon (11,356-liter) JP-8 fuelers; however, these air emissions would not be produced after the proposed improvements to power generation and fuel storage are accomplished.

Long-term, moderate, adverse effects on air quality would continue to occur after the proposed improvements to power generation and fuel storage are accomplished. Once the proposed improvements to power generation and fuel storage are completed, operational activities would produce air emissions that are greater than those produced from the initial deployment. This increase in air emissions would result from the use of larger generators (e.g., ranging from 420 kW to 1.3 MW) rather than the smaller generators (e.g., 3kW to 1.3 MW). Air emissions would also be produced from the operation of two 10,000-gallon (37,854-liter) JP-8 aboveground fuel pods rather than the three 3,000-gallon JP-8 fuelers.

Operational activities are contributing and would continue to contribute directly to emissions of GHGs from the combustion of fossil fuels. The estimated annual emission of CO_2 from operational activities is estimated to be 8,830 metric tpy with the current generators, 11,235 metric tpy with the replacement generators, and 729 metric tpy from mobile sources. These emissions are approximately 35.3, 44.9, and 2.9 percent of the 25,000 metric tpy meaningful assessment reference point established by the CEQ (2014), respectively.

An air emissions analysis containing detailed calculations and assumptions was conducted for the operational activities, which are summarized in **Table 4-2** and shown in detail in **Appendix B**. For the initial deployment phase, the calculations are based on the following:

- One 1.3-MW generator operating 500 hours per year, which is two engines limited to maximum of 1,763 horsepower total output; Caterpillar provided emission rates
- One 1.3-MW generator operating 8,760 hours per year, which is two engines limited to maximum of 1,763 horsepower total output; Caterpillar provided emission rates
- Three 3-kW generators operating 500 hours per year; AP-42 emission factors
- Fifteen 3-kW generators operating 8,760 hours per year; AP-42 emission factors.

For the phase after the proposed power improvements, the calculations are based on the following:

Table 4-2. Summary of Operational Air Emissions for Alternative 1

	NO_X (tpy)	CO (tpy)	VOC (tpy)	PM[(1)] (tpy)	SO_2 (tpy)	CO_2 (tpy)
Air Emissions from Stationary Sources (Potential Emissions)						
Initial Deployment of the Expeditionary THAAD System (Current Generators)	95.598	4.291	1.099	1.059	5.294	9,735.013
After Proposed Improvements to Power Generation (Proposed Generators)	124.692	51.662	5.569	2.963	6.133	12,386.676
Comparison to Major Regulatory Requirements for Stationary Sources (Potential Emissions)						
PSD Construction Permit Major Source Requirements	250	250	250	250	250	75,000[(2)]
Title V Air Operating Permit Major Source Requirements	100	100	100	100	100	100,000[(2)]

[(1)] Total PM emissions are assumed to be equivalent to PM_{10} and $PM_{2.5}$ emissions.
[(2)] This threshold would only apply if one of the other pollutants in this row exceeded their threshold.

	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
Air Emissions from Mobile Sources							
Operation of Personal and Government Vehicles	0.566	0.581	5.588	0.008	0.066	0.042	804.114
Significance Criteria Threshold for Mobile Sources							
Attainment Area Significance Criteria (250 tpy increase of any attainment criteria pollutant)	250	250	250	250	250	250	Not Applicable

- One 1.3-MW generator operating 500 hours per year, which is two engines limited to maximum of 1,763 horsepower total output; Caterpillar provided emission rates
- One 1.3-MW generator operating 8,760 hours per year, which is two engines limited to maximum of 1,763 horsepower total output; Caterpillar provided emission rates
- One 420-kW generator operating 500 hours per year; USEPA Tier 1 non-road engine standard emission rates
- One 420-kW generator operating 8,760 hours per year; USEPA Tier 1 non-road engine standard emission rates.

Air emissions from the operation of mowing equipment, application of herbicides that are assumed to have low VOC content, and implementation of other maintenance activities are assumed to be negligible and have not been quantitatively estimated.

Air Permitting. The generator sets that were installed during the initial deployment of the expeditionary THAAD System (i.e., those ranging from 3 kW to 1.3 MW) were installed on an emergency basis and, therefore, were not permitted with the appropriate regulatory bodies. However, appropriate permitting

actions would be taken for the generators that would be installed and retained after the proposed improvements to power generation are accomplished (i.e., those ranging from 420 kW to 1.3 MW).

The THAAD battery operations are under U.S. Army command and control, separate from Andersen AFB operations. Therefore, the U.S. Army will request the Guam EPA and USEPA to consider THAAD as a separate stationary source for purposes of air permitting, and THAAD will obtain its own applicable air permits. This separation of DoD operations under separate command and control on the same property for purposes of air permitting has been approved under a 1996 USEPA guidance memorandum applicable to military installations (USEPA 1996).

The unclassified/attainment designation for the area means that nonattainment NSR permitting does not apply to this Proposed Action. Potential emissions from the generators are estimated to be below the PSD major source thresholds for all applicable pollutants, as listed in **Table 4-2**. The THAAD mission would, therefore obtain an appropriate Guam EPA Air Pollution Source Construction Permit, with review and approval required by the Guam EPA and USEPA. Obtaining a construction permit would demonstrate conformance with the SIP for air quality in Guam. Conditions of the construction permit would include Federal New Source Performance Standards (NSPS) applicable to stationary compression ignition (e.g. diesel or JP-8) internal combustion engines. The generator engines for both the 420-kW and 1.3-MW generators have previously obtained a National Security Exemption from meeting the applicable USEPA Tier engine emission standards; however, they do meet the next lowest level Tier standard. The 1.3-MW generator engines were waived from Tier 4 standards, but meet Tier 2 standards (Tier 3 standards don't exist for this size engine) and the 420-kW generator engines were waived from Tier 2 standards, but meet Tier 1 standards.

The THAAD operations would also need to obtain a Title V operating permit because the potential emissions have been estimated at greater than 100 tpy for NO_X.

In summary, the adverse air quality effects from the operational component of Alternative 1 would be less than significant because of the U.S. Army's compliance with Federal and Guam air emission regulatory requirements, and conformance with the SIP for air quality in Guam.

4.1.1.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.1.2.1 Site Preparation and Construction Activities

Alternative 2 includes the site preparation and construction activities that already occurred with the initial deployment of the expeditionary THAAD system. The effects on air quality from these site preparation and construction activities are discussed under Alternative 1 in **Section 4.1.1.1.1**.

Short-term, minor, adverse effects on air quality would occur from the site preparation and construction activities associated with the permanent stationing of the THAAD battery and the CDZ expansion. Site preparation and construction activities would generate air pollutant emissions from site-disturbing and the operation of construction equipment. Fugitive dust emissions would result from ground-disturbing activities and from the combustion of fuels in construction equipment. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of activity. Site improvement activities would incorporate BMPs to minimize fugitive particulate matter emissions. Additionally, work vehicles are assumed to be well-maintained and might use diesel particulate filters to reduce particulate matter emissions. Construction workers commuting daily to and from the job site in their personal vehicles would also generate regulated pollutant air emissions.

Site preparation and construction activities would contribute directly to emissions of GHGs from the combustion of fossil fuels. The estimated emission of CO_2 from site preparation and construction

activities associated with the permanent stationing of the THAAD battery and the CDZ expansion is estimated to be 709 metric tpy, which is approximately 2.8 percent of the 25,000 metric tpy meaningful assessment reference point established by the CEQ (2014).

Emissions from site preparation and construction activities would be produced only for the duration of construction activities which, for the purposes of this air quality analysis, is conservatively assumed to be 12 calendar months or 240 workdays. An air emissions analysis containing detailed calculations and assumptions was conducted for the site preparation and construction activities, which are summarized in **Table 4-3** and shown in detail in **Appendix B**. In summary, the increase in air emissions from the site preparation and construction activities would be below applicable significance criteria.

Table 4-3. Summary of Site Preparation and Construction Air Emissions for Alternative 2

	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
Air Emissions							
Permanent Stationing of the THAAD Battery and the CDZ Expansion	5.975	0.587	3.268	0.471	101.429	10.506	781.933
Significance Criteria Threshold for Mobile Sources							
Attainment Area Significance Criteria (250 tpy increase of any attainment criteria pollutant)	250	250	250	250	250	250	Not Applicable

Note: Emissions during site preparation and construction would be from mobile sources.

4.1.1.2.2 Operational Activities

Alternative 2 entails all of the currently occurring and proposed operational activities associated with the initial deployment of the expeditionary THAAD system and the proposed improvements to power generation and fuel storage as presented under Alternative 1. The air emissions from stationary sources under Alternative 2 are the same as those shown in **Table 4-2** for Alternative 1. Identical air permitting implications also would result. Therefore, the effects on air quality from these operational activities would be the same as described under Alternative 1 in **Section 4.1.1.1.2**. The only pertinent difference from Alternative 1 is that Alternative 2 includes approximately 25 additional military personnel and 70 families (168 family member dependents of THAAD personnel) relocating to Guam. These additional persons would generate air emissions from the operation of their personal vehicles. An air emissions analysis containing detailed calculations and assumptions was conducted for the additional vehicular air emissions, which is summarized in **Table 4-4** and shown in detail in **Appendix B**. In summary, the air emissions from the additional military personnel and families would be below applicable significance criteria.

4.1.1.3 No Action Alternative

The No Action Alternative includes the site preparation and construction activities that already occurred, and the operational activities that have occurred to date, for the THAAD expeditionary mission. The effects on air quality from these activities are discussed under Alternative 1 in **Sections 4.1.1.1.1** and **4.1.1.1.2**.

Table 4-4. Summary of Yearly Operational Air Emissions for Alternative 2

	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
Air Emissions from Mobile Sources							
Operation of Personal and Government Vehicles	0.297	0.305	2.934	0.004	0.034	0.022	422.160
Significance Criteria Threshold for Mobile Sources							
Attainment Area Significance Criteria (250 tpy increase of any attainment criteria pollutant)	250	250	250	250	250	250	Not Applicable

Note: Emissions from the operation of personal and government vehicles are from mobile sources.

Short-term, negligible, adverse effects on air quality would occur from the removal and demolition of the infrastructure constructed for the THAAD expeditionary mission. Removal and demolition of this infrastructure would generate air pollutant emissions from site-disturbing and the operation of heavy equipment. Fugitive dust emissions would result from ground-disturbing activities and from the combustion of fuels in heavy equipment. Demolition workers commuting daily to and from the job site in their personal vehicles would also generate regulated pollutant air emissions. Such actions would also contribute directly to emissions of GHGs from the combustion of fossil fuels; however, these emissions are estimated to be 187 metric tpy, which is approximately 0.7 percent of the 25,000 metric tpy meaningful assessment reference point established by the CEQ (2014).

Emissions from the removal and demolition of this infrastructure would be produced only for the duration of removal and demolition activities which, for the purposes of this air quality analysis, is conservatively assumed to be 6 calendar months or 120 workdays. An air emissions analysis containing detailed calculations and assumptions was conducted for the removal and demolition activities, which are summarized in **Table 4-5** and shown in detail in **Appendix B**. In summary, the air emissions from the No Action Alternative would be below applicable significance criteria.

Table 4-5. Summary of Air Emissions from the Removal and Demolition of Infrastructure Supporting the THAAD Expeditionary Mission

	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	CO_2 (tpy)
Air Emissions							
Removal and Demolition of Infrastructure	1.018	0.100	0.717	0.053	1.188	0.164	206.442
Significance Criteria Threshold for Mobile Sources							
Attainment Area Significance Criteria (250 tpy increase of any attainment criteria pollutant)	250	250	250	250	250	250	Not Applicable

Note: Emissions during site preparation and construction would be from mobile sources.

Once the THAAD battery ceases operations and the demolition activities are completed, air emissions on NWF would, in general, return to THAAD pre-deployment levels. THAAD-related air emissions would no longer be produced from equipment and generator sets ranging from 3 kW to 1.3 MW; on-site fuel storage; and the operation of Government and personal vehicles driven by the 200 THAAD mission support personnel. No air permitting actions would be required under the No Action Alternative.

4.1.2 Noise

Noise impacts analyses typically evaluate potential changes to the existing noise environment that would result from implementation of a proposed action. Projected noise effects were evaluated qualitatively for the alternatives considered. Generally, noise impacts are considered adverse if they expose sensitive noise receptors to noise levels in excess of applicable standards.

4.1.2.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.2.1.1 Site Preparation and Construction Activities

Construction activities can cause a temporary increase in sound that is well above the ambient level. **Table 4-6** lists noise levels associated with common types of construction equipment. 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 area.

Table 4-6. Predicted Noise Levels for Construction Equipment

Construction Category and Equipment	Measured Noise Level at 50 feet (dBA)
Clearing and Grading	
Bulldozer	82
Grader	85
Truck	74–81
Roller	80
Excavation	
Backhoe	78
Jackhammer	89
Building Construction	
Concrete mixer	79
Welder	74
Pile driver	101
Crane	81
Paver	77

Source: FHWA 2006

Individual equipment used for construction activities would be expected to result in noise levels comparable to those shown in **Table 4-6**. Noise from construction activities varies depending on the type of equipment being used, the area that the action would occur in, and the distance from the noise source. To predict how these activities impact adjacent populations, noise from probable equipment was estimated. For example, construction usually involves several pieces of equipment (e.g., bulldozers and trucks) that can be used simultaneously. Under the Proposed Action, the cumulative noise from the equipment, during the busiest day, was estimated to determine the total impact of noise from construction activities at a given distance. Examples of expected cumulative construction noise during daytime hours at specified distances are shown in **Table 4-7**.

Table 4-7. Estimated Noise Levels from Construction Activities

Distance from Noise Source in feet (meters)	Estimated Noise Level in dBA
50 (15.2)	90–94
100 (30.5)	84–88
150 (45.7)	81–85
200 (61.0)	78–82
400 (121.9)	72–76
800 (243.8)	66–70
1,200 (365.8)	< 64

These sound levels were estimated by combining the noise from several pieces of equipment and then calculating the decrease in noise levels at various distances from the source. Because sound pressure levels are based on a logarithmic scale they cannot be added directly. The following equation was used to add sound pressure levels (OSHA 2005):

$$SPLT = 10 \times Log(\Sigma^{n}_{i=1}\ 10[SPLi \div 10])$$

Where *SPLT* is the total sound pressure level and *SPLi* is the *ith* sound pressure level to be summed.

Noise attenuation was estimated using the following equation for hemispherical radiation from a point source (OSHA 2005):

$$SPL2 = SPL1 - 20 \times Log(d2 \div d1)$$

Where *SPL1* is the sound pressure level at the original distance, *SPL2* is the sound pressure level at distance 2, *d2* is distance 2, and, *d1* is distance 1. Point source attenuation is applicable in this situation as the construction equipment is likely to be more or less stationary and grouped together for the duration of construction; unlike line source attenuation used for linear features such as highways.

There are no sensitive receptors within the ROI. There are recreational land areas located approximately 1 mile (1.6 kilometer) to the east. The nearest residences are south of Guam Highway 3, approximately 2 miles (3 kilometers) away. As a result, noise from construction activities would be approximately 48 dBA and not discernable over ambient noise levels. Suburban or residential areas typically have background noise levels of around 45 to 50 dBA (USEPA 1978). Temporary increases in truck traffic used to transport materials on- and off-site resulted in a temporary increase in localized noise. Greater noise disturbance has occurred within and near the construction corridors; however, the noise levels were temporary and intermittent. Therefore, no significant impacts on sensitive receptors would result from site preparation and construction activities.

To further reduce noise impacts from any additional construction activities, the following BMPs could be employed:

- Site laydown areas and designate haul roads to avoid sensitive receptors.

- Schedule noisy construction activities to occur simultaneously since combined noise levels may not be significantly greater than the level produced if the operations were performed separately.
- Operate equipment that produces high noise levels only when required and shut it down afterward.
- Use adequate mufflers to control engine noise.
- Equipment should receive routine maintenance as faulty or damaged mufflers and loose engine parts such as screws, bolts, or metal plates contribute to increased noise levels.

For construction noise impacts on wildlife see **Section 4.1.4,** *Biological Resources*. For construction noise impacts on workers see **Section 4.1.8,** *Human Health and Safety*.

4.1.2.1.2 Operational Activities

Noise from operational activities is generated within the THAAD emplacement site by the operation of generators, vehicles, and other equipment. The loudest equipment, the 1.3-MW prime power units, operates 24 hours per day. Sound levels from these generators are estimated to be 85 dBA at 98 feet (29.87 meters) (USASMDC 2012). Assuming no attenuation from vegetation or topography, noise levels from these generators decrease to 60 dBA at about 1,740 feet (530 meters) using the equation for hemispherical radiation from a point source (OSHA 2005). Other power units and sound-generating equipment required for the THAAD system have substantially lower sound energy emissions and generally are not audible over the sound of the 1.3-MW generators. In addition, aircraft noise from prior CDZ training operations at NWF (USAF 2000) has been reduced.

The nearest sensitive receptors (residences) are south of Guam Highway 3, approximately 2 miles (3 kilometers) away. Generator noise at such a distance is approximately 48 dBA and not discernable over ambient noise levels. Thus, no noise impacts on sensitive receptors have resulted from operational activities. Approximately 60 THAAD support personnel travel to and from NWF on a daily basis, including the use of local roadways such as Guam Highway 3. Such numbers could equate to 120 trips per day on local roads, but carpooling and the spread of trips throughout the day reduces the over effects. As a result, noise levels on local roadways have increased slightly; however, overall noise levels are not significant.

For operational activity noise impacts on wildlife, see **Section 4.1.4**. For operational activity noise impacts on workers, see **Section 4.1.8**.

4.1.2.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.2.2.1 Site Preparation and Construction Activities

Impacts would be similar to those described for Alternative 1. Under Alternative 2, there would be a greater area of land cleared and prepared (including the CDZ), and more substantial construction (e.g., perimeter fence, new guard towers, and four new buildings), than for Alternative 1.

4.1.2.2.2 Operational Activities

Noise-related impacts resulting from operation of the THAAD battery to date would be the same as that described for Alternative 1. For permanent stationing under Alternative 2, operational noise for the THAAD battery generally would be the same, with the exception of slightly greater traffic noise from the increase in military support personnel and dependents. The proposed Giant Voice warning system would

be audible to a distance of about 6,560 feet (2,000 meters); however, that system would be operated very infrequently for testing and emergencies.

With the return of airborne training operations to NWF at the proposed shifted CDZ, aircraft-related noise also would return. Noise impacts from CDZ operations would be similar to that analyzed in the CDZ EA (USAF 2000), which concluded that noise levels generated by airborne training activities would not result in significant impacts. Shifting the CDZ under Alternative 2, however, would shift flight paths and landing exercises to align with the NWF North Runway instead of the South Runway. The change in alignment likely would result in a negligible reduction in noise, as the receptors to the south would be further away.

Overall noise levels from operational activities under Alternative 2 would not be significant.

4.1.2.3 No Action Alternative

Under the No Action Alternative, noise impacts to date for the THAAD expeditionary mission (Alternative 1) would be the same. Noise impacts resulting from removal of the THAAD equipment and infrastructure would be similar to those described for Alternative 1 site preparation and construction activities.

Once the THAAD system and the associated support personnel are moved off the island, the long-term operational noise impacts would return to THAAD pre-deployment levels, as CDZ operations would resume at the NWF South Runway. The CDZ EA (USAF 2000) concluded that noise levels generated by airborne training activities on NWF would not result in significant impacts.

In summary, short-term and long-term noise levels for the No Action Alternative would not be significant.

4.1.3 Water Resources

The environmental consequences evaluation for water resources in this section considered the potential for adverse effects on groundwater quality from stormwater runoff, the accidental release of chemical contaminants, and salinity intrusions into the groundwater aquifer. With respect to the CZMA and GCMP, the Proposed Action is not expected to adversely affect Guam coastal waters. Therefore, the Proposed Action would comply with the water quality policies of the GCMP. The 94th AAMDC will prepare and submit a CZMA Consistency Determination to the GBSP requesting their review and concurrence.

4.1.3.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.3.1.1 Site Preparation and Construction Activities

For the site preparation (e.g., clearing, grubbing, and grading of forest and perennial scrub vegetation) and construction activities (including temporary roads and concrete pads) that occurred, potential environmental consequences can include groundwater contamination from (1) construction site stormwater runoff that may contain elevated sediment concentrations, and (2) spills and leaks of chemicals such as lubricants, fuels, or other construction materials. Additionally, indirect impacts may result from an increase in impervious areas, which may increase the potential for contaminated stormwater runoff to infiltrate the groundwater.

The potential for contaminated stormwater runoff from the THAAD emplacement site, however, is minimized through the development and implementation of a site-specific Erosion Control Plan (ECP),

which is generally required under Guam Soil Erosion and Sediment Control Regulations before any property can be cleared or graded. The ECP describes the BMPs to be implemented on site to eliminate and/or minimize nonpoint source pollution within Guam's waters. Such BMPs, as described in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006), may include diversion dikes/swales, silt fencing, grade stabilization, stabilization with vegetation.

Potential groundwater contamination from spills and leaks from fuel storage and equipment maintenance also are minimized through the development and implementation of a Spill Prevention, Control, and Countermeasure (SPCC) Plan that is mandated under the Clean Water Act and Oil Pollution Act. The SPCC includes written procedures for containing and cleaning up spills or leaks, notifying the appropriate personnel, and following the reporting procedures. One of the key BMPs required under the SPCC is the use of secondary containment systems to contain spills and leaks.

To help ensure that stormwater runoff from the emplacement site is free of contaminants, an Environmental Protection Plan (EPP) would be developed. The EPP describes required surface and groundwater pollution prevention measures, including BMPs to reduce and control pollutants associated with stormwater runoff.

Because of the implementation of appropriate BMPs at the THAAD emplacement site to contain contaminants and control stormwater runoff during the site preparation and construction phase, no significant impacts to the groundwater resources are expected under Alternative 1.

4.1.3.1.2 Operational Activities

Under Alternative 1, potential impacts from THAAD battery operational activities could include contamination due to latrine leakage, fuel spills, and leaks or spills of hazardous materials from motor pool operations. THAAD operations and related support activities require preparation of a site-specific SWPPP and SPCC Plan that describes specific measures to eliminate/minimize potential for groundwater contamination from leaks and spills from stored fuels, motor pool wastes, and other materials.

The 200 military and civilian personnel associated with ongoing operations under Alternative 1 represent a 2.6 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). This increase in population results in a daily potable water increase demand of approximately 20,000 gallons (75,708 liters) based on a typical use of 100 gallons (379 liters) per person per day. The U.S. Army would rely on existing Andersen AFB wells and other sources for the potable water. There would be no new groundwater wells installed, and no new potable water service connections for the THAAD mission and facilities. To mitigate potentially adverse effects on groundwater usage, Andersen AFB and the DoD are making further improvements to the existing DoD water distribution systems to reduce system leaks. The DoD would, as appropriate, adjust pumping rates at DoD wells if salinity (chloride) levels show an increase, and increase the use of surface water from Fena Reservoir to reduce overall withdrawals from the NGLA. Additionally, the water drawn for unit water pod systems (camels) used at the THAAD battery on NWF would be filled at alternate locations, if necessary. Thus, the projected increase in potable water demand for the THAAD mission is not expected to result in substantial additional groundwater withdrawals with minimal increase in salinity intrusions into the groundwater aquifer.

In summary, implementation of the required pollution prevention plans and BMPs should provide the necessary resource protection. Therefore, no significant impacts to groundwater resources are expected to occur from THAAD battery operations under Alternative 1.

4.1.3.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.3.2.1 Site Preparation and Construction Activities

For the permanent stationing of the THAAD battery under Alternative 2, the effects on water resources during the initial site preparation and construction phase are the same as those described for Alternative 1.

The additional grading and construction activities (including the new security fences, fiber optic line, drainage system, and four new buildings) proposed for permanent stationing of the THAAD battery could result in potential fuel spillage and contamination of stormwater runoff. In addition, the clearing of forest and perennial scrub vegetation for the fiber optic line (2.3 acres [0.9 hectares]) and the proposed CDZ expansion (approximately 53.2 acres [21.5 hectares] outside of the original CDZ and an additional 22.4 acres [9.1-hectare] within the original CDZ [USAF 2000]), would allow potential groundwater contamination to occur from construction site stormwater runoff, and spills and leaks from construction equipment and staging areas. However, such impacts would be minimized through the implementation of site-specific BMPs, which would be described in an ECP and EPP prepared for the project activities. Examples of the BMPs, as described in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006), include diversion dikes/swales, silt fencing, grade stabilization, stabilization with vegetation. The potential for groundwater contamination resulting from a spill or leak from fuel storage and maintenance facilities associated with construction equipment also would be minimized through the development and implementation of an SPCC Plan.

Because the new buildings and related structures would exceed 5,000 square feet (465 square meters) in total area of ground disturbance, the planning, design, and construction of the facilities would incorporate a low-impact development (LID) approach in accordance with United Facilities Criteria (UFC) 3-210-10 *Low Impact Development* and the *Technical Guidance on Implementing Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act* (USEPA 2009). The LID is a storm water management strategy designed to maintain site hydrology and mitigate the adverse impacts of stormwater runoff and nonpoint source pollution.

Overall, site preparation and construction activities associated with Alternative 2 are not expected to cause significant impacts on groundwater resources.

4.1.3.2.2 Operational Activities

Beyond the initial operational effects described under Alternative 1, long-term THAAD operations under Alternative 2 would present similar issues in terms of potential groundwater contamination from latrine leakage, fuel spills, and leaks or spills of hazardous materials from motor pool operations. In addition, the proposed Drainage System, consisting of an approximate 12,800-square foot (1,190-square meter) asphalt pad and concrete culverts/piping, would funnel stormwater drainage to a ravine at the east side of the emplacement site. The potential for impacts, however, would be minimized through the implementation of site-specific BMPs, which would be described in a site-specific SWPPP and SPCC Plan. The increase in impervious area for the drainage system and new buildings would not be substantial, considering the extent of existing pavement on NWF. No flooding downstream or pollutant releases are expected.

