Draft

Environmental Impact Statement / Overseas Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

Volume 2: Marine Corps Relocation – Guam

November 2009

Comments may be submitted to:

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Guam and CNMI Military Relocation EIS/OEIS

Volume 2: Marine Corps Relocation – Guam

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CHAPTER 1. PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

Volume 2 focuses on the proposed development and construction of facilities and infrastructure to support the United States (U.S.) Marine Corps relocation to Guam. Volume 3 will analyze development and construction of facilities for training and operations occurring on Tinian (The Commonwealth of the Northern Mariana Islands [CNMI]). The main components of the proposed action in Volume 2 are as follows:

- Develop and construct facilities and infrastructure to support approximately 8,600 Marines and their 9,000 dependents relocated from Okinawa (Japan) to Guam.
- Develop and construct facilities and infrastructure to support training and operations on Guam for the relocated Marines.

The proposed action for the Marine Corps relocation includes personnel from the units being relocated and the associated base support personnel that must also be present at an installation to support the military mission.

This volume is organized as follows:

Chapter 1: Purpose of and Need for Action. Presents the overarching purpose of, and need for, the proposed action and presents background information about the proposed action on Guam.

Chapter 2: Proposed Action and Alternatives. Describes the siting criteria and the screening process to evaluate and identify the reasonable alternatives, the proposed action and reasonable alternatives, and the no-action alternative.

Chapters 3-19: Resource Sections. Describes existing conditions and identifies potential impacts to the respective resources:

Chapter 3: Geological and Soil Resources
Chapter 4: Water Resources
Chapter 5: Air Quality
Chapter 6: Noise
Chapter 7: Airspace
Chapter 8: Land and Submerged Land Use
Chapter 9: Recreational Resources
Chapter 10: Terrestrial Biological Resources
Chapter 11: Marine Biological Resources
Chapter 12: Cultural Resources
Chapter 13: Visual Resources
Chapter 14: Marine Transportation. For a discussion of roadway transportation, please see Volume 6.
Chapter 15: Utilities and Infrastructure
Chapter 16: Socioeconomics and General Services
Chapter 17: Hazardous Materials and Waste

Chapter 18: Public Health and Safety
Chapter 19: Environmental Justice and Protection of Children
Chapter 20: References

1.2 PURPOSE AND NEED

As discussed in Volume 1, the overarching purpose for the proposed actions is to locate U.S. military forces to meet international agreement and treaty requirements and to fulfill U.S. national security policy requirements to provide mutual defense, deter aggression, and dissuade coercion in the Western Pacific Region. The need for the proposed actions is to meet the following criteria based on U.S. policy, international agreements, and treaties:

1. Position U.S. forces to defend the homeland including the U.S. Pacific territories
2. Location within a timely response range
3. Maintain regional stability, peace and security
4. Maintain flexibility to respond to regional threats
5. Provide powerful U.S. presence in the Pacific region
6. Increase aircraft carrier presence in the Western Pacific
7. Defend U.S., Japan, and other allies' interests
8. Provide capabilities that enhance global mobility to meet contingencies around the world
9. Have a strong local command and control structure

Volume 1 provides detailed information regarding the international context for the Purpose and Need for the proposed action. The following summarizes the context for choosing the location to implement the proposed action.

Treaty and Alliance Requirements

In the Western Pacific Region, there are five of the seven worldwide, longstanding U.S. mutual defense treaties that contain alliance requirements. They are:

- U.S.– Philippines (1952)
- ANZUS (Australia, New Zealand, U.S. [1952])
- U.S.– Korea (1954)
- Southeast Asia Collective Defense (U.S., France, Australia, New Zealand, Thailand, Philippines [1955])
- U.S.–Japan (1960)

The U.S.–Japan (1960) treaty, known as the *Treaty of Mutual Cooperation and Security*, (Mutual Security Treaty) is the most relevant to the proposed action. It contains general provisions on the further development of international cooperation and on improved future economic cooperation. Both parties assumed an obligation to maintain and develop their capacities to resist armed attack and assist each other in the event of an armed attack on either party in territories under Japanese administration. This provision is carefully crafted to be consistent with Japan's Constitution that limits its military capabilities to defensive capabilities only. The Agreed Minutes to the Treaty specify that the Japanese government must be consulted prior to major changes in U.S. force deployment in Japan and prior to the use of Japanese bases for combat operations, other than in defense of Japan itself. U.S. treaty commitments with the other nations listed above also require a timely response to incidents and a consistent U.S. presence of force as a deterrent in the Pacific region.

In response to the evolving security environment in the Pacific region, the DoD the Integrated Global Presence and Basing Strategy (IGPBS) and Quadrennial Defense Review (QDR) initiatives began to focus on posture changes in the Pacific region. These initiatives included reduction of overseas forces while striving to base forces in locations that support flexibility and speed of response to anywhere in an unpredictable environment. Based on the QDR recommendations for global repositioning and operational realignments in the Pacific Region, the Department of Defense began to identify suitable locations to relocate the Marine Corps from Okinawa that met: (1) treaty and alliance requirements; (2) response times to potential areas of conflict; and (3) freedom of action (use of base without restrictions).

In a parallel initiative with the IGPBS that began in December 2002, the U.S. engaged the Government of Japan in discussions to coordinate changes in U.S. force posture in Japan and the options on how best to coordinate those changes with other force realignments in the Pacific. Over a three and one-half-year period, the U.S. engaged with the Government of Japan in a series of sustained security consultations under the auspices of the U.S.-Japan Security Consultative Committee (SCC), the pre-eminent treaty oversight body, composed of the U.S. Secretary of State and Secretary of Defense and the Japanese Minister of Foreign Affairs and Minister of Defense. These talks, which came to be known as the Defense Policy Review Initiative (DPRI), were aimed at evolving the U.S.-Japan Security Alliance to reflect today's rapidly changing global security environment. The DPRI, which served as the primary venue for accomplishing U.S. IGPBS objectives regarding Japan, The DPRI focused on alliance transformation at the strategic and operational levels, with particular attention to the posture of U.S. and Japanese forces in Japan, as well as transforming capabilities in the Western Pacific around the U.S. and Japanese alliance.

Ultimately, these discussions and negotiations resulted in an agreement known as the Alliance Transformation and Realignment Agreement (ATARA). In development of the ATARA, the U.S. and Japan confirmed several basic concepts relevant to bilateral defense cooperation, the defense of Japan and responses to situations in areas surrounding Japan. These concepts include the following: (1) bilateral defense cooperation remains vital to the security of Japan as well as to peace and stability of the region; (2) the U.S. will maintain forward-deployed forces, and augment them as needed, for the defense of Japan and to deter and respond to situations in areas surrounding Japan; (3) the U.S. will provide all necessary support for the defense of Japan; (4) U.S. and Japanese operations in the defense of Japan, and responses to situations in areas surrounding Japan, must be consistent to ensure appropriate responses when situations in areas surrounding Japan threaten to develop into armed attacks against Japan, or when an armed attack against Japan may occur; and (5) U.S. strike capabilities and the nuclear deterrence provided by the U.S. remain an essential complement to Japan's defense capabilities and preparedness in ensuring the defense of Japan and contribute to peace and security in the region.

At the May 1, 2006, SCC meeting, the two nations recognized that the realignment initiatives described in the SCC document *U.S.-Japan Roadmap for Realignment Implementation* (the "Roadmap") would lead to a new phase in alliance cooperation. The Roadmap outlined details of different realignment initiatives, including the relocation of the Marines and associated arrangements for cost sharing by the Japanese government. The Mutual Security Treaty and follow-on U.S.-Japan agreements require the U.S. to respond quickly to areas of potential conflict in the Asia-Pacific region. Consistent with these obligations, the ATARA and Roadmap initiatives require relocating approximately 8,000 III Marine Expeditionary Force personnel and 9,000 dependents from Okinawa to Guam with a target completion date of 2014. Moving these forces to Guam would place them on the furthest forward element of sovereign U.S. territory in the Pacific capable of supporting such a presence, thereby maximizing their freedom of action while minimizing the increase in their response time relative to their previous stationing in Okinawa.

Under the ATARA and Roadmap, Japan has agreed to a cost-sharing arrangement with the U.S. that would assist in funding up to $6.09 billion of the facilities construction costs for the relocation of the Marines from Okinawa to Guam. This cost-sharing agreement acknowledges that the Marine Corps forces on Guam would continue to support U.S. commitments to provide for the defense and security of Japan. These international commitments for funding, and locations of the repositioned forces were re-affirmed on February 17, 2009 in the document titled: *Agreement Between the Government of the U.S. and the Government of Japan Concerning the Implementation of the Relocation of the III Marine Expeditionary Force Personnel and Their Dependents from Okinawa to Guam* (Guam International Agreement), signed by the U.S. Secretary of State and the Japanese Foreign Minister. The Agreement was approved by the Japanese Diet on May 13, 2009 and transmitted to the U.S. Congress in accordance with each party's respective legal procedures.

Response Time

Basing locations in the Pacific region were analyzed to determine those that would provide sufficient response times to potential areas of conflict to meet U.S. security interests in the Asia-Pacific region, including treaty commitments to Japan and other countries in the region. The U.S. locations in the Pacific Region considered for the military relocation were Hawaii, Alaska, California, and Guam. Non-U.S. locations considered included Korea, the Philippines, Singapore, Thailand, and Australia, because they are allies to the U.S. and are well situated for strategic force deployment for permanent basing opportunities.

One of DoD's highest priorities, highlighted in the QDR, is maintaining the readiness and sustainability of U.S. forces. In general terms, readiness is the overall ability of forces to arrive on time where needed, and be sufficiently trained, equipped, and supported to effectively carry out assigned missions. Forces must be placed and maintained so that they can be utilized in a timely fashion. The desired distance from the potential threat can vary based on unit type and need, as well as mode of transport. Traditionally, forces were deployed in a slow steady buildup over time. This planning methodology was known as the time-phased force deployment process. Now, however, crises manifest themselves quickly in a variety of locations. Forces must be placed and maintained such that they can provide a rapid and timely response. Therefore, it is critical to locate forces so that the amount of time required to reach a crisis location is kept to a minimum. Significant times and distances that must be overcome to deploy forces to various locations in the Pacific.

Although forward-positioned forces in Korea have the lowest response times in the region, their mission is to maintain stability on the Korean peninsula and they historically have not been available to provide a readily deployable force to other locations in the region. Moreover, at the time of the DPRI negotiations, the U.S. was in separate negotiations to reduce presence in Korea.

Forward-positioned forces in the Korea provide the lowest representative response times to Okinawa and Taiwan when compared with various non-U.S., allied ports. and is not located there to provide readily deployable forces to other locations in the region. Forward-positioned forces on Guam provide significantly reduced response times to Pacific locations when compared to forces positioned in other U.S. locations.

Freedom of Action

Freedom of action is the ability of the U.S. to use bases and training facilities freely and without restriction at a particular locale, as well as affording the U.S. the ability to engage in rapid force posture movements and contingency response from those locations. Freedom of action is variable based on the

location of the action with the most flexibility being available at facilities and bases located on sovereign U.S. soil. Guam, Hawaii, Alaska, and California are preferred over foreign countries because they provide the most flexibility for the troops during times of maximum threat. However, to ensure the most strategic location for basing, during the IGPBS process, the U.S. representatives consulted with representatives of allies to the U.S. in the Pacific Region that are well situated for strategic force deployment, to ascertain their willingness to host U.S. forces. A permanent basing location was sought because it would provide the greatest regional stability for the placement of military assets. Further, permanent basing, consistent with the host nation laws and policies, are much more likely to be developed to support the U.S. military's specific operational requirements. The allies consulted, while amenable to various degrees of temporary basing or cooperative security agreements, were unwilling to allow permanent basing of U.S. forces on their soil.

The military's goal is to locate forces where those forces are wanted and welcomed by the host country. Because these countries within the region have indicated their unwillingness and inability to host more U.S. forces on their lands, the U.S. military has shifted its focus to basing on U.S. sovereign soil.

Summary of Global Alternatives Analysis for Proposed Marine Relocation

Overall, Guam, Hawaii, Alaska, and California pose no limitation on freedom of action, and have available infrastructure. However, California, Alaska, and Hawaii all create significant strains on rapid response time, interoperability, and the U.S. ability to uphold treaties and protect other interests in the Asia-Pacific region. Commitments under those treaties require that certain forces be within range to project power, to deter aggression, and dissuade coercion in the Western Pacific. In addition, Japan's clear willingness to fund the development of facilities to support the relocation of the Marines to Guam, as reaffirmed by the Japanese Diet in its recent ratification of the Guam International Agreement, reflected Japan's recognition of the continuing linkages between those forces and U.S. commitments to Japan under the Mutual Security Treaty. Also, Guam's distance to many of the likely contingency areas in the region is comparable to distances from the other potential allied countries in the Pacific region considered for permanent basing, and is close enough to threats to employ rapid response capabilities and to implement the requirements of treaties. Finally, in contrast to Guam, which is U.S. sovereign soil that meets the freedom of action operational requirement for permanent basing, no consulted allied countries in the Pacific region were willing to host a large additional contingent of U.S. forces on a permanent basis. In sum, the fundamental requirement to support the treaties and alliances that ensure peace and stability in the region, and the pressing need to reduce friction on Okinawa make Guam the only location for the realignment of forces that meets all criteria.

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CHAPTER 2.
PROPOSED ACTION AND ALTERNATIVES

2.1 OVERVIEW

The proposed action evaluated in this Volume 2 of the Guam and Commonwealth of Northern Mariana Islands (CNMI) Military Relocation Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) is to establish a permanent Marine Corps base on Guam to support the mission and training requirements of Marine Corps units and personnel that will be relocated from Okinawa. The rationale for selecting Guam as the focal point of the proposed relocation is discussed in Chapter 1 of this volume and Volume 1 of the EIS/OEIS, and is therefore not repeated in this chapter. For purposes of the National Environmental Policy Act (NEPA) analysis in this volume of the EIS/OEIS, this Chapter focuses only on the functions, facilities, personnel, operations, and training that would be constructed, stationed, and implemented on Guam in order to accomplish the mission requirements of the proposed relocation. The NEPA analysis for training that would be implemented on Tinian (CNMI) supporting the relocation is in Volume 3.

This chapter of Volume 2 describes the key components of the proposed action, including the facility construction and operational requirements for a Marine Corps Base on Guam, as well as the development of a reasonable set of alternatives for implementing the proposed action and the no-action alternative.

2.1.1 Summary of Proposed Action: Establish a Marine Corps Base on Guam

The proposed action involves constructing and utilizing all required facilities, infrastructure, and training assets necessary to establish a Marine Corps base of operations on Guam. The Marine Corps would relocate approximately 8,600 Marines and their 9,000 dependents from Okinawa to Guam. The proposed action for the approximately 8,600 Marines includes personnel from the units being relocated and the associated base support personnel that must also be present at an installation to support the military mission.

There would be four relocating military elements:

- Command Element, III Marine Expeditionary Force (MEF). III MEF is the Marine Corps' forward-deployed Marine Air-Ground Task Force (MAGTF); it has the ability to deploy rapidly and conduct operations ranging from humanitarian assistance and disaster relief to amphibious assault and high intensity combat. The MAGTF command element consists primarily of headquarters (HQ) and supporting organizations. Collocation and communications connectivity is a primary facility siting requirement. Estimated personnel: 3,046.
- Ground Combat Element (GCE), 3rd Marine Division Units. The GCE has the mission of locating, closing with and destroying the enemy with fire, maneuver, and close combat. It provides infantry, armor, artillery, reconnaissance, anti-tank and other combat arms. It consists of Division HQ and subordinate organizations. Ground combat and combat support

organizations require proximity to ranges and training areas as well as traditional base support facilities. Estimated personnel: 1,100.

- Air Combat Element (ACE), 1st Aircraft Wing and subsidiary units. The ACE operates from a variety of sea- and shore-based facilities to support Marine Air Ground Task Force (MAGTF) expeditionary operations. The focus of the ACE is to support the MAGTF during assault landings and subsequent operations ashore. The ACE includes the Marine Aircraft Wing (MAW) HQ, expeditionary, and garrison supporting organizations. Unlike aircraft squadrons, aviation command and general supporting elements can be located close to the airfield and higher commands, and do not necessarily need to be located at the airfield. Estimated personnel: 1,856.
- Logistics Combat Element (LCE), 3rd Marine Logistics Group (MLG). The LCE provides all support functions beyond the capabilities of the GCE and ACE units. Functions include: communications, engineering support, motor transport, medical, supply, maintenance, air delivery, and landing support. The LCE consists of MLG HQ and supporting organizations that provide a variety of direct logistics support to the rest of the MEF. The MLG HQ element would be sited in proximity to Command HQ and other HQs. Indirect and industrial support facilities of the LCE would be located in proximity to support activities and maximize efficiency, with efficient access to roads, ports and airfields. Estimated personnel: 2,550.

There would also be a large transient component that includes the following units and approximate personnel numbers:

- Infantry battalion (800 people)
- Artillery battery (150 people)
- Aviation unit (250 people)
- Other (800 people)

For the purpose of clearly defining what amounts to a very complex endeavor, this chapter describes the proposed action and reasonable alternatives in terms of four major functional components of the Marine Corps relocation to Guam. These components represent core capabilities and support functions within the context of the overall Marine Corps mission. The mission capabilities of the units to be stationed in Guam are part of a larger mission capability supporting the overall national defense objectives of the U.S. in the western Pacific. The four functional components of the proposed action are:

1. *Main Cantonment Area functions*. Main cantonment military support functions (also known as base operations and support) include headquarters and administrative support, bachelor housing, family housing, supply, maintenance, open storage, community support (*e.g.*, retail, education, recreation, medical, day care, etc.), some site-specific training functions, and open space (e.g. parade grounds, open training areas, open green space in communities, etc), as well as the utilities and infrastructure required to support the cantonment area.
2. *Training functions.* There are three subclasses of training support functions required by Marine Corps units that would be stationed on Guam:
   - *Firing ranges* are required for live and inert munitions practice, which generates the need for safety buffers called Surface Danger Zones (SDZs), and special use airspace (SUA) for certain weapons.
   - *Non-fire maneuver ranges* are required for vehicle and foot maneuver training, including urban warfare training. Urban warfare training is conducted in buildings that simulate a

city or town. These buildings would be arranged close together so that Marines can practice entering and maneuvering in tight spaces.

- *Aviation training areas* are either improved (paved runway) or unimproved (unpaved landing sites) used to practice landing/takeoff and air field support (including loading/unloading of fuel, munitions, cargo, and personnel). Aviation training includes use of both international airspace and U.S. controlled airspace within the Mariana Islands Range Complex (MIRC).

3. *Airfield functions*. The proposed Marine Corps relocation would include aviation units and aviation support units that require runway and hangar space and maintenance, supply and administrative facilities. There is also a need for air embarkation operations that are comparable to, compatible with, and co-located with, existing Andersen Air Force Base (AFB) operations. Air embarkation operations refer to loading and unloading cargo and passengers to and from aircraft, comparable to a civilian airport terminal.
4. *Waterfront functions*. The ships and assault craft associated with the proposed Marine Corps relocation are transient (visiting). The transient vessels support Marine Corps operations and transient forces that presently train on Guam and in the CNMI. These ships would continue to support Marine Corps requirements in the western Pacific after the proposed relocation, and would continue to require transient vessel support facilities on Guam. The planning criteria for harbors, regardless of usage, differ from those for land-based facilities. Therefore, the proposed waterfront facilities required, although training-related, are being discussed in this EIS/OEIS as distinct from other training actions.

Each of these project components is characterized by unique facility and operational requirements that together comprise one proposed action. Figure 2.1-1 lists, for each of the four components, the types of facilities that would be constructed and operated under the proposed action. These proposed facilities and operations are described further in Sections 2.2.1, 2.3.1, 2.4.1, and 2.5.1, respectively, for each of the four functions.

The process and criteria used to develop and evaluate a set of reasonable alternatives for implementing the proposed action are described generally in Section 2.1.2 below. Results of the alternatives screening process for each of the four functional components of the action are described in Sections 2.2.2, 2.3.2, 2.4.2, and 2.5.2, respectively. Alternatives were identified for each of the following:

- Main Cantonment Area functions: eight alternatives representing different site-specific planning alignments for the required Main Cantonment functions (and selected training functions) were identified and evaluated, with four of these (Alternatives 1, 2, 3, and 8) being carried forward for detailed analysis in the EIS/OEIS.
- Live-fire Training Range Complex: Firing ranges would be collocated on land to be acquired east of Andersen AFB South (Andersen South). Two alternatives (Alternative A and B), representing different site-specific planning alignments of various range facilities required to conduct live-fire training, were identified and are carried forward for analysis in the EIS/OEIS.
- Access Road for Large Scale Maneuver Training Area: two alternatives representing different levels of improvement for a single location are carried forward for analysis in the EIS/OEIS.
- Munitions Storage Facilities at the existing Naval Munitions Site (NMS): two alternatives representing different locations and alignments for a proposed set of 10 new munitions storage magazines are carried forward for analysis in the EIS/OEIS.

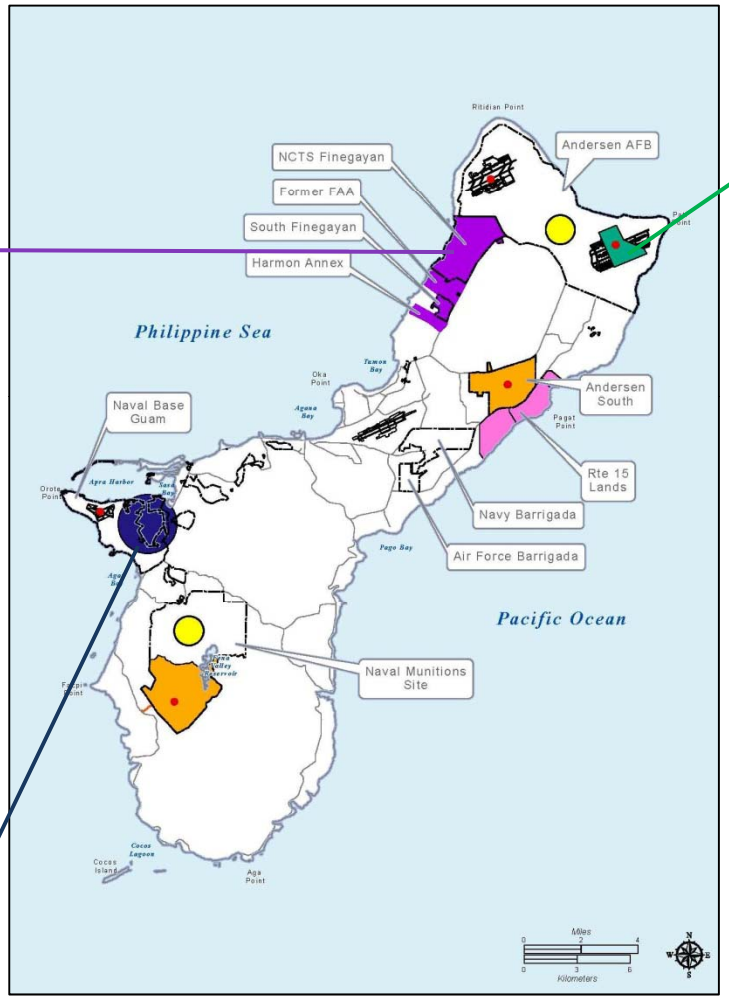
Figure 2.1-1 Overview of Proposed Facility Construction and Operations on Guam

Main Cantonment Functions

- Headquarters (HQ) and Administrative:
  - Administrative offices
  - Vehicle maintenance
  - Communications
  - Security
  - Warehousing
  - Armory
  - Fuel storage
  - HAZMAT, DRMO, Recycling
- Base Operations:
  - Administrative offices
  - Police/fire facilities
  - Base Access
  - Warehousing
  - Legal services, dental services, family services, and MWR support
- Bachelor's Quarters and Temporary Lodging
- Family Housing
- Educational Facilities
- Quality of Life (QOL) Functions:
  - community center, commissary, exchange, post office, theater, recreational, etc.
  - Applied instruction and auditorium
  - Services: restaurant, bank, gas station

Waterfront Functions

- Amphibious task force ship berthing
- Embarkation and cargo inspection and staging area
- LCAC/AAV laydown area
- Apra Harbor medical/dental clinic
- Relocations: Military Working Dog Kennels, USCG wharf and support facilities



Airfield Functions

- Air embarkation
- ACE beddown:
  - Hangars/aprons
  - Administrative
  - Maintenance
  - Fire and rescue

Training Functions

- Training Range Complex:
  - Live-firing ranges
  - Indoor small arms range
- Ammunition storage
- Non-firing Ranges:
  - Obstacle course
  - Hand-to hand combat
  - Gas chamber
  - Advanced motor vehicle course
  - Rappelling
  - Engineer equipment and decontamination training facility
  - Maneuver training
  - Range support buildings
- Aviation Training:
  - Marine Air Control Group (MACG) Training
  - Improved airfield
  - Landing zones
- Command, Control and Simulation:
  - Battle Staff Training
  - Combined arms training
  - Audio visual and simulation training

The alternatives introduced above are functionally independent of each other and could be combined, along with the other project elements listed below, to yield a proposed action that satisfies all of the Marine Corps' requirements for the proposed relocation to Guam (Figure 2.1-2). Table 2.1-1 lists the projects associated with the functional components for the proposed action.

The following are elements of the proposed action where no reasonable alternatives have been identified:

- Air Traffic Control Detachment Training Site: sites to support this component of Aviation Training are Northwest Field [NWF] and North Ramp at Andersen AFB.
- Tactical Air Operations Center: sites to support this component of Aviation Training are NWF and North Ramp at Andersen AFB.
- Demolition Range: the existing range at NWF would be used by the Marine Corps.
- Pistol Range: the existing pistol range at Naval Computer and Telecommunications Station (NCTS) does not meet the requirements for Marine Corps pistol qualification training and would be relocated as a component of the proposed live-fire Training Range Complex.
- Airfield facilities and operations would be implemented and integrated into existing Andersen AFB airfield operations and base support requirements.
- Ammunition storage facilities and related support facilities would be constructed at the existing Andersen AFB Munitions Storage Area and at the High 12 Group area at the NMS.
- Waterfront facilities and operations would be implemented and integrated into existing Naval Base Guam operations at Inner Apra Harbor.
- Aviation training would be integrated into existing training venues where possible. Aviation training would be conducted at existing paved runways at Andersen AFB, NWF, and Orote Point Airfield. Specific training requirements, including, air-to-air, and air-to-surface training, would be conducted at other existing aviation training areas in CNMI and international airspace (as addressed in the MIRC EIS/OEIS [Navy 2009]). New unimproved vertical lift landing zones (LZ's) would be developed at Andersen South and NMS.
- Non-firing company-level maneuver training would occur at Andersen South and NMS. New access to NMS would be required and two access road alternatives were identified as introduced above.

Some additional training requirements would be met by using training areas on the Island of Tinian in the CNMI. These proposed training activities are distinct from the proposed action on Guam and are addressed in Volume 3 of this EIS/OEIS.

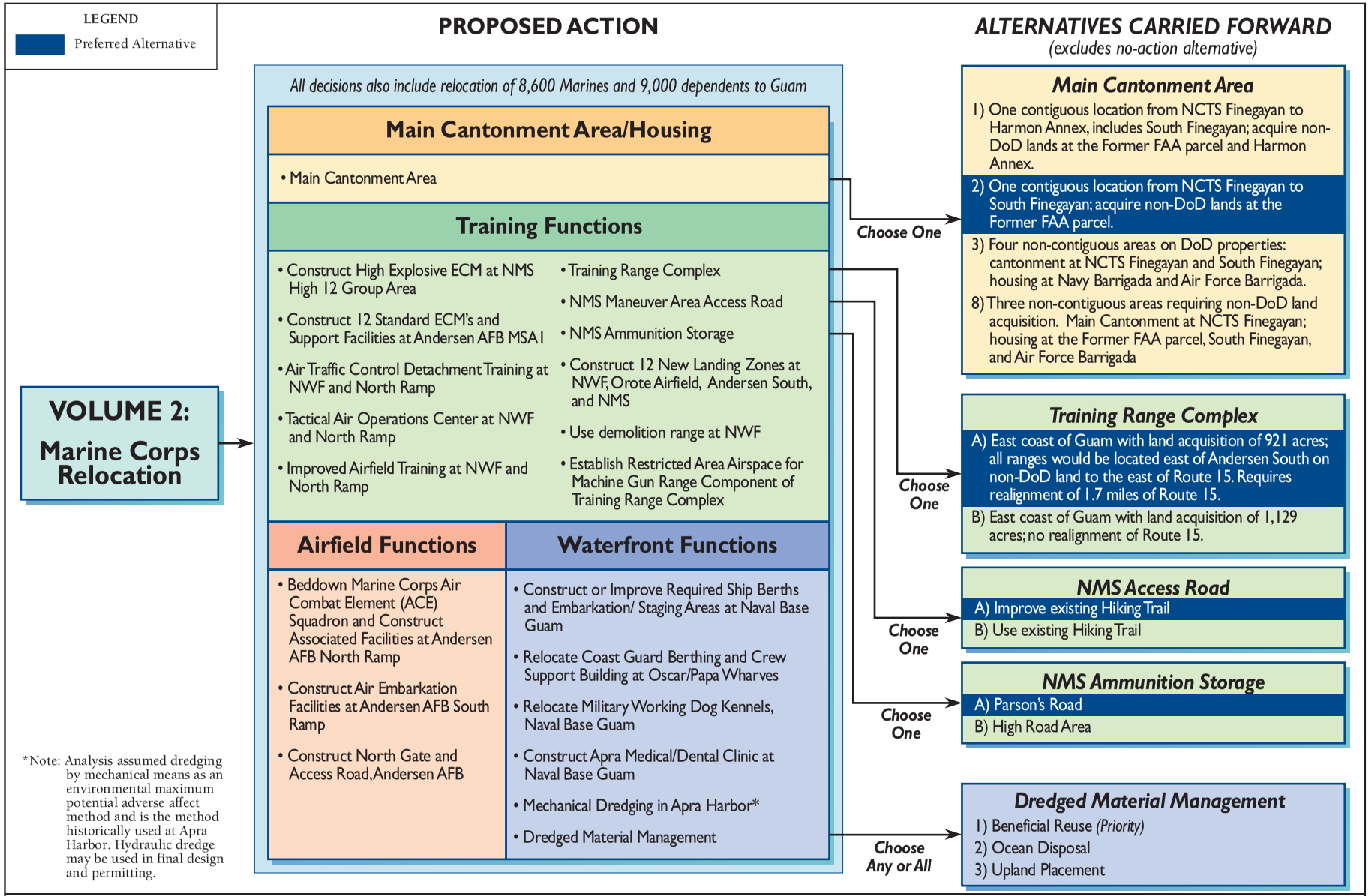


Figure 2.1-2
Summary of Proposed Action and Alternatives Carried Forward for the Marine Corps Relocation, Guam

Table 2.1-1. Projects Associated with the Relocation of Marines to Guam

Component	*Project Title*			*Con*	*Op*	*Location*
2.2/2.2-4	Main Cantonment	Headquarters and Administrative facilities, Base Operations, Temporary Lodging, Family Housing, Educational facilities, Quality of Life, Commercial Gate, Main Gate, and Residential Gate,	Main Cantonment: Alternative 1	X	X	North: NCTS Finegayan (Cantonment), Potts Junction (utilities), Former FAA, South. Finegayan, and Harmon Annex (Housing)
2.2/2.2-5	Main Cantonment	Headquarters and Administrative facilities, Base Operations, Temporary Lodging, Family Housing, Educational facilities, Quality of Life, Commercial Gate, Main Gate, and Residential Gate,	Main Cantonment: Alternative 2	X	X	North: NCTS Finegayan (Cantonment), Potts Junction (utilities), Former FAA and South Finegayan (Housing)
2.2/2.2-6	Main Cantonment	Headquarters and Administrative facilities, Base Operations, Temporary Lodging, Family Housing, Educational facilities, Quality of Life, Commercial Gate, Main Gate, and Residential Gate,	Main Cantonment: Alternative 3	X	X	North: NCTS Finegayan (Cantonment), Potts Junction (utilities), South Finegayan, Central: Navy Barrigada, AF Barrigada (Housing)
2.2/2.2-7	Main Cantonment	Headquarters and Administrative facilities, Base Operations, Temporary Lodging, Family Housing, Educational facilities, Quality of Life, Commercial Gate, Main Gate, and Residential Gate,	Main Cantonment: Alternative 8	X	X	North: NCTS Finegayan (Cantonment), Potts Junction (utilities), Former FAA, S. Finegayan, Central: AF Barrigada (Housing)
2.3/ 2.3-5	Training	Non-Firing/Maneuver	Access Roadway, Alternative A	X	X	South: NMS
2.3/ 2.3-5	Training	Non-Firing/Maneuver	Access Roadway, Alternative B		X	South: NMS
2.3/2.3-11	Training	Aviation Training	Improved airfield, ATC, TAOC		X	North: NWF, North Ramp, Andersen AFB
2.3/2.3-11	Training	Aviation Training	Landing Zone (4)		X	North: Andersen AFB - NWF
2.3/2.3-11	Training	Aviation Training	Landing Zone (2) (new)	X	X	Central: Andersen South
2.3/2.3-11	Training	Aviation Training	Landing Zone (1)		X	Apra Harbor: Orote
2.3/2.3-11	Training	Aviation Training	Landing Zone (5) (new)	X	X	South: NMS
2.3	Training	Aviation Training	Airfield Training		X	North: AAFB
2.3/NA	Training	Firing Ranges	Demolition Range		X	North: NWF

Table 2.1-1. Projects Associated with the Relocation of Marines to Guam

Component	*Project Title*			*Con*	*Op*	*Location*
2.3/2.3-17	Training	Firing Ranges	Hand Grenade Range and grenade house (HG1) (co-located with Firing Range Complex Alternative A)	X	X	Central: Andersen South
2.3/2.3-17	Training	Firing Ranges	Hand Grenade Range and grenade house (HG2) (co-located with Firing Range Complex Alternative B)	X	X	Central: Andersen South
2.3/2.3-16	Training	Live Fire: KD Range, Pistol Range, Square-Bay Range, UD Range, Range Control, Machine Gun Range; range roads, Realignment of Route 15; range towers; Proposed SUA Airspace	Firing Range Complex: Alternative A	X	X	Central: Rt 15 Plateau
2.3/2.3-16	Training	Live Fire: KD Range, Pistol Range, Square-Bay Range, UD Range, Range Control, Machine Gun Range; range roads; range towers; Proposed SUA airspace	Firing Range Complex: Alternative B	X	X	Central: Rt 15 Valley
2.3/2.3-13	Training	Munitions	Munitions Storage: Alternative A	X	X	South: NMS - Parsons Rd
2.3/2.3-13	Training	Munitions	Munitions Storage: Alternative B	X	X	South: NMS-High Rd Area
2.32.3-14	Training	Munitions	Munitions Storage High 12 Group	X	X	South: NMS
2.3/2.3-14	Training	Munitions	MSA1 Storage Improvements	X	X	North: Andersen AFB
2.3/2.3-6	Training	Non-Firing Ranges	Breacher and Shooting House (at MOUT)		X	Central: Andersen South
2.3/2.3-6	Training	Non-Firing Ranges; Pioneer Road	Convoy Course	X	X	Central: Andersen South
2.3/2.3-6	Training	Non-Firing Ranges	AMVOC	X	X	Central: Andersen South
2.3/2.3-6	Training	MOUT, Logistics/Administrative, Perimeter security fencing, gates	MOUT	X	X	Central: Andersen S
2.3/2.3-3	Training	Non-Firing Ranges	Maneuver Area		X	Central: Andersen S
2.3/2.3-3	Training	Non-Firing Ranges	Maneuver Area		X	South: NMS
2.3/2.2-4, 2.2-5, 2.2-6, 2.2-7	Training	Non-Firing Ranges	Engineering Equipment and Decontamination Training	X	X	Main Cantonment

Table 2.1-1. Projects Associated with the Relocation of Marines to Guam

Component	*Project Title*			*Con*	*Op*	*Location*
2.4/2.4-1	Airfield	ACE	MALS Hangar, Corrosion Hangar, Air Ops Center, AAFB North Ramp Parking, Squadron Aircraft Hangars, armories, fire station, control tower, maintenance shops, POV parking	X	X	North: Andersen AFB - North Ramp
2.4/2.4-3	Airfield	Air Embarkation	South Ramp - Joint w/ AMC	X	X	North: Andersen AFB - South Ramp
2.4/2.4-4, 2.4-5	Airfield	Gate/Access	North Gate and New Access Road.	X	X	North: Andersen AFB

These elements are depicted in Figure 2.1-3 and would be included in any proposed action that would be implemented by the Marine Corps on Guam, regardless of the mix of alternatives implemented for other components of the action.

The most substantial differences between the alternatives carried forward for any of the four functional project components relate to the orientation of main cantonment area functions. Alternatives 1, 2, and 8 include a requirement for obtaining a real estate interest in the former Federal Aviation Administration (FAA) land parcel. Alternative 1 also requires acquisition of a portion of the Harmon parcel of land. The acquisition of access rights and land parcels would be pursued with the appropriate land owners upon completion of the Record of Decision. The alternatives vary in the quantity of non-Department of Defense (DoD) land to be acquired in the vicinity of NCTS Finegayan and the quantity of NCTS Finegayan proposed for development. Two of the four alternatives (3 and 8) would divide the family housing/community support facilities between properties located in the eastern and western sides of Guam. All four action alternatives meet the purpose and need of the proposed action. Figure 2.1-4 illustrates the differences between the four Cantonment Area action alternatives.

2.1.2 Alternatives Analysis Methodology

This section summarizes the methodology and criteria used to identify potential project alternatives on Guam, to screen out alternatives that would not satisfy the purpose and need for the action, and to develop the range of reasonable action alternatives that are carried forward in the EIS/OEIS impact analyses. The alternatives development process that was used to identify a reasonable set of project alternatives for the proposed action on Guam involved the following four steps:

Step 1. *Identify Requirements*: Identify and evaluate the facility and operational requirements associated with the Marine Corps units moving to Guam within the context of the overall mission of the Marine Corps and DoD in the western Pacific.

Step 2. *Identify Site Alternatives*: Identify specific land parcels, training ranges, and other assets that would feasibly accommodate, with or without modification, each of the functional requirements identified in Step 1. Screening criteria were used to identify both DoD and non-DoD parcels that would feasibly accommodate either aggregated or disaggregated Marine Corps functions. No one contiguous area on Guam was identified that could support all the land use and operational requirements of the action, and the amount of available DoD land was insufficient to satisfy the requirements exclusively. Some project components, such as airfields and waterfront facilities, could be sited in Step 2 independent of other proposed land uses or requirements, as they could be accommodated at existing military facilities designed for those functions. Other project components, such as individual elements of the main cantonment area, required further analysis to evaluate various site plan characteristics that might enable feasible project alternatives within identified development sites.

Step 3. *Identify Site-Specific Planning Alternatives*: Evaluate specific sites or groupings of available sites identified in Step 2 to determine if alternative combinations of functional elements (e.g., individual main cantonment or training functions) could be feasibly planned to satisfy defined criteria and the purpose and need for the action.

Step 4. *Select Alternatives for Analysis*: In situations where multiple alternatives would be feasible for a particular function apply criteria to identify the alternatives that best satisfy the requirements identified in Step 1.

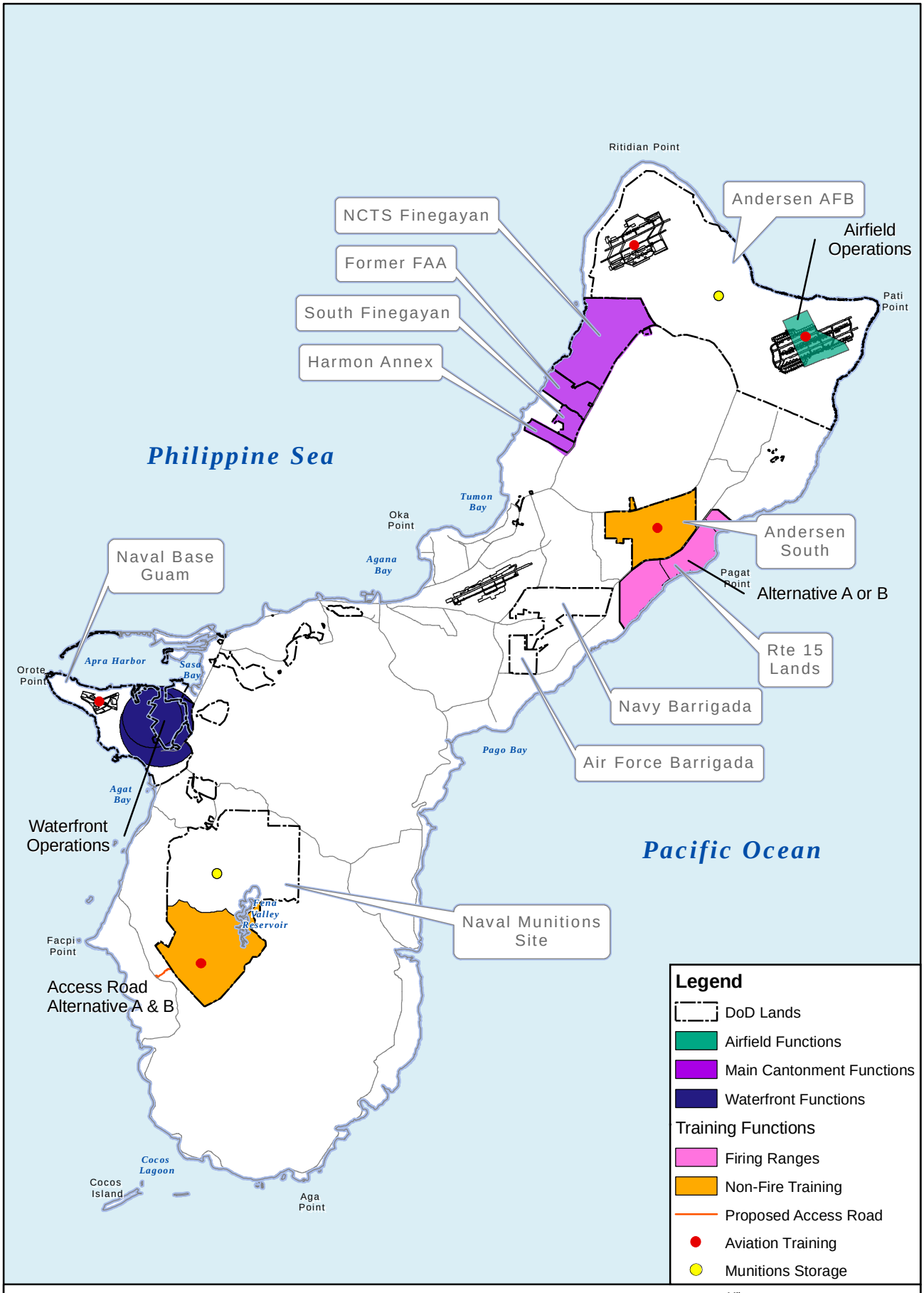


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Figure 2.1-3
Action Alternatives: Similarities

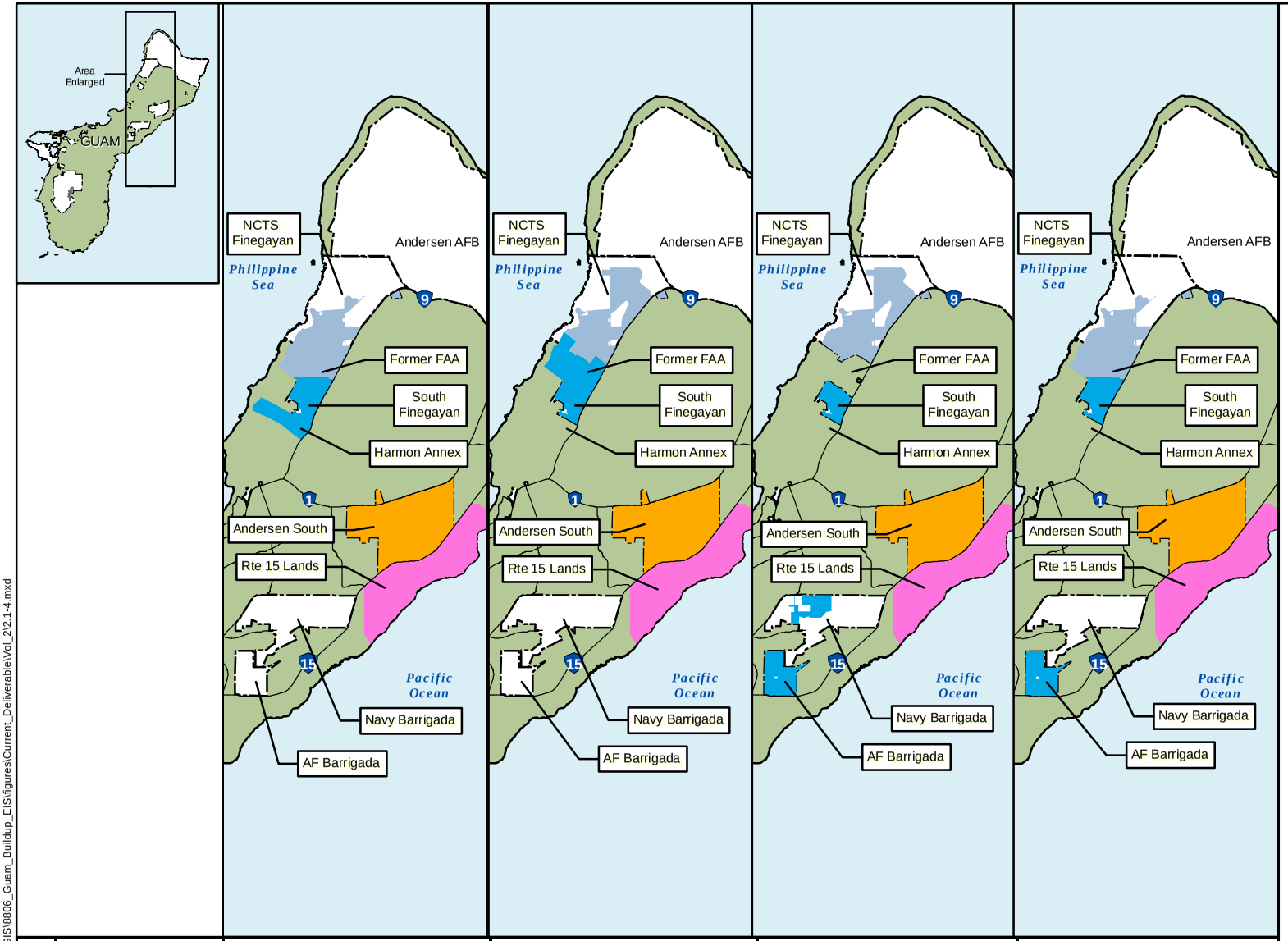

Figure 2.1-4
Comparison of Main Cantonment Area Alternatives

Characteristics	Alternative	1	2	3	8
	Percent of Overlay Refuge lost at NCTS Finegayan	29	53	53	29
	Fomer FAA (acres)	680	680	0	680
	Former Harmon Annex (acres)	326	0	0	0

This four-step process was applied independently for individual projects comprising each of the four functional components of the action: main cantonment, training, airfield, and waterfront. Sections 2.2 through 2.5 describe in detail, for each functional component of the action, the specific infrastructure projects and operations that comprise the proposed action, as well as the project alternatives that were identified. Section 2.6 summarizes the set of all reasonable alternatives for the proposed action, as well as the no-action alternative.

Alternatives associated with utility infrastructure requirements for the proposed action components (e.g., power, wastewater, potable water and solid waste management) are discussed in Volume 6. Utility planning requires technological alternatives analysis as well as siting alternatives analysis. The utilities planning would follow the overall master planning evolution.

2.1.2.1 Step 1 Requirements Analysis

Land use and operational requirements associated with the proposed Marine Corps relocation to Guam were based on intensive, multi-phased planning efforts conducted by the United States (U.S.) Navy and Marine Corps. Ongoing master planning efforts would continue throughout design and construction phases of the action. Details of the identified requirements for each functional component of the action are provided in Sections 2.2.1, 2.3.1, 2.4.1, and 2.5.1, respectively.

2.1.2.2 Step 2 Site Alternatives

In accordance with federal requirements on land usage, including Title 42 U.S. Code (USC) and applicable rules and regulations, the master planning effort identified the Marine Corps' specific facility and space requirements on Guam based upon unit mission, functions, and required capabilities. The total acreage of land required was estimated based on planning assumptions and planning guidance codified in Unified Facility Criteria (UFC) codes. The Guam Joint Military Master Plan (NAVFAC Pacific 2009) lists planning assumptions and criteria for the development plans (e.g., family housing density is based on 4-6 units per acre (ac) and maximum building height is four floors). Some of the assumptions were driven by operational requirements and others by military standards or existing on-island military construction. These assumptions were used for gross assessment of acreage required and are subject to change as the master planning is refined. The available DoD land was compared with the total facility requirements and evaluated against the potential loss of military mission capability. The results indicate that potential loss of mission capability was unacceptable when only DoD land was considered for development. Non-U.S. controlled property was considered in the analysis of the alternatives.

Initially, a key assumption was that most of NCTS Finegayan, excluding existing communications facilities and the Haputo Ecological Reserve, was developable. However, through subsequent informal agency consultations, agency review of a preliminary Description of Proposed Action and Alternatives (DOPAA) (April 2008), and subsequent partnering meetings, the Navy recognized the importance of keeping the Overlay Refuge as intact as possible. The Overlay Refuge was created to support the recovery efforts of four endangered species and is included in the recovery plans for certain species. The Overlay Refuge boundaries encumber 87% of NCTS Finegayan and 98% of Andersen AFB NWF as all operational areas were excluded from the original Overlay Refuge designation. The result of this consideration was a range of alternatives that differ from the DOPAA (April 2008) action alternatives and generally these new alternatives require more land acquisition and/or long term leasing than was initially estimated when assuming the majority of NCTS Finegayan was developable.

The Step 2 site selection process matched land parcels with required land use functions. The candidate parcels were NCTS and South Finegayan, Andersen South, Barrigada (Navy and Air Force), Naval Base

Guam, NMS; and specific non-DoD lands. The candidate DoD lands were selected because they had adequate areas of contiguous open space and had large areas of contiguous developable land.

Before acquiring real property by purchase or lease, a DoD Component shall determine that the requirement cannot be satisfied by: excess, under-utilized, or otherwise, available property held by other Military Departments or Federal Agencies (DoD Instruction 4165.71, Real Property Acquisition, January 2005). This instruction is aimed at maximizing the use of existing DoD land prior to acquiring non-DoD land. During Step 2, it became apparent that not all of the mission critical functions and requirements would fit on DoD land on Guam. Navy direction was to then consider non-DoD land for mission critical functions. Limiting non-DoD land use to mission critical functions did not provide sufficient land use flexibility and was an inefficient method to determine maximum and best land use. Ultimately, the main cantonment facilities were sited on non-DoD land. The preference was to consider for use non-DoD lands that were adjacent to DoD lands, thus maximizing best land use practices and formation of contiguous DoD property, affording both Guam planners and DoD planner's efficiencies in urban planning for community development. In addition, there were lands that were proposed for consideration by special interest groups or private parties (e.g., Leo Palace) or lands that were unique in function such as the Won Pat International airport. These lands are summarized in Table 2.1-2 and Table 2.1-3 and identified on Figure 2.1-5.

All DoD candidate parcels were considered suitable and feasible for at least one land use function. Of the non-DoD parcels, Won Pat International Airport, Guam Land Use Plan (GLUP) of 1977 (GLUP 77), and Leo Palace were eliminated from further consideration. The rationale for eliminating the Won Pat International Airport for airfield operations and Leo Palace for family housing is described below. GLUP 77 identified multiple DoD parcels for release. The Guam Excess Land Act of 1994 (Public Law 103–339; 108 Stat. 3116) addresses the release of these parcels. Throughout this EIS/OEIS the one parcel near NCTS Finegayan is referred to as the GLUP 77 parcel because it is the name that is familiar to most area residents. The elimination of GLUP 77 for any Marine Corps land use was based solely on the anticipated duration of the land acquisition or long term leasing process (10 years) relative to other non-DoD parcels (2 to 3 years). With an anticipated relocation in 2014, GLUP 77 land acquisition or long-term leasing would not meet the project purpose and need.

Table 2.1-2. DoD Parcels Considered

Location	*Current Uses*	*Total ac/hectare [ha] (approximate)*
Naval Base Guam	Industrial waterfront (includes ship repair), headquarters, administrative, bachelor and family housing, community support, ship	6,200/2,509
NMS	Munitions storage, breacher house (shell of building for practicing forced entry)	8,645/3,498
NCTS Finegayan	Communications facilities, housing, small arms range	2,700/1,093
South Finegayan	Family housing	290/117
Barrigada (Navy)	Communications facilities	1,417/573
Andersen AFB (includes NWF)	Airfield operations, headquarters, administrative, housing, community support, munitions storage	15,423/6,241
Barrigada (Air Force)	Weather tower (Next Generation Weather Radar [NEXRAD])	432/175
Andersen South	Urban warfare training	2,060/834

Source: NAVFAC Pacific 2009.

Table 2.1-3. Non-DoD Land Parcels Considered

Parcel Name	*Owner*	*Current Use*	*Total ac/ha (approximate)*
Won Pat International Airport, Former Naval Air Station Airfield located at Tiyan Guam	Government of Guam (GovGuam) Former DoD airfield. Some portions conveyed to private owners	Won Pat International airport, GovGuam offices, private commercial and residential parcels and economic development conveyance properties	undetermined
√ Former FAA housing parcel	Private owners and GovGuam	Mostly undeveloped with the exception of some apparent temporary use	681/276
GLUP 77 (Finegayan)	In process of transfer from federal to GovGuam	Undeveloped	450/182
Leo Palace	Private	Hotel/resort + golf course	1,310/530
√ Route 15 lands, located east of Andersen South	Private owners and GovGuam	Northern plateau mostly undeveloped with exception of Guam Raceway Park facility. Southern valley portion mostly undeveloped with the exception of a stone quarry operation and a few residences	1,100 to 1,800/ 455 to 728
√ Harmon Properties	Private owners and GovGuam	Mostly undeveloped with the exception of some apparent temporary structures and a few abandoned buildings	330 to 1,000/ 134 to 405
√ NMS Access (two alternatives)	Private owners and GovGuam	Alternative A and B location is an existing unimproved trail.	Alternative A: 1.9

Legend: √ = Parcels retained in EIS/OEIS action alternatives.
Source: TEC 2009.

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Figure 2.1-5
Location Map of Guam

Step 3 Site-Specific Planning Alternatives

In Step 2, proposed development sites were identified for waterfront, airfield, and some training functions; there were no reasonable alternative locations for these functions based on consistency and compatibility with existing land uses. Step 2 identified more than one area on Guam that would be suitable for main cantonment and selected training functions, so Step 3 planning analysis was applied to these areas to identify alternative ways to distribute and orient required facilities and functions within the candidate parcels identified in Step 2. Applying this process to cantonment area functions, for example, led to the identification of eight different alternatives representing variations in placement and orientation of the proposed facilities within the candidate parcels. Similarly, this process revealed two reasonable alternatives for positioning the various component ranges of the live-fire Training Range Complex.

2.1.2.3 Step 4 Selection of Alternatives Carried Forward for Analysis

Steps 2 and 3 of the alternatives analysis process were designed to yield project alternatives that are feasible strictly from a planning and project design perspective. In Step 4 of the process, other important factors were considered in order to eliminate alternatives that did not satisfy other defined (non-planning) criteria.

Three criteria were identified as necessary to make an alternative reasonable: (1) environmental, (2) political/public concerns, and (3) mission compatibility. Each alternative was classified as "meets" or "does not meet" for each of the criteria (JGPO Main Cantonment Info Brief Inputs v3 [draft] 2008 [JGPO 2008]):

1. Environmental. Alternative does not meet criteria if there are overwhelming negative environmental impacts, particularly in relationship to essential habitat as determined by informal consultations with environmental regulatory agencies. In this case, the alternative would be modified to reduce these impacts as much as possible.
2. Political/public concerns. Alternative does not meet criteria if there are issues that would cause overwhelming and inescapable lack of public support that would prevent program execution and harmonious relations between DoD and the community, as determined through ongoing discussions with representatives from the GovGuam and/or with Congresswoman Madeline Bordallo and her senior staff and other members of the Guam community.
3. Mission compatibility. Alternative does not meet criteria if it would be significantly detrimental to Marine Corps operations, readiness and mission. This evaluation was based on a Marine Corps evaluation of effects of the alternative on Marine Corps readiness as evaluated by leadership and operational commanders' professional judgment.

This step eliminates the alternatives that do not meet all of these criteria. An alternative does not meet the service criteria if it would be so challenging to the military commands that military mission, readiness and operations would be compromised and would not meet the purpose and need for the project.

2.1.3 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam, though they may continue to train on Guam as is the present practice. No additional training capabilities (beyond what is proposed in the MIRC EIS/OEIS) would be implemented for Guam to support the proposed action. There would be no land acquisition or long term leasing, dredging, new construction or infrastructure upgrades associated with Marine Corps forces stationed on Guam. The no-action alternative would fail to satisfy the purpose and need for the proposed action; however, as required by NEPA, the no-action alternative is carried forward for analysis in this EIS/OEIS.

2.2 PROPOSED ACTION: MAIN CANTONMENT AREA FUNCTIONS

The proposed action includes construction and operation of required facilities that would comprise the Main Cantonment Area for the proposed Marine Corps Base on Guam.

2.2.1 Requirements

Facility requirements for the Main Cantonment Area include a full range of facility types, not unlike a small city: various types of housing, workplaces, recreation areas, education facilities, and health and safety-related functions. The workplace facilities are typical of a military base and include headquarters, maintenance facilities, warehouses, training areas (field and classroom), equipment/vehicle storage, and hazardous materials management and storage areas. Facilities in support of waterfront and aviation operations are not included under the description of the Main Cantonment Area because it is not essential that the associated functions be located in close proximity to or contiguous with each other. Family housing and associated community support facilities may be included in a cantonment area but they can also be located separate from cantonment workplace facilities. A contiguous Main Cantonment provides operational efficiency, minimizes travel and traffic impacts, averts potential future encroachment, reduces operational costs, and decreases other potential impacts that could result from forces and facilities being decentralized throughout the island. When contiguous land is not available for Main Cantonment and family housing/community support facilities, neighborhoods of housing and community support are planned on non-contiguous parcels. Operationally, mission workplace functions need to be co-located with like functions to effectively support the military mission.

Cantonment area facility requirements are grouped into the following categories based on commonality of purpose and function:

Headquarter (HQ) and Administrative Support Functions

- Administrative offices
- Vehicle Maintenance
- Electronic/Communications Support and Maintenance
- Security
- Warehousing
- Armory
- Fuel Storage
- Recycling Center

Base Operations

- Administrative offices
- Military Police functions: brig/confinement, police offices, rehabilitation facilities, military dog kennels
- Fire station and alert force facilities
- Base access: gate house, pass and identification, photographic facilities

- Warehousing
- Legal services, dental services, family services, and Morale, Welfare, and Recreation (MWR) support
- Defense Reutilization and Marketing Office
- Hazardous Materials (HAZMAT) Management and Storage/Corrosion Control

Bachelor's Quarters and Temporary Lodging

- Bachelor enlisted quarters, club, dining, indoor fitness, and swimming pool
- Bachelor officer quarters, Officer's Club
- Temporary Lodging facilities

Family Housing

- Single-family and attached housing facilities of various sizes and types

Educational Facilities

- Child Development/daycare facilities
- Elementary schools
- Middle schools
- High School

Quality of Life (QOL) Functions

- Main Community Center: commissary, exchange, post office, theater, bowling alley, vehicle maintenance, hobby shop, medical clinic, religious ministry facilities
- Applied instruction and auditorium facilities
- Fitness centers, swimming pool, youth centers
- Services: restaurant, location exchange, bank, gas station, gate house

These are the facilities that would be constructed as part of the proposed action. Additional training support facilities, such as tactical trainers, obstacle courses, gas chamber, and indoor pistol range are discussed in Section 2.3. All of the proposed facilities would incorporate varying degrees of energy, locational, and water use efficiencies consistent with legal requirements and official Marine Corps policy. Various tools and design features would be used to achieve Leadership in Energy and Environmental Design (LEED) Silver certification for various development areas of the base and/or for specific buildings.

Table 2.2-1 provides specific details about the proposed facilities of each type listed above. The facility sizing and type was determined by the planned size of the base population, the UFCs, and completion of the Basic Facility Requirements sheets for each building.

Table 2.2-1. Details of Main Cantonment Facility Requirements

Facility Description	*Number of Facilities*	*Number of Personnel*[1]	*Hours of Operation*	*Facility Square Footage*	*Max # Floors*	*Max Building Height (ft)*	*Building Footprint*	*Site acreage*	*Assumed Site Coverage (%)*	*Assumed Site Coverage (ac)*	*Potential Disturbance (ac)*
MEF Command Element, 12th Marine Regiment, and 3d Marine Division HQ: administrative functions	7	1,500	0600-1900	164,915	3	40	103,269	28.0	70	19.6	28.0
III MEF Administration and Operations: administrative, vehicle maintenance, HAZMAT storage, electronic/ communication maintenance, armory, and warehousing functions	10	1,250	0600-1900	300,212	2	45	267,006	43.1	80	34.5	43.1
3d Marine Division Administration and Operations functions: vehicle maintenance, HAZMAT, administrative, armory, warehousing, and Army facilities	18	1,500	0600-1900	291,715	2	45	283,515	90.8	90	81.7	90.8
3d Marine Logistics Group Administration and Operations Areas: vehicle maintenance, HAZMAT, HAZMIN® administrative functions, an armory, an operational trainer, warehousing, and open storage	27	1,750	0600-1900	412,119	3	45	351,336	126.3	80	101.0	126.3
3d Marine Logistics Group and Base Industrial Area: recycling center, fuel storage area, warehousing, maintenance, HAZMAT, Defense Reutilization and Marketing Office, security gate house, and corrosion control	33	1,500	0600-1900	1,045,071	1	45	1,045,071	203.5	85	173.0	203.5
BEQ campus: enlisted quarters, enlisted club, enlisted dining, indoor fitness, and swimming pool facilities	13	3,800	24/7	3,174,711	4	50	909,261	209.5	60	125.7	209.5
Provost Marshall's Office and associated security area; brig/confinement, police, kennel, and rehabilitation center facilities	4	200	24/7	94,712	1	15	94,712	47.2	70	33.0	47.2
Main Gate and Base Operations Area: administrative, pass and ID, and photographic facilities	4	200	0600-1900	47,366	2	25	29,511	26.3	70	18.4	26.3
Bachelor Officer Quarters (BOQ) Campus: BOQ facilities and officer's club	7	1,600	24/7	244,706	4	50	67,852	30.5	60	18.3	30.5
Administrative, legal services, family services, and MWR support facilities	5	650	0600-1900	123,716	3	40	61,874	14.2	70	9.9	14.2
Temporary lodging facilities	1	150	24/7	140,558	3	40	46,853	13.4	60	8.0	13.4

Facility Description	*Number of Facilities*	*Number of Personnel*[1]	*Hours of Operation*	*Facility Square Footage*	*Max # Floors*	*Max Building Height (ft)*	*Building Footprint*	*Site acreage*	*Assumed Site Coverage (%)*	*Assumed Site Coverage (ac)*	*Potential Disturbance (ac)*
Main Community Center: religious facilities, vehicle maintenance, hobby shop, indoor fitness facilities, commissary, exchange, post office, theater, bowling alley, medical clinic, swimming pool, and other QOL facilities	13	1,000	0600-1900	510,921	2	25	485,546	92.4	75	69.3	92.4
Fire station and alert force facilities	2	45	0600-1900	29,031	1	25	29,031	5.3	70	3.7	5.3
Applied instruction and auditorium facilities	2	100	0600-1900	47,737	1	25	47,737	4.9	70	3.4	4.9
(MAW Administration and Operations facilities: administrative, vehicle/communication/electronic maintenance, armory, and warehousing facilities	11	800	0600-1900	294,889	3	45	208,837	48.3	80	38.6	48.3
Administrative areas, warehousing, dental clinic with dental equipment maintenance shop, and gate house facilities	4	100	0600-1900	125,452	2	45	98,981	29.6	70	20.7	29.6
Religious ministry facility, youth center, and swimming pool	3	50	0600-1900	67,121	1	25	67,121	16.6	60	10.0	16.6
Child Development Center	1	15	0700-1900	26,667	1	15	26,667	6.0	40	2.4	6.0
Elementary School	1	150	0700-1600	134,909	1	25	134,909	12.6	40	5.0	12.6
Middle School, High School	2	300	0700-1600	292,486	1	25	292,486	30.3	40	12.1	30.3
Child Development Center	1	15	0700-1900	26,667	1	15	26,667	6.7	40	2.7	6.7
Elementary School	1	150	0700-1600	135,387	1	25	135,387	24.7	40	9.9	24.7
Indoor fitness, swimming pool, and youth center facilities	2	30	0600-1900	55,628	1	25	55,628	16.5	60	9.9	16.5
Child Development Center	1	15	0700-1900	26,667	1	15	26,667	6.8	40	2.7	6.8
Elementary School, Middle School	2	300	0700-1600	247,313	1	25	247,313	30.4	40	12.2	30.4
Restaurant, location exchange, bank, gas station, and gate house facilities	5	30	0600-1900	39,390	1	15	39,390	14.3	70	10.0	14.3

Note: [1]Personnel numbers are estimates that may include on island residents.

2.2.2 Alternatives Analysis: Main Cantonment Area

2.2.2.1 Site Alternatives for Main Cantonment Area Functions

As with Andersen AFB and Naval Base Guam, the main cantonment area would ideally be constructed on contiguous parcels. Family housing would ideally be within the same installation. This facilitates land use efficiency, and organizational integrity. It minimizes traffic exterior to the base; reduces redundancy in infrastructure; increases the opportunities for walkable and energy efficient development; facilitates achievement of LEED and sustainability goals and requirements; and provides for cost savings on construction, maintenance and operation. It is important that the barracks population be able to walk to amenities and work without relying on personal vehicles in order to reduce traffic flows. The site-specific planning analysis described in Section 2.2.2.2 carries this ideal land use model further when addressing the distances between main cantonment, training ranges and family housing.

In Step 2 family housing and main cantonment were considered as separate functional areas because there were non-contiguous parcels that could potentially accommodate one functional use and not both.

Candidate Land Parcels

The following parcels were considered in the alternative site selection process for the main cantonment facilities (not including family housing/community services):

- NCTS and South Finegayan
- Andersen AFB South
- Andersen AFB
- Navy Barrigada
- Air Force Barrigada
- Former FAA parcels
- Harmon Annex
- GLUP 77

Figure 2.2-1 shows the location of each area, and Table 2.2-2 describes specific limitations that apply at each site. Single parcels that cannot accommodate the entire main cantonment requirement were only retained as candidate sites if adjacent parcels were also candidate sites.

Feasibility and Suitability Criteria

A qualitative assessment of the feasibility of using specific land areas for siting of Main Cantonment facilities was based on the following criteria: compatibility with future missions, environmental considerations (including cultural and historical significance), and anticipated public concerns. Suitability criteria included: land availability, proximity to ranges and the aviation complex (described in Section 2.4), operational capability, training capability, encroachment, and anti-terrorism/force protection (AT/FP). The basis of analysis is presented in a brief entitled *Guam Alternatives Basing Analysis, Guam Stakeholders Working Group*, dated August 21, 2007 and prepared by Naval Facilities Engineering Command (NAVFAC) Pacific.

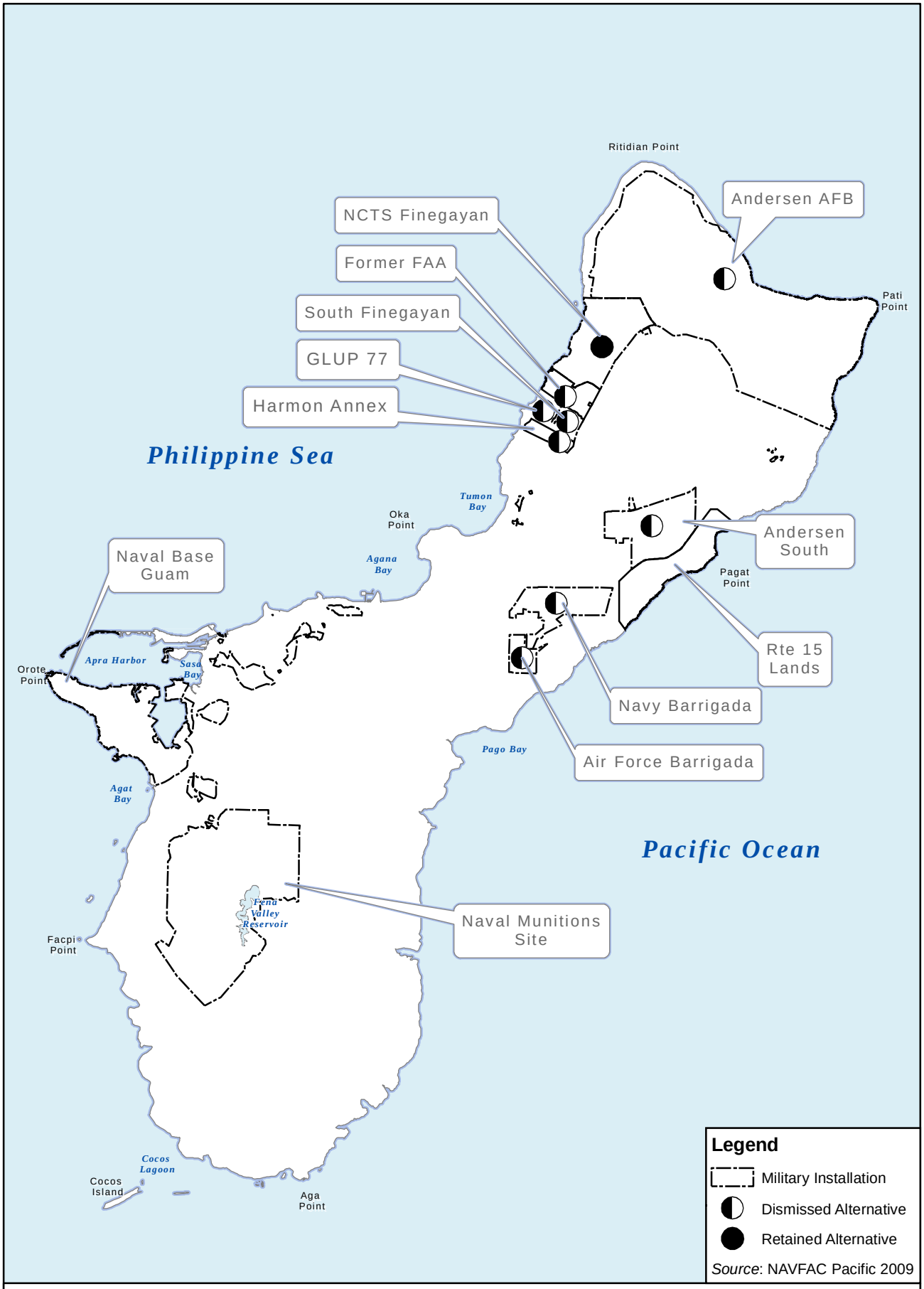

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Figure 2.2-1
Main Cantonment Alternatives Considered

Table 2.2-2. Considered and Dismissed Main Cantonment Sites

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
NCTS Finegayan	Yes	Feasibility criteria • Meets criteria Suitability criteria • Meets criteria
Andersen South	No	Feasibility criteria • Incompatible with future missions • Anticipated public concerns Suitability criteria • Limited potential for expansion
Navy and Air Force Barrigada	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Land availability
South Finegayan	No	Suitability criteria • Land availability
Former FAA (non DoD)	No	Suitability criteria • Land availability
Harmon Annex (non DoD)	No	Suitability criteria • Land availability
Leo Palace* (non-DoD)	No	Suitability criteria • Proximity to ranges and the aviation complex • Encroachment potential • Does not meet operational capability Feasibility criteria • Incompatible with future missions
Guam Land Use Plan (GLUP) 77 (non DoD)	No	Suitability criteria • Land availability

* = Combined family housing with main cantonment
Source: NAVFAC Pacific 2007.