Alternative 2 increases the number of military personnel and contractors to about 225 (25 more than Alternative 1) and adds approximately 168 military dependents. Under Alternative 2, the combined total of 393 additional people results in a 5 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). Such an increase in population would result in a daily potable water increase demand of about 40,000 gallons (151,416 liters) based on a typical use of about 100 gallons (379 liters) per person per day. Just as described for Alternative 1, the U.S. Army would rely on existing wells and other sources for the potable water. There would be no new groundwater wells installed, and no new

potable water service connections for the THAAD mission and facilities. To mitigate potentially adverse effects on groundwater usage, Andersen AFB and the DoD are making further improvements in the existing DoD water distribution systems to reduce system leaks. The DoD would, as appropriate, adjust pumping rates at DoD wells if salinity (chloride) levels show an increase, and increase the use of surface water from Fena Reservoir to reduce overall withdrawals from the NGLA. Additionally, the water drawn for unit water pod systems (camels) used at the THAAD battery on NWF would be filled at alternate locations, if necessary. Thus, the projected increase in potable water demand for the THAAD mission is not expected to result in substantial additional groundwater withdrawals with minimal increase in salinity intrusions into the groundwater.

In summary, implementation of the required pollution prevention plans would provide the necessary resource protection and, therefore no significant impacts to groundwater are expected to occur from THAAD battery operations under Alternative 2.

4.1.3.3 No Action Alternative

Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would result in no significant impacts to groundwater resources, the same as those described for Alternative 1. Additionally, as with Alternative 1, the THAAD battery operational activities to date would not result in significant impacts.

Removal of the THAAD battery, including ancillary equipment and related infrastructure (temporary fencing, concrete pads), and disposal of the waste concrete, could result in potential fuel spillage and contamination of stormwater runoff. The implementation of site-specific BMPs would ensure that no significant impacts to groundwater would occur. On a longer-term basis, the 200 THAAD mission support personnel to be removed from Guam would result in potable water usage and groundwater withdrawals being reduced, closer to THAAD pre-deployment levels.

In summary, the application of appropriate BMPs would provide adequate resource protection and, therefore, no significant impacts to groundwater resources are expected to occur under the No Action Alternative.

4.1.4 Biological Resources

This section describes the potential environmental consequences to terrestrial biological resources that occurred during site preparation and construction for the expeditionary placement and operation of the THAAD battery, and that could occur from permanent stationing of the system. Direct and indirect effects to vegetation communities, fauna, and special-status species are addressed. Special-status species include species classified as endangered, threatened, proposed, or candidates under the Federal ESA and species classified as threatened or endangered by Guam law.

4.1.4.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.4.1.1 Site Preparation and Construction Activities

Vegetation Communities—In April 2013, 237.4 acres (96.1 hectares) on NWF were fenced and occupied for the expeditionary emplacement of the THAAD battery, and a motor pool was established in a 12.0-acre (4.9-hectare) area south of the expeditionary emplacement area (**Figure 3-1)**. Prior to the expeditionary deployment, approximately 145.4 acres (58.8 hectares) of the emplacement area between and to the east of the runways were maintained as low, mixed herbaceous scrub for safe operation and use of the existing CDZ. An additional 68.3 acres (23.8 hectares) (including the motor pool area) were

existing paved runways, taxiways, and other developed land. Of the remaining 35.7 acres (14.4 hectares) that were cleared, grubbed, and graded, 16.6 acres (6.7 hectares) were determined in 2007 to be mixed limestone forest-plateau/secondary, 8.5 acres (3.4 hectares) were forested areas dominated by *Casuarina equisetifolia*, 6.3 acres (2.5 hectares) were forest dominated by closed canopy or sparse canopy *Vitex parviflora*, and 4.3 acres (1.7 hectares) were *Hibiscus* scrub (see **Table 4-8** and **Figure 3-1**).

Table 4-8. Vegetation Communities on Andersen AFB Affected by Alternative 1

Vegetation Community	Alternative 1 Emplacement Area (acres)	Andersen AFB (Installation-wide in 2007)[1] (acres)
Developed Land	**68.3**	4,501.2
Mixed Herbaceous Scrub (*Stachytarpheta*)	**145.4**	731.8
Total Forest/Perennial Scrub:	**35.7**	6338.8
• Mixed Limestone Forest-Plateau/Secondary (*Vitex, Ficus, Premna, Neisosperma, Guamia, Aglaia*)	16.6	4,107.3
• *Casuarina* Forest	8.5	102.3
• *Hibiscus* scrub	4.3	431.5
• *Vitex*-Closed Canopy	3.9	850.8
• *Vitex*-Sparse Canopy (*Vitex, Guamia, Aglaia*)	2.4	807.8

[1] Source: e^2M 2008

Based on mapping of vegetation communities conducted in 2007 (e^2M 2008), most forested and scrub vegetation communities cleared for deployment of the THAAD battery are relatively common on Andersen AFB (**Table 4-8**). The only exception is *Casuarina* forest, of which about 9 of 102 acres (4 of 41 hectares) were cleared. Small stands of this indigenous tree species occur uncommonly throughout Guam (GDAWR 2005). Although most vegetation communities cleared for this project are common on northern Guam, the loss of approximately 35.7 acres (14.4 hectares) of forested and perennial scrub land contributes to the cumulative loss of forests on the island (GDAWR 2005).

The area surrounding the emplacement area is vegetated with secondary limestone forest and *Hibiscus* scrub, with smaller amounts of *Casuarina* forest and closed and open canopy forests dominated by *Vitex.* Additionally, there is an approximate 15-acre (6-hectare) stand of primary limestone forest in Area 50, located between the THAAD original expeditionary emplacement and the motor pool (**Figure 3-1**). This is the only intact remaining stand of primary limestone forest on the plateau of NWF; all other primary limestone forest on northern Guam is located along and near the cliff line (JRM 2013). The forested stand within Area 50 was not directly affected by site preparation and construction activities.

To mitigate the effects of clearing vegetation and loss of wildlife habitat, 94th AAMDC, in cooperation with Andersen AFB and JRM, would establish a fenced conservation area on Andersen AFB. JRM currently plans to establish the conservation area immediately east of the THAAD compressed expeditionary emplacement (**Figure 4-1**). Philippine deer (*Rusa marianna*) and feral pigs (*Sus scrofa*) would be removed from the area. Removal of ungulates from the area would improve forest growth and result in a long-term increase in the abundance of native forest species.

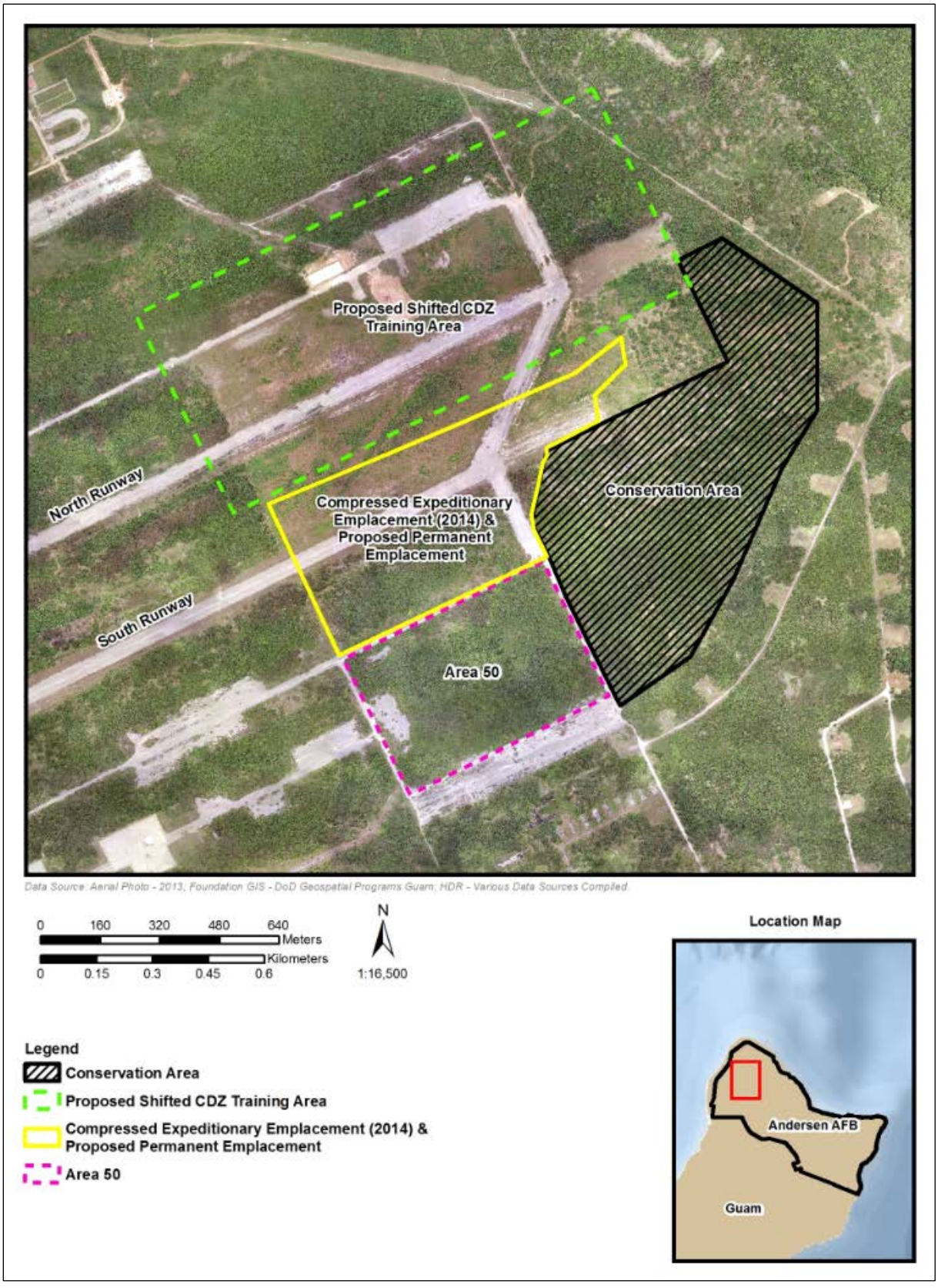

Figure 4-1. Planned Conservation Area to be Fenced and Protected

As currently planned, the conservation area is approximately 121 acres (49 hectares). The size of the established area might differ, as the boundary fence will need to avoid steep topography and other obstacles. Based on mapping of vegetation on Andersen AFB in 2007 (e^2M 2008), the following vegetation communities occur within the area:

- *Hibiscus* Scrub – 58.8 acres (23.8 hectares)
- Mixed Limestone Forest-Plateau/Secondary – 54.8 acres (22.2 hectares)
- Mixed Herbaceous Scrub – 6.3 acres (2.5 hectares)
- Developed Land – 1.0 acres (0.4 hectares)

Fauna. The clearing, grubbing, and grading of about 35.7 acres (14.4 hectares) of forest and perennial scrub vegetation communities reduced available habitat for the few remaining forest-dwelling birds, and the only remaining native mammal (the Mariana fruit bat) that occur on Guam. Those forested areas also would have been used by native and introduced reptile, amphibians, and invertebrates, and site preparation would have resulted in direct mortality and loss of habitat for skinks, geckos, and other species. Because there remains over 9,000 acres (3,642 hectares) of forest and scrub vegetation on Andersen AFB (e^2M 2008), the loss of habitat for site preparation and construction activities likely did not result in a decrease in the viability of any wildlife. Clearing of that land contributed to the cumulative loss and degradation of forested habitat on Guam, which is an important threat to wildlife there (GDAWR 2005). Development of a fenced conservation area (**Figures 3-1 and 4-1**) would, over time, increase the availability of forested habitat and benefit native fauna on Guam.

Clearing and maintaining the emplacement area as low, herbaceous and scrub vegetation likely increased habitat for non-native birds such as the black francolin and black drongo, and possibly for non-native reptiles and amphibians such as the marine toad. Populations of feral pigs and Philippine deer, which adversely affect forest habitat on Guam (JRM 2013), might also increase as a result of the clearing and maintenance of vegetation. Such a population increase could contribute to the cumulative degradation of forests on northern Guam cause by these non-native species. To counter such effects, Andersen AFB does implement ungulate control measures in certain areas of the installation.

Special Status Species. The following describes the potential effects from site preparation and construction to species classified as threatened, endangered, proposed, or candidates under the Federal ESA or by the Government of Guam. Only those species that are likely to occur on NWF, or that might be reintroduced there in the future, are addressed (see **Table 3-4**).

Plants

The endangered tree ***Serianthes nelsonii*** is extremely rare on Guam. As of 2012, one mature tree plus saplings planted in a fenced site in Tarague Basin, all on Andersen AFB, were the only individuals of this species known to occur on Guam (USFWS 2012a, JRM 2013). Although no surveys were conducted prior to clearing, it is very unlikely that individuals of this species occurred in the second growth forest and scrub vegetation within the THAAD original expeditionary emplacement. Therefore, it is very unlikely that site preparation and construction directly or indirectly adversely affected this species. The USFWS has identified approximately 11,668 acres (4,721 hectares) of habitat on Guam that is potentially suitable for *Serianthes nelsonii* (NAVFAC 2014), and the clearing of 35.7 acres (14.4 hectares) of forest and perennial scrub vegetation thus has had no or a very small effect on the future recovery of this species on Guam. Critical habitat has not been designated for this endangered species.

During a survey of Andersen AFB for fadang that was conducted between November 2012 and July 2013, three dead and no living individuals were found in the "NWF Central" area within and near the area cleared of vegetation for the THAAD expeditionary deployment (Marler 2014, p. 16). Because of the extent of vegetation clearing for the THAAD mission, a post-clearing survey of the species in the

disturbed areas was not possible. A much higher abundance of fadang was found in surrounding areas. Thus, a very small but unknown number of individuals of this species could have been destroyed during clearing of about 16.6 acres (6.7 hectares) of secondary limestone forest, and that habitat is no longer available for fadang.

Over 21,000 *Tabernaemontana rotensis* were documented during a comprehensive survey of Andersen AFB prior to 2007 (University of Guam 2007). None were found in the area cleared for the expeditionary deployment, or during previous surveys of the CDZ drop zone and surrounding area in 2000 (USAF 2000, Raulerson and Witteman 2000). Thus it is unlikely, but cannot be stated with certainty, that any *Tabernaemontana rotensis* were destroyed during clearing of about 16.6 acres (6.7 hectares) of secondary limestone forest.

Two plants classified as endangered by the Government of Guam, *Cyathea lunulata* and *Heritiera longipetiolata* are unlikely to have occurred in the secondary limestone forest and scrub vegetation cleared in 2013, and site preparation and construction therefore had little or no effect on those species.

Invertebrates

Two butterflies, the Mariana eight-spot butterfly and the Mariana wandering butterfly, are proposed for listing as endangered under the Federal ESA and as endangered by the Government of Guam. These species inhabit forest and forest clearings. The Mariana eight-spot butterfly has only been observed at Pati Point on Andersen AFB (Parsons 2006) and the Tarague Basin (HDR 2013), and its host plant is believed to be restricted primarily to inaccessible areas along the cliff line. Therefore, it is very unlikely that site preparation and construction directly or indirectly adversely affected this species. The Mariana wandering butterfly has not been observed on Guam since 1979 and is considered extirpated from the island, but host plants for this species, luluhot (*Maytenus thompsonii*), are common on NWF. Clearing of secondary forest for development of the THAAD original expeditionary emplacement therefore could have caused the long term loss of a small amount of habitat that might be used by this species if it were to be reintroduced or rediscovered on Guam.

Three tree snails, humped, Guam, and fragile, which are proposed for listing as endangered under the Federal ESA and classified as endangered by the Government of Guam, occur in cool, shaded, forested areas. Only two colonies of fragile tree snails are known to exist on Guam: one at Pugua Point (Smith et al. 2008) and one at Lost Pond in Hilaan (Fiedler 2014). The only known colony of tree snails on Andersen AFB is the Guam tree snail colony at EOD Beach (HDR 2013). No observations of these three candidate species were made during surveys within the CDZ in 2000 (Smith 2000). Most of survey plots evaluated were characterized by a xeric understory with a relatively open canopy, and they were not suitable for these snails. Extensive disturbance from both humans and introduced species was noted during that survey, rendering the majority of remaining habitat unsuitable for native tree snails. The black flatworm and predatory snails such as the rosy wolf snail (*Euglandina rosea*), which are threats to native snails, have also been noted during recent surveys (Smith 2000, Parsons 2006). Therefore, it is very unlikely that the humped, Guam, and fragile tree snails occurred within the forested areas cleared in April 2013, or that site preparation and construction directly or indirectly adversely affected these species.

Reptiles and Amphibians

The moth skink and Pacific slender-toed gecko, which are classified as endangered by the Government of Guam, occur in the secondary limestone forest on NWF. Clearing of forested habitat for development of the emplacement area caused the long-term loss of potential habitat for these species and individuals of both species could have been killed.

Birds

Three endangered forest and forest-edge dwelling birds, the Guam Micronesian kingfisher, Guam rail, and Mariana crow, have been extirpated from Guam. Prior to the introduction of the brown treesnake to the island, all three species occurred on NFW. The USFWS (2010b) has identified habitat on Guam that is suitable for the survival and recovery of these birds, and has estimated the amount of that habitat that would be needed for recovery of the species **(**see **Table 4-9**). About 38.8 acres (15.7 hectares) of suitable forested habitat for the kingfisher and crow were cleared for preparation of the THAAD original expeditionary emplacement, and 137.9 acres (55.8 hectares) of scrub and other suitable habitat for the rail was cleared. For all three species, the amount of habitat lost was substantially less than the amount of available habitat, and did not exceed the threshold of habitat remaining that would be required for recovery of the species (**Table 4-9**). Thus, site preparation and construction caused a long-term, small loss of potential habitat for the kingfisher and crow but, by itself, probably has not reduced the likelihood that they could be successfully reintroduced on Guam. Site preparation has, however, contributed to the cumulative long-term decrease in availability of suitable habitat for these and other forest-dwelling species on Guam. Most of the area occupied by the THAAD battery is being maintained with herbaceous vegetative cover similar to what existed within the recovery habitat for the Guam rail prior to April 2013. As a result, there has been and would be little or no net loss in acreage or conservation value of recovery habitat for the rail.

Table 4-9. Recovery Habitat (acres) on Guam for Three Threatened or Endangered Species

Habitat Area	Guam Micronesian kingfisher	Guam rail	Mariana crow
Required for recovery	13,134	41,184	7,463
Available in 2010	15,822	49,564	14,831
Remaining above recovery threshold	2,688	8,380	7,368
Alternative 1: Permanent Stationing of Expeditionary THAAD System			
• Disturbed	38.8	137.9	38.8
• Remaining available	15,783.2	49,426.1	14,792.2
• Remaining above recovery threshold	2,649.2	8,242.1	7,329.2
Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion			
• Disturb for THAAD permanent stationing	1.7	0.3	1.7
• Disturb for CDZ expansion	44.2	2.2	44.2
• Remaining after proposed activities	15,776.1	49,561.5	14,785.1
• Remaining above recovery threshold	2,642.1	8,377.5	7,322.1
Available within Conservation Area	80.5	40.3	80.5

[1] Calculations are based on the amount of habitat required and available on northern Guam for the kingfisher and crow, and all of Guam for the rail, as reported in USFWS (2010b)

Development of a fenced conservation area and removal of ungulates from that site (**Figure 4-1**) would, over time, increase the availability of forested habitat and benefit these bird species. The USFWS has classified 80.5 acres (32.6 hectares) of the 121-acre (49-hectare) conservation area as recovery habitat for the Guam Micronesian kingfisher and Mariana crow, and 40.3 acres (16.3 hectares) as recovery habitat for the Guam rail (**Table 4-9**).

Designated critical habitat for the Guam Micronesian kingfisher and Mariana crow is located on Guam National Wildlife Refuge (see **Figure 1-1**), more than 1 mile (1.6 kilometer) from the THAAD project

site. That critical habitat was not directly altered or indirectly affected during site preparation or construction activities.

The Mariana common moorhen occurs in marshes, ponds, and other wetlands with emergent vegetation and open water. There were no wetlands or other suitable habitat within or near the THAAD original expeditionary emplacement; therefore this species was not affected by site preparation and construction.

The Mariana swiftlet is very rare or absent from northern Guam, therefore clearing of vegetation for development of the original expeditionary emplacement had no effect on this species.

The Micronesian starling is known to occur on and near developed areas of Andersen AFB, and could occur occasionally within NWF. Clearing of the 35.7 acres (14.4 hectares) of forest and perennial scrub vegetation, therefore could have caused a long-term loss of a small amount of habitat for this species.

Mammals

On Guam, the Mariana fruit bat roosts and forages in primary and secondary limestone forest and other forested areas, primarily on the northern end of the island. During 2010–2011, bats were observed on Andersen AFB most often along and near the cliff line at Pati Point and in and around the MSA. They were observed very infrequently on NWF near the area cleared in 2013 for deployment of the THAAD battery. As of 2011, less than 25 bats were estimated to occur on Andersen AFB (SWCA 2012).

The USFWS (2010b) has identified 13,704 acres (5,545 hectares) of habitat on northern Guam that is suitable for the survival and recovery of the Mariana fruit bat. About 35.7 acres (14.4 hectares) of that habitat were cleared for preparation of the THAAD original expeditionary emplacement. Thus, clearing of forested areas has caused a long-term, small loss of foraging habitat, and possibly roosting habitat, for this species on Andersen AFB. In addition, noise and other disturbances during site preparation and clearing probably caused any Mariana fruit bats foraging or roosting near the project site to temporarily avoid the surrounding area. Because there is a substantial amount of suitable habitat still available on northern Guam, the very small remaining population of fruit bats probably is not limited by food or roost sites. The clearing of about 35.7 acres (14.4 hectares) of potential habitat, therefore, probably has no or very little short-term effect on Mariana fruit bats, but did contribute to the long-term cumulative loss and degradation of habitat for this species on northern Guam.

Development of a fenced conservation area and removal of ungulates from that site (**Figure 4-1**) would, over time, increase the availability of foraging, and possibly roosting, habitat for Mariana fruit bats. The USFWS has classified 80.5 acres (32.6 hectares) of the 121-acre (49-hectare) conservation area as recovery habitat for the Mariana fruit bat.

Designated critical habitat for the Mariana fruit bat is located on Guam National Wildlife Refuge, more than 1 mile (1.6 kilometer) from the THAAD project site. That critical habitat was not directly altered or indirectly affected during site preparation or construction activities.

Because of the availability of suitable habitat elsewhere, the clearing of approximately 35.7 acres (14.4 hectares) of forest and perennial scrub habitat and long-term operations under Alternative 1 is expected to have less than significant effects in the short term and on the survivability of special status species in the area, but would contribute to the long-term cumulative loss and degradation of habitat for such species on Guam.

4.1.4.1.2 Operational Activities

Vegetation Communities. Since the expeditionary emplacement of the THAAD battery in April 2013, operational activities have been compressed into an 82.0-acre (33.2-hectare) area (see **Figure 2-2**), and future operations and most site improvements are planned to occur within that compressed expeditionary

emplacement. Uneven terrain and piled debris within the compressed area and along some perimeters would be leveled for improved security, and vegetation would continue to be maintained as low, herbaceous or scrub growth. Most or all areas outside of the compressed area that were cleared for the original expeditionary emplacement likely would also continue to be maintained as low growth for operation of the CDZ.

Fauna. A number of tactical generators, ranging from 420 kW to 1.3 MW, are used to power the THAAD system. Noise from those generators could cause some wildlife to avoid habitat adjacent to the emplacement area, and could affect the behavior, reproduction, or survival of some wildlife that remain in the area. Sound levels from the largest 1.3-MW generators are 85 dBA at 98 feet (30 meters) (USASMDC 2012). Assuming no attenuation from vegetation or topography, noise levels from those generators would decrease to 60 dBA at about 1,740 feet (530 meters) using the equation for hemispherical radiation from a point source (OSHA 2005). The dense vegetation along the edge of and within the surrounding forested areas would cause a substantial reduction in sound levels within those areas, but noise levels have been and would continue to be detectably higher throughout most of Area 50 and portions of other forested areas surrounding the project site.

Security lights would be located on or near the perimeter security fence and surrounding the access control facility. All lighting would be shielded and pointed down to minimize illumination of surrounding forested areas. In accordance with strategic instructions for the Ballistic Missile Defense System Physical Security Program, the standard for lighting of permanently restricted areas is 0.2 foot-candle (0.2 lumen per square foot) for boundary lighting and 2.0 foot-candles (2.0 lumen per square foot) for entry control facilities. These values are similar to those recommended by the American Association of State and Highway Transportation Officials (2005) for illumination of minor and principal roadways. As an additional comparison, a 100-watt incandescent bulb produces over 130 foot-candles (130 lumen per square foot).

Security lighting could cause some animals to avoid at night areas surrounding the emplacement area. Increased lighting could also increase the risk to some species of predation. Because the lights to be used would have a low illumination, and would be shielded, and because dense vegetation would block light from penetrating far into forested areas, these adverse effects would occur in a relatively narrow band surrounding the emplacement area.

The THAAD radar system has operated and would continue to operate continuously as part of the THAAD mission. That radar emits EMR that could be harmful to wildlife. A personnel exclusion zone has been established 328 feet (100 meters) in front of and to the side of the radar equipment. This area is cleared of vegetation, and it is very unlikely that terrestrial wildlife would travel through or otherwise be within this area of highest danger.

The radar would be aimed upward and would not radiate lower than about 5 degrees. All vegetation within more than 2,000 feet (610 meters) of the radar has been cleared, and is maintained as low forbs, grass, and shrubs. At the distant edge of that cleared vegetation, the lower height of the EMR beam would be at least 170 feet (52 meters) high. The typical height of the canopy of secondary limestone forest on NWF is about 50 feet (15 meters) (USAF 2000); therefore, wildlife in or below the forest canopy would not be affected by EMR from the radar system.

Electromagnetic radiation could harm birds, bat, or other animals that fly directly through the beam of the radar system. These effects have been analyzed by the U.S. Army and Missile Defense Agency in past environmental assessments for the testing and operation of THAAD and other missile systems, as described below.

The 1993 Ground-Based Radar Family of Radars EA (USASMDC 1993) analyzed potential impacts to wildlife from EMR, in particular migrating birds that might fly through the radar beams. That analysis

concluded that because the main beam would normally be in motion, it would be extremely unlikely that a bird would remain within the most intense area of the beam for any considerable length of time. That analysis also noted that the size of the beam is "relatively small," further reducing the probability of birds remaining within this limited region of space, even if the beam remained still (USASMDC 1993, MDA 2005).

Radar units normally operate in scanning mode except when tracking a target. While scanning, phased array radars, such as that used for the THAAD system, move beam positions every 10 to 100 milliseconds. Exposure durations of birds and bats flying within the scanning area of a radar system in scanning mode would be less than 0.02 seconds, far short of the duration needed to be exposed to a harmful level of EMR (MDA 2005). Thus, during most operations, the risk to birds, bats, and other flying animals from the operation of the THAAD radar system is very low.

Risks to birds and bats could be higher when a unit is operating in tracking or calibration mode, because the beam would move less frequently than while operating in scanning mode. The potential effects to birds from a system operating in scanning mode has been evaluated based on (1) characteristics of radar units similar to but slightly more powerful than the unit used for the THAAD system; (2) characteristics of a small, slow flying bird (a warbler); and (3) conservative assumptions and calculations (MDA 2005). A slow flying (10 mph) small birds flying perpendicularly through a stationary radar beam and less than 328 feet (100 meters) from the unit could receive an EMR power density above the threshold reference value judged to indicate potential harm. There would be no risk to slow flying birds flying 984 feet (300 meters) from and perpendicular to the radar unit, and no risk to any birds flying faster than 30 miles per hour. Birds flying along the path of the stationary radar beam would be at higher risk, as they would be exposed to EMR for a longer period. The analysis indicates that during such a rare event, slow flying, small birds within 1,640 feet (500 meters) of the radar might be exposed to EMR above the reference value (MDA 2005).

In summary, EMR emitted from the THAAD radar has no or very little adverse effects on terrestrial or arboreal wildlife because vegetation in the hazard zone in front of the system has been cleared and because the radar is aimed upward. During most operations, when the radar is operating in scanning mode, the risk to birds, bats, or other flying animals is very low. During the infrequent periods when the radar is operating in tracking mode, an animal flying directly into the beam or slowly through the beam could be harmed by exposure to EMR; however, the risk of that occurring is low.

Adverse effects from brown treesnakes and other non-native species are some of the most important threats to wildlife on Guam and elsewhere in the Mariana Islands. The primary risk from emplacement and operation of the THAAD battery for the spread of invasive species onto Guam, or from Guam to other locations, is the transport of invasive species in or on project equipment, equipment of personnel, and other cargo shipped to and off of Guam for this project. With the exception of the personal belongings and gear of project personnel rotating onto and off of Guam, minimal equipment shipments are required for this project. This project does not involve the shipment of materials or personnel to the CNMI.

THAAD, as a tenant Command on Andersen AFB and within JRM, will continue to comply with 36th Wing Instruction 32-7004 (*Brown Treesnake Management*) and additional measures that might be developed by JRM in the future. The equipment and materials to be shipped for the project is a very small portion of the materials shipped through DoD and commercial ports on Guam; therefore, ongoing operations and permanent stationing of the THAAD battery will not stress the capacity to interdict brown treesnakes there.

Because equipment is not and will not be shipped frequently to and from Guam, and because all cargo has been and will be inspected as part of the ongoing interdiction effort by the DoD and other agencies, ongoing and planned project activities have a minimal risk of causing the spread of invasive species.

Special Status Species. Long-term operation of the THAAD battery would further reduce the availability of habitat for these threatened and endangered species as these species are likely to avoid habitat surrounding the emplacement area with high levels of noise or light at night. For example, Mariana fruit bats might avoid feeding or roosting in the primary limestone forest between the emplacement area and motor pool because of high noise levels from operation of the generators or increased levels of light. In a dual choice experiment with captive Sowell's short-tailed bats (*Carollia sowelli*), a central American frugivorous bat, food was less often explored and consumed in the dimly illuminated than in the dark compartment, indicating that artificial light alters the foraging behavior of these bats. From the observations of free-ranging Sowell's short-tailed bats, infructescence was less likely to be harvested when plants were illuminated by a street lamp than under natural darkness (Lewanzik et al. 2014). This particular species is a small, echolocating bat and might behave differently than Mariana fruit bats, which do not echolocate and use vision to detect food. To minimize effects to wildlife, all security lighting would be shielded and pointed down to reduce light levels in surrounding areas.

As described above, there is a small risk that Mariana fruit bats could be harmed if they fly across or along the beam of the radar system when it is operating in tracking mode.

Designated critical habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and Mariana crow is located more than 1 mile (1.6 kilometer) north of the THAAD project site. Noise and lights from the THAAD battery would not be detectable at that distance, and other operational activities would not directly or indirectly affect that habitat.

In summary, long-term operations under Alternative 1 are expected to have less than significant effects on the survivability of special status species in the area.

4.1.4.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.4.2.1 Site Preparation and Construction Activities

Under Alternative 2, the effects on biological resources during the initial site preparation and construction phase are the same as those described for Alternative 1. The additional clearing, grading, and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ would result in additional loss of vegetation communities and wildlife habitat, as described below.

Vegetation Communities. A 2.91-mile-long (4.68-kilometer-long) fiber optic communication line would be entrenched from existing facilities on NWF to the THAAD emplacement site. About 0.76 mile (1.22 kilometer) of that line would be located within the expeditionary emplacement in areas that are paved or cleared of vegetation. Of the remaining 2.15 miles (3.46 kilometers) of the route, about 0.55 mile (0.89 kilometer) (25 percent) is within developed land, and an additional 0.33 miles (15 percent) is within mixed herbaceous scrub maintained for the CDZ (see **Figure 3-1**). Assuming a 15-foot-wide (5-meter-wide) corridor is disturbed to bury the line, about 1.3 acre (0.52 hectare) of secondary limestone forest, and 1.0 acre (0.4 hectare) of other forest or scrub vegetation communities would be cleared of vegetation or otherwise disturbed (**Table 4-10**). This analysis likely overestimates the amount of secondary limestone forest that would be disturbed because, as shown in **Figure 2-3**, much of the proposed fiber optics route north of the emplacement area is along small roads, taxiways, or other linear disturbances that are not classified as developed land in the 2007 vegetation map used for this analysis.

Table 4-10. Vegetation Communities on Andersen AFB Affected by Alternative 2

Vegetation Community	Alternative 2 (acres)				Andersen AFB (Installation-wide in 2007)[4] (acres)
	Emplacement Area[1]	Fiber Optic Line[2]	CDZ Expansion[3]	Total Area Affected	
Developed Land	68.3	1.0	2.2	**71.5**	4,501.2
Mixed Herbaceous Scrub	145.4	0.6	4.7	**150.7**	731.8
Total Forest/Perennial Scrub:	35.7	2.3	53.2	**91.2**	6338.8
• Mixed Limestone Forest-Plateau/ Secondary	16.6	1.3	31.4	49.3	4,107.3
• *Casuarina* Forest	8.5	0.2	18.0	26.7	102.3
• *Hibiscus* scrub	4.3	0	3.6	7.9	431.5
• *Eugenia Forest*	0	0.3	0.2	0.5	39.14
• *Vitex*-Closed Canopy	3.9	0.1	0	4.0	850.8
• *Vitex*-Sparse Canopy	2.4	0.4	0	2.8	807.8

[1] The acreage of cleared vegetation shown already occurred during the THAAD expeditionary deployment in April 2013.

[2] Assuming a 15-foot-wide corridor temporarily disturbed during trenching.

[3] Area to be disturbed outside of the THAAD emplacement and current CDZ. At least 22.4 acres of additional vegetation within the current CDZ also would be cleared.

[4] Source: e^2M 2008

To prepare a CDZ training area on the North Runway, 63.1 acres (25.5 hectares) located outside of the original 248-acre (100-hectare) NWF CDZ would be used and cleared of vegetation, as necessary. Three acres (1 hectare) of that area have already been cleared for the expeditionary deployment of the THAAD battery in April 2013 and an additional 2.2 acres (0.9 hectares) is taxiways or other developed areas. Of the remaining 57.9 vegetated acres (23.4 hectares), 4.7 acres (1.9 hectares) is mixed herbaceous scrub and 53.2 acres (21.5 hectares) is forest and perennial scrub (**Table 3-4**).

Along with the 63.1 acres (25.5 hectares) outside of the original CDZ, additional vegetation would be cleared from some areas that remain forested within the current CDZ training area, including a 22.4-acre (9.1-hectare) tract in the northeastern corner of that area. Vegetation might also need to be removed from other, smaller areas within the original training area. Clearing of vegetation in that area was previously addressed in the CDZ EA (USAF 2000).

In total, 150.7 acres (61.0 hectares) of mixed herbaceous scrub and 91.2 acres (36.9 hectares) of forest and perennial scrub vegetation communities outside of the current CDZ training area have been or would be cleared under Alternative 2 (**Table 4-10**). Of the forest and perennial scrub vegetation, 49.3 acres (19.9 hectares) were determined in 2007 to be mixed limestone forest-plateau/secondary, 26.7 acres (10.8 hectares) were forested areas dominated by *Casuarina equisetifolia*, 6.8 acres (2.8 hectares) were dominated by closed canopy or sparse canopy *Vitex parviflora*, 0.5 acre (0.2 hectare) was *Eugenia* forest, and 7.9 acres (3.2 hectares) were *Hibiscus* scrub (**Table 4-10**).

With the exception of *Casuarina* forest, a very small portion of the vegetation communities on Andersen AFB have been or would be cleared under Alternative 2 (**Table 4-10**). Of the approximately 102.3 acres (41.4 hectares) of *Casuarina* forest on Andersen AFB, 26 percent has been or would be disturbed. Small stands of this indigenous tree species occur uncommonly throughout Guam (GDAWR 2005). Although

other vegetation communities cleared for this project are common on northern Guam, the loss of approximately 35.7 acres (14.4 hectares) of forested and perennial scrub land contributes to the cumulative loss of forests on the island (GDAWR 2005).

Development of a fenced conservation area and removal of ungulates from that site (**Figure 4-1**) would, over time, increase the availability of forested habitat and increase the abundance of native forest species on NWF.

Fauna. Installation of a fiber optic line and the expansion of the cargo drop zone would require the temporary and permanent disturbance of forest and scrub vegetation. The effects to wildlife from that habitat loss would be similar, but smaller in scale, to what occurred during the original expeditionary emplacement clearing of 35.7 acres (14.4 hectares) of forest and perennial scrub vegetation and the original CDZ clearing of 180 acres (USAF 2000) of secondary limestone forest.

Clearing of about 91.2 acres (36.9 hectares) of forest and perennial scrub vegetation communities reduces available habitat for the few remaining forest-dwelling birds, and the only remaining native mammal (the Mariana fruit bat) that occur on Guam. Forested areas on NWF also are used by native and introduced reptile, amphibians, and invertebrates, and competed and proposed activities would result in direct mortality and loss of habitat for skinks, geckos, and other species. Because there remain over 9,000 acres (3,642 hectares) of forest and scrub vegetation on Andersen AFB (e^2M 2008), the loss of habitat under Alternative 2 likely would not result in a decrease in the viability of any wildlife. However, clearing of that land contributed to the cumulative loss and degradation of forested habitat on Guam, which is an important threat to wildlife there (GDAWR 2005).

Development of a fenced conservation area (**Figure 4-1**) would, over time, increase the availability of forested habitat and benefit native fauna on Guam.

Clearing and maintaining the emplacement area and CDZ as low, herbaceous and scrub vegetation likely would increase habitat for non-native birds such as the black francolin and black drongo, and possibly for non-native reptiles and amphibians such as the marine toad. Populations of feral pigs and Philippine deer, which adversely affect forest habitat on Guam (JRM 2013), might also increase as a result of the clearing and maintenance of vegetation. Such a population increase could contribute to the cumulative degradation of forests on northern Guam cause by these non-native species. To counter such effects, Andersen AFB does implement ungulate control measures in certain areas of the installation.

Special Status Species. The effects to special status species under Alternative 2 are similar to those described under Alternative 1. As described in **Section 4.1.4.1.1**, most special status species that occur on Andersen AFB would not be affected by site preparation and construction activities. The following discusses the special status species that could be affected by those activities under Alternative 2.

Two special status plant species are known to occur within or near areas that have been or would be cleared. Fadang occur throughout NWF (Marler 2014), and a small number of individuals of this species could have been destroyed during clearing of about 16.6 acres (6.7 hectares) of secondary limestone forest, and additional plants would be destroyed during clearing of an additional 49.2 acres (19.9 hectares) of that forest during installation of the fiber optics line and expansion of the CDZ. *Tabernaemontana rotensis* have been found adjacent to an area to be cleared for expansion of the CDZ, but have not been found within any areas that have been or would be cleared (University of Guam 2007, USAF 2000, Raulerson and Witteman 2000). It is unlikely that any individuals of this species have been or would be destroyed during clearing of forested vegetation.

The moth skink and Pacific slender-toed gecko, which are classified as endangered by the Government of Guam, occur in the secondary limestone forest on NWF. Clearing of forested habitat would cause the long-term loss of potential habitat for these species and individuals of both species could be killed.

Habitat classified as essential for the recovery of the endangered Guam Micronesian kingfisher, Guam rail, and Mariana crow has been and would be disturbed. About 38.8 acres (15.7 hectares) of recovery habitat for the kingfisher and crow were cleared for preparation of the THAAD original expeditionary emplacement, and an additional 45.9 acres (18.6 hectares) of additional clearing is proposed (**Table 4-9**). The total amount of habitat for these two species that would be cleared under Alternative 2 would be about 0.6 to 0.7 percent of that available on northern Guam in 2010, and would not exceed the threshold of habitat remaining that would be required for recovery of the species.

About 137.9 acres (55.8 hectares) of recovery habitat for the Guam rail has been cleared, and an additional 0.5 acre (0.2 hectare) is proposed (**Table 4-9**). Under Alternative 2, about 0.3 percent of the habitat for this species that was available on Guam in 2010 would be disturbed, which would not exceed the threshold of remaining habitat that is required for recovery of the species. Most of the recovery habitat that was occupied or would be disturbed is or would be maintained with herbaceous vegetative cover similar to other recovery habitat on Guam. As a result, there has been and would be little or no net loss in acreage or conservation value of recovery habitat for the rail.

About 35.7 acres (14.4 hectares) of habitat for the Mariana fruit bat was cleared for preparation of the original expeditionary emplacement, and an additional 43.6 acres (17.6 hectares) of disturbance is proposed. This is a small portion of the 13,704 acres (5,545 hectares) of habitat on northern Guam that was available in 2010 for the survival and recovery of the Mariana fruit bat (USFWS 2010b). Clearing of forested areas has and would cause a long-term, small loss of foraging habitat, and possibly roosting habitat, for this species on Andersen AFB. In addition, noise and other disturbances during site preparation and clearing probably would cause any Mariana fruit bats foraging or roosting near the project site to temporarily avoid the surrounding area. Because there is a substantial amount of suitable habitat still available on northern Guam, the very small remaining population of fruit bats probably is not limited by food or roost sites. The clearing of about 79.3 acres (32.1 hectares) of potential habitat therefore probably would have no or very little short-term effect on Mariana fruit bats, but would contribute to the long-term cumulative loss and degradation of habitat for this species on northern Guam.

Development of a fenced conservation area and removal of ungulates from that site (**Figure 4-1**) would, over time, increase the availability of forested habitat and benefit these special status species. The USFWS has classified 80.5 acres (32.6 hectares) of the 121-acre (49-hectare) conservation area as recovery habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and Mariana crow, and 40.3 acres (16.3 hectares as recovery habitat for the Guam rail (**Table 4-9**).

Designated critical habitat for the Mariana fruit bat, Guam Micronesian kingfisher, and Mariana crow is located on Guam National Wildlife Refuge, more than 1 mile (1.6 kilometer) from the THAAD project site. That critical habitat has not and would not be directly altered or indirectly affected during completed or planned project activities.

Because of the availability of suitable habitat elsewhere, the clearing of approximately 91.2 acres (36.9 hectares) of forest and perennial scrub vegetation and long-term operations is expected to have less than significant effects in the short-term and on the survivability of special status species in the area, but would contribute to the long-term cumulative loss and degradation of habitat for such species on Guam.

4.1.4.2.2 Operational Activities

Once the new THAAD facilities are constructed and other site improvements completed, daily operations and training activities for the THAAD battery are expected to be similar to that of the Alternative 1 described in **Section 4.1.4.1.2**. These activities would include vegetation maintenance within and along the outer fence line of the proposed permanent emplacement site. Mowing would occur approximately once a week during the rainy season and less often during the dry season. Approved selective and non-selective herbicides (such as glyphosate) also would continue to be used to control vegetation growth in areas that are less accessible. All herbicide applications are conducted in accordance with the installation's Pest Management Plan (Andersen AFB 2014b). For the expanded CDZ at the NWF North Runway, similar vegetation maintenance activities would occur.

As described in **Section 4.1.4.1.2**, operation of tactical generators and security lights could cause some wildlife, including Mariana fruit bats, to avoid habitat adjacent to the emplacement area and could affect the behavior, reproduction, or survival of some wildlife that remain in the area. A Giant Voice system would be installed at the emplacement site to warn of incoming missile attacks or weather advisories. The system would be audible to a distance of about 6,560 feet (2,000 meters). The Giant Voice system would be operated very infrequently for testing and emergencies; thus would have little effect on wildlife.

EMR emitted from the THAAD radar would have no or very little adverse effects on terrestrial or arboreal wildlife because vegetation immediately in front of the system has been cleared and because the radar is aimed upward. During most operations, when the radar is operating in scanning mode, the risk to birds, bats, or other flying animals is very low. During the infrequent periods when the radar is operating in tracking mode, an animal flying directly into the beam or slowly through the beam could be harmed by exposure to EMR; however, the risk of that occurring is low.

Because equipment is not and will not be shipped frequently to and from Guam, and because all cargo has been and will be inspected as part of the ongoing interdiction effort by the DoD and other agencies, ongoing and planned project activities have a minimal risk of causing the spread of invasive species.

Just as for Alternative 1, long-term operations under Alternative 2 are expected to have less than significant effects on the survivability of special status species in the area.

4.1.4.3 No Action Alternative

The initial site preparation and construction phase of the THAAD were previously completed under emergency circumstances. Likewise, the THAAD battery has already been operational. Accordingly, the effects on biological resources and the survivability of special status species in the area are the same as those described in Alternative 1 (less than significant effects).

On a longer term basis, the THAAD battery would be removed and the site would be returned to near original conditions. Temporary structures, concrete pads, and fencing would be demolished or removed from the site and those areas cleared of vegetation for the THAAD emplacement and outside of the current CDZ would be allowed to revegetate. Refer to **Section 3.4.2** for a description of the original vegetation, fauna, and special status species conditions. Over time, there would be a beneficial effect to most native flora and fauna, including the special status species that occurred there, as forest vegetation returns to the approximately 35.7 acres (14.4 hectares) of disturbed land located outside of the CDZ training area.

4.1.5 Cultural Resources

Potential impacts of the Proposed Action and No Action Alternatives on cultural resources were assessed by (1) identifying the nature and importance of the resource in potentially affected areas and (2) identifying proposed activities that could directly or indirectly affect cultural resources by applying the Criteria of Adverse Effect at 36 CFR § 800.5(a)(1).

4.1.5.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.5.1.1 Site Preparation and Construction Activities

Site preparation and construction for the THAAD system expeditionary deployment at Andersen AFB had no significant direct or indirect effects on previously identified traditional cultural properties. The nearest such properties are at least 1 mile (1.6 kilometers) from the THAAD battery emplacement site and on the coastal plain several hundred feet below the emplacement. The THAAD battery is therefore too distant to pose any direct or indirect effects including visual or auditory effects to traditional cultural properties.

The THAAD expeditionary emplacement site is completely within the boundaries of the NRHP-eligible NWF (Olmo 1997, Thompson 1986). The expeditionary deployment of the THAAD battery had direct effects on NWF, specifically the use of a taxiway for a motor pool and removal of vegetation between runways and taxiways that are part of the airfield and its setting. Collectively, these actions represent alterations to character-defining elements of the historic property that contributed to its eligibility for listing in the NRHP, and would be considered adverse effects under 36 CFR § 800.5(a)(1) of the Section 106 process. They are also a significant, long-term impact under NEPA. With mitigation and best practice measures negotiated for and memorialized under a Section 106 Memorandum of Agreement between the U.S. Army and the Guam SHPO, the impact under NEPA of the expeditionary THAAD system deployment to NWF would be reduced to less than significant.

Based on information in Andersen AFB geospatial data (Andersen AFB 2014), the 2010 FEIS (JGPO 2010), the archaeological survey report prepared in support of that FEIS (Dixon et al 2010), and the CDZ EA (USAF 2000), the nearest previously recorded archaeological sites that have been recommended eligible for listing in the NRHP are at least 82 feet (25 meters) outside of THAAD emplacement site. These archaeological sites were not affected by the emergency deployment. As noted in **Section 3.5.2**, an archaeological survey of the THAAD compressed expeditionary emplacement site conducted after vegetation was cleared for the emergency deployment only identified archaeological materials that lacked integrity and, therefore, were recommended not eligible for listing in the NRHP by the surveyor (Rogers 2013).

NWF has been documented to HAER standards (Aaron et al. 2007) and the records are retained in the Library of Congress. Any alterations to the pavement of the runways, taxiways, or service areas of NWF due to the deployment of the THAAD system would be repaired in kind with like material according to the historic design, consistent with the Secretary of the Interior's standards for the rehabilitation of historic properties (National Park Service 1992). Removal of vegetation around paved facilities would be kept to the minimum necessary for the proposed project to minimize changes to the setting of NWF. Any adverse effects to NRHP-eligible archaeological properties in the APE caused by the activities detailed in **Section 2.1.1** would be addressed in compliance with Section 106 of the NHPA through avoidance, minimization, or mitigation of adverse effects. All future THAAD mission-related ground-disturbing activities detailed in **Section 2.1.1** of this document would be conducted in compliance with the procedures in the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010). In particular, in keeping with the measures requested on May 5, 2015 by the Guam SHPO (see correspondence in Appendix A), the 94th AAMDC would conduct pedestrian surveys of the areas that

would have additional vegetation clearance and that have not been previously surveyed for archaeological sites. Also, in keeping with the measures requested on May 5, 2010 by the Guam SHPO, the 94th AAMDC would conduct subsurface archaeological testing along portions of the proposed underground fiber optic line and conservation area fence line in areas where subsurface soils have not been previously disturbed by construction of NWF and other activities. Any archaeological resources discovered during these operations that could not be avoided by THAAD-related ground disturbing activities as detailed in this EA would be subject to data recovery and mitigation measures, if appropriate. If archaeological resources are inadvertently discovered during ground-disturbing activities, then the Standard Operating Procedures (SOPs) contained within the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010) would be followed, as well as all applicable government regulations and guidelines. In particular, the U.S. Army would follow SOPs covering the review of work orders, the inadvertent discovery of archaeological remains, the inadvertent discovery of human remains, ground-disturbing activity, emergency situations, natural disasters, and the maintenance and care of historic structures. These measures would be memorialized in a Section 106 Memorandum of Agreement signed by the Army and the Guam SHPO that would result in no significant impact to cultural resources under NEPA.

4.1.5.1.2 Operational Activities

Under Alternative 1, long-term operation of the THAAD battery on NWF would have no direct or indirect effects to cultural resources.

4.1.5.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.5.2.1 Site Preparation and Construction Activities

For the permanent stationing of the THAAD battery under Alternative 2, the effects on cultural resources at NWF during the initial site preparation and construction phase are the same as those described for Alternative 1.

The additional grading and construction activities (including the new security fences, fiber optic line, drainage system, new guard towers, and four new buildings) proposed for permanent stationing of the THAAD battery would have no significant direct or indirect effects on previously identified traditional cultural properties. The nearest such properties are at least 1 mile (1.6 kilometers) from the THAAD proposed permanent emplacement site and the CDZ expansion area, and on the coastal plain several hundred feet below the affected areas.

All but 2.2 acres (0.9 hectares) of the THAAD permanent emplacement site and the CDZ expansion are within the boundaries of the NRHP-eligible NWF (Olmo 1997, Thompson 1986). Alternative 2 would therefore have direct effects on NWF, specifically the use of a taxiway for a motor pool, removal of vegetation between runways and taxiways that are part of the airfield and its setting, and construction of all associated components: security fences, the motor pool, guard towers, four new support buildings, the fiber-optic communication line trench, the Giant Voice warning system, the communications trough, drainage culverts and piping, generators, above-ground fuel pods, and all other components of the project as described in **Section 2.1**. These actions represent alterations to character-defining elements of the historic property that contributed to its eligibility for listing in the NRHP, and would be considered adverse effects under 36 CFR § 800.5(a)(1) of the Section 106 process and a significant, long-term impact under NEPA without the implementation of appropriate mitigation and best practice measures.

Based on information in Andersen AFB geospatial data (Andersen AFB 2014), the 2010 FEIS (JGPO 2010), the archaeological survey report prepared in support of that FEIS (Dixon et al 2010), and the CDZ EA (USAF 2000), the nearest previously recorded archaeological sites that have been recommended eligible for listing in the NRHP are at least 82 feet (25 meters) from the THAAD permanent emplacement

site and CDZ expansion areas that historic photographs indicate were not cleared of vegetation in the 1940s. These archaeological sites are outside the THAAD emplacement site and CDZ expansion and would not be affected under Alternative 2. Based on archaeological materials identified near the permanent emplacement site and CDZ expansion areas, no significant prehistoric archaeological sites would be expected, although scattered World War II-era and Cold War-era features, such as foundations from support facilities and infrastructure, may be identified. As noted in **Section 3.5.2**, an archaeological survey of the THAAD compressed expeditionary emplacement site conducted after vegetation was cleared for the emergency deployment only identified archaeological materials that the archaeologist who conducted the survey judged to lack integrity and, therefore, recommended those materials not eligible for listing on the NRHP (Rogers 2013).

NWF has been documented to HAER standards (Aaron et al. 2007) and the records are retained in the Library of Congress. Any alterations to the pavement of the runways, taxiways, or service areas of NWF due to the deployment of the THAAD system would be repaired in kind with like material according to the historic design, consistent with the Secretary of the Interior's standards for the rehabilitation of historic properties (National Park Service 1992). Removal of vegetation around paved facilities would be kept to the minimum necessary for the proposed project to minimize changes to the setting of NWF. Any adverse effects to NRHP-eligible archaeological properties in the APE caused by the activities detailed in **Section 2.1.2** would be addressed in compliance with Section 106 of the NHPA through avoidance, minimization, or mitigation of adverse effects. All future THAAD mission-related ground-disturbing activities detailed in **Section 2.1.2** of this document would be conducted in compliance with the procedures in the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010). In particular, in keeping with the measures requested on May 5, 2015 by the Guam SHPO (see correspondence in Appendix A), the 94th AAMDC would conduct pedestrian surveys of the areas that would have additional vegetation clearance and that have not been previously surveyed for archaeological sites. Also, in keeping with the measures requested on May 5, 2010 by the Guam SHPO, the 94th AAMDC would conduct subsurface archaeological testing along portions of the proposed underground fiber optic line and conservation area fence line in areas where subsurface soils have not been previously disturbed by construction of NWF and other activities. Any archaeological resources discovered during these operations that could not be avoided by THAAD-related ground disturbing activities as detailed in this EA would be subject to data recovery and mitigation measures, if appropriate. If archaeological resources are inadvertently discovered during ground-disturbing activities, then the SOPs contained within the Andersen AFB Integrated Cultural Resources Management Plan (HDR/e^{2}M 2010) would be followed, as well as all applicable government regulations and guidelines. In particular, the U.S. Army would follow SOPs covering the review of work orders, the inadvertent discovery of archaeological remains, the inadvertent discovery of human remains, ground-disturbing activity, emergency situations, natural disasters, and the maintenance and care of historic structures. These measures would be memorialized in a Section 106 MOA signed by the Army and the Guam SHPO that would result in no significant impact to cultural resources under NEPA.