Sites Eliminated from Further Consideration

Based on the suitability criteria listed, the Barrigadas (Navy and Air Force) were eliminated from further consideration primarily because there is insufficient developable land at the parcels and no other parcels were identified adjacent to these DoD parcels. Andersen AFB provides bachelor quarters for the Navy helicopter squadron and was considered as a candidate site for housing the air combat element of the Marine Corps. However, Andersen AFB was eliminated from further consideration due to insufficient unencumbered land. GLUP 77 had insufficient land and the use of Andersen South would conflict with current and future training needs. NCTS Finegayan was the only candidate site (Figure 2.2-1) retained for further consideration.

Site Selection for Family Housing/Community Support Functions

Main cantonment areas often include family housing/community support facilities, but since none of the candidate land parcels is large enough to accommodate the entire facility requirement for family housing/community support and main cantonment, parcels were evaluated for suitability for family housing/community support alone.

Eleven sites (Figure 2.2-2) were evaluated for suitability and feasibility using the criteria described above for family housing and community support functions. The sites and their limitations are listed in Table 2.2-3. There is insufficient unencumbered land for all needed housing on Naval Base Guam and Andersen

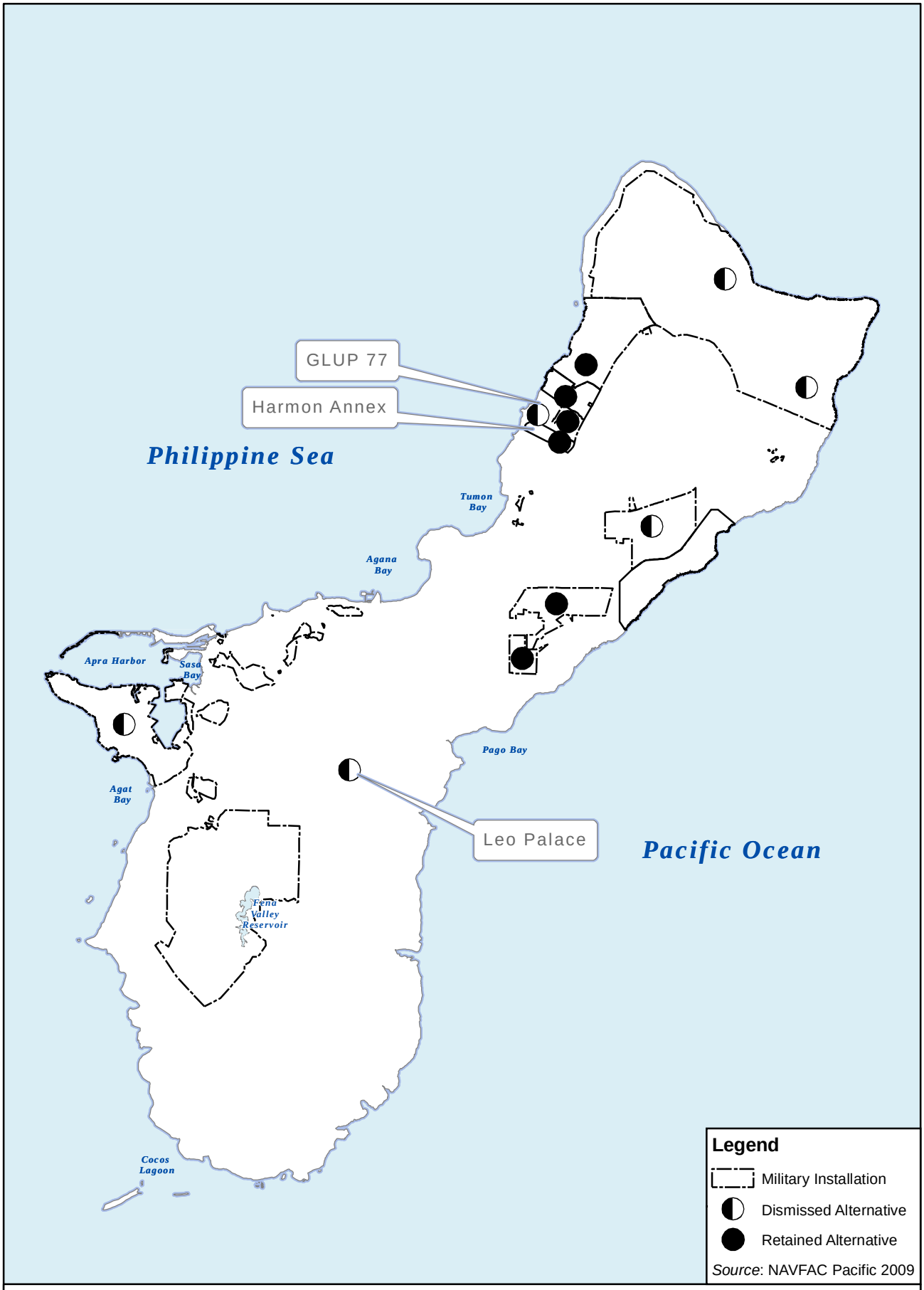

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Figure 2.2-2
Family Housing/Community Support Alternatives Considered

Table 2.2-3. Considered and Dismissed Family Housing/Community Support Sites

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
NCTS Finegayan	Yes	Feasibility criteria • Meets criteria Suitability criteria • Meets criteria
South Finegayan**	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Encroachment potential
Barrigada (Navy) **	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Encroachment potential
Barrigada (Air Force) **	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Encroachment potential
Andersen AFB	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Limited land availability (Insufficient unencumbered land)
Andersen South	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Impacts training capability
Naval Base Guam	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Limited land availability (insufficient unencumbered land) • Proximity to ranges and the aviation complex
Leo Palace* (non-DoD)	No	Feasibility criteria • Incompatible with future mission Suitability criteria • Proximity to ranges and the aviation complex • Encroachment potential
Former FAA (non-DoD)**	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Encroachment potential
Harmon Annex (non-DoD) **	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Encroachment potential

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
GLUP 77 (non-DoD)	No	Feasibility criteria • Anticipated public concerns • Incompatible with future missions Suitability criteria • Limited land availability • Encroachment potential

* = Combined main cantonment with family housing.
** = Existing land area not adequate for full complement of family housing; combined with adjacent parcels.

Source: Guam Alternatives Basing Analysis, Guam Stakeholders Working Group, dated August 21, 2007 and prepared by NAVFAC Pacific 2007.

AFB. The Navy uses five non-contiguous housing areas, but this is not an ideal situation. There is insufficient space at any or all of these housing areas to accommodate the Marine Corps population; therefore, these distinct housing areas, including Apra Heights and Nimitz Hill, were dismissed early in the alternatives analysis. Leo Palace was also examined as a location for military housig. The building requirements, including space allowances, for military housing are standardized and the existing Leo Palace units would not meet military standards and maximize the number of units per acre. Leo Palace was eliminated based on this reason and its incompatibility with future missions.

It is not practical from a land use or operational efficiency perspective to divide up the family housing and community support into multiple non-contiguous parcels. This step of the alternatives analysis focused on identifying property that could accommodate all or most of the housing requirement. Maximum efficiency is achieved with one contiguous parcel so redundancy in retail, recreation and other community support facilities is reduced. If a parcel can support a portion of the requirement, it is paired with other adjacent or nearby parcels to meet the total requirement as indicated in Table 2.3-3.

2.2.2.2 Site-Specific Planning Alternatives for Main Cantonment Area Functions

Based on Step 2 of the alternatives development analysis, there are several parcels that would accommodate some combination of main cantonment and family housing/community support functions. In Step 3 of the process, project planners identified alternative ways of arranging project facility requirements within the candidate parcels. Three planning alternatives were initially developed by project planners and were reviewed by agencies in the Spring 2008 DOPAA. In response to comments received on the document, and subsequent informal consultations held May through September 2008, a new range of feasible alternatives was later developed.

The primary driver for the next stage of selecting or eliminating alternatives was compatibility with surrounding land uses and the importance of the Guam National Wildlife Refuge Overlay Units (Overlay Refuge) as essential habitat for endangered species. The Overlay Refuge encumbers most (2,095 of 3,000 acres [ac] [848 hectares {ha} of 1,214]) of NCTS Finegayan, which was proposed as a prime development area in preliminary planning efforts. Subsequent planning indicated that maintaining the essential habitat intact would decrease the amount of developable DoD land and increase the acres of non-DoD land acquisition or long term leasing. Land being considered for development was further reduced by the elimination of Guam Excess Land Act 1994 parcels, also known as GLUP 77 lands, because this area would not meet the operational criteria based on time.

Eight alternatives resulted from the Step 3 site-specific planning analysis. The alternatives varied in their use of Overlay Refuge lands, the quantity of non-DoD land required, distances between the various land uses, and facility planning factors.

2.2.3 Alternatives Carried Forward for Analysis: Main Cantonment Area

A series of workshops was held between June 2007 and November 2008 to evaluate the 8 interim planning alternatives in Step 4 of the alternatives analysis process (see Section 1.2). Participants included local and federal representatives; master planners, biologists, legal counsel, and real estate personnel, operational experts; and service representatives. The Joint Guam Program Office issued a summary of the results of the session in November that was presented in various formats to DoD leadership for approval. The screening analysis served to narrow down the alternatives from eight to four through analysis of each alternative independent of the others. All of these alternatives included the contiguous location of Marine Corps administrative and operations.

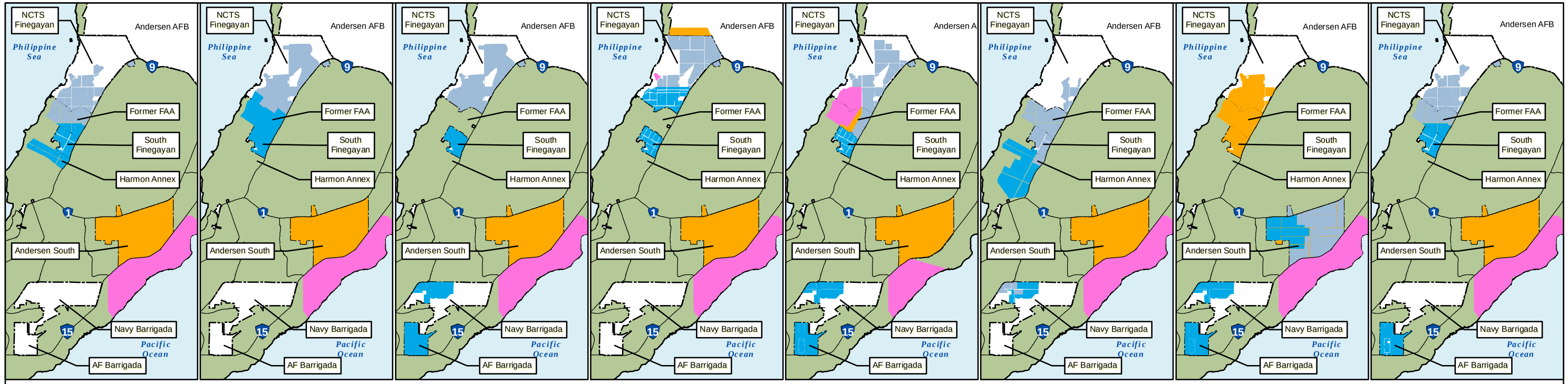
Section 1.2 described the three screening criteria used in Step 4 of the alternatives analysis process to evaluate the viability of site-specific planning alternatives when other factors were considered: (1) environmental, (2) public concerns, and (3) service. Each of the 8 alternatives was classified as "meets" or "does not meet" each of the criteria. If an alternative was classified as "does not meet" in any one of the three criteria, it was eliminated from further consideration in this EIS/OEIS (Environmental Impact Statement/Overseas Environmental Impact Statement). The criteria and a brief explanation of "does not meet" for each of the criteria are described in Section 1.2.

This screening process eliminated the alternatives that did not meet the selection criteria. An alternative does not meet the service criteria if it would be so challenging to the military commands that military mission, readiness and operations would be compromised and would not meet the purpose and need for the project. Maps were compiled from natural and cultural resource agencies and specialists to examine conflicts between siting of facilities and resource locations. This "constraints mapping" provided information to reduce effects to the resources by eliminating or revising alternatives. Figure 2.2-3 presents the eight alternatives side by side with a summary of the Step 4 site-specific planning analysis. Alternatives 4, 5, 6 and 7 were eliminated from further consideration. Alternative 4 did not meet the environmental criteria because it had an overwhelming impact on areas of essential habitat. Alternative 5 did not meet the public or the service criteria because of impacts to recreational and commercial ocean uses and the separation of live-fire and non-firing training does not support the Marine Corps requirements for operational efficiency. Alternative 6 was eliminated because the complexity of land acquisition or long term leasing would likely require more than 10 years, which would not meet the purpose and need. Alternative 7, similar to Alternative 5, did not meet the service criteria but in this alternative it was the separation of the firing range complex from the non-fire training that was the key operational deficiency.

As described in the following subsections, there are four alternatives for development of the Main Cantonment Area that would be carried forward for analysis in this EIS/OEIS.

2.2.3.1 Main Cantonment Alternative 1

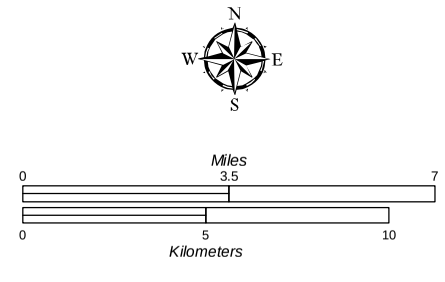
Implementation of Alternative 1 would require a total of 2,386 ac (966 ha) for the Main Cantonment and family housing areas. The Main Cantonment would include portions of NCTS Finegayan (1,090 ac [441 ha]), portions of South Finegayan (290 ac [117 ha]), the Former FAA parcel (680 ac [275 ha]), and a portion of the Harmon lands (326 ac [132 ha]) (Table 2.2-4). A total of 1,006 ac (407 ha) of privately held lands would be acquired under Alternative 1. Of the total acreage for this alternative, 599 ac (242 ha), or



Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 | Alternative 6 | Alternative 7 | Alternative 8

	Alternative	1	2	3	4	5	6	7	8
Characteristics	**Overlay Refuge Loss (percent)**	29	53	53	75	53	0	26	29
	Former FAA (acres)	680	680	0	0	680	680	680	680
	Former Harmon Annex	326	0	0	0	0	1014	0	0
	Firing Range Complex	RTE 15 A or B	RTE 15 A or B	RTE 15 A or B	RTE 15 A or B	West & East coast	RTE 15 A or B	RTE 15 B	RTE 15 A or B
	Non-firing range	Andersen S.	Andersen S.	Andersen S., NMS	Andersen S., Andersen AFB	Andersen S., FAA	Andersen S.	NCTS Fin., FAA, S. Fin.	Andersen S.
	Family Housing/Community Support	S. Fin., FAA, Harmon	FAA, S. Fin	S. Fin., Barrigada (Navy & AF)	S. Fin., NCTS Fin.	S. Fin., Barrigada (Navy & AF)	Harmon, Navy Barrigada	Barrigada (Navy & AF)	FAA, S. Fin, Barrigada (AF)
	Main Cantonment	NCTS Fin. & FAA	NCTS Fin.	NCTS Fin.	NCTS Fin.	NCTS Fin. & FAA	FAA, S. Fin. (Army AMD @ Barrigada -Navy)	Andersen S.	NCTS Fin. & FAA

shaded cells = alternatives not carried forward through EIS analysis.
S. = south
Fin. = Finegayan
NMS = Naval Munitions Site



Source: NAVFAC Pacific 2009

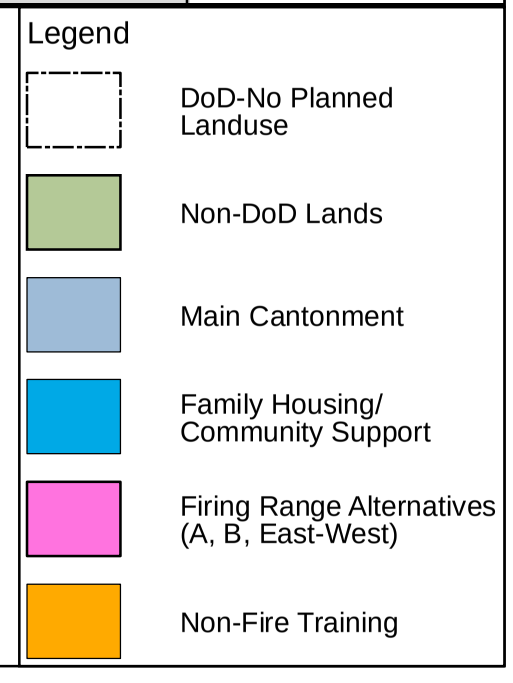


Figure 2.2-3

Main Cantonment Area Alternatives Analysis

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approximately 25% of the Main Cantonment would be developed in the Overlay Refuge, that is managed pursuant to a Memorandum of Agreement (MOA) with the United States Fish and Wildlife Service (USFWS) (DoD 1994). The term "Overlay Refuge" refers to specific areas of DoD properties on Guam that were established through a cooperative program with GDAWR . The Overlay Refuge is centered on the protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity.

Table 2.2-4. Summary of Parcels for Each Main Cantonment Alternative

Alternative	*Total Land (ac/ha)*	*DoD Lands*				*Private Lands*		*Overlay Refuge[1] (ac/ha)*
		NCTS Finegayan[1,2] (ac/ha)	*South Finegayan[3] (ac/ha)*	*Navy Barrigada[2] (ac/ha)*	*Air Force Barrigada[4] (ac/ha)*	*Former FAA[5] (ac/ha)*	*Harmon Land[6] (ac/ha)*	
1	2,386/966	1,090/441	290/117			680/275	326/132	599/242
2	2,580/1,044	1,610/652	290/117			680/275		1,106/448
3	2,707/1,096	1,610/652	290/117	377/153	430/174			1,106/448
8	2,490/1,008	1,090/441	290/117		430/174	680/275		599/242

Notes:
[1]Based on calculations for vegetation cover in chapter 10. [2] Proposed developed area only. [3] Assumes entire parcel is developed.
[4] Excludes NEXRAD. [5] Total acquisition area, including planned open space. [6] Total acquisition area.

The Main Cantonment area would be configured such that all facilities would be on one contiguous parcel of land, including the family housing areas under Alternative 1 (Figure 2.2-4). This alternative is bounded on the north by Andersen AFB NWF, and by Route 3; on the west by a cliff line (within DoD property) and the Philippine Sea. To the east the site is bounded by limited residential development and to the south by the Harmon Village residential area (non-DoD property). Although DoD property goes down to the waterline, the Main Cantonment area would be situated on the upper area of NCTS Finegayan and would not encroach on the cliff line leading to the ocean.

NCTS Finegayan is an operating communications station of 2,415 total ac (978 ha), of that, 857 ac (752 ha) are estimated to be usable for establishment of a new Main Cantonment area. The remaining 558 ac (226 ha) of the Finegayan site are dedicated to current and future communications activities. Just south of this site is the former FAA parcel that is owned by private individuals and GovGuam; and the South Finegayan Housing Area that is a Navy housing area of 290 ac (117 ha). There are approximately 60 Navy families now living in the housing units. It is possible the Marine Corps family housing could be developed around these existing units and the Navy housing units would not be relocated. The EIS/OEIS conservatively assumes the entire site would be redeveloped with family housing and community support facilities. The Navy housing could be included in the South Finegayan redevelopment. There is no Navy housing relocation project at this time. Bordering Finegayan to the north is Andersen AFB NWF, that has approximately 750 ac (304 ha) of contiguous land.

The NCTS Finegayan site is considered the most suitable site for development of the Main Cantonment area.

2.2.3.2 Main Cantonment Alternative 2

Alternative 2 would require a total of 2,580 ac (1,044 ha) for the Main Cantonment and family housing areas. The Main Cantonment would include portions of NCTS Finegayan (1,610 ac [652 ha]), portions of South Finegayan (290 ac [117 ha]), and the Former FAA parcel (680 ac [275 ha]) (Figure 2.2-5 and refer to Table 2.2-4). A total of 680 ac (275 ha) of privately held lands would be acquired under Alternative 2.

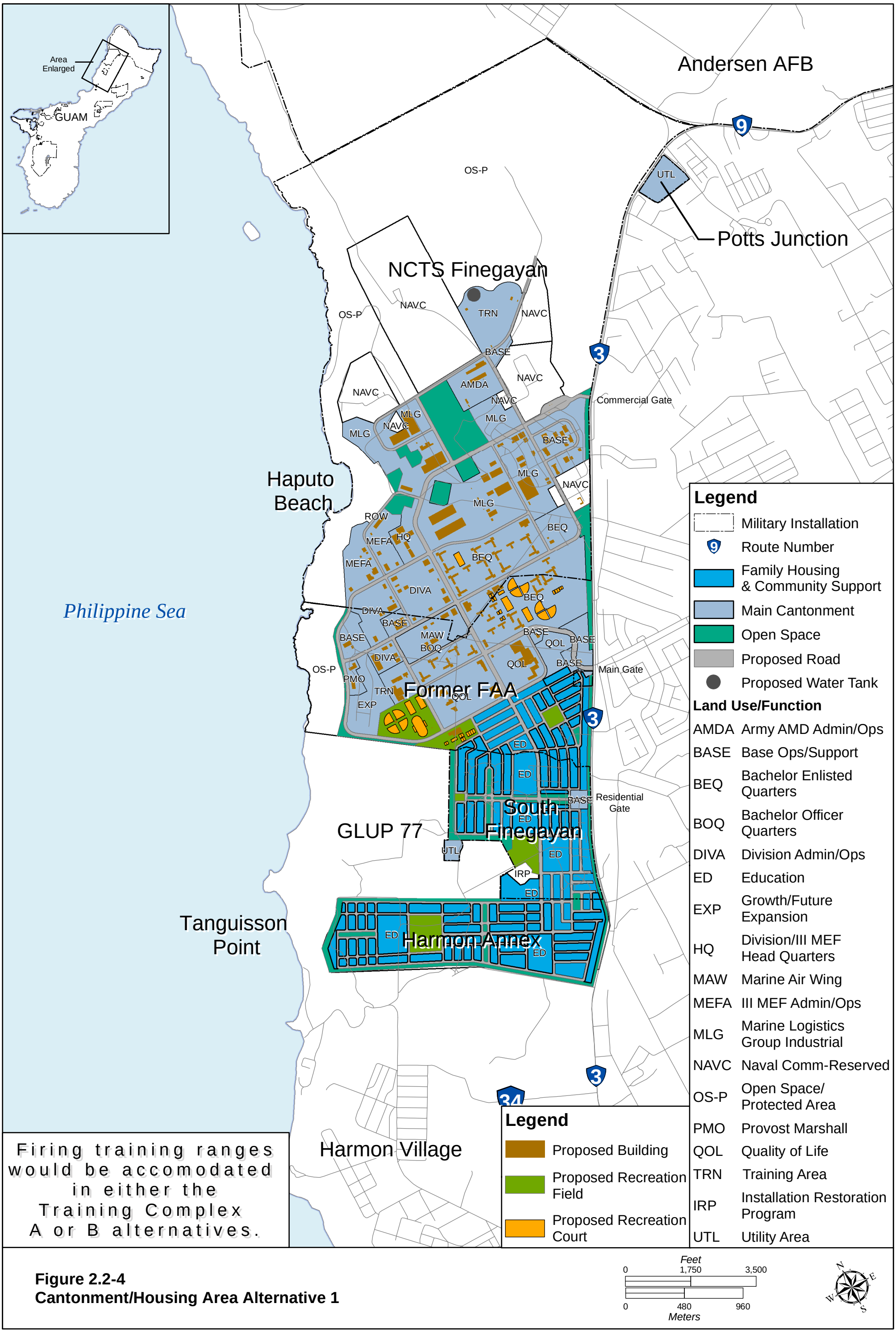

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Figure 2.2-4
Cantonment/Housing Area Alternative 1

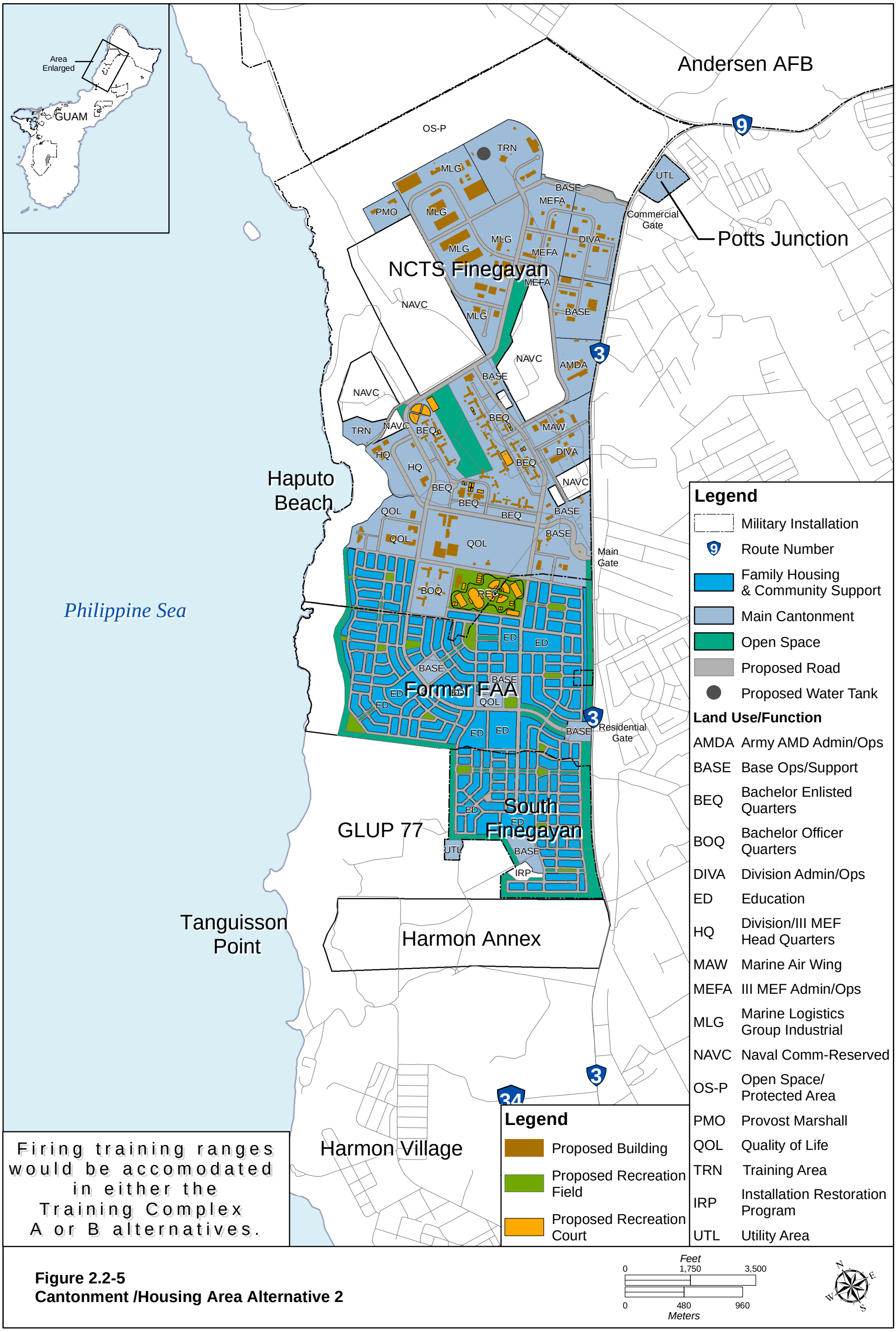

Figure 2.2-5
Cantonment /Housing Area Alternative 2

Of the total acreage for this alternative, 1,106 ac (448 ha), or approximately 41% of the Main Cantonment would be developed in the Overlay Refuge. Under Alternative 2, the Main Cantonment area would also be configured such that all facilities would be on one contiguous parcel of land, including the family housing area.

The site of Alternative 2 is also bounded on the north by Andersen AFB NWF, and by Route 3; on the west by a cliff line (within DoD property) and the Philippine Sea. To the east the site is bounded by limited residential development and to the south by the Harmon Village residential area (non-DoD property).

2.2.3.3 Main Cantonment Alternative 3

Alternative 3 would require a total of 2,707 ac (1,096 ha) for the Main Cantonment and family housing areas. The Main Cantonment would include portions of NCTS Finegayan (1,090 ac [441 ha]), and housing would be located on three geographically separated DoD parcels, including South Finegayan (290 ac [117 ha]), Air Force Barrigada (430 ac [174 ha]), and Navy Barrigada 377 ac [153 ha]) (Figure 2.2-6 and refer to Table 2.2-4). No privately held lands would be acquired under Alternative 3. Of the total acreage for this alternative, 1,106 ac (448 ha), or approximately 41% of the Main Cantonment would be developed in the Overlay Refuge. Under this alternative, the Main Cantonment area would be configured such that the housing would be located non-contiguous to the Main Cantonment.

This configuration of the Main Cantonment area is bounded on the north by Andersen AFB, on the west by a cliff line and the Philippine Sea, by Route 3 and limited residential development to the east, and by the former FAA area to the south. South Finegayan would be used for housing; it is located south of the former FAA area. Navy and Air Force Barrigada are located approximately 9 miles (mi) (14 kilometers [km]) from the proposed Main Cantonment, on the eastern side of Guam. Navy and Air Force Barrigada have Route 15 bordering the site to the east, and Routes 10 and 16 bordering the site to the west. Navy Barrigada is largely used to support DoD communication high frequency transmitting activities. Headquarter facilities for the Guam Army National Guard is located adjacent to Navy land at Barrigada. Navy Barrigada is 1,418 ac (574 ha), of that 250 ac (101 ha) are available for development. The Air Force Barrigada property is a 433-ac (175-ha) parcel that is used by the Air Force to accommodate the NEXRAD weather satellite receiver. It has been estimated that 400 ac (162 ha) of this parcel is available for development. Navy Barrigada and Air Force Barrigada are currently connected by the existing Navy Golf Course. The golf course may need to be removed if it was determined that the two parcels should be connected.

2.2.3.4 Main Cantonment Alternative 8

Alternative 8 would require a total of 2,490 ac (1,008 ha) for the Main Cantonment and family housing areas. Alternative 8 would include portions of NCTS Finegayan (1,090 ac [441 ha]), a portion of South Finegayan (290 ac [117 ha]), the former FAA parcel (680 ac [275 ha]), and a portion of the housing would be located on the geographically separated Air Force Barrigada parcel (430 ac [174 ha]) (Figure 2.2-7 and refer to Table 2.2-4). A total of 680 ac (275 ha) of privately held lands would be acquired under Alternative 8. Of the total acreage for this alternative, 599 ac (242 ha), or approximately 24% of the Main Cantonment would be developed in the Overlay Refuge. In Alternative 8, as with Alternative 3, the Main Cantonment area would be configured such that a portion of the housing would be located non-contiguous to the Main Cantonment.

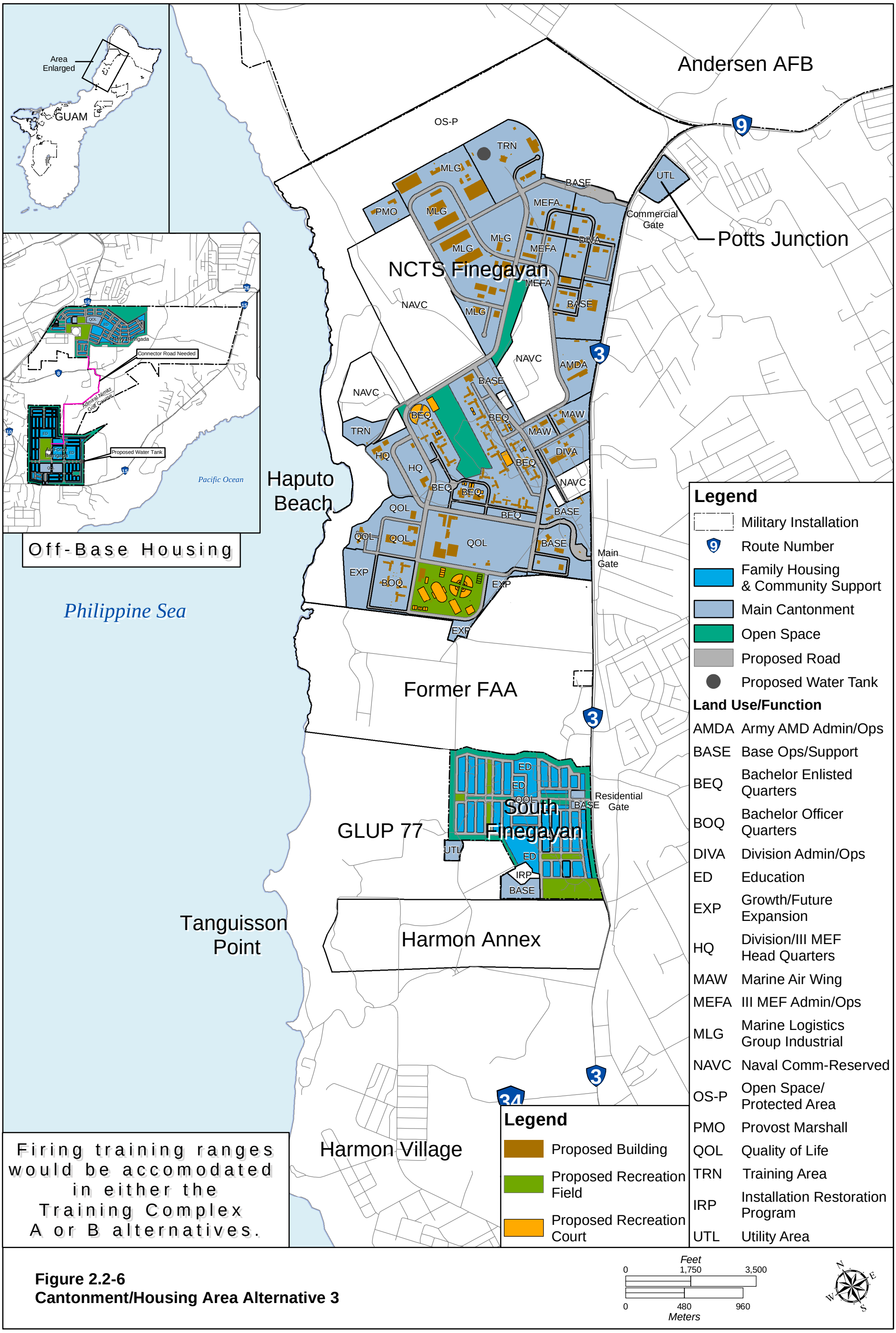

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Figure 2.2-6
Cantonment/Housing Area Alternative 3

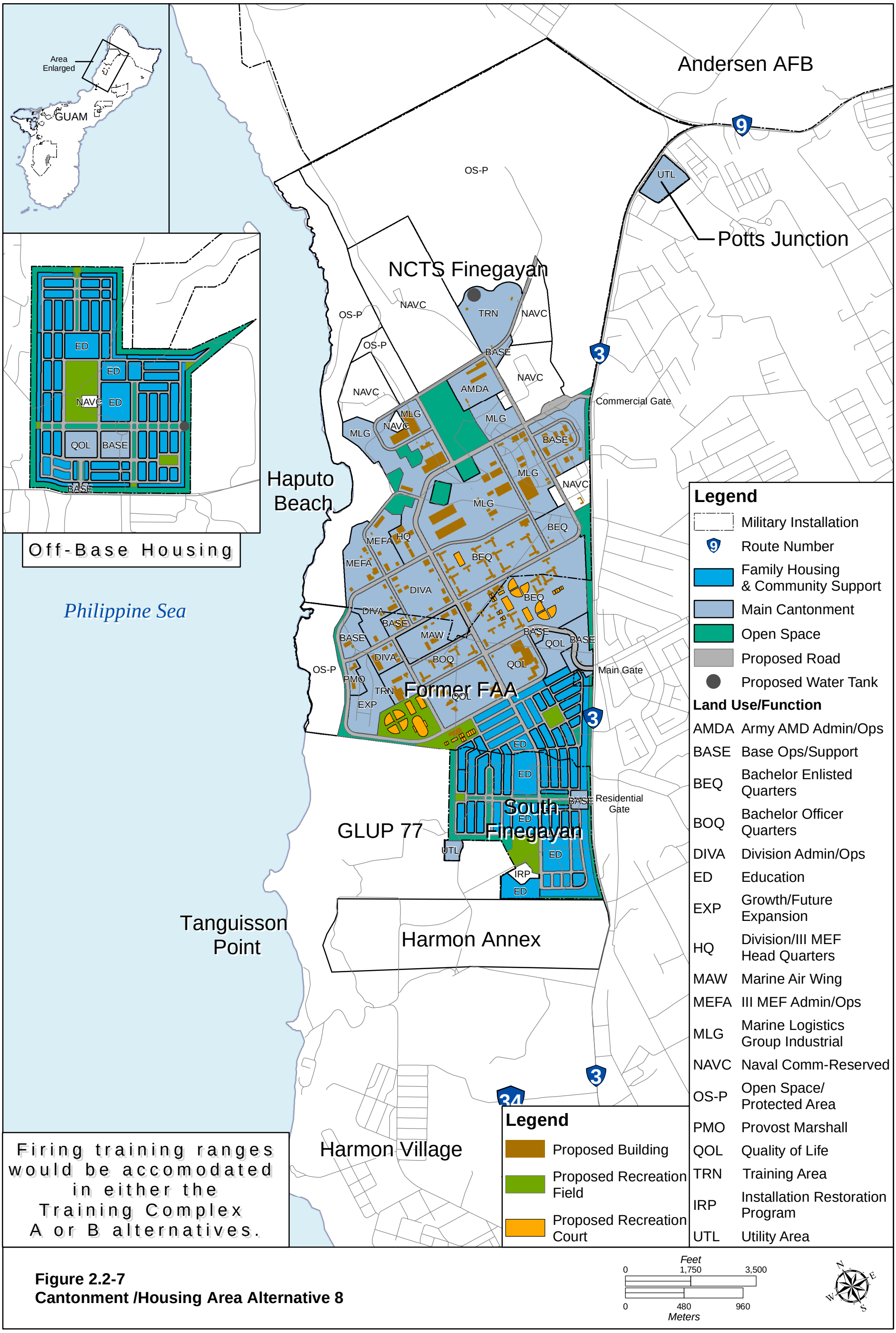

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Figure 2.2-7
Cantonment /Housing Area Alternative 8

2.3 PROPOSED ACTION: TRAINING FUNCTIONS

2.3.1 Requirements

Training requirements associated with relocating Marines from Okinawa to Guam were derived from the statement of operational requirements prepared by the Commander, U.S. Pacific Command as required by the Agreed Implementation Plan (AIP). This guidance was further developed in an operational concept for MAGTF operations and training by the Commander, Marine Forces Pacific. Together, these documents outline a concept for force movement, command and staff interaction, operations and training up to the MAGTF level.

The essence of this concept is to accomplish frequent, individual and small unit training close to home, and move farther away as needed for larger, more complex but less frequent training. The overarching goals are:

- Individual and military occupational skill (MOS) training on Guam.
- Small unit training up to company level on Guam.
- Re-qualification and sustainment training on Guam with individual weapons, machine guns and other infantry crew-served weapons.
- Enhanced battle staff planning and coordination among disparate III MEF command headquarters
- Optimized use of simulation and training devices.
- All infantry weapons and ground supporting arms training on existing DoD land assets in the Marianas including maneuver to the extent allowed by space and terrain.
- MAGTF multi-dimensional fire and maneuver.
- Aviation operations throughout the Marianas.

Table 2.3-1 lists the elements of the proposed action associated with Marine Corps training requirements on Guam (see Volume 1 Figure ES-2a for a graphical depiction of training locations).

The individual training facilities and projects have been organized into the following six training types or categories, and are discussed further in the corresponding subsections that follow the table:

- Ammunition Storage
- Command, Control, and Simulation
- Non-Firing General Military Skills Training
- Firing General Military Skills Training
- Aviation Training
- Airspace

Table 2.3-1. Proposed Training Projects on Guam

Type of Training	*Facility/Project Title*	*Location*
Ammunition Storage	11 new munitions storage magazines	NMS
	12 new munitions storage magazines and support facilities	Andersen AFB Munitions Storage Area (MSA) 1
Command, Control and Simulation	Battle Staff Training Facility (BSTF)	Main Cantonment, near MEF HQ
	Combined Arms Staff Trainer (CAST) and MAGTF Integrated Systems Training Center	Main Cantonment, near GCE
	Audio-visual and Simulation Training Support Facility	Main Cantonment, near billeting and administrative areas
Non-Firing: General Military Skills	Obstacle Courses	Main Cantonment
	Confidence Course	Main Cantonment
	Hand-to-Hand Combat Pit	Main Cantonment
	Rappelling Tower	Main Cantonment
	Gas Chamber	Main Cantonment
	Combat Training Tank	Main Cantonment
	General Purpose Auditorium	Main Cantonment
	Maneuver Training Areas	Andersen South and NMS
	Military Operations in Urban Terrain Complexes	Andersen South
	Advanced Motor Vehicle Operators Course	Andersen South
	Engineer Equipment and Decontamination Training Facility	Main Cantonment
Firing: General Military Skills	Training Range Complex – a combination of: • Range Control and Range Maintenance Buildings • Known Distance (KD) Range • Pistol Range • Square-Bay Range • Unknown Distance (UD) Range • Machine Gun Range • Hand Grenade Range • Grenade House	Alternative A: East Coast (with relocation of Route 15) or Alternative B: East Coast (with no relocation of Route 15)
	Demolition Range	Andersen AFB NWF
	Breacher and Shooting House	Andersen South
	Indoor Small Arms Range	Main Cantonment
Aviation Training	Marine Air Control Group (MACG) Training	North Ramp Andersen AFB, NWF
	Improved Airfield	North Ramp Andersen AFB, NWF
	Any Designated Airspace	Over Guam and surrounding waters
	Military Flight Corridors, Routes, or Navigation Area	Over Guam and surrounding waters
	Landing Zones	NWF, Orote Airfield, Andersen South, and NMS
Airspace	New SUA	Andersen South and off east coast Guam

A Training Concept Plan was prepared for Marine Forces Pacific in 2008 and it is the basis for project descriptions. Subsequent to completion of that report, land use alternatives continued to evolve and proposed siting of these facilities may have changed. Although projects are listed individually in Table 2.3-1, there is likely to be a bundling of projects and/or reassignment of project numbers during the funding/construction process. The projects are presented in order of the subsections that follow.

The description of each project is organized to provide information on the proposed facilities and operations (including relevant information regarding existing facilities and operations). The identification of alternative locations for each project is discussed in Section 2.3.2.

2.3.1.1 Ammunition Storage

The Marine Corps requires munitions storage to support wartime and training missions. Naval Munitions Command Detachment Guam (NMC DET) serves as the munitions logistics hub for all military services and conducts most of the munitions transport on Guam. Under the proposed action, NMC DET would continue in its existing capacity and support the munitions logistics associated with the Marine Corps move from Okinawa to Guam. Under the existing protocol, NMC DET serves all branches of the Armed Services by responding to a munitions request for a particular mission or handling arriving shipments. NMC DET receives or stages munitions for ship replenishment on Kilo Wharf. The airfield at Andersen AFB is another point of munitions receipt or shipment. The munitions are transported by truck on public roads to either the NMS or Andersen AFB Munitions Storage Area (MSA). At the MSA, the munitions are stored in facilities that reduce the explosive risk hazard, such as earth-covered magazines (ECMs).

Under the proposed action, Marine Corps munitions would arrive at Kilo Wharf and be transported to NMS by NMC DET. Long-term storage and storage for training not occurring on Guam would be at NMS. As needed, munitions would be trucked to Andersen AFB MSAs to support operations in the northern part of the island. The Andersen AFB MSA would support the Marine Corps ACE and the ground training that would occur in the northern part of Guam.

The *Military Munitions Annex to the Joint Guam Master Plan* was prepared for DoD Explosive Safety Board (DDESB) by NAVFAC Pacific (2009) to assess the Marine Corps munitions operations requirements, and recommends improvements and projects to meet those requirements. The proposed action elements related to munitions storage are based on this planning document.

Proposed Facilities

Under the proposed action, the following facilities would be constructed at the existing NMS:

Eleven ECMs are proposed at NMS to support the need for additional munitions movement and storage requirements on Guam. The ECMs would be constructed based on a standard design that provides required structural components, humidity control, and fire and lightning protection systems.

Under the proposed action, the following facilities would be constructed at the existing Andersen AFB MSA:

These facilities would consist of:

- Two concrete pads: both 150 by 150 ft (46 by 46 m) with a 50 by 100 ft (15 by 30 m) overhang. One of these would be an operational pad and the other would be a "stuff and unstuff" pad for ordnance buildup.
- Two–story reinforced concrete structure to provide approximately 4,000 ft^2 (372 m^2) of administrative space, plus 15,000 ft^2 (1,394 m^2) of inert warehouse space and maintenance areas.

Proposed Operations

The NMS currently has 132 magazines capable of storing munitions ranging from Class/Division 1.1 to 1.4. Most of the existing magazines at NMS are ECMs that were constructed during the 1950s and 1960s, and are generally in substandard condition according to Navy planning standards. At Andersen AFB,

munitions storage operations fall under the mission of the Air Force 36th Munitions Squadron and are located at an area northwest of the Andersen AFB main airfield and southeast of NWF. Under the proposed action, approximately 10 logistics support personnel would provide site management, roving security, munitions management, munitions technical support, and access control for the proposed Marine Corps munitions storage facilities.

2.3.1.2 Command, Control, and Simulation

Proposed Facilities

Under the proposed action, three Command, Control, and Simulation facilities would be constructed on Guam:

- BSTF complex, that includes:
  - 3-story, 80,000 ft^2 (7,432 m^2) facility with rooftop deck
  - Parking lot support approximately 200 vehicles
  - 640-person capacity auditorium
  - Sensitive Compartmental Information Facility capability
  - Defense Information Systems and Global Command and Control Systems services
  - Uninterruptible power sources, including stand-alone and back-up generator
- CAST and MAGTF Integrated Systems Training Center (MISTC). Construction would include:
  - A single 21,900 ft^2 (2,035 m^2) structure, with 5,000 ft^2 (465 m^2 for the basic CAST)
  - 4,500 ft^2 (418 m^2) for upgrades/add-ons to the CAST
  - 2,400 ft^2 (223 m^2) of classroom and instructor space; and 10,000 ft^2 (929 m^2) for storage
- Audio-Visual and Simulation Training Support Facility, that would include a 46,580 ft^2 (4,327 m^2) facility, with space for storage, operational trainers, and classrooms

Proposed Operations

The BSTF is a dual purpose facility used by the III MEF Command Element for exercises and as a Combat Operations Center for carrying out the command functions during operational contingencies. The proposed BSTF would be suitable for 400 exercise personnel and 100 controllers and exercise support personnel.

The CAST is a simulation device for training Marines at various levels in the use of combined arms. The facility would be operated by a staff of approximately 9 persons. The Audio-Visual and Simulation Training Support Facility would have classroom space for a company (200 persons) and office space for approximately 17 training and training systems support personnel.

2.3.1.3 Non-Firing General Military Skills Training Facilities

The general classes of non-firing general military skills training relevant to all Marines for survival on the battlefield include the following:

- Physical Fitness
- Individual Combat Skills
- Crew, Unit, and MOS Combat Skills
- Driving and Equipment Operations

Proposed Facilities and Operations

Brief project descriptions for each type of proposed facility and training activity are provided below. Issues related to the proposed siting of these facilities and any project alternatives are described in Section 2.3.2. For more information on all the training elements needed and proposed for Guam, see Appendix K.

Obstacle and Confidence Courses

Two proposed obstacle courses and one confidence course would be constructed in the same location. Components of these courses are standard throughout the Marine Corps. Each obstacle course would include a two-lane outdoor complex of wooden obstacles for Marines to hop, climb, crawl, and pull over. The confidence course would include additional obstacles and challenges added within the same footprint as the obstacle courses Figure 2.3-1 depicts a typical Marine Corps training obstacle course. The three courses would be located together on a 2-ac (.8-ha) site.

The courses would be used daily and accommodate approximately 25 to 60 personnel at a given time.

Hand-to-Hand Combat Pit

A hand-to-hand combat pit is needed for training in hand-to-hand combat techniques. Under the proposed action, a sand-filled area with padded retaining wall would be constructed to provide a safe area for training Marines in hand-to-hand combat techniques.

Rappelling Tower

Under the proposed action, a 60-ft (18-m) tower of four floors, approximately 26 ft (8 m) on a side with a rappelling wall, overhang, and climbing wall would be constructed. Figure 2.3-2 provides a photograph of a sample Marine Corps rappelling tower.

Gas Chamber

Under the proposed action, a 4,000 ft^2 (372 m^2) single building would be constructed, consisting of a 600-ft^2 (56-m^2) gas chamber, 1,500 ft^2 (139 m^2) of classroom and associated office space, a mechanical room for ventilation/filtration, and storage of training devices.

During training events in this type of facility, participants are exposed to a non-lethal "tear gas" that is typically used as a riot control agent. The training is designed to teach individual confidence in the application of a field protective mask in the presence of gas.

Combat Training Tank

Under the proposed action, one 13,000- ft^2 (1,208-m^2) swimming pool would be constructed to meet the training requirement for water survival and amphibious vehicle egress.

General Purpose Auditorium

Under the proposed action, an approximately 72,000-ft^2 (6,690-m^2) auditorium would be constructed to provide capacity to simultaneously brief 6,000 military personnel.

Maneuver Training Areas and MOUT

Maneuver training areas are used for training Marines in the variety of skills specified in the Infantry Training and Requirements Manual (NAVMC DIR 3500.87), as defined in the Required Capabilities Document. In general, for company-level (200 Marines) training, a 12 square mi (3,108 ha) maneuver space is optimal. This type of space is not available on Guam, but maneuver training can be conducted in smaller areas. The size requirement depends on the size of the Marine units and the size and complexity

Figure 2.3-1. Typical Marine Corps Obstacle Course

Figure 2.3-2. Example of Marine Corps Rappelling Tower

of a training event. Proximity is an important characteristic for efficient-to-use training areas, as cost and difficulty of transportation directly diminish the amount of training that can be accomplished within a given budget.

Based on the loading of Marines per the requirements of the AIP, an estimated 8,600 Marines transferred from Okinawa to Guam would require company-level maneuver training on Guam biannually. There is a shortage of open space for company-level maneuver training on Guam, and a hierarchy of maneuver training spaces in multiple areas would be needed to meet the unit training objective for Guam. Small areas within Main Cantonment would provide maneuver area training to include crew, fire team, and squad training such as gun drills, formations, and camouflage. It would primarily consist of foot maneuvers and would not include live-fire training, but would include firing of blanks in weapons and use of smoke (i.e., pyrotechnics) for marking. The use of smoke and flares would be limited seasonally. Air-ground operations would include Helicopter Support Team training for ground units. Personnel train in rappelling from the helicopter on ropes (sometimes called fast roping) and procedures that would be used in inserting and extracting troops via helicopter at combat locations. The maneuver area aviation training operations would be a component of training to meet the aviation training requirements further described in Section 2.3.1.5.

Proposed development at the two maneuver sites would be minimal. In addition to the required open space, there is also a requirement for a division-sized LZ and roads to support maneuver training. The two proposed large-scale maneuver training areas on Guam, located at Andersen South and NMS are depicted in Figure 2.3-3.

In these two maneuver training areas, operations would be as follows:

- *NMS:* Company-level patrolling, jungle training, land navigation, and air-ground operations to occur on 5-7 consecutive days, 12 weeks per year, day and night. Access to the NMS site would potentially occur via helicopter transport operations. Although improvements to an access road would be needed (and is further discussed below), no roads would be established within this training site When the existing Explosive Ordnance Disposal (EOD) demolition range at NMS is operational, an Explosive Safety Quantity Distance (ESQD) arc is generated at the proposed site for maneuver training. LZ NMS4 (Figure 2.3-4) would support maneuver training operations at NMS. This area would also be used for aviation training and include additional LZs. As shown in Figure 2.3-4, the maneuver area would require an access road.
- *Andersen South:* Convoy operations, Military Operations in Urban Terrain (MOUT)-related maneuver training, and general maneuver and air-ground operations to vary from small unit to company-level exercises to occur 5 days a week, 45 weeks per year, day and night. This area of Andersen South is currently used by the Air Force for expeditionary airfield training that has similarities to the proposed maneuver area training. The area would be scheduled to continue to support this Air Force training, while also accommodating the Marine Corps training requirements.

  An approximately 2,000 ac (809 ha) area at Andersen South near the proposed MOUT complex has been identified for maneuver training to include the convoy course (see Figure 2.3-3).

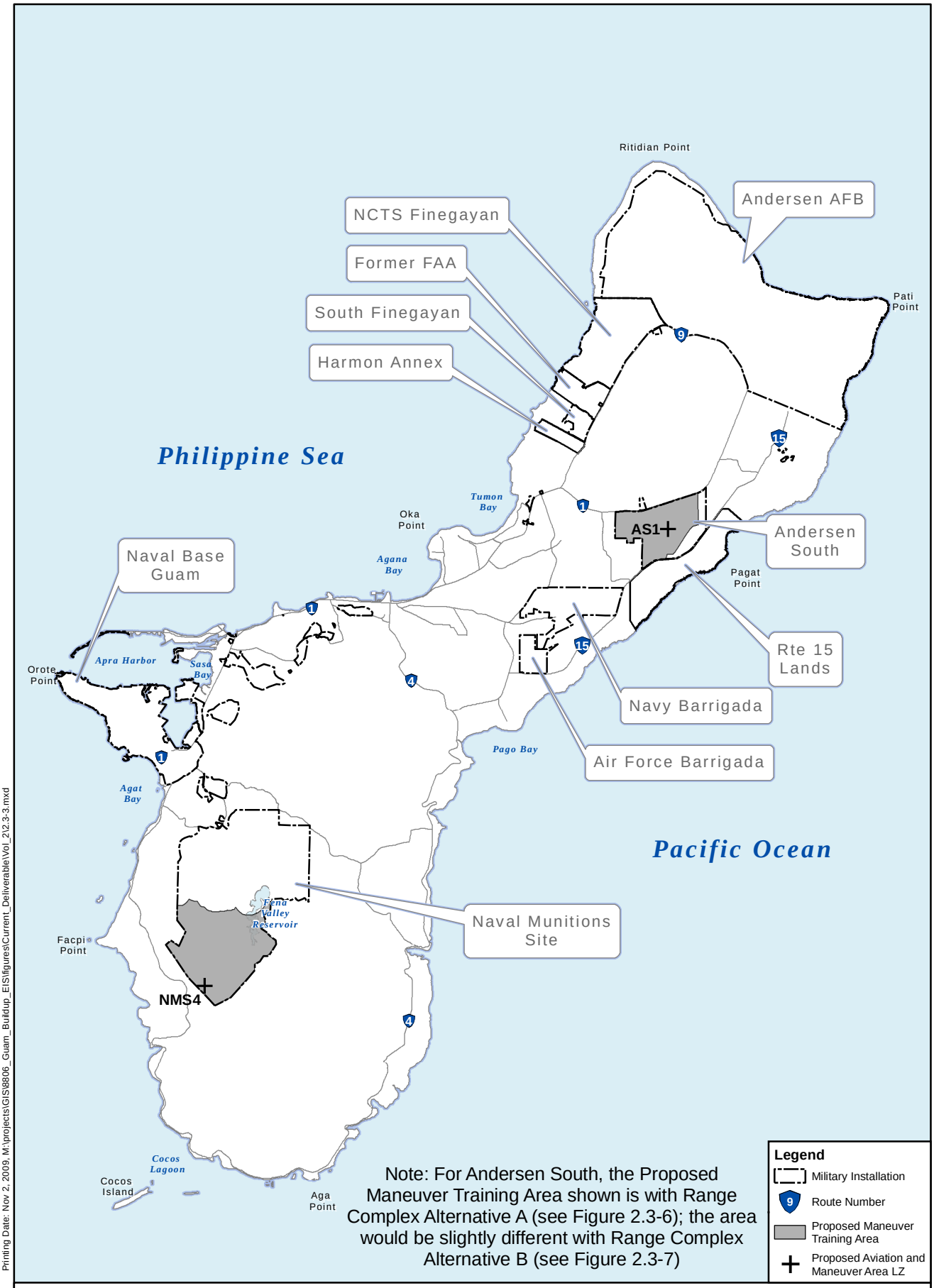


Figure 2.3-3
Proposed Large-Scale Maneuver Training Areas

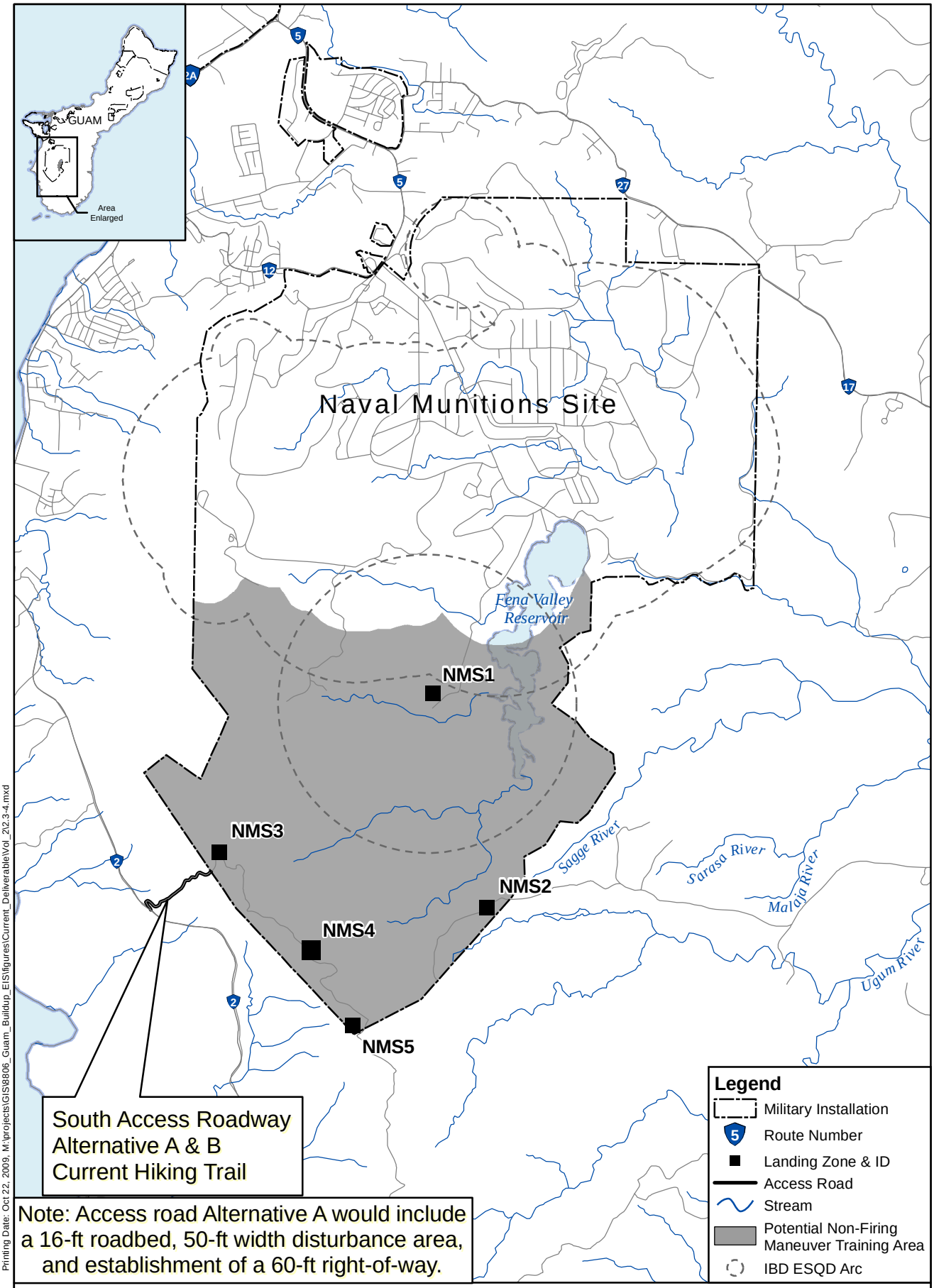


Figure 2.3-4
Naval Munitions Site Maneuver Area Access

LZ AS1 (described in Section 2.3.1.5) would support maneuver training operations at Andersen South (Figure 2.3-5). The convoy training course would use existing roadways and abandoned rights of way in the northwestern portion of Andersen South within areas identified for maneuver training use. The site plans depicted in Figure 2.3-6 and Figure 2.3-7 provide the location of the proposed convoy training course.

- MOUT training would be conducted in a complex of structures that would simulate urban rural and embassy environments. The MOUT at Andersen South would be suitable for units/organizations up to 800 Marines at a time, and would be used on a daily basis by 40 to 750 personnel. The MOUT may operate during daylight hours and at night. Night operations would comprise an estimated 15% of all operations. The MOUT would be used by III MEF units and organizations based on Guam, transients, and visiting regional allied forces. Units using the MOUT may bivouac in the vicinity, or arrive and depart daily. Forklifts or cranes would be used to reconfigure the modules of the MOUT to add variety and diversity to training (e.g., simulate a rural village or more complex setting). The MOUT facility requires surrounding maneuver space to provide room for tactical engagement.
- A fire management plan, currently being prepared by NAVFAC Pacific, would address the fire conditions under which use of pyrotechnics at Andersen South and NMS would be authorized and best management practices (BMPs) for use of those pyrotechnics. This plan would also address broad fire management and fire response at the Andersen South and NMS proposed maneuver areas.

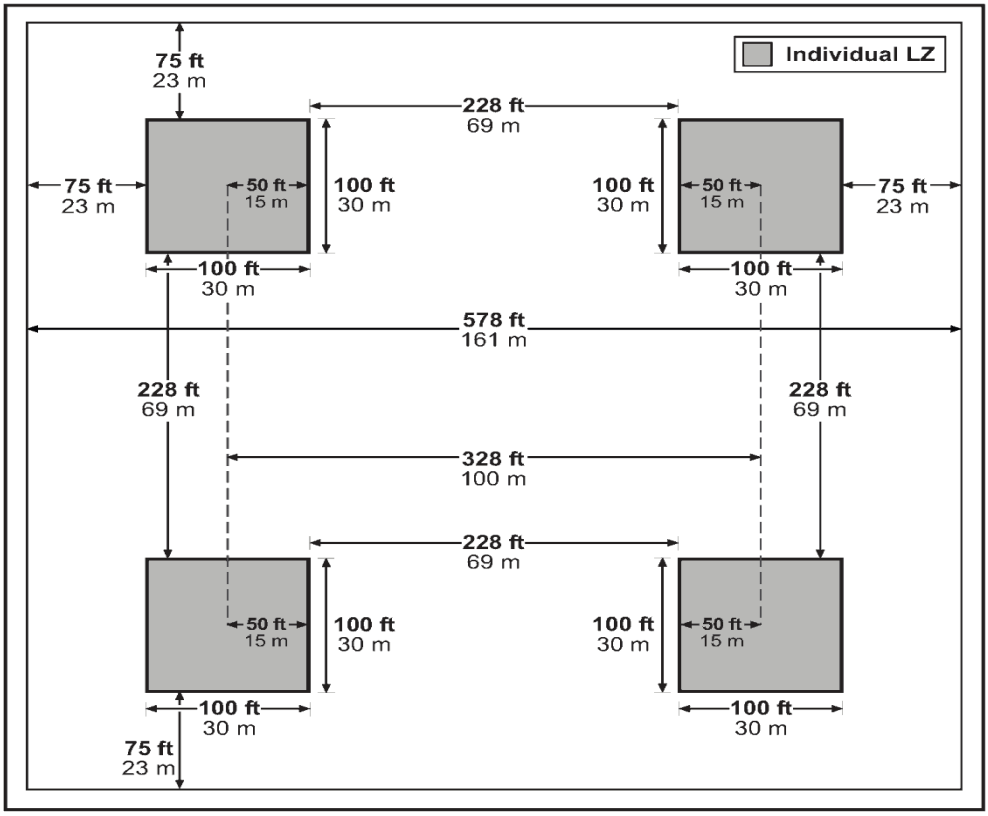
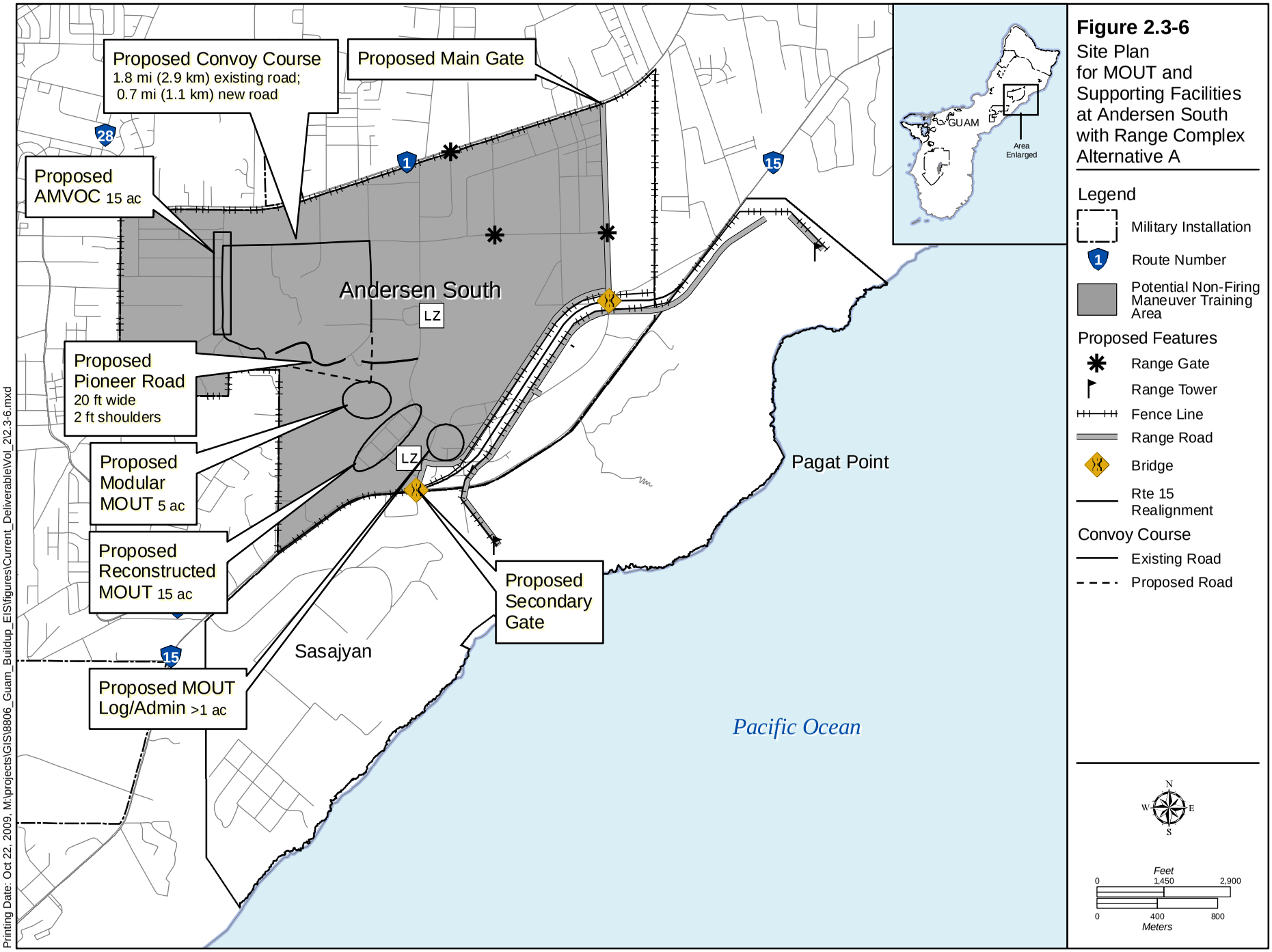


Figure 2.3-5. Standard Maneuver Area LZ Dimensions



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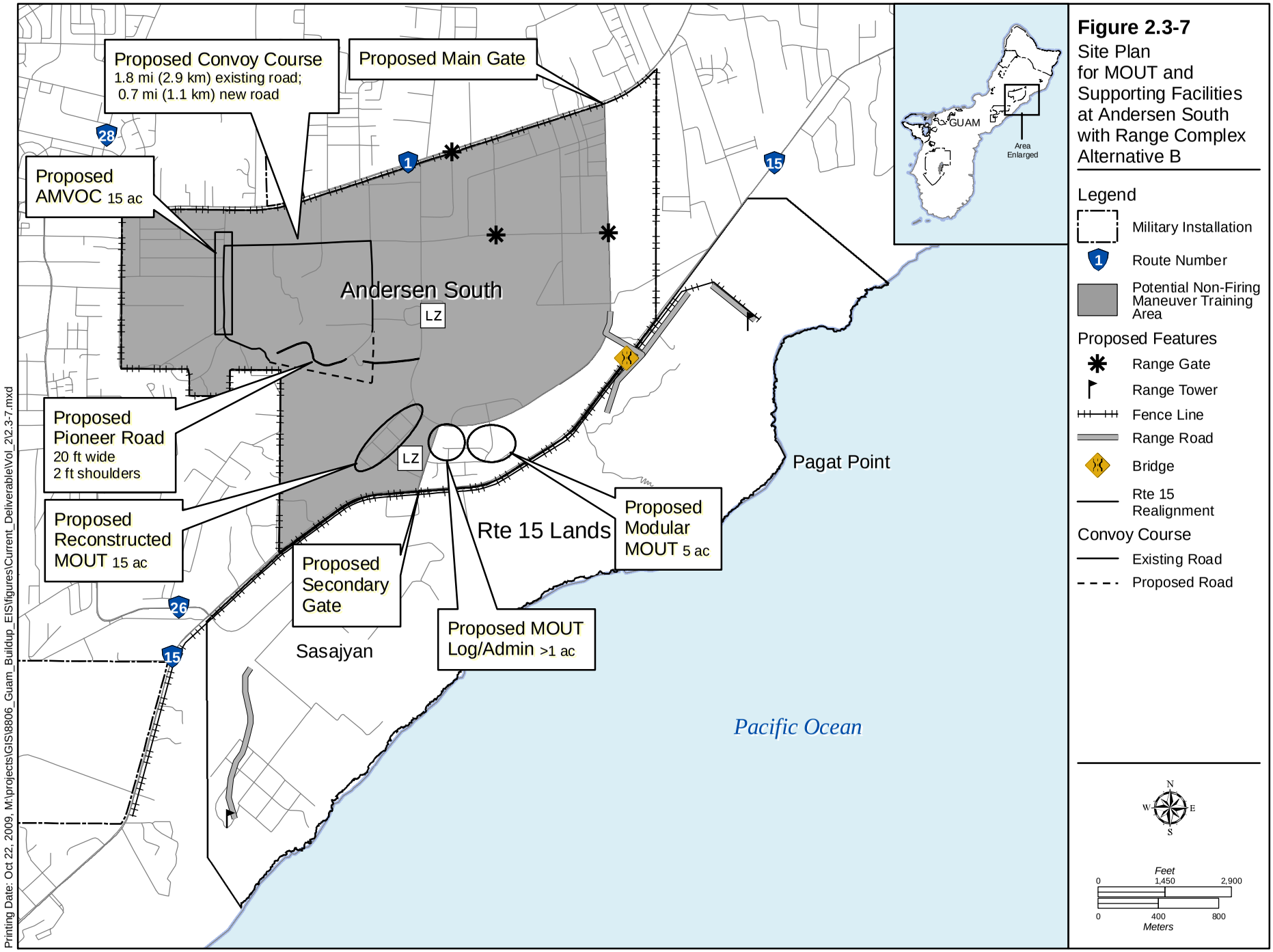

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MOUT Alternatives

The facilities and location information are presented together for the MOUT complex, as facilities requirements have been developed concurrently. Two site plans have been developed for the MOUT and supporting facilities at Andersen South, reflecting slight differences in configuration that would occur with the Range Complex Alternative A (see Figure 2.3-6). and Range Complex Alternative B (see Figure 2.3-7). The overall site plans for Andersen South also include the AMVOC, maneuver area, and convoy course.