4.1.5.2.2 Operational Activities

Just as for Alternative 1, long-term operation of the THAAD battery under Alternative 2 would have no direct or indirect effects to cultural resources.

4.1.5.3 No Action Alternative

Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would have the same impacts to cultural resources as those described for Alternative 1. Removal of the THAAD battery from NWF, including ancillary equipment and related infrastructure (temporary fencing, concrete pads) would have no significant direct or indirect effects on previously identified traditional cultural properties.

4.1.6 Airspace Management

Airspace management and use was assessed by evaluating the potential effects of the existing and proposed airspace restrictions on navigable airspace; on airport and airfield access and usage; and for changes in regular flight course, altitude, or instrument procedures.

4.1.6.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.6.1.1 Site Preparation and Construction Activities

The site preparation and construction activities under Alternative 1 have had no effect on airspace management.

4.1.6.1.2 Operational Activities

For THAAD radar operations, the U.S. Army requested and received a TFR from the FAA on the northern end of Guam. A TFR is a regulatory action that temporarily restricts certain aircraft from operating within a defined area in order to protect persons or property in the air or on the ground. Temporary Flight Restrictions are issued in a Notice to Airman (NOTAM) and are not depicted on any navigational charts.

The current TFR is documented in a Letter of Agreement between the Army, USAF, FAA, and Guam Air Route Traffic Control Center to support THAAD radar operations. When the TFR is active, all aviation activities are restricted within its boundaries. TFRs are normally temporary until a more permanent solution is implemented. However, under Alternative 1, the current TFR would continue to be used during THAAD radar operations.

Guam International Airport and Andersen AFB units are impacted by the current TFR. The TFR encroaches into Guam International Airport initial approach areas of RNAV GPS Y RWY 24L/24R, and RWY 06 departures, left turns only. Aircraft executing these procedures are rerouted to avoid the TFR area. The Andersen AFB training on NWF is impacted when the TFR is active.

Overall, the long-term impacts from the TFR would not be significant as procedures are in place to reroute aircraft.

4.1.6.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.6.2.1 Site Preparation and Construction Activities

Just as for Alternative 1, the site preparation and construction activities under Alternative 2 would have no effect on airspace management.

4.1.6.2.2 Operational Activities

Under Alternative 2, impacts on airspace management to date from implementation of the THAAD TFR would be the same as for Alternative 1. For THAAD radar operations in support of THAAD permanent stationing, the U.S. Army would request the establishment of a Restricted Area on the northern end of Guam. Restricted Areas contain airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft (FAA 2014). As shown on **Figure 4-2**, the proposed Restricted Area would be named R-XXXX and is described in the following.

Figure 4-2. Proposed Restricted Area R-XXXX

- **Boundaries:** Beginning at coordinates 13º38'54"N/144º47'57"E; to 13º41'35"N/144º53'21"E; to 13º38'24"N/144º54'57"E; to 13º35'45"N/144º49'34"E; to the point of the beginning. The altitude would be from the surface up to 22,000 feet (6,706 meters) above msl, but minus altitudes from surface to 3,000 feet (914 meters) above ground level for the coordinates starting at 13°40'50"N/144°51'51"E; to 13°41'21"N/144°52'53"E; to 13°40'59"N/144°53'38"E; to 13°40'29"N/144°53'54"E; to 13°40'50"N/ 144°51'51"E; to the point of beginning.
- **Designated Altitudes:** Surface to 22,000 feet (6,706 meters) msl (FL220)
- **Time of Designation:** Continuous
- **Controlling Agency:** FAA, Guam CERAP
- **Using Agency:** U.S. Army

Establishing a Restricted Area in accordance with FAA Order JO 7400.2K

FAA Order JO 7400.2K, *Procedures for Handling Airspace Matters*, outlines the environmental and aeronautical processes to establish SUA. The aeronautical and environmental processes may not always occur in parallel; however, both processes are required to establish SUAs.

There were operational activities occurring in the airspace over NWF where R-XXXX is proposed. Airspace/airfield impacts due to the establishment of the proposed R-XXXX were assessed based on the following criteria: 1) disruption of the existing flow of air traffic to and from Andersen AFB and Guam International Airport, and 2) effect to current training occurring at NWF. Impacts are considered short-term, long-term, minor, moderate, and/or major.

Assumptions have been made for the purpose of analysis at this stage. They would either be confirmed or re-analysis would occur based on the results of the Aeronautical Study and/or Safety Management System

Plan, which are used to ensure the safety of air navigation and the efficient utilization of navigable airspace by aircraft.

Guam Center Radar Approach (CERAP)

Implementation of the proposed Restricted Area would present long-term major impacts on the Guam CERAP. Guam CERAP is responsible for safely transiting aircraft within close proximity to each other and obstructions (i.e., SUA). There are also long-term minor impacts: 1) the proposed Restricted Area encroaches on the initial approach area of RNAV GPS Y RWY 24L and RNAV GPS Y RWY 24R, and 2) requires aircraft departing Guam International Airport on RWY 06L/06R departures to execute a sharp left turn or fly an additional 10 minutes to avoid the area. These impacts would require terminal instrument procedural updates to avoid the proposed R-XXXX. Overall, the long-term impacts on the Guam CERAP would not be significant as procedural changes would be implemented.

Andersen AFB

Implementation of the proposed Restricted Area would present long-term minor impacts on Andersen AFB because it encroaches on all terminal instrument procedures for the Category D Circling Area and Andersen AFB Class D Airspace (see **Figure 4-3**). The circling area is where aircraft circle to land under visual conditions after completing an instrument landing approach. Each aircraft is assigned a category to which the appropriate obstacle clearance areas, and landing and departure minimums, can be established.

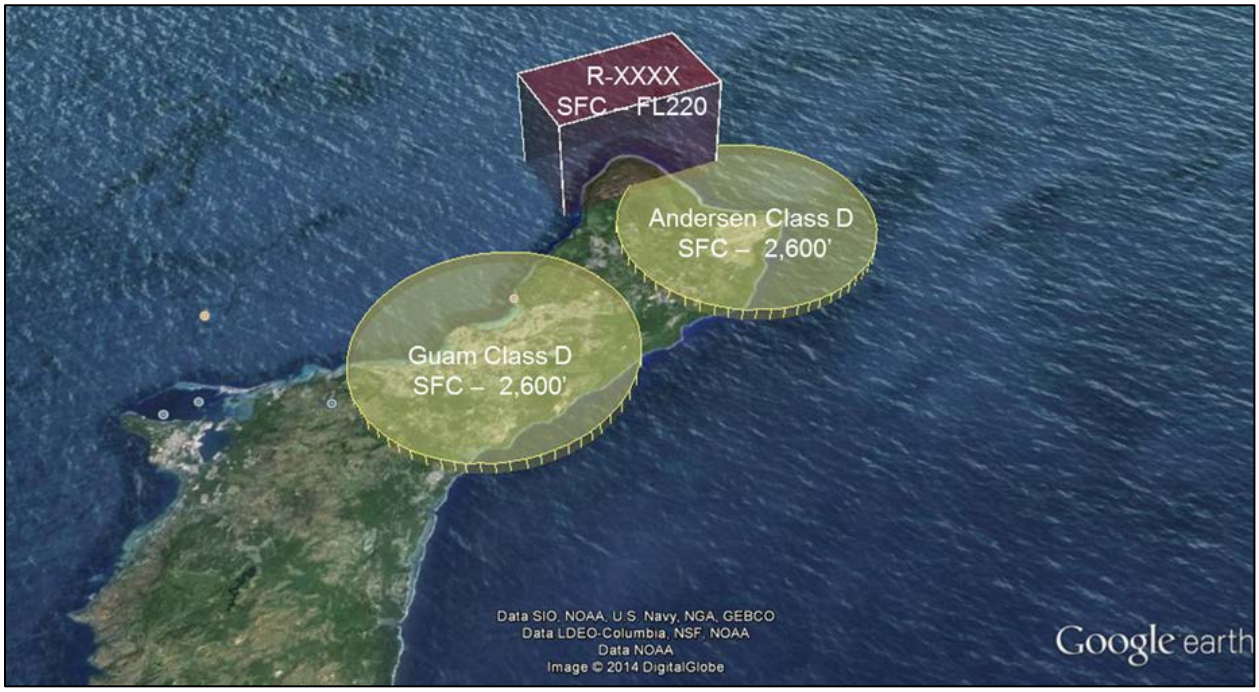

Figure 4-3. Guam International Airport and Andersen AFB Class D Airspace in Relation to the Proposed Restricted Area R-XXXX

Because of the proposed Restricted Area, Andersen AFB would be required to eliminate Category D Circling west of the airfield and reconfigure its Class D Airspace to eliminate the encroachment.

Under Alternative 2, shifting the CDZ to the NWF North Runway would reestablish training capability at NWF. Joint Service access to the R-XXXX, including NWF, the landing zone, and the expanded CDZ, would be coordinated through the development of an inter-service agreement (e.g., memorandum of understanding [MOU], letter of authorization [LOA]), as well as a letter of procedure with the FAA as

appropriate. Thus, long-term impacts on Andersen AFB training operations are considered non-significant and expected to be mitigable to minor.

Divert Landings

The impact to airspace and airfield operations due to a divert landing would depend on the situation. A divert landing could be caused when the primary airfield is temporarily unavailable or there is an in-flight emergency. Continuing the flight may jeopardize the safety of the aircraft. Divert landings can occur at any time and would have an impact on airspace and airfield operations. There are adequate published instrument approach procedures to assist aircraft transitioning to land at both Andersen AFB and Guam International Airport. The proposed THAAD Restricted Area, R-XXXX, may be required to provide emergency aircraft with the most direct expeditious route to an airfield. Because divert landings are generally considered an emergency situation and given airspace priority, no impacts on divert landings are expected.

Military Exercises

Implementation of military exercises would present short-term minor impacts on the airspace. It is assumed that each aircraft would take-off and land twice a day during exercises and individual units would periodically land and take-off to become familiar with the airspace while in the Area of Responsibility. Aircraft would be required to remain clear of the proposed Restricted Area; entry for training events would require prior coordination/approval. For large-force exercises, it would require pre-coordinated, inter-service agreements (e.g., MOU, LOA), as well as a letter of procedure with the FAA as appropriate.

4.1.6.3 No Action Alternative

Under the No Action Alternative, the THAAD radar operations would cease and the current TFR would be removed. This change would allow airspace management on the northern end of Guam to return to THAAD pre-deployment status.

4.1.7 Hazardous Materials and Wastes

Potential impacts related to hazardous materials and hazardous wastes, including toxic substances, were evaluated by assessing impacts of the Proposed Action on the procedures, policies, plans, and infrastructure required to safely and responsibly store, handle, and dispose of additional hazardous materials, toxic substances, and/or hazardous waste. The analysis also considered the likelihood of generating and encountering hazardous waste during clearing and construction activities.

4.1.7.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.7.1.1 Site Preparation and Construction Activities

During site preparation and construction activities, potential impacts can occur from the accidental release of POLs and coolant from equipment. BMPs have been implemented to prevent the accidental release of fluids, such as daily inspections of construction vehicles and equipment for fluid leaks, secondary containment provisions for equipment fueling sites, and proper handling and disposal of vehicle wastes. The use of hazardous materials and generation of hazardous wastes during site preparation and construction activities has not been substantial. All hazardous materials and wastes generated are handled and disposed of in accordance with applicable Federal, Air Force, and Guam regulations.

No DERP related impacts are expected to occur under Alternative 1. There are no open IRP or MMRP sites within the THAAD emplacement area. Should munitions or contamination/hazardous wastes be encountered as part of construction activities, personnel would cease work and immediately report the finding to the appropriate installation hazardous material or ordnance disposal response group.

No impacts from ACMs, LBP, or PCBs are expected because there are no known facilities or utilities that would harbor such materials that are a part of the Proposed Action. If asbestos pipe is encountered, it would be handled and disposed of in accordance with applicable regulations.

Thus, no significant impacts are expected for hazardous materials and wastes as a result of this alternative.

4.1.7.1.2 Operational Activities

During THAAD battery operational activities, hazardous materials used and wastes generated as part of routine equipment maintenance consist primarily of POLs, solvents, and coolant (ethylene glycol). The fueling and maintenance activities associated with tactical vehicles, generators, ASTs, and other equipment can potentially result in accidental release of such materials. However, secondary containment systems are in place and the equipment is maintained in good working order to prevent leakage.

Wastes generated per quarter as a result of THAAD motor pool operations include approximately 450 gallons (1,703 liters) of POLs, ten 55-gallon (208-liter) drums of combined solid waste (oily rags/oil filters/fuel filters), and 50 gallons (189 liters) of contaminated (used) coolant. The POLs and combined solid waste drums are destined for recycling or disposal as non-RCRA regulated wastes. The contaminated coolant, however, is managed as a hazardous waste. On rare occasions, THAAD equipment maintenance operations have the potential to generate up to 400 gallons (1,514 liters) of contaminated coolant at one time.

Up to 55 gallons (208 liters) of hazardous wastes are allowed to be stored at the THAAD motor pool satellite accumulation area. Any excess over 55 gallons (208-liter) requires removal within 3 days in accordance with USEPA regulations (40 CFR § 262.34(c)). Because of the higher amount of contaminated coolant that could be generated at one time (up to 400 gallons [1,514 liters] of waste coolant), the potential exists for the storage limit at the satellite accumulation area to be exceeded. On such rare occasions, possible scheduling issues with hazardous waste collection and transport from the THAAD motor pool satellite accumulation area could result in a violation of the RCRA 3-day limit for hazardous waste storage, which also increases the risk for mishap. The 36th Wing is in the process of establishing a 90-day hazardous waste accumulation site on NWF in accordance with 40 CFR 262.34(a). Thus, the potential for a hazardous waste storage violation at the THAAD motor pool satellite accumulation area will be significantly reduced. The new storage facility is expected to be in place later in 2015. Regulatory requirements for 90-day accumulation sites are more stringent than those for satellite accumulation areas. These additional requirements include weekly inspections, locating containers holding ignitable or reactive waste at least 49 feet (15 meters) from the facility property line, and special requirements for storing incompatible wastes.

The installation's HMMP, HWMP, and SPCC would be updated accordingly to take into account THAAD operations, which would help reduce amounts of hazardous materials and wastes used or stored, as well as expedite spill response and clean-up efforts. All hazardous materials and wastes are handled and disposed of in accordance with applicable Federal, Air Force, and Guam regulations.

Operational activities are not expected to result in DERP, ACM, LBP, or PCB related impacts.

The storage, handling, and application of herbicides to control vegetation growth in areas inaccessible to mowing equipment are conducted in accordance with the installation's Pest Management Plan (Andersen AFB 2014b).

As a result, no significant impacts are expected for hazardous material and waste management under this alternative. The risk for a storage violation at the THAAD motor pool satellite accumulation area is relatively low and temporary until the new 90-day hazardous waste accumulation site on NWF is established.

4.1.7.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.7.2.1 Site Preparation and Construction Activities

Impacts would be similar to those described for Alternative 1. Because this alternative involves more construction compared to Alternative 1, more types and greater volumes of hazardous materials and wastes (including paints, sealants, and adhesives) likely would be used or generated. Once completed, the new buildings could suffer radon gas intrusion; however, radon resistant construction techniques would be used on these facilities to prevent radon buildup.

As with Alternative 1, hazardous materials and wastes would be handled and disposed of in accordance with applicable regulations. No significant impacts are expected.

4.1.7.2.2 Operational Activities

Impacts resulting from operation of the THAAD battery and motor pool would be similar to those described for Alternative 1. There would be a long-term, minor increase in the use of hazardous materials and generation of hazardous wastes from the upkeep and maintenance of the security fences, roadways, and support buildings (e.g., paints, sealants, adhesives, and herbicides). Just as for Alternative 1, all hazardous materials and wastes would be handled and disposed of in accordance with applicable Federal, Air Force, and Guam regulations. Thus, no significant impacts are expected for hazardous material and waste management as a result of this alternative. The risk for a storage violation at the THAAD motor pool satellite accumulation area would remain relatively low and temporary until the new 90-day hazardous waste accumulation site on NWF is established.

4.1.7.3 No Action Alternative

Impacts resulting from site preparation and construction would be the same as those described for Alternative 1. Following removal of the THAAD battery, there would be no hazardous materials used or hazardous wastes generated from operational activities. No significant impacts are expected for hazardous materials and wastes as a result of this alternative.

4.1.8 Human Health and Safety

The analysis of potential effects under this resource topic considered both public and occupational health and safety. Analyses evaluated the types of activities to occur as part of site preparation and construction, and operations; the introduction of new health or safety risks; the location of hazardous operations and activities with respect to sensitive receptors and the general public; and the adequacy of safety related planning and procedures in place.

4.1.8.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.8.1.1 Site Preparation and Construction Activities

Construction activities pose increased risk of construction-related accidents, such as falls, electric shock, object impacts, and workers caught in/between equipment. Impacts to construction worker health and safety are reduced through the development and implementation of a site-specific Health and Safety Plan, donning of applicable personal protective equipment (e.g., hard hat, eye protection, gloves for expected job hazards, and respiratory protection as necessary), marking and fencing off construction areas, and having properly trained personnel operating the equipment. Should unexploded munitions or hazardous materials/wastes be encountered as part of the grading and construction activities, workers should cease activities and immediately report the finding to the appropriate installation safety personnel. Due to the nature of the site preparation and construction activities, the risk of impacts on construction worker safety from implementation of Alternative 1 has been minimal. There have been no impacts to public health and safety from site preparation and construction because those activities have occurred entirely within the boundaries of Andersen AFB.

4.1.8.1.2 Operational Activities

Health and safety concerns for on-site personnel during operational activities include vehicle and equipment accidents, exposure to excessive noise from the generators, and exposure to EMR emitted from the THAAD radar system. A hearing conservation program may need to be implemented as necessary per DoD Instruction 6055.12 to address noise exposure to personnel working around the generators and other loud equipment. Refer to **Section 4.1.2** for more information about noise impacts.

On-site personnel are expected to exercise their respective duties in accordance with the established SOPs for the THAAD battery operation, thereby controlling and minimizing health and safety risks. This includes an exclusion zone of 328 feet (100 meters), +/- 90 degrees of the axis of orientation of the THAAD radar system to avoid injury to personnel from EMR. An earthen berm in front of the radar further reduces the ground-level EMR exposure risks. It is incumbent upon THAAD operations to ensure that personnel and equipment associated with adjacent land use activities are in compliance with the established THAAD radar exclusion zones. Because the THAAD battery radar operations do not affect any land or ocean surface areas outside of the installation boundary, no members of the public would be exposed to harmful EMR. The current TFR provides a safety measure to keep aircraft from being adversely affected by the operation of the THAAD radar and avoid any aircraft equipment malfunctions. See **Section 4.1.6** for more information about impacts to airspace.

Established ESQD arcs at the Andersen AFB MSA do not need to be modified for THAAD munitions. New ESQD arcs have been established for the THAAD missile launchers in accordance with DoD regulatory requirements; no areas outside the installation boundary are affected.

Thus, no significant impacts on health and safety are expected during operational activities.

4.1.8.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.8.2.1 Site Preparation and Construction Activities

Impacts to health and safety would be similar to those described for Alternative 1. There would be no impacts to public health and safety.

4.1.8.2.2 Operational Activities

Impacts to health and safety would be similar to those described for Alternative 1. Expansion of the current CDZ represents a shifting of prior airborne training operations from the South Runway to the North Runway within the existing NWF airfield, resulting in little change to aircraft accident potential zones. Thus, no significant impacts are expected. Refer to **Section 4.1.2** for information about noise impacts. See also **Section 4.1.6** for information about impacts to airspace.

4.1.8.3 No Action Alternative

Impacts to health and safety would be similar to those describe for Alternative 1; however, additional minor impacts would arise from demolition activities. There would be no operational impacts. Upon THAAD battery shut down and removal, there would be no safety impacts from generator noise or radar emissions.

4.1.9 Socioeconomics

The analysis of potential impacts on socioeconomics took into consideration changes in the local population; changes in housing and community services (healthcare, police, fire protection, and schools) from the demands of increased population; and changes to employment, Government spending, local business opportunities, and tourism as an effect on the local and regional economy.

4.1.9.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.9.1.1 Site Preparation and Construction Activities

For the THAAD expeditionary deployment, clearing and construction-related activities required a small workforce of military personnel and contractors (no more than 20 workers at any one time). The site preparation and construction phase has had a temporary positive effect on the local economy through increased employment; however, such effects are insignificant. Because the activities required few temporary workers, there are no adverse effects on public services or local housing.

4.1.9.1.2 Operational Activities

The long-term operational activities under Alternative 1 include the addition of 200 military and civilian personnel, resulting in a 2.6 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). When compared to the entire island, it represents a 0.1 percent increase to the overall population on Guam.

The increase in military personnel and Federal spending in support of the THAAD mission has a small beneficial impact on local businesses and on Guam's overall economy, although insignificant. Alternative 1 is not expected to have any effect on Guam's tourism industry.

Most of the military and contractor personnel live in existing billeting facilities on Andersen AFB. Thus, there are no significant impacts on housing demands on base and no impacts off base. Overall, the increase in island population resulted in a minor increase in the use of public services, but no adverse effects are expected.

In summary, the THAAD-related operational activities for Alternative 1 would have no effect or insignificant beneficial impacts on socioeconomics.

4.1.9.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.9.2.1 Site Preparation and Construction Activities

Under Alternative 2, the effects on socioeconomics during the initial site preparation and construction phase are the same as those described for Alternative 1. The proposed permanent stationing of the THAAD battery and expansion of the CDZ, however, would involve additional clearing and construction-related activities, requiring a small workforce consisting of military personnel and no more than 50 contract workers at any one time. These activities would have a temporary positive effect on the local economy through increased employment, although such effects would be insignificant. Because the clearing and construction activities would require few temporary workers, there would be no adverse effects on public services or local housing.

4.1.9.2.2 Operational Activities

Beyond the initial operational effects described under Alternative 1, long-term THAAD operations for Alternative 2 would increase military personnel and contractors to about 225 (25 more than Alternative 1), and adds approximately 168 military dependents. The combined total of 393 people results in a 5 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). Operational activities associated with the expansion of the CDZ would result in no additional permanent personnel, contractors, or dependents. When compared to the entire island, this alternative would result in a 0.2 percent increase to the overall population on Guam.

The increase in military personnel and families, and Federal spending in support of the THAAD mission, would have a small beneficial impact on local businesses and on Guam's overall economy that is slightly greater than for Alternative 1, but still insignificant. Alternative 2 is not expected to have any effect on Guam's tourism industry.

Just as for Alternative 1, most of the military personnel would live in existing billeting facilities on Andersen AFB. In addition, all or most of the approximate 70 families moving to Guam would be placed in existing or future JRM housing on the island (depending on when new housing becomes available). Thus, there would be no significant impacts on housing demands either on- or off-base. Most children of the military families are expected to be enrolled in the DoD Domestic Dependent Elementary and Secondary School System. Overall, the permanent increase in island population would result in a minor increase in the use of public services, including public schools and health care facilities, but no adverse effects are expected.

In summary, the THAAD-related operational activities for Alternative 2 would have minor but insignificant beneficial impacts on socioeconomics.

4.1.9.3 No Action Alternative

Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would result in the same minor beneficial socioeconomic effects as described for Alternative 1. The THAAD battery operational activities to date also would result in minor beneficial effects, similar to that of Alternative 1.

Removal of the THAAD equipment, temporary facilities, and infrastructure would require a small, temporary workforce consisting of military personnel and no more than 20 contract workers at any one time. These activities would have a temporary beneficial effect on the local economy through increased employment, although such effects would be insignificant. Because the activities would require few temporary workers, there would be no adverse effects on public services or local housing.

On a longer-term basis, removal of the THAAD mission and the 200 support personnel from Guam would result in no effects from the return to THAAD pre-deployment socioeconomic conditions.

4.1.10 Utilities and Transportation Infrastructure

Impacts on infrastructure were evaluated based on the potential for disruption, excessive use, or improvement to the existing level of service. As part of the analysis, existing capacities were compared to projected demands under the Proposed Action. Any violations in permit conditions are also considered.

4.1.10.1 Alternative 1: Permanent Stationing of Expeditionary THAAD System

4.1.10.1.1 Site Preparation and Construction Activities

The THAAD mission-related clearing, grading, and construction activities that occurred under Alternative 1 required a small workforce consisting of military personnel and contractors (no more than 20 workers at any one time). Because of the limited increase in workforce personnel and construction activities, utility demands have been temporary and minimal, and did not exceed system capacities.

All electrical power distribution from on-site generators is via above-ground cables and conduits (no trenching). With the exception of grading for gravel roads that occurred inside the emplacement site and some repairs of existing roadways to the site, there would be no construction of new roads. During construction activities, temporary increases in local traffic and roadway use have been minimal.

Thus, no impacts to utilities and transportation infrastructure are expected during site preparation and construction activities for Alternative 1.

4.1.10.1.2 Operational Activities

For the THAAD mission and facilities, current plans do not include any new service connections for potable water, sewer, or electrical power. All THAAD personnel have been placed in existing installation housing already permitted for sewer and water. At the emplacement site on NWF, all electrical power is provided by generators and distributed via aboveground cables and conduits. Potable water for emplacement site use is trucked-in using unit water pod systems (camels), as needed. Additionally, portable latrines provided on site require periodic emptying by contractors, with the sewage then taken to one of the existing WWTPs in a position for accepting and treating the wastes. Existing wash racks on base are used for vehicle washing, when necessary. Such wash facilities utilize oil/water separators before discharging wastewater to a sanitary sewer.