If Route 15 is realigned under Alternative A for the Firing Range Complex (see Section 2.3.1.4), access roads and gates would be needed for the portion of Andersen South north of the route realignment. The plan assumes two bridges would be constructed across Route 15. If only one bridge is constructed, then a parallel road would be needed for the road segment north of the Route 15 realignment, between the proposed secondary gate and the intersection with the proposed north-south road that would lead to the proposed main gate, in order to provide adequate traffic circulation. The proposed secondary gate is an existing gate that would be upgraded. If Route 15 is not realigned as would be the case under Alternative B for the Firing Range Complex (see Section 2.3.2.4), the existing gate would be upgraded and the bridge would not be constructed at that location (see Figure 2.3-7). Under both alternatives a perimeter security fence and gravel parking area would be constructed to serve the complex.

Advanced Motor Vehicle Operators Course (AMVOC)

Tactical motor vehicle operator training is a continuous requirement for MEF units. The proposed AMVOC would consist of a route along where a series of obstacles would be placed for driver trainees to negotiate (Figure 2.3-8).

Figure 2.3-8. Sample AMVOC Course

The AMVOC course would be constructed on the western side of Andersen South (see Figure 2.3-6 and Figure 2.3-7).

The capacity of the AMVOC facility would range from 25 to 60 personnel and would be used for individual, section, squad, or platoon training. An estimated 20 drivers per week would train at the AMVOC, primarily with High Mobility Multi Wheeled Vehicles (HMMWVs).

Engineer Equipment and Decontamination Training

The engineer equipment training site or "engineering pit" would be similar to a permanent construction site and would be located at the Main Cantonment. The engineer equipment site would be designed to support all three engineer units (approximately 750 Marines) to be stationed on Guam. Types of vehicles that would operate at the "engineering pit" include bulldozers, graders, material handling equipment, and Armored Combat Engineer vehicles. Decontamination training involves using wash-down equipment to simulate decontamination of equipment exposed to a chemical or biological agent. The decontamination site would be used on a weekly basis with equipment and personnel throughput to vary based on the training scenario.

2.3.1.4 Firing General Military Skills Training

Overview

General military skills training involving the firing of munitions includes the following categories:

- Individual Weapons Training
- Individual Combat Skills

Live-fire weapons ranges proposed for Guam include four small arms qualification ranges and a machine gun operational range. Four explosive ranges are also proposed:

- A hand grenade range that would be used to fulfill an integral part of Individual Combat Skills Training
- A hand grenade house that would supplement the hand grenade range to provide hand grenade training in an urban environment
- A demolition range that would be used for sustainment training in preparing and priming various military explosives
- A breacher/shooting house that would be used for training in forced entry in an urban environment using small breacher charges

Volume 9, Appendix D provides a summary of the munitions and munitions constituents to be used at the proposed ranges.

Criteria from Marine Corps Order 3570.1B define the SDZs for individual weapons systems based on the weapon and munitions characteristics. For planning purposes in this EIS/OEIS, SDZs have been developed based on the placement of ranges. As the planning process progresses, and range designs mature, the SDZs would be certified in accordance with Marine Corps Order 3550.9, Marine Corps Ground Range Certification and Recertification Program. Limitations to use of land, water and airspace affected by SDZs are subject to regulation by the DoD, U.S. Coast Guard (USCG), U.S. Army Corps of Engineers (USACE), and the FAA, as appropriate.

Proposed Facilities and Operations

The proposed action would include construction of the following live-firing training facilities:

- Training Range Complex that would include five individual small arms ranges of various types and a range control facility
- Hand Grenade Range and Hand Grenade House
- Breacher and Shooting House
- Indoor Small Arms Range

2.3.1.5 Aviation Training

The types of aviation training and facility requirements associated with Marine Corps units that would relocate to Guam are listed in Table 2.3-2. Marine Corps aviation training requirements on Guam have been evaluated based on the aircraft and aircrew loading presented in Table 2.3-3. A total of 25 aircraft and 50 aircrews would be based in Guam under the proposed action.

Table 2.3-2. Aviation Training Types

Training Type		*Facility/Airspace Requirements*
FAM	Familiarization and Instrument Flight	Improved airfield with air rescue available. FAM is a daylight operation. Instrument flight is day and night.
FORM	Formation Flights	Flying in formation, often in Air Traffic Controlled Assigned Airspace (ATCAA) assigned by FAA. Also includes helicopter flying Visual Flight Rules (VFR) in formation. Day and night use.
CAL	Confined Area Landing	Ground space, helicopter landing zones in approx. 10 locations. Day and night.
TERF	Terrain Flights	1 or more routes in ATCAA assigned by FAA over varying terrain for day and night flights at 50 to 200 ft (15 to 61 m) above ground level.
EXT	External Loads	Both unimproved and improved LZs for day and night use. Unimproved LZs at remote sites. Ground access needed to pre-position external loads that cannot be carried across public roads or populated areas.
GTR	Ground Threat Reaction	Tactical flight maneuver area or route where ground based threat simulators can be placed. Air routes similar to TERF. Day and night. Includes training on Tinian that is addressed in Volume 3.
FCLP	Field Carrier Landing Practice	Simulated ship deck paved area. Day and night.
TAC	Tactics	Routes over water or land of at least 50 nm (93 km), for chaff, flares, and .50 cal machine gun engagement. Day and night. Includes training in CNMI that is addressed in the MIRC EIS/OEIS.
AG	Aerial Gunnery	Air-to-Ground gun munitions against ground targets. Day and night. Includes training in CNMI that is addressed in the MIRC EIS/OEIS.
HIE	Helicopter Insertion and Extraction	Fast rope, rappelling, helo-casting, and parachute operations in improved fields, drop zones, and water operating areas. Day and night.
DM	Defensive Maneuvers	Airspace routes similar to TERF, but at higher altitude. Day and night.

Source: NAVFAC Pacific 2009.

Table 2.3-3. Aircraft and Aircrew Loading under the Proposed Action

Number and Type of Aircraft	*Number of Aircrews*	*Aircraft Range (nm)*	*Aircraft Endurance (hours)*
12 MV-22	24	879	4
3 UH-1	6	225	approximately 2
6 AH-1	12	350	3
4 CH-53E	8	360	3 (with regular tanks)

Aviation training would generate a minimum of 1,552 training sorties annually. A sortie consists of one aircraft performing a take-off, a training event, and a landing; an operation consists of the performance of a military training mission that may involve the use of one or more individual military training airspace components in order to accomplish that mission.

The aircraft squadrons are proposed for basing at Andersen AFB North Ramp, in a separately constructed air facility (see Section 2.4). Andersen AFB North Ramp currently has two parallel runways: one 11,185 ft (3,411 m) and one 10,558 ft (3,220 m) long. Currently, 29,542 sorties are generated at North

Ramp and under the 2014 no-action alternative, 68,139 sorties would be generated at Andersen AFB (Czech and Kester 2008). Typical training missions can occur both day and night.

In addition, aviation training would occur along proposed flight corridors and SUA within and offshore Guam and integrated with MIRC training operations. Specific aviation training proposals for Guam and surrounding airspace are discussed below.

Marine Air Control Group (MACG) Training

The MACG is part of the ACE of the MAGTF. MACG training involves coordination of air command and control and air defense within the Marine Aircraft Wing. Tactical Air Operations Center (TAOC) training involves establishment of operating air traffic control radar and radar frequency emitters and facilities consisting of shelters, a portable tower, and electrical power sources in about 48 hours, and dismantling them in approximately the same time.

For the TAOC, facilities to be constructed would consist of a 150 ft by 150 ft (46m by 46 m) or 0.5-ac (0.20 ha) concrete pad that would provide a permanent operational location to be used for placement of vans and shelters during routine training events. Equipment operated at the site would include AN/TPS 59 and AN/TPS-63 radars.

Improved Airfield Training

FCLP training requires a lighted pad sized for a large amphibious deck ship for day/night use and with night vision goggles. FAM requires an improved airfield with Aircraft Rescue and Fire Fighting for autorotation and simulated engine-out approaches. FCLP and FAM training would occur at an improved airfield. FCLP training involves landing on a simulated aircraft carrier. Approximately 3 training operations are conducted with each FAM sortie and five training operations with each FCLP sortie. Both are conducted during both day and night.

On Guam, aviation training would occur at an existing improved airfield at North Ramp and NWF, both at Andersen AFB. Table 2.3-4 provides an estimate of aviation training that would occur at each of these sites under the proposed action based on the minimum bi-annual training requirement for FAM and monthly training requirement for FCLP for aircrews associated with the proposed action.

Table 2.3-4. Estimated Annual Training Sortie Activities at Improved Airfields

Location and Training Type	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*Duration/ Sortie-Op (Minutes)*	*Duration of Sortie-Ops by Aircraft Type (Minutes)*				*Total Annual Sortie-Op Minutes*	*% Night*	*% Below 3,000 ft AGL*	*Annual Freq. Training/ Location (Days)*
	CH-53	*MV-22*	*AH-1*	*UH-1*			*CH-53*	*MV-22*	*AH-1*	*UH-1*				
Andersen AFB North Ramp														
FCLP	20	120	30	15	185	2	40	240	60	30	370	50%	100%	12-18
FAM	11	48	16	4	79	3	33	144	48	12	237	10%	100%	4-6
NWF														
FCLP	80	240	60	30	370	2	160	480	120	60	740	50%	100%	12-18
FAM	11	48	16	4	79	3	33	144	48	12	237	10%	100%	4-6
Interfacility Operations	131	212	542	184	1069	1	131	212	542	184	1069	10%	100%	16-24

Agreements with FAA, GovGuam, COMNAV Marianas, and Andersen AFB agreements would be needed to establish a military flight corridor, route, or tactical navigation area. Potential routes include southern Guam with mountainous areas and low population density associated with NMS.

Table 2.3-5 provides an estimate of aviation training that would occur in designated airspace in Guam based on the minimum bi-annual training requirement for TERF, GTR, and DM for aircrews associated with the proposed action. In addition, sorties associated with the transport personnel from Andersen South North Ramp to NMS or Andersen South for maneuver training is also estimated in Table 2.3-5 (as MAN-LFT).

Table 2.3-5. Estimated Annual Training Sortie Activity in Military Flight Corridors, Routes, or Tactical Navigation Area in Guam Based on Minimum Training Requirements

Location and Training Type	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*Duration/ Sortie-Op (Minutes)*	*Duration of Sortie-Ops by Aircraft Type (Minutes)*				*Total Annual Sortie-Op Minutes*	*% Night*	*% Below 3,000 ft AGL*
	CH-53	*MV-22*	*AH-1*	*UH-1*			*CH-53*	*MV-22*	*AH-1*	*UH-1*			
TERF	16	48	24	12	100	90	1,440	4,320	2,160	1,080	9,000	10%	90%
GTR	16	48	24	6	94	90	1,440	4,320	2,160	540	8,460	10%	80%
DM	16	48	24	6	94	90	1,440	4,320	2,160	540	8,460	10%	80%
MAN-LFT	912	0	0	0	912	10	9,120	0	0	0	9,120	10%	80%

Landing Zones (LZs)

Figure 2.3-9 depicts proposed LZ locations at Andersen South, NWF, NMS, and Orote Airfield. Aviation training at NWF and Orote Airfield LZ locations would not involve any LZ construction or clearance of approach-departure clearance zones as the existing infrastructure would support the proposed aviation training at these sites. However, new LZs would be developed to support proposed aviation training at Andersen South and NMS.

2.3.1.6 Airspace

Overview

The FAA has overall responsibility to manage and control U.S. airspace, including that used by commercial, civil, and military aircraft. To ensure safe and efficient airspace use, the FAA defines the types of airspace and the nature of activities that each type can accommodate. Within this system, military services identify specific needs for airspace (the horizontal and vertical boundaries) and request that the FAA designate SUA to meet those needs. Although the FAA retains overall management of SUA, individual military units schedule and coordinate airspace use with other units using Letters of Agreement with the FAA to formalize and delineate areas of responsibility.

There are two types of SUA airspace requirements associated with the proposed action on Guam. The first is the need for designation of airspace related to the vertical ricochet hazard associated with the proposed firing ranges (discussed further below). The second is use of existing SUA and Air Traffic Controlled Assigned Airspace (ATCAA) to accommodate proposed Marine Corps aviation training. Such training would involve the use of training sites at NWF and North Ramp at Andersen AFB, Orote Airfield, Andersen South, and NMS, as well as training along flight routes, corridors, operating areas, or other designated airspace over Guam and adjacent waters. No additional SUA over Guam would be needed to support the aviation training requirements.

It is assumed that a formal joint military airspace proposal will be made to the FAA in the future; at that time a separate determination would be made as to further environmental documentation requirements.

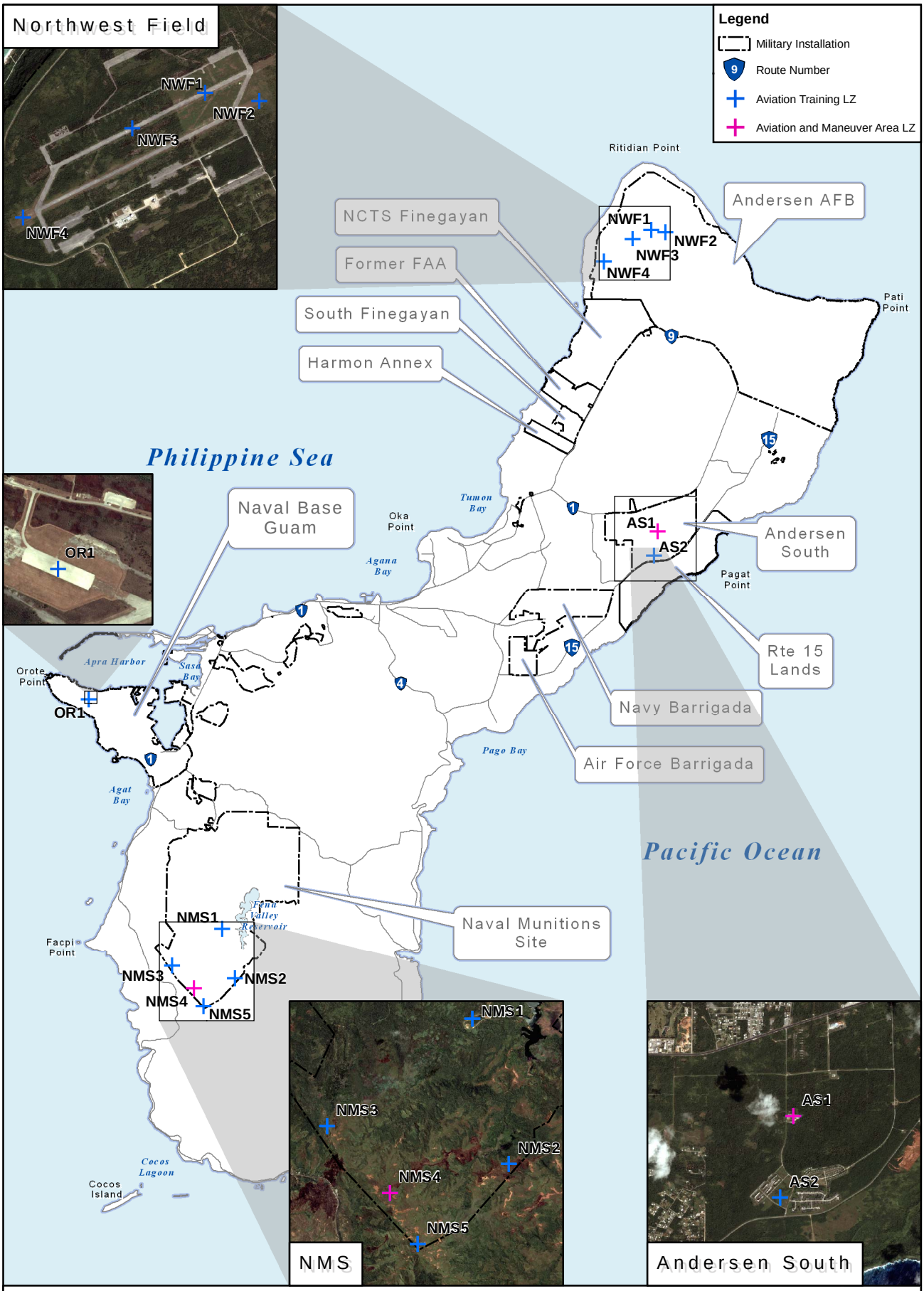

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Figure 2.3-9
Landing Zones

Airspace Requirements: Firing Range Safety

Figure 2.3-10 depicts the proposed SUA associated with the machine gun range component under the firing range complex Alternatives A and B. SUA would be needed to accommodate the associated vertical hazard area. Exact coordinates are pending environmental, safety and other analysis, and are based upon proposed general range layouts and associated coordinates. Proposed R-7202 Guam boundaries for the Anderson South/Plateau Alternative would start at lat.13°26'48"N., long.144°54'30"E.; to lat.13°29'28"N., long.144°51'08"E.; to lat.13°31'15"N., long.144°53'22"E.; to lat.13°28'31"N., long.144°56’53"E.; to the point of beginning.

Proposed R-7202 Guam boundaries for the Anderson South/Valley Alternative would start at lat.13°25'20"N., long.144°52'47"E.;to lat.13°29'03"N., long.144°50'27"E.;to lat 13°31'29"N., long.144°52'58"E.;to lat 13°27'36"N., long.144°55'34"E.; to the point of beginning. Altitudes would be from the surface to 3,000 feet AGL. Times of use would be Monday-Sunday 0600-2300 local, other times by NOTAM. Activation of proposed R-7202 would be for those periods when live fire includes larger caliber weapons such as 7.62 caliber rifles to accommodate higher vertical hazard values.

2.3.2 Alternatives Analysis: Training Functions

2.3.2.1 Feasibility and Suitability Criteria

A qualitative assessment of the feasibility of using specific DoD land areas for siting of training facilities was based on the following criteria:

- compatibility with future missions,
- environmental considerations (including cultural and historical resource constraints and terrain),
- anticipated public concerns.

Suitability criteria included:

- land availability for facility including associated safety or clearance zones,
- supports operational requirements,
- supports training requirements,
- minimizes encroachment,
- consistent with AT/FP requirements, and
- compliance with military vision.

The basis of analysis is presented in a brief entitled *Guam Alternatives Basing Analysis, Guam Stakeholders Working Group*, dated August 21, 2007 and prepared by NAVFAC Pacific.

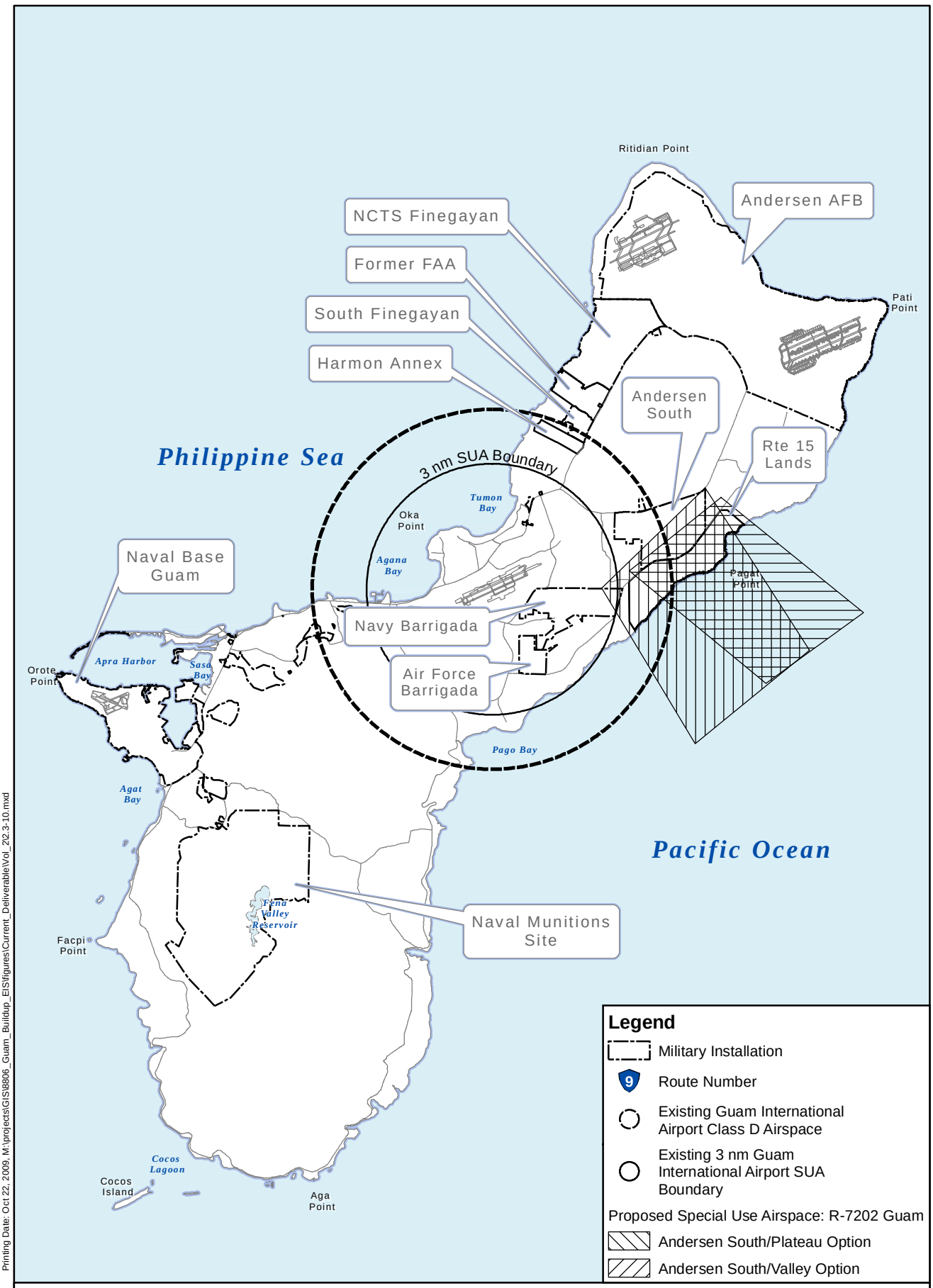

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Figure 2.3-10
New Special Use Airspace Requirements for the Proposed Action

2.3.2.2 Ammunition Storage Alternatives

Only existing munitions storage areas were considered to be candidate sites for the proposed munitions storage facilities under the proposed action. This narrowed the candidate sites to NMS and the Andersen AFB MSAs. Within these two areas, the primary factors in selecting alternative munitions storage configurations were as follows:

- Operational: the ECMs should be sited as close together as safety setback distances allow to minimize logistical and maintenance requirements and total area encumbered by ESQD arcs.
- Biological: the amount of habitat disturbed should be minimized (e.g., siting ECMs on previously cleared or paved areas or areas of lesser habitat value, and avoiding removal of mature trees) and the ECMs should be sited to avoid sensitive essential habitat for T&E species.
- Safety: ECMs must be sited in accordance with all regulatory guidance to ensure the safe working environment for munitions and other base personnel (i.e., the direction that the igloos are oriented in relation to each other, safety setback distances between ECMs, and explosive safety arcs within and outside of munitions storage area).

As shown on Figure 2.3-11, two locations at NMS were considered as potential sites for these 10 ECMs: the Parson's Road Area and the High Road Area. In the Parson's Road Area, there are two alternatives for layout of the 10 ECMs in a configuration that would allow for a combined 360,000 lb NEW capacity. In the High Road area, there is one site that could accommodate the 10 ECMs in a configuration that would allow for a combined capacity of 500,000 lb NEW.

The EIS/OEIS evaluates the development of munitions storage facilities in currently undeveloped areas. This does not preclude replacement or upgrade alternatives within implementation, but rather conservatively estimates potential impacts for the purposes of this EIS/OEIS.

Within MSA1, there was one alternative identified for the placement of ECMs, work areas, administrative/inert warehouse building, and storage for munitions, chaff, and flares (Figure 3.2-12). All proposed munitions facilities would be sited within existing munitions area boundaries and would not alter the existing ESQD arcs. Land use constraints at each site include natural resources and proximity to other munitions storage facilities and infrastructure.

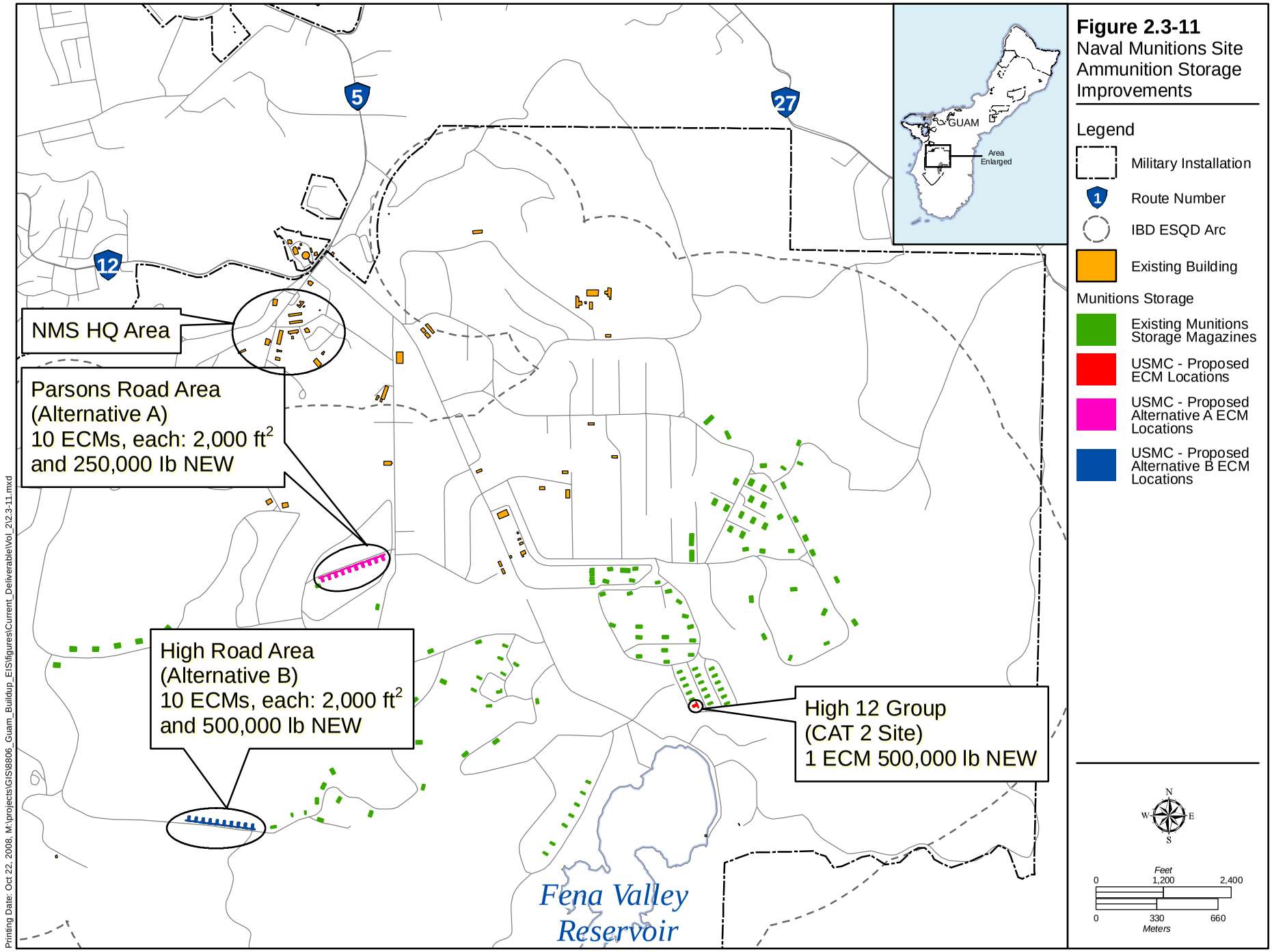
2.3.2.3 Command, Control, and Simulation Alternatives

All three proposed Command, Control and Simulation facilities would be located within the Main Cantonment area to capitalize on functional support relationships with headquarters and administrative functions; the specific sites are being determined through the Main Cantonment master planning process.

2.3.2.4 Non-Firing General Military Skills Training Alternatives

The non-fire training elements of the proposed action are described in Section 2.3.1 To ensure operational efficiency, it is important all or as many as possible of these training requirements be collocated. Candidate site locations are shown in Figure 2.3-13 (for both non-firing and firing ranges).

Table 2.3-6 lists the parcels considered as potential sites for some or all of the required non-firing range facilities, along with the limitations of each site.


NMS HQ Area
Parsons Road Area
(Alternative A)
10 ECMs, each: 2,000 ft2
and 250,000 lb NEW
High Road Area
(Alternative B)
10 ECMs, each: 2,000 ft2
and 500,000 lb NEW
High 12 Group
(CAT 2 Site)
1 ECM 500,000 lb NEW
Fena Valley
Reservoir
5
27
12
GUAM
Area
Enlarged
Figure 2.3-11
Naval Munitions Site
Ammunition Storage
Improvements
Legend
Military Installation
Route Number
IBD ESQD Arc
Existing Building
Munitions Storage
Existing Munitions
Storage Magazines
USMC - Proposed
ECM Locations
USMC - Proposed
Alternative A ECM
Locations
USMC - Proposed
Alternative B ECM
Locations
N
W
E
S
Feet
0
1,200
2,400
0
330
660
Meters
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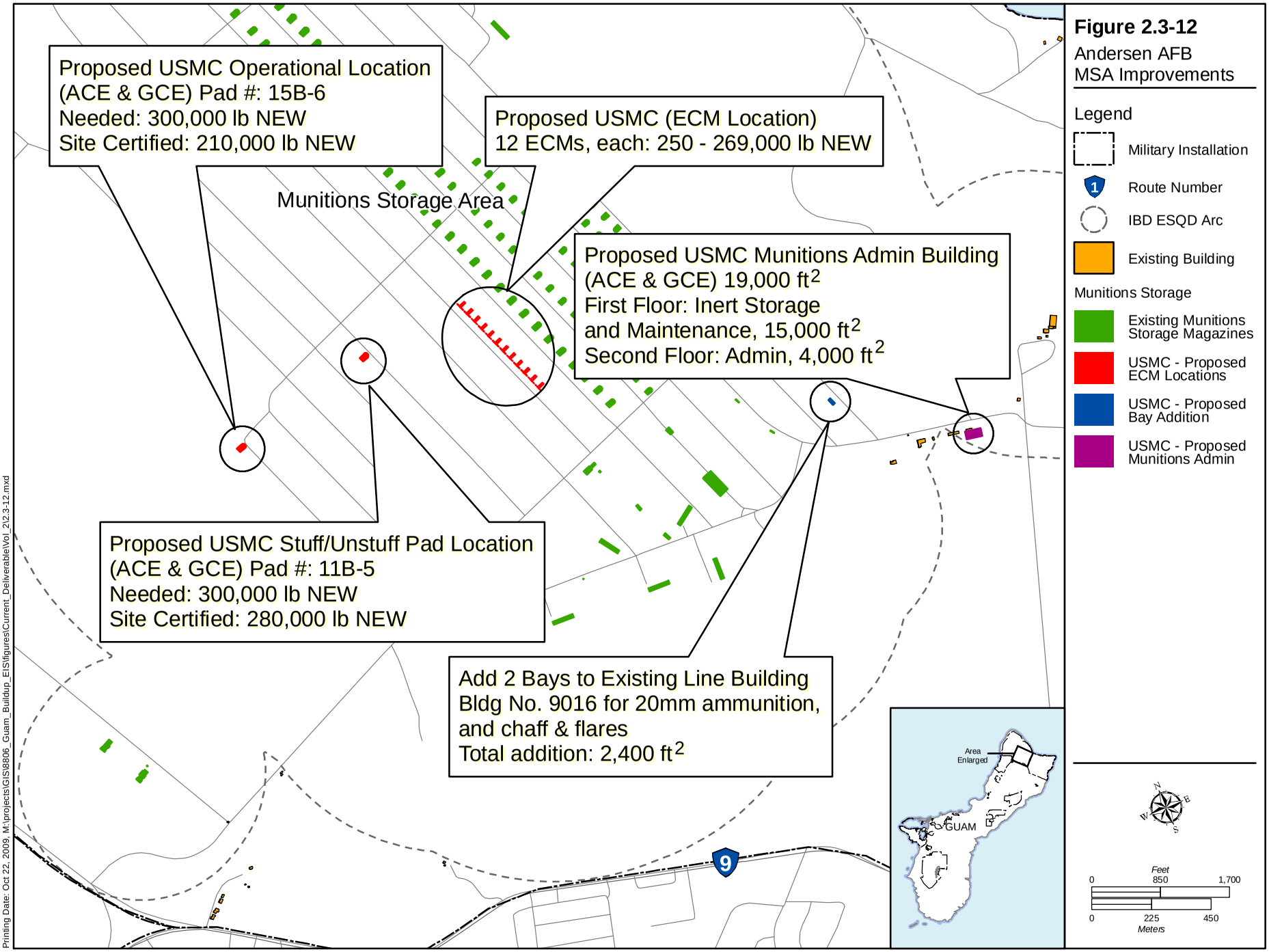
Proposed USMC Operational Location
(ACE & GCE) Pad #: 15B-6
Needed: 300,000 lb NEW
Site Certified: 210,000 lb NEW
Proposed USMC (ECM Location)
12 ECMs, each: 250 - 269,000 lb NEW
Munitions Storage Area
Proposed USMC Munitions Admin Building
(ACE & GCE) 19,000 ft2
First Floor: Inert Storage
and Maintenance, 15,000 ft2
Second Floor: Admin, 4,000 ft2
Proposed USMC Stuff/Unstuff Pad Location
(ACE & GCE) Pad #: 11B-5
Needed: 300,000 lb NEW
Site Certified: 280,000 lb NEW
Add 2 Bays to Existing Line Building
Bldg No. 9016 for 20mm ammunition,
and chaff & flares
Total addition: 2,400 ft2
9
Area Enlarged
GUAM
Figure 2.3-12
Andersen AFB
MSA Improvements
Legend
Military Installation
Route Number
IBD ESQD Arc
Existing Building
Munitions Storage
Existing Munitions Storage Magazines
USMC - Proposed ECM Locations
USMC - Proposed Bay Addition
USMC - Proposed Munitions Admin
N
E
W
S
Feet
0
850
1,700
0
225
450
Meters
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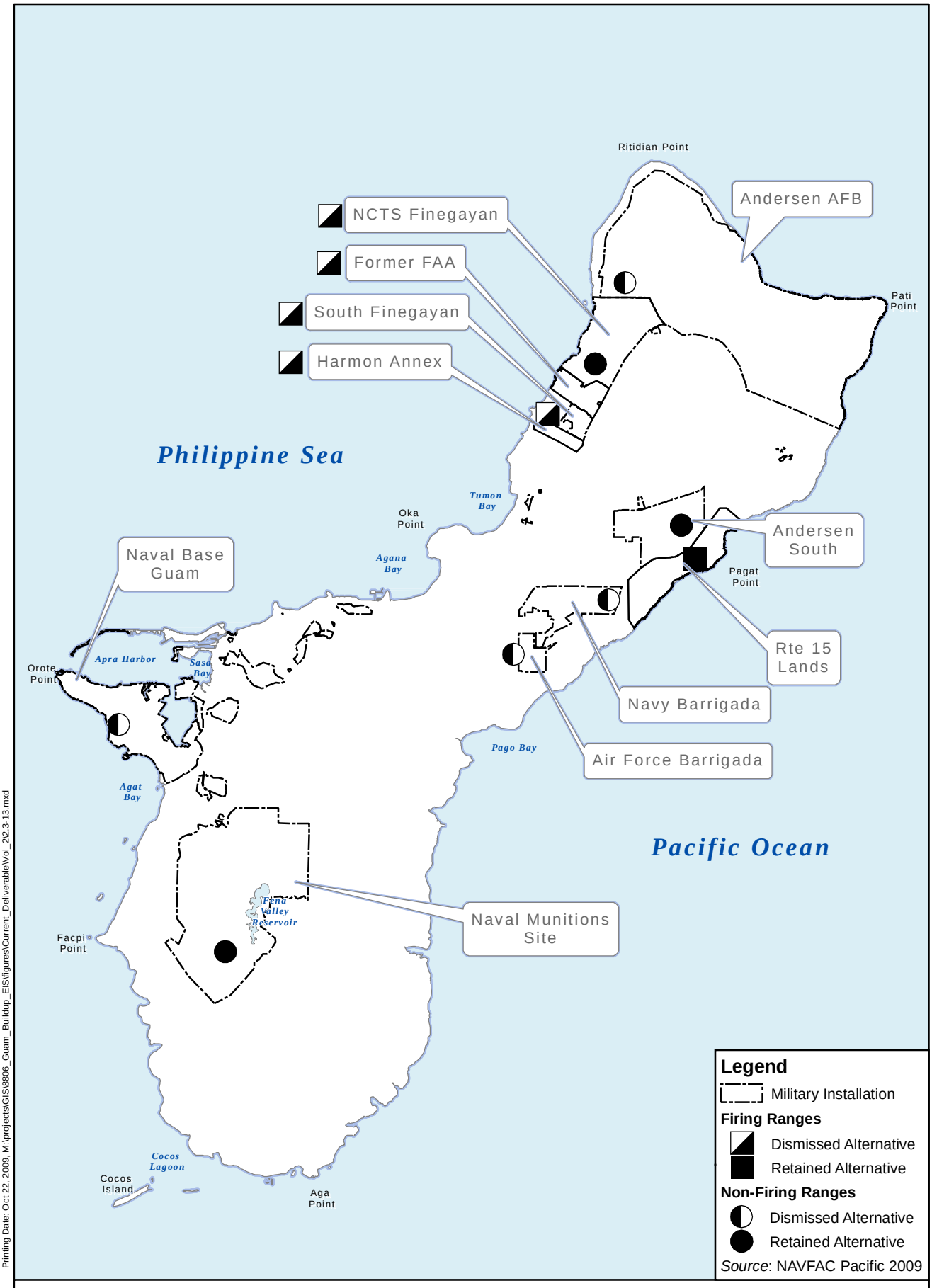

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Figure 2.3-13
Firing & Non-Firing Range Alternatives Considered

Table 2.3-6. Maneuver and Non-Fire General Skills Training Sites

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
Barrigada (Navy)	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Limited land availability
Barrigada (Air Force)	No	Feasibility criteria • Incompatible with future missions Suitability criteria • Limited land availability
Orote Peninsula	No	Feasibility criteria • Incompatible with future missions • Environmental considerations (Historical area conflict) Suitability criteria • Limited land availability
Andersen AFB NWF	No	Feasibility criteria • Incompatible with future missions • Environmental considerations Suitability criteria • Limited land availability
Area north of NCTS Finegayan	No	Feasibility criteria • Incompatible with future missions • Environmental considerations (Overlay Refuge)
NMS (company-sized units only)	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability • Limited proximity to ranges and the aviation complex • Limited training capability
NCTS Finegayan	Yes	Feasibility criteria • Meets criteria Suitability criteria • Limited land availability
Andersen South	Yes	Feasibility criteria • Meets criteria Suitability criteria • Meets all criteria

Source: NAVFAC Pacific 2007.

Andersen South is the largest existing MOUT facility on Guam and the only existing MOUT facility large enough to support the required company level training. It is the only location identified for the required MOUT improvements. Two site plans have been developed for the MOUT and supporting facilities at Andersen South, reflecting slight differences in configuration that would occur with the Training Range Complex Alternatives A and B (refer to Section 2.3.1.3). The overall site plans for Andersen South also include the AMVOC, a maneuver area, and a convoy course.

The maneuver requirements were described in Section 2.3.1. Large-scale maneuver requirements would be met using two separate areas at Andersen South and NMS, since there is no single area on Guam that provides sufficient space for large-scale maneuvers. The proposed action includes development and use of both areas, and no reasonable alternatives have been identified on Guam for either area. Development and

use of the maneuver area at NMS would also require construction of an access road, for which two reasonable alternatives have been identified.

The purpose of the proposed access road is to allow military re-supply and transport vehicles to access the southern portion of NMS where proposed large-scale maneuvers would occur. The access road would allow HMMWVs and 7-ton trucks to bring supplies and Marines to the NMS.

The road would begin at Route 2 and end at the top of the ridgeline just inside the NMS boundary. There would be a turn around and drop off area at that point, but it would not connect into any existing roads. This is the approximate location where a bivouac area (i.e., encampment) would be established in support of large-scale maneuvers. The road would be 0.4 mi (0.6 km) long, 16 ft (5 m) wide; construction disturbance width, including vegetation clearing, is assumed to be up to 50 ft (15 m). The proposed access road is on non-DoD land, so a 60-ft (10-m) wide right-of-way would be acquired to grant control of the road to DoD. Locked, unmanned gates would be placed at the beginning of the access road and at the entrance to the NMS. Also, lockable vehicle barriers would be established at the top and bottom of the proposed access road. The road would be used on average one week per month, up to 10 vehicles per day (HMMWVs and 7-ton trucks).

The DoD would control use of the access road. Public access would be allowed when the military is not conducting training. This access would be limited to foot traffic to access public hiking trails and sites. Vehicle traffic would not be allowed due to concerns over encroachment in the NMS by hunters/poachers. The road would be controlled by DoD; use of the road by the general public would need to be coordinated with DoD.

There are two action alternatives for the proposed NMS access road (see Figure 2.3-4 in Section 2.3.1.3):

1. NMS Access Road Alternative A: Roadway improvements would occur along an existing hiking trail 0.4 mi (0.6 km) in length, covering approximately 0.8 ac (0.3 ha) at a 16-ft (5-m) width, and includes no stream crossings.
2. NMS Access Road Alternative B: Under this alternative, the road would be the same length but would not be improved. It would be used by foot traffic and by 4-wheeled all-terrain vehicles (ATVs).

2.3.2.5 Firing General Military Skills Training Alternatives

Live-Fire Training Range Complex

Depending on the configuration and siting, the total area required for the range complex could be as large as 1,680 ac (680 ha).

These target firing ranges would use live-fire munitions and would generate fan-shaped SDZs that extend well beyond, above, and to the side of the targets. Access to the SDZ is restricted. No development can be within the SDZs and none is proposed, except for perimeter security fencing, but the area may be amenable to adaptive management strategies that improve the environment. The number of firing points and the assignment of multiple types of training to a specific range would impact the size of the SDZ. If extending over water, these areas would be set aside through announcements in the Federal Register by the Corps of Engineers. The SDZs can overlap to minimize the amount of land or water encumbered. The alternatives analysis considered the feasibility and suitability of various land areas for one or more of the ranges. The Step 2 site selection candidates for live-fire training ranges were initially limited to DoD lands and included NCTS Finegayan, expansion of Andersen AFB Tarague Beach Rifle Range to the west, Andersen South, NWF (Andersen AFB), Air Force Barrigada, Orote Peninsula, and NMS. All of

these individual DoD candidate sites were dismissed due to not meeting feasibility criteria for compatibility with future missions. After the initial review of individual DoD parcels' capability for meeting firing range requirements, the analysis was expanded to include non-DoD lands on the west coast, east coast and a combination of east and west coasts.

The East-West and the west coast alternatives described in Table 2.3-7 were eliminated following advice of the office of the Governor. The amount of submerged land that would be encumbered by the SDZs generated by the ranges on the west coast would an unacceptable impact on recreational activities and traditional fishing areas, which are prevalent on the west coast. Step 2 site selection therefore identified only one feasible site for the live-fire Training Range Complex.

Table 2.3-7. Considered and Dismissed Live-Fire Range Complex Alternatives

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
West Coast: Some or all of the following: • NCTS Finegayan • South Finegayan • GLUP 77 • Former FAA • Harmon Properties	No	Feasibility • Anticipated public concerns
East Coast: Lands east of Andersen South and Route 15	Yes	Feasibility • Meets all criteria Suitability • Meets most criteria
East-west combination. Former FAA only	No	Feasibility • Anticipated public concerns

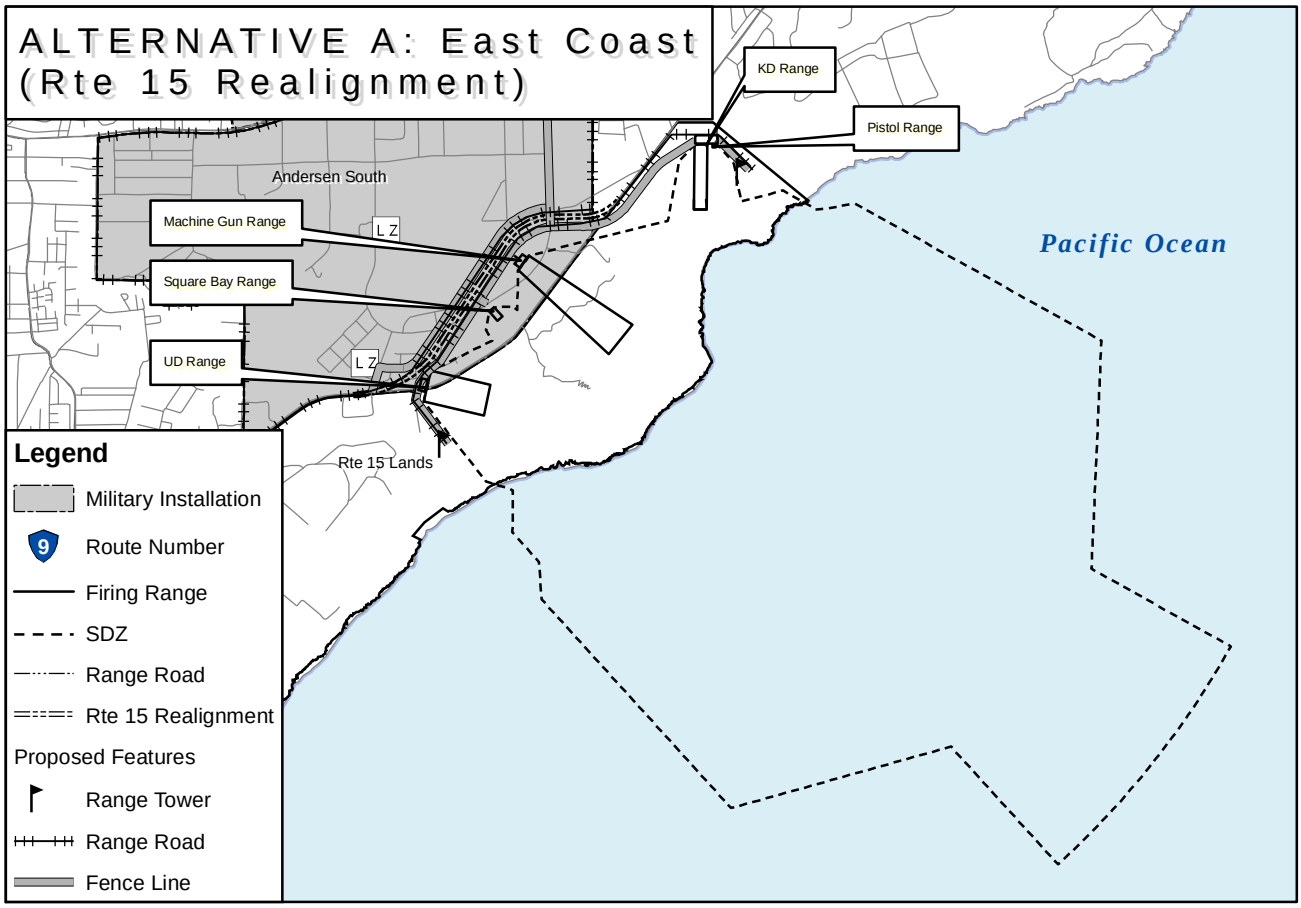
Legend: √ = Site retained as a reasonable alternative for analysis.
Source: NAVFAC Pacific 2007.

Step 3 of the alternatives analysis (site-specific planning) was then applied to identify reasonable alternatives at the east coast site. The Step 3 analysis identified two alternatives to accommodate all live-fire ranges on non-DoD lands on the east coast of Guam. Alternatives A and B are shown in Figure 2.3-14. Both alternatives would require land acquisition or long term leasing, but less land would be required with Alternative A (921 ac [373 ha]) than with Alternative B (1,129 ac [456 ha]). Under Alternative A, there would be more land area in the SDZ as compared to Alternative B; however, the full extent of the SDZ would be primarily located over water under both options. Additionally, Alternative A provides more land area in close proximity to the target, where a majority of the used ammunition collects. All SDZs over water would be established through a Federal Register announcement by the USACE.

Both alternatives are carried forward in this EIS/OEIS impact analyses.

Hand Grenade, Demolition, and Pistol Firing Ranges

Live-fire training ranges include hand grenade, demolition, and pistol ranges. All hand grenade and pistol firing ranges are considered part of the training range and would be co-located there. The Demolition training would occur at an existing range on NWF.



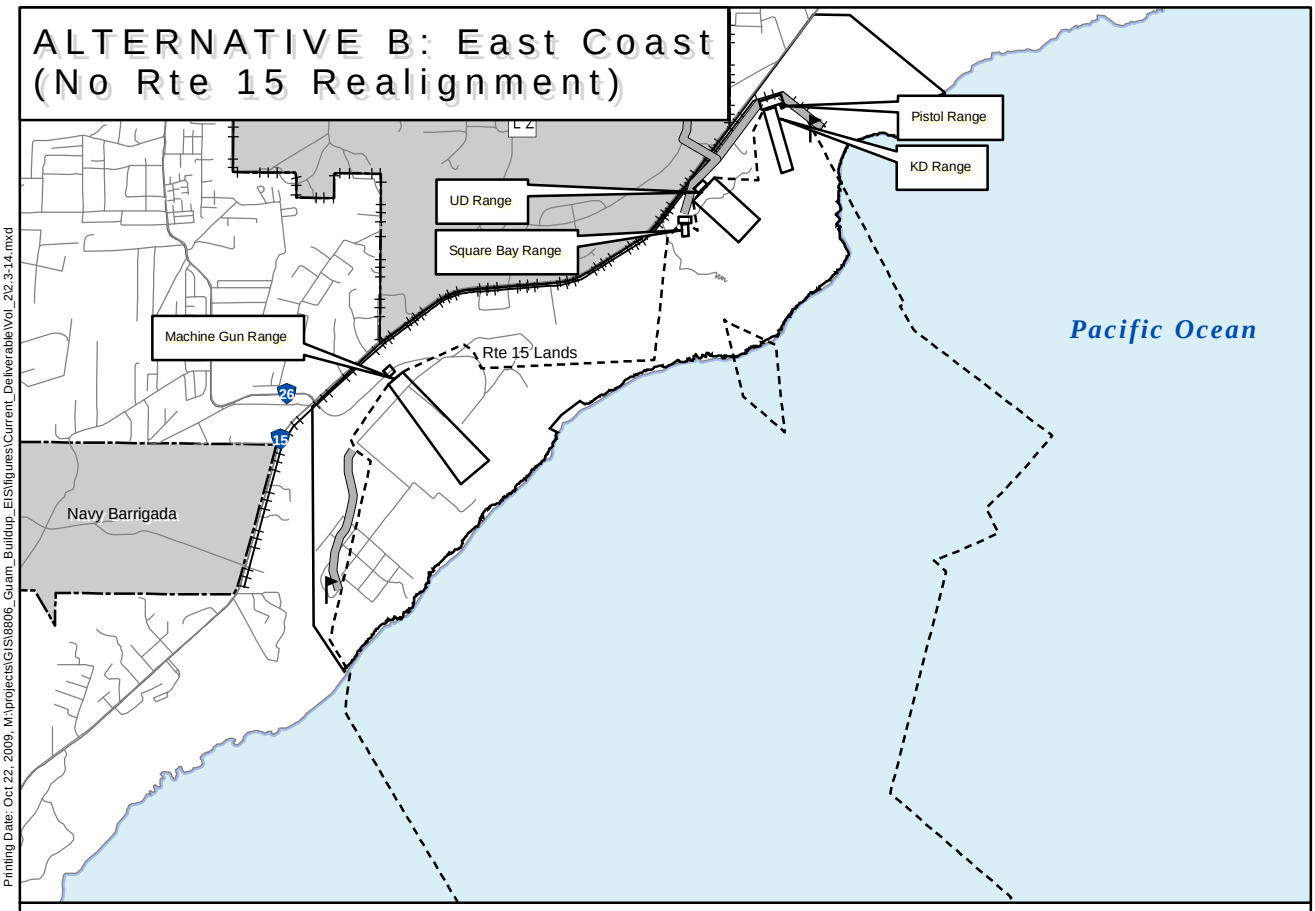


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Figure 2.3-14
Training Range Alternatives

Feet
0 3,100 6,200
0 830 1,660
Meters

Aviation Training Alternatives

The candidate sites for the Guam proposed aviation training include: Andersen AFB, NWF, Orote Airfield, Andersen South, NMS, and Barrigada (Navy and Air Force). The training requires both improved (paved) and unimproved landing sites. Table 2.3-8 summarizes the sites and limitations. The criteria applied to these sites are the same as those described above for airfield functions.

Table 2.3-8. Considered and Dismissed Aviation Training Sites

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
Active runways, Andersen AFB	Yes	Feasibility • Meets criteria
NWF	Yes	Feasibility • Meets criteria Suitability • Limited land availability/insufficient unencumbered land • Encroachment potential • Limited operational capability
Orote Airfield	Yes	Feasibility • Meets criteria Suitability • Limited land availability/insufficient unencumbered land • Encroachment potential • Limited operational capability
Andersen South	Yes	Feasibility • Meets criteria Suitability • Encroachment potential
NMS	Yes	Feasibility • Meets criteria Suitability • Limited land availability/insufficient unencumbered land
Barrigada (Navy and AF)	No	Feasibility • Incompatible with future missions

Legend: √ = Sites retained as a reasonable alternative for analysis.
Source: NAVFAC Pacific 2007.

Because of the mix of requirements and the need for diversity in training locations, no single aviation training site would fulfill the requirements. Five of the sites that were proposed and described above would be used for aviation training.

Two locations for TAOC training and facilities have been identified on Guam: one at NWF and one near the North Ramp at Andersen AFB.

2.3.2.6 Airspace Alternatives

As described in Section 2.3.1.6, the proposed action with regard to airspace requirements includes: (1) the use of existing SUA in the vicinity of Guam to support aviation training requirements; and (2) the establishment of a Restricted Area (or SUA) to correspond to the vertical hazard area associated with a proposed machine gun range. Since existing airspace designations meet the Marine Corps requirements, the establishment of new SUA is not necessary. Any alternative associated with the establishment of a Restricted Area (or SUA) for the machine gun range would be a function of the location of that range.

2.3.3 Alternatives Carried Forward for Analysis: Training Functions

2.3.3.1 Ammunition Storage Facilities

As summarized in Table 2.3-9, the alternatives analysis identified one action alternative for the high explosive ECM at the existing NMS, two alternative sites for the standard ECMs at the NMS, and one action alternative for the 12 standard ECMs and associated support facilities at the existing Andersen AFB MSA 1. All of these alternatives are carried forward for analysis in this EIS/OEIS. Details of the construction and operation of each of the proposed facilities were described in Section 2.3.1.1.

Table 2.3-9. Alternatives Carried Forward for Analysis: Ammunition Storage Facilities

Facility	*Alternatives Carried Forward*	*Figure Reference*
High Explosive ECM	NMS: High 12 Group Area	2.3-11
10 standard ECMs	NMS: Parson's Road Area Alternative A	2.3-11
	NMS: High Road Area Alternative B	
12 standard ECMs and related support facilities	Andersen AFB MSA1	2.3-12

2.3.3.2 Command, Control, and Simulation Facilities

To support and sustain functional relationships with headquarters and administrative functions in the Marine Corps Main Cantonment Area, all three proposed Command, Control, and Simulation facilities would be sited as a function of the master planning conducted for the Main Cantonment Area, as discussed in Section 2.2. Accordingly, action alternatives for Command, Control, and Simulation facilities that are carried forward for analysis in this EIS/OEIS are incorporated within Alternatives 1, 2, 3, and 8 for the Main Cantonment Area (see also Section 2.6.1).

2.3.3.3 Non-Firing General Military Skills Training

Table 2.3-10 summarizes the alternatives carried forward for analysis with regard to non-fire general military skills training. Under the proposed action, the smaller non-fire range facilities that support physical fitness and unit-level training would be constructed in conjunction with the Main Cantonment Area facilities in order to encourage frequency and efficiency of use. No other alternative sites for such facilities and training activities were identified based on operational requirements.

Table 2.3-10. Alternatives Carried Forward for Analysis: Non-Fire General Skills Training

Facility/Type of Training	*Alternatives Carried Forward*	*Figure Reference*
Obstacle Courses	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Confidence Course	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Hand-to-Hand Combat Pit	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Rappelling Tower	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Gas Chamber	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Combat Training Tank	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
General Purpose Auditorium	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Engineer Equipment and Decontamination Training	Incorporated in Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Maneuver Training Area 1	Andersen South	Figures 2.3-6 and 2.3-7
Maneuver Training Area 2	Southern half of NMS with Access Road Alternative A	Figure 2.3-4
	Southern half of NMS with Access Road Alternative B	
MOUT Complexes	Andersen South: incorporated in Training Range Complex Alternative A	Figure 2.3-6
	Andersen South: incorporated in Training Range Complex Alternative B	Figure 2.3-7
AMVOC	Andersen South	Figure 2.3-5 and 2.3-6

The two MOUT complexes and the tactical vehicle course would be developed at Andersen South. Two alternative site plans have been developed for the MOUT and supporting facilities at Andersen South, reflecting slight differences in configuration that would occur with the Training Range Complex Alternatives A and B (refer to Section 2.3.1.3). The overall site plans for Andersen South also include the AMVOC, a maneuver area, and a convoy course.

Large-scale maneuver areas would be developed under the proposed action at Andersen South and NMS, since there is no single area on Guam that provides sufficient space for large-scale maneuvers. No other reasonable alternatives have been identified on Guam. Development and use of the maneuver area at NMS would also require construction of an access road, for which two reasonable alternatives have been identified.

2.3.3.4 Firing General Military Skills Training Facilities

Marine Corps requirements for live-fire training facilities include a composite Training Range Complex (consisting of eight distinct training facilities and range control/maintenance facilities), a breacher and shooting house, and an indoor small arms range. As depicted in Figures 2.3-6 and 2.3-7, there are two potential action alternatives for the range complex. The overarching elements of the two alternatives are discussed below.

Alternative A: Realignment of Route 15

Alternative A includes all required ranges at a location east of Andersen South on non-DoD land to the east of Route 15 and would require the realignment of a portion of Route 15. The ranges would be tightly configured and overlap SDZs would result in a smaller combined SDZ area. Land acquisition or long term leasing (921 ac [373 ha]) would be required for development of the ranges and control of lands associated with the SDZs. This area is largely devoid of modern manmade structures and overgrown with vegetation with the exception of Route 15, abandoned housing at Andersen South, and Guam International Raceway (which is located where the KD and pistol range would be located under this alternative).

The associated SDZs would encompass approximately 921 ac (373 ha) of land and 4,439 ac (1,796 ha) of the Pacific Ocean.

An approximately 1.7 mi (2.8 km) segment of Route 15 that passes along the boundary of Andersen South would be relocated to the north. A new range access road would be constructed parallel to and south of Route 15 for access to the range complex. Access road, gate, and bridge alternatives remain under development.

Alternative B: No Realignment of Route 15

Alternative B is at the same location as Alternative A, and varies from Alternative A only in that 1) the Machine Gun Range (which contains the largest SDZ) would be located in non-DoD land in the valley area farther to the south and 2) relocation of Route 15 would not be required. Land acquisition or long term leasing (1,129 ac [456 ha]) would be required for development of the ranges and control of lands associated with the SDZs. Table 2.3-11 compares the area of land and ocean that would be encumbered by the SDZs for each of the Firing Range Complex alternatives.

Table 2.3-11. Areas Encumbered by SDZs for Each

Range Complex Configuration	*SDZ Encumbered Area (ac)*		
	Land	*Ocean*	*Total*
Alternative A	921	4,439	5,360
Alternative B	1,129	6,003	7,132

Note: areas estimated using GIS analysis of SDZs.

2.3.3.5 Aviation Training

Under the proposed action, improved airfield training would take place at NWF and North Ramp on Andersen AFB, but would also involve flight activity in any existing designated military airspace, including military flight corridors, routes, and tactical navigation areas (Table 2.3-12).

Table 2.3-12. Alternatives Carried Forward for Analysis: Aviation Training

Facility/Type of Training	*Alternatives Carried Forward*	*Figure Reference*
Improved Airfield Training	North Ramp Andersen AFB and NWF	Figure 2.1-4
ATC Detachment Training	North Ramp Andersen AFB and NWF	Figure 2.1-4
TAOC Training and Facilities	North Ramp Andersen AFB and NWF	Figure 2.1-4
12 New Landing Zones (Improved and Unimproved)	Proposed sites at NWF, Orote Airfield, Andersen South, and NMS	Figure 2.3-9

2.3.3.6 Airspace

Since no additional SUA is needed over Guam to support aviation training requirements, the only action alternative associated with aviation training is the use of existing airspace. The establishment of a Restricted Area (or SUA) above the machine gun range would necessarily be integrated in each of those range alternatives.

2.4 PROPOSED ACTION: AIRFIELD FUNCTIONS

2.4.1 Requirements

Key project components associated with airfield operations include the beddown of ACE facilities, air embarkation facilities, and development of a gate and access road to the airfield. All of these components would be sited at Andersen AFB airfield. A new access road onto Andersen AFB is proposed to improve traffic from the Main Cantonment at NCTS Finegayan to the airfield.

2.4.1.1 ACE Beddown

Proposed Facilities

The ACE beddown would require operational, maintenance, and administrative facilities to support the presence of permanently assigned or visiting Marine Corps aircraft on Guam. All facilities would be sized in accordance with Navy criteria for airfield and heliport planning and design. The North Ramp of Andersen AFB airfield is the proposed site for the operations. Table 2.4-1 describes the facilities required. This site constitutes an infill development at the already developed North Ramp area of Andersen AFB. The majority of the ACE Beddown project area is an inactive, previously disturbed area north of the existing Andersen AFB airfield. This proposed project would be used for vertical lift aircraft operations, maintenance, and related training and support functions. Airspace and biosecurity requirements must also be met and are currently being researched. A biosecurity plan (invasive species plan) is being developed in conjunction with the National Invasive Species Council, USFWS, U.S. Department of the Agriculture (USDA), Guam Division of Aquatic and Wildlife Resources (GDAWR), and other interested parties to facilitate a comprehensive approach to control invasive species' export, import, and spread. An outcome from the Biosecurity Plan may include actions associated with integrated pest management such as those used for brown treesnake (BTS). The plan would be comprehensive for all DoD actions on Guam, including those being proposed in this EIS/OEIS.

Land use constraints in the vicinity of the ACE beddown site include a large sinkhole (IRP Site 66), approximately 700 ft by 900 ft (213 m by 274 m), located just east of the project site. Intact native forests and Overlay Refuge are located north of the site.

Layouts for the air operations at North Ramp have been proposed (Figure 2.4-1). This plan is subject to change.

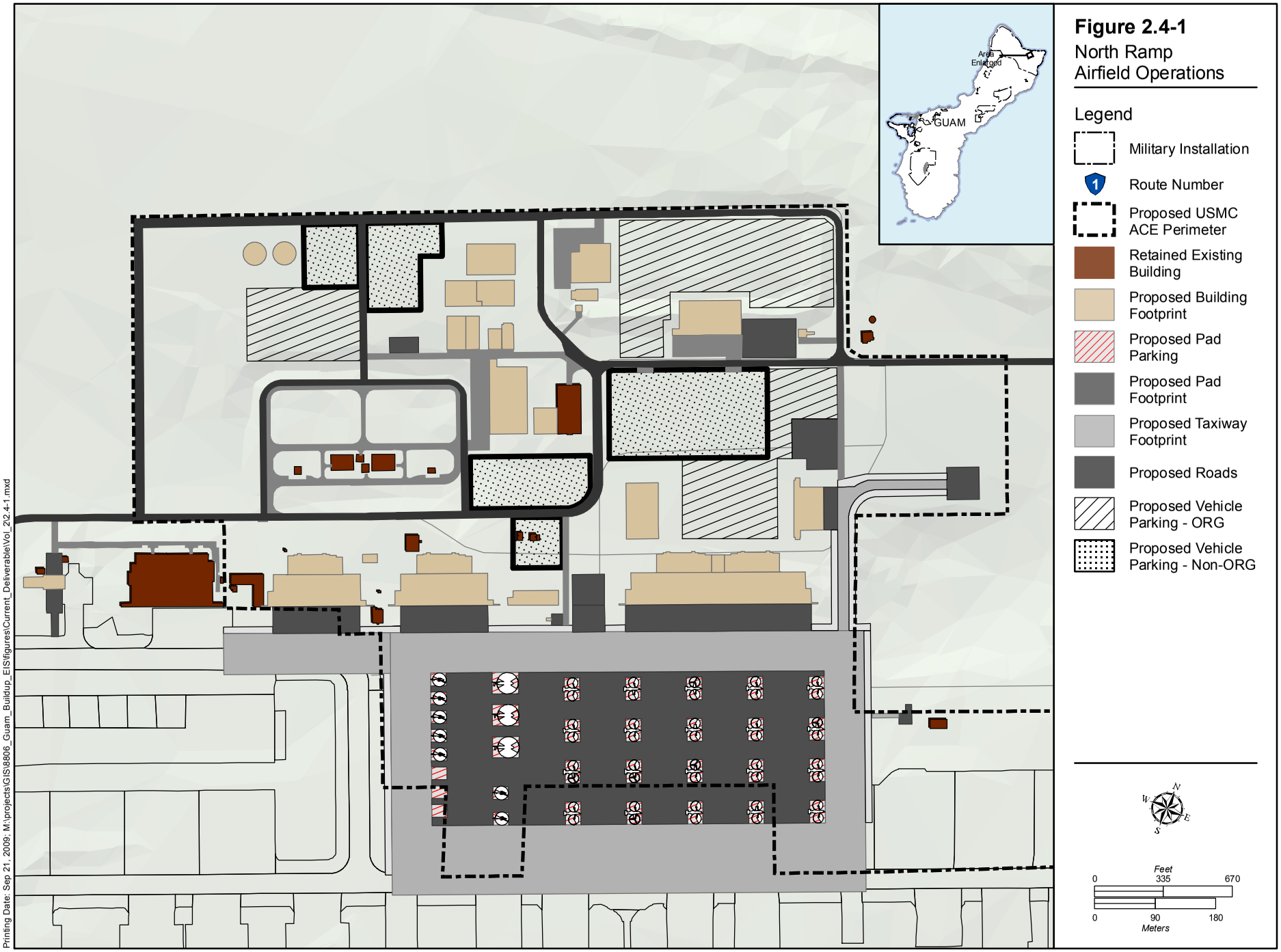
Proposed Operations

The ACE beddown facilities would operate 24 hours per day and 7 days per week. Approximately 2,000 people would occupy this space during the day shift and 400 people would be present at night. Traffic would include government owned vehicles, personal vehicles, and shuttle buses from the Main Cantonment area. Air traffic would include helicopter, vertical lift aircraft, fixed wing, and unmanned aircraft arrivals and departures. Air traffic rates are contingent on surge and operational requirements.