Under Alternative 1, the addition of 200 military personnel and contractors has resulted in a 2.6 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). Such a small increase in base population has not placed substantial demands on existing utilities or cause major increases in local roadway use. This population increase results in a daily potable water increase demand of approximately 20,000 gallons (75,708 liters) based on a typical use of 100 gallons (379 liters) per person per day. The daily increase in wastewater generation resulting from the added population is approximately 12,000 gallons (45,425 liters) based on 60 gallons (227 liters) per person per day. Although the Northern District WWTP is currently unable to meet the new secondary treatment discharge limits of the 2013 National Pollutant Discharge Elimination System permit; the minor increase in wastewater generation does not impact the current capacities for meeting primary treatment standards.

The fiscal year 2014 Consolidated Appropriations Act (Public Law No. 113-76) appropriated $106,400,000 for civilian water and wastewater improvements on Guam. It is expected that repairs and improvements to the Northern District WWTP and wastewater collection systems will be included in

these projects over the next few years. Such improvements are anticipated to bring the WWTP into compliance.

As a result, THAAD-related operational activities under Alternative 1 would not have a significant impact on the existing utility and transportation infrastructure.

4.1.10.2 Alternative 2: THAAD System Permanent Stationing and Cargo Drop Zone Expansion

4.1.10.2.1 Site Preparation and Construction Activities

Under Alternative 2, the effects on utility and transportation infrastructure during the initial site preparation and construction phase are the same as those described for Alternative 1. The additional clearing, grading, and construction activities proposed for permanent stationing of the THAAD battery and expansion of the CDZ, however, would require a small workforce consisting of military personnel and no more than 50 contract workers at any one time. Because of the limited increase in workforce personnel and construction activities (including the new THAAD security fence, motor pool fence, fiber optic line, Giant Voice warning system, communications trough, drainage system, and four new buildings), utility demands would be temporary, minimal, and not exceed existing capacities.

To meet IT/COMM requirements for permanent stationing, a new fiber optic line would be trenched from the RED HORSE Squadron facilities to the emplacement site and other facilities just to the west. Just as for Alternative 1, all electrical power distribution from on-site generators would be via above-ground cables and conduits (no trenching). With the exception of grading for additional gravel roads inside the emplacement site and some repairs of existing roadways to the site, there would be no construction of new roads under the Proposed Action. During construction activities, temporary increases in local traffic and roadway use would be minimal.

Just as for Alternative 1, no impacts to utilities and transportation infrastructure would be expected during site preparation and construction activities under Alternative 2.

4.1.10.2.2 Operational Activities

As with Alternative 1, Alternative 2 includes no plans for new service connections for potable water, sewer, or electrical power. Nearly all THAAD personnel and military dependents would be placed in existing housing or in future JRM permitted housing (depending on when new housing becomes available). JRM would be responsible for obtaining sewer and water connection permits for the future housing. At the emplacement site on NWF, all electrical power would be provided by generators and distributed via aboveground cables and conduits. Potable water for emplacement site use would be trucked-in using unit water pod systems (camels), as needed. Additionally, portable latrines provided on site would require periodic emptying by contractors, with the sewage then taken to one of the existing WWTPs in a position for accepting and treating the wastes. Existing wash racks on base would be used for vehicle washing, when necessary.

Following the initial operational effects described under Alternative 1, long-term THAAD operations for Alternative 2 would increase military personnel and contractors to about 225 (25 more than Alternative 1), and adds approximately 168 military dependents. The combined total of 393 people results in a 5 percent increase in the current population of about 7,770 at Andersen AFB (DoD 2014). This increase in base population would not place substantial demands on existing utilities or cause major increases in local roadway usage. The projected population increase of about 393 would result in a daily water increase demand of about 40,000 gallons (151,416 liters) based on a typical use of 100 gallons (379 liters) per person per day. Increased wastewater generation resulting from the associated population increase would be approximately 23,600 gallons (89,336 liters) per day based on 60 gallons (227 liters) per person per

day. Just as for Alternative 1, the Northern District WWTP is currently unable to meet the new secondary treatment discharge limits of the 2013 National Pollutant Discharge Elimination System permit. However, the minor increase in wastewater generation would not impact the current capacities for meeting primary treatment standards.

The fiscal year 2014 Consolidated Appropriations Act (Public Law No. 113-76) appropriated $106,400,000 for civilian water and wastewater improvements on Guam. It is expected that repairs and improvements to the Northern District WWTP and wastewater collection systems will be included in these projects over the next few years. Such improvements are anticipated to bring the WWTP into compliance.

Overall, THAAD-related operational activities under Alternative 2 would not have a significant impact on the existing utility and transportation infrastructure. The proposed expansion of the CDZ would not impose any additional impacts on utility or transportation systems.

4.1.10.3 No Action Alternative

Under the No Action Alternative, the initial site preparation and construction phase of the THAAD battery emplacement would result in no impacts to the utilities and transportation infrastructure, the same as those described for Alternative 1. Additionally, as with Alternative 1, the THAAD battery operational activities to date would not result in significant impacts.

Removal of the THAAD battery, including temporary facilities and infrastructure, would require a small, temporary workforce consisting of military personnel and no more than 20 contract workers at any one time. Because the activities would require few temporary workers, utility demands would be temporary, minimal, and not exceed system capacities. Local roadway use also would be minimal.

On a longer-term basis, removal of the THAAD battery and the 200 mission support personnel from Guam would result in no effects from the return to THAAD pre-deployment conditions for utilities and transportation infrastructure.

4.2 Cumulative Effects

Council on Environmental Quality regulations stipulate that the cumulative impacts analysis within an EA should consider the potential environmental impacts resulting from "the incremental impacts of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR § 1508.7). Recent CEQ guidance in considering cumulative impacts involves defining the scope of the other actions and their interrelation with a proposed action. Actions with an overlapping schedule with, or in proximity to a proposed action, would be expected to have more potential for a relationship than those more geographically separated. To identify cumulative impacts, the following three fundamental questions need to be addressed:

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

Just as for the potential environmental impacts caused by implementation of the proposed action alone, cumulative impacts associated with the proposed action also must be described in terms of their significance.

4.2.1 Approach to Analysis

4.2.1.1 Overview

The scope of the cumulative impacts analysis involves both the geographic extent of the impacts and the timeframe in which the impacts could be expected to occur. It is possible that analysis of cumulative impacts might go beyond the scope of the project-specific direct and indirect impacts to include expanded geographic and time boundaries, and a focus on broad resource sustainability. This approach is becoming increasingly important as growing evidence suggests that the most significant impacts result from the combination of individual, often minor, impacts of multiple actions over time. The underlying issue is whether or not a resource can adequately recover from the impact of an action before the environment is exposed to subsequent actions.

As discussed in **Section 4.1**, potential environmental impacts from implementing the Proposed Action or No Action Alternative, while not significant, would be expected from the vegetation clearing, construction, and related activities. Operational impacts would include the placement of additional military and civilian persons on base, and the long-term operation of THAAD battery equipment, particularly the system radar and generators. Identification of potential cumulative impacts in this case required an understanding of interactions with other past, present, or reasonably foreseeable future actions that involve forest clearing or ground-disturbing activities, habitat alterations, and similar emissions issues.

4.2.1.2 Study Area Geographic Boundaries and Timeframe for Analysis

In general, the geographic or spatial area of consideration for potential cumulative impacts varies by resource topic. The spatial area of consideration for some resources might only include the project vicinity, such as for biological resources, while air quality could include the entire air quality control region. This cumulative impacts analysis focuses on those projects within the Proposed Action area, and the ROIs for both air quality and airspace management. For cumulative analysis purposes, the timeframe is Fiscal Year 2010 through 2020.

4.2.2 Identification of Other Past, Present, and Reasonably Foreseeable Future Actions that could contribute to Cumulative Impacts

Geographic distribution, intensity, duration, and historical effects of similar activities are considered when determining whether a particular activity might contribute cumulatively and significantly to the impacts of the Proposed Action or No Action Alternative on the resource areas analyzed in **Section 4.1**. In identifying other past, present, and reasonably foreseeable future actions, the following resources were reviewed:

- FEIS for the *Guam and CNMI Military Relocation; Relocating Marines from Okinawa; Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force* (JGPO 2010).
- Draft Supplemental EIS for the *Guam and CNMI Relocation (2012 Roadmap Adjustments)* (JGPO 2014).
- *Environmental Assessment, Beddown of Training and Support Initiatives at Northwest Field, Andersen AFB, Guam* (PACAF 2006).

- *Andersen AFB Cargo Parachute Drop Zone Environmental Assessment* (USAF 2000).
- Endangered and Threatened Wildlife and Plants; 5-Year Status Reviews of 46 Species in Idaho, Oregon, Washington, Nevada, Montana, Hawaii, Guam, and the Northern Mariana Islands (USFWS 2012b).

The following projects were analyzed for potential cumulative impacts associated with the Proposed Action and No Action Alternative.

4.2.2.1 Cantonment/Family Housing Preferred Alternative

Calculations in the 2012 Roadmap for the development of the cantonment and family housing (JGPO 2014) were reduced by 64 percent from the 2010 FEIS. These reductions account for the slower construction timeframe and reduced overall military need on Guam. The acreage estimated for these facilities at the Preferred Alternative (Finegayan) would be 784 acres (317 hectares). This estimate includes building footprints, roadways, drainage, future growth and a contingency for unknown factors.

4.2.2.2 LFTRC Preferred Alternative

The Preferred Alternative location outlined in the 2012 Roadmap for the USMC live-fire training range complex (LFTRC) would be near the northern end of NWF (JGPO 2014). Range components would include separate ranges for rifles, pistols, multi-purpose machine gun, a non-standard small arms range, a modified record of fire range, and a grenade range. The total range footprint is estimated to be 4,016 acres (1,625 hectares), most of which would be surface danger zone. Each range would also contain an operations tower, target storage and maintenance shed, hardening and security implements, and parking. The land would be cleared during construction, and range areas would be replanted and maintained with non-invasive grasses. Clearing for the LFTRC footprint and support facilities would result in the loss of approximately 315 acres (128 hectares) of primary and secondary limestone forest on northern Guam.

4.2.2.3 Perimeter Fence and Road Construction and Main Gate Relocation

The project involved construction of a new perimeter chain-link fence and perimeter gravel road in the western portion of Andersen AFB along Routes 3a and 9 (JGPO 2010). Total disturbance for fence and roadway was 16.0 acres (6.5 hectares). The relocation of the main gate was reconfigured and expanded resulting in disturbance of 5.5 acres (2.2 hectares). Work was complete in 2011.

4.2.2.4 Beddown of Training and Support Initiatives at NWF

This project combined facilities for RED HORSE, the Pacific Air Forces (PACAF) Commando Warrior and Silver Flag training programs, and combat communications squadron at NWF (PACAF 2006). Utilities and infrastructure were upgraded to accommodate 400+ personnel, along with new construction of field training areas, classrooms, and warehouses in NWF.

4.2.2.5 Air Force Cargo Drop Zone

Partial vegetation clearing for the CDZ on NWF was completed for the North and South Runways, and the parachute drop zone, which measures 4,500 x 2,400 feet (1,372 x 732 meters) (USAF 2000). Additional land clearing and vegetation maintenance is expected.

4.2.2.6 USFWS 5-year review of Threatened and Endangered Species in Guam

USFWS has identified habitat on Guam that is suitable for the survival and recovery of the Guam Micronesian kingfisher, Guam rail, Mariana crow, and the Mariana fruit bat (USFWS 2012b). They have also estimated that amount of that "recovery habitat" that would be required to achieve the levels of reproduction, population size, and distribution of self-sustaining populations specified in the recovery goals for the three species extirpated from Guam. The amount of remaining available recovery habitat is used as a baseline to evaluate how proposed projects on Guam would affect the recovery of those species. USFWS is updating these estimates and could use the updated values to evaluate effects to listed species during formal consultation on the THAAD battery project.

4.2.3 Analysis of Potential Cumulative Impacts

The following analysis examines the potential cumulative impacts on the natural and man-made environment that would result from the cumulative impact of the Proposed Action, or No Action Alternative, in combination with the other actions described in **Section 4.2.2**. Based on the assessment of past, present, and reasonably foreseeable future actions at NWF and in the vicinity, the proposed alternatives would result in environmental effects from the various clearing, construction, and operational activities that would impact air quality, groundwater resources, terrestrial biological resources, airspace management, and wastewater treatment infrastructure. *De minimis* cumulative impacts are anticipated for all other resources topics.

4.2.3.1 Air Quality

The past, present, and reasonably foreseeable future actions combined with the Proposed Action would not result in significant, cumulative air quality impacts or GHG emissions. Land clearing and facility construction activities for the Proposed Action would overlap the same timeframe of the proposed cantonment/housing construction and the proposed development of the LFTRC. The proposed clearing and construction-related activities would generate air pollutant emissions from land clearing activities and operation of construction equipment that would result in criteria pollutant and GHG emissions within the immediate area. Air emissions would be temporary and typical for such activities, and cumulative emissions would not cause or contribute to a violation of any NAAQS or State Ambient Air Quality Standards and would represent a small percentage of overall air emissions in Guam. Impacts from the removal of the THAAD battery under the No Action alternative would result in similar non-significant cumulative impacts during the removal of temporary facilities and demolition work.

The THAAD battery equipment includes several generator sets which run continuously to provide power to the weapons system, temperature control systems, lights, computers, and motor pool. Potential annual emissions from the generators are estimated to be below the PSD major source thresholds for all applicable pollutants. The THAAD installation would therefore require an appropriate Guam EPA Air Pollution Source Construction Permit, with review and approval required by the Guam EPA and USEPA, and a Title V operating permit because the potential emissions have been estimated at greater than 100 tpy for NO_X. Obtaining and operating within the conditions of these permits ensures the Guam SIP is being followed and ambient air quality standards are being met. In addition to the permanent power supply for the THAAD system, increases in air emissions would be expected from personal vehicles related to the increase in staff and families on base. The proposed operational emissions when considered cumulatively with the other local projects would impose a less than significant, long-term adverse impact to air quality. Under the No Action Alternative, there would be no long-term operational cumulative impacts from operation of the THAAD battery generators following their removal.

4.2.3.2 Water Resources

No stormwater-related impacts are expected from the Proposed Action in combination with other past, present, and reasonably foreseeable future actions on NWF. Stormwater BMPs would be implemented for all construction and other ground disturbance areas. In addition, the planning, design, and construction of new facilities would incorporate a LID strategy to maintain site hydrology and mitigate the adverse impacts of stormwater runoff and nonpoint source pollution.

Up to approximately 393 personnel and military dependents associated with the THAAD mission, in combination with several thousand additional Marines and dependents moving to Guam as part of the 2012 Roadmap (JGPO 2014), would place major potable water demands on the NGLA. Such demands could potential lead to increased salinity intrusions into the groundwater aquifer. THAAD Alternative 1 and 2 requirements, however, do not include any new groundwater wells being installed or new potable water service connections for facilities and operations. Nearly all THAAD personnel and military dependents would be placed in existing housing or in future JRM permitted housing (depending on when new housing becomes available). JRM would be responsible for obtaining potable water connection permits for the future housing.

To mitigate potentially adverse effects on groundwater usage, Andersen AFB and the DoD are making further improvements to the existing DoD water distribution systems on Guam to reduce system leaks. The DoD would, as appropriate, adjust pumping rates at DoD wells if salinity (chloride) levels show an increase, and increase the use of surface water from Fena Reservoir to reduce overall withdrawals from the NGLA. Additionally, the water drawn for unit water pod systems (camels) used at the THAAD battery on NWF would be filled at alternate locations, if necessary.

Thus, the THAAD mission when considered cumulatively with the other local projects is not expected to result in significant cumulative impacts on water resources, particularly since the Proposed Action does not include new groundwater wells being installed or new potable water service connections for housing, support facilities, and mission operations. Under the No Action Alternative, there would be no long-term cumulative impacts on groundwater resources.

4.2.3.3 Biological Resources

For the Proposed Action, clearing and site preparation of the THAAD emplacement and for the CDZ expansion (Alternative 2 only), when combined with other past, present, and reasonably foreseeable future actions, would result in the cumulative loss of primary and secondary limestone forest, and perennial scrub habitat, for several species on Guam. No designated critical habitat would be affected; however, there would be a cumulative loss of primary recovery habitat on NWF. **Table 4-11** shows the amount of recovery habitat that was lost and is anticipated to be lost from projects on northern Guam. When the loss of recovery habitat from the THAAD-related actions are combined with the habitat loss required for the proposed 2012 Roadmap actions (JGPO 2014), a minimum of 1,542 acres (624 hectares) of recovery habitat above the regulatory threshold would still remain for the three bird species listed. Additionally for the Mariana fruit bat, there are still well over 13,500 acres (5,463 hectares) of recovery habitat available on northern Guam (USFWS 2010b). Noise on NWF from the combination of the THAAD generators, airborne training, and proposed LFTRC activities could add to habitat loss in some areas, but such effects would be localized near the noise-generating sources. Development of a fenced conservation area (approximately 121 acres [49 hectares] in size) adjacent to the THAAD emplacement site would, over time, increase the availability of habitat for some species. Thus, no significant cumulative impacts on these species would be expected.

Table 4-11. Cumulative Impacts on Primary Recovery Habitat in Northern Guam

Habitat Area	Guam Micronesian kingfisher	Guam rail	Mariana crow
Habitat Available in 2010 (USFWS 2010b)	**15,822**	**49,564**	**14,831**
Habitat Loss			
• THAAD Expeditionary Deployment (initial clearing actions associated with Alternatives 1 and 2)	(38.8)	(137.9)	(38.8)
• THAAD Proposed Action (clearing for fiber optic line and CDZ expansion under Alternative 2 only)	(45.9)	(2.5)	(45.9)
• 2012 Roadmap (JGPO 2014)[1]	(1,061)	(1,071)	(1,068)
Total Habitat Loss	**(1,145.7)**	**(1,211.4)**	**(1,152.7)**
Remaining Habitat Available	14,676	48,353	13,678
Required for recovery	13,134	41,184	7,463
Total Remaining Habitat above the Recovery Threshold	**1,542**	**7,169**	**6,215**

[1] The estimated habitat loss associated with the 2012 Roadmap is due to the Cantonment/Family Housing Preferred Alternative (**Section 4.2.2.1**) and the LFTRC Preferred Alternative (**Section 4.2.2.2**).

Under the No Action alternative, the THAAD emplacement site would be returned to near original conditions. Over time, there would be a beneficial effect to most native flora and fauna, including the special status species that occurred there, as forest vegetation returns to the approximately 35.7 acres (14.4 hectares) of disturbed land located outside of the original CDZ training area.

4.2.3.4 Airspace Management

The past, present, and reasonably foreseeable future actions combined with the Proposed Action would not result in significant, cumulative impacts on airspace management. Under Alternative 1, the Letter of Agreement for the current THAAD TFR would need to be rewritten to include the USMC and account for the proposed SUA Restricted Area needed to operate the future LFTRC. Thus, no cumulative impacts would be expected.

For Alternative 2, operational impacts of THAAD would combine with operational impacts from the proposed LFTRC, resulting in minor long-term beneficial cumulative impacts. The proposed Restricted Area, R-XXXX, that would be used for THAAD would encompass the USMC proposed Restricted Area for the LFTRC. This action would result in one SUA Restricted Area that meets the needs of both THAAD and LFTRC. The Restricted Area would be continuously active.

Under the No Action Alternative, there would be no long-term cumulative impacts from THAAD mission-related airspace restrictions. The THAAD radar would cease operations and the current TFR would be removed. Prior CDZ-related operations at NWF would no longer be encumbered. The proposed LFTRC would still require a SUA, but that area would not include the additional Restricted Area required for THAAD radar operations.

4.2.3.5 Utilities and Transportation Infrastructure

The Proposed Action in combination with other past, present, and reasonably foreseeable future actions is not expected to result in significant cumulative impacts on existing utilities and roadway use, with the possible exception of significant but mitigable cumulative impacts on wastewater treatment systems. Up to approximately 393 personnel and military dependents associated with the THAAD mission, in combination with several thousand additional Marines and dependents moving to Guam as part of the 2012 Roadmap (JGPO 2014), would place much higher demands on wastewater collection and treatment systems on Guam. The Northern District WWTP is currently unable to meet the new secondary treatment discharge limits of the 2013 National Pollutant Discharge Elimination System permit. Any additional strain on the existing system could cause increases in sanitary sewer overflows, which then could potentially have an adverse effect on near-shore waters.

THAAD Alternative 1 and 2 requirements do not include any new service connections for sewer or potable water. Nearly all THAAD personnel and military dependents would be placed in existing installation housing or in future JRM permitted housing (depending on when new housing becomes available). JRM would be responsible for obtaining sewer and potable water connection permits for the future housing. Additionally, portable latrines provided at the THAAD battery site require periodic emptying by contractors, with the sewage then taken to one of the existing WWTPs in a position for accepting and treating the wastes.

The fiscal year 2014 Consolidated Appropriations Act (Public Law No. 113-76) appropriated $106,400,000 for civilian water and wastewater improvements on Guam. It is expected that repairs and improvements to the Northern District WWTP and wastewater collection systems will be included in these projects over the next few years. Such improvements are anticipated to bring the WWTP into compliance.

Thus, the THAAD mission when considered cumulatively with the other local projects is not expected to result in long-term, significant cumulative impacts on wastewater treatment systems or on other utilities and transportation infrastructure. Under the No Action Alternative, removal of the THAAD battery and the 200 mission support personnel from Guam would result in no effects from the return to THAAD pre-deployment conditions.

4.3 Overview of the Environmental Consequences Associated with the 2010 Final Environmental Impact Statement Preferred Alternative for Permanent Stationing of an Army AMDTF

This section describes the overall environmental effects associated with the Army AMDTF Preferred Alternative identified in **Section 2.3**. A summary of the potential effects for each of the 10 environmental resource areas, as analyzed and concluded in the 2010 FEIS (JGPO 2010), is provided in this section to use as a comparison of impacts in **Section 4.1** for this document's Proposed Action. In general, the findings from this comparison are that the overall impacts associated with the Proposed Action discussed in **Section 4.1** would be substantially less than those identified for the proposed AMDTF analyzed in the 2010 FEIS. These findings are largely due to the more extensive scope of the earlier AMDTF—in terms of more weapon systems based in Guam, a significantly higher number of military support personnel and dependents transferred to Guam, and more extensive operational and logistical requirements on island—when compared to the current THAAD battery emplacement. The entire 2010 FEIS is accessible for download from the Internet at: *http://www.guambuildupeis.us/archived-documents*.

Air Quality

The Preferred Alternative for the permanent stationing of an Army AMDTF on Guam was expected to result in less than significant impacts on air quality. Construction of the AMDTF was found to generate air emissions that were well below significance thresholds. The FEIS did not explicitly identify operational air emissions from the AMDTF, but included them with the larger discussion of related utility and infrastructure upgrade actions.

Noise

For the AMDTF headquarters, housing, and munitions storage, noise from construction activities would be less than significant. Construction traffic would not create permanent, adverse noise impacts to human health or the local environment. Estimated construction noise levels for the proposed Headquarters/Housing construction activities ranged from 72 dBA to 76 dBA at the closest receptors located on and off-installation, respectively.

Noise from headquarters and housing related operations, specifically noise resulting from increased vehicle traffic, would be mitigated to a less than significant impact through the use of BMPs such as noise barriers. Noise resulting from the construction and operation of the munitions Storage facility would be barely audible to off-installation receptors. The 2010 FEIS determined that these impacts would be less than significant.

For the weapons emplacement sites, there are no sensitive receptors in or near the project area. Construction noise levels would attenuate to approximately 71 dBA at the nearest receptor off Andersen AFB. Noise generation would last only for the duration of construction activities. The primary operational noise sources include traffic noise from increased vehicle trips, and intermittent generator use. The 2010 FEIS identified that these impacts would be less than significant.

Water Resources

Impacts from headquarter, housing, munitions storage, and weapons emplacement related construction activities on both surface and groundwater resources were projected to be less than significant. In compliance with Guam's NPDES permitting program, all construction activities related to the AMDTF would be conducted under a Construction General Permit, which would require preparation and implementation of a SWPPP. Temporary increases in stormwater runoff, erosion, and sedimentation could be minimized through application of the Construction General Permit, SWPPP, and construction-specific BMPs. Temporary increase in potential for groundwater contamination due to proximity of proposed injection control wells associated with the weapons emplacement would be minimized through use of construction BMPs.

Biological Resources

Construction of the headquarters, housing, and related facilities would require the loss of several hundred acres of limestone forest, including habitat determined to be important for the recovery of the of Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat. Development of munitions storage capacity on NWF would require the clearing of about 3 acres (1 hectare) of forest identified as important for the recovery of those species, and development of weapons emplacement areas would result in the loss of an additional approximately 150 acres (61 hectares) of forested recovery habitat for those species. The USFWS (2010b) concluded that implementation of all activities associated with the Proposed Action would result in the loss abandonment of the last roost site used by Mariana fruit bats on Andersen AFB. Overall impacts from the loss of recovery habitat were considered significant. Operations would also result in significant indirect impacts to special-status species, but the impacts would be mitigable to less than significant.

Cultural Resources

Construction activities for the proposed weapons emplacement site would have had direct adverse effects to four NRHP-eligible archaeological sites. The 2010 FEIS, however, did not consider the NWF historic site in the analysis of the weapons emplacement alternatives. The impacts were considered significant, but mitigable to less than significant through data recovery. The operations phase would have no effects on cultural resources.

Construction of the headquarters on Finegayan would have direct and indirect significant adverse effects to two NRHP-eligible archaeological sites, which would be mitigated to less than significant through data recovery. Operation of the housing area on South Finegayan would cause indirect significant adverse impacts to one traditional cultural property. Construction and operation of the AMDTF munitions storage facilities would have no direct or indirect effects to cultural resources of any type.

Airspace Management

The proposed SUA would eliminate a large volume of useable airspace on the northern end of Guam. There would be no change to enroute airways or Instrument Flight Rule procedures, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. Arrival and departures for Andersen AFB would be impacted, but changes and coordination of proposed SUA use with Andersen AFB arrival and departure control would limit impacts. Therefore, impacts to airspace management would be less than significant.

Hazardous Materials and Wastes

The Proposed Action would result in increases in the volume of hazardous material/waste and would represent potential impacts to soils, surface water, groundwater, air, and biota. The hazardous materials/waste would be handled and disposed of in accordance with BMPs, SOPs, and applicable Federal and local regulations, as well as DoD requirements. Therefore, the impacts from the increase in hazardous materials/waste would be less than significant.