Table 2.4-1. Proposed ACE Beddown Facilities and Dimensions

List of Structures (Assumed)	*Total Floor Area (square feet [ft^2])*	*Total Floor Area (square meters [m^2])*
1: Battalion/Squadron HQ, MWSS-172	20,775	1,930
3: Auto Organizational Shop and Hazard/Flam, MWSS-172	20,599	1,914
4: Electronic/Communication Maintenance Shop and Battery Shop, MWSS-172	4,109	381
5: Organic Unit Storage, MWSS-172	30,327	2,817
6: Aircraft Operations Building	9,759	906
7: Aircraft Fire and Rescue Station	7,239	672
8: Fire and Rescue Vehicle Alert Pad	2,708	251
9: Corrosion Control Hangar	19,402	1,803
10. HMLA (AH-1Z and UH-1N), Maintenance Hangar and HMH (CH-53E), Maintenance Hangar	40,489	3,762
12: VMM (CH-53D/MV-22), Maintenance Hangar	799,908	7,424
13: MALS, Maintenance Hangar	40,489	3,762
14: Operation Haz/Flam Material Storage	1,757	163
15: Organic Unit Storage - DSSC Functions	35,810	3,327
16: Engine Test Cell	1,209	112
17: Tactical Support Van Pad	29,979	2,785
18: Aircraft Washrack-Pavement	13,799	1,282
19: Aircraft Rinse Facility	9,809	911
20: Armory Small Arms Ammo	880	82
21: Aviation Armaments Shop	3,849	357
22: Parachute Survival Equipment Shop	4,200	390
23: Aviation GSE Maintenance Shop	6,250	581
24: Aviation GSE Holding Shed	8,749	812
25: Open Storage Area - General Supply	28,800	2,676
26: Aircraft Compass-Calibration Pad	14,400	1,338
27: Liquid Oxygen Pad	6,274	583
28: Fire Suppression Water Tanks	5,841 x 2	542 x 2
29: Taxiway	1,060,154	98,492
30: Aircraft Parking Apron	148,872	13,831
31: Aircraft Access Apron	12,000	1,115
32: Line Vehicle Parking	1,819	169
33: Organizational Vehicle Parking [b]	502,396	46,674
34: Helicopter Landing Pad [c]	39,600	3,679
35: MCCS Facility (Fitness Center/Mess Hall)	24,688	2,294
36: Explosive Ordnance Division Facility [d]	8,370	778

Legend: MCCS = Marine Corps Community Services: TBD = to be determined.
Notes: [a] Based on information from the Military Munitions Annex Annex.
[b] Current Plan is to provide this parking requirement as a parking lot.
[c] Current Plan is to site this (4–-5 spots) on the Andersen AFB North Runway, some improvements (pavement, and paint may be required).
[d] Current Plan is to make improvements to existing AF EOD building (located on site – Bldg #), which is only 50 % utilized, to accommodate Marine Corps EOD staff.
Source: NAVFAC Pacific 2009.


Area Enlarged
GUAM
Figure 2.4-1
North Ramp
Airfield Operations
Legend
Military Installation
1
Route Number
Proposed USMC ACE Perimeter
Retained Existing Building
Proposed Building Footprint
Proposed Pad Parking
Proposed Pad Footprint
Proposed Taxiway Footprint
Proposed Roads
Proposed Vehicle Parking - ORG
Proposed Vehicle Parking - Non-ORG
N
W
E
S
Feet
0
335
670
0
90
180
Meters
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The anticipated aircraft loading is as shown in Table 2.4-2.

Table 2.4-2. Proposed Aircraft Loading

Element	*Number*	*Type*
Permanent stationed: Rotary wing (helicopters)	12	PCS (12) MV-22 (Assault Transport)
Transients: Rotary wing	12	MV-22 Transport (Osprey)
	3	UH-1 Multipurpose Utility (Huey)
	6	AH-1 Attack (Super Cobra)
	4	CH53E
Fixed wing (airplanes)	2	KC-130
	24	F/A-18
	4-6	F-4 (visiting Allied Forces)

The baseline scenario and proposed aircraft operations at Andersen AFB are shown in Table 2.4-3. Rotary wing aircraft operations may occur at the airfield, in various proposed training areas on Guam, and on Tinian (see Volume 3). Fixed wing aircraft operations would occur only in the immediate airfield environment of Andersen AFB. Aircraft would then leave this area to conduct activities within established training areas of the MIRC or in other locations.

Table 2.4-3. Proposed Flight Operation Increases at Andersen AFB

Mission Group	*Aircraft Type*	*No-Action Alternative (2014)*	*Proposed Action (2014)*	*Total*
Based	Helicopter	18,951	19,255	38,206
	Jet	0	4,564	4,564
Visiting Aircraft Carrier Wing	Jet	602	1,704	2,306
	Propeller	52	156	208
	Helicopter	78	234	312
Transient ISR/Strike	**Jet**	**25,043**	**0**	**25,043**
Other local and transient operations	**Mix**	**23,413**	**5,291**	**28,704**
	Total	**68,139**	**31,204**	**99,343**

Source: Czech and Kester 2008.

2.4.1.2 Air Embarkation

Proposed Facilities

Andersen AFB planners identified a suitable new air embarkation site for an Air Mobility Campus (AMC) on an infill area at the eastern end of South Ramp (Figure 2.4-2). The Air Embarkation Project includes the AMC, Organic Marine Corps Cargo, and passenger operations. The proposed facilities are listed in Table 2.4-4. The total project area is 28 ac (11.33 ha). The proposed project site is adjacent to the southeast boundary of the installation where there is land available for expansion and redevelopment (see Figure 2.4-2). The site currently includes paved airfield parking and disturbed, unused land adjacent to the airfield. This site would serve as the passenger terminal for Andersen AFB and temporary cargo storage (Figure 2.4-3).

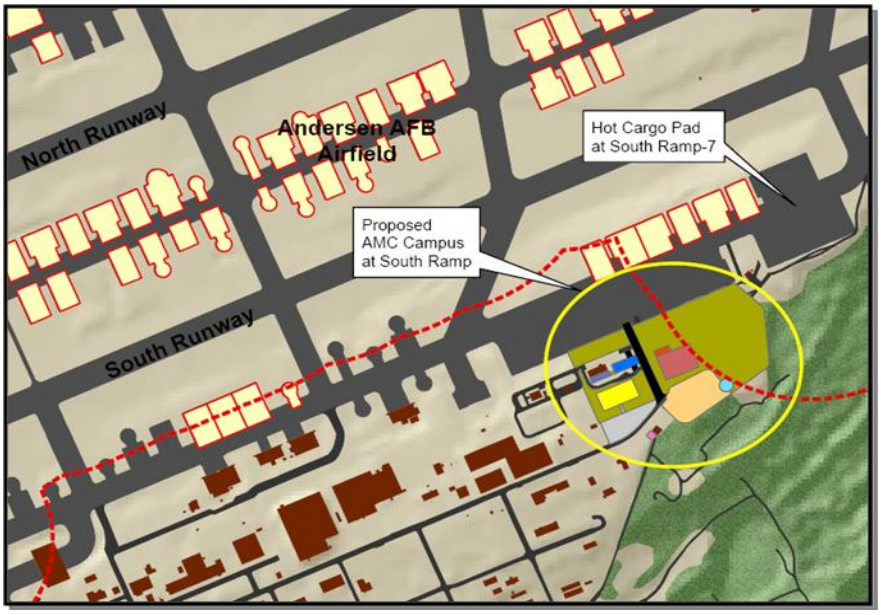


Figure 2.4-2. Location of Proposed AMC at South Ramp

Table 2.4-4. Proposed AMC Campus Facilities and Dimensions

List of Structures (Assumed):	*Total Floor Area (ft^2)*	*Total Floor Area (m^2)*
1: Water Tower	Size: TBD	Size: TBD
2: New passenger terminal & 734 Air Mobility Squadron HQ	45,600	4,236
3: New Freight Terminal/ Marine Office	55,000	5,110
4: Military Message Handling System	6,250	581
5: Hazardous Waste Storage Facility	3,275	304
6: Material Handling Equipment Washrack	15,163	1409
7: Airfield Pavement: Loading Area	539,660	50,136
8: Airfield Pavement: Facilities	143,986	13,377
9: Undefined Air Mobility Command Building	6,594	613
10: Air Mobility Campus Parking	129,887	12,067
11: New passenger 734 AMS Staff Parking	64,054	5,951
12: Passenger area	1,364	127
13: New Roads/Access Driveways	48,351	4,492

Source: NAVFAC Pacific 2009.

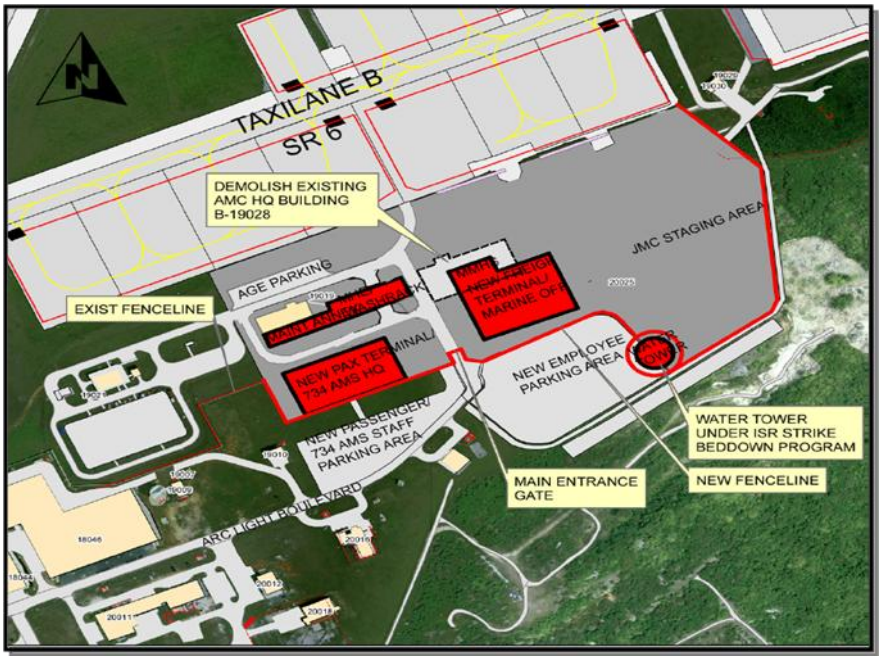


Figure 2.4-3. Proposed Joint AMC/Marine Corps Campus

Proposed Operations

Air Embarkation/Disembarkation refers to the loading and unloading of passengers or cargo to aircraft. The passenger facilities are comparable to those of a small airport: luggage handling, wait area, and ticket/documentation area. Cargo is staged in the area awaiting loading to aircraft or disbursement to warehouses or individual commands. There are searches of cargo and baggage. The Air Force has Air Embarkation facilities at South Ramp of the airfield. A new joint-use Air Embarkation site is proposed and the Air Force is taking the lead on design. The site would operate 24 hours per day and 7 days per week. Staffing levels are to be determined and would be contingent upon surge and operational requirements.

2.4.1.3 North Gate and Access Road

Proposed Facilities

New facilities associated with the proposed north gate include the following:

- One-story entry control point (ECP) (204.4 ft^2) (18.99 m^2] with restrooms, telecommunications, four parking stalls, and installation fencing.
- One-story Pass and Identification Office (783.6 ft^2) (72.8 m^2) with 12 parking stalls, restrooms, and telecommunications to be located approximately 4,058.8 ft (1,235 m) from the ECP.
- Vehicle Inspection Facility (VIF), including a one-story Vehicle Queuing Control Facility (26.21 ft^2) (7.99 m^2) with two parking stalls and an exit lane.
- A high bay, open VIF with two open, concrete-lined, underground pits (7.5 ft by 2.3 ft and 5.9 ft deep) (2.3 m by 0.7 m and 1.8 m deep) for viewing the undercarriage of trucks; overhead remote video monitoring of the tops of vehicles; and a one-story inspection administration building (3,440.3 ft^2) (319.61 m^2) with waiting room, office space, military working dog holding room, two restrooms, 12 parking stalls, and telecommunications.

- A one-story, one-room overwatch station (26.2 ft^2) (7.99 m^2) with one parking stall.

AT/FP security measures (UFC 4-010-01) would be incorporated into project design and construction. Cable reinforced fencing 6.9-ft (2.1-m) high with six strands of barbed wire (total height of 7.9 ft [2.4 m]) would be installed near the landfill and at the entrance where it would connect with existing perimeter fencing. Rolling crash-proof gates at the entrance would be used during non-operating hours. Active barrier controls are proposed at the ECP (tire shredder at exit), VIF, and overwatch building. A low protective concrete wall would be constructed in front of the overwatch building.

Exterior site work would include grading and grubbing; demolition of existing road pavement (portion of proposed road); earthwork; 31 parking spaces; landscaping (grass at buildings and base entrance only, no irrigation); exterior security lighting at buildings; traffic signage and markings; installation entrance signage; and roadway and building lighting. Street lighting would be incorporated within the project areas, including the Route 9 portion. Construction would meet UFC 4-022-01 criteria and consist of high pressure sodium fixtures mounted on steel poles rated for 170 miles per hour (mph) winds. Demolition of pavement remnants would be required, and would be recycled/reused where possible to reduce construction waste, but no buildings would be demolished. No relocation of utilities would be required.

The ECP would connect to GovGuam utilities in Route 9. The other facilities would tap into existing Andersen AFB utilities at 5th Avenue, except for wastewater. A septic/leach field system would be constructed for the VIF and Pass and ID Office. There would be two emergency generators: one at the ECP and the other at the VIF. No underground storage tanks are required.

Per Navy and Marine Corps policy, LEED certification would be pursued for this development. Other sustainability features would be incorporated where appropriate and feasible.

New construction associated with the access road would include the following:

- A new traffic signal is proposed, subject to GovGuam approval.
- Two new lanes would be constructed on Route 9
- The pavement along the road and at the built-up areas (not including the truck inspection lanes) would consist of 3.9 inches (in) (100 mm) of asphalt concrete surface, 5.9 in (150 mm) of aggregate base, and 5.9 in (150 mm) of aggregate sub-base. The truck inspection lanes would be jointed and unreinforced and consist of 10.5 in (267 mm) of Portland cement concrete, 5.9 in (150 mm) of untreated aggregate base, and 5.9 in (150 mm) of aggregate sub-base.
- Vehicle barrier controls would be installed at the ECP, overwatch, Vehicle Queuing Control Facility, and VIF. The final denial barrier would be at the overwatch building. The project includes a 12-ft (3.7- m) wide access road to intersect Route 9 approximately 10,561 ft (3,219 m) north of the existing Andersen AFB ECP and extend into Andersen AFB approximately 6,561.66 ft (2,000 m) until it terminates at 5th Avenue.
- Roadway paving, street lighting, and drainage would be constructed for the entire length of the alignment. Figure 2.4-4 and Figure 2.4-5 illustrate the North Gate and Access Road location map and site plan.

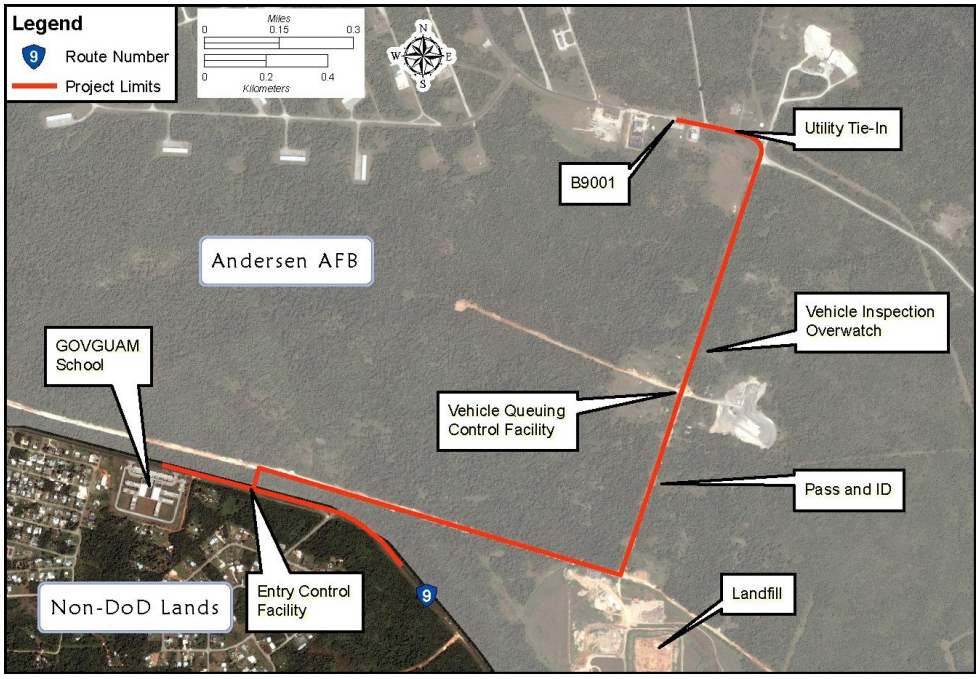


Figure 2.4-4. North Gate & Access Road: Location Map

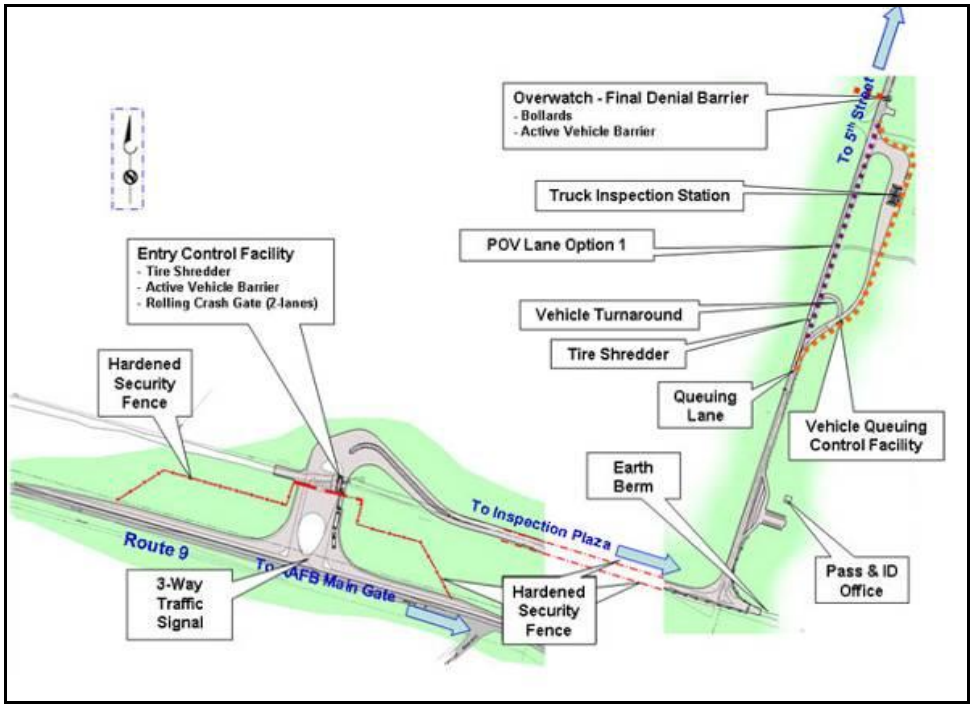


Figure 2.4-5. North Gate & Access Road: Site Plan

Proposed Operations

The North Gate and Access Road project is intended to improve the traffic flow and the physical security of vehicles traveling to and from Andersen AFB. The ECP would be a commercial and personal vehicle access gate for the ACE Ramp and Air Force Guam Forward Loading Operation Ramp. It is anticipated

that the gate would operate 24 hours per day and 7 days per week. The existing South Gate averages 11,000 vehicle movements per day. Similar traffic loads are assumed for the proposed North Gate based on personnel working at Intelligence, Surveillance, and Reconnaissance Strike, Marine Corps North Ramp, and overflow from the already congested South Gate of Andersen AFB. It is assumed that the traffic load would include 200+ trucks and construction vehicles per day.

2.4.2 Alternatives Analysis: Airfield Functions

Four sites on Guam were considered for airfield functions: North Ramp Andersen AFB, Won Pat International Airport, Orote Airfield at Naval Base Guam, and NWF at Andersen AFB. Feasibility was a qualitative assessment of compatibility with future missions, environmental considerations (including cultural and historical significance), and anticipated public concerns. Suitability criteria included: land availability, operational capability, training capability, encroachment, AT/FP, and compliance with military vision. The basis of analysis is presented in a brief entitled *Guam Alternatives Basing Analysis, Guam Stakeholders Working Group*, dated August 21, 2007 and prepared by NAVFAC Pacific.

Although there are site limitations, Andersen AFB met all of the suitability and feasibility criteria and is the only reasonable alternative. It is an existing DoD airfield that has sufficient space to accommodate the aircraft proposed for relocation from Okinawa. The criteria that were not met are listed as limitations in Table 2.4-5.

Table 2.4-5. Considered and Dismissed Alternatives: Airfield Operations

Candidate Sites	*Carried Forward for Analysis*	*Compatibility with Major Criteria*
Active runways, Andersen AFB	Yes	Feasibility • Meets all criteria
Won Pat International Airport, Tiyan	No	Feasibility • Anticipated public concerns • Incompatible with future missions Suitability • Limited land availability/insufficient unencumbered land • Limited anti-terrorism/force protection (AT/FP)
Orote Airfield	No	Feasibility • Incompatible with future missions Suitability • Limited land availability/insufficient unencumbered land • Encroachment potential
NWF	No	Feasibility • Incompatible with future mission • Overwhelming environmental considerations Suitability • Limited land availability/insufficient unencumbered land

There are two distinct types of airfield facilities needed to support the proposed Marine Corps relocation to Guam: (1) support for the aircraft (fixed and rotary wing) that would be relocating, and (2) air embarkation for processing cargo and personnel in and out of Andersen AFB. The first type of facility could only be sited at the North Ramp of Andersen AFB because space is available to house the aircraft relocating to Guam. In addition, there are other rotary aircraft facilities (Navy) in the area, resulting in consistent land use planning. Andersen AFB's North Ramp is the only proposed site for construction and operation of airfield functions and would be included in any proposed action selected for implementation.

Andersen AFB also has a requirement for air embarkation facilities for the Air Force's AMC. The Air Force plans to consolidate its embarkation facilities and relocate to an area at the east end of South Ramp. Marine Corps embarkation facilities would be collocated with AMC's to achieve maximum land use and operational efficiency. No other reasonable alternatives for air embarkation facilities were identified.

2.4.3 Alternatives Carried Forward for Analysis: Airfield Functions

The Marine Corps requirements for airfield functions would be accommodated at the existing airfield at Andersen AFB. Other airfields on Guam were eliminated in Step 2 of the alternatives analysis.

2.5 PROPOSED ACTION: WATERFRONT FUNCTIONS

2.5.1 Requirements

2.5.1.1 General Overview

Relocation of Marine Corps forces to Guam would result in frequent embarkation operations to support amphibious transportation of Guam-based Marines and transiting amphibious forces for potential contingency, humanitarian, and exercise operations in the Pacific Theater. The Navy's amphibious task forces and the Marine Expeditionary Unit (MEU) are transient forces that have traditionally come to Guam for port visits and training. Frequency of visits is highly variable based upon operational commitments; however, transient training events occur approximately twice annually. Under the proposed action, transient port calls would increase, amphibious task force visits are dependent on operational requirements but it is anticipated that the task force visits would increase between 2 to 4 annually with the relocation. The composition of the amphibious task force would be dependent on the specific mission. Typically, there are three ships carrying amphibious vehicles, equipment and personnel designed to support amphibious operations and an additional four surface combatant ships that escort the amphibious ships. In addition, naval anti-submarine and strike force surface and subsurface assets may accompany the task force. Local transport of Marines and supplies between Guam and Tinian not connected to the visiting MEU would most likely be via airlift (see Volume 3 for more information).

Under the proposed action, MEU training would increase to occur regularly at a minimum of two additional times per year (for a total of four times per year) for three weeks duration each visit on Guam. Depending on the mission requirements and training activities planned for the Marianas, the MEU would travel from Okinawa or California to Guam, and continue on to Tinian; or, alternatively, the MEU would go directly to Tinian for tactical ship to objective maneuver training. For training on Guam, the aircraft would beddown at North Ramp Andersen AFB, the amphibious ships would offload personnel and amphibious craft at Apra Harbor, and troops and equipment would travel administratively to and bivouac (camp) at proposed training/maneuver areas on Guam. The escort combatant ships may or may not accompany the amphibious task force.

Existing general purpose Navy wharves in Inner Apra Harbor are currently used by the amphibious task force during visits by MEUs. In order to accommodate the proposed increase in the number of amphibious task force visits and use of recent model (class) ships, upgrades to these wharf structures and utilities, an embarkation area for loading and unloading of ships, and an amphibious vehicle/small boat laydown area would be required and are proposed.

All training would be a continuation of existing training capabilities within Apra Harbor complex. Hence amphibious training is not part of the proposed action, but would occur as described in the MIRC EIS/OEIS.

When in port, the amphibious ships and escort ships listed in Table 2.5-1 would be berthed in Inner Apra Harbor. In addition, 12 AAVs, two Rigid Hull Inflatable Boats (RHIB), and eight Combat Rubber Raiding Craft (CRRC) would be permanently based at the proposed Landing Craft Air Cushion/Amphibious Assault Vehicle (LCAC/AAV) laydown area as part of the proposed action.

Table 2.5-1. Amphibious Task Force Ships and Based Amphibious Vehicles and Boats

Proposed Vessel	*Quantity*	*Permanent/ Visiting*	*Total Wharf Length/ Requirement (ft)*	*Draft (ft)*
Ships Carrying Amphibious Vehicles				
LHD	1	Visiting	1,044	28
LSD	1	Visiting	710	20
LPD	1	Visiting	669	23
Amphibious Vehicles				
LCAC	4	Visiting (transported on ships)	Not applicable	2.8 ft (full stop, no cushion) 0 ft (navigation) 1-20 inches of water depression @ 18 knots
LCU	4	Visiting (transported on ships)	Not applicable	7 (fully loaded)
AAV- predominantly a land vehicle	Varies	Visiting (transported on ships)	Not applicable	6
AAV	14	Permanent	Not applicable	6
Reconnaissance Boats				
RHIB/CRRC	2/8	Permanent	Not applicable	Nominal
Escort Combatants				
Guided Missile Cruiser (CG-47)	2	Visiting	1,335	34
Guided Missile Destroyer (DDG)	2	Visiting	1,210	33

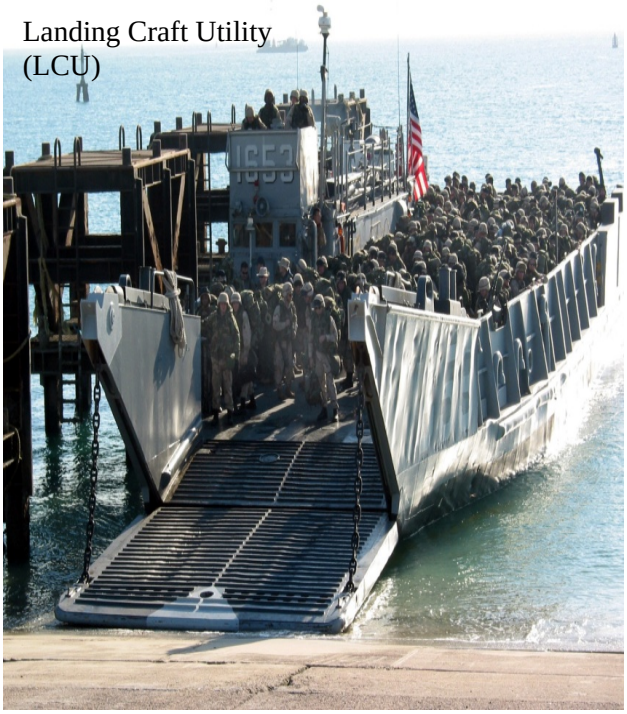
Legend: CRRC = combat rubber raiding craft; LCU = landing craft utility; RHIB = rigid hull inflatable boat.

Although a quantity of ships is specified in Table 2.5-1, the actual number and types of ships would vary with the amphibious task force mission. The types of ships presented in the table do not differ from those associated with visiting amphibious task forces that currently berth in Apra Harbor with the existing approximately two MEUs annually; however, with the relocation of Marine Corps forces to Guam, amphibious task force mission ships would be berthed in Inner Apra Harbor two additional times annually (for a total of four annual visits). When the amphibious task force is not in port, the general purpose wharves would be used by other ships at Port Operations discretion.

The amphibious craft would be deployed from the "big deck" amphibious ships (Amphibious Assault Ship [LHD], Dock Landing Ship [LSD], and Amphibious Transport Dock [LPD]) either in Inner Apra Harbor or Outer Apra Harbor, then travel to the proposed amphibious laydown area in Apra Harbor. These smaller amphibious landing craft would typically include LCAC, and AAVs. The Landing Craft Utility (LCU) is also currently used in lieu of the LCAC, but is being phased out and, therefore, the assessment in this EIS/OEIS is focused on the LCAC. General operational features of these vessels are described in this section and photos are shown on Figure 2.5-1 and Figure 2.5-2.

LCACs are the largest landing craft. They are pre-loaded from ramps (fore and aft) with land vehicles, cargo and personnel to deploy within 25 nm (46 km). The LCAC can transport one tank, four AAVs, or 250 personnel. Personnel ride within a prefabricated shell that protects them against spray and noise. The LCACs are released from the well decks of the amphibious ships. Maximum speed is approximately 50

Figure 2.5-1
Ships



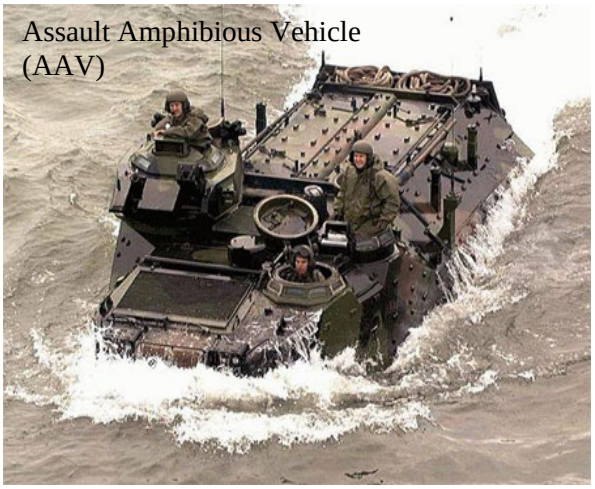


Figure 2.5-2
Amphibious Ships

knots in smooth seas. They ride above the water on a cushion of air captured under an inflatable skirt surrounding the craft. Lift fans create the cushion of air between the hull and the water surface or hard substrate (i.e., coral). LCAC operations depress the surface of the water 12-18 in (309 - 457 mm) and can create a bow wave. They are designed to cross the high water line and remain on cushion to move inland before decreasing lift and landing on the ground where cargo is offloaded. When returning to the water, the lift fans raise the craft 1 to 3 in (25 to 76 mm) and the skirt permits air to escape around the edges. The LCACs then return to the amphibious ship to be re-loaded.

LCU is a displacement hulled craft with a large open center bay and ramps fore and aft. It can operate in approximately 8 ft (2.4 m) of water prior to lowering its ramp to the shoreline or pier. An anchor may be set in rough ocean conditions for added stability. It does not land at beaches protected by offshore shallow reefs that may damage the hull. It can transport 200 tons of cargo or 200 persons.

AAVs are lightly armored personnel carriers propelled by water jets in the ocean and tracked suspension in shallow water and on land. The speeds of newer models (Advanced AAV) are capable of about 25 knots. The tracks engage land at about water depth of approximately 6 ft (1.8 m). It may be launched directly from the ship or carried by one of the larger landing craft. Each AAV can carry approximately 23 combat-equipped Marines or five tons of cargo. The Marines may debark on beach landing or remain on the AAV for inland travel. On land, the AAV is capable of traveling 25 mph. Each track block is rubber – padded that in turn minimizes damage to paved roads.

RHIB is a light-weight, high performance and high capacity boat constructed with a solid, shaped hull and flexible tubes at the gunwale. The inflatable collar allows the vessel to maintain buoyancy if a large quantity of water is shipped aboard.

CRRCs are used for inserting lightly-armed raiding parties or reconnaissance teams onto beaches, piers, offshore facilities and larger vessels. The CRRC can be inflated in minutes by foot pump, compressor or carbon dioxide tank and can be deployed from shore and a variety of vessels. Its chief advantages are stealth, versatility, lightweight, compact size when stowed, and the safety imparted by its hyper-buoyant nature, which gives it the ability to operate in relatively high seas for a craft of its size.

When in Apra Harbor, the vehicles and equipment unloaded or being loaded on the ship are subject to inspection and washdown on arrival and departure to prevent introduction of foreign agricultural and public health threats. All washdowns are conducted and supervised by trained personnel in accordance with Armed Forces Technical Guide 31 (Defense Pest Management Information Analysis Center 2004). USDA personnel participate in inspections. These activities are conducted in a designated paved area with a washdown area and sufficient space for segregating clean from dirty equipment/vehicles. The brown treesnake (BTS) is of particular concern and there is a MOA signed by DoD, USDA, GovGuam, and State of Hawaii that states these agencies would cooperate with BTS research, control and inspections, and eradication. The COMNAV Marianas Instruction 5090.10A, Brown Treesnake Control and Interdiction Plan (February 14, 2005) implements this MOA. Special BTS perimeter barriers 4.5 ft (1.4 m) tall pre-cast concrete with a 1 ft (0.3 m) outward projecting lip to deter snakes from scaling the barrier) and sliding chain-link fence gates with fabric barriers to block all vehicle access points are standard protective measures. All waste onboard the ship is steam sterilized prior to disposal in regulated landfills in accordance with BMPs and base operating procedures.

A biosecurity plan (invasive species plan) would be developed in conjunction with the National Invasive Species Council, USFWS, USDA, GDAWR, and other interested parties to facilitate a comprehensive approach to control invasive species export, import, and spread. The plan would be comprehensive for all

Air Force, Marine Corps and Navy actions on Guam, including those being proposed in this EIS/OEIS for Marine Corps actions on Guam and Tinian (see Volume 1, Section 1.6).

2.5.1.2 Proposed Waterfront Embarkation Projects

There are five waterfront facility projects included in the proposed action, the first two of which are directly related to amphibious task forces as follows (Figure 2.5-3, projects shaded black):

- Ship berthing and embarkation/staging area. Includes ships that carry amphibious craft, and combatant escorts
- Amphibious craft (LCAC/AAV) laydown area (i.e., location for storing, maintaining and deploying amphibious craft)
- USCG berthing and crew support building relocation
- Military working dog kennel relocation
- Apra Medical/Dental Clinic

The USCG and Military Working Dog Kennel (MWDK) relocation projects are required to accommodate the Marine Corps waterfront project requirements. The fifth project, Apra Medical/Dental Clinic, is also described in this section. It is not directly related to the amphibious task force waterfront requirements, but is the only other proposed Marine Corps action requiring construction at Naval Base Guam. Some of these projects may being construction as early as 2010. The anticipated duration of construction for the projects is 18-20 months, but that could be accelerated.

Each of these five projects is described in subsequent sections. The sections are organized as follows:

- Proposed Facilities and Construction
- Proposed Operations

An analysis of alternatives for each project is described in Section 2.5.2.

Waterfront Project: Amphibious Task Force Ship Berthing and Embarkation

Proposed Facilities and Construction

The facilities required to support an amphibious task force include general purpose wharves, a new cargo staging area/new washdown area, a waterfront operations support facility, and a small maintenance/equipment storage facility.

The Navy's general purpose wharves are on the western side of Inner Apra Harbor. Other wharves are not general purpose and have specific uses, such as submarine berthing or supply ship berthing. General purpose berths are used at the discretion of Port Operations based on ship size, requirements (draft of ship and utility requirements) and wharf availability at the time of arrival; however, ships that are homeported in Guam are generally assigned a particular wharf that would provide the ship-specific requirements. Master planning for general purpose wharves requires development of a berthing plan to ensure that there is enough wharf length to accommodate foreseeable ship arrivals, including the visiting or transient ships if the majority were in port at one time. In planning, specific ship types are mapped to specific wharves. In Navy planning the berthing plan is used to justify specific improvement or construction projects. In reality, once the planning effort is over and wharves are improved to meet the foreseeable range of ships, Port Operations would assign berths to ships on arrival. The assigned berth may not match the berthing plan but would meet the wharf and infrastructure requirements of the ship.

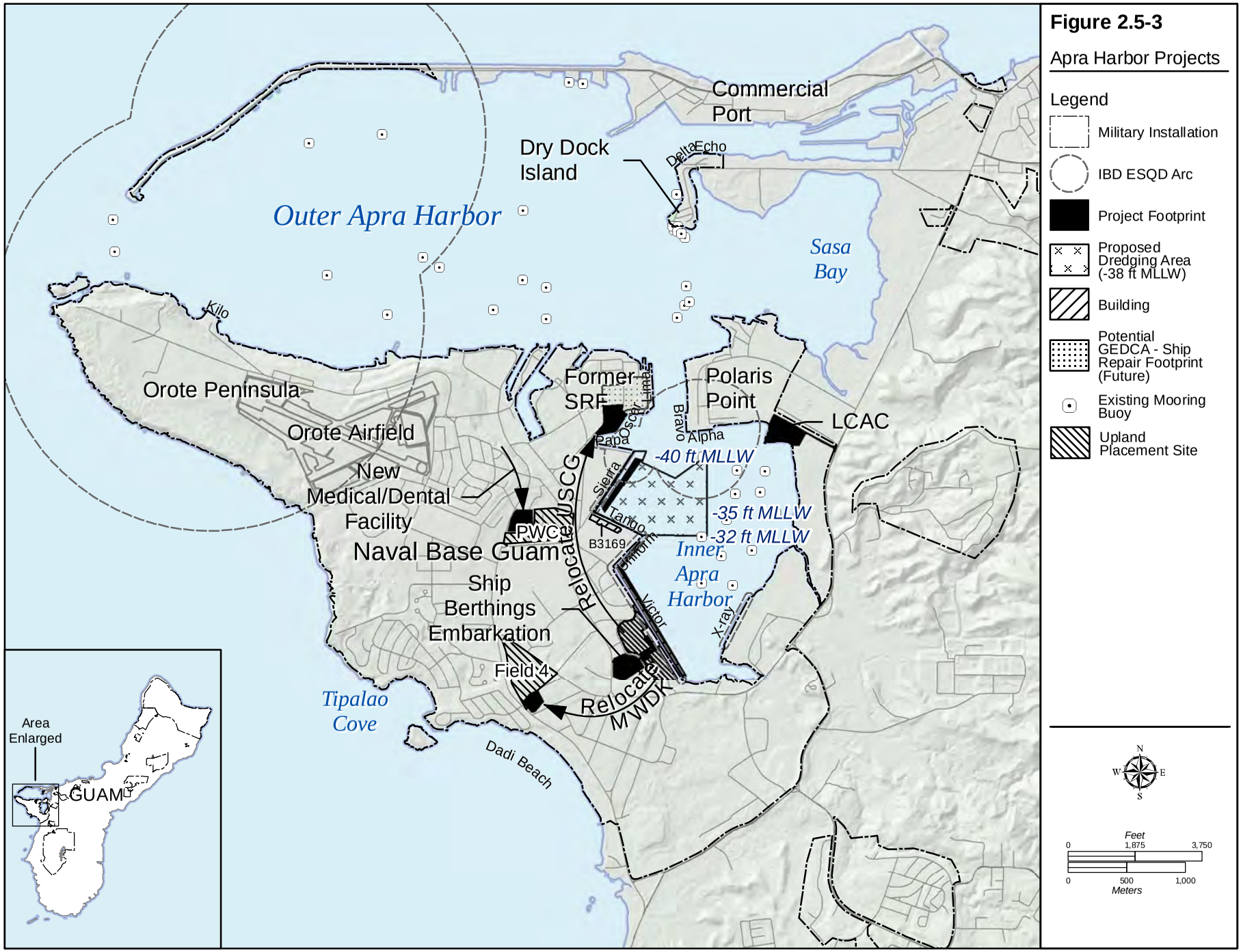


Figure 2.5-3
Apra Harbor Projects
Legend
Military Installation
IBD ESQD Arc
Project Footprint
Proposed Dredging Area (-38 ft MLLW)
Building
Potential GEDCA - Ship Repair Footprint (Future)
Existing Mooring Buoy
Upland Placement Site
Commercial Port
Dry Dock Island
Delta
Echo
Outer Apra Harbor
Sasa Bay
Kilo
Orote Peninsula
Orote Airfield
New Medical/Dental Facility
Former SRF
Polaris Point
LCAC
Papa
Oscar
Limas
Bravo
Alpha
-40 ft MLLW
Sierra
Tango
-35 ft MLLW
-32 ft MLLW
PWC
B3169
Uniform
Naval Base Guam
Ship Berthings Embarkation
Relocate USCG
Inner Apra Harbor
Victor
X-ray
Field 4
Relocate MWDK
Tipalao Cove
Dadi Beach
Area Enlarged
GUAM
N
W
E
S
Feet
0
1,875
3,750
0
500
1,000
Meters
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The berthing plan developed for Inner Apra Harbor to address Marine Corps training requirements also addresses the other anticipated ships visiting Guam. Should a new or unanticipated type of ship visit Apra Harbor, they too would be able to use the general purpose wharves as long as the minimum draft and shore side requirements of the specific ship are met. This EIS/OEIS describes the improvements required specifically to meet Marine Corps requirements with the understanding that these wharves are available for use by other ships.

The siting of ships at the general purpose berths was based on Marine Corps requirements for embarkation operational efficiency while maintaining the operational efficiency of existing waterfront operations. The Navy Regional Commander made the ultimate determination of where new facilities would be sited -including where improvements could be made, maximizing use of underutilized wharves and adjacent areas. Although Inner Apra Harbor has the total wharf length to support the amphibious task force ship berthing, all of the general purpose wharves of Inner Apra Harbor require repair and utility upgrades/improvements to meet ship specifications and seismic building codes.

To achieve amphibious task force operational efficiency, the ships that carry amphibious vehicles would be at contiguous berths and the supporting embarkation facilities would be adjacent to these wharves. Standard practice is for all ships entering Inner Apra Harbor to be assisted by two tug boats (COMNAV Marianas 2009).

Victor Wharf is used for transient vessels and USCG owns 200 ft (61 m) of berthing, but the wharf is generally underutilized. There is adequate area adjacent to Victor Wharf for the port operations building, and the cargo staging/vehicle wash area can be located a reasonable walking distance (600 ft [183 m]) from the wharf. Victor Wharf met the embarkation requirements for contiguous berthing of the amphibious task force ship composition. These ships would require the entire length of Victor Wharf (3,620 ft [1103.4 m]) including the USCG berthing. Relocation of USCG berthing and support facilities is described as a separate project later in this section. No dredging would be required to accommodate the amphibious task force ships as the required draft of 28 ft (8.5 m) is accommodated at Victor and Uniform Wharves, which have a 32 ft (9.7 m) mean lower low water (MLLW) depth. Victor Wharf was determined to be the operational preference and is underutilized.

This planning process considered the potential berthing of inter-island intermodal passenger/ferry vessels, including High Speed Vessels (HSVs). An HSV is a high speed catamaran used to ferry cargo and personnel, which may be used in the future for regional CNMI exercises. Once the amphibious task force ships were assigned general purpose wharves, Uniform Wharf remained for the berthing of HSVs and other intermodal ferry or support vessels of limited draft. This would provide operational efficiencies because the HSV would be berthed in proximity to the embarkation activities at Victor Wharf.

The MWDK is located in the security compound that is adjacent to Victor Wharf and the proposed embarkation area. The noise generated by the embarkation activities would be disruptive to the dogs; therefore, the MWDK would be relocated.

Figure 2.5-4 shows the proposed Victor Wharf embarkation facility site plan. The specific facilities and improvements required are listed in Table 2.5-2. There would likely be phasing or grouping of the project components under multiple contracts to facilitate continued base operations and continued support for visiting ships during reconstruction. The reconstruction is estimated to require 26 months. Table 2.5-2 lists the key components of the embarkation waterfront facilities. It is assumed that the construction would occur from 0600—1700, Monday through Friday and that the construction staging area would be within the project footprint or nearby on paved or previously developed land.

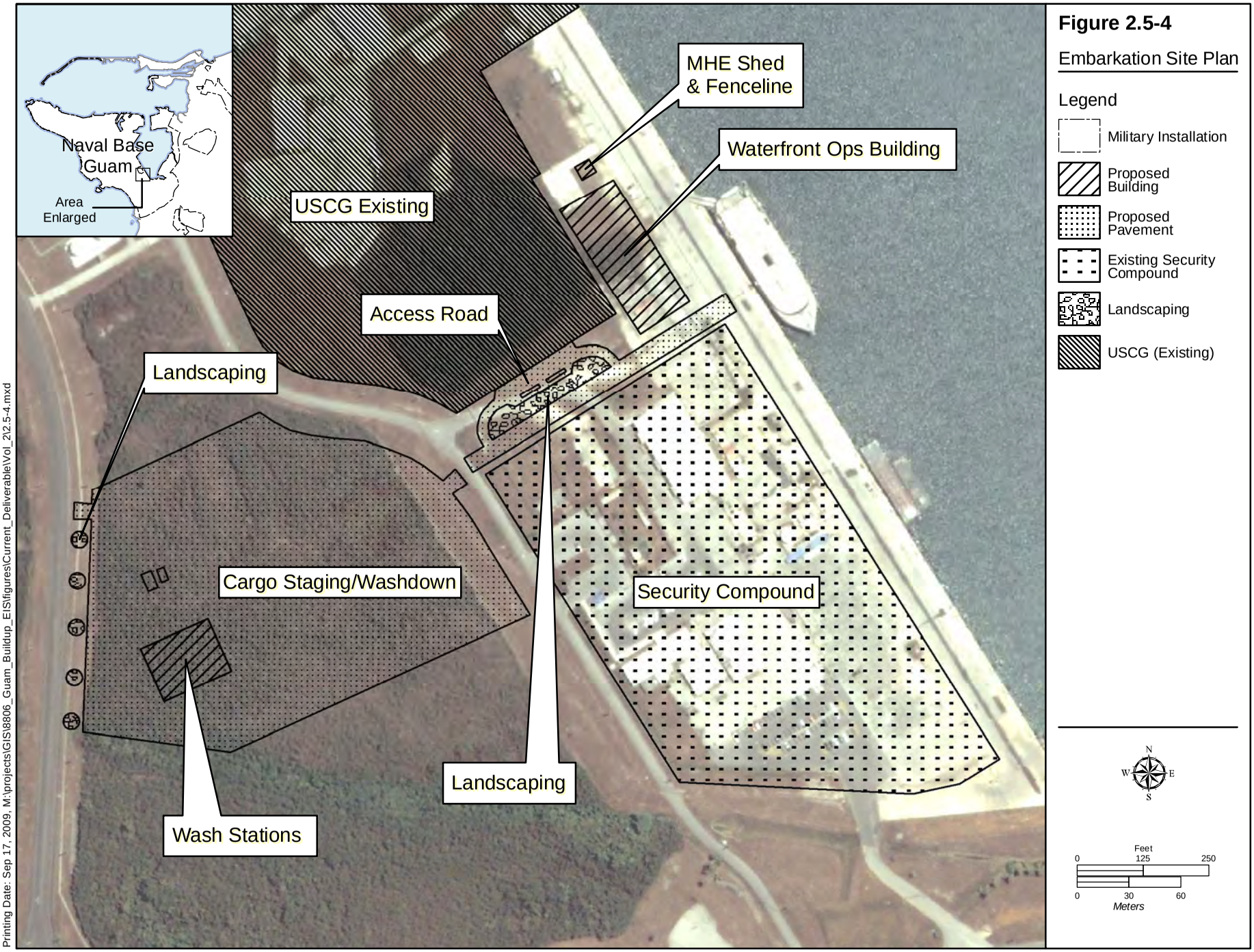

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Table 2.5-2. Embarkation Waterfront Facilities

Location	*Purpose*	*Construction/Improvement Details*
Victor/Uniform Wharf	Victor: Ships carrying amphibious vehicles Uniform: HSVs	• No dredging • Victor/Uniform- repair concrete wharf deck surface, and replace mooring hardware, fenders • Strengthen/reconstruct Uniform to meet seismic and typhoon design standards: • Replace sheetpile bulkhead wharf structure at Uniform to match Victor • Repair voids in soil beneath Uniform wharf • Upgrade/install shoreside electrical, water , wastewater telecommunications infrastructure at Victor and Uniform: • Replace Bilge Oily Waste Treatment with new: generator, processing tank, storage tank, load equalization tank, manifolds with ship connection risers; gravity Bilge Oily Waste Treatment System lines; manholes; force mains; and lift station • Replace sewer collection system: ship connection risers, gravity sewer lines, and manholes • New steam plant: concrete building with boilers, fuel storage, demineralized water production. Replace steam distribution lines • Replace potable water system and fire hydrants • New low pressure compressed air plant • Communications: replace ductlines and include four 4-in (10-cm) ducts for copper and fiber optic cables, and a 2-in (5-cm) duct for cable television cables • Power: ductlines from the Orote Substation to 1 new shore power substation at Uniform and 4 at Victor • Security lighting allowing visual surveillance 100 ft (30.5 m) from wharf face. • Manual fire alarm system for new buildings and sprinkler system for cable hut • Welcome arrival area: kiosks and telephones • Stormwater system upgrades would include new trench drains, storm drain lines, and treatment tanks to prevent surface runoff into the harbor

Location	*Purpose*	*Construction/Improvement Details*
Sierra/Tango Wharves (Note: Tango Wharf included because it must be strengthened to meet new Sierra Wharf dredge depth.	Escort combatants' berthing	Improvements proposed for Sierra Wharf would be implemented for Tango Wharf: • Dredge from -35 to -38 ft MLLW (-10.7 to -11.6 m), approximately 508,877cubic yards (CY) (389,064 cubic meters (m^3)) of dredged material, including 2 feet of overdredge • Wharf strengthening to meet new depth, and seismic and typhoon criteria: repair sheetpile, and tiebacks, and cathodic protection • New concrete deck • Utility/Infrastructure Improvements: • Remove BOWTS system and install a new BOWTS collection and transfer to connect with new BOWTS at Victor • Replace sewer collection system: ship connection risers, gravity sewer lines, and manholes; and connect to existing wastewater system • Replace steam plant with concrete walls • Replace potable water system in existing trenches and fire hydrants. Future planned projects would upgrade offsite supply and pressure deficiencies • New low pressure compressed air plant • Communications: new ductlines would contain four 4-in (10-cm) ducts for copper and fiber optic cables, and a 2-in (5-cm) duct for cable television cables. A new cable hut at Uniform Wharf for distribution of the system • Construct new ductlines for power feeders from the new Orote Substation to the new Ship Repair Facility Substation • 2 new substations • New trench drains, storm drain lines, and treatment tanks to prevent surface runoff into the Harbor • New 6 by12-ft (1.8 by 3.7-m) foam filled fenders and mooring hardware • New Welcome Arrival Center in Sierra/Tango area and one at Victor/Uniform • Security lighting • Manual fire alarm system for new buildings and sprinkler system for cable hut
Southwest of Victor Wharf	New cargo staging area for 230 vehicles and 500 pieces of cargo	• 270,000 ft^2 (25,084 m^2) open paved areas • security perimeter fence • BTS barrier on perimeter
	New wash down area where all equipment and vehicles are rinsed prior to proceeding to cargo staging area	• collocated with cargo staging • 270,000 ft^2 (25,084 m^2) paved area • Vehicle wash area* • BTS barrier on perimeter *

Location	*Purpose*	*Construction/Improvement Details*
Adjacent to Victor Wharf	Waterfront Operations Support Facility	• 34,860ft^2 (3,239 m^2) building footprint • no demolition of existing buildings • single story (plus control tower), concrete construction • administrative space for 6 (975 ft^2) (90.6 m^2) • open-bay billeting for 40 people (2,880 ft^2) (268 m^2) • dining facility (1,840 ft^2) (171 m^2) • restrooms • classrooms • open warehouse for customs and mustering 2,000 troops with gear (20,000 ft^2) (1,858 m^2) • control tower (600 ft^2) (55.7 m^2) • multi-channel public address system • radon barriers • archaeological monitoring during construction • shielded exterior security lighting • new storm water system to prevent surface water from entering the Harbor • new lines and meters for electrical and water utilities (including an electrical transformer), for telephone, fiber optics, and sanitary sewer.
	Material Handling Equipment Storage	• 2,000 ft (610 m) temporary storage for material handling equipment (weather protection) • 1,000 gallon (3,785 liter) de-fueling tank to hold excess fuel removed from trucks prior to loading onto ships

Note: COMNAV Marianas 2001.

The port operations building would be constructed of reinforced concrete with pile foundations. The Material Handling Equipment Storage facility would be reinforced concrete with slab on grade. No subgrade floors are proposed.

The entire cargo staging/vehicle wash area would be paved. There would be BTS perimeter fencing and two gates, providing one-way flow of traffic through the site. There would be a wash-water waste management system that would pre-treat the waste water prior to discharging it to the sanitary sewer. The design would be developed during the design phase.

No demolition of existing buildings would be required but utility structures and boxes along the wharves would be replaced. The entire project area has been paved or landscaped. Trees and shrubs within the cargo staging/wash down area perimeter would be removed.

All utility distribution lines and ductwork would be located underground, generally within existing utility corridors. The storm water management system(s) would have underground pre-treatment components.

Asbestos, lead or polychlorinated biphenyl (PCB) containing material may be present at the wharves and inspections would be conducted prior to construction. Work would comply with applicable regulations for the survey/inspection and management of these materials. Radon mitigation would be incorporated in the building design. There are ESQD arcs at Victor and Sierra (and Romeo), which would not be modified. The port operations building is outside of the ESQD arc. Table 2.5-2 lists the wharf and utility improvements required at the wharf.

Victor, Sierra, and Tango Wharves. Existing wharves are steel sheet pile bulkhead constructed of MZ-38 section steel sheet piles that are laterally supported by 2-3/8 in-diameter (6 cm) tie rods. The bulkhead has a concrete cap/seawall, which extends 2 ft (0.6 m) below the MLLW elevation and encases the internal wale. There is a utility trench in the asphalt. The condition of these wharves is similar. There are sinkholes/depressions in the wharf deck that would be repaired. The sinkholes in the deck would be back filled and paved with asphalt as a safety consideration. Concrete spalling and cracks in the concrete seawall would be repaired. The spalls in the concrete cap could be repaired by removing any loose concrete, installing forms over the spalls, and pumping them with concrete to ensure the long-term durability of the structure. Where there is no cathodic protection the sheet pile is subject to corrosion. Cathodic protection would be installed where it is missing and depleted sacrificial nodes replaced. Steel plates would be welded over holes in the sheet pile grout. The term tremie concrete refers to the pipe used to transfer concrete underwater, in this case, to fill voids near piers and/or abutments. The tremie typically consists of a vertical steel pipe, the lower end of which is designed to remain immersed in the concrete or grout (a mixture of cementitious material and water, with or without aggregate, proportioned to produce a pourable consistency) that is being pumped into the void so that a minimum amount of material comes in contact with the surrounding water. The repair methodology has not been determined, but this is one option for repairing the voids. Mooring hardware, fenders and utility covers would be replaced.

Wharf Repairs. All of the wharves in Apra Harbor have sustained earthquake damage in the past (e.g., the 1993 earthquake) and Uniform Wharf is in the worst condition compared to Victor, Sierra and Tango Wharves. The top of the deck is generally in poor condition, with two areas of continuous depressions and one large sinkhole, up to several feet deep, located along the entire top of the deck. There are vertical stress cracks and the north end of the bulkhead is displaced. There are holes in the sheet pile bulkhead. Further investigations of the tie-back system are required to determine the extent of the repair. The repairs to Victor and Sierra (and Tango) are listed in Table 2.5-2. The proposed action does not require the additional wharf length of Tango Wharf; however, structural improvements are required to avoid structural failure when the adjacent area fronting Sierra Wharf is dredged. Utility upgrades and other improvements would be implemented concurrently with Sierra Wharf improvements for maximum cost effectiveness. These improvements are addressed in this EIS/OEIS.

Wharf improvement contractors would ensure that construction debris does not enter or impact navigable waters. All applicable local, state and federal certifications and permits would be obtained prior to construction, including: Department of Army permit under Section 10 of the Rivers and Harbors Act, Section 404 of the Clean Water Act and Guam Environmental Protection Agency Section 401 Water Quality Certification.

Wharf restoration would likely be conducted using a barge. Demolition waste would consist primarily of concrete or asphalt. Metal would be segregated from the waste for recycling. Demolition debris would be retained on the construction platform and prevented from dropping into the bay. The debris would be offloaded by crane at Romeo or Uniform Wharf into trucks. To the extent possible, and consistent with Navy guidance, construction debris would be recycled.

Dredging. The proposed dredging footprint at Sierra Wharf is shown on Figure 2.5-3. The dredge volume is in Table 2.5-2. Appendix D in Volume 9 of this EIS/OEIS has additional information on dredging. The inverted angular shape of the dredge area shown on the northern boundary is the delineation of the recently completed (2008) Alpha/Bravo dredging to a new construction depth of -40 ft (-12.2 m). There are two general types of dredging operations that could be implemented: mechanical dredging operations and hydraulic dredging operations. The operations vary by the method used to loosen the material from its

in situ state and transport the material from the seafloor to the water surface. The type of dredging equipment that is used would affect the characteristics of the dredged material. Differences in dredged material characteristics resulting from dredging methods as well as logistical considerations relevant to the use of mechanical and hydraulic dredges are described in Appendix D in Volume 9 of this EIS/OEIS. The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane attached to clamshell buckets to retrieve the sediment and deposit it on a scow (barge). It is likely that this method would be used for the proposed dredging; however, the decision would not be made until the final design. The project would likely be a design/build contract that would not be awarded until this EIS/OEIS process has been completed with an approved, signed and published Record of Decision. Mechanical dredging is assessed as the environmentally conservative method of dredging in this EIS/OEIS. Should the contractor choose to use an alternative method, informal consultation with agencies and approval by USACE would be required. The construction tempo is assumed to be 24 hours per day for dredging activity for a construction duration of 8 to 12 months.

A Rivers and Harbors Act, Section 10 (33 USC 403), Clean Water Act, Section 404 (33 USC 1344), and Marine Protection Research and Sanctuaries Act Section 103 (USC 1413) permit application would be submitted to the USACE for approval and would be reviewed by other regulatory agencies. USACE Section 10/404/103 permit is the abbreviated reference for the three permits that are reviewed under one application. Site-specific Best Management Practices would also be developed in coordination with federal agencies and incorporated in this EIS/OEIS as they become available and included in the USACE permit application.

Sediment Characterization. Sediment characterization data for the Sierra Wharf (and the two alternative aircraft carrier wharf locations described in Volume 4) site suggest most, if not all, of the material would meet the testing criteria and be suitable for upland placement, or ODMDS disposal (NAVFAC Pacific 2006). Chapter 4, Water Resources, summarizes the sediment characterization data. No Navy dredging project on Guam has required designation of an upland site for the treatment or remediation of sediment. None is anticipated for this proposed action. This EIS/OEIS relies on the existing sediment characterization results to assess impacts. Laboratory data are generally considered valid for a three-year period and additional analysis per 40 Code of Federal Regulations Part 227 would be the basis of a dredged material management plan that would be included in the USACE Section 404/10/103 permit application. It is possible that multiple disposal methods would be appropriate for the project.

Dredged Material Disposal. The EIS/OEIS considers four potential disposal scenarios: 100% ODMDS disposal, 100% upland placement, 100% beneficial reuse, and 20-25% beneficial reuse/75-80% ocean disposal, which are discussed further below.

Under the 100% upland placement scenario, five upland placement sites on Navy land have been identified for potential use in support of the proposed dredging action. These sites are referred to as Field 3, Field 4, Field 5, PWC Compound and Polaris Point and are described in Appendix D (Volume 9). Fields 3 and 5 and Polaris Point have been proposed for other dredging projects and have been addressed in other NEPA documents. Field 4 and PWC Compound sites are addressed in this EIS/OEIS. Two of the alternative sites, Polaris Point and Field 5, would have sufficient capacity to accommodate all of the anticipated dredged material from the proposed action with modification of existing berms at the sites. Thus, used in combination with ODMDS and beneficial reuse, only a portion of the candidate sites would be required to accommodate the dredged material.

Beneficial reuse is the preferred disposal option for clean dredged material when practical. The material must meet engineering specifications for the specific beneficial reuse. A number of opportunities for

beneficial use have been identified, including beach re-nourishment, backfill for a commercial port expansion, construction material for roads, or daily landfill cover. Prior to beneficial use, the dredged material must be tested to ensure it meets the engineering specifications for the proposed reuse. If a beneficial reuse is not identified for this dry material it would occupy valuable space that could otherwise be available for more dredged material.

Between 1 to 1.1 million cubic yards (cy) of dredged material would be excavated from the Inner and Outer Apra Harbor for the proposed Marine Corps and Navy actions. The dredged material is expected to consist of a mixture of sediments including sand from the outer harbor and silts/clays from the inner harbor. Additionally, there will be coral fragments and other submerged rubble that would be included in the volume of dredged material from the outer harbor dredging.

Beneficial reuse of portions of this total volume would be possible and several local projects have been identified. These local projects include:

- *Support shoreline stabilization below Aircraft Carrier Wharf:* As part of the construction process, some fill would be used with the rip rap stone that would be placed along the shoreline and under the wharf to support the piles. Approximately 40,000 cy of quarry stone in addition to an estimated 20,000 cy of rip rap stone is envisioned for this stabilization purpose. It is possible that some of the rubble or some other suitable material from the dredged material could be used and mixed in below the quarry stone layer. Therefore, it is estimated that approximately 50% of the quarry stone amount or 20,000 cy of the dredged material could be used.
- *Fill of berms and backstops at proposed military firing ranges on Guam:* There are a number of berms and backstops that would be constructed as part of the development of new military firing ranges on Guam. The berms range in length from 35 to 255 ft (11 to 78 m); 7 to 56 ft (2 to 17m) in width; and 3 to 7 ft (1 to 2 m) in height. Fill would be used to create these earthen mound structures. The volume within these berms and backstops has been calculated and equals an estimated 160,000 cy.
- *Port Authority of Guam (PAG) expansion program:* The PAG has prepared a Master Plan that includes a proposed eighteen acre area for expansion of fast land to support new commercial port cargo handling in Apra Harbor. The potential in-water expansion project is an ambitious endeavor that may be confronted with cost, feasibility and ecological concerns and also requires full environmental documentation by the USACE and subsequent permit approval before implementation. Up to 1.5 million cy of fill would be needed to create this new land if this PAG expansion program comes to fruition. The Navy has a memorandum of agreement with PAG to provide fill from proposed dredging projects should the material be deemed suitable and the timing and logistics of both projects work out.

Given the potential availability of these upland beneficial use projects on Guam, the following four scenarios are possible for the disposal or placement of the proposed dredging projects in the inner and outer Apra Harbor:

- 100% beneficial use with all dredged material being used as artificial fill for the PAG expansion program (either direct waterfront placement or following placement at PAG upland placement site)
- 20-25% beneficial use of dredged material in berm construction and under wharf for shore and pile stabilization (assumes no PAG need and/or logistics/approval problems for use of fill) and 75 to 80% ODMDS placement;

- 100% upland placement on existing Navy confined disposal facilities on base on Apra Harbor; and
- 100% placement in the Guam ODMDS.

The U.S. Environmental Protection Agency (USEPA) is pursuing the designation of an ODMDS approximately 11 to 14 nm (20 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and an ODMDS EIS is being prepared concurrent with this EIS/OEIS. Ocean disposal is regulated under Title 1 of the Marine Protection, Research, and Sanctuaries Act (33 USC 1401 et seq). Formal designation of an ODMDS does not constitute approval of dredged material for ocean disposal.

Results from additional analysis and testing would be required to develop a dredged material management plan and the USACE Section 404/10/103 permit application. Ocean disposal is only allowed when USEPA and USACE determine that the project dredged material: 1) is environmentally suitable according to testing criteria, as determined from the results of physical, chemical, and bioassay/ bioaccumulation testing that is briefly described in Section 2.7 (USEPA and USACE 1991); 2) does not have a viable beneficial reuse; and 3) there are no practical land placement options available. Any dredged material deemed not suitable for ocean disposal would need to be placed on land as the method of disposal.

Volume 9, Appendix D contains additional detail about dredging issues related to the proposed action, including potential dredging methods that could be used, Alternatives for reusing or disposing of dredged material, and specific assumptions made in the EIS/OEIS analysis.

Proposed Operations

This section provides more detail on the specific proposed projects on the western side of Inner Apra Harbor. The duration of each amphibious task force visit would range between 6 and 21 days. A typical schedule on Guam is shown in Table 2.5-3. Distribution throughout the year may vary, due to the subjective and mission-dependent nature of MEU-level events. Inclement weather may also impact event schedules.

Table 2.5-3. Approximate MEU Administrative/Non-Tactical Event Schedule

2–3 Days	*2 Days*	*5 Days*	*2 Days*	*2–3*
Agricultural Inspections	Debarkation/Set-up	Active Firing Range Use	Clean-Up	Agricultural Inspections

The MEU training would bring approximately 2,000 additional military personnel to Guam as a transient (i.e., visiting) population. They would not be provided housing or be using on- or off-base amenities (except during periods of leave and liberty). They would be camping and training 24-hours per day. The MEU may train on Guam or continue to Tinian after a Guam port call. The amphibious task force ships would continue to occupy a majority of the wharves in western Inner Apra Harbor. The ships carrying amphibious vessels would berth near the embarkation facilities. The combatant escort ships would berth at other Inner Harbor Wharves. Specific wharf assignments are determined by operational requirements by Naval Base Port Operations.

The Port Operations Group is part of the on-island Marine Logistics Group (CLR-37). They work closely with Base Operations to provide logistics support at the waterfront before, during and after amphibious task force visits. They are provided administrative space and a port control tower in a stand-alone building at the waterfront. They would support other training events when the amphibious task force is not in port.

Cargo arrives in Guam preloaded on trucks (or LCACs) that are transported by the amphibious task force ships. If there is a training mission on Guam, the trucks drive off the ships' stern ramps. Other cargo may be offloaded by mobile crane. Large 50,000-pound-capable forklifts, assigned to the CLR-37, would be used to move the cargo and would be stored temporarily in a material handling equipment building at the waterfront.

No maintenance of equipment or vehicles is anticipated in the support buildings.

Biennial Reporting System inspections would be conducted with significant involvement of USDA personnel based on procedures developed in the Biosecurity Plan. Wash racks are raised platforms with ramps at either end that facilitate cleaning of undercarriages. The design system assumptions are based on a description of a similar facility on Guam that was never built (COMNAV Marianas 2001). Vacuum, high pressure water and steam would be provided in addition to a wash water waste treatment system. The facility would include sedimentation, oil/water separation/filter pressure booster pumps and pressure, and filters. The filtered water would be stored on site and fresh water would be added to make up losses from recycling. When washing is complete, wastewater from the systems would drain to the sanitary sewer. Final design of wash system is pending.

Shipboard solid waste would be steam-cleaned prior to disposal in the Navy landfill or other on-island landfill, such as the GovGuam proposed landfill in Dandan. Any regulated or hazardous waste would be managed in accordance with base standard operating procedures.

Personnel, cargo, and equipment would travel in trucks, buses, and HMMWV or Humvee on civilian roads to a bivouac/expeditionary camp site at Andersen South or other training venue. It is anticipated that these transport events would occur during evening hours or other non-peak travel hours to avoid peak traffic periods. Approximately 15 trucks would travel as a group, with distance and time between caravans to minimize interruptions to civilian traffic flow. The number of trips varies with the mission. On return to the wharf, the vehicles and equipment would be inspected and washed prior to being loaded onto the ships carrying amphibious vehicles. The amphibious task force would arrive fully supplied to meet all training requirements or would be replenished, as needed, prior to training on Tinian.

Prior to being loaded on the ships, trucks may be required to offload fuel and there would be a 1,000 gallon above ground storage tank at the wharf for holding this fuel.

During embarkation events, the amount of noise generated would be typical of large congregations of people, buses, and trucks. There would be diesel equipment (i.e., forklifts) to move cargo.

When there are no Marine Corps operations at the site, other transient ships would be berthed at Victor Wharf at Port Operations Department discretion. Transient vessels may be permitted to use port operations facilities.

All facilities would have security lights mounted on either buildings or steel poles. Lighting along the wharves would consist of 1,000 watt high pressure sodium floodlights mounted on new or existing poles. The lighting would be shielded and aimed such that the majority of the illumination would be directed towards the wharf deck and extend over water about 100 ft (30.5 m) to satisfy security requirements. No other aerial structures are proposed.

Due to the frequency and duration of the amphibious task force visits, the ships require more shoreside utility support than is currently provided. The requirement for transient ship support, as described in Volume 4, is that ships should be provided full service utility infrastructure support to enable them to turn off their shipboard systems and rely on shoreside utilities for maintenance and repair activities. Under the

proposed action, there would be utility, infrastructure and wharf improvements at Victor, Uniform and Sierra Wharves to allow the ships to turn-off all onboard utility systems and rely entirely on shoreside systems for communications, cable, wastewater, water, bilge oily waste treatment system (BOWTS), fire protection, compressed air and steam. The specific improvements are listed in Table 2.5-2. The new BOWTS facility would be constructed at Victor Wharf but serve other wharves including Sierra and Uniform Wharves.

Stormwater would be pre-treated to remove contaminants prior to discharge into the Harbor. The design would be developed during the design phase. There would likely be multiple systems to cover the entire project area. The system would be designed to a typical Guam storm event, not a 100-year storm.

The wharves were constructed in 1946 and all sustained damage in a severe earthquake in 1993. Uniform Wharf is not in use because of the extent of the damage. It would be reconstructed to accommodate a depth of -32 ft (-10 m) to match Victor Wharf's structure. Cathodic protection would be provided and the design would meet seismic and typhoon resistance standards. Soil voids beneath the deck would be repaired.

Waterfront Project: LCAC/AAV Laydown Area

Proposed Facilities and Construction

The LCAC/AAV laydown needs to be remote from other operations because of the noise and spray associated with the LCACs. An alternatives analysis was conducted as described below. The only site that is retained for this EIS/OEIS analysis is in the northeast corner of Inner Apra Harbor southeast of Alpha Wharf. The site plan is shown on Figure 2.5-5.

The proposed site is on DoD land, vacant, within a man-made fill area. No land use constraints were identified. A new asphalt access road is required that connects with Marine Drive. No traffic signal is proposed, but standard traffic management practices would be followed. Utilities (wastewater, potable water, communications, and power) would be extended to the site from Marine Drive.

The entire site (468,000 ft^2 [43478.6 m^2]) would be developed. Four buildings proposed at the site are listed in Table 2.5-4.

Table 2.5-4. LCAC/AAV Laydown Area Buildings

Facility	*Area ft^2/m^2*
AAV Maintenance Shop	2,131/198
AAV Communications/Electrical Shop	4,080/379
Hazardous materials/flammables Storage	40/3.7
Reconnaissance Boat Shop	8,670/805

Source: NAVFAC Pacific 2009.

The majority of the site would be paved for use as an LCAC parking apron, taxiway and landing ramp, and AAV ramp and parking area. There would also be parking (10,600 ft^2 [984.8 m^2]) provided for personal vehicles and a MEU vehicle staging area (60,550 ft^2 [5,625.3 m^2]). A vehicle wash facility, which has not yet been sited, would be provided to rinse the salt water from the vessels. A 2,500 gallon tank for fresh water would be at the site and the washrack design may include recycling and pre-treatment. Washwater runoff treatment and reuse would be incorporated into the final design. The design of this wash facility would be smaller and less complex than the wash facility proposed at the cargo laydown area near Victor Wharf.