Human Health and Safety

Health and Safety factors of the Preferred Alternative were considered for the extent/degree to which implementation would subject the public to increased risk of contracting a disease or experiencing personal injury. The analysis was broken down into construction and operation phases for headquarters/housing, munitions storage, and weapons emplacement.

For the AMDTF headquarters, housing, and munitions storage, significant impacts to water-related illness, health care services, protective services, and notifiable diseases would be expected due to Guam's poor water infrastructure and the population increase of the resulting from the Preferred Alternative and natural population growth on Guam. Less than significant impacts to health and safety from air quality impacts, from unexploded ordnance (UXO), and those impacts due to increases in mental illness cases (from increase in population). There would be no impacts to health and safety associated with hazardous substances and traffic incidents.

For the weapons emplacement sites, less than significant impacts due to construction hazards, UXO, and air quality and operational safety (explosives safety and EMR) would result from the Preferred Alternative. Less than significant impacts due to construction hazards, UXO, and air quality. Impacts to public health and safety due to operational safety (explosives safety and EMR) would be less than significant. A beneficial impact to public safety would result from the increased level of protection provided by the AMDTF forces.

Socioeconomics

Including active-duty Army personnel and dependents (about 1,700 people), the proposed AMDTF activities would add nearly 6,300 residents to Guam's population in peak year 2015 (primarily from the construction workforce) and a subsequent more stable estimate of 2,150 residents (including spin-off jobs) in the following years.

Most long-term economic impacts would be beneficial, though less than significant, through increased government revenues and labor force demands. The Proposed Action would provide jobs for about 3,800 civilian workers at the 2015 construction peak and about 550 on a more permanent basis. It would add $99 million to the Gross Island Product in 2015 and nearly $17 million a year from 2016 on. Although the construction activity for the Army AMDTF would contribute to economic expansion, it also would result in potentially significant adverse impacts from the rapid population influx and added pressures on public service agencies. Such impacts, however, would be temporary.

Civilian housing unit demand would peak at about 920 units in 2015, then falling to about 150 units for the steady-state phase. No significant effects on housing would be expected.

Utilities and Transportation Infrastructure.

The 2010 FEIS evaluated potential impacts on utilities resulting from the combination of all of the Proposed Actions (including the AMDTF) identified in **Section 1.2.1** of this EA. The combination of these actions predicted a population growth induced by the DoD relocation that varied from nearly 39,500 in 2014 (peak year including construction workforce) to the projected steady state of 10,639 by 2019.

The substantial increase in population was deemed to have less than significant impacts on electrical power. Implementation of the preferred basic alternative would result in adequate power in all years, including the peak year of 2014, although the power distribution system on Andersen AFB would need to be expanded. Impacts to solid waste disposal were also found to be less than significant because of sufficient disposal capacity, and that the projected lives of the Layon and Navy landfills would be reduced minimally.

For potable water, potential impacts were found to be significant, but mitigable by transferring excess DoD water production capacity to the GWA in the interim, making infrastructure improvements, and slowing population growth rates. Potential impacts on wastewater services were also deemed to be significant but mitigable. Although the Northern District WWTP would be physically able to handle the increased interim wastewater flows, a compliance agreement issued by USEPA Region 9 to GWA would be needed to temporarily allow increased wastewater flows that exceed the design capacity.

For transportation infrastructure, the increased number of Army AMDTF personnel and their dependents (approximately 1,700 people) would add to the number of vehicles on Guam's roadways and potentially increase travel times; however, there would be no impact of increased traffic incidents.

4.4 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (EO 12898)

An Environmental Justice analysis is included in this document to comply with the intent of EO 12898, and U.S. Army and DoD guidance. The EO states that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." In addition, the EO requires that minority and low-income populations be given access to information and opportunities to provide input to decisionmaking

on Federal actions. This EA and the draft Finding of No Significant Impact were made available for public review and comment.

As described in **Section 2.1**, all construction activities and THAAD battery operations would occur within the boundaries of Andersen AFB. Additionally, THAAD radar operations would not affect access to public beaches or coastal waters adjacent to the base. This EA has identified no human health, environmental, or other effects by the Proposed Action that would result in disproportionately high or adverse effect on minority or low income-populations in the area. The Proposed Action activities also would be conducted in a manner that would not exclude persons from participating in, deny persons the benefits of, or subject persons to discrimination because of their race, color, national origin, or socioeconomic status.

4.5 Federal Actions to Address Protection of Children from Environmental Health Risks and Safety Risks (EO 13045, as Amended by EO 13229)

This EA has not identified any environmental health and safety risks that may disproportionately affect children, in compliance with EO 13045, as amended by EO 13229. All project construction and THAAD battery operations would occur within NWF on Andersen AFB, well away from schools, residential, parks, and other public areas.

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6. List of Agencies and Organizations Consulted

The following agencies and organizations were consulted or provided information during the preparation of the EA:

Federal Agencies

Andersen AFB, 36th Wing
Federal Aviation Administration, Air Traffic Organization, Western Service Area
Federal Aviation Administration, Guam Air Traffic Control Center
Joint Guam Program Office
Joint Region Marianas
U.S. Army Pacific
U.S. Fish and Wildlife Service, Guam National Wildlife Refuge
U.S. Navy, Helicopter Sea Combat Squadron 25

Guam Agencies

Bureau of Statistics and Plans
Department of Agriculture, Division of Aquatic and Wildlife Resources
Guam State Historic Preservation Office

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8. Distribution List

The following is a list of officials, agencies, and interest groups that were directly notified about a NOA of the EA, including the Draft FNSI, for the THAAD Permanent Stationing in Guam. The NOA indicates when the document was issued; where copies may be obtained or reviewed; the duration of the comment period; where comments may be sent; and the location, date, and time of the Public Information Meetings regarding the EA. Private citizens may receive an NOA, but their names are not included in the list. Also included is a list of libraries receiving a hard copy and compact disc (CD) electronic copy of the EA including the Draft FNSI.

Elected Officials – Guam

30th Guam Legislature, The Honorable Senator Judith T. Won Pat, Ed.D.
Office of the Governor of Guam, The Honorable Governor Eddie Baza Calvo
Office of the Lt. Governor of Guam, The Honorable Lt. Governor Ray Tenorio
U.S. House of Representatives, The Honorable Congresswoman Madeleine Z. Bordallo

Federal Agencies

Federal Aviation Administration—Guam CERAP
Federal Aviation Administration—Seattle
USEPA, Pacific Islands Office, Region 9
USFWS, Guam National Wildlife Refuge
USFWS, Pacific Islands Office, Hawaii

Guam Agencies

A.B. Won Pat International Airport, Guam
Bureau of Statistics and Plans
Bureau of Statistics and Plans, Guam Coastal Management Program
Guam Environmental Protection Agency
Guam State Historic Preservation Office

Guam Interest Groups

Chamorro Tribe
Guam Chamber of Commerce
Guam Contractor's Association

Libraries Receiving a Hard Copy and CD electronic copy of the EA

Nieves M. Flores Memorial Library, Hagåtña, Guam
University of Guam Robert F. Kennedy Memorial Library, Guam

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APPENDIX A

AGENCY CORRESPONDENCE

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY AERONAUTICAL SERVICES AGENCY
9325 GUNSTON ROAD, SUITE N319
FORT BELVOIR, VA 22060-5582

REPLY TO
ATTENTION OF:

Airspace Branch

AUG 15 2013

Federal Aviation Administration
Director, Airspace Services (Mr. Dennis Roberts)
800 Independence Avenue, SW
Washington, DC 20591

Dear Mr. Roberts:

On behalf of the Department of the Army, request FAA participation as a Cooperating Agency during preparation of the environmental study process for the establishment of a Restricted Area on Guam.

This request is made in accordance with the President's Council on Environmental Quality, the National Environmental Policy Act (NEPA) Regulations, 40 CFR § 1501.6, Cooperating Agencies and Appendix 8 of FAA Order 7400.2J, Procedures for Handling Airspace Matters, dated February 9, 2012. Cooperating Agency participation during preparation of the environmental study process will help ensure all mutual NEPA concerns are addressed and will eliminate duplication of effort.

Specifically, the Army asks for your support as Cooperating Agency by participating in the scoping process; assuming responsibility, upon request, for developing information and by preparing analyses on issues for which your agency has special expertise; making staff support available to enhance interdisciplinary reviews; and ensuring that the document meets NEPA standards.

My point of contact for coordination at headquarters is Mr. Paul Gillick, (703) 806-4864, email: paul.e.gillick.civ@mail.mil.

Sincerely,

Lawrence S. Dibble
Director, Plans, Policy, and Programs

U.S. Department
of Transportation
**Federal Aviation
Administration**

Mr. Lawrence S. Dibble
Director of Plans, Policy and Programs
U.S. Army Aeronautical Services Agency
Fort Belvoir, VA 22060-5582

Dear Mr. Dibble:

Thank you for your letter requesting that the Federal Aviation Administration (FAA) participate as a cooperating agency in the environmental study process for the establishment of a Restricted Area on Guam.

Since the proposal involves special use airspace (SUA), the FAA will follow the guidelines described in the Memorandum of Understanding between the FAA and the Department of Defense Concerning SUA Environmental Actions, dated October 4, 2005 and in accordance with 40 CFR § 1501.6, National Environmental Policy Act (NEPA) regulations regarding cooperating agencies. Please be aware that the FAA will need to rely on the Army's NEPA documentation in order to complete any final rule-making establishing this SUA. The FAA does not have a categorical exclusion that would preclude establishing a restricted area from full environmental review; therefore, FAA will require an environmental assessment or environmental impact statement for this action.

Establishment of SUA resides under the jurisdiction of the Western Service Center, Operations Support Group, 1601 Lind Avenue, SW, Renton, Washington. Mr. Clark Desing, Manager of the Operations Support Group at the Western Service Center, will be the primary focal point for matters related to airspace and associated environmental matters.

FAA Order 7400.2, Procedures for Handling Airspace Matters, Chapter 32, indicates that the airspace and environmental processes be conducted in tandem as much as possible. Approval of either the aeronautical process or the environmental process does not imply approval of the entire process. Enclosed is Apendex 2, 3 and 4 of FAA Order 7400.2 for additional details.

A copy of the incoming correspondence and this response is being forwarded to Mr. Desing. He can be contacted at 425-203-4500 for further processing of your proposal.

Sincerely,

Dennis E. Roberts
Director, Airspace Services
Air Traffic Organization

Enclosures (3)

DEPARTMENT OF THE ARMY
HEADQUARTERS, 94TH ARMY AIR AND MISSILE DEFENSE COMMAND
JOINT BASE PEARL HARBOR-HICKAM, HI 96818

REPLY TO ATTENTION OF

March 26, 2015

Field Supervisor
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, HI 96850

Dear Sir or Madam,

By this letter, the 94th Army Air and Missile Defense Command (AAMDC) requests informal consultation and concurrence under Section 7 of the Federal Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.),* for the emergency deployment and expeditionary operation of the Terminal High Altitude Area Defense (THAAD) ballistic missile defense system, the permanent stationing of the THAAD missile battery, and the proposed modification of a cargo drop zone (CDZ) training area on Northwest Field, at Andersen Air Force Base (AFB), in Guam.

In April 2013, the Secretary of Defense ordered the U.S. Army to immediately deploy a THAAD ballistic missile defense battery to Guam on an emergency basis in response to potential North Korean missile launch activity. The attached Biological Assessment (BA) provides the information required by 50 CFR 402.05(b) to support completion of the consultation for that emergency deployment and the ongoing expeditionary operation of the THAAD battery. Based on the analysis of the effects of that emergency action that is contained in the attached BA, the 94th AAMDC concludes that the emergency deployment and expeditionary operation of the THAAD battery may have affected, but was not likely to have adversely affected, the Mariana fruit bat (*Pteropus mariannus mariannus*).

Pursuant to 50 CFR 402.05 and 402.14(b), the 94th AAMDC requests written concurrence with this conclusion to complete the informal consultation process for this emergency action.

Because of the continuation of existing and emerging missile threats in the region, the 94th AAMDC is now proposing to permanently station the THAAD missile battery at Andersen AFB. As described in the attached BA, the 94th AAMDC concludes that permanent stationing and operation of the THAAD missile battery may affect, but is not likely to adversely affect, the Mariana fruit bat.

The 94th AAMDC requests written concurrence with this conclusion to complete our consultation requirements for this proposed action.

Permanent stationing of the THAAD missile battery will require modifying an existing CDZ training area on Northwest Field. The 94th AAMDC concludes that modification of the training area may affect, but is not likely to adversely affect the Mariana fruit bat.

The 94th AAMDC requests written concurrence with this conclusion to complete our consultation requirements for this proposed action.

The BA also evaluates effects to recovery habitat of extirpated listed species, and to species proposed for listing as threatened or endangered that may have been or may be affected by the above actions. This information is included to document the conclusions of the 94th AAMDC about potential effects of the above actions on those species and that habitat.

In view of the multiple Department of Defense (DOD) consultations required for the DOD strategic shift to the Pacific, and recognizing the U.S. Fish and Wildlife Service (USFWS), Pacific Islands Office, administrative backlog caused in part by the complexity of consultations and manning limitations, 94th AAMDC is submitting this consultation with the understanding that it will not interfere with on-going Joint Guam Program Office consultations. If you do not concur with our findings as described above and feel that a formal consultation is warranted, we request notification before a lengthy consultation is initiated that might adversely affect timely consultations on other programmed DOD actions. Upon receiving such notification, Joint Region Marianas will provide USFWS with the prioritization for on-going/upcoming DOD consultations in the Marianas in order to ensure their proper sequencing.

In summary, pursuant to Section 7 of the ESA, we request informal consultation and, if USFWS agrees, concurrence in writing, finding that the described projects are not likely to adversely affect the special status species identified in the enclosed analysis. We look forward to working with you on this matter. If you have any questions, or, if you require additional information, please contact Major Douglas Simmons at (808) 448-1519 and douglas.s.simmons2.mil@mail.mil.

Sincerely,

Carlos Betancourt
Colonel, U.S. Army
Chief of Operations, 94th AAMDC

cc: JRM (J45)
U.S. Army Pacific

-2-

DEPARTMENT OF THE ARMY
HEADQUARTERS, 94TH ARMY AIR AND MISSILE DEFENSE COMMAND
JOINT BASE PEARL HARBOR-HICKAM, HI 96818

REPLY TO
ATTENTION OF

March 26, 2015

Ms Lynda Bordallo Aguon
Guam State Historic Preservation Office
490 Chalan Palasyo
Agana Heights, Guam 96910

Dear Ms Aguon,

In accordance with the National Historic Preservation Act, the 94th Army Air and Missile Defense Command (AAMDC) has prepared a Cultural Resources Evaluation (CRE) for an undertaking at Anderson AFB. This CRE analyzes the Terminal High Altitude Area Defense (THAAD) system deployment to Northwest Field at Anderson AFB.

A request for assistance was originally submitted to the Guam HPO on October 27, 2014. An update, that included a larger area of potential effect, was submitted to the HPO on January 5, 2015.

We appreciate that the HPO has been extremely busy with other consultations and that the State Archaeologist has already devoted a great deal of time and research into this request. We would now like to open formal consultation for this undertaking in accordance with Section 106 of the NHPA. We look forward to working with you on this matter. If you have any questions, or, if you require additional information, please contact Mr. Mark Hubbs, SMDC/ARSTRAT, Environmental Division, CMCL (256) 955-2608, or mark.e.hubbs.civ@mail.mil.

Sincerely,

Carlos Betancourt
Colonel, U.S. Army
Chief of Operations, 94th AAMDC

cc: JRM (J45)
U.S. Army Pacific

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) 475-6296/7
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822

Raymond F.Y. Blas
Director

William N. Reyes
Deputy Director

In reply refer to:
RC2014-1078

May 5, 2015

Carlos Betancourt
Colonel, U.S. Army
Chief of Operations, 94th AAMDC
Department of the Army
Headquarters, 94th Army Air and Missile Defense Command
Joint Base Pearl Harbor, Harbor-Hickam, Hi 96818

Dear Colonel Betancourt:

We have reviewed the 94th Army Air and Missile Defense Command (AAMDC) Cultural Resources Evaluation (CRE) for the Terminal High-Altitude Area Defense (THAAD) system deployment to Northwest Field at Andersen AFB and concur with AAMDC's determination "that the emplacement of the THAAD system and the expansion of the Andersen AFB cargo drop zone (CDZ) potentially would have adverse effects on historic properties as defined by Section 106 of the National Historic Preservation Act (NHPA)."

In light of this, we are requesting that AAMDC conduct an archaeological survey to locate and identify all cultural resources i.e. artifact scatters, structures, features, etc., that have been identified in previous surveys (Dixon, Walker, Shaefer 2011, etc.) that will be encompassed or adversely affected by the proposed "areas of potential effects (APE)" of the emplacement requirements of the THAAD system and the expansion of the current cargo drop zone (CDZ) training area. The survey's Scope of Work (SOW) should include the 57.9 acres to be cleared for the propose CDZ expansion and the additional vegetation clearing needed north of the previously cleared CDZ areas. It should also include subsurface testing, monitoring, data recovery and mitigation measures to address all adverse effects on historic properties affected by the ground disturbing requirements, as follow:

- Proposed double and single security fences.
- Proposed underground fiber optic line trenches.
- Proposed fence to enclose the planned conservation area.
- Proposed JP-8 fuel pod, if containment structure required.
- Proposed buildings/facilities, including the 2-story Tactical Equipment Maintenance Facility.
- Grading for additional gravel roads along fence line and leveling of uneven terrain within the proposed permanent emplacement.
- Excavation of communication trough to run cables.
- Installation of combination of concrete drainage culverts and underground piping.

We recommend that a AAMDC representative, a representative of the archaeological firm selected for the project and our office schedule a meeting to discuss these mitigation measures and other concerns that you may have with regards to the proposed undertaking.

Should you have any question, please contact our office.

Sincerely,

Raymond F.Y. Blas
Director

Lynda Bordallo Aguon
State Historic Preservation Officer

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APPENDIX B

AIR EMISSIONS CALCULATIONS

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Air Emissions from the Initial Deployment of the Expeditionary THAAD System

	NO_x (ton)	VOC (ton)	CO (ton)	SO_2 (ton)	PM_{10} (ton)	$PM_{2.5}$ (ton)	CO_2 (ton)
Combustion	5.354	0.463	2.327	0.426	0.379	0.367	609.885
Fugitive Dust	-	-	-	-	43.862	4.386	-
Haul Truck On-Road	0.016	0.001	0.009	0.000	0.001	0.000	4.125
Construction Commuter	0.056	0.057	0.551	0.001	0.006	0.004	79.310
Total	***5.425***	***0.522***	***2.887***	***0.427***	***44.248***	***4.758***	***693.320***

Note: Total $PM_{10}/_{2.5}$ fugitive dust emissions are assuming USEPA 50% control efficiencies.

CO_2 emissions converted to metric tons = ***628.841*** ***metric tons***
Percent of 25,000 metric tpy reference point = ***2.5%***

Combustion Emissions

Combustion Emissions of VOC, NO_x, SO_2, CO, $PM_{2.5}$, $PM_{10,}$ and CO_2 due to Construction and Demolition

	General Construction Activities--Alternative 1	Area Disturbed		Source and Assumptions
1.)	Clear secondary limestone forest and scrub area within original emplacement area	1,555,092	ft^2	Section 2.1.1.1. No clearing would be required on the 68.3-acre paved area. Clearing of the 145.4-acre area between and to the east of the runways would not require heavy equipment as these areas were maintained as low, mixed herbaceous scrub. Only negligible air emission would be produced.
2.)	Construct temporary fence around original emplacement area	45,000	ft^2	Disturbance line is 3 feet wide by 15,000 feet long
3.)	Construct temporary guard towers for original emplacement area	2,250	ft^2	Ten towers measuring 15 feet by 15 feet
4.)	Clear Motor Pool Area	0	ft^2	Section 2.1.1.1 -- No clearing required. Already a paved surface.
5.)	Construct temporary fence around compressed emplacement area	10,200	ft^2	Disturbance line is 3 feet wide by 3,400 feet long
6.)	Construct temporary guard towers for compressed emplacement area	1,125	ft^2	Five towers measuring 15 feet by 15 feet
7.)	Construct concrete pads	28,200	ft^2	Section 2.1.1.1
	Total Building Construction Area:	3,375	ft^2	(3,6)
		0.077	acres	
	Total Building and Roadway Demolition Area:	0	ft^2	
		0.000	acres	
	New Roadway Construction Area	28,200	ft^2	(7)
		0.647	acres	
	Total Disturbed Area:	1,641,867	ft^2	(1-7)
		37.692	acres	
	Construction Duration:	12	months	
	Annual Construction Activity:	240	days	Assumes 4 weeks per month, 5 days per week of work.

Emission Factors Used for Construction Equipment

References: Guide to Air Quality Assessment, SMAQMD, 2004; and U.S. EPA NONROAD Emissions Model, Version 2005.0.0
Emission factors are taken from the NONROAD model and were provided to HDR by Larry Landman of the Air Quality and Modeling Center (Landman.Larry@epamail.epa.gov) on 12/14/07. Factors provided are for the weighted average US fleet for CY2007.
Assumptions regarding the type and number of equipment are from SMAQMD Table 3-1 unless otherwise noted.

Grading

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Bulldozer	1	13.597	0.957	5.502	1.017	0.895	0.868	1456.904
Motor Grader	1	9.689	0.726	3.203	0.797	0.655	0.635	1141.647
Water Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Total per 10 acres of activity	3	41.641	2.577	15.710	3.449	2.546	2.469	4941.526

Paving

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Paver	1	3.831	0.374	2.055	0.281	0.350	0.340	401.932
Roller	1	4.825	0.443	2.514	0.374	0.434	0.421	536.074
Truck	2	36.712	1.788	14.009	3.271	1.992	1.932	4685.951
Total per 10 acres of activity	4	45.367	2.606	18.578	3.926	2.776	2.693	5623.957

Demolition

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Loader	1	13.452	0.992	5.579	0.949	0.927	0.899	1360.098
Haul Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Total per 10 acres of activity	2	31.808	1.886	12.584	2.585	1.923	1.865	3703.074

Building Construction

Equipment[d]	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Stationary								
Generator Set	1	2.381	0.317	1.183	0.149	0.227	0.220	213.059
Industrial Saw	1	2.618	0.316	1.966	0.204	0.325	0.315	291.920
Welder	1	1.124	0.378	1.504	0.078	0.227	0.220	112.393
Mobile (non-road)								
Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Forklift	1	5.342	0.560	3.332	0.399	0.554	0.537	572.235
Crane	1	9.575	0.665	2.393	0.651	0.500	0.485	931.929
Total per 10 acres of activity	6	39.396	3.130	17.382	3.116	2.829	2.744	4464.512

Note: Footnotes for tables are on following page

Architectural Coatings

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c]	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Air Compressor	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Total per 10 acres of activity	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773

a) The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.

b) The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC. The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors.

c) The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Action will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO2 emissions by more than a factor of two.

d) Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier*	Project-Specific Emission Factors (lb/day)						
		NO_x	VOC	CO	SO_2**	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	4	166.565	10.308	62.840	13.797	10.182	9.877	19766.105
Paving Equipment	1	45.367	2.606	18.578	3.926	2.776	2.693	5623.957
Demolition Equipment	1	31.808	1.886	12.584	2.585	1.923	1.865	3703.074
Building Construction	1	39.396	3.130	17.382	3.116	2.829	2.744	4464.512
Air Compressor for Architectural Coating	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Architectural Coating**			4.735					

*The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

**Emission factor is from the evaporation of solvents during painting, per "Air Quality Thresholds of Significance", SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NOx = (Total Grading NOx per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft^2)	Total Area (acres)	Total Days	
Grading:	1,641,867	37.692	6	(from "Grading" worksheet)
Paving:	28,200	0.647	4	
Demolition:	0	0.000	0	
Building Construction:	3,375	0.077	240	
Architectural Coating	3,375	0.077	20	(per SMAQMD "Air Quality of Thresholds of Significance", 1994)

NOTE: The 'Total Days' estimate for paving is calculated by dividing the total number of acres by 0.21 acres/day, which is a factor derived from the 2005 MEANS Heavy Construction Cost Data, 19th Edition, for 'Asphaltic Concrete Pavement, Lots and Driveways - 6" stone base', which provides an estimate of square feet paved per day. There is also an estimate for 'Plain Cement Concrete Pavement', however the estimate for asphalt is used because it is more conservative. The 'Total 'Days' estimate for demolition is calculated by dividing the total number of acres by 0.02 acres/day, which is a factor also derived from the 2005 MEANS reference. This is calculated by averaging the demolition estimates from 'Building Demolition - Small Buildings, Concrete', assuming a height of 30 feet for a two-story building; from 'Building Footings and Foundations Demolition - 6" Thick, Plain Concrete'; and from 'Demolish, Remove Pavement and Curb - Concrete to 6" thick, rod reinforced'. The 'Total Days' estimate for building construction is assumed to be 240 days.

Total Project Emissions by Activity (lbs)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	999.389	61.848	377.038	82.785	61.092	59.260	118,596.632
Paving	181.469	10.423	74.314	15.703	11.104	10.771	22,495.827
Demolition	-	-	-	-	-	-	-
Building Construction	9,455.116	751.154	4,171.754	747.924	678.970	658.601	1,071,482.802
Architectural Coatings	71.481	102.158	31.308	5.023	6.186	6.001	7,195.467
Total Emissions (lbs):	**10,707.456**	**925.583**	**4,654.414**	**851.434**	**757.353**	**734.633**	**1,219,770.729**

Results: Total Project Annual Emission Rates

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Total Project Emissions (lbs)	10,707.456	925.583	4,654.414	851.434	757.353	734.633	1,219,770.729
Total Project Emissions (tons)	5.354	0.463	2.327	0.426	0.379	0.367	609.885

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

	Emission Factor	Units	Source
Construction and Demolition Activities	0.190	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006
New Road Construction	0.420	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006

$PM_{2.5}$ Emissions

$PM_{2.5}$ Multiplier	0.100	(10% of PM_{10} emissions assumed to be $PM_{2.5}$)	EPA 2001; EPA 2006
Control Efficiency	0.500	(assume 50% control efficiency for PM_{10} and $PM_{2.5}$ emissions)	EPA 2001; EPA 2006

New Roadway Construction (0.42 ton PM_{10}/acre-month)

Duration of Construction Project	12	months
Area	0.647	acres

General Construction and Demolition Activities (0.19 ton PM_{10}/acre-month)

Duration of Project	12	months
Area	37.045	acres

	Project Emissions (tons/year)			
	PM_{10} uncontrolled	**PM_{10} controlled**	**$PM_{2.5}$ uncontrolled**	**$PM_{2.5}$ controlled**
New Roadway Construction	3.263	1.631	0.326	0.163
General Construction Activities	84.462	42.231	8.446	4.223
Total	**87.725**	**43.862**	**8.772**	**4.386**

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.190 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM_{10}/acre-month for sites without large-scale cut/fill operations. A worst-case emission factor of 0.42 ton PM_{10}/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM_{10}/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM_{10}/acre-month) and 75% of the average emission factor (0.11 ton PM_{10}/acre-month). The 0.19 ton PM_{10}/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM_{10}/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas.