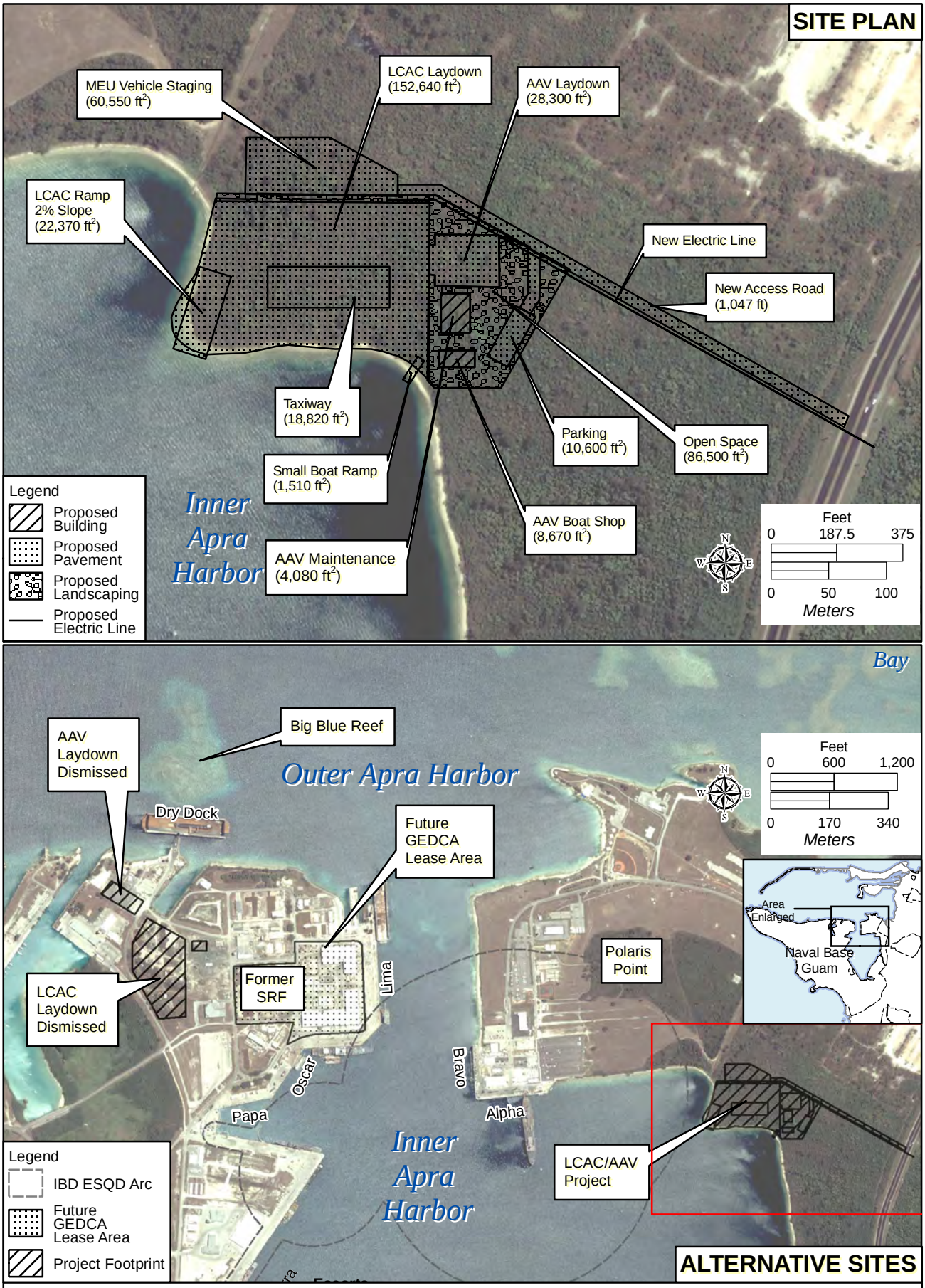

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Figure 2.5-5
LCAC/AAV Laydown

The facility perimeter would be a concrete BTS barrier except the 30 ft (9.1 m) gate, which would have BTS deterrent mesh fabric. The fence would be dual purpose: BTS deterrent and security.

The buildings would be reinforced concrete slab on grade and designed to resist 170 mph winds and meet Guam seismic standards. The design would meet LEED silver criteria. Stormwater would be pre-treated prior to discharge into the harbor.

The site is undeveloped and no demolition is required. Vegetation including trees and shrubs would be removed from the site. The entire project area (468,000 ft^2 [43478.7 m^2]) would be graded and grubbed. The construction staging area would be located within the development area. The area is within the wildlife Overlay Refuge. There are no mangroves/wetlands identified at the laydown site or access road area.

In-water work would consist of two new concrete ramps, which are similar to recreational boat ramps observed at marinas. The slope of the AAV ramp would range between 12 and 15%. Ramp surface would be paved down to an elevation of 3 ft (0.91 m) below extreme low water. The top would be rounded over on a 20 ft (6.1 m) vertical curve until it becomes nearly level at about 2 ft (0.6 m) above extreme high water. The single lane AAV ramp would be approximately 15-ft (4.57-m) wide. Any part of the ramp that must be placed underwater would be of precast sections. The LCAC ramp has a 2% slope requirement and construction would be similar to the AAV ramp. Construction would likely be during daylight hours only, Monday through Friday, but there is potential for a 7-day work week.

Proposed Operations

On average, four LCACs and 12 to 15 AAVs would participate in the MEU activities on Guam. In Apra Harbor, the LCACs and AAVs would launch from the ship in Inner or Outer Apra Harbor and travel to a proposed laydown area near Alpha Wharf at Polaris Point.

The AAV and LCAC could be berthed at a wharf but it is easier to unload cargo and vehicles from the vessels on land. With the proposed project, the LCAC and the AAV would each have a dedicated ramp to access their respective laydown areas, which are adjacent to each other in the same BTS "safe" zone. The ramps are designed for one vessel at a time. Each vehicle would be rinsed on arrival to remove sand and salt spray. The vehicles may be carrying cargo to the laydown area and conversely cargo might be loaded onto the vehicles at the laydown area. With each MEU event, an estimated 15-20 LCAC loads (including personnel, equipment, and cargo) would be transited sea to shore from the LHD, LSD, and/or LPDs in Outer Apra Harbor to the proposed LCAC/AAV laydown area upon the arrival and departure and of the visiting amphibious task force ships. These transits would occur in tandem between the hours of 0700 and 1900 and would adhere to speeds consistent with the Inner Apra Harbor no wake zone. If cargo is loaded or unloaded at the LCAC/AAV laydown area, agricultural inspection is required as described for the embarkation cargo staging area at Victor Wharf.

Each vehicle would be rinsed on arrival to remove sand and salt spray, which deters corrosion and increases vessel efficiency.

AAVs produce noise comparable to a diesel powered boat on water. On land, the AAV tracks generate noise when moving on hard surfaces.

LCACs are powered by gas turbines using two large shrouded propellers at the stern for forward propulsion. The thrust from the propellers is up to 32,000 lb in forward mode. Two bow thrusters are rotated as a pair with 360 degree capability. During forward movement the thrusters are pointed aft. The bow thrusters are fed by the lift system; therefore, sand, gravel or other debris on the ground that gets

sucked into the intake points would be thrust out of the bow thrusters at high velocity (5,050 lb is the maximum thrust in forward motion). Impacts 100 yards (yd) (91.44 m) away have been noted (anecdotal observation). LCACs generate a significant amount of noise that is generated primarily by the fans and propellers, not the engines that power these systems. The number of personnel on the laydown area during LCAC operations is restricted to minimum number of trained personnel to maximize safety. The following assumptions are made regarding LCAC operations in Apra Harbor:

- *Departure:* LCACs would be at idle power for 4 minutes in the parking stall, depart the stall and taxi at 5 knots to the ramp, and accelerate at the ramp hitting the ocean at 20 knots before decelerating and operating at a speed that does not impact berthing at Polaris Point or on the main side.
- *Arrival:* LCACs would decelerate to ramp approach power, then taxi to the washdown area. LCACs would be at the wash rack for 5 minutes at idle power and then taxi to the parking stall and idle for 2 minutes before shutting down.

Although no amphibious training or maneuvers conducted in Inner Apra Harbor are analyzed in this EIS/OEIS, any amphibious training or maneuvers that would be conducted in Apra Harbor are described in the MIRC EIS/OEIS (e.g., at Reserve Craft Beach).

Waterfront Project: USCG Berthing and Crew Support Building Relocation (MILCON P-1002)

Proposed Facilities and Construction

A site plan is shown on Figure 2.5-6. The entire length of Oscar and Papa Wharves (1,079 ft [328.88 m]) are required to berth the USCG vessels (Table 2.5-5). The rescue boats (small inflatable's) are kept on the cutter unless they are deployed for operations or undergoing maintenance.

Table 2.5-5. USCG Ships

Vessel	*Vessel Length (ft)/m*	*Feet of Berthing per Vessel (includes tie down) (ft)/m*	*Number of Vessels*
Cutter	110/34	320/98	2
Buoy tender (WPB, WLB)	225/69	270/82	2 -WPB, 1- WLB
Response Boat-S (RB-S)	25/8	90/27	3

The primary facilities required are as follows:

- 2 single-story Fleet Landing Support Buildings for:
  - Patrol boats (5,576 ft^2 [518.02 m^2])
  - Cutter (9,558 ft^2 [888 m^2])
- Hazardous material storage locker (215 ft^2 [20 m^2])
- Utilities/infrastructure:
  - Pole mounted lights security lights
  - Power: emergency generator, electrical substation, underground secondary power distribution and manhole duct system and utility mounds to support the wharf use
  - Storm water management: a new system would provide pre-treatment prior to discharge into the Harbor
  - Water and wastewater systems
  - BOWTS
  - Fire protection water supply
  - Communications
- Parking: personal vehicles and bicycles
- Perimeter security fencing/gate

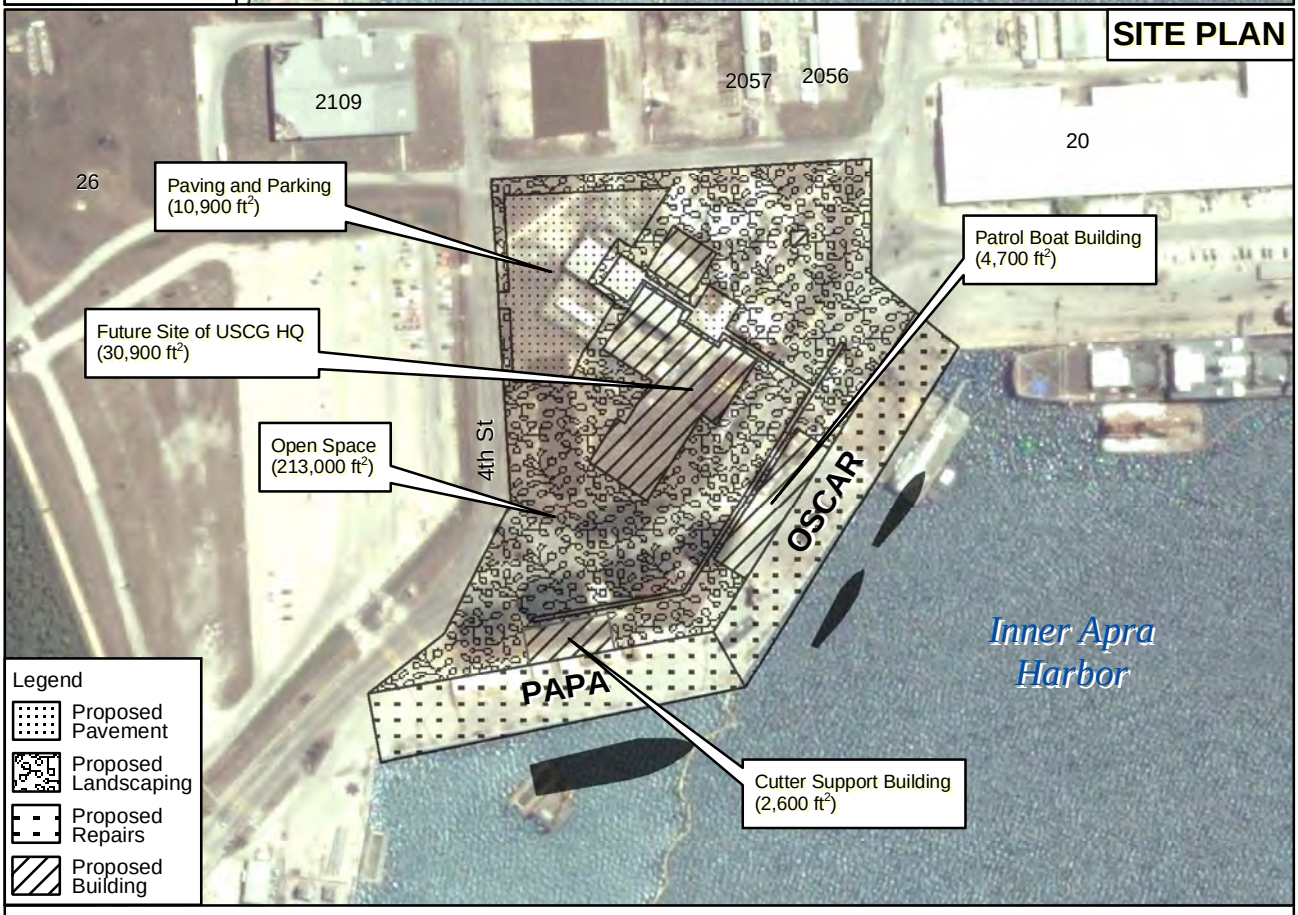

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Figure 2.5-6
USCG Site Plan

Feet: 0, 125, 250
Meters: 0, 30, 60
N, W, E, S

The Fleet Landing Support Buildings contain administrative spaces, male/female bathrooms, laundry facilities, shop spaces, storage, mechanical and janitorial spaces. Munitions and weapons are stored on the cutter. The armory would be an existing facility off site.

There are existing access roads (4th Street) to the site as shown on the aerial (refer to Figure 2.5-6). There may be a need to redirect non-USCG traffic that currently goes through the site to another existing route for security reasons. Traffic in the area is primarily ship repair workers and Navy personnel.

Wharf upgrades include repair of the concrete bulkhead, a new fender system, and mooring hardware. No dredging is required. There would be repairs to the concrete bulkhead, but the repairs would not require demolition or replacement of the support structure. Portions of the work may have to be conducted from the water on a barge moored at the wharf. Precautions would be required to prevent construction material or waste from entering the harbor. Conditions imposed at the recently completed Alpha /Bravo Wharves Improvement project would be similar to those for the USCG project and include:

- The Contractor would install a moveable containment shield/platform mounted along the face of the existing wharves during concrete chipping, roughening, and core drilling work to prevent debris from falling into the water during work at the existing and new concrete bulkheads.
- No contamination from trash, debris disposal, and alien species introductions would be permitted. Equipment operated at the wharves would be adequately maintained and periodically checked to ensure no leakage of fuel, hydraulic fluids, or other lubrication product into the water.

The site has been extensively developed, and there are seven buildings (Buildings 24, 27, 29, 40, 42, 43, and 2078) (refer to Figure 2.5-6), as well as utility structures at the site. All facilities would be demolished. Some of these structures are in use by the civilian shipyard and those operations would have to be relocated to the proposed consolidated ship repair compound, pending lease renegotiation. The construction staging area would likely be within the site boundary or possibly in adjacent graded areas.

There is documentation of environmental contamination at the former shipyard repair facility (Building 27, near Oscar wharf) and soil remediation may be required prior to construction, pending soil analysis. The existing cluster of trees would be retained in the area designated for open space. Assume the remainder of the site would be re-graded.

All buildings would be reinforced concrete slab on grade. No basements or subfloors are proposed. There would likely be excavation for soil remediation and there would be subgrade ducts for utilities and stormwater control components. Any contaminated soil would be managed in accordance with the project environmental management plan. Stormwater runoff control would be implemented in accordance with the NPDES permit and the Stormwater Pollution Prevention Plan.

Grading may require approximately 9,809 CY (7,500 m^3) of fill. Grading and grubbing is required over approximately 80,700 ft^2 (7,500 m^2). Facility design would meet LEED Silver criteria and comply with Energy Policy Act 2005.

Proposed Operations

The USCG conducted a relocation feasibility study in anticipation of Marine Corps embarkation requirements at Victor Wharf. Three candidate sites were identified and the preferred site is 9.2 ac (3.72 ha) in the vicinity of Oscar and Papa Wharves, which are located in the northwest corner of Inner Apra Harbor (refer to Figure 2.5-6). The land is Navy-owned and has historically been used as a Navy Ship

repair facility until it was closed as a result of the 1995 DoD Base Realignment and Closure Commission decisions. The area was requested for civilian reuse by GovGuam following closure. Use of the facility assets was transferred through leasehold to the private sector through the Guam Economic Development and Commerce Authority (GEDCA), although the Navy retains title to the property. The term of the lease ends in 2012 and there is an opportunity to reduce the footprint of the ship repair facilities, which are dispersed through the lease area, during contract renegotiation.

The relocation and consolidation would occur in phases as funding becomes available. The first phase addresses the Marine Corps requirement for the use of Victor Wharf, in its entirety, to berth the amphibious task force ships. USCG owns a 200 ft (61 m) length of Victor Wharf and holds a license agreement on an additional 250 ft (76 m). USCG floating assets and support facilities are a priority for relocation to the Oscar/Papa Wharves site and are covered in this EIS/OEIS. The existing USCG HQ facility would remain in the vicinity of Victor Wharf, pending funding for Phase 2 of the relocation.

Approximately 110 personnel would drive their own vehicles to work at the Oscar/Papa Wharves during the standard Monday through Friday work week. Twenty of these personnel are administrative and remain at the site during the day. The presence of the other personnel is mission-dependent. Weekend personnel (approximately 16–20) work on the ships. There is no shift or evening work; however, emergency response and ships returning from missions would occur during evening hours.

Supplies for the cutter are delivered to the wharves from Navy supply warehouses. No agricultural inspection is anticipated. Supplies would not be delivered to the wharf from other locations by USCG ships.

No land use constraints were identified at the site that would interfere with USCG operations. The proximity of commercial ship repair facilities requires a anti-terrorism force protection stand-off distance from access routes and non-Navy buildings.

The units relocating during the first phase of relocation would include:

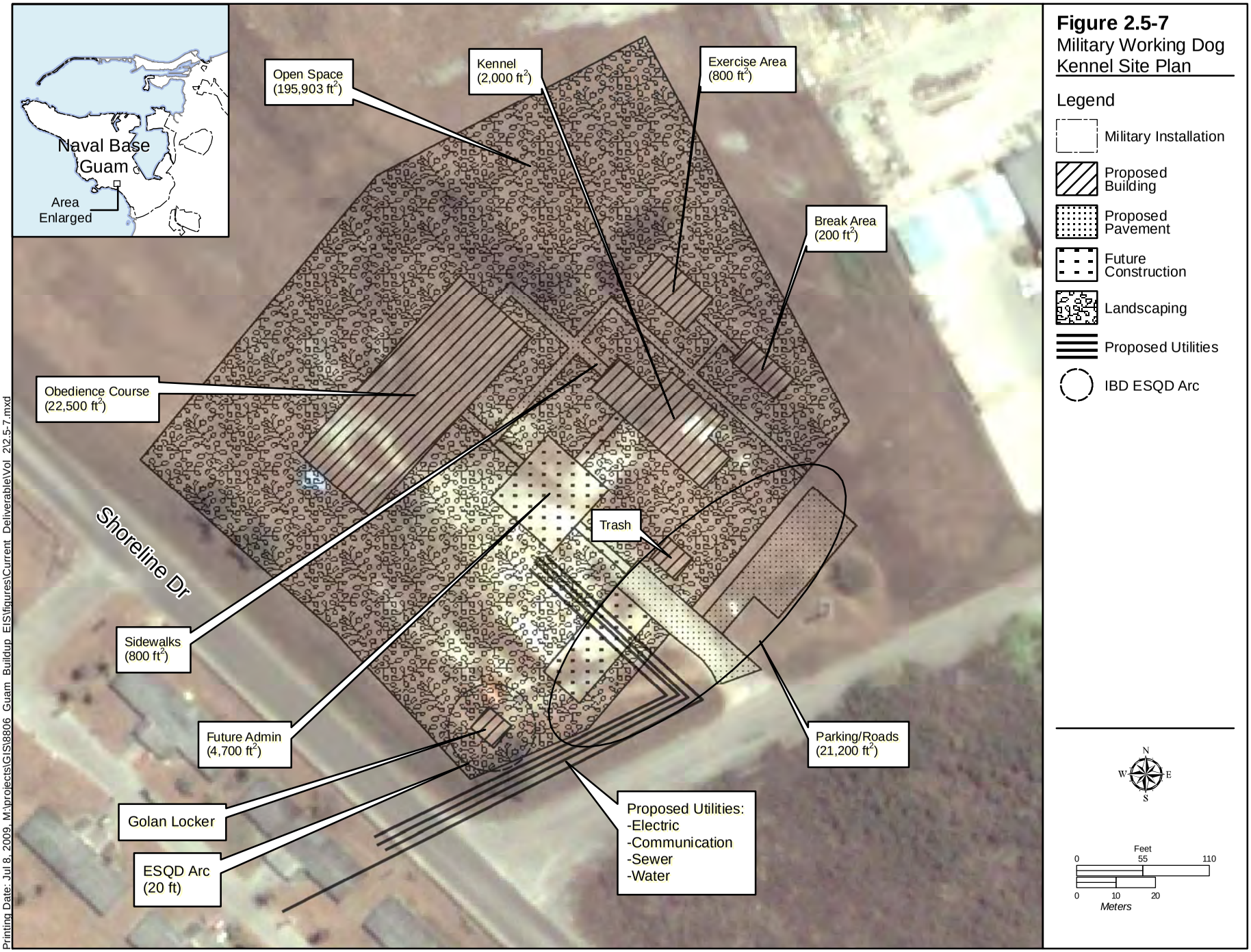
- Electronic Support Detachment, which provides electronic, telephone, and computer support to Sector Guam, Coast Guard Cutter (CGC) Galveston Island, Far East Activities Japan, Far East Activities Detachment Singapore, Marine Safety Detachment Saipan, and secondary support for CGC Sequoia.
- CGC Galveston Island and CGC Sequoia. CGC Galveston Island performs law enforcement, search and rescue and military readiness missions, while CGC Sequoia primarily is responsible for maintaining the fixed and floating aids to navigation for the territorial waters of Guam and the CNMI.

The use of the site would be typical of other working wharves and access to buildings and wharf areas would be restricted by perimeter fencing and gates with locks and traffic bollards. Trucks would arrive regularly at the site to deliver supplies for the cutters and there would be equipment such as forklifts on site to load supplies on the ship. Minor equipment maintenance and repair would occur in the support structures. The site would not generate noise or light that is different from other Navy wharves.

Waterfront-Related Project: Military Working Dog Kennel Relocation

Proposed Facilities and Construction

The MWDK facility (Figure 2.5-7) would include a 2,040 ft^2 (190 m^2) single-story building that provides space for dog kennels for 10 military working dogs (includes both indoor and outdoor runs), four quarantine runs, two tack rooms, bulk storage area, food storage area, food preparation area,



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administration space for 13 personnel, bathroom, locker room, veterinary exam area, multi-purpose conference/break area, outdoor dog wash, circulation space, and a mechanical equipment room and exterior enclosure for dehumidification equipment, and relocating the existing explosive/hazardous material locker (Golan 10 locker). The locker would generate a 20-ft (1.9-m) radius ESQD arc. There would be an outdoor obedience/training course (22,500 ft^2 [2,090 m^2]), exercise area (800 ft^2 [74 m^2]) and break area (200 ft^2 [19 m^2]), all with self closing/self-latching gates. The project would provide Intrusion Detection System at gate entrance and at building door entrance.

Site improvements include an 8-ft (2-m) high chain link fence with 3 strands of straight wire along the perimeter of the working dog site with a 20-ft (6.1-m) wide service gate for vehicular access for food deliveries to the kennels and other access requirements into the working dog compound. Project includes a perimeter fence for the Golan 10 hazardous material area at the 20-ft (6.1-m) arc setback with a gate for vehicular access, and fencing around the obedience training course, exercise and break areas. Hedges would be used as a visual screen to minimize distractions from other dogs while training. Parking would be provided for personal vehicles and organizational vehicles.

There would be security lighting and lighting specifically for the obedience training course, which would be mounted on poles and the building. A central dehumidification system would provide a controlled environment for the dogs in the building. Fire sprinklers systems and air conditioning would be throughout the building. Utilities provided to the site would be underground and include water, wastewater, and telecommunications.

The existing facilities at Victor Wharf are not scheduled for demolition as part of new site construction. The proposed site is currently used for a temporary laydown area for base maintenance contractors. There are conex containers on site that would be relocated by maintenance contractor. No demolition at the site is required.

No land use constraints were identified at the site except radon. Radon mitigation is included in the inhabited building design. Low levels of PCB contaminants have been identified approximately 400 ft (121.92 m) north of the site. Soil testing would be conducted prior to construction. No trees would be cleared. Access to the site would be from existing roads and utilities would tie into the utilities along the roadways. Area of grading/grubbing is approximately 85,301.84 ft^2 (26,000 m^2) and landscaping would be required for 65,617 ft^2 (20,000 m^2).

The single story buildings would be constructed of reinforced concrete and/or concrete masonry unit with seismic upgrades, pile foundation, and with all components such as exterior walls, windows, roofing, mechanical and electrical systems compatible with the Guam environment and COMNAV Marianas design standards.

The project provides for electrical and mechanical systems including fire alarm and fire monitoring/ control panels, information systems, telephone, Energy Management Control Systems, plumbing, fire protection systems, and heating, ventilation, and air conditioning systems. Information systems include telephone and data. Utilities at the site would include power, emergency generator, water, and wastewater. Utility tie-in would be at Shoreline Drive. There is a trash enclosure on site.

The kennels would have a central dehumidification system that controls indoor environment to meet 9 Code of Federal Regulations Chapter 1 Part 3 “Animal and Animal Products Standards” regarding temperature and humidity.

Project includes AT/FP building and site measures in compliance with UFC 4-010-01, dated October 8, 2003, including Change 1, January 22, 2007. AT/FP protection measures include the required standoff distances from parking, roadways, and existing inhabited buildings in the area. Physical security equipment includes intrusion detection system for the GOLAN 10 hazardous material locker and the drug storage area.

The total area of ground disturbance during construction would be 209,100 ft^2 (19,426 m^3) The building would be constructed of reinforced concrete with slab on grade foundations, meet current design seismic standards, and be able to withstand 170 mph winds. The facility would meet LEED silver standards and comply with Energy Policy Act 2005 requirements. The specific LEED design features would be developed with final design but would include battery storage photovoltaic systems, high efficiency windows (low-e coated glazing), and water conserving plumbing fixtures with electronic controls where possible.

Construction duration is estimated at 1 year, with a Monday through Friday work week during daylight hours. Construction skills and equipment are typical of Navy base construction. Solid waste would be transported to the Navy Landfill.

Proposed Operations

A new MWDK is proposed to replace the one within the Security Compound at Victor Wharf (refer to Figure 2.5-7). The noise generated by the Marine Corps during embarkation operations at Victor Wharf and at the proposed adjacent cargo staging area would likely disturb and distract the military working dogs. Relocation of the facility is proposed.

The military dogs are required for explosive/narcotic detection, antiterrorism force protection, and are deployed. The dogs live and train at the kennel. There is one handler assigned to each dog. They train and deploy as a team. There are typically nine teams in residence at the kennel, but the schedule is mission driven and unpredictable. The dogs are provided indoor and outdoor runs.

The facility is staffed by a kennel master and a kennel support person. There are frequent visits by organized groups of students and youth groups. Access to the site is generally by car. Training is done on site during the day and at night in outdoor obedience training courses. Working hours for the staff are generally 8:00 a.m. to 5:00 p.m.; however, evening missions would require staff. Evening training is a routine event. The dogs also train at other training facilities on-island and the frequency is dependent on the use of the other facilities. There are six patrol cars on site for transporting the dogs. Training aids include narcotics and explosives which are stored and handled in accordance with DoD regulations.

The proposed facility does not provide for USDA inspection dogs. The missions, characteristics, and needs of the USDA BTS dogs are different from the Military Working Dogs; therefore, separate areas are required for the agency-unique management and specialized training requirements of the two types of dogs and their handlers.

There is room for expansion at the proposed site to accommodate future expansion. No heavy equipment is used at the site. There are minor amounts of hazardous materials (oxidizers) stored in a suitable cabinet. Explosives (1.1 CD) are kept in a hazardous material locker (Golan Locker) that generates an ESQD arc (20-ft [6.1-m] radius) on the premises.

The dog wastes would be washed into the sanitary sewer system.

Waterfront-Related Project: Apra Harbor Medical Clinic (MCH-006)

Proposed Facilities and Construction

The proposed site is centrally located on the installation on Marine Drive, near existing family and bachelor housing areas. The clinic (Figure 2.5-8) would include administrative spaces, medical, mental health and dental clinic spaces, urgent care clinic, preventive medicine, ancillary services, and parking for personal and emergency vehicles (approximately 290 spaces) (see Figure 2.5-8). The space allocation and designs are provided by Bureau of Medicine and Surgery (BUMED). Apra Branch Health Clinic (medical and dental) would be a single-story concrete facility of 43,091 ft^2 (4,003.28 m^2).

The total project area within the perimeter of the facility equals 334,000 ft^2 (31,029.62 m^2). Security lighting would be mounted to the building and poles in the parking area. Assume an emergency generator would be provided to provide back-up power.

The site is vacant. A portion of the area was used for base maintenance activities and there are remnants of large paving areas where buildings were previously located. There are no known land use constraints in the vicinity, except radon is a concern in Guam soils. Radon mitigation is proposed in the floor design. No tree removal or wetland disturbance is expected.

The project consists of constructing one single-level outpatient facility. Assume the entire site (334,000 ft^2 [31029.62 m^2]) would be graded during construction. The facility would be constructed of reinforced concrete with slab on grade foundations, and with all components such as exterior walls, windows, roofing, mechanical and electrical systems compatible with the Guam environment and COMNAV Marianas design standards.

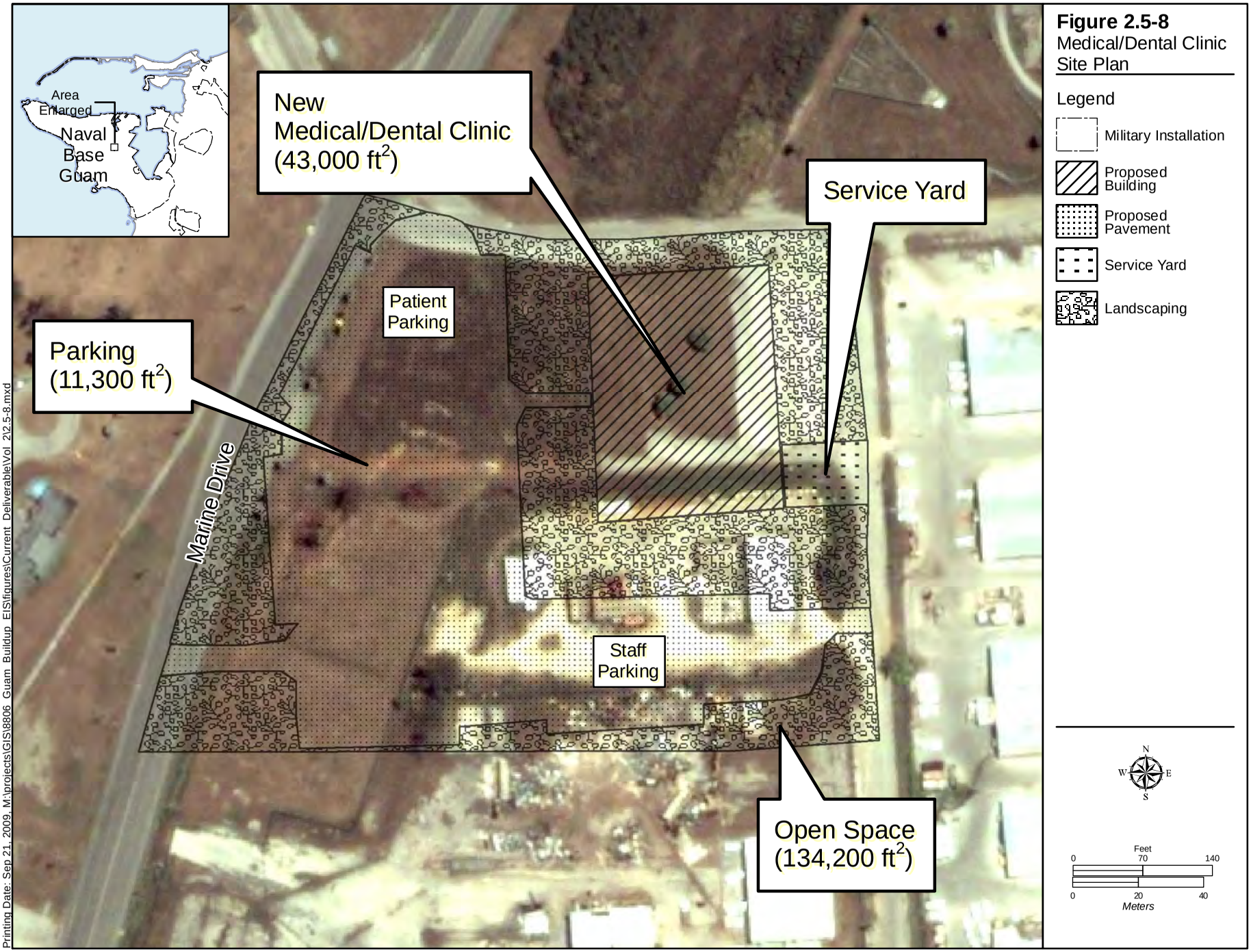
Facilities include administrative spaces, medical, mental health and dental clinic space, urgent care clinic, preventive medicine, ancillary services, and required support spaces. There would be parking for an approximately 36 staff vehicles. Site improvements include landscaping, sidewalks (with nonslip surface), curbs, and gutters. Subgrade construction would include utility lines and possible storm water management systems (not designed yet). Project costs would include new lines and meters for electrical, water and gas utilities. Facilities would be fully equipped with sprinkler and air conditioning systems.

Facilities would be designed to Zone 4 seismic requirements, to withstand 170 mph winds, and to include appropriate AT/FP distance setbacks. All design and construction would comply with the Energy Policy Act 2005 (106th Congress 2005) requirements and UFC 4-510-01, Design: Medical Military Facilities. Various tools and design features would be used to achieve LEED Silver certification for various development areas of the base and/or for specific buildings.

The construction staging area would be within the site boundaries. Construction waste would be disposed of at the Navy landfill. The duration of construction is estimated at 18 months and the work would occur in daylight hours Monday through Friday. Typical construction equipment would be used including bulldozers, backhoes and cement trucks.

Proposed Operations and Existing Conditions

Medical services on Guam are managed under the Navy BUMED. A "Medical Facilities Master Planning Study Update for the DoD Healthcare Beneficiaries, Guam, and Mariana Islands" was prepared in April 2007 by NAVFAC Pacific and most of the information in this section was derived from that study. The purpose was to revisit the planned new Naval Hospital construction plans with consideration of the Marine Corps relocation requirements.


Area Enlarged
Naval Base Guam
New Medical/Dental Clinic (43,000 ft2)
Service Yard
Patient Parking
Parking (11,300 ft2)
Marine Drive
Staff Parking
Open Space (134,200 ft2)
Figure 2.5-8
Medical/Dental Clinic Site Plan
Legend
Military Installation
Proposed Building
Proposed Pavement
Service Yard
Landscaping
N
W
E
S
Feet
0
70
140
0
20
40
Meters
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Two similarly sized new clinics are proposed to meet the Marine Corps relocation requirements, one at Naval Base Guam and the other at the main cantonment. In an effort to maintain the footprint of the programmed new hospital (inpatient and outpatient facilities) on the Naval Hospital site and to place primary care/dental services proximate to Navy beneficiaries, the majority of the primary care, preventive medicine and occupational medicine was moved from the hospital construction project and placed in the two separate and similar medical clinic projects with Dental Services. The new Naval Base Guam clinic would replace an existing clinic that is in poor physical condition, and does not meet the future medical service requirement of the proposed increased population on Guam. The second medical clinic is proposed in the Main Cantonment area and described under that section of this EIS/OEIS.

The current Naval Hospital provides outpatient services in addition to emergency and critical care services. If outpatient services are relocated to medical clinics, sufficient space would be available at the new Naval Hospital to expand critical care medical specialties and meet the military population requirements on island. Specialty clinics and a limited family practice clinic would remain in the new Naval Hospital.

The existing Navy Branch Medical Clinic is located in a two story facility designed and built for use as a dormitory (barracks). The size and shape of the building is not conducive to the operation of an efficient and functional medical clinic, and are inadequate for the required medical activities. The projected population increases would add more stress on the ability of these facilities to function effectively. For example, the x-ray room is much smaller than that required by current DoD space planning criteria, and it also serves as the x-ray film files room. The treatment room is smaller than that required by criteria, and the narrow width of the room severely restricts functionality. Building access and circulation on the first floor for handicapped persons is adequate; however, the lack of an elevator in this building does not allow compliant access to the second floor. The overall condition of the roof requires near term replacement.

The existing Branch Dental Clinic was built in 1955 and is significantly "out-of-date" with current Dental Clinic procedures and design criteria. The main corridor is used as a return air plenum, which is a violation of codes and criteria. With no urgent care capability, patients must be transported to the Naval Hospital (approximately 30 minutes), and there are no intervening accredited civilian medical facilities available on the island in the event a patient's condition worsens during transit. The Dental Clinic is not handicap accessible; however, there is an accessible entrance in one end of the facility. There are smoke detectors in the corridor, but the building is not equipped with a sprinkler system.

The proposed Apra Medical/Dental Clinic would be an outpatient medical facility. The preferred project location at Apra Main Base is a vacant 13-ac (5.26 ha) site on Marine Drive (see Figure 2.5-8), near existing family and bachelor housing areas. The medical facility would be open 7 days a week, and it is assumed that it would operate during normal business hours. The clinic would be staffed by 32 individuals, with 345 visitors expected per day. Clinic staff and patients would be transported to and from the facility by personal or government vehicle, bus, or walking. It is expected that human sensitive receptors would be present on site during operating hours including children, infirm, and elderly persons.

No heavy equipment, vehicles, or machinery would be used during facility operations. It is assumed that outdoor lighting of the facility would consist of security lighting. It is also assumed that the facility would produce human biowaste, typical of any medical facility, which would be treated and disposed of in accordance with BUMED requirements. The fire risks associated with the medical clinic would be typical of concrete buildings. It would be equipped with a fire protection system, including a sprinkler system.

2.5.2 Alternatives Analysis: Waterfront Functions

2.5.2.1 Waterfront Project: Amphibious Task Force Ship Berthing and Embarkation

The rationale for siting all proposed waterfront facilities at Apra Harbor is it is the only on-island DoD harbor. The Navy's general purpose wharves that are suitable for meeting amphibious task force requirements are on the western side of Inner Apra Harbor (see Figure 2.5-3). Victor, Uniform, Romeo, and Sierra were the candidate wharves for berthing the ships. They have been used before by the amphibious task force. There are other general purpose wharves that are not suitable. Tango Wharf's availability for general ship berthing is limited by the space reserved for the Navy dive locker and access to the decompression facilities in Building 3169. Alpha/Bravo Wharves at Polaris Point east of the channel entrance are designated for the nuclear submarines and the submarine tender. X-Ray Wharf, in the southern portion of the Harbor, is designated as the supply wharf with large warehouses, including frozen and cold storage, conveniently located adjacent to the wharf to support these operations. The northwest area and associated wharves (Lima, Mike, Oscar, and Papa) are leased to GEDCA for ship repair.

The combatant escort ships are more difficult to site than the amphibious ships, because of their water depth requirement (referred to as draft), the largest being 34 ft (10 m). An additional 4 ft (1.2 m) of water depth is required by Navy specifications, resulting in a total dredge depth required of -38 ft MLLW (-12 m). The water depth in Inner Apra Harbor is -32 ft MLLW (-10 m) in the south, -35 ft MLLW (-11 m) in the area of Sierra/Tango Wharves and -42 ft MLLW (-13 m) in the area of Alpha/Bravo Wharves. Berthing the combatant escort ships in the deeper water near Sierra and Romeo Wharves would result in less dredging and was the logical choice for the combatant ships. Maintenance dredging for the entire Inner Apra Harbor was recently (within the last 5 years) completed; therefore, the original construction depths are restored. This provided adequate depth for amphibious shipping at Victor and Uniform wharves.

The alternatives analysis was a systematic, flexible and iterative process focusing on the most efficient and cost effective way to berth all the ships while minimizing the impact on existing operations. The other facilities were sited based on proximity to the ships that carry amphibious vehicles.

There were no existing buildings that were underutilized and that could meet the requirements for the Port Operations building. That building needed to be sited on the waterfront and in proximity to the ships carrying amphibious vehicles (Victor Wharf). The site selected was the only space available. The nearest available land for staging was selected for cargo staging/wash area. No reasonable alternative sites for these functions were identified.

The Navy planned to improve the structure and utilities at the general purpose wharves. Ships that arrive in port are berthed at the general purpose wharves, except Uniform Wharf is too degraded for use. Although berthing plans are developed for planning purposes, the fact is that ships are assigned berths based on availability and water depth. Alternative berthing plans were developed but they have less to do with wharf improvements than with wharf shoreside requirements, such as lay down area. The land available for embarkation and cargo staging was generally in the area of Victor Wharf. Based on operational considerations the site presented above was selected.

2.5.2.2 Amphibious Craft Laydown Area

Siting facilities at a busy waterfront is largely a function of space availability. In the case of the LCAC/AAV laydown area, there is the additional consideration of noise impacts and water spray damage to adjacent land uses. Base planners identified two available areas for the facilities that would be

consistent with waterfront land use plans and operations. Construction of LCAC and amphibious operations facilities on Polaris Point provides the best solution for reducing impacts from noise on surrounding operations. The area is a sufficient distance from the Alpha/Bravo Wharves and CSS-15 personnel do not anticipate any impacts on submarine berthing operations around the Tender. Construction of a new road from Marine Drive directly to the compound on Polaris Point would mitigate potential congestion with Navy traffic on the peninsula.

The other alternative considered is located in the inlet where the Dry Dock is moored (see Figure 2.5-5). The AAV laydown would be located adjacent to EOD facilities on Navy land and the LCAC laydown area would be on land currently leased by GEDCA. The reasons for dismissal of this site alternative were noise interference with EOD operations and the need for dredging at the entrance to the inlet. In addition, proximity to Big Blue Reef and the desire to avoid any potential impacts to coral ecosystems was a consideration for dismissal.

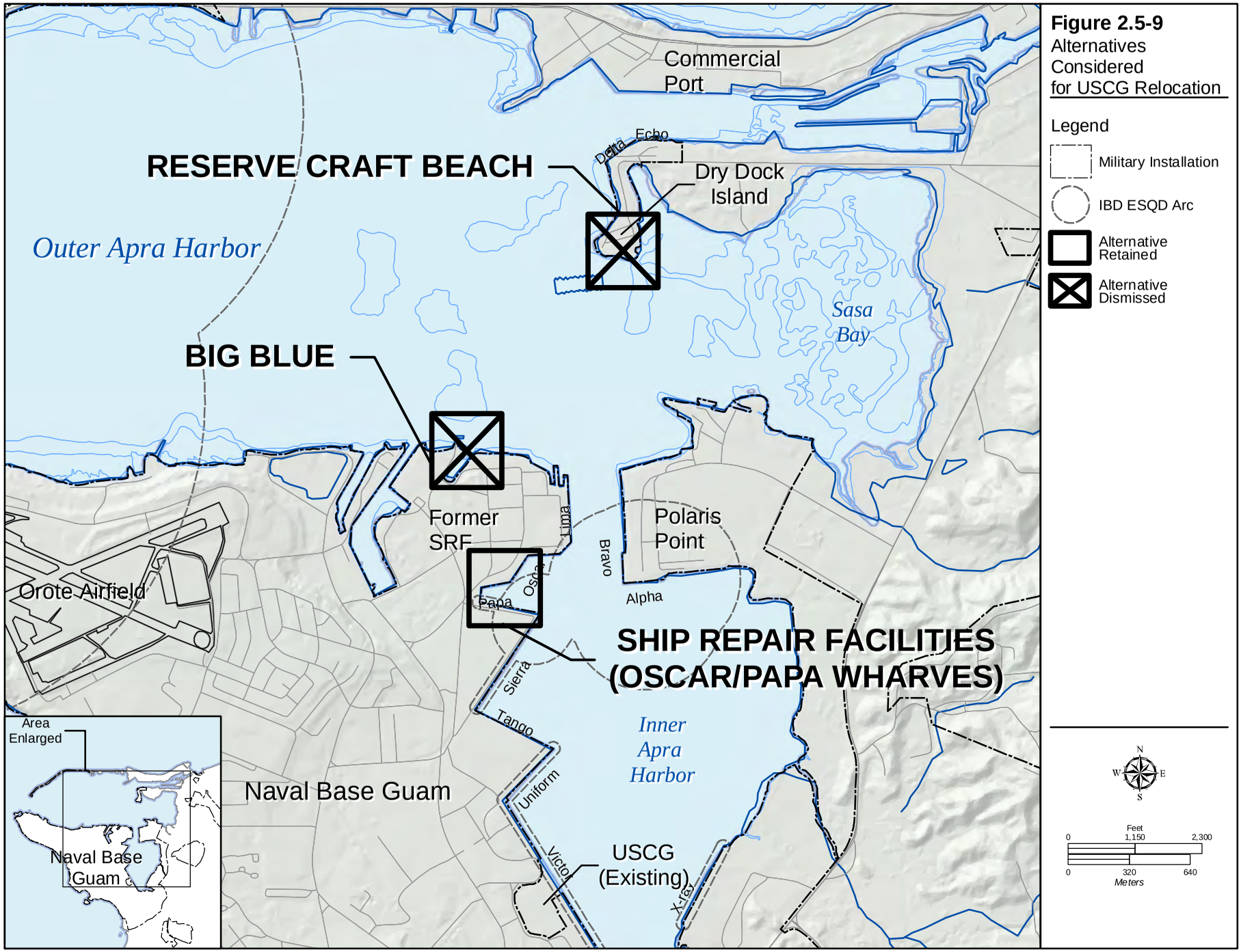
2.5.2.3 USCG Berthing and Crew Support Buildings

The USCG Maintenance and Logistics Command Pacific prepared the Sector Guam – Relocation Feasibility Study (June 2007) to assess the feasibility and potential for relocating Sector Guam facilities from their current location on Victor Wharf to other suitable waterfront property controlled by the Navy. This EIS/OEIS addresses the relocation of only a portion of the total USCG facilities and personnel that were addressed in the feasibility study. The portion that is addressed herein is that directly related to the Marine Corps Victor wharf requirements, namely wharf frontage and crew support facilities. The assumption is that the remaining facilities and personnel would relocate when funding became available.

Three sites were considered in the Step 2 site selection process (Figure 2.5-9): Big Blue, Reserve Craft Beach on Dry Dock Island, and the Oscar and Papa Wharves (Ship Repair Facility). The first two of these were dismissed from further consideration in this EIS/OEIS due to a number of functional concerns. These included such mission requirements as AT/FP capability; quality of access; existence of waterfront facilities or capability to development such facilities; relationship to Apra Harbor; environmental concerns, particularly site contamination concerns; physical size and layout; and others.

Each of the three sites reviewed in this study appears to be a feasible relocation site candidate. Evaluation criteria were as follows:

- Least total development cost
- Anticipated lower cost utility servicing
- Fewest unknowns in terms of potential development costs
- Optimal relationship to on-base community support facilities
- Good visual relationship to Outer Harbor
- Good functional relationship / boat access to Outer Harbor
- Provides adequate cutter berthing and tie-up facilities
- May require dredging to ensure sufficient hull clearance
- Adequate site development area
- Adequate site expansion area
- Good on-base site access
- Secured within base perimeter
- Allows for public access during disaster / emergency response
- Secure neighboring facilities
- Minimal environmental problems



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- Potential access to small boat launch location (new build required)
- Potential exposure to typhoon storm surge
- Potential to satisfy USCG Mission in co-located facility for all branches

Each site has advantages that the others do not have, and there is no obvious preferred site. The disadvantages of each are summarized in Table 2.5-6. The ultimate decision to choose the Ship Repair Facility was made jointly between the USCG and the Navy Command based on siting of other planned and programmed projects.

Table 2.5-6. Key Disadvantages of the Alternatives

Dry Dock Island	*Big Blue*	*Ship Repair Facility (Oscar/Papa Wharves)*
AT/FP inefficient	New pier construction	Ship Repair Facility lease renegotiation
Increased Cost Based on the Need for Increased Support Facilities	Dredging may be required	No Outer Apra Harbor visibility
Lengthy Utility Runs lead to Increase costs	Must relocate Big Blue (the drydock)	May best be reserved for Navy ships with deeper draft
Separation from Naval Base may limit JHOC port command possibilities	Cutters cannot turn in basin	Major utility infrastructure improvements required
Outside Naval Base Perimeter	Utility costs unknown	N/A
Requires All New Pier Facilities	Being considered for a new aircraft carrier berth	N/A

Notes: N/A = not applicable
Source: USCG 2007.

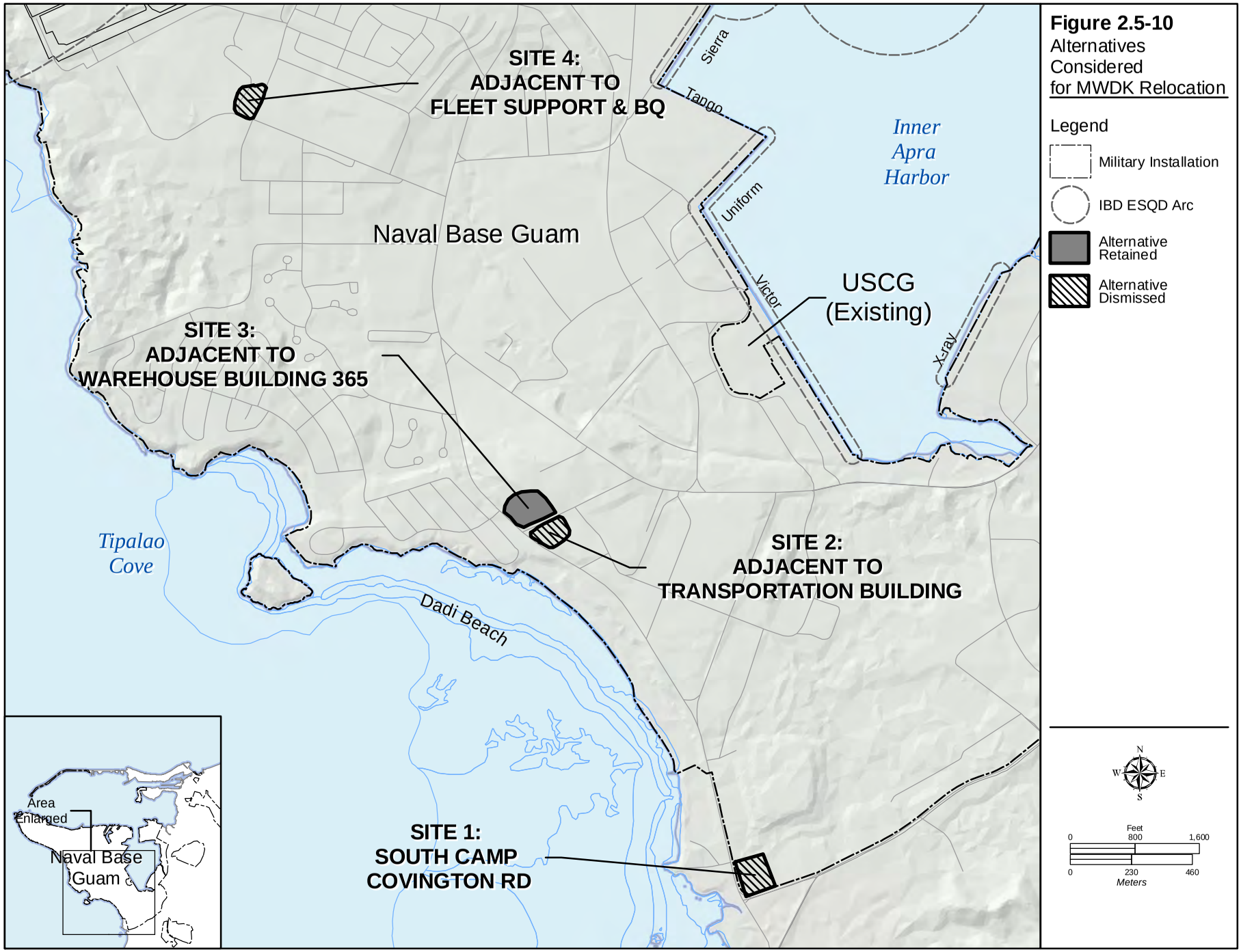
2.5.2.4 Military Working Dog Kennel

Four MWDK sites were evaluated by Navy base development planners in conjunction with the Military Working Dog Command, and three were dismissed from further consideration in this EIS/OEIS (Figure 2.5-10). The criteria and results are summarized in Table 2.5-7. Though not ranked highest, Site 3 was selected over Site 2, as vehicle noise from the transportation complex near Site 2 may affect Military Working Dogs training. Also, nearby PCB contamination was assessed as a minor issue (see Figure 2.5-10).

Table 2.5-7. Military Working Dog Kennel Alternative Site Evaluation

Criteria	*Site 1: South Camp Covington (4.4 ac) (1.8 ha)*	*Site 2: Adjacent to Warehouse Behind Transportation Building (4.2 ac)(1.7 ha)*	*Site 3: Adjacent to Warehouse (4.3 ac) (1.7 ha)*	*Site 4: Adjacent to Fleet Support Services, and Barracks Complex (3.0 ac) (1.2 ha)*
Located away from busy areas of the base (heavy traffic, high pedestrian volume)?	Yes	Yes	Yes	No
Located away from noisy areas (small arms ranges, taxiways, runways)?	Yes	Yes	Yes	No
Located away from recreational areas or gathering places?	Yes	Yes	Yes	No
Located proximate to base security?	No	Yes	Yes	No
Located away from environment/cultural sensitive areas?	Yes	Yes	No[1]	Yes

Note: [1]Discussions with NAVFAC Pacific Environmental indicate the presence of low-level PCB contaminants located roughly 400 ft (122 m) north of Site 3.


SITE 4:
ADJACENT TO
FLEET SUPPORT & BQ
Sierra
Tango
Uniform
Victor
X-ray
Inner
Apra
Harbor
Naval Base Guam
USCG
(Existing)
SITE 3:
ADJACENT TO
WAREHOUSE BUILDING 365
Tipalao
Cove
SITE 2:
ADJACENT TO
TRANSPORTATION BUILDING
Dadi Beach
Area
Enlarged
Naval Base
Guam
SITE 1:
SOUTH CAMP
COVINGTON RD
Figure 2.5-10
Alternatives
Considered
for MWDK Relocation
Legend
Military Installation
IBD ESQD Arc
Alternative
Retained
Alternative
Dismissed
N
W
E
S
Feet
0
800
1,600
0
230
460
Meters
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2.5.2.5 Apra Medical/Dental Clinic

An alternatives analysis was conducted and is described in detail in the *Medical Facilities Master Planning Study Update* (2007), Volume II. Five alternatives were considered and Site 1, Former Public Works Center site, is the one site that is being carried through for impact assessment in this EIS/OEIS. The site provides convenient access for on-base personnel from Marine Drive and for beneficiaries living in the southern portion of Guam. It is also located in close proximity to the barracks and family housing areas.

Four other Naval Base Guam candidate sites for the medical/dental clinic that were considered and dismissed are shown on Figure 2.5-11. These are described below.

- Site 2. This 18-ac (7.3-ha) site is located near the back entrance to the base in proximity to the existing Exchange and Commissary. The site is vacant with only remnants of past use.
- Site 3. This 15-ac (6.07-ha) site is located between the barracks and family housing units and adjacent to MWR activities. The site is vacant, but a portion of the area is impacted by the ESQD from Navy Construction Battalion quarry operations to the west.
- Site 4. This 20-ac (8.09-ha) site is centrally located along Marine Drive. The area is largely vacant, although a portion is used as a DoD ball field. The base wastewater treatment facility is located across Marine Drive. Two alternatives were considered at this site.
- Site 5. This 15-ac (6.07-ha) site is located to the west of the barracks housing area, and south of the furniture storage warehouse. The area is vacant, but ESQD from Kilo Wharf and the quarry area impact the site.

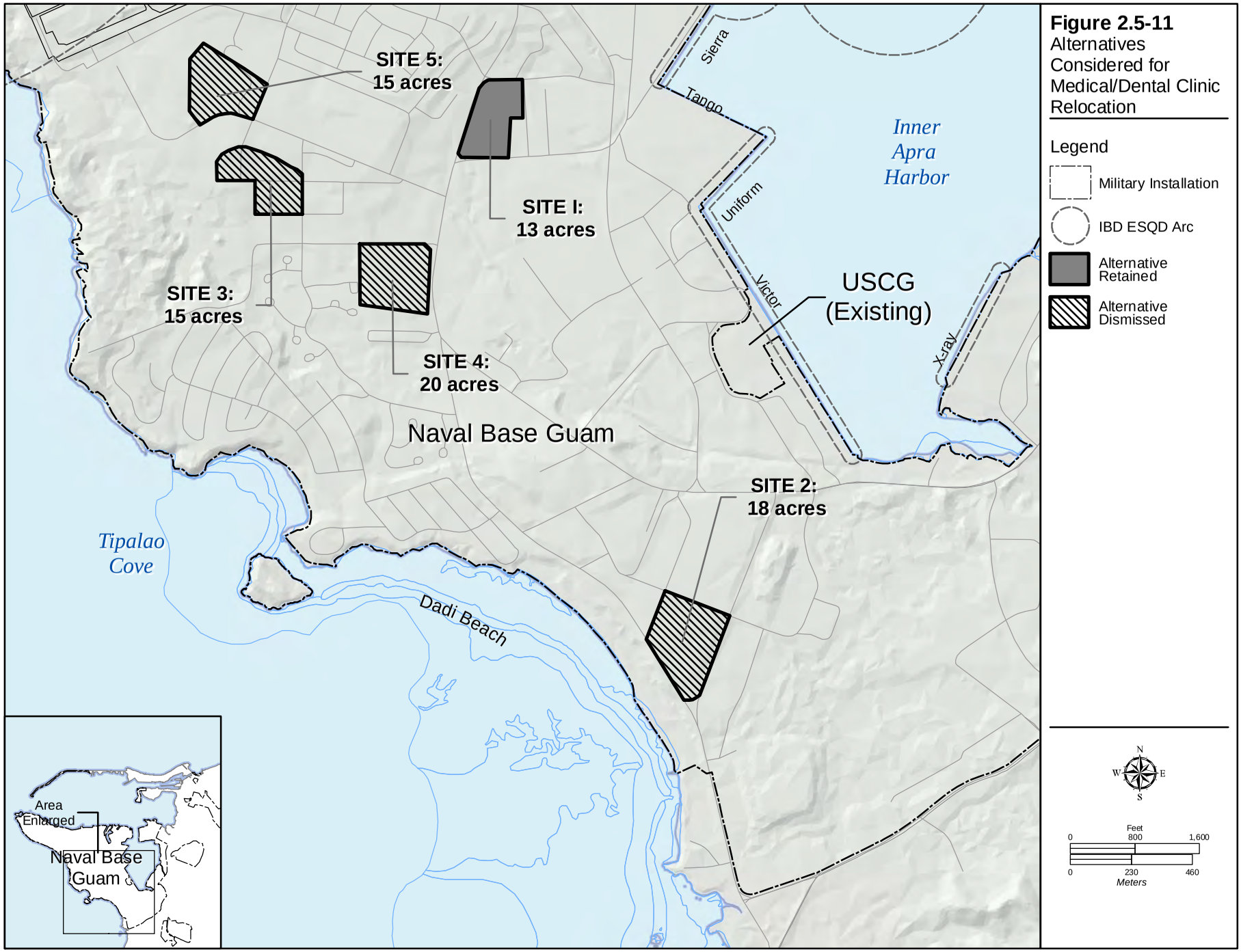

Figure 2.5-11
Alternatives Considered for Medical/Dental Clinic Relocation

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These four sites were dismissed by COMNAV Marianas based on existing land use constraints and planned future development on base. The pros and cons of each alternative are shown in Table 2.5-8.

Table 2.5-8. Medical/Dental Clinic Alternatives Assessment Summary

Site	*Pros*	*Cons*
1	• Site is adequate in size and can accommodate future expansion • Gently sloping site • Utilities readily available • Relatively convenient access for on-base active duty/active duty family member • No known environmental wetlands, flora/fauna concerns • No Electromagnetic Radiation constraints • No ESQD constraints	• Possible archaeological/historical concerns on the north end of the site since it is adjacent to Japanese POW amphitheatre • Would require demolition of some on site structures and pavement areas • Located adjacent to an industrial area on the east side of the site and industrial/storage area to the south • Potential soil contamination concerns based on its previous and current uses even though it has been remediated to an acceptable "industrial level of contamination" • Storm water drainage concerns on the south end of the site • Potential chlordane-containing soils • Hazardous waste temporary collection point would need to be relocated.
2	• Site is adequate in size • Relatively flat open area • Utilities readily available • No onsite buildings to demolish • Located in the "community" area of the Base near the Navy Exchange and Commissary • No known environmental concerns (wetlands, flora/fauna or soil contamination) • No activities to be relocated • No EMR constraints • No ESQD constraints	• AT/FP concerns (site is near coastal area and there is no perimeter fence between the Base and coastline) • Less convenient access for AD/ADFM living on-base than other sites • Near Base landfill • Adjacent to archaeological/historical site • Portions of the site may be archaeologically sensitive • Would require demolition of foundations and pavements • Potential chlordane-containing soils
3	• Site is adequate in size • Gently sloping site • Utilities readily available • Located between on-base family and barracks housing areas • Convenient access for on-base AD/ADFM • No known environmental concerns (wetlands, flora/fauna or soil contamination) • No EMR constraints • No ESQD constraints	• Future BQs are being planned for this site. Not a viable alternative for the clinic at this time • Relatively remote and circuitous route from the Base Main Gate via Marine Drive, Chappell Road and Market Street • Rock Quarry adjacent to southwest portion of site • Possible congestion with bowling alley, child care center and other proposed activities, (Bachelor Quarters, fitness center and swimming pool) in the immediate vicinity

Site	*Pros*	*Cons*
4	• Site is marginally adequate in size for the Medical/Dental Clinic • Relatively flat, clean/open area • Utilities readily available • No onsite buildings to demolish • Close to on-base family and barracks housing area • No known environmental concerns (wetlands, archaeological, flora/fauna or soil contamination) • No EMR constraints • No ESQD constraints • Good access from anywhere on-base via Marine Drive	• "One stop support center" would not fit on site with the Medical/Dental Clinic • Small site size limits expansion capability of the Medical/Dental Clinic • Relatively close (986 ft) (301 m) to Waste Water Treatment Plant (potential odor problem)
5	• Site is adequate in size • Relatively flat, open area • Utilities readily available • Located near family and barracks housing areas • Convenient access for on-base AD/ADFM • No known environmental concerns (wetlands, flora/fauna or soil contamination) • No activities to be relocated • No EMR constraints • Only one small "temporary" type structure to be removed	• ESQD restraints limit building location on the site and limit building expansion • Parking inside the ESQD Arc • The "buildable" portion of the site is not large enough for the "one stop support center" and the clinic

2.5.3 Alternatives Carried Forward for Analysis: Waterfront Functions

Table 2.5-9 summarizes the action alternatives carried forward in the EIS/OEIS for proposed waterfront facilities and operations.

Table 2.5-9. Waterfront Action Alternatives Carried Forward

Project	*Action Alternatives Carried Forward*
Amphibious task force ship berthing/embarkation	Victor/Uniform Wharves
Amphibious task force escort ship berthing	Sierra/Tango Wharves
Cargo staging and wash down areas	Southwest of Victor Wharf
Waterfront Operations Support Facility and Material Handling Equipment Storage	Adjacent to Victor Wharf
LCAC/AAV laydown	East of Alpha Wharf at Polaris Point
USCG berthing and crew support building relocation	Oscar/Papa Wharves (Ship Repair Facility)
Military Working Dog Kennel relocation	Site 3: Adjacent to warehouse on Shoreline Drive, Naval Base Guam
Apra Harbor Medical/Dental Clinic	Site 1: Former Public Works Center Site on Naval Base Guam
Dredging	Mechanical (see Appendix D, Volume 9)
Disposal of dredge spoils	3 Alternatives, individually or in combination: beneficial reuse, upland placement, and ocean disposal. 5 site Alternatives for upland placement. (see Appendix D, Volume 9)

2.6 SUMMARY OF ALTERNATIVES

2.6.1 Proposed Action Alternatives

As described in previous subsections of this chapter, the Marine Corps conducted a comprehensive screening and planning process to identify reasonable alternatives for the proposed development of a Marine Corps base of operations on Guam. The proposed action was organized into four categories of requirements (main cantonment/housing, training functions, airfield functions, and waterfront functions) and a four-step process was implemented to evaluate the facility and operational requirements of each category (see Section 2.1). Screening criteria were developed to identify alternative sites for specific functions and site-specific planning considerations were applied to identify alternative alignments within particular candidate sites.

In some cases, several alternatives were carried forward for analysis in this EIS/OEIS, and in other cases only one reasonable alternative was identified. Each set of alternatives carried forward (e.g., an munitions storage facility or a particular training range) represents a choice that would need to be made by decision-makers in the Record of Decision, provided that the action proceeds to implementation (see Figure 2.1-2).

The remainder of this subsection summarizes the major project elements that comprise the proposed action, including all alternatives carried forward for analysis in this EIS/OEIS. Figure 2.1-2 illustrates the set of choices that would need to be made in the Record of Decision to yield a selected alternative for the proposed action should the action be implemented. The proposed action would also include the relocation of 8,600 Marines, 1,700 civilian personnel, 2,000 transient Marines, and an estimated 9,000 dependents to Guam. An alternative to the proposed action is the no-action alternative, which is also described below in Section 2.6.2. Per the requirements of the NEPA, the no-action alternative is also carried forward for analysis in this EIS/OEIS.

2.6.1.1 Least Environmentally Damaging Practicable Alternative (LEDPA)

Chapter 4 of this volume contains an analysis of the least environmentally damaging practicable alternative (LEDPA), which is required under the Section 404(b)(1) guidelines of the Clean Water Act (CWA). Specifically, Section 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the United States, which include wetlands, shall be permitted if there is a practicable alternative (LEDPA) which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Furthermore, an alternative is considered practicable if it is available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes. The Section 404 (b)(1) guidelines are applicable to proposed action that is analyzed in this volume.

2.6.1.2 Alternatives Carried Forward for Cantonment Area/Housing Functions

As was described in more detail in Section 2.2.3, four action alternatives (out of eight initially considered in detail) were carried forward for the proposed development of Marine Corps Main Cantonment Area. All four of these alternatives also include areas to accommodate certain selected training functions

(Section 2.3.1) that present mission advantages when collocated with the cantonment and housing functions.

Alternative 1

Alternative 1 represents one contiguous location (total of 2,386 ac [966 ha]) for cantonment area functions and family housing/community support functions. It would include portions of NCTS Finegayan (1,090 ac [441 ha]) and South Finegayan (290 ac [117 ha]), as well as acquisition or long term leasing of non-DoD lands at the Former FAA parcel (680 ac [275 ha]) and the Harmon Annex parcel (326 ac [132 ha]). Of the total Overlay Refuge (2,095 ac [848 ha] in the Finegayan area, this alternative would develop approximately 29% (599 ac [242 ha]). Details of the proposed Alternative 1 layout are shown in Figure 2.2-4 in Section 2.2.

Alternative 2

Alternative 2 also represents one contiguous land area (a total of 2,580 ac [1,044 ha]) for the cantonment and family housing/community support functions. It would include portions of NCTS Finegayan (1,610 ac [652 ha]), portions of South Finegayan (290 ac [117 ha]), and the acquisition or long term leasing of 680 ac (275 ha) of privately-held lands in the Former FAA parcel. Of the total Overlay Refuge (2,095 ac [848 ha] in the Finegayan area, this alternative would develop approximately 53% (1,106 ac [448 ha]). Details of the proposed Alternative 2 layout are shown in Figure 2.2-5 in Section 2.2. Alternative 2 is the preferred alternative for development of the cantonment area and housing proposed action.

Alternative 3

Alternative 3 would require a total of 2,707 ac (1,096 ha) for the main cantonment and family housing/community support areas. The main cantonment would include portions of NCTS Finegayan (1,610 ac [652 ha]), and housing would be located on three geographically separated DoD parcels, including South Finegayan (290 ac [117 ha]), Air Force Barrigada (430 ac [174 ha]), and Navy Barrigada 377 ac [153 ha]). No privately held lands would be acquired under Alternative 3. Of the total Overlay Refuge (2,095 ac [848 ha] in the Finegayan area, this alternative would develop approximately 53% (1,106 ac [448 ha]). Details of the proposed Alternative 3 layout are shown in Figure 2.2-6 in Section 2.2.

Under this alternative, the housing would be located non-contiguous to the main cantonment. The proposed housing area at South Finegayan is located south of the former FAA area. Navy and Air Force Barrigada are located approximately 9 m (14 km) from the proposed Main Cantonment Area, on the eastern side of Guam. Navy Barrigada and Air Force Barrigada are currently connected by the existing Navy Golf Course. The golf course would need to be removed if it was determined that the two parcels should be connected.

Alternative 8

Alternative 8 would require a total of 2,409 ac (1,008 ha) for the main cantonment and family housing/community support areas. Alternative 8 would include portions of NCTS Finegayan (1,090 ac [441 ha], a portion of South Finegayan (290 ac [117 ha]), the former FAA parcel (680 ac [275 ha]), and a portion of the housing would be located on the geographically separated Air Force Barrigada parcel (430 ac [174 ha]). A total of 680 ac (275 ha) of privately held lands would be acquired by purchase or long term lease under Alternative 8. Of the total Overlay Refuge (2,095 ac [848 ha] in the Finegayan area, this alternative would develop approximately 29% (599 ac [242 ha]). Under Alternative 8, a portion of the

required housing would be non-contiguous to the Main Cantonment Area. Details of the proposed Alternative 8 layout are shown in Figure 2.2-7 in Section 2.2.

2.6.1.3 Alternatives Carried Forward for Training Functions

Training requirements associated with relocating Marines from Okinawa to Guam are described in detail in Section 2.3. Individual training facilities, ranges, and areas that comprise the required training functions on Guam have been organized into the following six training types or categories:

- Ammunition Storage
- Command, Control, and Simulation
- Non-Firing General Military Skills Training
- Firing General Military Skills Training
- Aviation Training
- Airspace

Ammunition Storage

As summarized in Table 2.6-1, the alternatives analysis identified one alternative for the high explosive ECM at the existing NMS, two alternatives at NMS for construction of 10 standard ECMs, and one alternative for 12 standard ECMs and associated support facilities at the existing Andersen AFB MSA1. All of these alternatives are carried forward for analysis in this EIS/OEIS. Details of the construction and operation of each of the proposed facilities were described in Section 2.3.1.

Table 2.6-1. Alternatives Carried Forward for Analysis: Ammunition Storage Facilities

Requirement	*Alternatives Carried Forward*	*Figure Reference*
High Explosive ECM	NMS: High 12 Group Area	Figure 2.3-11
10 standard ECMs	NMS Alternative 1: Parson's Road Area	Figure 2.3-11
	NMS Alternative 2: High Road Area	
12 standard ECMs and related support facilities	Andersen AFB MSA1	Figure 2.3-12

Command, Control, and Simulation

All three of the proposed Command, Control, and Simulation facilities would be sited as a function of the master planning conducted for the Main Cantonment Area. Accordingly, action alternatives for Command, Control, and Simulation facilities that are carried forward for analysis in this EIS/OEIS are incorporated within Alternatives 1, 2, 3, and 8 for the Main Cantonment Area.

Non-Firing General Military Skills Training

Table 2.6-2 summarizes the alternatives carried forward for analysis with regard to non-fire general military skills training. Under this proposed action, the smaller non-fire range facilities that support physical fitness and unit-level training would be constructed in conjunction with the Main Cantonment Area facilities in order to encourage frequency and efficiency of use. Specific placement and orientation of such facilities within the Main Cantonment Area is a function of master planning efforts for those functions (see Figures 2.2-4 to 2.2-7 in Section 2.2). No other alternative sites for such facilities and training activities were identified.

Table 2.6-2. Alternatives Carried Forward for Analysis: Non-Fire General Skills Training

Facility/Type of Training	*Alternatives Carried Forward*	*Figure Reference*
Obstacle Courses	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Confidence Course	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Hand-to-Hand Combat Pit	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Rappelling Tower	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Gas Chamber	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Combat Training Tank	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
General Purpose Auditorium	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7
Maneuver Training Area 1	Andersen South	Figures 2.3-6 and 2.3-7
Maneuver Training Area 2	Southern half of NMS with Access Road Alternative A	Figure 2.3-4
	Southern half of NMS with Access Road Alternative B	
MOUT Complexes	Andersen South: part of Training Range Complex AlternativeAlternativeAlternative A	Figure 2.3-6
	Andersen South: part of Training Range Complex AlternativeAlternativeAlternative B	Figure 2.3-7
AMVOC	Andersen South	Figure 2.3-6 and 2.3-7
Engineer Equipment and Decontamination Training	Part of Main Cantonment Alternatives 1, 2, 3, and 8	Figures 2.2-4 to 2.2-7

The two MOUT complexes and the tactical vehicle course would be developed at Andersen South. Andersen South is the largest existing MOUT facility on Guam and the only existing MOUT facility large enough to support the required company level training. It is the only location identified for the required MOUT improvements. Two alternative site plans have been developed for the MOUT and supporting facilities at Andersen South, reflecting slight differences in configuration that would occur with the Training Range Complex Alternatives A and B (discussed below). The overall site plans for Andersen South also include the AMVOC, a maneuver area, and a convoy course.

Large-scale maneuver areas would be developed under the proposed action at Andersen South and NMS, since there is no single area on Guam that provides sufficient space for large-scale maneuvers. No other reasonable alternatives have been identified on Guam for either area. Development and use of the maneuver area at NMS would also require construction of an access road, for which three reasonable alternative alignments have been identified.

Firing General Military Skills Training

Marine Corps requirements for live-fire training facilities include a composite Training Range Complex (consisting of eight distinct training facilities and range control/maintenance facilities), a breacher and shooting house, and an indoor small arms range. There are two potential action alternatives for the range complex:

- *Training Range Complex Alternative A* includes all required ranges at a location east of Andersen South on non-DoD land to the east of Route 15 and would require the realignment of a portion of Route 15. The ranges would be tightly configured and overlapping SDZs would result in a smaller combined SDZ area. Land acquisition or long term leasing would be required for development of the ranges and control of lands associated with the SDZs.
- *Training Range Complex Alternative B* is at the same general location as Alternative A, and varies from Alternative A only in that 1) the Machine Gun Range (which contains the largest SDZ) would be located in non-DoD land in the valley area farther to the south and 2) relocation of Route 15 would not be required. This range configuration would be more

dispersed as compared to Alternative A and, as a result, there is less overlap and a larger area encompassed in the composite SDZ.

The proposed breacher and shooting house operations would be integrated into the MOUT facility, the alternatives for which include Alternatives A and B associated with the Training Range Complex. The proposed indoor small arms range would be integrated into the Main Cantonment Area. Accordingly, alternatives associated with the potential location of this facility would be a function of master planning for the Main Cantonment Area, as reflected in Alternatives 1, 2, 3, and 8.

The requirement for a demolition range could be met by the use of the existing demolition range on NWF that supports Air Force Rapid Engineer Deployable Heavy Operations (REDHORSE).

Aviation Training

Aviation training requirements of the proposed Marine Corps relocation would include improved airfield training at NWF and North Ramp at Andersen AFB along with ATC Detachment Training and TAOC trainng and facilities at the same locations (see Figure 2.1-4). Twelve new LZs (improved and unimproved) would be established at Orote Field (1), NWF (4), Andersen South (2), and NMS (5) (see Figure 2.3-9). Under the proposed action, such training would also involve flight activity in any existing designated military airspace, including military flight corridors, routes, and tactical navigation areas.

Airspace

Since no additional SUA is needed over Guam to support aviation training requirements, the only action alternative associated with aviation training is the use of existing airspace.

Under the proposed action a CFA or Restricted Area would be established to satisfy range safety requirements associated with the machine gun range component of the proposed Training Range Complex; the alternatives for this type of airspace are therefore integrated into Alternatives A and B for the Training Range Complex.

2.6.1.4 Alternatives Carried Forward for Airfield Functions

The Marine Corps requirements for airfield functions would be accommodated at the existing airfield at Andersen AFB. Other airfields on Guam were eliminated in Step 2 of the alternatives analysis.

2.6.1.5 Alternatives Carried Forward for Waterfront Functions

Table 2.6-3 summarizes the action alternatives carried forward in the EIS/OEIS for proposed waterfront facilities and operations.

Table 2.6-3. Waterfront Action Alternatives Carried Forward

Project	*Action Alternatives Carried Forward*
Amphibious task force ship berthing/embarkation	Victor/Uniform Wharves
Amphibious task force escort ship berthing	Sierra/Tango Wharves
Cargo staging and wash down areas	Southwest of Victor Wharf
Waterfront Operations Support Facility and Material Handling Equipment Storage	Adjacent to Victor Wharf
LCAC/AAV laydown	East of Alpha Wharf at Polaris Point
USCG berthing and crew support building relocation	Oscar/Papa Wharves (Ship Repair Facility)
Military Working Dog Kennel relocation	Site 3: Adjacent to warehouse on Shoreline Drive, Naval Base Guam
Apra Harbor Medical/Dental Clinic	Site 1: Former Public Works Center Site on Naval Base Guam

Project	*Action Alternatives Carried Forward*
Dredging	Mechanical (see Appendix D, Volume 9)
Disposal of dredge spoils	3 alternatives, individually or in combination: beneficial reuse, upland placement, and ocean disposal. 5 site Alternatives for upland placement. (see Appendix D, Volume 9)

2.6.2 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam, though they may continue to train on Guam as they currently do. No additional training capabilities (beyond what is proposed in the MIRC EIS/OEIS [Navy 2009]) would be implemented for Guam to support the proposed action. The project objectives, including U.S.- Government of Japan agreements, would not be met. There would be no land acquisition or long term leasing, dredging, new construction or infrastructure upgrades associated with Marine Corps forces stationed on Guam. There would be no construction costs associated with this alternative.

2.6.2.1 Main Cantonment/Family Housing

Without the Main Cantonment facilities, NCTS Finegayan would continue to be used for critical communications facilities and possibly proposed air and missile defense facilities. There would be a large area with no specified use and buildings proposed for demolition would be demolished. South Finegayan would continue to be used for Navy family housing and projects would be proposed to upgrade these units. No land would be acquired for Main Cantonment.

All the areas proposed for family housing would continue current operations. Guam Army National Guard would construct new facilities at Navy Barrigada. The communications facilities and golf course in the area would remain in operation. These activities would occur with the Marine Corps build-up. Air Force Barrigada would continue to be used as a NEXRAD site.

2.6.2.2 Training Functions

Training activities to support all military services, including transient Marine Corps forces, would continue as described in the MIRC EIS/OEIS (Navy 2009). Projects proposed in the MIRC EIS/OEIS would be completed pending funding. There would be no land acquisition or long term leasing to support training. The firing range complex would not be constructed. The MOUT facility at Andersen South would likely be improved, pending funding. No construction would occur at NWF except to support other military service mission requirements.

2.6.2.3 Airfield Functions

Under the no-action alternative, no new facilities to support the Marine Corps would be constructed at North or South Ramp. The project area at North Ramp would likely be developed with future Air Force mission facilities. The South Ramp embarkation facility would be constructed to meet Air Force requirements only. The North Gate and Access Road project would likely be constructed by the Air Force depending on funding.

2.6.2.4 Waterfront Functions

Though the Navy has identified these projects for funding, the capitalization schedule for these projects is being established as a result of the proposed actions analyzed in this EIS/OEIS. The Carrier Vessel Nuclear (CVN) is accompanied by a group of escort vessels and collectively they form the Carrier Strike Group (CSG). The CSG escort vessels are similar to the amphibious task force escort vessels and the

wharf requirements are the same. The fact that these projects had already been identified partially explains why only one alternative set of wharf improvements is proposed. Under the no-action alternative, assuming no Navy or Marine Corps funding, the CSG escort vessels and the visiting amphibious task force vessels would continue to be accommodated at Apra Harbor at inadequate wharf facilities. Uniform Wharf would not be used because it is not structurally sound, but the other wharves in Apra Harbor could be used.

Under the no-action alternative, the embarkation areas and the LCAC/AAV laydown area would not be constructed. The USCG would not relocate facilities from Victor to Oscar and Papa Wharves, and the MWDK would not be relocated.

Development of the new clinic under the proposed action was largely stimulated by the need to expand hospital services at the Navy Hospital to meet increased populations, which meant that outpatient services would need to be provided at the installations. The Apra Medical/Dental Clinic under the proposed action would not be built at the same size with the same services; however, the existing medical and dental clinics are substandard facilities and eventually a new clinic would be built.

The Air Force military population would grow as projected for Intelligence, Surveillance, and Reconnaissance Strike (see cumulative projects). The Army population would increase by 630 soldiers and an additional 950 dependents and the Navy by 1,250 active duty and 50 dependents.

2.6.2.5 Summary

The no-action alternative does not meet the purpose and need of the proposed action. U.S. military forces would not be relocated to meet international agreement and treaty requirements and fulfill U.S. national security policy requirements in the Western Pacific Region. For purposes of this EIS/OEIS, the no-action alternative serves as a baseline, representative of the "status quo," against which the action alternatives can be compared when assessing potential environmental impacts.

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CHAPTER 3. GEOLOGICAL AND SOIL RESOURCES

3.1 AFFECTED ENVIRONMENT

3.1.1 Definition of Resource

This chapter discusses existing conditions and assesses how the proposed Guam Relocation action alternatives would potentially affect geological and soil resources within the region of influence (ROI). Geology describes the surface and subsurface materials of which a land area is composed, including soils and rocks. The characteristics of soils and underlying rocks include stability, slope, compatibility, shear strength, and productivity. Discussions of this resource area typically identify existing geological conditions and determine how action alternatives would likely affect geological and soil resources. Because geology and soils relate to the physical foundation of Guam, the proposed land uses associated with the action alternatives would affect characteristics of erosion and surface changes (such as land clearing, slope cuts) but not the overall geological and soil conditions. Instead, geology and soils considerations are more pertinent with respect to the placement or location of a particular land use; for example, a sinkhole could provide an obstacle to establishing a housing land use. Consequently, the geological and soil characteristics of an area would have impact on the proposed action as well as the proposed action impacting the geology.

This chapter is organized to first discuss existing conditions, followed by an analysis and identification of impacts for each alternative and area component (North, Central, Apra Harbor, and South Guam). The chapter concludes with a comparison of impacts among all alternatives and the identification and discussion of any potential mitigation measures if significant impacts have been identified.

3.1.1.1 Geologic Overview

Guam is located on the Mariana Ridge, a volcanic arc approximately 100 miles (mi) (160 kilometers [km]) west of the Mariana Trench. This ridge was formed as a result of subduction of the Pacific Plate, the oceanic plate of the earth's crust, under the Philippine Plate (COMNAV Marianas 2001). See Section 3.1.7 for more details on plate tectonics in this region.

The geology of individual islands in the Marianas is largely dependent on the degree of recent volcanism. The older southern islands, including Guam, generally consist of a volcanic core covered by coralline limestone in layers up to several hundred meters thick. As the original volcanoes subsided beneath the ocean surface, coral formations grew, ultimately forming the limestone caps on these southern islands. The limestone plateaus were formed by alternating sea level heights and wave action. Uplifting of the Philippine Plate resulted in the limestone caps being pushed several hundred meters above sea level. The volcanic core is exposed in some areas through either recent volcanic activities or erosion.

The foundation of the island of Guam is volcanic rock that is covered in limestone over approximately 60% of its surface. The volcanic rock has low permeability due to its texture and poor sorting, while the limestone tends to be highly permeable due to its high porosity (Gingerich 2003).

Guam can be divided into four distinct geophysical regions: (1) the volcanic remnants of south Guam; (2) the deformed beds of the Alutom Formation of central Guam (the Alutom Formation underlies all exposed rocks); (3) the limestone formations of the northern plateau; and (4) the coastal lowlands. A geologic map of Guam is provided in Figure 3.1-1.

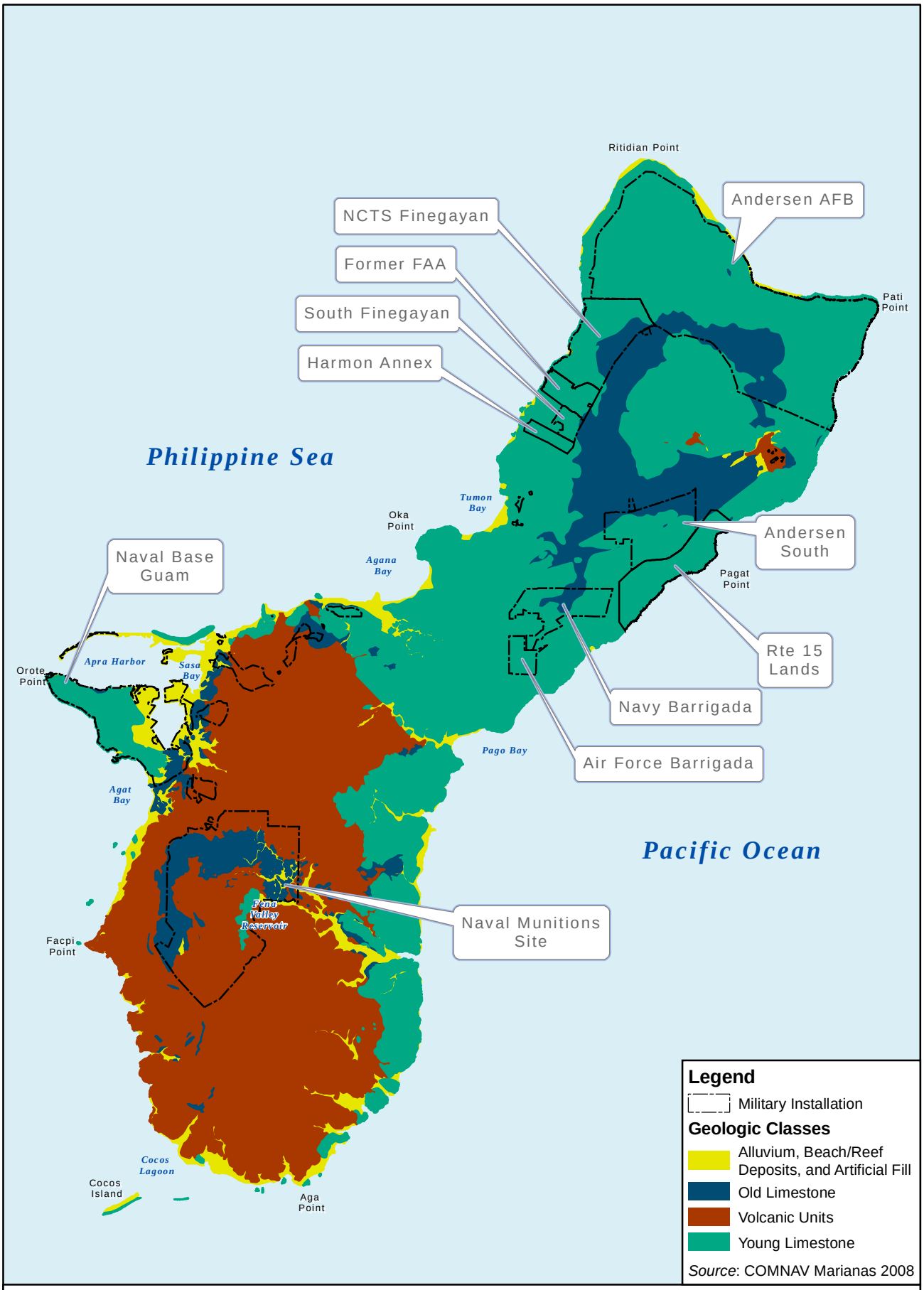

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Figure 3.1-1
Guam Geologic Map

3.1.1.2 Topography

Topography comprises the natural and man-made features of a place or region that shows relative positions and elevations. Topography generally dictates the suitability of land for building purposes, and can be a major factor in defining an appropriate use of an area.

Northern Guam is a flat limestone plateau ranging in elevation from 98 feet (ft) (30 meters [m]) to 482 ft (147 m). There are no permanent streams for surface drainage from this portion of the island because all water percolates through the highly permeable limestone. Seasonal streams exist in times of heavy rainfall. Central Guam is composed of rolling limestone hills and plateaus, while southern Guam is mountainous with numerous rivers running through. Figure 3.1-2 shows Guam's topography, and the differences between the north, central, and southern parts of the island.

3.1.1.3 Geologic Units

A geologic unit is a volume of rock or ice of identifiable origin and age range that is defined by the distinctive, dominant, easily-mapped and recognizable physical characteristics and features that characterize it. Guam comprises seven major geologic units (Gingerich 2003) as summarized below.

All rock units on the island are underlain by the Facpi and Alutom Formations that are volcanic in origin. These formations are exposed over approximately 20% of the island's surface and are found at the highest elevations of northern Guam and on the highlands of central and southern Guam. Contained within these formations are pillow basalts and pyroclastic rocks from tuffaceous shale, conglomerates of coarse boulders, and breccia. Due to their variable composition, the permeability of these formations is low.

The Umatac Formation is exposed over approximately 15% of the island, mainly in the southern and central highlands and plateaus. This formation is underlain by the Alutom Formation. The Umatac Formation increases in thickness moving south to 1,050 ft (320 m) along its southwestern edge. It is composed of reef limestone, tuff breccias, volcanic conglomerate, and basalt flows. The permeability of this unit is low due to its composition.

Overlying the Alutom and Umatac Formations are three limestone units: Bonya and Alifan Limestones, and the Janum Formation. These units cover approximately 5% of the island's surface and range in thickness from 70 ft (21 m) to 200 ft (61 m). The Bonya Limestone and Janum Formation are considered to be permeable but contain only small amounts of water due to their small size. The Alifan Limestone is highly permeable and acts as a feed for perennial springs on the southern part of Guam.

The Barrigada Limestone covers approximately 9% of Guam's surface and contains much of the groundwater in the northern part of the island. The material is highly permeable, formed of fine-grained foraminifera detrial limestone greater than 540 ft (165 m) thick.

The Mariana Limestone covers much of the northern half and parts of the southeastern area of Guam, approximately 45% of the surface area. The material is composed of fore-reef faces and lagoonal limestone that is rich in clay near the uplands. The areas without clay are considered highly permeable due to the abundance of fissures and channels, while permeability in the clay-rich areas is moderate to high. The unit is thickest near the coast and thins to near zero thickness inland.

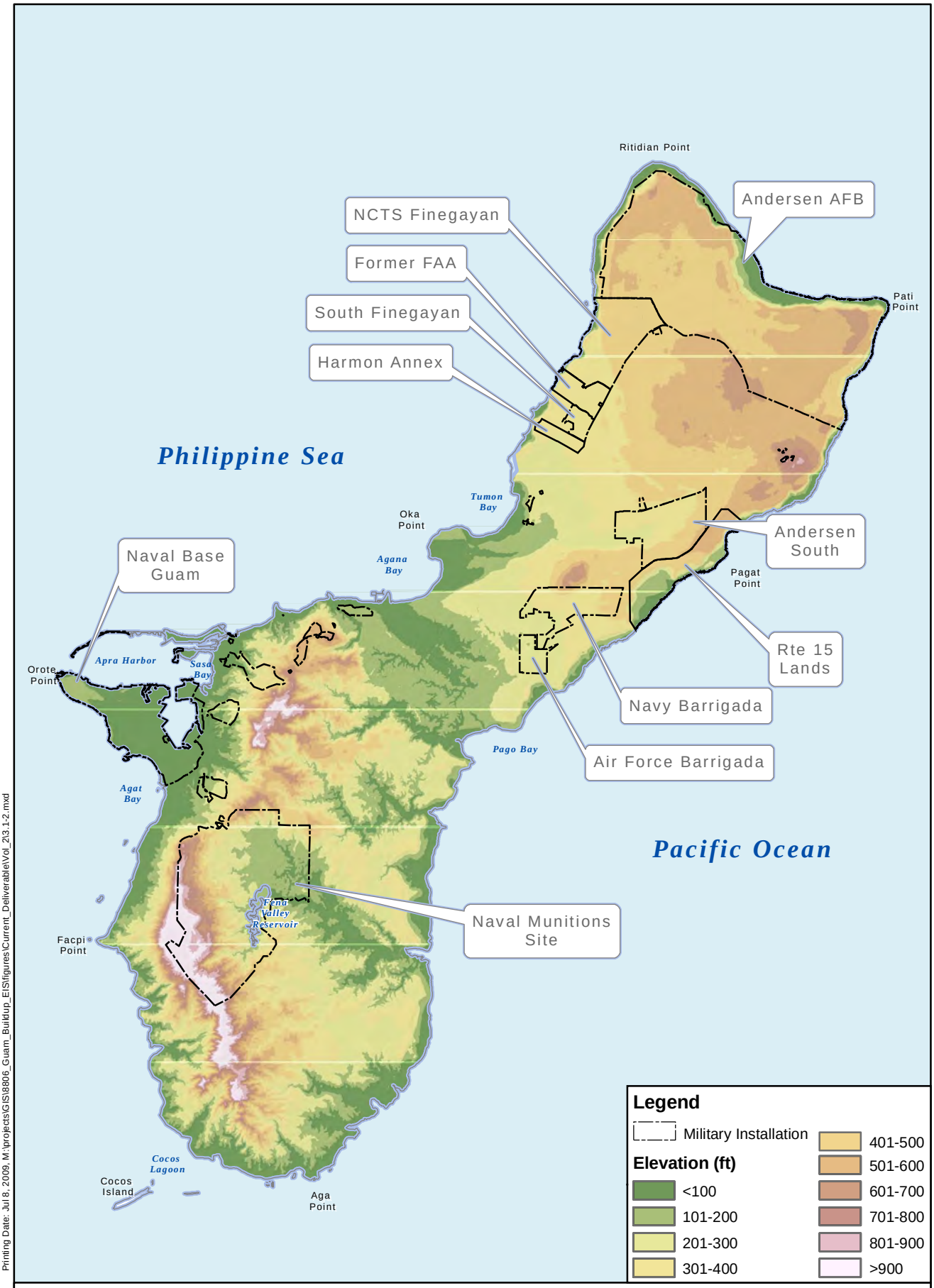

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Figure 3.1-2
Guam Topography Map

Approximately 7% of the island surface is covered by reef beach deposits. These deposits are composed of poorly consolidated sediments, the origin of which is calcareous sand and gravel and volcanic sand. Such deposits reach thicknesses up to 200 ft (61 m) near river mouths. Merizo Limestone is composed of reef deposits and may be 12 ft (4 m) in thickness, while stream valleys and coastal lowlands are covered with alluvial clay deposits.

Karst Geology

Karst is a distinctive topography formed by dissolution of underlying soluble rocks by surface water or groundwater. Karst geology occurs when rainwater dissolves carbonate rocks, such as limestone, causing voids including epikarst, sinkholes, and caves in the surface and subsurface. Limestone is a soluble rock, primarily composed of calcium carbonate. Mylroie et al. (1999) discuss karst geology in Guam, including epikarst, sinkholes, and caves.

Epikarst is defined as the upper layer of eroded rock, characterized by rough surfaces, little soil, and small cavities. Epikarst acts as a medium for flow of surface water to the aquifer below either by diffusion or through pits connected directly to the groundwater. Unsaturated epikarst may provide a large amount of water storage in voids. The fast flow of water through the joints and planes of the epikarst does not allow for adsorption, uptake, or microbial processes to remove pollution from groundwater (Islam 2005).

Sinkholes are a result of karst collapse that occurs when material overlying the karst geologic formations subsides down along the karst cavity. Sinkholes are concave areas in the ground surface that act as catchments for surface water. The collected surface water then infiltrates to the aquifer below. Northern Guam has 1,252 identified sinkholes that range in depth to over 98 ft (30 m) and attain lengths of hundreds of feet (Taborosi 2004). Fewer sinkholes are located in southern Guam, with only 197 identified. The largest concentration is found northeast of Fena Reservoir (Taborosi 2004).

Although sinkholes can be hazardous and cause many environmental problems, they also provide an outlet for movement of stormwater. During times of heavy rain, sinkholes support natural ponding; however, severe flooding can occur if a sinkhole is blocked by debris or inundated by excess runoff. Filling sinkholes or using them as receptacles for solid waste increases flooding risk. Additionally, sinkholes may collapse, thereby destroying any structures built above. Subsurface voids must be identified and examined before construction occurs in areas of karst geology (Taborosi 2004). Construction activities are major sources of karst collapse and can occur as a result of excavation, change of drainage patterns, and lowering of groundwater (Islam 2005). Soil disturbance from construction causes deposits to form in openings near the bedrock surface that get heavier when saturated, causing the underlying structure to collapse. Sinkholes are not only relevant to geological processes, they can potentially contain archaeological resources and be culturally significant.

Caves are the third type of karst feature. Three main types of caves are found on Guam: stream caves, pit caves, and flank margin caves. Stream caves are formed through the contact of streams with soluble limestone surfaces and tend to form large springs. They may be found near the Naval Magazine and Mount Alamagosa in the south, or the flanks of Mount Santa Rosa in the north. Pit caves are conglomerations of voids that transport water from the epikarst to groundwater. These caves, although not usually large in size, increase the rate of water transport to the subsurface. Flank margin caves are low, wide chambers that form where the freshwater lens contacts the underlying salt water. Due to their shape and orientation, these caves act as mixing zones for fresh and salt water rather than as water conduits. Figure 3.1-3 shows the locations of sinkholes and caves found across the island.

Karst geology for each of the proposed project areas is described in further detail below.

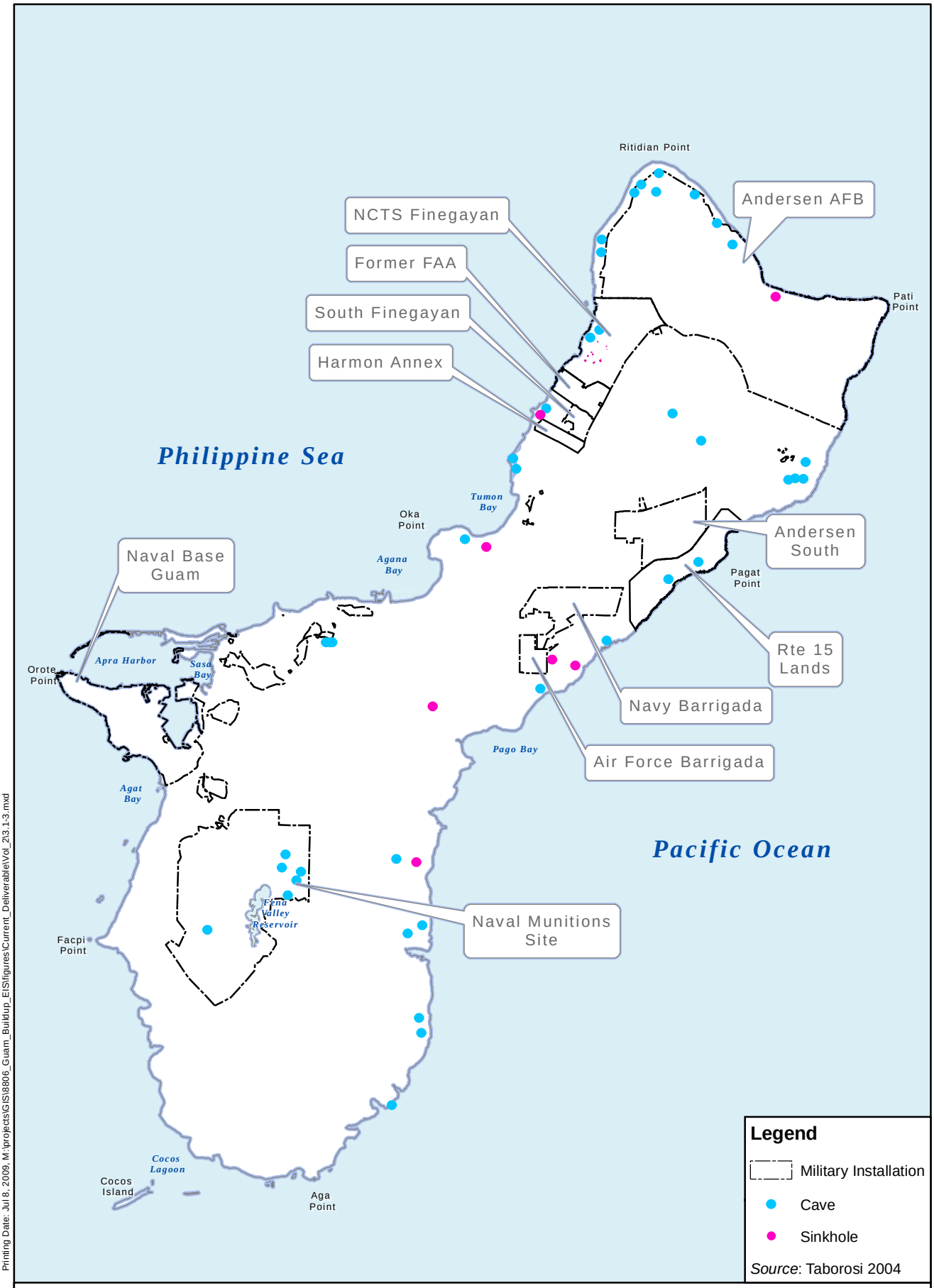

Figure 3.1-3
Guam Major Sinkholes & Caves

3.1.1.4 Soils

Major soil types found on Guam include laterite (volcanic), riverine mud, coral rock, coral sand, and argillaceous (mixtures of coral and laterite soil). Other minor soil types are also found throughout the island (Figure 3.1-4). Soils on Guam are categorized as: bottomland, volcanic upland, or limestone upland. Soils developed on volcanic rock tend to be poorly drained clays, while soils developed on limestone are usually shallow and highly porous. Soil classes across Guam were identified by the United States (U.S.) Department of Agriculture (USDA) Soil Conservation Service in 1985 (Young 1988) and the descriptions of each soil type are summarized in Table 3.1-1.

Soil types and characteristics dictate the potential for soils to erode. The USDA defines soil erosion as the removal of material from the surface soil that is the part of the soil having an abundance of nutrients and organic matter vital to plant growth. Natural causes of erosion include wind and water, but humans can exacerbate erosion particularly by construction projects (Muckel 2004). During construction, grading and filling are often required; this may reduce soil quality that in turn may affect plant growth and runoff. When topsoil is removed, biological activity decreases, as does the presence of organic matter and plant nutrients, thereby affecting plant nutrition, control of pests and disease, water infiltration, and resistance to erosion. Compaction also typically occurs at construction sites and can also increase erosion potential. Compaction occurs when vehicles drive on and off a construction site and compact the soil beneath it. Compaction can lower rates of water infiltration and inhibit plant growth, both increasing runoff. Typically, construction vehicle tires track mud onto streets and roadways, thereby increasing runoff. It has been reported that erosion potential on construction sites are approximately 100 times greater than on agricultural land (Muckel 2004).

Table 3.1-1 shows soil erodibility factors for soils found across Guam. A soil's erodibility factor (K) represents both its susceptibility to erosion and it's runoff rate, and is determined using a standard plot 72.6 ft (22.1 m) long on a 9% slope (USDA1978, 1996). K denotes the vulnerability of a soil to sheet and rill erosion and is a factor of the Universal Soil Loss Equation (USLE). The value is based on percentage of silt, fine sand, sand, and organic matter, soil structure and permeability. The higher the K value, the more susceptible the soil is to sheet and rill erosion (Young 1988).

Table 3.1-1. Soils Across Guam

Soil Class	*Soil Description*	*Runoff Rate*	*Permeability*	*Erodibility Factor (K)*	*Soil Category*
Inarajan - Inarajan Varient	Deep and very deep, somewhat poorly drained and poorly drained, level and nearly level soils; on valley bottoms and coastal plains	Medium	0.02 – 0.5	0.24	Bottom Lands
Akina	Very shallow to very deep, well drained, moderately steep to extremely steep soils; on strongly dissected mountains and plateaus	Slow	1.5 – 5.0	0.20	Volcanic Uplands
Agfayan	Very shallow to very deep, well drained, moderately steep to extremely steep soils; on strongly dissected mountains and plateaus	Slow	0.5 – 1.5	0.20	Volcanic Uplands
Togcha	Very deep, somewhat poorly drained and well drained, gently sloping soils, on plateaus and in basins	Slow	0.5 – 1.5	0.15	Volcanic Uplands
Chacha – Chacha Varient	Shallow, deep and poorly drained, and found on steep slopes: plateaus and hills	Medium	0.02 – 0.5	0.15	Limestone Uplands

Soil Class	*Soil Description*	*Runoff Rate*	*Permeability*	*Erodibility Factor (K)*	*Soil Category*
Guam Cobbly Clay Loam	Very shallow, well drained, nearly level to moderately sloping soils; on plateaus	Slow	5.0 – 15.0	0.05	Limestone Uplands
Guam Urban Land	Very shallow and shallow, well drained, level to gently sloping soils, and Urban land; on plateaus	Slow	5.0 – 15.0	0.05	Limestone Uplands
Ritidian - Rock outcrop	Very shallow, well drained, gently sloping to extremely steep soils, and rock outcrop; on plateaus, mountains, and escarpments	Very slow	5.0 – 15.0	0.02	Limestone Uplands
Pulantat	Shallow, well drained, gently sloping to steep soils; on dissected plateaus and hills	Medium	0.02 – 0.5	0.24	Limestone Uplands
Pulantat – Kagman - Clay	Shallow, deep, and very deep, somewhat poorly drained and well drained, nearly level to strongly sloping soils; on plateaus and hills	Medium	0.02 – 0.5	0.15	Limestone Uplands
Ylig	Very deep, somewhat poorly drained and well drained, gently sloping soils, on plateaus and in basins	Medium	0.5 – 1.5	0.24	Volcanic Uplands
Shioya Loamy Sand	Deep, rapidly permeable, well drained soil on coastal strands.	Slow	15.0-50	0.15	Coastal Limestone Sands

Source: Young 1988.

Table 3.1-1 shows that Inarajan Variant and Pulantat soils have the highest K values (0.28, 0.24, 0.28) and are the most vulnerable to sheet and rill erosion. These soil types are found in southern Guam near Naval Base Guam and the Naval Munitions Site (NMS). Young (1988) uses USLE to describe physical and chemical properties of soils. The equation was created to predict the long term average annual rate of erosion on a field slope based on rainfall patterns, soil type, topography, crop system, and management practices. USLE predicts the amount of soil loss that results from sheet or rill erosion on a single slope. Sheet erosion describes uniform removal of soil in thin layers, while rill erosion is the removal of soil by condensed water running through small streams.

Fire

Wildfire is a significant cause of increased soil erosion on Guam. Prior to the arrival of humans, Guam seldom experienced wildfire due to environmental conditions unfavorable to fire ignition. The introduction of anthropogenic fire has lead to the expansion of savanna vegetation (Athens and Ward 2004) and may be aiding the spread of invasive species, particular grasses that are tolerant of and promote further burning. The presence of savanna vegetation instead of forest contributes to elevated soil loss, as erosion in savanna areas may be 100 times higher than in scrub forest.

Even 18 months following a burn, after vegetation had returned to pre-burn levels of biomass, soil loss from burned savanna was twice as high compared to unburned savanna because of changes in species during revegetation (Minton 2005).

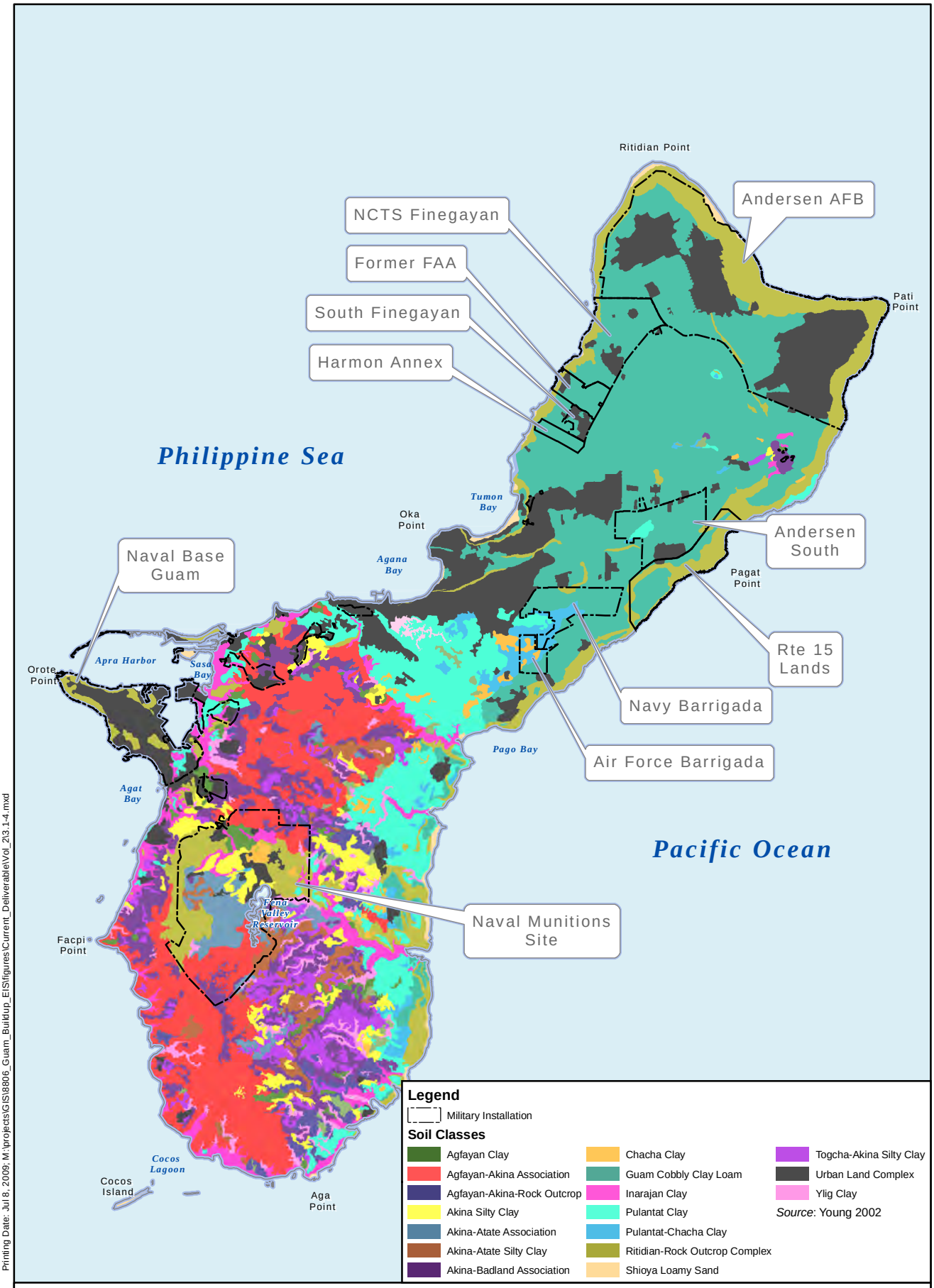

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Figure 3.1-4
Guam Soils Map

Fire history records available from 1979 – 2002 indicate that over this 23-year period more than 16,000 fires have occurred in Guam (averaging more than 700 per year) that have burned in excess of 100,000 acres (ac) (40,469 hectares [ha]). For the same period on Naval Base Guam, primarily at Apra Harbor and NMS, the number of fires was 477 (just over 21 per year) burning more than 9,800 ac (3,966 ha) (Brooke 2008).

Fire has become an integral part of the local culture, particularly among game hunters. Hunters set fires because deer are attracted to new vegetation that occurs during succession. While local laws exist criminalizing wildland arson (9 Guam Code Annotated §34.20), fire use has not slowed. Enforcement and prosecution are sporadic at best.

3.1.1.5 Geologic Hazards and Seismicity

Seismic Activity

Many geological phenomena, such as earthquakes, tsunamis, and volcanic eruptions, originate in areas where plates meet (U.S. Geological Survey [USGS] 2008). The Marianas are positioned where the Philippine and Pacific Plates converge.

Earthquake activity is common on Guam and across the entire Mariana Island chain (Lander et al. 2002). Earthquake is a term used to describe the sudden slip of a fault that results in ground shaking and radiated seismic energy caused by the slip, volcanic or magmatic activity, or other sudden stress changes in the earth (USGS 2008).

Faults, the cause of seismic activity, zigzag across Guam and are the result of collisional stresses and rock failure, where the Philippine Plate and the Pacific Plate converge (Siegrist et al. 1998). A fault is defined as a bedrock fracture along which opposite sides have moved. Fault activity on Guam can be inconsistent and unpredictable, and ultimately dependent on the angle that the Philippine Plate collides with the Pacific Plate, the rate of subduction, and the dip in the Benioff Zone (Siegrist et al. 1998). The USGS defines the Benioff Zone as a dipping flat zone of earthquakes produced by the interaction of a downgoing oceanic crustal plate with a continental plate. These earthquakes can be produced by: (1) a slip along the subduction thrust fault, or (2) a slip on faults within the downgoing plate as a result of bending and extension as the plate, is pulled down.

Fault types differ across Guam. Normal faults, or dip-slip faults, are inclined fractures where the blocks have mostly shifted vertically. If the rock mass above an inclined fault descends, the fault is termed normal; however, if the rock above the fault ascends, the fault is termed reverse (USGS 2008). Strike-slip faults are vertical (or nearly vertical) fractures where the blocks have mostly moved horizontally. Figure 3.1-5 shows the fault lines that run across Guam. The figure shows that the Adelup Fault Zone separates southern Guam from the limestone plateau of northern Guam. The Tamuning-Yigo Fault runs south-southwest from the Mount Santa Rosa Fault Zone to the Tamuning-East Agana boundary. The Talofofo Fault Zone is made up of multiple parallel normal faults, and runs from the Pacific Ocean at Talofofo embayment west-northwest past the NMS, and is assumed to continue along the southern coast of Orote Peninsula. The Cocos Fault strikes along the southern coast.

Landslides

The effects of an earthquake are typically local, but they can also affect areas beyond its origin. Local effects may include slope failures and landslides, predominantly in limestone terrain. The tropical weather on Guam, which includes high precipitation and annual storms, rapidly weathers and easily erodes the volcanic rock found on the island. Slope destabilization and landslides often occur from a combination of

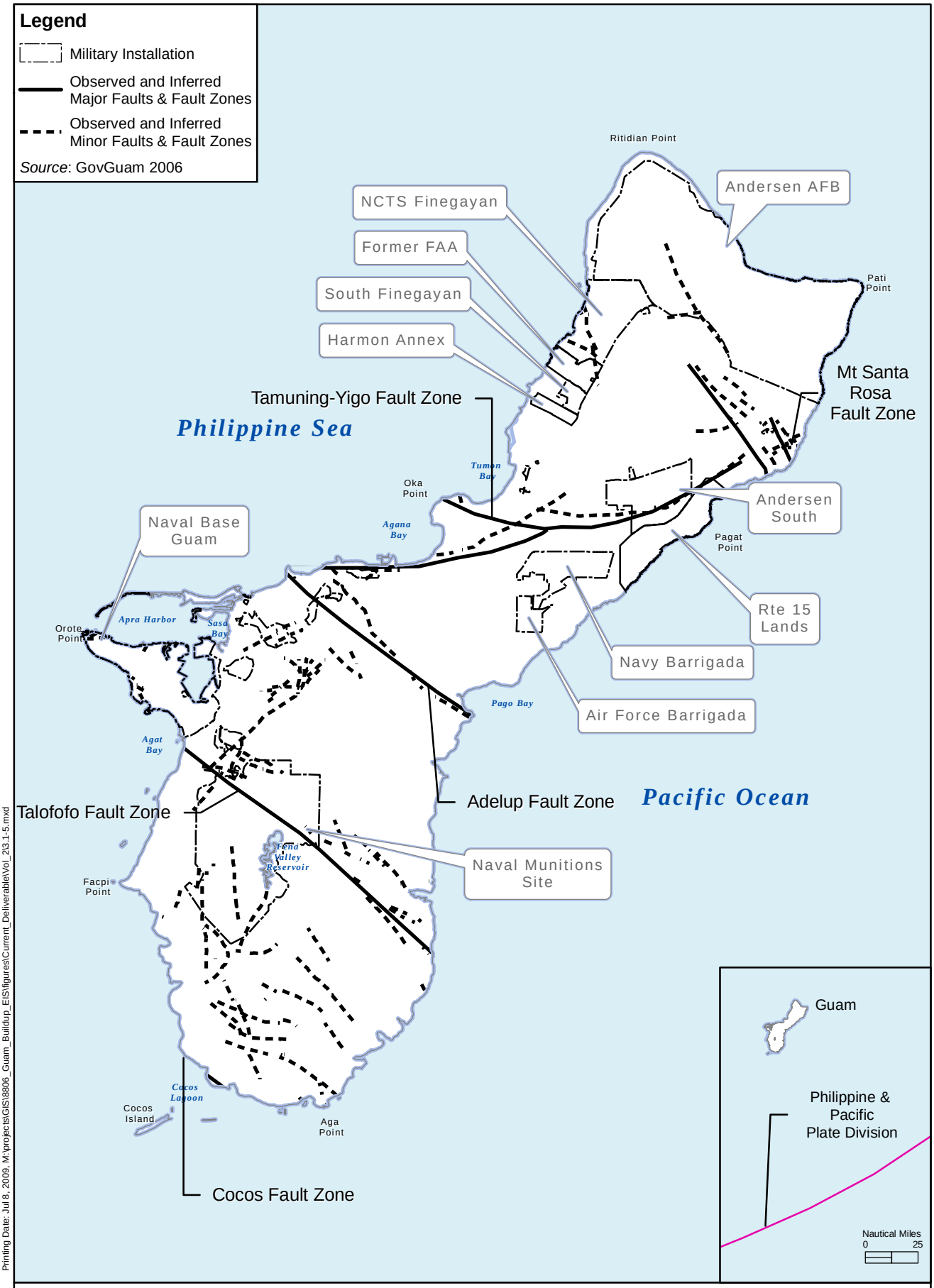

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Figure 3.1-5
Guam Fault Lines

natural events, and seismic activity usually destabilizes a slope. When destabilization is followed by heavy rainfall, the destabilized slope is saturated, and slides result.

Limestone boulders commonly slide and tumble down steep inclines and fall off fault cliffs in northern Guam. Several localized rockfalls, rockslides, and boulder slides occurred on the plateau following a quake on August 8, 1993, and several others have occurred within earthquake weakened rock sections during heavy rains. On Marine Drive in East Agana, a small rockslide destroyed several parked vehicles. One large fall-slide combination destroyed the coastal spring at Janum on the northeast coast. Additionally, a major rockfall at Mergagan Point on the north coast closed a large popular sea cave on the edge of Andersen Air Force Base (AFB) (Siegrist et al. 1998).

Potential landslide occurrence depends on thegeology, the angle of a slope, groundwater depths, rainfall, and local geologic structures (e.g., faults and joints). According to the Guam Hazard Mitigation Plan (GHMP) (GovGuam 2008), the most appropriate approach to defining landslide hazard risks on Guam involves determining the vulnerability of an area based on geologic units mapped at the surface (see Section 3.1.2). Vulnerability has been determined by the geology and the slope angle of the various specific areas on the island (Table 3.1-2). The GHMP uses these two factors to develop a qualitative rating of the potential of an area for a landslide to occur. The potential ratings in the GHMP are expressed as high, moderate to high, moderate, and low (Table 3.1-2).

Table 3.1-2. Risk Potential for Landslides to Occur

Slope Angle	*Potential Risk of Landslide*
Less than 5%	Low potential regardless of geologic deposits
30% or more	Moderate to high

Source: GovGuam 2008.

Approximately 47.2 square mi (mi^2) (122.25 square km [km^2]), or 22.5%, of Guam have a very high potential for landslides. About 9.3 mi^2 (24 km^2), or 4.4% of the island, have a high potential. 37.6 mi^2 (97.4 km^2), or 17.9 % have a moderate potential and 116.3 mi^2 (301 km^2), or 55.4%, have a low potential (GovGuam 2008).

The overall likelihood for landslides to occur on northern Guam is generally low, and the landslide potential for southern Guam is mostly moderate to high. The sea cliffs and cliff faces at the coastline along the perimeter of northern Guam have a high potential for landslides. Aside from these cliff faces and a moderate to high potential along the flanks of Mount Santa Rosa, the remainder of northern Guam is primarily flat. In general, the limestone geology of this area has a low potential for landslides.

The relatively flat areas along the east coast of northern Guam and the flat areas of Apra Harbor have a low potential for landslides.

Liquefaction

Another effect of seismic activity is liquefaction, a process where water-saturated sediment temporarily loses strength and acts as a fluid (USGS 2008).

Due to the high potential for strong seismic events to occur in and around Guam, there is a relatively consistent probability of occurrence for liquefaction and lateral spreading throughout the island (GovGuam 2008). However, certain conditions and geological units are more susceptible to liquefaction than others. Geologic information and historical occurrences are the only data available to determine susceptibility to liquefaction.

GHMP reports that 14 mi^2 (36 km^2) of Guam have a potential risk for liquefaction. About 0.5 mi^2 (1.3 km^2), or 0.3% of Guam, mainly located around parts of Apra Harbor, have a very high risk of

liquefaction. This is the area with the greatest historical record of liquefaction. Large areas of Apra Harbor contain widespread areas of fill. Areas with a high risk of liquefaction include parts of Tumon Bay and the northern portion of Andersen AFB. Approximately 2.8 mi^2 (7.3 km^2), 1.3% of Guam, is at high risk of liquefaction (GovGuam 2008). Approximately 7.3 mi^2 (18.9 km^2), or 3.5% of Guam, have moderate risk of liquefaction (GovGuam 2008).

The only known incidence of liquefaction on Guam is from the 7.8 magnitude earthquake of August 1993, when liquefaction occurred at Apra Harbor and in downtown Agana (GovGuam 2008). Liquefaction occurred in areas where coral fill overlaid fine-grain estuarine deposits. At the commercial port at Apra Harbor, horizontal displacement of up to 24 inches (in) (61 centimeters) occurred and cracks measuring up to 8 ft (2.4 m) deep and up to 300 ft (91.4 m) long (GovGuam 2008). At Navy port facilities at Apra Harbor, most wharves were damaged by liquefaction, and the damage was estimated at $25.15 million (GovGuam 2008). Liquefaction at Piti Power Plant caused up to 4 ft (1.2 m) of settlement (GovGuam 2008).

Tsunamis

Earthquakes and landslides can cause big wave events called tsunamis. A tsunami is a sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands (USGS 2008). Table 3.1-3 shows a history of tsunamis on Guam, their location, the vertical run-up of the wave, the location of the earthquake that caused the event, and the magnitude of the earthquake. According to Lander et al. (2002), the impacts of a local tsunami would most likely occur on Guam's east coast, due to the eastern location of the Mariana Trench, the origin of many local earthquakes. If a tsunami has a southern origin it can impact both the west and east coast of Guam (Lander et al. 2002).

Table 3.1-3. Historic Tsunamis on Guam

Date	*Tsunami Location*	*Vertical Run-up ft (m)*	*Earthquake Location*	*Magnitude (Modified Mercalli Scale [MM])*
1819	Guam, Mariana Islands	-	Mariana Islands	-
24 June 1849	Guam, Mariana Islands	11.5 (3.5)	Mariana Islands	7.5
16 May 1892	Agana, Guam	-	Guam, Mariana Islands	7.5
Feb 1903	Guam, Mariana Islands	-	Philippines	-
9 Dec 1909	Guam, Mariana Islands	-	Guam, Mariana Islands	8.1
4 Mar 1952	Apra Harbor, Guam	0.03 (0.1)	SE. Hokkaido Island, Japan	8.1
4 Nov 1952	Guam, Mariana Islands	0.03 (0.1)	Kamchaka, Russia	8.2
9 Mar 1957	Guam, Mariana Islands	0.03 (0.1)	Central Aleutian Islands, Alaska	8.3
22 May 1960	Guam, Mariana Islands	0.07 (0.2)	Central Chile	8.6
13 Oct 1963	Guam, Mariana Islands	0.03 (0.1)	Kuril Islands, Russia	8.1
28 Mar 1964	Guam, Mariana Islands	0.03 (0.1)	Gulf of Alaska-Alaska Pen.	8.5
8 Aug 1993	Pago Bay, Guam	-	Guam, Mariana Islands	8.2

Note: MM = Modified Mercalli scale that measures earthquake intensity.
Source: National Geophysical Data Center as reported in GovGuam 2008.

The band of coral reef that surrounds Guam provides protection from tsunamis, and the steep slope of the ocean floor surrounding the island lowers the risk of significant wave run-up. Therefore, the possibility of a large tsunami causing extensive damage on Guam is generally low (GovGuam 2008).

The maximum reported vertical run-up on Guam was approximately 11.5 ft (3.5 m) in an 1849 tsunami event. GHMP reports that the area most prone to large tsunamis are landmasses below 16.4 ft (5 m) in

mean sea elevation, which encompasses 10.8 mi^2 (28 km^2), 5.2% of the island. The project area most vulnerable to potential tsunami impacts is Apra Harbor (GovGuam 2008).

The Pacific Tsunami Warning Center considers the tsunami evacuation safety zone to be above 30 ft (9 m) elevation and over 100 ft (30 m) inland. Guam is recognized as Tsunami Ready and Storm Ready by the National Weather Service. To qualify as a Tsunami Ready community, a community must:

- Establish a 24-hour warning point and emergency operations center
- Create a system that monitors local weather and ocean conditions
- Develop multiple ways to receive tsunami and severe weather warnings, and alert the public in a timely manner
- Develop a formal hazard plan and conduct emergency exercises
- Promote public readiness through community education

3.1.2 North

3.1.2.1 Andersen AFB

Topography

Total area of Andersen AFB measures 15,423 ac (6,241.5 ha). Andersen AFB is located on the limestone formations of the northern plateau, underlain by massive limestone formations (see Figure 3.1-1). The limestone plateau's elevation ranges from 295 to 590 ft (90 to 180 m) above mean sea level (msl). Steep cliffs surround the plateau on the north, east, and west with a narrow coastal lowland terrace at the bottom of these cliffs. This coastal terrace is 300 to 900 ft (90 to 270 m) wide from the base of the cliff to the ocean. The underlying limestone subtypes range from brittle to well-cemented (Pacific Air Force [PACAF] 2006). All proposed project areas are on the limestone plateau that is relatively flat with gradual changes in elevation.

Geology

Andersen AFB overlies limestone rock, primarily of younger age rocks (Pliocene to Pleistocene, 1.5-5 million years ago) (refer to Figure 3.1-1). A large sinkhole (IRP Site 66), approximately 700 ft by 900 ft (213 m by 274 m), is located on the northeast portion of the base, near the coastline (refer to Figure 3.1-3). The upper few hundred feet of the plateau are composed of basalt and andesite, sedimentary rock, and limestone (COMNAV Marianas 2008). The area is karst, containing cavities and sinkholes in the porous limestone. Rainwater easily percolates through the porous limestone (Gingerich 2003). The Mount Santa Rosa Fault Line is located just south of Andersen AFB and smaller lines are located throughout.

Soil

Soil formation on northern Guam is the result of intense weathering of the permeable limestone to form the silica-poor soils that are rich in iron oxides and gibbsite clays (Young 1988). Soil at Andersen AFB is classified as limestone upland (refer to Figure 3.1-4). This soil exhibits moderately rapid permeability and low water capacity (Young 1988). A thin layer (from 4 to 10 in [10 to 25 centimeters]) of Guam Cobbly Clay Loam overlies the northern limestone substrate, contributing to a shallow vegetation root structure (PACAF 2006). Erosion does not present a significant problem in this project area because it is generally located on a broad limestone reef plateau underlain by volcanic rocks.

The South Ramp, North Ramp, and much of Northwest Field and the Munitions Storage Area (MSA) are in areas classified as Guam-Urban Land Complex, 0% to 3% slopes. This soil type is described by Young (1988) as 55% Guam Cobbly Clay Loam and 45% urban land. Urban land consists of land developed with roads, buildings, parking lots, and airstrips. A small part of the North Ramp and the North Gate

Access Road are in Guam Cobbly Clay Loam, 3% to 7% slopes. This soil is described previously in Table 3.1-1.

Geologic Hazards

Andersen AFB overlies a minor fault line and is susceptible to earthquake events. However, the overall likelihood for landslides to occur on northern Guam is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events.

GHMP reports that the northern portion of Andersen AFB has a high risk of liquefaction.

The maximum reported tsunami waves height reached on Guam was approximately 11.5 ft (3.5 m) in an 1849 tsunami event. GHMP reports that the area most prone to large tsunamis are landmasses below 16.4 ft (5 m) in mean sea elevation. The sites considered under the proposed action are at higher elevation and not at susceptible to tsunami inundation.

3.1.2.2 Finegayan

Topography

Naval Computer and Telecommunications Station (NCTS) Finegayan encompasses 2,700 ac (1,092.7 ha). NCTS Finegayan lies in the northern limestone structural province (refer to Figure 3.1-1). Elevations at the top of the plateau range from 500 to 600 ft (152 to 183 m) above msl. At the edge of the plateau to the north, west and east, steep cliffs drop down to an intermittent narrow coastal lowland terrace. The coastal areas range from 200 to 900 ft (61 to 274 m) stretching from the base of the cliffs to the shore. The substrate comprises a heterogeneous mixture of limestone subtypes ranging from highly friable to well-cemented depending on the depositional source (COMNAV Marianas 2001).

The coastline in this area includes two small, localized but important reef flats: one off Haputo Beach and the second reef flat is inshore of Double Reef (also known as Pugua Patch Reef). The Haputo area is established as an Ecological Reserve Area. This Ecological Reserve Area has a diverse assemblage of marine habitats, including Double Reef. Double Reef is the most striking offshore feature along the entire northwest coast of Guam because it is the beginning of a young barrier reef that breaks the ocean surface (Paulay et al. 2002). It lies on a shallow shelf that extends considerably further from the coast than adjacent areas. The area around Double Reef is topographically heterogeneous because of variation created by reef growth and the erosive action of the large quantities of freshwater discharge from the islands freshwater aquifer (Paulay et al. 2002).

Geology

At Finegayan, the ground surface elevation of the site generally grades downward from east-northeast to west-southwest. A north-south trending fault pattern may control formation of the karst topography. Both the southwest and southeast portions of Finegayan have evidence of sinkhole formation and clay filling of sinkhole depressions (GovGuam 2008). The small valley oriented perpendicular to the cliff line in the northwest area may be enhancing the erosion of the Mariana Limestone along the cliff line that could affect surface drainage patterns (GovGuam 2008). Numerous solution cavities and caves exist within the porous limestone bedrock. As previously discussed, collapses of these subterranean cavities often form sinkholes (COMNAV Marianas 2001).

Soils

The majority of the soils at Finegayan are shallow, well-drained soils on the limestone plateaus (Figure 3.1-4). The cliff line areas are primarily rock outcrops and very shallow and well drained coralline limestone soils (COMNAV Marianas 2001). Nearly all of the plateau area is Guam Cobbly Clay Loam,

3% to 7% slopes. This soil is described in Table 3.1-1. Erosion does not present a significant problem in Finegayan because it is located on a broad limestone reef plateau underlain by volcanic rocks.

Geologic Hazards

Finegayan overlies a minor fault line and is susceptible to earthquake events, although the overall likelihood for landslides to occur is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. Finegayan has a low risk of liquefaction and tsunami inundation.

3.1.2.3 Non-Department of Defense (DoD) Land

Former Federal Aviation Administration (FAA) Parcel

Topography

The Former FAA Parcel lies in the northern limestone structural province (refer to Figure 3.1-1). Elevations at the top of the plateau range from 500 to 600 ft (152 to 183 m) above msl. At the edge of the plateau to the north, west, and east, steep cliffs drop down to an intermittent narrow coastal lowland terrace. The coastal areas range from 200 to 900 ft (61 to 274 m) stretching from the base of the cliffs to the shore. The substrate comprises a heterogeneous mixture of limestone subtypes ranging from highly friable to well-cemented depending on the depositional source (COMNAV Marianas 2001).

Geology

At the Former FAA Parcel, the ground surface elevation of the site generally grades downward from east-northeast to west-southwest. A north-south trending fault pattern may control formation of the karst topography. Numerous solution cavities and caves exist within the porous limestone bedrock. As previously discussed, collapses of these subterranean cavities often form sinkholes (refer to Figure 3.1-1) (COMNAV Marianas 2001).

Soils

The majority of the soils at the Former FAA Parcel are shallow, well-drained soils on the limestone plateaus (refer to Figure 3.1-4). The cliff line areas are primarily rock outcrops and very shallow and well drained coralline limestone soils (COMNAV Marianas 2001). Nearly all of the plateau area is Guam Cobbly Clay Loam, 3% to 7% slopes. This soil is described in Table 3.1-1. Erosion does not present a significant problem at the Former FAA Parcel because it is located on a broad limestone reef plateau underlain by volcanic rocks.

Geologic Hazards

The Former FAA Parcel overlies a minor fault line and is susceptible to earthquake events, although the overall likelihood for landslides to occur is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. The Former FAA Parcel has a low risk of liquefaction and tsunami inundation.

Harmon Annex

Topography

Harmon Annex lies in the northern limestone structural province (refer to Figure 3.1-1). Elevations at the top of the plateau range from 500 to 600 ft (152 to 183 m) above msl. At the edge of the plateau to the north, west, and east, steep cliffs drop down to an intermittent narrow coastal lowland terrace. The coastal areas range from 200 to 900 ft (61 to 274 m) stretching from the base of the cliffs to the shore. The

substrate comprises a heterogeneous mixture of limestone subtypes ranging from highly friable to well-cemented depending on the depositional source (COMNAV Marianas 2001).

Geology

At Harmon Annex, the ground surface elevation of the site generally grades downward from east-northeast to west-southwest. A north-south trending fault pattern may control formation of the karst topography. Numerous solution cavities and caves exist within the porous limestone bedrock. As previously discussed, collapses of these subterranean cavities often form sinkholes (refer to Figure 3.1-3) (COMNAV Marianas 2001).

Soils

The majority of the soils at Harmon Annex are shallow, well-drained soils on the limestone plateaus (refer to Figure 3.1-4). The cliff line areas are primarily rock outcrops and very shallow and well drained coralline limestone soils (COMNAV Marianas 2001). Nearly all of the plateau area is Guam Cobbly Clay Loam, 3% to 7% slopes. This soil is described in Table 3.1-1. Erosion does not present a significant problem at Harmon Annex because it is located on a broad limestone reef plateau underlain by volcanic rocks.

Geologic Hazards

Harmon Annex overlies a minor fault line and is susceptible to earthquake events, although the overall likelihood for landslides to occur is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. Harmon Annex has a low risk of liquefaction and tsunami inundation.

3.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

Roadway projects in the northern portion of Guam include pavement strengthening, road widening, and construction of a new road, as well as military access point construction for facilitating access to Finegayan and Andersen AFB. The roadway project action alternatives, which are described in detail in the Proposed Action and Alternatives chapter, Roadway Projects section in Volume 6, comprise 13 projects proposed for the North Region of Guam.

Topography

A limestone plateau covers the northern half of Guam. The Guam Road Network (GRN) projects that would occur along Routes 1, 3, 9, 15, and 28, as well as the new Finegayan Connection within the North Region, would be located on the limestone plateau with elevations that range from 295 ft (90 m) to 590 ft (180 m) above msl. These project areas on the limestone plateau are relatively flat with gradual changes in elevation.

Geology

The GRN projects that would occur along Routes 1, 3, 9, 15, and 28, as well as the new Finegayan Connection within the North Region, would be located on limestone rock of younger and old age, as shown in Figure 3.1-6. Rock, and limestone comprise the upper few hundred feet of the plateau.

Soils

Soils beneath Routes 1, 3, 9, 15, and 28, as well as the new Finegayan Connection within the North Region are classified as Limestone Uplands, which are very shallow, well-drained, and nearly level to moderately sloping soils on plateaus. Intense weathering of the permeable limestone form silica-poor soils rich in iron oxides and gibbsite clays (Young 1988). Guam Cobbly Clay Loam is the predominant soil class found along the GRN project locations in the North Region. This soil type has a slow rate of runoff and a relatively low rate of erosion.

Soils and geologic hazards within the study area for the roadway projects in the North Region are shown in Figure 3.1-6.

One cave is located in the vicinity of Route 1 north of Andersen South.

3.1.3 Central

3.1.3.1 Andersen South

Topography

The elevation of the Andersen South site gently rises from approximately 300 ft (91 m) msl in the northwestern portion to 500 ft (152 m) above msl at the southeastern corner of the site (refer to Figure 3.1-2).

Geology

The geology of Andersen South is characterized by a broad limestone reef plateau underlain by volcanic rocks (Figure 3.1-1). The southern portion of the site consists of young limestone rock (Pliocene to Pleistocene, 1.5-5 million years ago) and the northern portion is old limestone rock (Miocene to Pliocene, 5-25 million years ago). Numerous caves are located at Andersen South.

Soils

Soil types at Andersen South include: (1) Guam Cobbly Clay Loam, covering the majority of the area, and in smaller amounts; (2) Guam Urban Land Complex and Pulantat Clay in the western portion of the project area; (3) Pulantat-Kagman Clay in a small section in the center of the western border of the project area; and (4) Ritidian-Rock Outcrop Complex at the southeastern corner of Andersen South (refer to Figure 3.1-4). In general, erosion risks at Andersen South are slight to moderate, but do not present a major problem because the area is located on a broad limestone reef plateau. Soil characteristics are further summarized in Table 3.1-1.

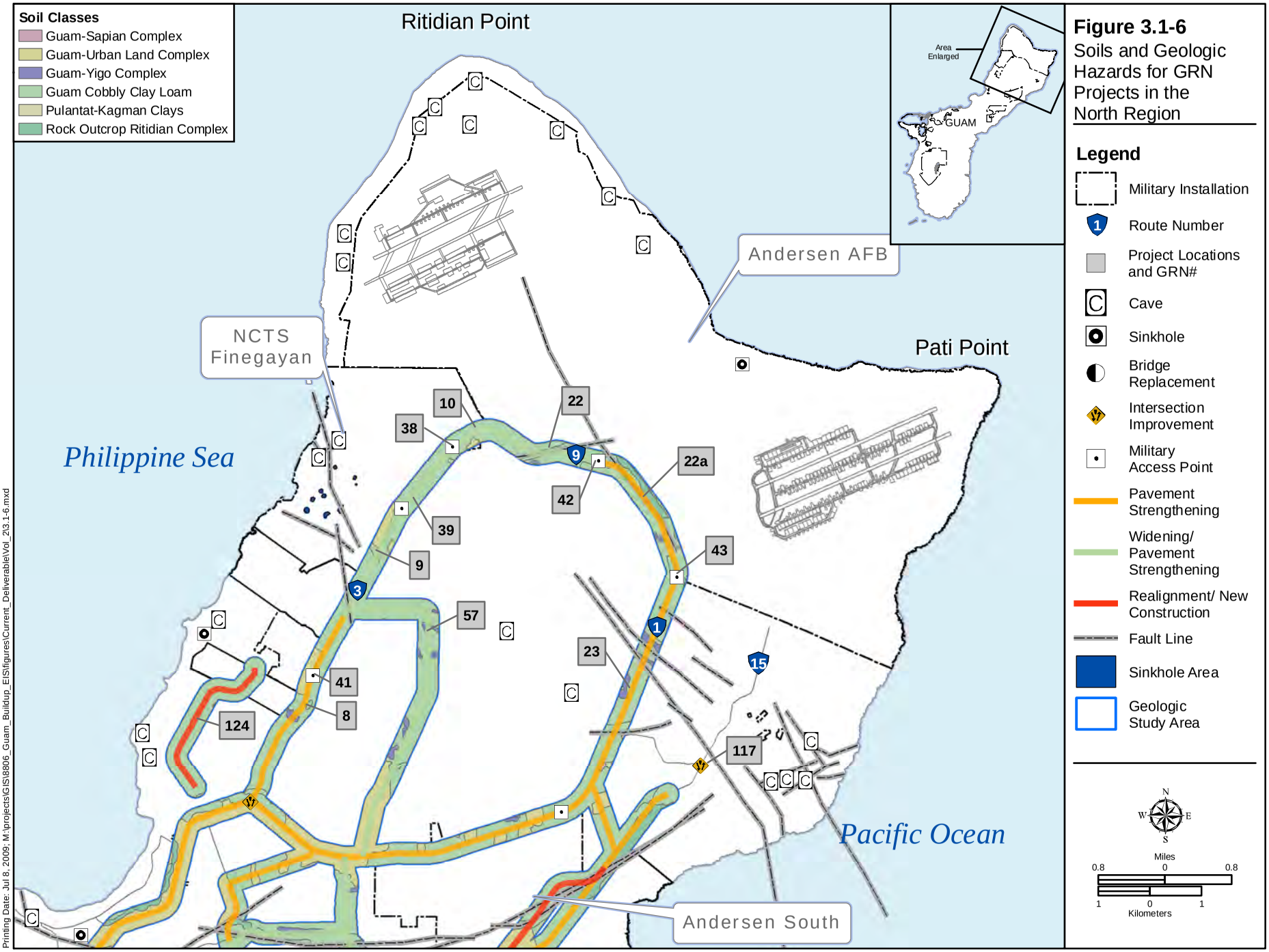
Geologic Hazards

Andersen South overlies both a major and minor fault line and is susceptible to earthquake events.The overall likelihood for landslides to occur on northern Guam is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. Andersen South is not an area of high risk for liquefaction or tsunami inundation.