New Road Construction Emission Factor

0.420 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM_{10}/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM10/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

$PM_{2.5}$ Multiplier **0.100**

$PM_{2.5}$ emissions are estimated by applying a particle size multiplier of 0.10 to PM_{10} emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM_{10} and $PM_{2.5}$ **0.500**

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999.* EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.

EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants.* Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.

MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1).* Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Grading Schedule

Estimate of time required to grade a specified area.

Input Parameters
Construction area: 37.692 acres/yr (from Combustion Worksheet)
Qty Equipment: 12.000 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.
Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day)	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8.000	acre/day	8.000	0.125	37.692	4.712
2230 500 0300	Stripping	Topsoil & stockpiling, adverse soil	1,650	cu. yd/day	2.045	0.489	37.692	18.427
2315 432 5220	Excavation	Bulk, open site, common earth, 150' haul	800	cu. yd/day	0.992	1.008	18.846	19.003
2315 120 5220	Backfill	Structural, common earth, 150' haul	1,950	cu. yd/day	2.417	0.414	18.846	7.796
2315 310 5020	Compaction	Vibrating roller, 6 " lifts, 3 passes	2,300	cu. yd/day	2.851	0.351	37.692	13.220
TOTAL								63.158

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 63.158
Qty Equipment: 12.000
Grading days/yr: 5.263

Haul Truck Emissions

Emissions from hauling excavation material, demolition materials, and construction supplies are estimated in this spreadsheet.

Emission Estimation Method:
United States Air Force (USAF). 2009. *Air Emission Factor Guide to Air Force Mobile Sources. Methods for Estimating Emissions of Air Pollutants For Mobile Sources at U.S. Air Force Installations.* December 2009.

Assumptions:
Haul trucks carry 20 cubic yards of material per trip.
The average distance from the project site to the materials source is 15 miles; therefore, a haul truck will travel 30 miles round trip.
Estimated number of trips required by haul trucks = total amount of material/20 cubic yards per truck
Assumes soil would not need to be hauled to or from the site.

Amount of Building Materials =	500	cubic yards	Assumes 4 cubic feet of building material are needed per square foot of building space
Amount of Paving Material =	1,044	cubic yards	Assumes 1 cubic foot of pavement material is needed per square foot of new pavement
Amount of Building Debris =	0	cubic yards	Assumes 4 cubic feet of demolition debris is generated per square foot of building space
Amount of Pavement Debris =	0	cubic yards	Assumes 1 cubic foot of pavement debris is generated per square foot of pavement
Number of trucks required =	77	heavy duty diesel haul truck trips	
Miles per trip =	30	miles	

Heavy Duty Diesel Vehicle (HDDV) Average Emission Factors (grams/mile)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
HDDV	**6.23**	**0.58**	**3.33**	**0.02**	**0.20**	**0.19**	**1615.20**

Notes:
Assumes Haul Trucks are Class 8b (HDDV8b; >60,000 lbs Gross Vehicle Weight)
Guam is located at a low altitude (<5,000 feet above sea level)
Construction assumed to occur in Calendar Year 2015, and construction vehicles are assumed to be on average 10 years old (Model Year 2005).
Emission factors for all pollutants are from USAF 2009, Appendix A, On-Road Vehicle Emission Factors, electronic pages 458-464.

HDDV Haul Truck Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**31.818**	**2.962**	**17.007**	**0.102**	**1.021**	**0.970**	**8249.295**
tons	**0.016**	**0.001**	**0.009**	**0.000**	**0.001**	**0.000**	**4.125**

Example Calculation: NO_x emissions (lbs) = 30 miles per trip * 5,021 trips * NO_x emission factor (g/mile) * lb/453.6 g

Construction Commuter Emissions

Emissions from construction workers commuting to the job site are estimated in this spreadsheet.

Emission Estimation Method: Emission factors from the South Coast Air Quality Management District (SCAQMD) EMFAC 2007 (v 2.3) Model (on-road) were used. These emission factors are available online at http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

Assumptions:
Passenger vehicle emission factors for scenario year 2012 are used.

The average roundtrip commute for a construction worker =	20	miles
Number of construction days =	240	days
Number of construction workers (daily) =	30	people

Passenger Vehicle Emission Factors for Year 2012 (lbs/mile)

NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.00078	0.00080	0.00765	0.00001	0.00009	0.00006	1.10153

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated April 24, 2008. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed 16 November 2011.
Notes:
The SMAQMD 2007 reference lists emission factors for reactive organic gas (ROG). For purposes of this worksheet ROG = VOC.

Construction Commuter Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**111.719**	**114.664**	**1102.284**	**1.545**	**12.930**	**8.279**	**158619.657**
tons	**0.056**	**0.057**	**0.551**	**0.001**	**0.006**	**0.004**	**79.310**

Example Calculation: NO_x emissions (lbs) = 40 miles/day * NO_x emission factor (lb/mile) * number of construction days * number of workers

Emissions from operating government and personal vehicles are estimated on this spreadsheet.

Emission Estimation Method: Emission factors from the South Coast Air Quality Management District (SCAQMD) EMFAC 2007 (v 2.3) Model (on-road) were used. These emission factors are available online at http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

Assumptions:
Passenger vehicle emission factors for scenario year 2012 are used.

The average daily trip =	20	miles
Number of days =	365	days
Number of workers =	200	people

Passenger Vehicle Emission Factors for Year 2012 (lbs/mile)

NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.00078	0.00080	0.00765	0.00001	0.00009	0.00006	1.10153

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated April 24, 2008. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed 16 November 2011.
Notes:
The SMAQMD 2007 reference lists emission factors for reactive organic gas (ROG). For purposes of this worksheet ROG = VOC.

Commuter Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**1132.709**	**1162.567**	**11175.930**	**15.663**	**131.096**	**83.944**	**1608227.077**
tons	**0.566**	**0.581**	**5.588**	**0.008**	**0.066**	**0.042**	**804.114**

Example Calculation: NO_x emissions (lbs) = 40 miles/day * NO_x emission factor (lb/mile) * number of construction days * number of workers

CO_2 emissions converted to metric tons =	***729.331***	***metric tons***
Percent of 25,000 metric tpy reference point =	***2.9%***	

Summary of Operational Air Emissions from the Expeditionary Emplacement of the THAAD System (Alternatives 1 and 2)

Assumption: There are 20 generators. Two have 1.3MWs of output; eighteen have 3 kWs of output. One 1.3 MW generator and fifteen 3kW generators operate continously. One 1.3MW generator and three 3 kW generators are emergency generators.

Emissions (tons/yr)	NOx	CO	HC/TOC	PM-10	SO_2	CO_2
1.3MW Generator--Emergency Use Only	4.622	0.115	0.019	0.019	0.250	505.557
1.3MW Generator--Running Continously	80.970	2.020	0.337	0.337	4.386	8857.359
3kW Generator--Emergency Use Only	0.113	0.024	0.008	0.008	0.007	4.200
3kW Generator--Running Continously	9.893	2.131	0.735	0.695	0.651	367.898
TOTAL	**95.598**	**4.291**	**1.099**	**1.059**	**5.294**	**9,735.013**

CO_2 emissions converted to metric tons = ***8,829.657 metric tons***

Percent of 25,000 metric tpy reference point = ***35.3%***

Calculates Air Emissions for the PPU -- Emergency

Assumptions:

Number of Engines:	2
Generator Fuel:	Diesel
Hours of Use (yearly):	500

Max. Engine Horsepower (total combined)
1743.3

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.0106042	0.0002646	0.0000441	0.0000441	0.0005744	1.1600000
Source:	Caterpillar	Caterpillar	Caterpillar	Caterpillar	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	HC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	9,243.19	230.60	38.43	38.43	500.67	1,011,114.00

	NOx	CO	HC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**4.622**	**0.115**	**0.019**	**0.019**	**0.250**	**505.557**

MDA indicates that the THAAD system uses two Caterpillar C32 diesel engines each rated for 1,200 horsepower; however, Thomas Jewart of MDA indicates the system firmware has a hard limit on the maximum combined engine output at a total of 1.3 MW or 1,743.3 hp; email dated 18 March 2015.

PM2.5 and PM10 are assumed to be the same as PM

The sulfur content of JP-8 assumed to be 0.071% by weight.

Hydrocarbons (HC) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:

Caterpillar. 2010. Diesel Generator Set C32, 910 kilowatt. Specification sheet provided by Dan Spiegelberg with MDA on 23 February 2015.

USEPA. 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Calculates Air Emissions for the PPU -- Continuous

Assumptions:

Number of Engines:	2
Generator Fuel:	Diesel
Hours of Use (yearly):	8760

Max. Engine Horsepower (total combined)
1743.3

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.0106042	0.0002646	0.0000441	0.0000441	0.0005744	1.1600000
Source:	Caterpillar	Caterpillar	Caterpillar	Caterpillar	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	HC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	161,940.67	4,040.10	673.35	673.35	8,771.69	17,714,717.28

	NOx	CO	HC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**80.970**	**2.020**	**0.337**	**0.337**	**4.386**	**8857.359**

MDA indicates that the THAAD system uses two Caterpillar C32 diesel engines each rated for 1,200 horsepower; however, Thomas Jewart of MDA indicates the system firmware has a hard limit on the maximum combined engine output at a total of 1.3 MW or 1,743.3 hp; email dated 18 March 2015.

PM2.5 and PM10 are assumed to be the same as PM

The sulfur content of JP-8 assumed to be 0.071% by weight.

Hydrocarbons (HC) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:

Caterpillar. 2010. Diesel Generator Set C32, 910 kilowatt. Specification sheet provided by Dan Spiegelberg on 23 February 2015.

USEPA. 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Calculates Air Emissions from a Small (<600 HP) Engine

Assumptions:

Number of Generators:	3
Generator Power Rating:	3 kilowatts
Generator Fuel:	Diesel
Hours of Use (yearly):	500

Generator Kilowatts		Conversion from kW to Btu/hr	Engine Btu/hr (Assume 30% efficiency converting mechanical to electrical power)	Engine MMBtu/hr
3		3414.4	34,144	0.03

Diesel Industrial Engine Emission Factors from AP-42, Section 3.3	NOx	CO	TOC	PM-10	SO_2	CO_2
	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu
Emission Factor	4.41	0.95	0.3276	0.31	0.29	164

Source: USEPA 1996. AP-42. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines. Table 3.3-1. Page 3.3-6.

Total Emissions	NOx	CO	TOC	PM-10	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	225.86	48.66	16.78	15.88	14.85	8,399.49

	NOx	CO	TOC	PM-10	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**0.113**	**0.024**	**0.008**	**0.008**	**0.007**	**4.200**

Total Organic Compounds (TOCs) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available in AP-42. Because JP-8 is similar to diesel, this analysis uses diesel emission factors from AP-42 as a surrogate for JP-8.

Calculates Air Emissions from a Small (<600 HP) Generator

Assumptions:

Number of Generators:	15
Generator Power Rating:	3 kilowatts
Generator Fuel:	Diesel
Hours of Use (yearly):	8760

Generator Kilowatts		Conversion from kW to Btu/hr	Engine Btu/hr (Assume 30% efficiency converting mechanical to electrical power)	Engine MMBtu/hr
3		3414.4	34,144	0.03

Diesel Industrial Engine Emission Factors from AP-42, Section 3.3	NOx	CO	TOC	PM-10	SO_2	CO_2
	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu	lb/MMBtu
Emission Factor	4.41	0.95	0.3276	0.31	0.29	164

Source: USEPA 1996. AP-42. Emission Factors for Uncontrolled Gasoline and Diesel Industrial Engines. Table 3.3-1. Page 3.3-6.

Total Emissions	NOx	CO	TOC	PM-10	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	19,785.71	4,262.23	1,469.80	1,390.83	1,301.10	735,795.12

	NOx	CO	TOC	PM-10	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**9.893**	**2.131**	**0.735**	**0.695**	**0.651**	**367.898**

Total Organic Compounds (TOCs) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available in AP-42. Because JP-8 is similar to diesel, this analysis uses diesel emission factors from AP-42 as a surrogate for JP-8.

Summary of Operational Air Emissions from Improved Power Generation for the THAAD System (Alternatives 1 and 2)

Emissions (tons/yr)	NOx	CO	TOC	PM	SO_2	CO_2
PPU -- Emergency	4.622	0.115	0.019	0.019	0.250	505.557
PPU -- Continuous	80.970	2.020	0.337	0.337	4.386	8857.359
MEP-810A/B -- Emergency	2.111	2.674	0.282	0.141	0.081	163.270
MEP-810A/B -- Continuous	36.989	46.853	4.932	2.466	1.416	2860.490
TOTAL	**124.692**	**51.662**	**5.569**	**2.963**	**6.133**	**12,386.676**

CO_2 emissions converted to metric tons = ***11,234.715 metric tons***

Percent of 25,000 metric tpy reference point = ***44.9%***

Calculates Air Emissions for the PPU -- Emergency

Assumptions:

Number of Engines:	2
Generator Fuel:	Diesel
Hours of Use (yearly):	500

Max. Engine Horsepower (total combined)
1743.3

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.0106042	0.0002646	0.0000441	0.0000441	0.0005744	1.1600000
Source:	Caterpillar	Caterpillar	Caterpillar	Caterpillar	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	HC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	9,243.19	230.60	38.43	38.43	500.67	1,011,114.00

	NOx	CO	HC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**4.622**	**0.115**	**0.019**	**0.019**	**0.250**	**505.557**

MDA indicates that the THAAD system uses two Caterpillar C32 diesel engines each rated for 1,200 horsepower; however, Thomas Jewart of MDA indicates the system firmware has a hard limit on the maximum combined engine output at a total of 1.3 MW or 1,743.3 hp; email dated 18 March 2015.

PM2.5 and PM10 are assumed to be the same as PM

The sulfur content of JP-8 assumed to be 0.071% by weight.

Hydrocarbons (HC) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:

Caterpillar. 2010. Diesel Generator Set C32, 910 kilowatt. Specification sheet provided by Dan Spiegelberg on 23 February 2015.

USEPA. 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Calculates Air Emissions for the PPU -- Continuous

Assumptions:

Number of Engines:	2
Generator Fuel:	Diesel
Hours of Use (yearly):	8760

Max. Engine Horsepower (total combined)
1743.3

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.0106042	0.0002646	0.0000441	0.0000441	0.0005744	1.1600000
Source:	Caterpillar	Caterpillar	Caterpillar	Caterpillar	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	HC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	161,940.67	4,040.10	673.35	673.35	8,771.69	17,714,717.28

	NOx	CO	HC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**80.970**	**2.020**	**0.337**	**0.337**	**4.386**	**8857.359**

MDA indicates that the THAAD system uses two Caterpillar C32 diesel engines each rated for 1,200 horsepower; however, Thomas Jewart of MDA indicates the system firmware has a hard limit on the maximum combined engine output at a total of 1.3 MW or 1,743.3 hp; email dated 18 March 2015.

PM2.5 and PM10 are assumed to be the same as PM

The sulfur content of JP-8 assumed to be 0.071% by weight.

Hydrocarbons (HC) have been used in place of VOCs for this analysis.

Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:

Caterpillar. 2010. Diesel Generator Set C32, 910 kilowatt. Specification sheet provided by Dan Spiegelberg on 23 February 2015.

USEPA. 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Calculates Air Emissions for the MEP-810A/B -- Emergency

Assumptions:

Number of Generators: 1
Generator Power Rating (each): 420 kilowatts (derated from 460 kW per Mr. Ronald Steele with USAF AFMC TEAS; email dated March 18, 2015)
Generator Fuel: Diesel
Hours of Use (yearly): 500

Engine Horsepower
563

Horsepower obtained from Mr. Ronald Steele with USAF AFMC TEAS; email dated 18 March 2015.

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.015	0.019	0.002	0.001	0.0005744	1.16
Source:	EPA Tier 1 Standards	EPA Tier 1 Standards	EPA Tier 1 Standards	EPA Tier 1 Standards	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	TOC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	4,222.50	5,348.50	563.00	281.50	161.69	326,540.00

	NOx	CO	TOC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**2.111**	**2.674**	**0.282**	**0.141**	**0.081**	**163.270**

PM2.5 and PM10 are assumed to be the same as PM
The sulfur content of JP-8 assumed to be 0.071% by weight.
Hydrocarbon has been used in place of VOCs for this analysis.
Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:
USEPA 2015. 40 CFR 89, Tier 1 Non-Road Engine Emissions Standards (converted to lb/hp-hr). Letters from Mr. Ronald Steele USAF AFMC TEAS state the 420 kW MEP-810 generators meet Tier 1 standards and have a National Security Exemption from Tier 2 standards; email provided by Mr. Steele on 18 March 2015.
USEPA 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Calculates Air Emissions for the MEP-810A/B -- Continuous

Assumptions:

Number of Generators: 1
Generator Power Rating (each): 420 kilowatts (derated from 460 kW per Mr. Ronald Steele with USAF AFMC TEAS; email dated March 18, 2015)
Generator Fuel: Diesel
Hours of Use (yearly): 8760

Engine Horsepower
563

Horsepower obtained from Mr. Ronald Steele with USAF AFMC TEAS; email dated 18 March 2015.

	NOx	CO	HC	PM	SO_2	CO_2
	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr	lb/hp-hr
Emission Factor	0.015	0.019	0.002	0.001	0.0005744	1.16
Source:	EPA Tier 1 Standards	EPA Tier 1 Standards	EPA Tier 1 Standards	EPA Tier 1 Standards	AP-42, Section 3.4	AP-42, Section 3.4

Total Emissions	NOx	CO	TOC	PM	SO_2	CO_2
	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)	(lbs/yr)
Emissions (lbs/yr)	73,978.20	93,705.72	9,863.76	4,931.88	2,832.82	5,720,980.80

	NOx	CO	TOC	PM	SO_2	CO_2
	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)
Emissions (tons/yr)	**36.989**	**46.853**	**4.932**	**2.466**	**1.416**	**2860.490**

PM2.5 and PM10 are assumed to be the same as PM
The sulfur content of JP-8 assumed to be 0.071% by weight.
Hydrocarbon has been used in place of VOCs for this analysis.
Emission factors for JP-8 are not available. Because JP-8 is similar to diesel, this analysis uses diesel emission factors as a surrogate for JP-8.

Sources:
USEPA 2015. 40 CFR 89, Tier 1 Non-Road Engine Emissions Standards (converted to lb/hp-hr). Letters from Mr. Ronald Steele USAF AFMC TEAS state the 420 kW MEP-810 generators meet Tier 1 standards and have a National Security Exemption from Tier 2 standards; email provided by Mr. Steele on 18 March 2015.
USEPA 1996. AP-42. Section 3.4. *Large Stationary Diesel And Stationary Dual-fuel Engines.* Table 3.4-1. Page 3.4-5.

Air Emissions from Alternative 2

	NO_x (ton)	VOC (ton)	CO (ton)	SO_2 (ton)	PM_{10} (ton)	$PM_{2.5}$ (ton)	CO_2 (ton)
Combustion	5.888	0.509	2.526	0.470	0.411	0.399	672.760
Fugitive Dust	-	-	-	-	101.009	10.101	-
Haul Truck On-Road	0.013	0.001	0.007	0.000	0.000	0.000	3.426
Construction Commuter	0.074	0.076	0.735	0.001	0.009	0.006	105.746
Total	***5.975***	***0.587***	***3.268***	***0.471***	***101.429***	***10.506***	***781.933***

Note: Total $PM_{10}/_{2.5}$ fugitive dust emissions are assuming USEPA 50% control efficiencies.

CO_2 emissions converted to metric tons = ***709.213*** ***metric tons***
Percent of 25,000 metric tpy reference point = ***2.8%***

Combustion Emissions

Combustion Emissions of VOC, NO_x, SO_2, CO, $PM_{2.5}$, $PM_{10,}$ and CO_2 due to Construction and Demolition

	General Construction Activities--Proposed Permanent Stationing of the THAAD	Area Disturbed		Source and Assumptions
1.)	Construct dual perimeter fences, single motor pool fence, Big Voice System.	44,655	ft²	Trenching for lighting, intrusion detection, and utilties would be included. Disturbance line is two, 3-foot wide by 6,080 feet long segments, plus one, 3-foot wide by 2,725 ft. long segment.
2.)	Construct security towers (concrete)	900	ft²	Four towers measuring 15 feet by 15 feet
3.)	Construct entry control facility	160	ft²	Section 2.1.2.1
4.)	Trench fiber optic cable from Red Horse to emplacement area and other facilities	251,777	ft²	GIS Data
5.)	Grade Roadways	50,000	ft²	Assumption
6.)	Construct Fire Direction Center	1,000	ft²	20 ft. by 50 ft. building
7.)	Construct Communication Trough	400	ft²	Assumed 100 ft. in length and 4 ft. wide.
8.)	Construct Drainage System with asphalt pad	13,800	ft²	Assumed Drainage System disturbance is 250 ft. in length and 4 ft. wide; asphalt pad is 12,800 square feet.
9.)	Construct Security Control Center	1,000	ft²	20 ft. by 50 ft. building
10.)	Construct Tactical Equipment Maintenance Facility	2,400	ft²	Section 2.1.2.1
11.)	Clear forest and scrub vegetation outside of the orginal drop zone	2,517,768	ft²	Section 2.1.2.2
12.)	Clear forest and scrub vegetation within the orginal drop zone	975,744	ft²	Section 2.1.2.2

Total Building Construction Area:	5,460	ft²	(2, 3, 6)
	0.125	acres	
Total Building and Roadway Demolition Area:	0	ft²	
	0.000	acres	
New Roadway Construction Area	0	ft²	
	0.000	acres	
Total Disturbed Area:	3,859,604	ft²	(1-8)
	88.604	acres	
Construction Duration:	12	months	
Annual Construction Activity:	240	days	Assumes 4 weeks per month, 5 days per week of work.

Emission Factors Used for Construction Equipment

References: Guide to Air Quality Assessment, SMAQMD, 2004; and U.S. EPA NONROAD Emissions Model, Version 2005.0.0
Emission factors are taken from the NONROAD model and were provided to HDR by Larry Landman of the Air Quality and Modeling Center (Landman.Larry@epamail.epa.gov) on 12/14/07. Factors provided are for the weighted average US fleet for CY2007.
Assumptions regarding the type and number of equipment are from SMAQMD Table 3-1 unless otherwise noted.

Grading

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Bulldozer	1	13.597	0.957	5.502	1.017	0.895	0.868	1456.904
Motor Grader	1	9.689	0.726	3.203	0.797	0.655	0.635	1141.647
Water Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Total per 10 acres of activity	3	41.641	2.577	15.710	3.449	2.546	2.469	4941.526

Paving

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Paver	1	3.831	0.374	2.055	0.281	0.350	0.340	401.932
Roller	1	4.825	0.443	2.514	0.374	0.434	0.421	536.074
Truck	2	36.712	1.788	14.009	3.271	1.992	1.932	4685.951
Total per 10 acres of activity	4	45.367	2.606	18.578	3.926	2.776	2.693	5623.957

Demolition

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Loader	1	13.452	0.992	5.579	0.949	0.927	0.899	1360.098
Haul Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Total per 10 acres of activity	2	31.808	1.886	12.584	2.585	1.923	1.865	3703.074

Building Construction

Equipment[d]	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Stationary								
Generator Set	1	2.381	0.317	1.183	0.149	0.227	0.220	213.059
Industrial Saw	1	2.618	0.316	1.966	0.204	0.325	0.315	291.920
Welder	1	1.124	0.378	1.504	0.078	0.227	0.220	112.393
Mobile (non-road)								
Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Forklift	1	5.342	0.560	3.332	0.399	0.554	0.537	572.235
Crane	1	9.575	0.665	2.393	0.651	0.500	0.485	931.929
Total per 10 acres of activity	6	39.396	3.130	17.382	3.116	2.829	2.744	4464.512

Note: Footnotes for tables are on following page

Architectural Coatings

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c]	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Air Compressor	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Total per 10 acres of activity	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773

a) The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.

b) The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC. The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors.

c) The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Action will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO2 emissions by more than a factor of two.

d) Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier*	Project-Specific Emission Factors (lb/day)						
		NO_x	VOC	CO	SO_2**	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	9	374.771	23.193	141.389	31.044	22.910	22.222	44473.737
Paving Equipment	1	45.367	2.606	18.578	3.926	2.776	2.693	5623.957
Demolition Equipment	1	31.808	1.886	12.584	2.585	1.923	1.865	3703.074
Building Construction	1	39.396	3.130	17.382	3.116	2.829	2.744	4464.512
Air Compressor for Architectural Coating	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Architectural Coating**			6.022					

*The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

**Emission factor is from the evaporation of solvents during painting, per "Air Quality Thresholds of Significance", SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NOx = (Total Grading NOx per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft^2)	Total Area (acres)	Total Days	
Grading:	3,859,604	88.604	6	(from "Grading" worksheet)
Paving:	0	0.000	0	
Demolition:	0	0.000	0	
Building Construction:	5,460	0.125	240	
Architectural Coating	5,460	0.125	20	(per SMAQMD "Air Quality of Thresholds of Significance", 1994)

NOTE: The 'Total Days' estimate for paving is calculated by dividing the total number of acres by 0.21 acres/day, which is a factor derived from the 2005 MEANS Heavy Construction Cost Data, 19th Edition, for 'Asphaltic Concrete Pavement, Lots and Driveways - 6" stone base', which provides an estimate of square feet paved per day. There is also an estimate for 'Plain Cement Concrete Pavement', however the estimate for asphalt is used because it is more conservative. The 'Total 'Days' estimate for demolition is calculated by dividing the total number of acres by 0.02 acres/day, which is a factor also derived from the 2005 MEANS reference. This is calculated by averaging the demolition estimates from 'Building Demolition - Small Buildings, Concrete', assuming a height of 30 feet for a two-story building; from 'Building Footings and Foundations Demolition - 6" Thick, Plain Concrete'; and from 'Demolish, Remove Pavement and Curb - Concrete to 6" thick, rod reinforced'. The 'Total Days' estimate for building construction is assumed to be 240 days.

Total Project Emissions by Activity (lbs)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	2,248.626	139.157	848.335	186.266	137.458	133.334	266,842.423
Paving	-	-	-	-	-	-	-
Demolition	-	-	-	-	-	-	-
Building Construction	9,455.116	751.154	4,171.754	747.924	678.970	658.601	1,071,482.802
Architectural Coatings	71.481	127.907	31.308	5.023	6.186	6.001	7,195.467
Total Emissions (lbs):	**11,775.224**	**1,018.219**	**5,051.397**	**939.212**	**822.615**	**797.936**	**1,345,520.692**

Results: Total Project Annual Emission Rates

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Total Project Emissions (lbs)	11,775.224	1,018.219	5,051.397	939.212	822.615	797.936	1,345,520.692
Total Project Emissions (tons)	5.888	0.509	2.526	0.470	0.411	0.399	672.760

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

	Emission Factor	Units	Source
Construction and Demolition Activities	0.190	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006
New Road Construction	0.420	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006

$PM_{2.5}$ Emissions

$PM_{2.5}$ Multiplier	0.100	(10% of PM_{10} emissions assumed to be $PM_{2.5}$)	EPA 2001; EPA 2006
Control Efficiency	0.500	(assume 50% control efficiency for PM_{10} and $PM_{2.5}$ emissions)	EPA 2001; EPA 2006

New Roadway Construction (0.42 ton PM_{10}/acre-month)

Duration of Construction Project	12	months
Area	0.000	acres

General Construction and Demolition Activities (0.19 ton PM_{10}/acre-month)

Duration of Project	12	months
Area	88.604	acres

	Project Emissions (tons/year)			
	PM_{10} uncontrolled	**PM_{10} controlled**	**$PM_{2.5}$ uncontrolled**	**$PM_{2.5}$ controlled**
New Roadway Construction	0.000	0.000	0.000	0.000
General Construction Activities	202.018	101.009	20.202	10.101
Total	**202.018**	**101.009**	**20.202**	**10.101**

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.190 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM_{10}/acre-month for sites without large-scale cut/fill operations. A worst-case emission factor of 0.42 ton PM_{10}/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM_{10}/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM_{10}/acre-month) and 75% of the average emission factor (0.11 ton PM_{10}/acre-month). The 0.19 ton PM_{10}/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM_{10}/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas.

New Road Construction Emission Factor

0.420 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM_{10}/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM10/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

$PM_{2.5}$ Multiplier **0.100**

$PM_{2.5}$ emissions are estimated by applying a particle size multiplier of 0.10 to PM_{10} emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM_{10} and $PM_{2.5}$ **0.500**

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999.* EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.

EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants.* Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.

MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1).* Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Grading Schedule

Estimate of time required to grade a specified area.

Input Parameters
Construction area: 88.604 acres/yr (from Combustion Worksheet)
Qty Equipment: 27.000 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.
Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day)	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8.000	acre/day	8.000	0.125	88.604	11.076
2230 500 0300	Stripping	Topsoil & stockpiling, adverse soil	1,650	cu. yd/day	2.045	0.489	88.604	43.318
2315 432 5220	Excavation	Bulk, open site, common earth, 150' haul	800	cu. yd/day	0.992	1.008	44.302	44.671
2315 120 5220	Backfill	Structural, common earth, 150' haul	1,950	cu. yd/day	2.417	0.414	44.302	18.327
2315 310 5020	Compaction	Vibrating roller, 6 " lifts, 3 passes	2,300	cu. yd/day	2.851	0.351	88.604	31.076
TOTAL								148.467

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 148.467
Qty Equipment: 27.000
Grading days/yr: 5.499

Haul Truck Emissions

Emissions from hauling excavation material, demolition materials, and construction supplies are estimated in this spreadsheet.

Emission Estimation Method:
United States Air Force (USAF). 2009. *Air Emission Factor Guide to Air Force Mobile Sources. Methods for Estimating Emissions of Air Pollutants For Mobile Sources at U.S. Air Force Installations.* December 2009.

Assumptions:
Haul trucks carry 20 cubic yards of material per trip.
The average distance from the project site to the materials source is 15 miles; therefore, a haul truck will travel 30 miles round trip.
Estimated number of trips required by haul trucks = total amount of material/20 cubic yards per truck
Assumes soil would not need to be hauled to or from the site.

Amount of Building Materials =	809	cubic yards	Assumes 4 cubic feet of building material are needed per square foot of building space
Amount of Paving Material =	474	cubic yards	Assumes 1 cubic foot of pavement material is needed per square foot of new pavement
Amount of Building Debris =	0	cubic yards	Assumes 4 cubic feet of demolition debris is generated per square foot of building space
Amount of Pavement Debris =	0	cubic yards	Assumes 1 cubic foot of pavement debris is generated per square foot of pavement
Number of trucks required =	64	heavy duty diesel haul truck trips	
Miles per trip =	30	miles	

Heavy Duty Diesel Vehicle (HDDV) Average Emission Factors (grams/mile)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
HDDV	**6.23**	**0.58**	**3.33**	**0.02**	**0.20**	**0.19**	**1615.20**

Notes:
Assumes Haul Trucks are Class 8b (HDDV8b; >60,000 lbs Gross Vehicle Weight)
Guam is located at a low altitude (<5,000 feet above sea level)
Construction assumed to occur in Calendar Year 2015, and construction vehicles are assumed to be on average 10 years old (Model Year 2005).
Emission factors for all pollutants are from USAF 2009, Appendix A, On-Road Vehicle Emission Factors, electronic pages 458-464.

HDDV Haul Truck Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**26.431**	**2.461**	**14.128**	**0.085**	**0.849**	**0.806**	**6852.651**
tons	**0.013**	**0.001**	**0.007**	**0.000**	**0.000**	**0.000**	**3.426**

Example Calculation: NO_x emissions (lbs) = 30 miles per trip * 5,021 trips * NO_x emission factor (g/mile) * lb/453.6 g

Construction Commuter Emissions

Emissions from construction workers commuting to the job site are estimated in this spreadsheet.

Emission Estimation Method: Emission factors from the South Coast Air Quality Management District (SCAQMD) EMFAC 2007 (v 2.3) Model (on-road) were used. These emission factors are available online at http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

Assumptions:
Passenger vehicle emission factors for scenario year 2012 are used.

The average roundtrip commute for a construction worker =	20	miles
Number of construction days =	240	days
Number of construction workers (daily) =	40	people

Passenger Vehicle Emission Factors for Year 2012 (lbs/mile)

NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.00078	0.00080	0.00765	0.00001	0.00009	0.00006	1.10153

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated April 24, 2008. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed 16 November 2011.
Notes:
The SMAQMD 2007 reference lists emission factors for reactive organic gas (ROG). For purposes of this worksheet ROG = VOC.

Construction Commuter Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**148.959**	**152.886**	**1469.711**	**2.060**	**17.240**	**11.039**	**211492.876**
tons	**0.074**	**0.076**	**0.735**	**0.001**	**0.009**	**0.006**	**105.746**

Example Calculation: NO_x emissions (lbs) = 40 miles/day * NO_x emission factor (lb/mile) * number of construction days * number of workers

Emissions from operating government and personal vehicles are estimated on this spreadsheet.

Emission Estimation Method: Emission factors from the South Coast Air Quality Management District (SCAQMD) EMFAC 2007 (v 2.3) Model (on-road) were used. These emission factors are available online at http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

Assumptions:
Passenger vehicle emission factors for scenario year 2012 are used.

The average daily trip =	20	miles
Number of days =	365	days
Number of workers =	105	people (70 dependents and 35 military personnel)

Passenger Vehicle Emission Factors for Year 2012 (lbs/mile)

NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.00078	0.00080	0.00765	0.00001	0.00009	0.00006	1.10153

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated April 24, 2008. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed 16 November 2011.
Notes:
The SMAQMD 2007 reference lists emission factors for reactive organic gas (ROG). For purposes of this worksheet ROG = VOC.

Commuter Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**594.672**	**610.348**	**5867.363**	**8.223**	**68.825**	**44.070**	**844319.216**
tons	**0.297**	**0.305**	**2.934**	**0.004**	**0.034**	**0.022**	**422.160**

Example Calculation: NO_x emissions (lbs) = 40 miles/day * NO_x emission factor (lb/mile) * number of construction days * number of workers

CO_2 emissions converted to metric tons =	***382.899***	***metric tons***
Percent of 25,000 metric tpy reference point =	***1.5%***	

Air Emissions from the Removal and Demolition of the Initial Deployment of the Expeditionary THAAD System

	NO_x (ton)	VOC (ton)	CO (ton)	SO_2 (ton)	PM_{10} (ton)	$PM_{2.5}$ (ton)	CO_2 (ton)
Combustion	0.630	0.037	0.249	0.051	0.038	0.037	73.448
Fugitive Dust	-	-	-	-	1.135	0.114	-
Haul Truck On-Road	0.360	0.034	0.192	0.001	0.012	0.011	93.339
Construction Commuter	0.028	0.029	0.276	0.000	0.003	0.002	39.655
Total	***1.018***	***0.100***	***0.717***	***0.053***	***1.188***	***0.164***	***206.442***

Note: Total $PM_{10}/_{2.5}$ fugitive dust emissions are assuming USEPA 50% control efficiencies.

CO_2 emissions converted to metric tons = ***187.243*** ***metric tons***
Percent of 25,000 metric tpy reference point = ***0.7%***

Combustion Emissions

Combustion Emissions of VOC, NO_x, SO_2, CO, $PM_{2.5}$, $PM_{10,}$ and CO_2 due to Construction and Demolition

General Construction Activities--Alternative 1	Area Disturbed		Source and Assumptions
1.) Remove temporary fence around orginal emplacement area	45,000	ft^2	Disturbance line is 3 feet wide by 15,000 feet long
2.) Demolish temporary guard towers for orginal emplacement area	2,250	ft^2	Ten towers measuring 15 feet by 15 feet
3.) Remove temporary fence around compressed emplacement area	10,200	ft^2	Distrubance line is 3 feet wide by 3,400 feet long
4.) Demolish temporary guard towers for compressed emplacement area	1,125	ft^2	Five towers measuring 15 feet by 15 feet
5.) Demolish concrete pads	28,200	ft^2	Section 2.2
Total Building Construction Area:	0	ft^2	
	0.000	acres	
Total Building and Roadway Demolition Area:	31,575	ft^2	(2, 4, 5)
	0.725	acres	
New Roadway Construction Area	0	ft^2	
	0.000	acres	
Total Disturbed Area:	86,775	ft^2	(1-5)
	1.992	acres	
Construction Duration:	6	months	
Annual Construction Activity:	120	days	Assumes 4 weeks per month, 5 days per week of work.

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Paving

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Demolition

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
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Building Construction

Equipment[d]	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c] (lb/day)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Stationary								
Generator Set	1	2.381	0.317	1.183	0.149	0.227	0.220	213.059
Industrial Saw	1	2.618	0.316	1.966	0.204	0.325	0.315	291.920
Welder	1	1.124	0.378	1.504	0.078	0.227	0.220	112.393
Mobile (non-road)								
Truck	1	18.356	0.894	7.004	1.635	0.996	0.966	2342.975
Forklift	1	5.342	0.560	3.332	0.399	0.554	0.537	572.235
Crane	1	9.575	0.665	2.393	0.651	0.500	0.485	931.929
Total per 10 acres of activity	6	39.396	3.130	17.382	3.116	2.829	2.744	4464.512

Note: Footnotes for tables are on following page

Architectural Coatings

Equipment	No. Reqd.[a] per 10 acres	NO_x (lb/day)	VOC[b] (lb/day)	CO (lb/day)	SO_2[c]	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)	CO_2 (lb/day)
Air Compressor	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Total per 10 acres of activity	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773

a) The SMAQMD 2004 guidance suggests a default equipment fleet for each activity, assuming 10 acres of that activity, (e.g., 10 acres of grading, 10 acres of paving, etc.). The default equipment fleet is increased for each 10 acre increment in the size of the construction project. That is, a 26 acre project would round to 30 acres and the fleet size would be three times the default fleet for a 10 acre project.

b) The SMAQMD 2004 reference lists emission factors for reactive organic gas (ROG). For the purposes of this worksheet ROG = VOC. The NONROAD model contains emissions factors for total HC and for VOC. The factors used here are the VOC factors.

c) The NONROAD emission factors assume that the average fuel burned in nonroad trucks is 1100 ppm sulfur. Trucks that would be used for the Proposed Action will all be fueled by highway grade diesel fuel which cannot exceed 500 ppm sulfur. These estimates therefore over-estimate SO2 emissions by more than a factor of two.

d) Typical equipment fleet for building construction was not itemized in SMAQMD 2004 guidance. The equipment list above was assumed based on SMAQMD 1994 guidance.

PROJECT-SPECIFIC EMISSION FACTOR SUMMARY

Source	Equipment Multiplier*	Project-Specific Emission Factors (lb/day)						
		NO_x	VOC	CO	SO_2**	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	1	41.641	2.577	15.710	3.449	2.546	2.469	4941.526
Paving Equipment	1	45.367	2.606	18.578	3.926	2.776	2.693	5623.957
Demolition Equipment	1	31.808	1.886	12.584	2.585	1.923	1.865	3703.074
Building Construction	1	39.396	3.130	17.382	3.116	2.829	2.744	4464.512
Air Compressor for Architectural Coating	1	3.574	0.373	1.565	0.251	0.309	0.300	359.773
Architectural Coating**			0.000					

*The equipment multiplier is an integer that represents units of 10 acres for purposes of estimating the number of equipment required for the project.

**Emission factor is from the evaporation of solvents during painting, per "Air Quality Thresholds of Significance", SMAQMD, 1994

Example: SMAQMD Emission Factor for Grading Equipment NOx = (Total Grading NOx per 10 acre)*(Equipment Multiplier)

Summary of Input Parameters

	Total Area (ft^2)	Total Area (acres)	Total Days	
Grading:	86,775	1.992	2	(from "Grading" worksheet)
Paving:	0	0.000	0	
Demolition:	31,575	0.725	37	
Building Construction:	0	0.000	0	
Architectural Coating	0	0.000	0	(per SMAQMD "Air Quality of Thresholds of Significance", 1994)

NOTE: The 'Total Days' estimate for paving is calculated by dividing the total number of acres by 0.21 acres/day, which is a factor derived from the 2005 MEANS Heavy Construction Cost Data, 19th Edition, for 'Asphaltic Concrete Pavement, Lots and Driveways - 6" stone base', which provides an estimate of square feet paved per day. There is also an estimate for 'Plain Cement Concrete Pavement', however the estimate for asphalt is used because it is more conservative. The 'Total 'Days' estimate for demolition is calculated by dividing the total number of acres by 0.02 acres/day, which is a factor also derived from the 2005 MEANS reference. This is calculated by averaging the demolition estimates from 'Building Demolition - Small Buildings, Concrete', assuming a height of 30 feet for a two-story building; from 'Building Footings and Foundations Demolition - 6" Thick, Plain Concrete'; and from 'Demolish, Remove Pavement and Curb - Concrete to 6" thick, rod reinforced'. The 'Total Days' estimate for building construction is assumed to be 240 days.

Total Project Emissions by Activity (lbs)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Grading Equipment	83.282	5.154	31.420	6.899	5.091	4.938	9,883.053
Paving	-	-	-	-	-	-	-
Demolition	1,176.880	69.764	465.599	95.641	71.158	69.023	137,013.726
Building Construction	-	-	-	-	-	-	-
Architectural Coatings	-	-	-	-	-	-	-
Total Emissions (lbs):	**1,260.163**	**74.918**	**497.019**	**102.539**	**76.249**	**73.962**	**146,896.779**

Results: Total Project Annual Emission Rates

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
Total Project Emissions (lbs)	1,260.163	74.918	497.019	102.539	76.249	73.962	146,896.779
Total Project Emissions (tons)	0.630	0.037	0.249	0.051	0.038	0.037	73.448

Construction Fugitive Dust Emissions

Construction Fugitive Dust Emission Factors

	Emission Factor	Units	Source
Construction and Demolition Activities	0.190	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006
New Road Construction	0.420	ton PM_{10}/acre-month	MRI 1996; EPA 2001; EPA 2006

$PM_{2.5}$ Emissions

$PM_{2.5}$ Multiplier	0.100	(10% of PM_{10} emissions assumed to be $PM_{2.5}$)	EPA 2001; EPA 2006
Control Efficiency	0.500	(assume 50% control efficiency for PM_{10} and $PM_{2.5}$ emissions)	EPA 2001; EPA 2006

New Roadway Construction (0.42 ton PM_{10}/acre-month)

Duration of Construction Project	6	months
Area	0.000	acres

General Construction and Demolition Activities (0.19 ton PM_{10}/acre-month)

Duration of Project	6	months
Area	1.992	acres

	Project Emissions (tons/year)			
	PM_{10} uncontrolled	**PM_{10} controlled**	**$PM_{2.5}$ uncontrolled**	**$PM_{2.5}$ controlled**
New Roadway Construction	0.000	0.000	0.000	0.000
General Construction Activities	2.271	1.135	0.227	0.114
Total	**2.271**	**1.135**	**0.227**	**0.114**

Construction Fugitive Dust Emission Factors

General Construction Activities Emission Factor

0.190 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The area-based emission factor for construction activities is based on a study completed by the Midwest Research Institute (MRI) Improvement of Specific Emission Factors (BACM Project No. 1), March 29, 1996. The MRI study evaluated seven construction projects in Nevada and California (Las Vegas, Coachella Valley, South Coast Air Basin, and the San Joaquin Valley). The study determined an average emission factor of 0.11 ton PM_{10}/acre-month for sites without large-scale cut/fill operations. A worst-case emission factor of 0.42 ton PM_{10}/acre-month was calculated for sites with active large-scale earth moving operations. The monthly emission factors are based on 168 work-hours per month (MRI 1996). A subsequent MRI Report in 1999, Estimating Particulate Matter Emissions From Construction Operations, calculated the 0.19 ton PM_{10}/acre-month emission factor by applying 25% of the large-scale earthmoving emission factor (0.42 ton PM_{10}/acre-month) and 75% of the average emission factor (0.11 ton PM_{10}/acre-month). The 0.19 ton PM_{10}/acre-month emission factor is referenced by the EPA for non-residential construction activities in recent procedures documents for the National Emission Inventory (EPA 2001; EPA 2006). The 0.19 ton PM_{10}/acre-month emission factor represents a refinement of EPA's original AP-42 area-based total suspended particulate (TSP) emission factor in Section 13.2.3 Heavy Construction Operations. In addition to the EPA, this methodology is also supported by the South Coast Air Quality Management District as well as the Western Regional Air Partnership (WRAP) which is funded by the EPA and is administered jointly by the Western Governor's Association and the National Tribal Environmental Council. The emission factor is assumed to encompass a variety of non-residential construction activities including building construction (commercial, industrial, institutional, governmental), public works, and travel on unpaved roads. The EPA National Emission Inventory documentation assumes that the emission factors are uncontrolled and recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas.

New Road Construction Emission Factor

0.420 ton PM_{10}/acre-month Source: MRI 1996; EPA 2001; EPA 2006

The emission factor for new road construction is based on the worst-case conditions emission factor from the MRI 1996 study described above (0.42 tons PM_{10}/acre-month). It is assumed that road construction involves extensive earthmoving and heavy construction vehicle travel resulting in emissions that are higher than other general construction projects. The 0.42 ton PM10/acre-month emission factor for road construction is referenced in recent procedures documents for the EPA National Emission Inventory (EPA 2001; EPA 2006).

$PM_{2.5}$ Multiplier **0.100**

$PM_{2.5}$ emissions are estimated by applying a particle size multiplier of 0.10 to PM_{10} emissions. This methodology is consistent with the procedures documents for the National Emission Inventory (EPA 2006).

Control Efficiency for PM_{10} and $PM_{2.5}$ **0.500**

The EPA National Emission Inventory documentation recommends a control efficiency of 50% for PM_{10} and $PM_{2.5}$ in PM nonattainment areas (EPA 2006). Wetting controls will be applied during project construction.

References:

EPA 2001. *Procedures Document for National Emissions Inventory, Criteria Air Pollutants, 1985-1999.* EPA-454/R-01-006. Office of Air Quality Planning and Standards, United States Environmental Protection Agency. March 2001.

EPA 2006. *Documentation for the Final 2002 Nonpoint Sector (Feb 06 version) National Emission Inventory for Criteria and Hazardous Air Pollutants.* Prepared for: Emissions Inventory and Analysis Group (C339-02) Air Quality Assessment Division Office of Air Quality Planning and Standards, United States Environmental Protection Agency. July 2006.

MRI 1996. *Improvement of Specific Emission Factors (BACM Project No. 1).* Midwest Research Institute (MRI). Prepared for the California South Coast Air Quality Management District, March 29, 1996.

Grading Schedule

Estimate of time required to grade a specified area.

Input Parameters
Construction area: 1.992 acres/yr (from Combustion Worksheet)
Qty Equipment: 3.000 (calculated based on 3 pieces of equipment for every 10 acres)

Assumptions.
Terrain is mostly flat.
An average of 6" soil is excavated from one half of the site and backfilled to the other half of the site; no soil is hauled off-site or borrowed.
200 hp bulldozers are used for site clearing.
300 hp bulldozers are used for stripping, excavation, and backfill.
Vibratory drum rollers are used for compacting.
Stripping, Excavation, Backfill and Compaction require an average of two passes each.
Excavation and Backfill are assumed to involve only half of the site.

Calculation of days required for one piece of equipment to grade the specified area.

Reference: Means Heavy Construction Cost Data, 19th Ed., R. S. Means, 2005.

Means Line No.	Operation	Description	Output	Units	Acres per equip-day)	equip-days per acre	Acres/yr (project-specific)	Equip-days per year
2230 200 0550	Site Clearing	Dozer & rake, medium brush	8.000	acre/day	8.000	0.125	1.992	0.249
2230 500 0300	Stripping	Topsoil & stockpiling, adverse soil	1,650	cu. yd/day	2.045	0.489	1.992	0.974
2315 432 5220	Excavation	Bulk, open site, common earth, 150' haul	800	cu. yd/day	0.992	1.008	0.996	1.004
2315 120 5220	Backfill	Structural, common earth, 150' haul	1,950	cu. yd/day	2.417	0.414	0.996	0.412
2315 310 5020	Compaction	Vibrating roller, 6 " lifts, 3 passes	2,300	cu. yd/day	2.851	0.351	1.992	0.699
TOTAL								3.338

Calculation of days required for the indicated pieces of equipment to grade the designated acreage.

(Equip)(day)/yr: 3.338
Qty Equipment: 3.000
Grading days/yr: 1.113

Haul Truck Emissions

Emissions from hauling excavation material, demolition materials, and construction supplies are estimated in this spreadsheet.

Emission Estimation Method:
United States Air Force (USAF). 2009. *Air Emission Factor Guide to Air Force Mobile Sources. Methods for Estimating Emissions of Air Pollutants For Mobile Sources at U.S. Air Force Installations.* December 2009.

Assumptions:
Haul trucks carry 20 cubic yards of material per trip.
The average distance from the project site to the materials source is 15 miles; therefore, a haul truck will travel 30 miles round trip.
Estimated number of trips required by haul trucks = total amount of material/20 cubic yards per truck
Assumes soil would not need to be hauled to or from the site.

Amount of Building Materials =	0	cubic yards	Assumes 4 cubic feet of building material are needed per square foot of building space
Amount of Paving Material =	0	cubic yards	Assumes 1 cubic foot of pavement material is needed per square foot of new pavement
Amount of Building Debris =	6,750	cubic yards	Assumes 4 cubic feet of demolition debris is generated per square foot of building space
Amount of Pavement Debris =	28,200	cubic yards	Assumes 1 cubic foot of pavement debris is generated per square foot of pavement
Number of trucks required =	1,748	heavy duty diesel haul truck trips	
Miles per trip =	30	miles	

Heavy Duty Diesel Vehicle (HDDV) Average Emission Factors (grams/mile)

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
HDDV	**6.23**	**0.58**	**3.33**	**0.02**	**0.20**	**0.19**	**1615.20**

Notes:
Assumes Haul Trucks are Class 8b (HDDV8b; >60,000 lbs Gross Vehicle Weight)
Guam is located at a low altitude (<5,000 feet above sea level)
Construction assumed to occur in Calendar Year 2015, and construction vehicles are assumed to be on average 10 years old (Model Year 2005).
Emission factors for all pollutants are from USAF 2009, Appendix A, On-Road Vehicle Emission Factors, electronic pages 458-464.

HDDV Haul Truck Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**720.035**	**67.034**	**384.866**	**2.312**	**23.115**	**21.959**	**186677.381**
tons	**0.360**	**0.034**	**0.192**	**0.001**	**0.012**	**0.011**	**93.339**

Example Calculation: NO_x emissions (lbs) = 30 miles per trip * 5,021 trips * NO_x emission factor (g/mile) * lb/453.6 g

Construction Commuter Emissions

Emissions from construction workers commuting to the job site are estimated in this spreadsheet.

Emission Estimation Method: Emission factors from the South Coast Air Quality Management District (SCAQMD) EMFAC 2007 (v 2.3) Model (on-road) were used. These emission factors are available online at http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

Assumptions:
Passenger vehicle emission factors for scenario year 2012 are used.

The average roundtrip commute for a construction worker =	20	miles
Number of construction days =	120	days
Number of construction workers (daily) =	30	people

Passenger Vehicle Emission Factors for Year 2012 (lbs/mile)

NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
0.00078	0.00080	0.00765	0.00001	0.00009	0.00006	1.10153

Source: South Coast Air Quality Management District. EMFAC 2007 (ver 2.3) On-Road Emissions Factors. Last updated April 24, 2008. Available online: <http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html>. Accessed 16 November 2011.
Notes:
The SMAQMD 2007 reference lists emission factors for reactive organic gas (ROG). For purposes of this worksheet ROG = VOC.

Construction Commuter Emissions

	NO_x	VOC	CO	SO_2	PM_{10}	$PM_{2.5}$	CO_2
lbs	**55.860**	**57.332**	**551.142**	**0.772**	**6.465**	**4.140**	**79309.828**
tons	**0.028**	**0.029**	**0.276**	**0.000**	**0.003**	**0.002**	**39.655**

Example Calculation: NO_x emissions (lbs) = 40 miles/day * NO_x emission factor (lb/mile) * number of construction days * number of workers