3.1.3.2 Barrigada

Topography

Navy and Air Force Barrigada lie in the northern limestone structural province (refer to Figure 3.1-1). The substrate comprises a heterogeneous mixture of limestone subtypes ranging from highly friable to well-cemented depending on the depositional source. Elevations at the site range from approximately 240 ft (73 m) to 500 ft (152 m) above msl (refer to Figure 3.1-2). The most prominent feature is Barrigada Hill


Soil Classes
Guam-Sapian Complex
Guam-Urban Land Complex
Guam-Yigo Complex
Guam Cobbly Clay Loam
Pulantat-Kagman Clays
Rock Outcrop Ritidian Complex
Ritidian Point
Area Enlarged
GUAM
Andersen AFB
NCTS Finegayan
Pati Point
Philippine Sea
Pacific Ocean
Andersen South
10
38
22
22a
42
39
9
43
57
23
41
8
124
117
15
Figure 3.1-6
Soils and Geologic Hazards for GRN Projects in the North Region
Legend
Military Installation
Route Number
Project Locations and GRN#
Cave
Sinkhole
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Fault Line
Sinkhole Area
Geologic Study Area
N
W
E
S
Miles
0.8
0
0.8
1
0
1
Kilometers
Printing Date: Jul 8, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\3.1-6.mxd

that rises in the north-central part of the area with a maximum height of roughly 600 ft (183 m) just north of the site boundary.

Geology

The geology of Navy and Air Force Barrigada is characterized by a broad limestone reef plateau underlain by volcanic rocks (refer to Figure 3.1-1). Most of the site consists of young limestone rock (Pliocene to Pleistocene, 1.5-5 million years ago) but the central-northern portion of Navy Barrigada is old limestone rock (Miocene to Pliocene, 5-25 million years ago). Numerous cavities and caves exist within the porous limestone bedrock in the general area and collapses of these subterranean cavities form sinkholes (COMNAV Marianas 2001).

Soils

Soil formation on northern and most of central Guam is the result of intense weathering of the permeable limestone to form silica-poor soils rich in iron oxides and gibbsite clays (Young 1988). The soil survey results for this area show the following soil types: (1) Guam Cobbly Clay Loam 3% to 7% slopes, covering the majority of the area, and in smaller amounts; (2) Guam Urban Land Complex; (3) Pulantat Clay; (4) Pulantat-Kagman, Chacha Clay 0% to 5% slopes; and (5) Ritidian-Rock Outcrop Complex (refer to Figure 3.1-4). In general, erosion risks at Navy and Air Force Barrigada are slight to moderate, but do not present a major problem because the area is located on a broad limestone reef plateau. Soil characteristics are further summarized in Table 3.1-1.

Geologic Hazards

While Navy and Air Force Barrigada do not directly overlie any fault lines, like all of Guam, the areas are susceptible to earthquake events.The overall likelihood for landslides to occur at Navy or Air Force Barrigada is low due to the lack of steep areas with soil vulnerable to slipping in seismic events. Navy and Air Force Barrigada are not in an area vulnerable to liquefaction, nor are they in danger of tsunami inundation.

3.1.3.3 Non-DoD Land

Non-DoD land in Central Guam proposed for DoD use is limited to the Route 15 Parcel (Alternatives A and B).

Topography

The Route 15 Parcel lies in the northern limestone structural province (refer to Figure 3.1-1). The substrate comprises a heterogeneous mixture of limestone subtypes ranging from highly friable to well-cemented, depending on the depositional source. Elevations at the top of the plateau range from 500 to 600 ft (152 to 183 m) to the west and steep cliffs drop down to a narrow coastal lowland terrace (refer to Figure 3.1-2). The coastal areas range from 200 to 900 ft (61 to 274 m) wide stretching from the base of the cliffs to the sea (COMNAV Marianas 2001).

Geology

The geology of the Route 15 Parcel is characterized by a broad limestone reef plateau underlain by volcanic rocks (refer to Figure 3.1-1). Most of the site consists of young limestone rock (Pliocene to Pleistocene, 1.5-5 million years ago). Karst features are present throughout the area. Cockpit karst (a term for the sharp and jagged mature tropical karst topography) is present in areas near the cliff line and in the lowland terrace. Marbo Cave, a flank margin cave, is located on the northeast coast (Taborosi 2002).

Soils

Intense weathering of permeable limestone in the north and most of central Guam forms silica-poor soils rich in iron oxides and gibbsite clays (Young 1988). The soil survey results for this area show the following soil types for the site: (1) Guam Cobbly Clay Loam 3% to 7% slopes, covering the majority of the area, and in smaller amounts; (2) Guam Urban Land Complex; (3) Pulantat Clay; (4) Pulantat-Kagman; (5) Chacha Clay 0% to 5% slopes; and (6) Ritidian-Rock Outcrop Complex (refer to Figure 3.1-4). In general, erosion risks at the Route 15 Parcel are slight to moderate, but do not present a major problem because the area is located on a broad limestone reef plateau. Soil permeability, runoff, and erosion hazards are summarized in Table 3.1-1.

Geologic Hazards

The Route 15 Parcel overlies both a major and minor fault line and is susceptible to earthquake events. The overall likelihood for landslides to occur on the Route 15 Parcel is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events and it is not vulnerable to liquefaction. The Route 15 Parcel is located on the east coast of Guam and is at risk of tsunami inundation.

3.1.3.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Topography

GRN project locations near Navy Barrigada, Air Force Barrigada, and Andersen South in the central region of Guam are located on a broad limestone reef plateau underlain by volcanic rocks. Elevations range from 300 ft (91 m) to 500 ft (152 m) above msl.

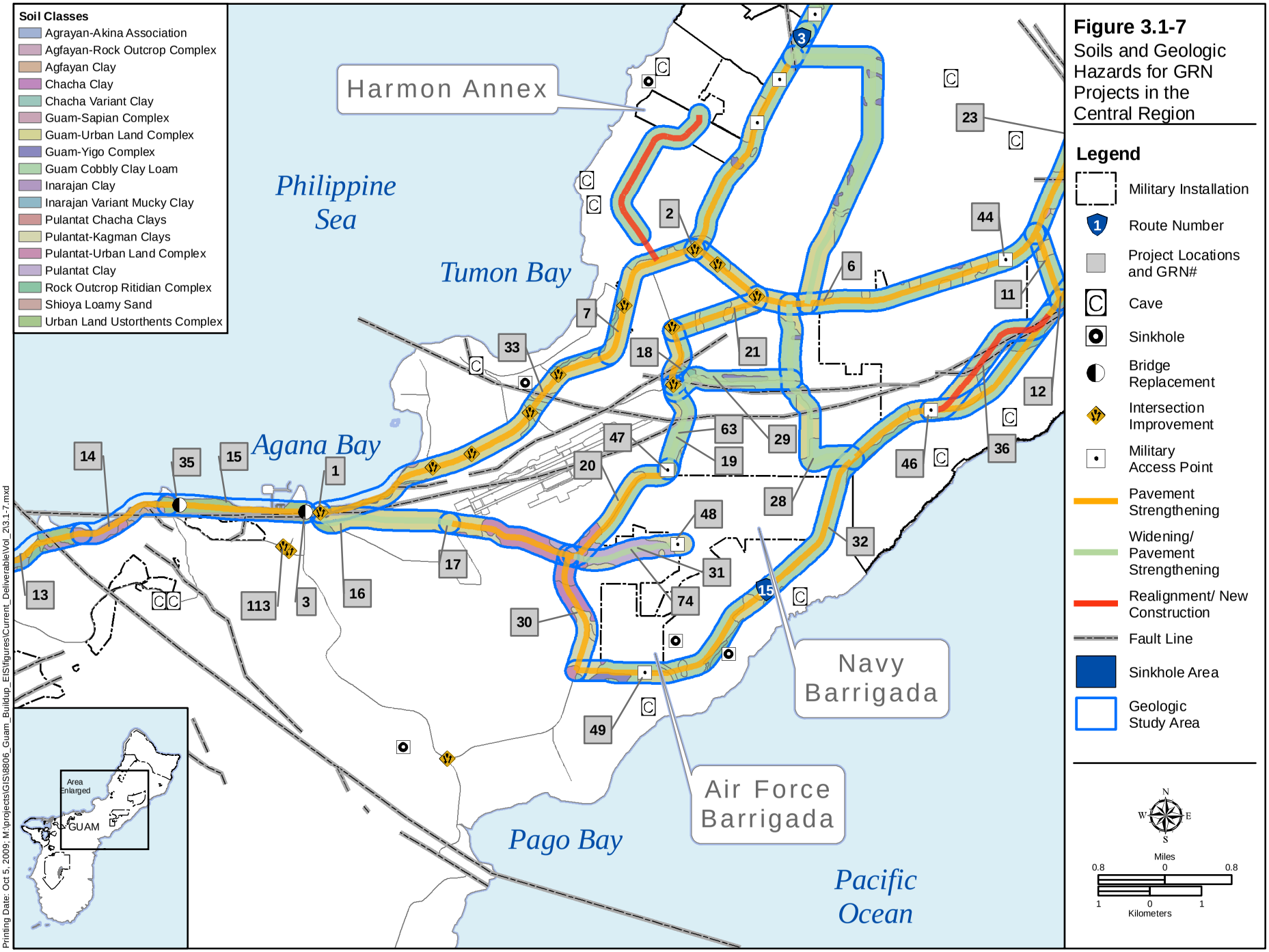
Geology

The GRN projects within the central region would be located on limestone rock of younger and old age, as shown in Figure 3.1-7. Caves formed from collapsed sinkholes in limestone forest are found along the coastline near Routes 1 and 15. Four known sinkholes are located in this region. The Tamuning-Yigo Fault Zone is situated in an east-west direction through Andersen South and extends across the center of the island. This fault zone connects to the Adelup Fault Zone bisecting the island at Pago Bay (Figure 3.1-7). Observed and inferred minor fault zones are found within the central region of the island. The potential for landslides in the central region of Guam is generally low. Roadways in the Tumon Bay area, such as Route 1, would have a high potential for liquefaction. The central region of Guam has low vulnerability for tsunami damage.

Soils

Soils beneath roadways in the central region of Guam are classified as Limestone Uplands, which are very shallow, well-drained, and nearly level to moderately sloping soils on plateaus. The primary soil classes found in the central region are Guam Cobbly Clay Loam; Guam Urban Land Complex and Pulantat Clay; Pulantat-Kagman Clay; and Ritidian-Rock Outcrop Complex. These soil types have slow to medium rates of runoff rates. With the exception of the Pulantat soils, which are more vulnerable to sheet and rill erosion, soils beneath roadways in the central region have a relatively low rate of erosion.

Soils and geologic hazards within the study area for the roadway projects in the central region are shown in Figure 3.1-7.


Soil Classes
Agrayan-Akina Association
Agfayan-Rock Outcrop Complex
Agfayan Clay
Chacha Clay
Chacha Variant Clay
Guam-Sapian Complex
Guam-Urban Land Complex
Guam-Yigo Complex
Guam Cobbly Clay Loam
Inarajan Clay
Inarajan Variant Mucky Clay
Pulantat Chacha Clays
Pulantat-Kagman Clays
Pulantat-Urban Land Complex
Pulantat Clay
Rock Outcrop Ritidian Complex
Shioya Loamy Sand
Urban Land Ustorthents Complex
Harmon Annex
Philippine Sea
Tumon Bay
Agana Bay
Navy Barrigada
Air Force Barrigada
Pago Bay
Pacific Ocean
Area Enlarged
GUAM
Figure 3.1-7
Soils and Geologic Hazards for GRN Projects in the Central Region
Legend
Military Installation
Route Number
Project Locations and GRN#
Cave
Sinkhole
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Fault Line
Sinkhole Area
Geologic Study Area
N
W
E
S
Miles
0.8 0 0.8
1 0 1
Kilometers
Printing Date: Oct 5, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\3.1-7.mxd

3.1.4 Apra Harbor

3.1.4.1 Apra Harbor

Topography

Apra Harbor is a natural deep water harbor measuring 3 mi (5 km) by 0.5 mi (0.8 km). Inner Apra Harbor ranges in depth from 15 to 46 ft (5 to 14 m) and Outer Apra Harbor ranges in depth from 100 to 150 ft (30 to 46 m). The Orote Peninsula, the southern boundary of Apra Harbor, consists of a raised limestone plateau (refer to Figure 3.1-2). The manmade Glass Breakwater extends from Cabras Island, making up the northern boundary to the harbor (U.S. Fish and Wildlife Service [USFWS] 2006).

Geology

Apra Harbor's shoreline consists of large areas of basaltic and calcareous fill (USFWS 2006) (refer to Figure 3.1-1). The fill makes the area susceptible to liquefaction; GovGuam 2008 reports that 0.5 mi^2 (1.3 km^2) at Apra Harbor have a very high risk of liquefaction. This is the area with the greatest historical record of liquefaction. There is no karst geology in the project area.

Soils

Permeability of the soil is moderately rapid and runoff is slow; however, the majority of the onshore area is paved, resulting in rapid runoff. Extensive areas along Apra Harbor consist of coastal fill covered by roads, buildings, and parking lots. Soil consists of urban land coastal fill that is quarried fill material consisting of crushed coral gravel and cobbles, and few areas of very gravelly clay and clay loam (refer to Figure 3.1-4) (COMNAV Marianas 2006). Sediment from Inner Apra Harbor is primarily fine-grained and classified as clay, sandy clay, and silty clay. While silty soils are prone to erosion, the lack of slope lessens erosion hazards. Soil characteristics are summarized in Table 3.1-1.

Geologic Hazards

Apra Harbor lies near a major fault line and is susceptible to earthquake events. The overall likelihood for landslides to occur at Apra Harbor is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. About 0.5 mi^2 (1.3 km^2) of Apra Harbor has a very high risk of liquefaction. This is the area with the greatest historical record of liquefaction. Apra Harbor has the highest likelihood of being affected by tsunamis near Guam (GovGuam 2008).

3.1.4.2 Naval Base Guam

Topography

Naval Base Guam consists of relatively low and flat land surrounding the harbor and Orote Peninsula, a raised limestone plateau reaching 190 ft (58 m) elevation. The plateau slopes eastward towards the sea (COMNAV Marianas 2001). Much of the land has been substantially altered by shaping, dredging, and filling (COMNAV Marianas 2008).

Geology

The geology of the project area is much like that of northern Guam (refer to Section 3.1.8.1 for additional discussion). The coastline is composed of a relatively narrow margin of beach interspersed with basalt or limestone rock formations. There is no Karst geology in the proposed project areas.

Soils

Large areas of Orote Peninsula have highly disturbed soils classified as Guam Urban Land Complex (refer to Figure 3.1-4 and Table 3.1-1 for soil description). Extensive areas along Apra Harbor consist of coastal fill covered by roads, buildings, and parking lots. The Naval Base Guam area is dominated by shallow, well-drained limestone soils; however, areas of soil formed on bottomlands and volcanic plateaus are also present in specific areas. The Dry Dock Island Peninsula, Polaris Point, and sections of the shoreline are the result of dredging and filling. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (COMNAV Marianas 2001). Erosion hazards are slight in these areas.

Geologic Hazards

Naval Base Guam lies near a major fault line and is susceptible to earthquake events. The overall likelihood for landslides to occur at Naval Base Guam is generally low due to the lack of steep areas with soil vulnerable to slipping in seismic events. About 0.5 mi^2 (1.3 km^2), or 0.3% of Guam, mainly located around parts of Apra Harbor, have a very high risk of liquefaction. This is the area with the greatest historical record of liquefaction. Naval Base Guam is included in the area considered most vulnerable to potential tsunami impacts (GovGuam 2008).

3.1.4.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Topography

Roadways in the Apra Harbor Region consist of Routes 1, 2A, 5, and 11. These roadways are located at relatively flat terrain at elevations that are less than 100 ft (30 m) above msl.

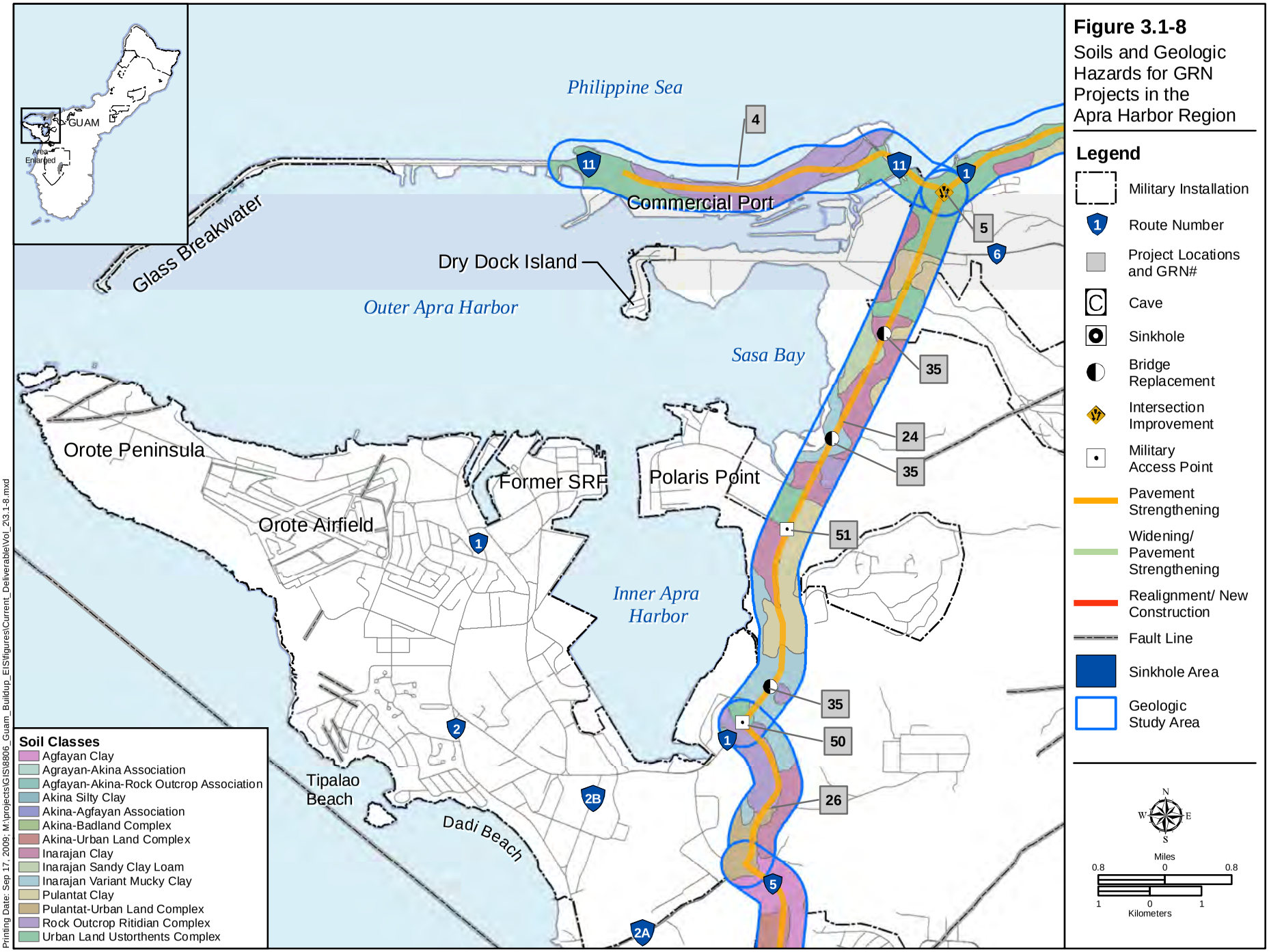
Geology

The GRN projects that would occur along Routes 1, 2A, 5, and 11 within the Apra Harbor Region would be located in areas of older limestone rock, artificial fill, and volcanic units, as shown in Figure 3.1-8. There are no karst geologic formations in the Apra Harbor Region, so sinkholes and caves are not present. There are no major faults or fault zones in the Apra Harbor Region of Guam, although there are areas of observed or inferred minor faults in this region (Figure 3.1-8). The potential for landslides in the Apra Harbor Region of Guam is low. The Apra Harbor Region, including areas of artificial fill, has a very high risk of liquefaction. Although impacts of a tsunami would most likely occur on Guam's east coast, the area most prone to potential tsunami impact is Apra Harbor, based on the elevation of its landmass.

Soils

Soils beneath Routes 1, 2A, 5, and 11 within the Apra Harbor Region consist of Urban Land coastal fill, gravelly clay, and clay loam. These soils have slow runoff rates, although rapid runoff occurs due to paving over most areas. Soils in the Apra Harbor Region exhibit a low rate of erosion.

Soils and geologic hazards within the study area for the roadway projects in the Apra Harbor Region are shown in Figure 3.1-8.


GUAM
Area Enlarged
Philippine Sea
Glass Breakwater
Commercial Port
Dry Dock Island
Outer Apra Harbor
Sasa Bay
Orote Peninsula
Former SRF
Polaris Point
Orote Airfield
Inner Apra Harbor
Tipalao Beach
Dadi Beach
4
11
11
1
5
6
35
24
35
51
35
50
26
5
2A
2B
1
2
1
Soil Classes
Agfayan Clay
Agrayan-Akina Association
Agfayan-Akina-Rock Outcrop Association
Akina Silty Clay
Akina-Agfayan Association
Akina-Badland Complex
Akina-Urban Land Complex
Inarajan Clay
Inarajan Sandy Clay Loam
Inarajan Variant Mucky Clay
Pulantat Clay
Pulantat-Urban Land Complex
Rock Outcrop Ritidian Complex
Urban Land Ustorthents Complex
Figure 3.1-8
Soils and Geologic Hazards for GRN Projects in the Apra Harbor Region
Legend
Military Installation
Route Number
Project Locations and GRN#
Cave
Sinkhole
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Fault Line
Sinkhole Area
Geologic Study Area
N
W
E
S
Miles
0.8
0
0.8
1
0
1
Kilometers
Printing Date: Sep 17, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\3.1-8.mxd

3.1.5 South

3.1.5.1 Naval Munitions Site

Topography

Southern Guam is a mountainous upland with many rivers that form wide valleys and plains near the coast (refer to Figure 3.1-2). The western boundary of Naval Munitions Site (NMS) coincides with a range of low mountains orientated on a north to south axis. This range includes Mount Alifan, Mount Almagosa, Mount Lamlam, and Mount Humuyong (COMNAV Marianas 2001).

Geology

NMS is located in the southern structural provinces of Guam. Most of the areas in southern Guam are volcanic in origin, but limestone may be found near the coast and surrounding Mount Lamlam and Mount Alifan (Young 1988). Southern Guam is underlain by weathered basalt and tuff-derived sedimentary rocks (COMNAV Marianas 2008).

The mountain range at the western boundary lies on the Bolanos structural block that consists of rock from the Miocene-aged Umatac Formation. The Umatac Formation is composed of east-dipping volcanic rocks, including flow basalts and tuff, breccia, sandstone, and shale. The tuff is consolidated volcanic ash that was marine deposited and uplifted. Breccia refers to the angular fragments of the conglomerate. Portions of the range have alternated between periods of submergence and emergence as evidence from the presence of Alifan Limestone (COMNAV Marianas 2001).

Southern Guam is an uplifted volcanic highland containing a karst terrain on limestone remnants (Mylroie et al. 1999). These units are positioned above the influence of the fresh water lens, sea water mixing, and sea level change; therefore, the karst is classic tropical continental. Its characteristics include contact springs issuing from well-developed caves, sinking streams with resurgences, and conical cockpit karst. The NMS area includes numerous caves and karst features (Taborosi 2004) including Almagosa Cave/Spring and Bonya Spring that serve as water sources for the Navy.

Soils

The NMS area contains soils formed on bottomland, volcanic plateaus, and limestone plateaus. The soils found at higher elevations along the mountain range from Mount Alifan to Mount Lamlam are made up of shallow, well-drained, limestone soils (refer to Figure 3.1-4 and Table 3.1-1). Extensive areas of highly weathered volcanic soils are present in the central and southern portions of the site. River bottoms tend to consist of poorly drained soils formed by erosion of upland limestone and volcanic soils (COMNAV Marianas 2001).

Soils within the Fena Watershed, part of NMS, are either volcanic in origin or were formed from old limestone parent material. The limestone soils within the Fena Watershed are distinguished from the volcanic soils on the basis of parent material and associated properties. According to Young (1988), parent material is the single most important soil-forming factor used to explain the differences between the soils of Guam.

The limestone soils formed mainly in the residue from coralline limestone, whereas the volcanic soils formed from volcanic sediments or deposition. The pH is slightly to moderately alkaline (pH 7.4 to 8.4) throughout the profile. Soils formed over limestone are typically very shallow, well drained, and have low water-holding capacity. Permeability is very rapid and these soils are not highly erosive. Moderate and steep soils are rated as having very slow runoff and are a slight erosion hazard.

Volcanic soils range from deep to very deep with minor inclusions of shallow to very shallow volcanic soils. In general, the volcanic soils have high water holding capacity and high potential for runoff. Permeability is generally slow throughout all horizons of volcanic soils and on moderate slopes volcanic soils have a medium runoff and moderate erosion hazard. The pH of volcanic soils ranges from neutral to strongly acid. The lower horizons are typically moderately to strongly acid.

Erosion in the Fena Watershed (approximately 3,600 ac [1,457 ha]) measures 120,000 tons (108,862 metric tons) per year or 34 tons (31 metric tons) per acre annually (COMNAV Marianas 2004). This erosion is responsible for the majority of the sediment into Fena Reservoir. The steep ravine forests and savannas contribute to the severe erosion, as do bare badlands that have lost topsoil due to water and wind erosion. Badland erosion contributes the greatest to erosion on a per acre basis (COMNAV Marianas 2004). The exposed subsoil usually has a very low pH, and lacks organic matter and many essential plant nutrients (COMNAV Marianas 2001). Steep savanna, steep ravine forest, and badlands near the Fena Reservoir have higher sediment delivery rates and contribute greater amounts of sediment than similar cover with similar slopes in other parts of the watershed.

Within the Fena Watershed, the Imong Subwatershed erodes at an average rate of 51 tons/ac/year, Sadog Gago at 47, East Fena at 35, West Fena at 31, Maulap at 26, Almagosa at 24, and Almagosa Sink at 7 tons/ac/year. The high rates for the first two basins are explained by the fact that nearly 94% of both Imong and Sadog Gago Subwatersheds consist of steeply sloping savanna, steeply sloping ravine forest, or badlands (COMNAV Marianas 2004).

Geologic Hazards

NMS overlies a major fault line and four minor fault lines and is susceptible to earthquake events. The overall likelihood for landslides to occur in southern Guam is high due to steep areas with soil vulnerable to slipping in seismic events. NMS has a low risk of liquefaction and tsunami inundation.

3.1.5.2 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Topography

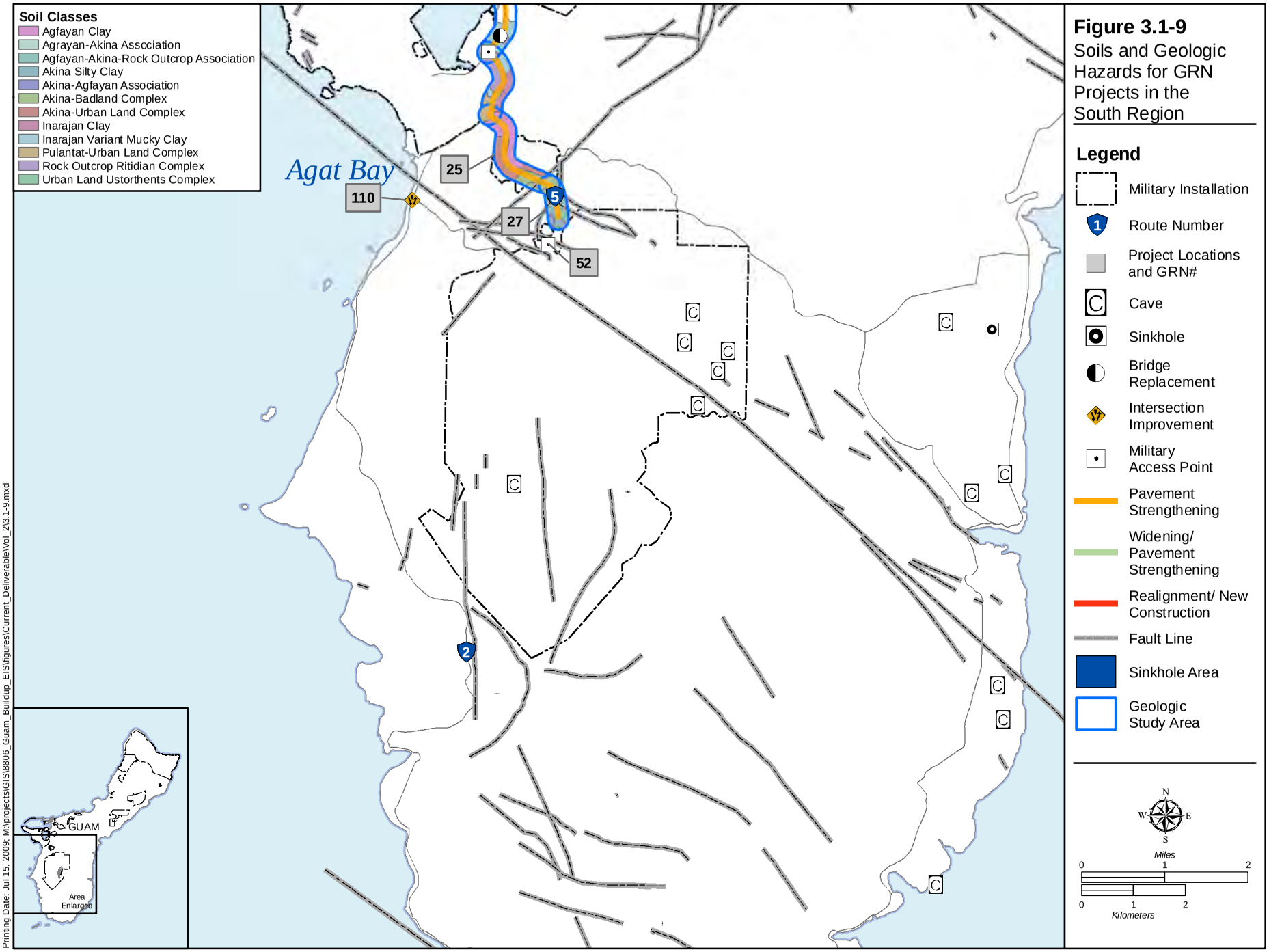
The topography of roadway locations in the south region (Routes 5 and 12) varies in elevation from below 100 ft (30 m) to 300 ft (91 m) above msl.

Geology

The GRN projects that would occur along Routes 5 and 12 within the south region would be located on older limestone rock and volcanic units, as shown in Figure 3.1-9. Sinkholes and caves are not known from these GRN project locations. The Talofofo Fault Zones runs in a northwest direction in the south region (refer to Figure 3.1-6). Observed and inferred minor fault zones are located along portions of the Navy Housing and the NMS. The potential for landslides in the south region of Guam is moderate to high. This area has a low potential for liquefaction and a low vulnerability for tsunami damage.

Soils

Soils beneath Routes 5 and 12 within the south region are classified as Urban Land Complex and Guam Cobbly Clay Loam. These soils are very shallow, well-drained, and nearly level to moderately sloping soils on plateaus. These soil types have a slow rate of runoff and a relatively low rate of erosion.


Soil Classes
Agfayan Clay
Agrayan-Akina Association
Agfayan-Akina-Rock Outcrop Association
Akina Silty Clay
Akina-Agfayan Association
Akina-Badland Complex
Akina-Urban Land Complex
Inarajan Clay
Inarajan Variant Mucky Clay
Pulantat-Urban Land Complex
Rock Outcrop Ritidian Complex
Urban Land Ustorthents Complex
Agat Bay
110
25
27
52
5
2
GUAM
Area Enlarged
Figure 3.1-9
Soils and Geologic Hazards for GRN Projects in the South Region
Legend
Military Installation
Route Number
Project Locations and GRN#
Cave
Sinkhole
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Fault Line
Sinkhole Area
Geologic Study Area
N
W
E
S
Miles
0
1
2
Kilometers
0
1
2
Printing Date: Jul 15, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\3.1-9.mxd

Soils and geologic hazards within the study area for the roadway projects in the south region are shown in Figure 3.1-9.

3.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

3.2.1 Approach to Analysis

3.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to geology and soil resources was established through geologic and soil studies and reports, along with federal laws and regulations, including state and local building codes and grading ordinances. The assessment of geological and soils impacts was conducted, in part, by reviewing available literature such as previously published National Environmental Policy Act (NEPA) documents for actions in the Mariana Islands Range Complex (MIRC) and surrounding area. A site-specific geotechnical investigation was not undertaken for all of the areas covered in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), although one was completed for Naval Computer and Telecommunications Station (NCTS) Finegayan to identify geologic features. The impact analyses presented in this section discuss each alternative (Main Cantonment, Training, Airfields and Waterfront) of the proposed action with geologic and soil impacts by geographic area, as described in the previous affected environment section. Geology and soils also affect the placement or location of a land use; where such constraints occur, they are discussed. In master planning, topography and geological features were assessed and buildings were sited to avoid steep slopes, karst features, and geologic hazards. The geology and soils ROI includes all the geologic resources on Guam that are subject to construction and operation activities.

LIDAR Contour Data were used to identify potential sinkholes on proposed sites. Proposed road alignments were adjusted to avoid these potential sinkhole locations, and buffer areas of 100 ft (30 m) or more were implemented around the potential sinkhole sites. These buffer areas would be maintained in their current natural state and would not be used for any facility development. Analysis of topography, soil, and vegetation was completed during site characterization using LIDAR Contour Data, geotechnical reports, and site visits to ensure minimal impacts to geological and soil resources.

Project effects and constraints that can take place during construction and operations or may limit activities may include:

<u>Construction</u>

- Cut and fill activities leading to soil erosion
- Removal of vegetation and landscaping leading to soil erosion
- Use of heavy equipment resulting in soil compaction
- Identification and avoidance of karst geological features, such as caves and sinkholes
- Increased risk of damage from liquefaction, landslides, tsunamis

Operation

- Impervious surface increase resulting in increased runoff and soil erosion
- Vehicle movements resulting in increased soil erosion and compaction
- Troop movements resulting in increased soil erosion
- Munitions impacts resulting in soil and subsurface contamination
- Explosive detonations resulting in soil and subsurface contamination
- Fires resulting in reduced vegetation and increased soil erosion

Potential geology and soils impacts are limited to elements of current and proposed activities that could affect onshore land forms or that could be affected by geologic hazards. Aircraft training activities are not expected to have substantial effects on geology and soils. Potential soil contamination issues are addressed in Volume 2, Chapter 17, Hazardous Materials and Waste. Increased soil erosion also may indirectly impact water quality and aquatic ecosystems. Potential impacts to these resources are described in Volume 2, Chapter 4, Water Resources; Chapter 10, Terrestrial Biological Resources; and Chapter 11, Marine Biological Resources.

Actions with potential impacts to soil and geology resources include:

- Construction and operation activities at Andersen Air Force Base (AFB)
- Main Cantonment construction and operation activities
- Waterfront and Naval Base Guam improvements at Apra Harbor
- Range operations at Navy Barrigada and NMS
- Training activities at Andersen South and Route 15 Parcel

Applicable Regulatory Standards

The United States (U.S.) Environmental Protection Agency (USEPA) Region 9 gives the Guam Environmental Protection Agency (GEPA) the authority to enforce portions of federal statutes via a Memorandum of Agreement.

Under this agreement, the Safe Drinking Water Program, Water Resources Management Program, and the Water Pollution Control Program are administered by GEPA. GEPA Water Pollution Control Program is responsible for protecting Guam's resources from point and non-point source pollution, including administration of the National Pollutant Discharge Elimination System (NPDES) program. NPDES Construction General Permits are required for large and small construction activities. Requirements include a Notice of Intent, a Notice of Termination and a construction site Storm Water Pollution Prevention Plan (SWPPP). Permits are required for projects that disturb greater than one acre of soil, including lay-down, ingress and egress areas. Phase I regulates construction activity disturbing 5 ac (2 ha) or more of total land area and Phase II regulates small construction activity disturbing between 1 and 5 ac (0.4 and 2 ha) of total land area.

An Environmental Protection Plan (EPP) is required for projects at the discretion of the GEPA Administrator**.** EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section 10103.C.5(d). EPPs would include nonpoint source control management measures including erosion and sedimentation control, vegetation, wildlife and coral/marine resource protection measures, fugitive dust control, solid and hazardous waste management and disposal procedures, nutrient management plan, integrated pest management strategy/plan, confined animal facilities management plan, irrigation water management plan, personnel safety procedures, work site maintenance, and typhoon contingency plans, as necessary, depending on the work, project, activity and facility function.

Seismic, liquefaction and ground shaking effects would be reduced by following Unified Facility Code (UFC) 3-310-04 Seismic Design for Buildings (U.S. Army Corps of Engineers [USACE] 2007).

3.2.1.2 Determination of Significance

standards, as well as by subjective criteria. To be considered a significant impact, the additional factors would be considered for each project area:

- Any increase in rate of erosion and soil loss from physical disturbance
- Reduced amounts of productive soils
- Alteration of surrounding landscape and effect on important geologic features (including soil or rock removal and filling of sinkholes)
- Diminished slope stability
- Increased vulnerability to a geologic hazard (e.g., seismic activity, tsunami, liquefaction), and the probability that such an event could result in injury

3.2.1.3 Issues Identified During Public Scoping Process

The following analysis focuses on potential affects to geology and soils resources that would be impacted by the proposed action. As part of the analysis, concerns relating to geology and soils resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These included:

- Implementing erosion control measures for construction and post construction phases
- Ensuring that proper permitting and local government clearances are sought where applicable

3.2.2 Alternative 1

3.2.2.1 North

Andersen AFB

The proposed activities at Andersen AFB include construction at North Ramp, building new embarkation facilities at South Ramp, ammunition storage at MSA1, and constructing the North Gate and Access Road; using an existing demolition range at Northwest Field (NWF) and conducting aviation training at North Ramp and NWF.

The majority of the North Ramp at Andersen AFB is undeveloped, but has been previously disturbed. The Air Combat Element Beddown project area is approximately 69 ac (27 ha) on an inactive, previously disturbed area north of the existing Andersen AFB airfield.

The total project area for Air Mobility Command at the South Ramp is 28 ac (11.33 ha). The site currently includes paved airfield parking and disturbed, unused land adjacent to the airfield.

The North Gate and Access Road project includes a 12-ft (3.66-m) wide access road to intersect Route 9 and extend into Andersen AFB approximately 6,561 ft (2,000 m) until it terminates at 5th Avenue. A new Entry Control Point facility is also proposed. Roadway paving, street lighting, and drainage would be constructed the entire length of the alignment. Other associated construction totals 1,014 ft^2 (94 m^2) in area.

Construction

Development under Alternative 1 would disturb soil during construction. There is a risk of increased rate of erosion, compaction and soil loss from physical disturbance whenever there is construction activity, but Standard Operating Procedures (SOPs) and a SWPPP (required by the NPDES Construction General

Permit) would be implemented to minimize impacts. Soil found at Andersen AFB and other locations potentially affected by Alternative 1 are shown in Table 3.2-1. Soil at Andersen AFB does not have a high erodibility factor and construction is not proposed on steep slopes. Erodibility factors for each soil type can be found in Table 3.2-1.

Table 3.2-1. Soil Types at Proposed Sites

Soil Type	*Location*
Guam Cobbly Clay Loam at 3-7% slope	Andersen AFB
Guam Cobbly Clay Loam at 7-15% slope	Andersen AFB
Guam Urban Land Complex at 0-3% slope	Andersen AFB
Guam Urban Land Complex at 0-3% slope	NCTS Finegayan
Guam Cobbly Clay Loam at 3-7% slope	NCTS Finegayan
Guam-Yigo Complex at 0-7% slope	South Finegayan
Guam Cobbly Clay Loam at 3-7% slope	South Finegayan
Guam Urban Land Complex at 0-3% slope	South Finegayan
Guam Cobbly Clay Loam at 3-7% slope	FAA Parcel
Guam Urban Land Complex at 0-3% slope	FAA Parcel
Guam Cobbly Clay Loam at 3-7% slope	Harmon Annex
Guam Cobbly Clay Loam at 7-15% slope	Andersen South
Guam Cobbly Clay Loam at 7-15% slope	Andersen South
Guam Urban Land Complex at 0-3% slope	Andersen South
Guam Cobbly Clay Loam at 7-15% slope	Navy Barrigada
Pulantat Clay at 3-7% slope	Navy Barrigada
Pulantat Clay at 7-10% slope	Navy Barrigada
Urban Land Coastal Fill at 0 -3% slope	Navy Barrigada
Guam Cobbly Clay Loam at 3-7% slope	Air Force Barrigada
Chacha Clay at 0-5% slope	Air Force Barrigada
Pulantat-Kagman Clays at 0-7% slope	Air Force Barrigada
Guam Urban Land Complex at 0-3% slope	Apra Harbor
Ritidian Rock Outcrop Complex 3-15% slope	Apra Harbor
Urban Land-Ustorthents Complex, nearly level	Apra Harbor
Inaranjan Clay at 0-4% slope	NMS
Akina Silty Clay at 7-15% slope	NMS
Akina-Atate at steep slope	NMS
Akina-Urban Land Complex at 0-7% slope	NMS

Source: Young 1988.

The construction SOPs would include requirements for stormwater compliance, with Best Management Practices (BMPs), including the SWPPP to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A list of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction. Construction SOPs would be followed to prevent soil erosion. Therefore, Alternative 1 would not result in significant impacts to geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

Construction activities under Alternative 1 for the Main Cantonment and alternatives associated with training and waterfront activities would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscape around previously disturbed areas, such as buildings and base entrance. Temporary, rather than permanent loss of vegetation would occur. Therefore, these alternatives would result in minimal impacts to unique geologic resources with little change to the landscape of the affected area.

There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in area, just east of the project site. The sinkhole would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. The sinkhole would not be affected by construction activities. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

Under these alternatives, proposed developments would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, construction relating to Alternative 1 and training and waterfront alternatives would not result in significant impacts associated with geologic hazards.

Operation

Alternative 1 operations activities would not disturb or compact soil or cause an increase in erosion. There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in area, just east of the project site. The sinkhole would be avoided during operations and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. If deemed hazardous, this sinkhole, along with any others found, could be fenced off and signs put in place to warn of the potential danger. Less than significant impacts are expected.

The potential for wildfire that might impact soil and geological resources would be minimal since proposed training exercises under Alternative 1 are non-firing. A Marine Corps fire station with alert force facilities (45 people) would be located at the Main Cantonment. That unit would help to ensure fire safety procedures and, along with the Andersen AFB fire department, would be responsible for controlling any fires that could be started during training exercises. There would be an Aircraft Fire and Rescue Station at the main cantonment at NCTS Finegayan which would respond to air-ground training incidents, and would be present during some training exercises as a precautionary measure. Based on a low fire potential and fire response capabilities, impacts to soil and geological resources would be less than significant.

Finegayan

A total of 1,090 ac (441 ha) at NCTS Finegayan and 290 ac (117 ha) at South Finegayan would be developed under Alternative 1 as the Main Cantonment. Although DoD property encompasses an area down to the waterline, the proposed Alternative 1 Main Cantonment would be situated on the upper area of NCTS Finegayan and would not encroach on the cliff line leading to the ocean. Table 3.2-2 shows the ground area that would be disturbed by development of each area of the proposed Main Cantonment.

Table 3.2-2. Alternative 1 Main Cantonment Footprint Area

Area Number	*Facility*	*Total Area Affected ac (ha)*
Area 1	Marine Expeditionary Force (MEF) Command Element, 12th Marine Regiment, and 3d Marine Division Headquarters	19.6 (7.9)
Area 2	No construction proposed	0
Area 3	III MEF Admin. & Operations	34.5 (14.0)
Area 4	3d Marine Div. Admin. & Operations	81.7 (33.1)
Area 5	Marine Logistics Group (MLG) and Admin. & Operations	101.0 (40.9)
Area 6	MLG and Base Industrial Area	173.0 (70.0)
Area 7	Bachelor's Enlisted Quarters Campus	125.7 (50.9)
Area 8	No construction proposed	0
Area 9	Provost Marshall's Office	33.0 (13.4)
Area 10	Main Entry Control Point Gate and Base Operations Area	18.4 (7.4)
Area 11	Bachelor's Officer's Quarters, Campus & Officer's Club	18.3 (7.3)
Area 12	administrative, legal services, family services, and Morale, Welfare, and Recreation support facilities	9.9 (4.0)
Area 13	temporary lodging facilities	8.0 (3.2)
Area 14	Main Community Center	69.3 (28.0)
Area 15	fire station and alert force facilities	3.7 (1.5)
Area 16	applied instruction and auditorium facilities	3.4 (1.4)
Area 17	Marine Air Wing	38.6 (15.6)
Area 18	administrative areas, warehousing, dental clinic, and gate house facilities	20.7 (8.4)
Area 19	religious ministry facility, youth center, and swimming pool	10.0 (4.0)
Area 20	Child Development Center	2.4 (1.0)
Area 21	elementary school	5.0 (2.0)
Area 22	middle and high school	12.1 (4.0)
Area 23	Child Development Center	2.7 (1.1)
Area 24	elementary schools	9.9 (4.0)
Area 25	indoor fitness, swimming pool, and youth center facilities	9.9 (4.0)
Area 26	Child Development Center	2.7 (1.1)
Area 27	elementary and middle school	12.2 (4.9)
Area 28	restaurant, location exchange, bank, gas station, and gate house	10.0 (4.0)
Family Housing	Area A	181.2 (73.3)
Family Housing	Area B	76.8 (31.1)
	Total Impervious Area for Main Cantonment:	**1,093.9 ac (442.7 ha)**

Hazardous materials storage would occur in Areas 3, 4, 5, 6, 17 and 18. Hazardous materials storage areas present the potential to impact soil resources if the materials are not properly handled. BMPs and mitigation measures are discussed in Volume 2, Chapter 17, Hazardous Materials and Waste.

Construction

The proposed Alternative 1 Main Cantonment development would disturb soil during construction. Construction activities under Alternative 1 would include building of facilities, infrastructure, utilities, and roadways, which would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity, but stormwater BMPs would serve to provide erosion and sediment control. Erosion potential for soils found at Finegayan is shown in Table 3.1-1.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction.

Construction SOPs and a SWPPP required by the NPDES permit would be followed to prevent soil erosion. Therefore, Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed description of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around all sinkholes to prevent further erosion or expansion. The sinkholes would not be affected by construction activities. If deemed hazardous, this sinkhole, along with any others found, could be fenced off and signs put in place to warn of the potential danger. Less than significant impacts are expected.

Finegayan is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Operation

Although Finegayan is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, slope instability and liquefaction are minimal. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Operations activities would not disturb or compact soil or cause an increase in erosion. The predominant limestone bedrock is not vulnerable to liquefaction. If deemed hazardous, any sinkholes found in the area could be fenced off and signs put in place to warn of the potential danger. Less than significant impacts are expected.

Non-DoD Land

Under Alternative 1, 326 ac (132 ha) of Harmon Annex would be developed as Military Family Housing. An additional 680 ac (2755 ha) of the former FAA parcel would be developed as part of the proposed Main Cantonment.

Construction

The proposed Alternative 1 Main Cantonment and Family Housing development would disturb soil during construction. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity; however, stormwater BMPs would provide erosion and sediment control. Erosion potential for soils found at Harmon Annex and the Former FAA Parcel are shown in Table 3.1-1.

The soil types that would be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. Therefore, Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed description of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Construction activities under Alternative 1 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 1 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There is at least one sinkhole in the Harmon Annex, and none found at the Former FAA Parcel. The sinkhole would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. The sinkhole would not be affected by construction activities. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

Harmon Annex and the Former FAA Parcel are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Operation

Although Harmon Annex and the Former FAA Parcel are located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, slope instability and liquefaction are minimized during construction. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Operations activities would not disturb or compact soil or cause an increase in erosion. The predominant limestone bedrock is not vulnerable to liquefaction. Therefore, Alternative 1 would not result in significant impacts associated with geologic resources or hazards.

3.2.2.2 Central

Andersen South

Andersen South would be developed as a non-firing training range complex under Alternative 1. Maneuver training would would be conducted within the 2,000 acre (809 ha) area with two landing zones (LZ). It would also include hand grenade training and a grenade house. The majority of the site is currently vacant. The abandoned buildings and vacant lands are currently used for non-firing training, thus very little change to land use for training and limited construction of access roads would occur. A

perimeter fence would be constructed around Andersen South with a main gate and three range gates for access. Erosion potential for soil found at Andersen South can be found in Table 3.1-1.

Construction

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed description of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Construction activities under Alternative 1 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscape. Temporary loss of vegetation would occur. Therefore, Alternative 1 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There are no known sinkholes at Andersen South. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

The Alternative 1 proposed developments would be located on a relatively flat, broad limestone reef plateau that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Due to the limited duration of construction activities, potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Operation

Training activities are conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion. Therefore, Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

Although Andersen South is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, slope instability and liquefaction are minimal. The Alternative 1 proposed range complex is to be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Non-DoD Land

The proposed range complex on the Route 15 parcel would encompass approximately 1,000 ac (405 ha). The land disturbance required for firing ranges is concentrated at the firing points and targets. The majority of the site would remain naturally vegetated open space and encompass the Surface Danger Zones (SDZs). Establishment of Special Use Airspace (SUA) would not have any impact on geological and soil resources.

The two alternatives for the proposed firing range are Alternative A and Alternative B. If firing range Alternative A is selected, then Route 15 would be relocated to Andersen South, where it would be constructed below grade for the 1.2 mi (1.9 km) of its 1.7 mi (2.8 km) length. The relocation would

require soil moving and grading for proper highway grade. Its average distance below grade would be approximately 15 ft (5 m). Roadway cut would measure 323,509 cubic yards (cy) (247,340 m^3), and fill would be 34,837 cy (26,635 m^3).

Firing range Alternative B would require construction of a frontage road adjacent to Route 15 to serve range traffic crossing Route 15 in either one or two locations. In this alternative, a machine gun range of the same size, 58 ac (23 ha), 3,280 ft (1,000 m) maximum gun-target distance, would require 121,602 cy (92,971 m^3) of cut and 1,670,000 cy (1,276,659 m^3) of fill.

Alternative A and Alternative B would both require relocation of the International Raceway Park and residences. Demolition would temporarily disturb soil. The majority of the 1,000-ac (405-ha) site is undeveloped.

Construction

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner that would minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed description of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Construction activities under Alternative 1 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 1 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There are no known sinkholes at the Route 15 Parcel. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

The Alternative 1 proposed developments would be located on a relatively flat, broad limestone reef plateau that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Operation

Military training activities at the Route 15 parcel would result in localized disturbances to soil. Training activities are conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion and would not result in significant impacts to geological and soil resources. Soil types that could be disturbed would not be agriculturally productive soils. Erosion potential for soils found at the Route 15 Parcel is shown in Table 3.1-1.

Munitions and explosive detonations could potentially result in soil contamination. However, the unexploded ordnance management policies require containment and frequent disposal of these munitions in firing ranges. Proposed activities for range maintenance include removing expended rounds from the ranges periodically and transporting them to an appropriate recycling contractor or smelter in accordance with appropriate regulations. Therefore, there would be minimal potential for soil or subsurface contamination and no significant impacts are expected.

There is potential for ordnance-ignited wildfires that could impact soil and geological resources. The potential for erosion would depend on how much land area is burned. To minimize impacts, a fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods. It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing or tracers may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, a fire fighting water system; protocols for using units to be briefed by range control on requirements suitable to the conditions of the day; and protocols should a fire occur (e.g., specifying how the range would shut down and fire suppression action would be taken). With implementation of standard fire management measures, impacts from wildfire on soil and geological resources would be less than significant.

Barrigada

Construction

There would be no construction in Navy Barrigada or Air Force Barrigada under the proposed alternative.

Operation

There would be no operation in Navy Barrigada or Air Force Barrigada under the proposed alternative.

3.2.2.3 Apra Harbor

Apra Harbor

Renovation and construction at Apra Harbor would support an increase in traffic to the harbor resulting from the proposed action. The support facilities at Victor Wharf, Oscar/Papa Wharves and the cargo staging area would be on areas that have been disturbed by previous construction and activities. Landing craft air cushion and the amphibious assault vehicle would each have a dedicated ramp to access their respective lay down areas that are adjacent to each other. Each vehicle would be rinsed on arrival to remove sand and salt spray to deter corrosion and increase vessel efficiency. U.S. Coast Guard facilities would be relocated to the Former SRF.

Dredged material may be disposed at a USEPA-designated Ocean Dredged Material Disposal Site; the potential impacts of the site use are being addressed in a separate EIS (USEPA 2009). When the material is dry it can be reused or stockpiled. Dredging activities are addressed in Volume 2, Chapter 4, Water Resources.

For upland placement, the dredged material is unloaded into a shoreside containment area or directly into sealed-end dump trucks at a designated wharf (e.g., Uniform Wharf has been used in the past). No free water is anticipated to drain back into Apra Harbor. The retention area would be constructed in accordance with Navy specifications for Temporary Environmental Control that requires a filter fabric liner. The trucks haul the dredged material to a pre-designated upland placement site for potential subsequent beneficial use.

The upland placement sites are enclosed by earthen berms approximately 16 to 30 ft (5 to 9 m) in height. The dredged material would be at or below the berm height. The berms would have an exterior horizontal to vertical slope of 2:1. No soil or fill would be brought to the site for construction. Vegetation would be cleared and soil compacted. No effluent is anticipated. Non-hazardous dredged material water is allowed to evaporate or percolate through the ground. Utilities at the site would be realigned outside of the enclosure. No closure plan or environmental monitoring is proposed. The exterior slopes would be seeded to discourage erosion and minimize visual impact. The drying material is unlikely to generate dust, but once dry, there would be dust associated with relocating the dry materials. No ponding water is

anticipated that might attract migrating birds. In the event a site becomes an attractive site for migrating birds, they could be easily discouraged by decoys and noise makers. Once the dredged material is removed, the site could be re-leveled for alternative use, or re-used for future dredged material placement.

Construction

Alternative 1 would disturb soil during construction at Apra Harbor. There is a risk of increased rate of erosion and soil loss from physical disturbance and compaction caused by construction activity, but stormwater BMPs would provide erosion and sediment control. Erosion potential for soils found at Apra Harbor is shown in Table 3.1-1.

Soil types that could be disturbed would not be agriculturally productive soils. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. Therefore, Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impact. A more detailed description of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

There are no known sinkholes in the vicinity. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

Apra Harbor is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at the Apra Harbor is vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

Operation

Operations under Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

Although Apra Harbor is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and liquefaction would be minimized during construction. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

Naval Base Guam

The proposed Alternative 1 at Naval Base Guam includes the Military Working Dog Kennel, U.S. Coast Guard relocations, and a New Medical Clinic. Aviation training at Orote Point is proposed as well, on existing paved surfaces. Proposed activities would disturb soil during construction. There is a risk of increased rate of erosion and soil loss from physical disturbance caused by construction activity, however

stormwater BMPs would be implemented to prevent impacts. Erosion potential for soils found at Naval Base Guam is shown in Table 3.1-1.

The feasible upland disposal sites are described in Volume 2, Chapter 4 (Water Resources) of this EIS/OEIS. The disposal sites are considered temporary (3 to 4 years). The sites are all vacant and would be developed with bermed perimeters approximately 13 ft (4 m) in height.

Military Working Dog Kennel

The Military Working Dog Facility would include a 2,040 ft^2 (190 m^2) single-story building. The locker would generate a 20-ft (1.9-m) radius explosive safety quantity distance arc. There would be an outdoor obedience/training course (22,500 ft^2 [2,090 m^2]), exercise area (800 ft^2 [74 m^2]) and break area (200 ft^2 [19 m^2]), all with self closing/self-latching gates.

Site improvements include an 8ft (2.4 m) high chain link fence with three strands of straight wire along the perimeter of the working dog site with a 20 ft (6.1 m) wide service gate for vehicular access. Low levels of polychlorinated biphenyls contaminants have been identified approximately 400 ft (121.92 m) north of the site. Soil testing would be conducted prior to construction. No trees would be cleared. Access to the site would be from existing roads, and utilities would tie into the utilities along the roadways. Area of grading/grubbing is approximately 85,301.84 ft^2 (26,000 m^2) and landscaping would be required for 65,617 ft^2 (20,000 m^2).

Medical Clinic

The new Naval Base Guam clinic project consists of constructing one single-level outpatient facility. It is assumed that the entire site (334,000 ft^2 [31,029.62 m^2]) would be graded during construction. The facility would be constructed of reinforced concrete with slab on grade foundations.

Construction

Soil types that could be disturbed would not be agriculturally productive soils. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. Therefore, Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

There are no known sinkholes in the vicinity of any of the proposed projects. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

Naval Base Guam is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Naval Base Guam is vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground

shaking and fault rupture would be minimal. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

Operation

Operations under Alternative 1 would not result in significant impacts to unique geologic resources or result in significant soil erosion or compaction or loss of agriculturally productive soil.

Although Naval Base Guam is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and liquefaction would be minimized during construction. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

3.2.2.4 South

Training activities, including aviation training, non-firing operations training, and storage of munitions, would occur at NMS. Eleven new magazines are proposed for the area that would require concrete slab foundations. The footprint of each magazine would be 80 ft (24 m) long and no wider than 30 ft (9.1 m). Each earth covered magazine (ECM) is covered in a minimum of 24 inches (61 centimeters) of soil. Non-firing maneuver training facilities that already exist would be subject to greater use in Southern NMS. The proposed unimproved helicopter landing zone would be sited on vacant land. No improvements would be made that would increase erosion or runoff into Fena Reservoir.

Construction

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Construction activities under Alternative 1 would include clearing, grading and grubbing, demolition of existing earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 1 would result in minimal impacts to geologic resources by changing the landscape of the affected area.

There are no known sinkholes at NMS. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

The Alternative 1 proposed developments would be located in an area subject to slope instability. SOPs would be implemented to avoid geologic hazards from slope instability, such as landslides. The area is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Operation

An increase in military training activities would result in localized disturbances to topographic features and soil. Training activities are conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion. Erosion potential for soil found at NMS can be found in Table 3.1-1. There would be minimal impact to soil and geological resources from training activities and short-term impacts

on soil and geological resources during construction of munitions magazines. No significant impacts are expected.

Fire potential would be increased due to the presence of Marines during ground training exercises, especially through the use of such pyrotechnics such as smoke for marking. Potentially greater access to trespassers including hunters due to the development of the proposed NMS training access road would be prevented by installation of fencing and gates at the access road entrance. A fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods (see Section 10.2.2.5). Fire-related geological impacts resulting from the proposed action would be less than significant.

3.2.2.5 Summary of Impacts

Construction Impacts

At Finegayan, construction activities under Alternative 1 would include building of facilities, infrastructure, utilities, and roadways, which would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and landscaping. Permanent loss of vegetation would occur. Therefore, Alternative 1 would result in adverse but not significant impacts to topography at Finegayan by changing the landscape of the affected area.

Construction activities at all other locations under Alternative 1 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 1 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal impacts from soil erosion. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction, except for at Apra Harbor, where BMPs would be used to prevent significant soil erosion.

NMS encompasses areas of soil with high erodibility factors, including Akina and Atate soils. BMPs to manage erosion and stormwater during the construction process (refer to Table 3.1-2) would be implemented to control erosion.

There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in the area just east of the project site, at least ten in the vicinity of the proposed Main Cantonment Area, and one found at Harmon Annex. The sinkholes would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. The sinkholes would not be affected by construction activities. Therefore, Alternative 1 would not result in significant impacts to a unique geologic resource.

The Alternative 1 proposed developments in north and central Guam would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments at NMS would be located in an area subject to slope instability. SOPs would be implemented to avoid geologic hazards from slope instability, such as landslides. The area is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards.

Although Apra Harbor and Naval Base Guam are located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

Operation Impacts

Training activities at Andersen South, NMS, and at the Route 15 parcel would be conducted with established procedures aimed at minimizing topsoil loss and erosion. Vehicle movements and troop movements would occur on paved routes and would not increase erosion and compaction. Erosion potential for soils found at NMS is shown in Table 3.1-1.

The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability during operations. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 1 would not result in significant impacts associated with geologic hazards at Andersen AFB, NCTS Finegayan, Finegayan South, and nearby non-DoD lands.

Although Apra Harbor is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and liquefaction would be minimized during construction. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor is vulnerable to liquefaction. Adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007) during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact operations. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

If deemed hazardous, any sinkholes found in the area could be fenced off and signs put in place to warn of the potential danger. No significant impacts are expected.

There is potential for ordnance-ignited wildfires that might impact soil and geological resources in central Guam, where live-fire training would occur. A fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods (see Section 3.2.2.7). It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing or tracers may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, and a fire fighting water system; protocols for using units to be briefed by range control on requirements suitable to the conditions of the day; and protocols should a fire occur (e.g., specifying how the range would shut down and fire suppression action would be taken). With implementation of these measures, impacts from wildfire would be less than significant.

3.2.2.6 Potential Mitigation Measures

A fire management plan would be developed to include burn hazard assessment (fire danger rating system), fire fighting water systems, on-call helicopter fire suppression,Since implementation of the proposed action and alternatives would not result in any significant impacts, no mitigation measures would be required.

3.2.3 Alternative 2 (Preferred Alternative)

3.2.3.1 North

Andersen AFB

Construction and operation impacts are the same as for Alternative 1.

Finegayan

A total of 1,610 ac (652 ha) at NCTS Finegayan and 290 ac (117 ha) at South Finegayan would be developed under Alternative 1. Construction and operation impacts are the same as for Alternative 1.

Non-DoD Land

Harmon Annex would not be developed under Alternative 2, thus there would be no impact to soil and geological resources at Harmon Annex under Alternative 2.

Construction and operation impacts to the Former FAA Parcel are the same as for Alternative 1.

3.2.3.2 Central

Andersen South

Construction and operation impacts are the same as for Alternative 1.

Non-DoD Land

Construction and operation impacts are the same as for Alternative 1.

Barrigada

Construction Impacts

There would be no construction in Navy Barrigada or Air Force Barrigada under the proposed alternative.

Operation Impacts

There would be no operation in Navy Barrigada or Air Force Barrigada under the proposed alternative.

3.2.3.3 Apra Harbor

Harbor

Construction and operation impacts are the same as for Alternative 1.

Naval Base Guam

Construction and operation impacts are the same as for Alternative 1.

3.2.3.4 South

Construction and operation impacts are the same as for Alternative 1.

3.2.3.5 Summary of Impacts

Construction Impacts

Construction activities under Alternative 2 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 2 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

The construction SOPs would include requirements for stormwater compliance with stormwater Best BMPs, including the SWPPP, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction, except for at Apra Harbor, where BMPs would be used to prevent significant soil erosion. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. Therefore, Alternative 2 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

NMS encompasses areas of soil with high erodibility factors including Akina and Atate soils. BMPs to manage erosion and stormwater during the construction process would be implemented to control erosion. There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in area, just east of the project site. There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. The sinkholes would not be affected by construction activities. Therefore, Alternative 2 would not result in significant impacts to a unique geologic resource.

The Alternative 2 proposed developments in northern and central Guam would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 2 proposed developments at NMS would be located in an area subject to slope instability. SOPs would be implemented to avoid geologic hazards from slope instability, such as landslides. The area is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 2 would not result in significant impacts associated with geologic hazards.

Apra Harbor and Naval Base Guam are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 2 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor and Naval Base Guam is vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Alternative 2 would result in adverse but not significant impacts associated with geologic hazards.

Operation Impacts

Training activities at Andersen South and at the Route 15 parcel would be conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion. Vehicle movements and troop movements would occur on paved routes and would not increase erosion and compaction.

Military training activities at NMS would result in localized disturbances to soil. Training activities are conducted with established procedures aimed at minimizing topsoil loss and erosion. Soil types that could be disturbed would not be agriculturally productive soils. Erosion potential for soils found at NMS is shown in Table 3.1-1.

The Alternative 2 proposed developments would be located on a relatively flat area that would not be subject to slope instability during operations. Exposure potential to seismic ground shaking and fault rupture would be minimized during construction. Therefore, Alternative 2 would not result in significant impacts associated with geologic hazards at Andersen AFB, Finegayan, Finegayan South,

Although Apra Harbor is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and slope instability are minimal. The underlying fill at Apra Harbor is vulnerable to liquefaction. Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact operations. Alternative 2 would result in adverse but not significant impacts associated with geologic hazards.

Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger. Alternative 2 would not result in impacts associated with geologic resources or hazards that would require mitigation.

There is potential for ordnance-ignited wildfires that might impact soil and geological resources in central Guam, where live-fire training would occur. As mitigation, a fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods (see Section 3.2). It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing or tracers may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, and a fire fighting water system; protocols for using units to be briefed by range control on requirements suitable to the conditions of the day; and protocols should a fire occur (e.g., specifying how the range would shut down and fire suppression action would be taken). With implementation of these measures, impacts from wildfire would be less than significant.

3.2.3.6 Potential Mitigation Measures

Since implementation of Alternative 2 would not result in significant impacts to soils and geological resources, no mitigation measures would be required.

3.2.4 Alternative 3

3.2.4.1 North

Andersen AFB

Construction and operation impacts would not differ from those of Alternative 1.

Finegayan

Impacts to Finegayan would not differ from those of Alternative 2.

Non-DoD Land

There would be no impact to Non-DoD land under Alternative 3; neither Harmon Annex nor the Former FAA Parcel would be developed.

3.2.4.2 Central

Andersen South

Construction and operation impacts would not differ from those of Alternative 1.

Non-DoD Land

Construction and operation impacts would not differ from those of Alternative 1.

Barrigada

Construction

Three hundred seventy-seven ac (153 ha) of Navy Barrigada and 430 ac (174 ha) of Air Force Barrigada would be developed as family housing/community support under Alternative 3.

The proposed Alternative 3 at Navy and Air Force Barrigada would disturb soil during construction. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity, but construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. The construction SOPs would include requirements for stormwater compliance with stormwater BMPs, including the SWPPP, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. Erosion potential for soils found at Barrigada is shown in Table 3.1-1.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction. Construction SOPs would be followed to prevent soil erosion. Therefore, Alternative 3 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

Construction activities under Alternative 3 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 3 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There are no known sinkholes at Navy and Air Force Barrigada. Therefore, Alternative 3 would not result in significant impacts to a unique geologic resource.

Navy and Air Force Barrigada are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). No fault lines run directly through the Barrigada area. The Alternative 3 proposed developments would be located on a relatively flat plateau that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Due to the limited duration and amount of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 3 would not result in significant impacts associated with geologic hazards.

Operation

Although Finegayan is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, slope instability and liquefaction would be minimized during construction. The Alternative 3 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Operations activities would not disturb soil or cause an increase in erosion. The predominant limestone bedrock is not vulnerable to liquefaction. Therefore, Alternative 3 would not result in significant impacts associated with geologic resources or hazards.

3.2.4.3 Apra Harbor

Harbor

Construction and operation impacts would not differ from those of Alternative 1.

Naval Base Guam

Construction and operation impacts would not differ from those of Alternative 1.

3.2.4.4 South

Construction and operation impacts would not differ from those of Alternative 1.

3.2.4.5 Summary of Impacts

Construction Impacts

Construction activities under Alternative 3 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 3 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

The construction SOPs would include requirements for stormwater compliance with stormwater BMPs, including the SWPPP, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent significant erosion and compaction, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction, except for at Apra Harbor, where BMPs would be used to prevent significant soil erosion. Construction SOPs would be followed at all proposed sites to prevent soil erosion. Therefore, Alternative 3 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

NMS encompasses areas of soil with high erodibility factors, including Akina and Atate soils. BMPs to manage erosion and stormwater during the construction process would be implemented to control erosion.

There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in area, just east of the project site. There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction

to ensure that all sinkholes have been identified. The sinkholes would not be affected by construction activities. Therefore, Alternative 3 would not result in significant impacts to a unique geologic resource.

The Alternative 3 proposed developments in North and Central Guam would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 3 proposed developments at NMS would be located in an area subject to slope instability. SOPs would be implemented to avoid geologic hazards from slope instability, such as landslides. The area is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 3 would not result in significant impacts associated with geologic hazards.

Apra Harbor and Naval Base Guam are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 3 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor and Naval Base Guam is vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Alternative 3 would result in adverse but not significant impacts associated with geologic hazards.

Operation Impacts

Military training activities at Andersen South, NMS, and at the Route 15 parcel would result in localized disturbances to topographic features. Training activities would be conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion. Vehicle movements and troop movements would occur on paved routes and would not increase erosion and compaction. Erosion potential for soil found at training sites can be found in Table 3.1-1. There would be minimal impact to soil and geological resources from training activities and short-term impacts on soil and geological resources during construction of munitions magazines.

The Alternative 3 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Potential damage from seismic ground shaking and fault rupture would be minimized during construction. Therefore, Alternative 3 would not result in significant impacts associated with geologic hazards at Andersen AFB, Finegayan, and Finegayan South.

Apra Harbor is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized during construction. The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor is vulnerable to liquefaction. Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact operations. Alternative 3 would result in adverse but not significant impacts associated with geologic hazards.

Sinkholes would be fenced off and educational signs would be put in place to warn residents of their potential danger. Alternative 3 would result in impacts associated with geologic resources or hazards that would require mitigation.

There is potential for ordnance-ignited wildfires that might impact soil and geological resources in central Guam, where live-fire training would occur. A fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods (see Section 3.2.4.7). It would

include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing or tracers may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, and a fire fighting water system; protocols for using units to be briefed by range control on requirements suitable to the conditions of the day; and protocols should a fire occur (e.g., specifying how the range would shut down and fire suppression action would be taken). With implementation of these measures, impacts from wildfire would be less than significant.

3.2.4.6 Potential Mitigation Measures

Since implementation of Alternative 3 would not result in significant impacts to soils and geological resources, no mitigation measures would be required.

3.2.5 Alternative 8

3.2.5.1 North

Andersen AFB

Construction and operation impacts would not differ from those of Alternative 1.

Finegayan

Construction and operation impacts would not differ from those of Alternative 1.

Non-DoD Land

There would be no impact to Harmon Annex under Alternative 8. Impacts to Former FAA Parcel would not differ from those of Alternative 1.

3.2.5.2 Central

Andersen South

Construction and operation impacts would not differ from those of Alternative 1.

Non-DoD Land

Construction and operation impacts would not differ from those of Alternative 1.

Barrigada

There is no action at Navy Barrigada under Alternative 8, thus there are no construction or operation impacts to soil or geological resources at Navy Barrigada.

Construction and operation impacts to soil and geological resources at Air Force Barrigada would not differ from those of Alternative 3.

3.2.5.3 Apra Harbor

Harbor

Construction and operation impacts would not differ from those of Alternative 1.

Naval Base Guam

Construction and operation impacts would not differ from those of Alternative 1.

3.2.5.4 South

Construction and operation impacts would not differ from those of Alternative 1.

3.2.5.5 Summary of Impacts

Construction Impacts

Construction activities under Alternative 1 would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur. Therefore, Alternative 8 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

The construction SOPs would include requirements for stormwater compliance, with BMPs, including the SWPPP, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7 of this EIS/OEIS. Implementation of measures such as revegetation as soon as possible after any ground disturbance or grading and minimizing construction and grading during times of inclement weather would prevent erosion and compaction, thus there would be minimal soil erosion impacts. A more detailed explanation of regulatory permitting requirements can be found in Volume 8 of this EIS/OEIS.

Soil types that could be disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or nearshore waters that are not located near the proposed construction, except for at Apra Harbor, where BMPs would be used to prevent significant soil erosion. Construction SOPs would be followed at all proposed sites to prevent soil erosion. Therefore, Alternative 8 would not result in significant impacts to unique geologic resources or result in significant soil erosion or loss of agriculturally productive soil.

NMS encompasses areas of soil with high erodibility factors, including Akina and Atate soils. BMPs to manage erosion and stormwater during the construction process would be implemented to control erosion.

There is a sinkhole in the vicinity of the North Ramp approximately 700 ft by 900 ft (213 m by 274 m) in area, just east of the project site., as well as ten sinkholes at the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around it to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. The sinkholes would not be affected by construction activities. Therefore, Alternative 8 would not result in significant impacts to a unique geologic resource.

The Alternative 8 proposed developments in north and central Guam would be located on a relatively flat area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 8 proposed developments at NMS would be located in an area subject to slope instability. SOPs would be implemented to avoid geologic hazards from slope instability, such as landslides. The area is not vulnerable to liquefaction. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 8 would not result in significant impacts associated with geologic hazards.

Apra Harbor and Naval Base Guam are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 8 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor is vulnerable to liquefaction. Potential damage from seismic ground shaking and fault rupture

would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). Alternative 8 would result in adverse but not significant impacts associated with geologic hazards.

Operation Impacts

Military training activities would result in localized disturbances to topographic features. Training activities are conducted with established procedures aimed at minimizing topsoil loss, compaction, and erosion. Erosion potential for soils affected is shown in Table 3.1-1. There would be minimal impact to soil and geological resources from training activities and short-term impacts on soil and geological resources during construction of munitions magazines.

Training activities at Andersen South, NMS, and at the Route 15 parcel would be conducted with established procedures aimed at minimizing topsoil loss and erosion. Vehicle movements and troop movements would occur on paved routes and would not increase erosion and compaction.

The Alternative 8 proposed developments at Andersen AFB, Finegayan, Finegayan South, and Barrigada would be located on a relatively flat area that would not be subject to slope instability. Due to the limited duration of construction activities, exposure potential to seismic ground shaking and fault rupture would be minimal. Therefore, Alternative 8 would not result in significant impacts associated with geologic hazards.

Although Apra Harbor is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture, and slope instability are minimal. The Alternative 8 proposed developments would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor is vulnerable to liquefaction. Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact operations. Alternative 1 would result in adverse but not significant impacts associated with geologic hazards.

Sinkholes would be fenced off and educational signs would be put in place to warn of their potential danger. Alternative 8 would not result in impacts associated with geologic resources or hazards that would require mitigation.

There is potential for ordnance-ignited wildfires that might impact soil and geological resources in central Guam, where live-fire training would occur. A fire management plan would be developed for use in this area which would include prevention, planning, and suppression methods (see Section 3.2.5.7). It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing or tracers may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, and a fire fighting water system; protocols for using units to be briefed by range control on requirements suitable to the conditions of the day; and protocols should a fire occur (e.g., specifying how the range would shut down and fire suppression action would be taken). With implementation of these measures, impacts from wildfire would be less than significant.

3.2.5.6 Potential Mitigation Measures

Since implementation of Alternative 8 would not result in significant impacts to soils and geological resources, no mitigation measures would be required.

3.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur. Existing DoD operations on Guam would continue. Therefore, implementation of the no-action alternative would

maintain existing conditions and there would be no impact to geological resources and soils. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

3.2.7 Summary of Impacts

Tables 3.2-3, 3.2-4, 3.2-5, and 3.2-6 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 3.2-7 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Relocation of Marine Corps personnel from Okinawa to Guam would require construction and renovation that would potentially disturb soil, increase erosion, and change the landscape of Guam in multiple areas.

Temporarily increased rates of erosion and soil loss from physical disturbance of construction would occur during construction. With the implementation of protective measures, there would be no significant impacts from soil erosion. Soil types lost would not be agriculturally productive soils. Topographic or landscape features would not be changed substantively by the proposed action and it is not located in a seismically-active zone. The action area is located in areas with karst geologic features that are of concern for the construction and operation of these facilities. Careful construction planning would be required to minimize changes to geological features like Guam's unique karst caves and sinkholes. Construction on previously disturbed land is less likely to impact soil and geological resources. Liquefaction is a risk at Apra Harbor, but impacts to development are not significant.

Table 3.2-3. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
LSI • Alternative 1 would result in adverse but not significant impacts to topography at Finegayan, where 1,093 ac (442 ha) of land would be permanently altered. LSI • Alternative 1 would result in minimal impacts to topography by changing the landscape at Andersen AFB, Andersen South, Harmon Annex, Former FAA, Route 15, Apra Harbor, and NMS. • Alternative 1 would result in minimal impacts to topography as a result of training activities at Andersen South, NMS, and Route 15.	LSI • Alternative 2 would result in adverse but not significant impacts to topography at Finegayan, where 1,093 ac (422 ha) of land would be permanently altered. LSI • Alternative 2 would result in minimal impacts to topography by changing the landscape at Andersen AFB, Andersen South, Former FAA, Route 15, Apra Harbor, and NMS. • Alternative 2 would result in minimal impacts to topography as a result of training activities at Andersen South, NMS, and Route 15.	LSI • Alternative 3 would result in adverse but not significant impacts to topography at Finegayan, where 1,093 ac (422 ha) of land would be permanently altered. LSI • Alternative 3 would result in minimal impacts to topography by changing the landscape at Andersen AFB, Andersen South, Barrigada, Route 15, Apra Harbor, and NMS. • Alternative 3 would result in minimal impacts to topography as a result of training activities at Andersen South, Route 15 and NMS.	LSI • Alternative 8 would result in adverse but not significant impacts to topography at Finegayan, where 1,093 ac (422 ha) of land would be permanently altered. LSI • Alternative 8 would result in minimal impacts to topography by changing the landscape at Andersen AFB, Andersen South, Former FAA, Route 15, Barrigada, Apra Harbor, and NMS. • Alternative 8 would result in minimal impacts to topography as a result of training activities at Andersen South, Route 15 and NMS.
LSI • During construction, sinkholes would be avoided and a buffer zone of vegetation would be left around them to prevent further erosion or expansion at Andersen AFB, Finegayan, and Harmon Annex. Minimal impacts to sinkholes would occur under Alternative 1. • Sinkholes would not be adversely impacted by operations.	LSI • During construction, sinkholes would be avoided and a buffer zone of vegetation would be left around them to prevent further erosion or expansion at Andersen AFB and Finegayan. Minimal impacts to sinkholes would occur under Alternative 2. • Sinkholes would not be adversely impacted by operations.	LSI • During construction, sinkholes would be avoided and a buffer zone of vegetation would be left around them to prevent further erosion or expansion at Andersen AFB. Minimal impacts to sinkholes would occur under Alternative 3. • Sinkholes would not be adversely impacted by operations.	LSI • During construction, sinkholes would be avoided and a buffer zone of vegetation would be left around them to prevent further erosion or expansion at Andersen AFB. Minimal impacts to sinkholes would occur under Alternative 8. • Sinkholes would not be adversely impacted by operations.

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Operation			
LSI • Alternative 1 operations would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur.	LSI • Alternative 2 operations would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur.	LSI • Alternative 3 operations would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur.	LSI • Alternative 8 operations would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur.

Table 3.2-4. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
LSI • Alternative A would result in minimal impacts to topography by changing the landscape at Route 15. • Slope stability would not be altered, thus minimal impacts to soil resources would occur. • Risk of damage to structures from seismic, liquefaction and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.	LSI • Alternative B would result in minimal impacts to topography by changing the landscape at Route 15. • Slope stability would not be altered, thus minimal impacts to soil resources would occur. • Risk of damage to structures from seismic, liquefaction and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.
Operation	
LSI • Alternative A would result in minimal impacts to topography as a result of firing range training activities at Route 15. • Alternative A operations would not result in significant soil erosion or loss of agriculturally productive soil. • Risk of damage to structures from seismic, liquefaction and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.	LSI • Alternative B would result in minimal impacts to topography as a result of firing range training activities at Route 15. • Alternative B operations would not result in significant soil erosion or loss of agriculturally productive soil. • Risk of damage to structures from seismic, liquefaction and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 3.2-5. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
LSI • Alternative A would result in minimal impacts to topography by changing the landscape at Andersen AFB and NMS. • Alternative A construction would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur. • Risk of damage to structures from seismic, ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.	LSI • Alternative B would result in minimal impacts to topography by changing the landscape at Andersen AFB and NMS. • Alternative B construction would not result in significant soil erosion or loss of agriculturally productive soil. • Slope stability would not be altered, thus minimal impacts to soil resources would occur. • Risk of damage to structures from seismic, and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.
Operation	
LSI • Alternative A would result in minimal impacts to topography as a result of training activities at Andersen South and NMS. • Alternative A operations would not result in significant soil erosion or loss of agriculturally productive soil. • Risk of damage to structures from seismic, ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.	LSI • Alternative B would result in minimal impacts to topography as a result of training activities at Andersen South and NMS. • Alternative B operations would not result in significant soil erosion or loss of agriculturally productive soil. • Risk of damage to structures from seismic, liquefaction and ground shaking hazards would be minimized by adherence to required building safety codes and design guidelines.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 3.2-6. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
LSI • Alternative A would result in minimal impacts to topography by changing the landscape at NMS.	LSI • Alternative B would result in minimal impacts to topography by changing the landscape at NMS.
Operation	
LSI • Alternative A would result in minimal impacts to topography as a result of training activities at NMS.	LSI • Alternative B would result in minimal impacts to topography as a result of training activities at NMS.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 3.2-7. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Alternatives would result in minimal impacts to topography by changing the landscape at Andersen AFB, Andersen South, Harmon Annex, Former FAA, Route 15, Apra Harbor, and NMS. • Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact construction; minimal impacts would occur. • Presence of sinkholes near construction areas poses safety hazard for construction and installation personnel, sinkholes would be fenced off as needed with warning signs. Minimal impacts would occur.	LSI • Alternatives would result in minimal impacts to topography by changing the landscape at Andersen AFB. • Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, ground shaking hazards that could potentially impact construction; minimal impacts would occur. • Presence of sinkholes near construction areas poses safety hazard for construction and installation personnel, sinkholes would be fenced off as needed with warning signs. Minimal impacts would occur.	LSI • Alternatives would result in minimal impacts to topography by changing the landscape at Apra Harbor. • Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact construction; minimal impacts would occur.
Operation		
LSI • Alternatives would result in minimal impacts to topography as a result of training activities at Andersen South, NMS, and Route 15. • Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures from seismic, ground shaking hazards that could potentially impact operations; minimal impacts would occur. • Presence of sinkholes near construction areas poses safety hazard for construction and installation personnel, sinkholes would be fenced off as needed with warning signs. Minimal impacts would occur.	LSI • Alternatives would result in minimal impacts to topography as a result of training activities at Andersen AFB. • Presence of sinkholes near operation areas poses safety hazard for construction and installation personnel; sinkholes would be fenced off as needed with warning signs. Minimal impacts would occur.	LSI • Alternatives would result in minimal impacts to topography as a result of training activities at Apra Harbor. • High risk of liquefaction at Apra Harbor and risk of damage to structures from seismic, liquefaction and ground shaking hazards exists. Adherence to UFC 3-310-04 Seismic Design for Buildings would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards that could potentially impact operations; minimal impacts would occur.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

3.2.8 Summary of Potential Mitigation Measures

Implementation of alternatives 1, 2, 3 and 8 and associated specific project components would not result in significant impacts to soils and geological resources. No mitigation measures are required.

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CHAPTER 4. WATER RESOURCES

4.1 AFFECTED ENVIRONMENT

4.1.1 Definition of Resource

4.1.1.1 Water Resources Overview

Water resources as defined in this Environmental Impact Statement/ Overseas Environmental Impact Statement (EIS/OEIS) are sources of water available for use by humans, flora, or fauna, including surface water, groundwater, nearshore waters, and wetlands. Surface water resources, including but not limited to stormwater, lakes, streams and rivers, are important for economic, ecological, recreational, and human health reasons. Groundwater may be used for potable water, agricultural irrigation, and industrial applications. Groundwater is classified as any source of water beneath the ground surface, and is the primary source of potable water used to support human consumption.

Potable groundwater is discussed in detail in the Potable Water Section in the Utilities Volume 6, Chapter 15, of this EIS/OEIS. Consistent with the definition contained in 22 Guam Administrative Rule (GAR) 5105, nearshore waters are defined as all coastal waters lying within a defined reef area, all coastal waters of a depth of less than ten fathoms (60 feet [ft], 18.3 meters [m]), and all coastal waters greater than 10 fathoms up to 1000 ft (305 m) offshore where there is no defined reef area. Nearshore waters can be directly affected by human activity, and are important for human recreation and subsistence. Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, and include marshes, swamps, and similar areas. Areas described and mapped as wetland communities may also contain small streams or shallow ponds, or pond or lake edges. Surface water, groundwater, nearshore waters, and wetlands of Guam are discussed below.

4.1.1.2 Surface Water

<u>Surface Water Availability</u>

Rainfall on Guam averages between 85 and 115 inches (in) (215 and 292 centimeters [cm]) a year, most of which falls during the rainy season from July to December. Figure 4.1-1 shows the average annual distribution of rainfall on Guam. On average, southern Guam receives more rain than northern Guam, especially around the Naval Munitions Site (NMS). In the highly permeable limestone geology of northern Guam, surface runoff occurs only during heavy rainfall events due to the high rates of surface water infiltration into the underlying groundwater basins. Less infiltration occurs in the low-permeability volcanic rocks of southern Guam, resulting in more surface runoff.

Guam has 97 rivers and streams, ranging in length from 0.6 mile (mi) (1 kilometer [km]) to more than 3.1 mi (5 km). All of the rivers and streams are found in the central and southern half of the island. Northern Guam does not have perennial streams due to the karst geology of this area. Due to the high permeability of the limestone, water in this area does not flow at the surface, but instead infiltrates quickly into the subsurface, recharging the freshwater groundwater lens. Because of the lack of perennial streams, there are no estuaries in the north.

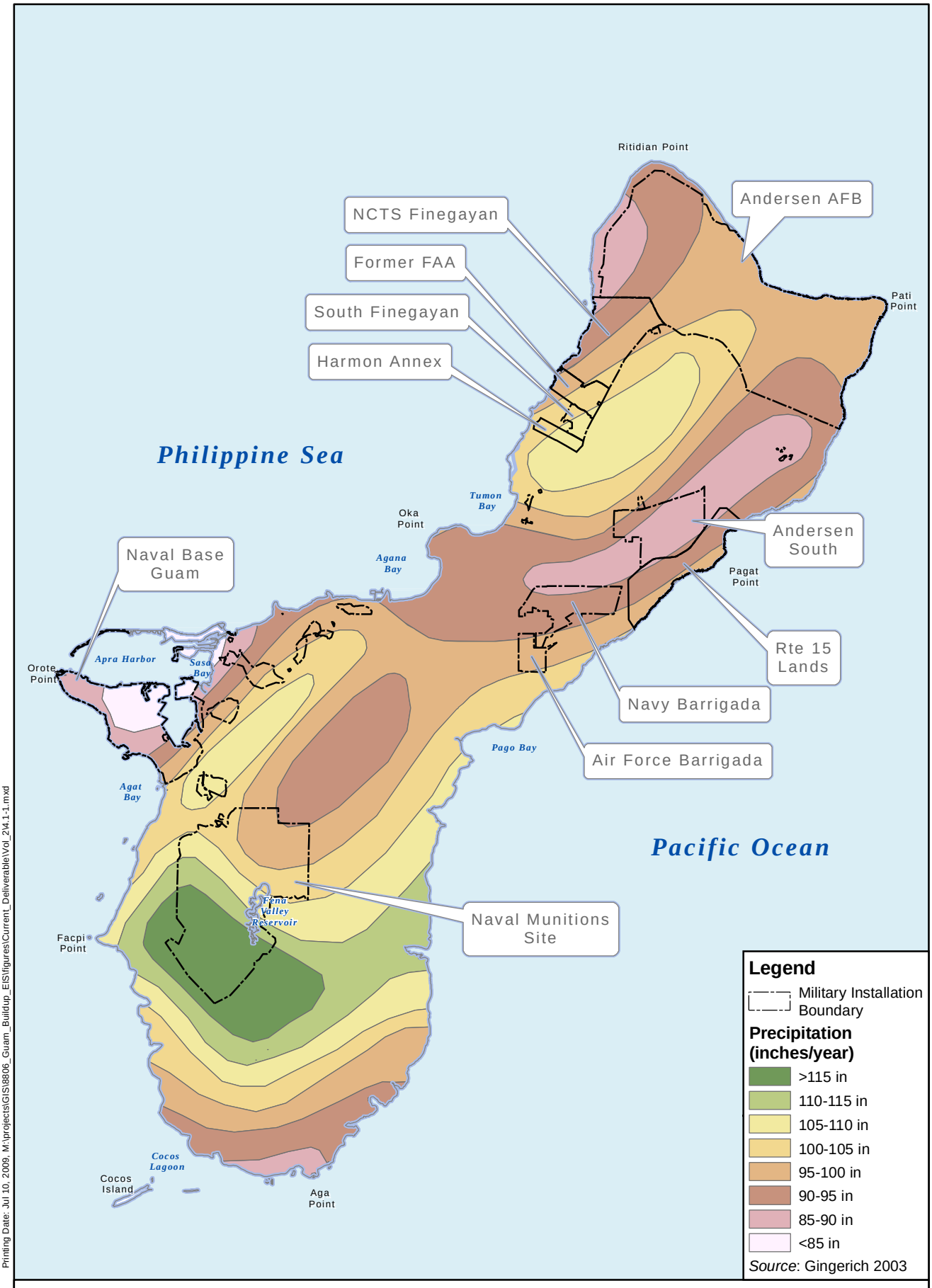

Figure 4.1-1
Guam Annual Rainfall

Figure 4.1-2 shows Guam's streams and graphically depicts the lack of surface water in the northern part of the island. In southern Guam, a mountain ridge runs along the western coast and creates small, steep drainage basins to the west. To the east, broader floodplains drain into longer, larger rivers. Forty-six of Guam's rivers and streams drain into the ocean, five drain into lakes, and the remainder feed into other rivers. Detailed information on surface waters is provided in the following site-specific discussions.

Surface Water Quality

Surface water quality, in general, is good, but Guam's surface waters are vulnerable to contamination from sewage disposal overflows, animal wastes, and sediment erosion carried into streams during periods of heavy rainfall. Inland surface water bodies are of highest quality, whereas coastal regions contain surface water bodies of medium to low quality (NAVFAC Pacific 2008).

Federal Regulations

The Clean Water Act

The Clean Water Act (CWA) of 1972 is the primary federal law that protects the nation's waters, including lakes, rivers, wetlands and coastal areas. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters. In Guam, CWA oversight responsibilities lie with the Guam Environmental Protection Agency (GEPA). Under GEPA, Guam's Water Pollution Control Program reviews and certifies National Pollutant Discharge Elimination System (NPDES) permit applications and the United States (U.S.) Environmental Protection Agency (USEPA) coordinates, drafts, and issues NPDES permits for storm water and point source pollution discharges. The United States Army Corps of Engineers (USACE) issues permits for the discharge of dredged or fill material under Section 404 of the CWA.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas (COMNAV) including instruction and procedures is included in COMNAV Marianas Instruction 3500.4 (Marianas Training Handbook [COMNAV Marianas 2000]). This guidance identifies specific land use constraints to enable protection of environmental resources during military training.

Guam Regulations

Surface Water Designations

The GEPA classifies surface waters into three categories: S-1, S-2, and S-3, depending on the location within the watershed. Both S-1 and S-2 designations fully protect recreational uses, including swimming, and all stages of aquatic life. An S-1 designation is more stringent in that no pollutants are allowed to be discharged into S-1 waters. Waters designated as S-1 are to be kept free of substances or pollutants that may impact water quality.

The surface water designations encompass all fresh surface water bodies, including: (1) waters that flow continuously over land surfaces in a defined channel or bed, such as streams and rivers; (2) standing water in basins such as lakes, wetlands, marshes, swamps, ponds, sinkholes, impoundments, and reservoirs either natural or man-made; and (3) all waters flowing over the land as runoff, or as runoff confined to channels with intermittent flow (see Figure 4.1-2). Figure 4.1-3 depicts the surface water designations. Below are the category descriptions from the GEPA (GEPA 2001):

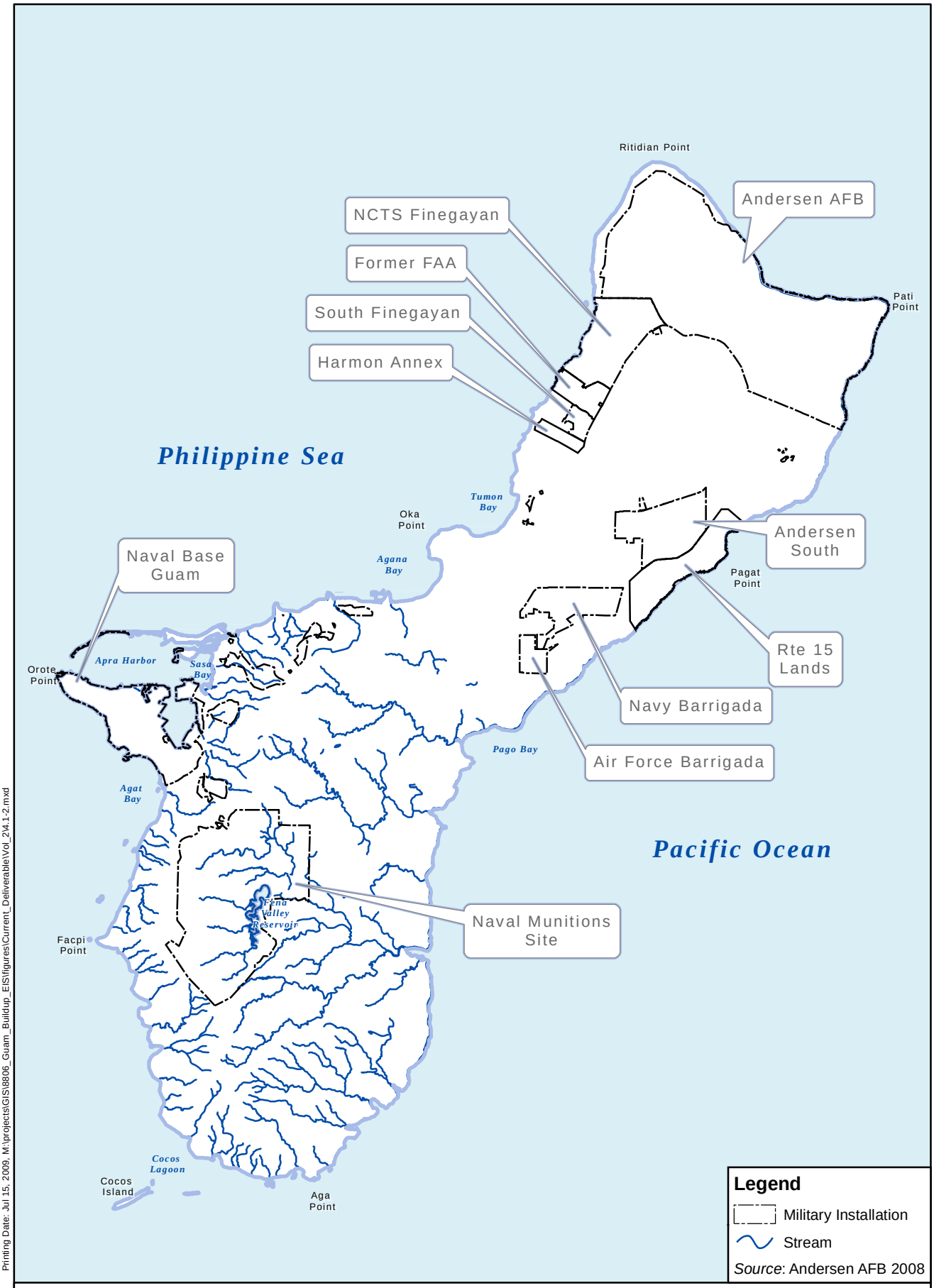

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Figure 4.1-2
Surface Waters of Guam

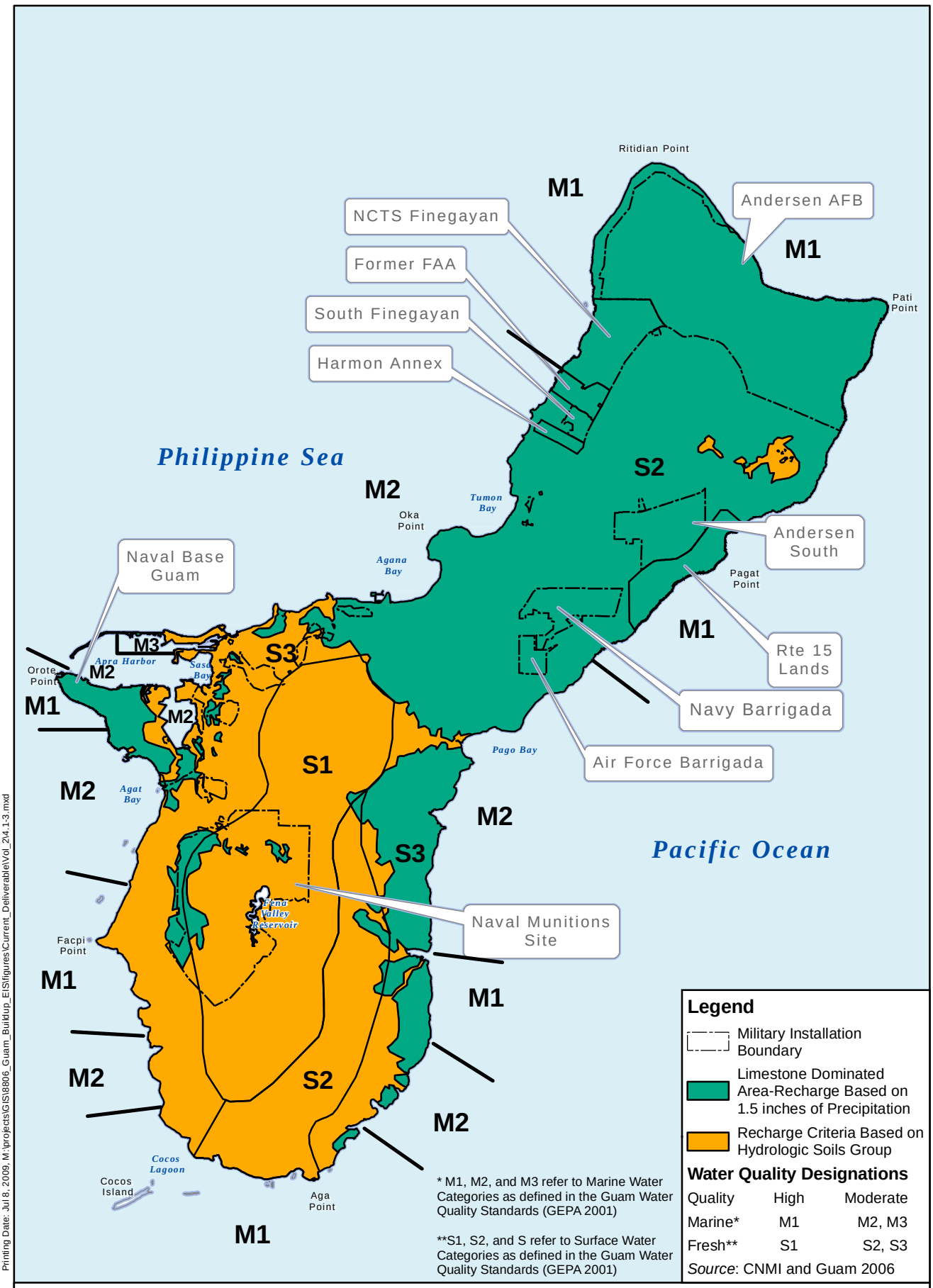


Figure 4.1-3
Water Quality Criteria Designations and Stormwater Recharge Zones

(1) Category S-1 HIGH. Surface waters in this category are used for drinking water resources, conservation of wilderness areas, and propagation and preservation of aquatic life and aesthetic enjoyment. It is the objective of these standards that these waters shall be kept free of substances or pollutants from domestic, commercial and industrial discharges, or agricultural activities, construction or other land-use practices that may impact water quality. No pollutant discharges would be permitted into S-1 waters via discharge or as a result of land uses adjacent to S-1 waters. Mixing zones would not be allowed within the boundaries of Category S-1.

(2) Category S-2 MEDIUM. Surface waters in this category are used for recreational purposes including water contact recreation, as potable water supply after adequate treatment is provided, and for propagation and preservation of aquatic wildlife and aesthetic enjoyment.

(3) Category S-3 LOW. Surface waters in this category are primarily used for commercial, agricultural and industrial activities. Aesthetic enjoyment and compatible recreation are acceptable in this zone, as well as maintenance of aquatic life. Compatible recreation may include limited body contact activities. All discharges within this zone that are not required to have construction and/or discharge permits under existing regulations may be required by the Agency to obtain such permits under these regulations.

The Guam Watershed Planning Committee (WPC) was established in 1998 and consists of representatives from 14 federal and local organizations and agencies, including GEPA, U.S. Department of Agriculture's Natural Resource Conservation Service, Guam Waterworks Authority, Guam Department of Commerce, Guam Department of Agriculture, Guam Bureau of Planning, College of Agriculture and Life Sciences at the University of Guam, Water and Environmental Research Institute, Guam Department of Land Management, Navy Public Works Center, COMNAV Marianas, Air Force, and Southern Soil and Water Conservation District. One of the WPC subcommittees focuses on restoration of the Northern Guam Lens Aquifer (NGLA).

Flood Zones

Floodplains are low-lying areas subject to flooding. Heavy rainfall in areas such as NMS may cause flooding in the stream drainage basins (Gingerich 2003). Figure 4.1-4 shows the 100-year and 500-year flood zones on Guam. As shown in the figure, areas of NMS are located within the 100-year flood zone. In addition, numerous areas at Apra Harbor and Cabras are also located within the 100-year flood zone.

4.1.1.3 Groundwater

The availability and quality of groundwater on Guam is greatly influenced by the island's geology; therefore, please refer to Volume 2, Chapter 3**,** Geological and Soils Resources, for information regarding geological conditions on Guam to increase the understanding of the following groundwater discussion.

Groundwater Availability

Water is held in pores in the soil by cohesive attraction between water molecules and the soil grains. Water transport in the soil, due its lower permeability, is slow compared to the rate of movement in the limestone found in northern Guam. Dissolution of the limestone by percolating rainwater has resulted in a complex underground drainage system, including caves and sinkholes. The large pore spaces and fractures in limestone rock allow water to percolate rapidly downward resulting in minimal surface runoff and groundwater recharge. The limestone in northern Guam overlies much less permeable volcanic rock. In the saturated zone of northern Guam this low permeability volcanic rock stratum underlies the

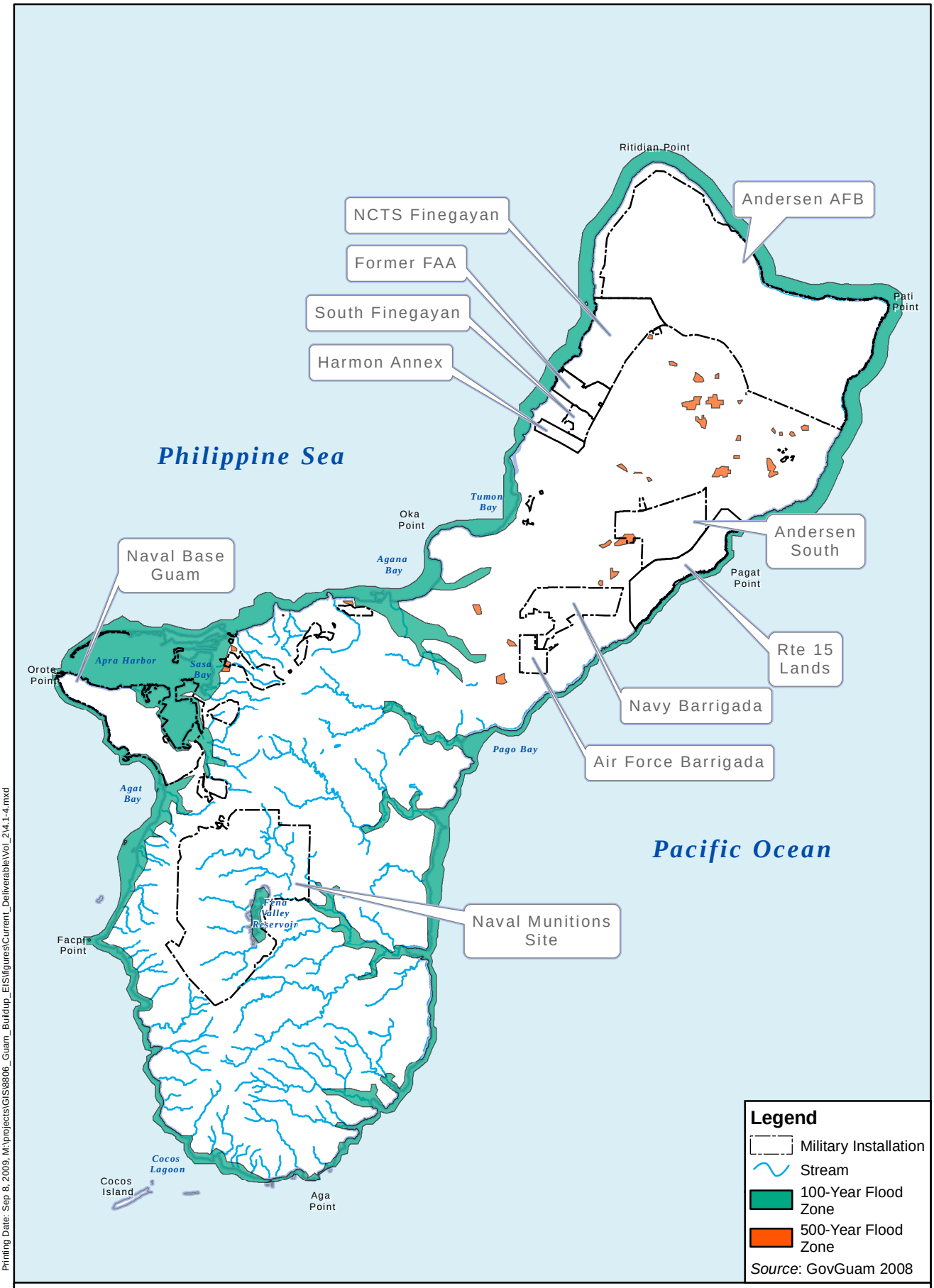


Figure 4.1-4
Guam Flood Zones

freshwater portion of the aquifer, except in the west-central portion of this region where the limestone/volcanic layer interface is above the freshwater/saltwater transition zone (Gingerich 2003).Percolation of precipitation through the rock formations to the underlying saltwater forms a lens of fresh groundwater that floats on top of the saltwater. Due to the density difference between freshwater and saltwater, the interface between the two is approximately 40 ft (12 m) below sea level for every foot the water table is above sea level. This 1:40 relationship is commonly referred to as the Ghyben-Herzberg relation after the two scientists that independently discovered it in the late 19th century (Freeze and Cherry 1979). The boundary between the two water bodies is not sharp but rather a gradual transition that begins at some depth that is 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.

On Guam, the freshwater lens is divided into two zones based on chloride concentrations. The upper zone is the basal freshwater lens where the chloride concentration is less than the USEPA secondary Maximum Concentration Level (MCL) of 250 milligrams per liter (mg/L). The transition zone between freshwater and saltwater begins where the chloride concentration exceeds 250 mg/L down to a point where the chloride concentration is nearly equal to that of seawater. From a water resources perspective, that portion of the basal lens from the water table down the top of the transition, the basal freshwater lens, is most important. It represents the potable water portion of the aquifer that can be pumped for human use.

The thickness of the basal freshwater lens is dependent on the rate of recharge, the permeability of the aquifer formations, and the heterogeneity of the aquifer formations. Limestone formations are very porous providing a large of amount of freshwater storage volume. If the freshwater in the limestone extends downward far enough to intersect the low permeability volcanic rock, it is referred to as parabasal water. The low permeability of the volcanic rock acts as a barrier between the freshwater and underlying saltwater, mitigating the effects of saltwater intrusion. Figure 4.1-5 presents the groundwater zones on Guam.

In northern Guam, the basal freshwater lens is primarily recharged by rainwater falling across the island surface (area recharge). However, point recharge through sinkholes and dissolution caverns provides a direct path for surface water to reach the groundwater table. The continued development of northern Guam has resulted in once undeveloped areas being sealed with impervious materials (houses, roads, and parking areas), thus preventing or severely reducing groundwater area recharge rates. This change in land cover also generates large amounts of runoff during storm events. To manage this increase in surface water runoff, municipal rainwater collection and conduits have been installed to direct rainwater into sinkholes where the water rapidly percolates to the groundwater; however, data indicate that this stormwater often contains pollutants, which then negatively impacts groundwater quality (Navy 2009).

Unlike the highly permeable limestones that are found in northern Guam, low permeability volcanic rocks and their weathered products dominate the geology of southern Guam. Precipitation falling on southern Guam encounters soils derived from submarine volcanic rock formations. The small size of the clay particles in these soils readily retains any water deposited on the surface but has slow drainage due to the low permeability of these soils, thus resulting in comparatively more surface water runoff and less groundwater. The groundwater table elevations in the volcanic rock formations are much higher than in the limestone formations. In many areas in southern Guam, the water table intersects the ground surface, resulting in the discharge of groundwater into streams. Approximately 23% to 57% of the stream flow in gauged streams in Guam is from groundwater discharge to surface water (Gingerich 2003).

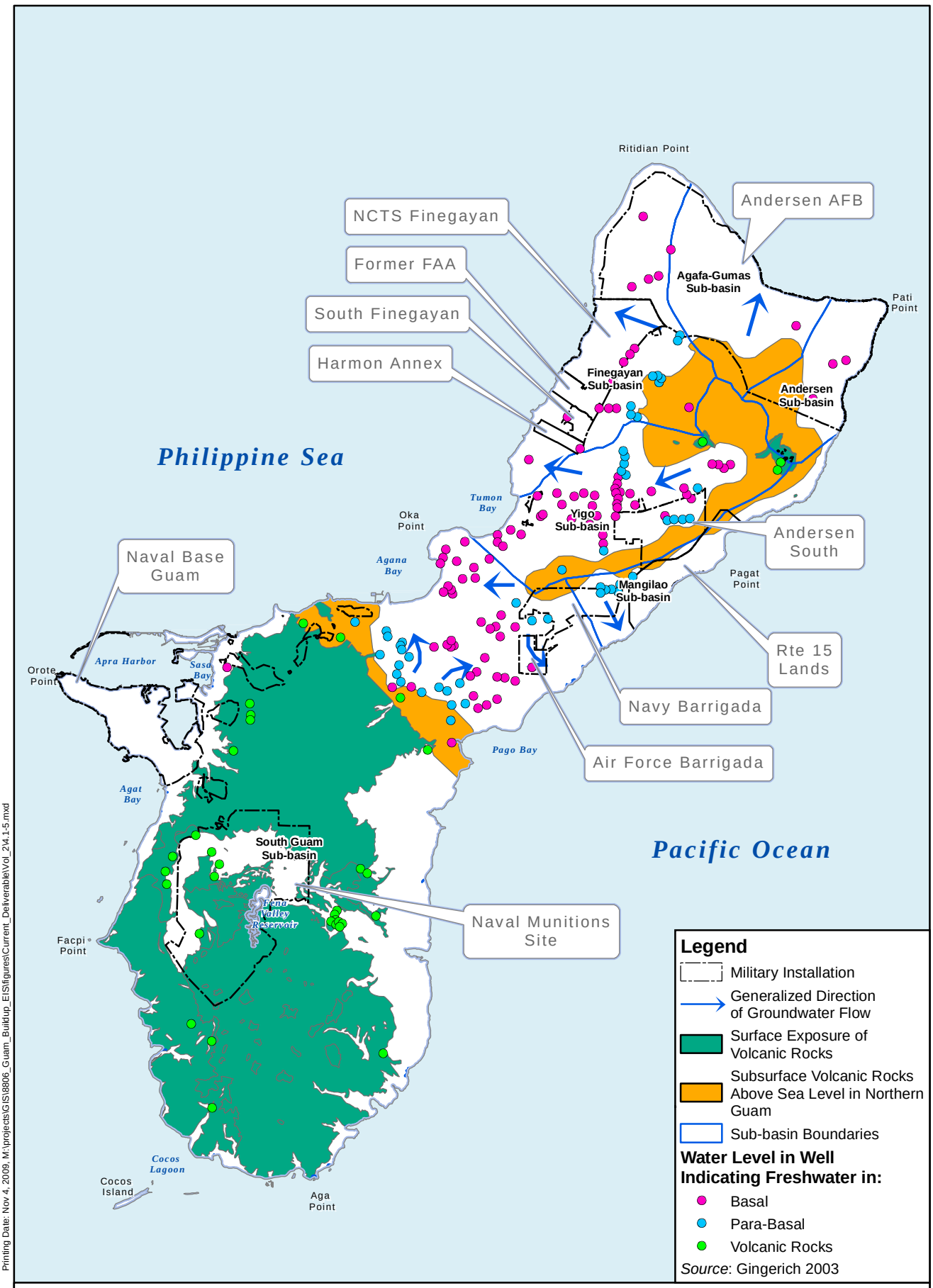


Figure 4.1-5
Guam Groundwater Resources

The freshwater aquifers on Guam are susceptible to contamination from surface activities and from saltwater intrusion. The high permeability of the limestone in northern Guam allows rapid infiltration of rainfall and the large pore size in the limestone formations allow contaminants (if present in the surface water) to reach the groundwater table. The thickness of the freshwater lens (the distance from the water table to the depth the salinity increases to 10% of seawater) is 150 to 200 ft (45 to 61 m) at the southern end of Guam. Further to the north the thickness decreases to approximately 100 ft (30 m). The thickness of the groundwater lens is directly related to the recharge rate and to water withdrawal rates (increased pumping generally results in a thinner lens).

The primary aquifer on Guam is the NGLA that extends from the northern most tip of the island to where the southern highlands start north of Apra Harbor. The NGLA is composed of six distinct subbasins (the Agana, Mangilao, Andersen, Agafa-Gumas, Finegayan, and Yigo-Tumon). Water levels in the NGLA vary daily and seasonally in response to ocean tides, recharge rates, and groundwater withdrawal. Daily fluctuation of water levels driven by tidal changes are about 0.5 ft (0.15 m) in wells near the coast, but these fluctuations decrease as distance from the coast increases and as the permeability of the aquifer material decreases. Well water levels in limestone formations can increase several feet in a matter of days when large storm events (and associated runoff) occur. Seasonal water level variations in the most permeable parts of the NGLA are less than 10 ft (3 m). In the southern part of the NGLA the seasonal water level variations can exceed 20 ft (6 m).

The NGLA is being considered by GEPA for designation as groundwater under direct influence of surface water (GEPA 2009). Drinking water extracted from groundwater designated as groundwater under direct influence of surface water would be subject to the same level of treatment as surface water. In addition, the aquifer has been designated by USEPA as a Sole Source Aquifer under the Safe Drinking Water Act.

On Guam, a significant portion of rainfall is lost to evapotranspiration and some is lost to surface runoff. Of the average annual rainfall of approximately 94 in (239 cm) in northern Guam, evapotranspiration has been estimated to account for 33% (Camp Dresser and McKee [CDM] 1982 in Guam Waterworks Authority [GWA] 2007) to 63% (Barrett 1991 in GWA 2007) of total rainfall. The portion that infiltrates to the subsurface recharges the underlying water table at an annual average rate of approximately 35 in (89 cm) per year (Navy 2009).

There are two published studies estimating the sustainable yield of the NGLA. In general terms, the sustainable yield is the amount of water that can be pumped from an aquifer without impairing the utility or quality of the water resource. To sustain a groundwater resource in an ocean island setting, the rate of groundwater withdrawal would be significantly less than the rate of recharge because seaward flow of groundwater is required to maintain the freshwater lens. An assessment done in 1982 (CDM 1982) determined the sustainable yield at 57.4 million gallons per day (MGd), and a study in 1991 determined a value of 80.5 MGd (Barrett 1991). Both studies are cited by various sources as the current estimate of sustainable yield. For example U.S. Geological Survey (USGS) (2007) lists the values from 1982, while the GWA in their Water Resources Master Plan (GWA 2007) uses the 1991 values. Part of the difference between the 1982 and 1991 sustainable yield values is due to a change in the subbasin boundaries. Since the 1991 study is most recent and was a more comprehensive study, these values are believed to more accurately reflect conditions on Guam and are used in this analysis. These studies of estimated sustainable yield of the aquifer subbasins have been reviewed by the University of Guam.. The findings of this September 2009 review confirm that the 1991 esimtates of sustainable yield are the more reliable of the

two studies. Table 4.1-1 lists the subbasins, their sustainable yields, and recent average pumping rates (in MGd).

Table 4.1-1. Sustainable Yield Estimates and Recent Annual Average Pumping, NGLA

Subbasin	*1982 Sustainable Yield (MGd)*	*1991 Sustainable Yield (MGd)*[1]	*Current Well Production (MGd)*	*Current Available Yield (MGd)*[2]
Agana	11.7	20.5	10.9	9.6
Mangilao	3.9	6.6	2.5	4.07
Andersen	6.2	9.8	0.7	9.05
Agafa-Gumas	10.1	12.0	0.0	12.0
Finegayan	6.4	11.6	8.2	3.36
Yigo-Tumon	19.1	20.0	21.3	-1.33
Total	**57.4**	**80.5**	**43.7**	**36.75**

Note: [1]As part of the EIS/OEIS, a re-evaluation of the sustainable yield of the NGLA has been conducted and confirmed that the 1991 sustainable yield estimate is the more appropriate. .

[2] The current available yield is the difference between current well production and the 1991 sustainable yield. Numbers may not add exactly due to rounding.

*Sources***:** CDM 1982, Barrett 1991, USGS 2007, NAVFAC Pacific 2008.

Based on these estimates, it is clear that groundwater resources are underdeveloped within the Andersen and Agafa-Gumas subbasins, compared to the southern subbasins. A parabasal zone exists in both the Andersen and Agafa-Gumas subbasins, meaning that these subbasins have the potential for increased production rates.

Groundwater Quality

GEPA manages several environmental programs that serve to protect groundwater resources. Most programs are fully established but undergo continuous revision based on changes in statutes or regulations or to maintain effective control measures. Two potential sources of negative impact to the groundwater resources in Guam are 1) over-pumping resulting in saltwater intrusion, and 2) contaminated leachate from the ground surface or shallow subsurface degrading the water quality. Due to potential increases in demand, saltwater intrusion poses the most significant threat to groundwater resources.

Wells closer to the coast have the potential to be most affected by saltwater intrusion brought on by pumping; some wells are already experiencing high chloride concentrations (concentrations >250 mg/L). For example, current chloride data indicate that some wells, particularly in the Finegayan and Agana Subbasins, are drawing water high in chloride concentrations from the transition zone into their intakes. This could indicate over-pumping of these subbasins or that the well intakes were installed too deep.

The groundwater quality within the NGLA is considered good but the aquifer is highly vulnerable to contamination from chlorides, and raw sewage leaking from the collection system. Bacteria, nutrients, chlorides, and toxic contaminants have been detected in groundwater from the NGLA. Many single-family dwellings on Guam, especially in the northern and central areas of the island, use septic systems with leach fields. Leach fields are perforated pipes typically buried in fully excavated fields that allow effluent to leach out into the surrounding soil or limestone formation. Where organic soil is present in fields, the soil acts as a filter and biologic purifier, removing pathogens and degrading contaminants to benign substances; however, since organic soils are absent in most systems constructed in northern Guam due to very shallow soil profiles, minimal nutrient and pathogen removal may occur. Thus, there is a potential for modified effluent to reach the NGLA. Since there are frequent discharges to a septic system and leach field, the treated effluent would eventually percolate down to the water table. This leachate may still contain problematic concentrations of contaminates such as nitrate or pharmaceuticals. This problem

is exacerbated where there is a high density of septic systems or where they are not operating properly. These individual wastewater systems are considered a potential threat to the quality of the NGLA.

Federal Regulations

Safe Drinking Water Act

The Safe Drinking Water Act regulates the nation's drinking water supplies by establishing standards for drinking water to protect against both naturally occurring and man-made contaminants. This act also seeks to prevent contamination of drinking water resources by establishing requirements under programs such as the underground injection control program.

The Safe Water Drinking Act relates directly to groundwater resources on Guam as groundwater provides a majority of the drinking water. The Guam Safe Drinking Water Act was enacted in 1977 by Public Law 14-90. It establishes a policy for the protection and provision of safe drinking water via the establishment of primary and secondary standards.

Groundwater Rule

The Groundwater Rule (40 CFR Parts 9, 141 and 142) provides for increased protection against microbial contamination. This is a risk-based rule that mandates treatment of groundwater used by public drinking water system be disinfected if indicator bacteria are detected in this water. Since the NGLA is overlain by permeable limestone and there is a high density of individual wastewater systems, the rule may be applicable to groundwater in Guam that is used for drinking water.

Technical Standards and Corrective Action Requirements for Owners and Operator of Underground Storage Tanks

This regulation (40 CFR Chapter 1, Part 280) protects groundwater by establishing regulations and procedures for underground storage tanks that contain regulated substances such as petroleum products. Owners and operators are required to take specific action when investigating releases for their tanks.

Guam Regulations

Guam's groundwater falls into one of three classifications: G-1 (Resource Zone), G-2 (Recharge Zone), and G-3 (Buffer Zone). The G-1 category includes all groundwater and the water in the unsaturated zone extending 100 ft (30 m) above the water table or 20 ft (6 m) below the ground surface, whichever is lower. The G-1 water must meet drinking water quality standards (GEPA 2001). The G-2 water is tributary to and replenishes G-1 water. A description of the classifications (GEPA 2001) follows:

> §5102(b). Groundwater. This major type of water encompasses all subsurface waters and includes basal and parabasal water, perched water, all water below the groundwater table, water percolating through the unsaturated zone (vadose water), all saline waters below and along the perimeter of the basal freshwater body (freshwater lens), and water on the surface that has been collected with the specific intent of recharging or disposing of that water to the subsurface by means of injection, infiltration, percolation or other means. The northern Guam water lens (the Principal Source Aquifer) and any other groundwater resource as they are identified shall continue to receive protection under Guam's groundwater regulations.
>
> Category G-1. RESOURCE ZONE
>
> The primary use of groundwater within this zone is for drinking (human consumption) and this use must be protected. Virtually all water of the saturated zone of Guam is included. Specifically it includes all water occurring in the saturated zone below the groundwater table, all vadose water

occurring in an unsaturated zone interval extending 100 ft (30 m) above any water table, or to within 20 ft (6 m) of the ground surface above all fresh groundwater bodies, all water and the basal and parabasal freshwater bodies, and all water of and below the freshwater/salt-water transition zone beneath the basal water body.

Because any water discharges within this zone would (by definition) be tributary to groundwater bodies that are actual or potential sources of fresh, potable groundwater, no discharges within this zone would be allowed.

Category G-2. RECHARGE ZONE

Water within this zone is tributary to, replenishes and recharges the Category G-1 groundwater and must be of drinking water quality before it enters the Resource Zone. All water discharges within the Recharge Zone must receive treatment to the degree necessary to protect the underlying Category G-1 groundwater from any contamination.

Category G-2 is divided into two distinct subcategories based upon the boundaries of the protected groundwater area. The protected groundwater area includes all land over the entire NGLA, from coastline to coastline. Category G-2a exists within the protected groundwater area and extends from the ground surface to the top of the G-1 Zone. Category G-2b exists only outside the protected groundwater area and includes all waters that are collected and recharged or disposed of within a zone is bounded above by G-3 and below by G-1. Vertically, this zone extends 20 ft (6 m) below the ground surface to the upper surface of the Category G-1 waters. Input to groundwater within this zone occurs primarily through storm water injection wells.

It is recognized that surface water would percolate through soil/rock media before reaching the Resource Zone. In this way it may undergo some degree of natural treatment consisting of filtration and subsequent purification. However, the degree of treatment is not easily demonstrated. Thus, due to the need to protect G-1 waters and considering the difficulty in tracing pollutants reaching the G-1 zone to a particular source, discharge limitations have been established to regulate discharges to the G-2 zone.

Category G-3. BUFFER ZONE

Category G-3 exists only outside the protected groundwater area and includes all waters that are collected and disposed of or recharged at or near the existing groundwater supply. Vertically, the zone for this category extends from the surface to 20 ft (6 m) below the surface. Disposal methods that may result in discharges to groundwater within this zone include, but are not limited to, ponding basins, rapid infiltration, slow rate land treatment, surface or spray irrigation and all subsurface discharges (seepage, leaching).

Discharges equal to or less than 3,000 gallons per day (gpd) (11,356 liters per day [lpd]) within the G-3 zone are designated by G-3a. Water quality criteria for all discharges within zone G-3 that are >3,000 gpd (11,356 lpd) are designated G-3b. This differentiation in criteria addresses the fact that minor discharges typified by small scattered individual dwelling units probably have less adverse impact on underlying groundwater than major point source discharges and thus are allowed less restrictive water quality limits (i.e., equivalent to primary treatment). All discharges within this zone may require discharge permits under these regulations.

4.1.1.4 Nearshore Waters

Definition

For the purposes of this analysis, nearshore waters include all coastal waters having a salinity >0.5 parts per thousand (ppt) from the mean low water mark to a depth of 60 ft (18 m) and monitored under the Guam Coastal Assessment program. While not entirely satisfying this definition (it is >60 ft [18 m] deep), Apra Harbor is included in the nearshore discussion.

Oceanography

Guam tides are semidiurnal with a mean range of 1.6 ft (0.5 m) and diurnal range of 2.3 ft (0.7 m). Extreme predicted tide range is about 3.5 ft (1.1 m). Surface sea temperatures average close to 80 degrees Fahrenheit (°F) year-round (GEPA 2006).

Nearshore Water Quality

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Nutrients are chemicals necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. Water pollutants alter the basic chemistry of seawater in various ways (Navy 2009).

The vast expanse of offshore waters, their distance from the shore, and mixing and transport effects of currents work together to maintain a generally high quality of water. The major chemical parameters of marine water quality include pH, amount of dissolved oxygen, and nutrient concentrations.

The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution. Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam. Soil erosion is one of the most serious nonpoint source pollution problems, particularly in the southern areas. Grading or clearing of land by burning results in significant topsoil loss during heavy rain storms leaving the more compact soil behind that makes re-vegetation difficult. Runoff of feedlot waste has also been identified as a nonpoint source of pollution needing mitigation. Urban runoff is one of Guam's most voluminous nonpoint source problems which impacts both groundwater and coastal waters. Runoff may contain bacterial contamination, inorganic nutrients, various organic compounds, and metals (GEPA 2006).

The Water Monitoring Strategy for the Territory of Guam began in 1978. It includes the Surface Water Monitoring Network and the Recreational Beach Monitoring Strategy. The goals of the Water Monitoring Strategy for the Territory of Guam are to:

- Conduct a comprehensive assessment of water quality throughout the island using a rotating basin approach
- Complete a thorough evaluation of monitoring data
- Evaluate if the quality of the island's waters is suitable for their designated uses
- Evaluate if the Guam Water Quality Standards (GWQS) are appropriate and relevant to present conditions in the waters of the island
- Coordinate new approaches to improving and protecting the island's water resources (GEPA 2008b)

The Recreational Beach Monitoring Program takes water samples of 44 recreational beaches every Wednesday and analyzes the samples for concentrations of the *enterococcus* bacteria indicator. Advisories are based on an instantaneous standard of not >104 *enterococci*/100 ml and a geometric mean standard of not >35 *enterococci*/100 ml (GEPA 2008b).

Swimming advisories are issued based upon either an instantaneous concentration of 104 most probable number/ 100 ml or a geometric mean concentration of 35 most probable number/100 ml, over a 5-week period. For calendar year 2004, 39 beaches were monitored for the USEPA-approved *enterococci* indicator (weekly, year round). This resulted in approximately 1,881 samples analyzed and 864 swimming advisories issued. In calendar year 2005, 42 beaches were monitored for the USEPA-approved *enterococci* indicator (weekly, year round). This resulted in approximately 2,236 samples analyzed and 535 swimming advisories issued (GEPA 2006).

Federal Regulations

CWA or Federal Water Pollution Control Act

The purpose of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Under Section 404 of the CWA the USACE has regulatory jurisdictions over the discharge of dredged or fill material into waters of the U. S. including wetlands.

Coastal Zone Management Act (CZMA)

The CZMA establishes a federal-state partnership to provide for the comprehensive management of coastal resources. Coastal states and territories develop management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act provides that water resources development programs must consider wildlife conservation. Under this act, federal agencies proposing actions, including issuance of permits, that would affect any body of water, must consult with U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the affected state or territory's fish and wildlife management agency.

Merchant Marine Act

This law empowers the Maritime Administration to investigate causes of congestion at ports; to investigate the practicability and advantage of harbor, river, and port improvements in connection with foreign and coastwise trade; and to investigate any other matter that may tend to promote use by vessels of ports.

Rivers and Harbors Act

The original purpose of the Rivers and Harbors Act was to establish the federal interest in interstate navigation. Section 10 of the Act requires approval from the USACE prior to undertaking any work with the potential to affect the course, capacity, use, or quality of navigable waters.

Water Resources Development Acts

Dredging projects are authorized by Congress through the Water Resources Development Acts that are reauthorized biennially. Water Resources Development Act 86 introduced cost sharing for construction projects whereby the local sponsor pays between 20% and 60% of the construction cost based on the depth of the navigation channel. The Water Resources Development Act cost sharing provisions apply to

Federal dredging projects implemented by the USACE Civil Works Program, and are not applicable to dredging undertaken by other agencies.

Guam Regulations

Guam Water Pollution Control Act

As defined in 10 Guam Code Annotated, Chapter 47 (Water Pollution Control Act), this Act's primary statutory provisions include the: Water Resources Conservation Act (ground and surface water management/development); well head regulations; water development (wells) regulations; ground and surface water protection/management; pollution discharge permiting; erosion control and control of other point/nonpoint pollution sources; and the Safe Drinking Water Act, which authorizes primary and secondary drinking water standards.

Guam Water Quality Standards (GWQS)

The GWQS identify three classes of marine water that apply to all coastal waters from the mean high water mark, including estuarine waters; lagoons and bays; brackish areas; wetlands and other special aquatic sites; and other inland waters that are subject to ebb and flow of the tides, as follows:

- *Category M-1 EXCELLENT.* Water in this category must be of high enough quality to protect for whole body contact recreation, and to ensure the preservation and protection of marine life, including corals and reef dwelling organisms; fish and related fisheries resources; and enable the pursuit of marine research as well as aesthetic enjoyment. This category shall remain substantially free from pollution attributed to domestic, commercial and industrial discharges; shipping and boating; or mariculture, construction and other activities that can reduce the waters' quality.
- *Category M-2 GOOD.* Water in this category must be of sufficient quality to allow for the propagation and survival or marine organisms, particularly shellfish and other similarly harvested aquatic organisms; corals and other reef related resources; and whole body contact recreation. Other important and intended uses include mariculture activities, aesthetic enjoyment and related activities.
- *Category M-3 FAIR.* Water in this category is intended for general, commercial and industrial use, while allowing for the protection of aquatic life, aesthetic enjoyment and compatible recreation with limited body contact. Specific intended uses include the following: shipping, boating and berthing, industrial cooling water and marinas (GEPA 2001).

Guam's marine waters, including nearshore waters, are designated primarily as M-1 and M-2 waters. Outer Apra Harbor and Inner Apra Harbor are designated as M-2 waters. M-3 waters can be found in the northeast portion of Apra Harbor (GEPA 2001). The designation of marine waters as M-2 in the vicinity of Tanguisson Beach Park located on the western coast of central Guam is of particular interest. In 1991, three people died after consuming seaweed, Gracilaria tsudae, collected from the beach. Therefore, since 1991, there has been a standing fish/seaweed consumption advisory for that particular beach. The exact source of the contamination has not been identified and a no-harvesting advisory remains in effect (Clean Water Action Plan 1998).

Guam Laws, Permits and Regulations Governing Dredging and Contamination of Nearshore Waters

U.S. CWA Section 401 Water Quality Certification

A number of federal permits, most of which are identified in the federal CWA, for construction, fill, dredging, and discharges to waters of the U.S. and Territorial Waters require Territorial (GEPA) Section 401 Water Quality Certification (WQC). Section 401 WQC issuance identifies that construction or operation of a proposed project or facility would be conducted in a manner consistent with GWQS.

Guam Water Quality Standards

The GWQS were revised in 1999-2000, partly in response to the needs of the Memorandum of Understanding (MOU) for the Section 309 Guam Harbors Sediment Project, Phase III. These final revised regulations include a revised and streamlined approach to the Section 401 WQC process administered by GEPA.

Guam Environmental Protection Act

Public Law 11-191 created GEPA in 1973, with responsibilities for comprehensive protection of Guam's land, water and air.

Guam Seashore Protection Act and Permit System

The Guam Seashore Protection Act (GCA Title 21, Chapter 63) establishes the Guam Seashore Reserve and the Guam Seashore Protection Commission, that must review and act on any applications for development, including any dredging, within the reserve. The reserve includes all subtidal areas down to ten fathoms and extends inland to within 328 ft (100 m) (amended to 33 ft [10 m] of the mean high high-water mark).

Guam Soil Erosion and Sedimentation Control Regulations/Permits

Erosion Control Permits are issued by GEPA while the Department of Public Works issues Clearing and Grading Permits. Since Clearing and Grading Permits require GEPA review for compliance with the Guam Soil Erosion and Sedimentation Control Regulations, GEPA actually assumes the lead in review and approval responsibility. For most clearing and/or grading permits there must be an accompanying Erosion Control Plan to protect water quality of the affected water resources, fresh or marine.

Water Quality Monitoring Plan

Water Quality Monitoring Plans may be required to evaluate the effectiveness of any number of different environmental permits and/or performance standards. Monitoring plans are formulated to identify ambient or control conditions at a particular site and to capture deviations from those conditions resulting from a project or operations of a facility. Water Quality Monitoring Plans may range in complexity from visual inspections for sedimentation and protection measure failure to laboratory or field analysis of chemical and biological effects on water quality or organisms (acute/chronic bioassay), dependent on a given water resource. Water Quality Monitoring Plans always include procedures for reporting results and observations to GEPA and provisions for corrective actions. Water quality monitoring is a standard requirement for all dredging, industrial point source discharges, municipal wastewater treatment plant discharges, thermal discharges, marine and underwater construction activities, aquaculture effluent discharges, and mass clearing and grading projects such as golf course construction.

Environmental Protection Plan

Environmental Protection Plans are required for most clearing, grading, dredging, and marine related construction work. The Environmental Protection Plan should be developed by a project contractor who would be responsible for its implementation.

National Pollution Discharge Elimination System

The NPDES is a federal permit for all stormwater and other point source pollution discharges. GEPA assists in the administration of these permits and reviews and certifies (Section 401 WQC) the permit for compliance with all local regulations and policies and in accordance with the GWQS (Title 10 GCA Chapter 47 Water Pollution Control). USEPA coordinates, drafts, and issues the permit for facilities that require wastewater discharges such as sewage treatment plants, electrical power generation plants, industrial processing facilities, stormwater outfalls, aquaculture facilities, aquariums, and similar operations must be permitted under this permit system.

Pollution Discharge Permit

For discharges similar to those covered by the NPDES permit, as authorized under the Guam Water Pollution Control Act, GEPA may require a Government of Guam (GovGuam) Pollution Discharge Permit. This permit may be issued for any number of liquid, gaseous, solid or thermal discharges to territorial waters that fall below the minimum criteria defined in the federal CWA. Applicability is determined by the Administrator on a case-by-case basis.

Test Boring and Dewatering Permits

Individuals conducting soil test boring and measurement activities are required to obtain a GEPA Test Boring Permit. Authorized under 10 Guam Code Annotated, Chapter 46 (Water Resources Conservation Act), permitted test boring activities include drilling and excavations deeper than 6 ft (1.8 m) deep for a number of soil and structural engineering analysis work. In addition, if the water table is encountered during excavation work for building foundations and similar construction activities, a Dewatering Permit is required to control and treat water pumped from an excavation prior to final discharge. Dewatering Permits may apply to dredging operations as well.

4.1.1.5 Wetlands

Definition

Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation including marshes, swamps, and similar areas. The recurrent excess of water in wetlands imposes controlling influences on all biota (plants, animals, and microbes). Areas described and mapped as wetland communities may also contain small streams or shallow ponds or pond or lake edges.

Marshes are generally located in low places along the coast, along streams, in depressions and sinkholes with argillaceous limestone, or in poorly drained areas with volcanic soils. Marshes may be inundated with freshwater or brackish water if near the ocean. Swamps are generally located along rivers, especially near the coast or near sea level along river valleys if inland, and are usually designated as ravine communities rather than as wetland communities.

Wetland Areas and Quality

USFWS National Wetland Inventory (NWI) data indicate there are approximately 4,056 acres (ac) (1,642 hectares [ha]) of potential wetland areas on Guam. These NWI-indicated wetland areas do not equate to the amount of USACE-certified jurisdictional wetlands; however, they indicate the potential for wetland

areas on Guam. The USFWS neither designed nor intended the NWI program to produce legal or regulatory products. Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that presented in the NWI maps.

For regulatory purposes, potentially affected wetlands must be formally delineated and a jurisdictional determination obtained from the USACE as part of the Section 404 CWA permitting process. In the absence of other data, NWI data can indicate the potential for wetland areas and be used for macro-level impact analysis, with the qualification that the analysis is not based on a jurisdictional determination (USFWS 2009). In this EIS/OEIS/OEIS, the best available wetland data are used including NWI maps, previous wetland delineations and site visits by certified wetlands scientists in September 2009.

Guam's wetlands generally fall into four of the major wetland subclasses used by the USFWS (USFWS 2009) which follow the classification system developed by Cowardian et al in 1979 for the USFWS (USFWS 1979) to describe wetlands and are as follows:

1. Palustrine, forested (freshwater swamps of woody vegetation). Found along edges of emergent wetland areas and in areas with less water than emergent wetlands, most notably in southern Guam.
2. Palustrine, emergent (freshwater marshes dominated by reeds and sedges). Typified by Agana Marsh.
3. Lacustrine (man-made open water impoundments). Examples include areas around the margins of Fena Reservoir and small man-made ponds.
4. Estuarine (mangrove and lower channels of rivers). An example would be the mangroves located within the Inner Apra Harbor.

The northern limestone plateau lacks substantial wetlands because of the high permeability of the karst limestone in the area. The majority of wetlands are found in southern Guam due to the lower permeability volcanic soils in the area. Primary threats to wetlands on Guam include feral ungulates, human disturbance, invasive plants species, and sedimentation and erosion.

Federal Regulations

Federal Water Pollution Control Act (CWA 33 U.S. Code [USC] §1251 et seq.)

The Water Pollution Control Act gives the USACE regulatory jurisdiction over the discharge of dredged or fill material into jurisdictional waters of the U.S., including wetlands. Actions require federal consistency with State Nonpoint Source Pollution Control Plans.

Statement of Procedures on Floodplain Management and Wetlands Protection; 40 CFR Part 6, Appendix A

These procedures set forth USEPA policy and guidance for carrying out Executive Orders 11990 and 11988.

Endangered Species Act, 16 USC §1531 et seq.; 50 CFR Parts 17, Subpart I, and 50 CFR Part 40

The Endangered Species Act of 1973 and subsequent amendments provide for the conservation of threatened and endangered species of animals and plants, and the habitats in which they are found. The act requires federal agencies, in consultation with the Secretary of the Interior, to verify that any agency supported action is not likely to jeopardize the continued existence of any endangered or threatened species or its critical habitat, or result in the destruction or adverse modification of a critical habitat of such species. Exemptions may be granted by the Endangered Species Committee.

Fish and Wildlife Coordination Act (16 USC § 662)

The Fish and Wildlife Coordination Act requires consideration of the effects of a proposed action on wetlands and areas affecting streams (including floodplains), as well as other protected habitats. Federal agencies must consult with the USFWS and the appropriate state agency with jurisdiction over wildlife resources prior to issuing permits or undertaking actions involving the modification of any body of water (including impoundment, diversion, deepening, or otherwise controlled or modified for any purpose). The requirements of this act are applicable for alternatives involving remediation activities in wetlands or floodplains.

National Wildlife Refuge System Administration Act of 1966 (16 USC §§ 668dd-668ee)

The Act provides for the administration and management of the national wildlife refuge system, including wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas and waterfowl production areas.

Guam Regulations

Wetlands, 21 GCA 60101

Real Property requirement implemented by 18 GAR - Land Management, Chapter 3 - Territorial Planning Commission, Article 5 - Wetland Areas. The purpose of these regulations is to establish procedural guidelines and performance standards for development and conservation, mapping and identification of wetland areas pursuant to Executive Orders No. 78-21 and 90-13 (Protection of Wetlands). These regulations apply to those land and water areas delineated as Wetland Areas of Particular Concern on an official map of wetlands as approved by the Guam Land Use Commission.

4.1.2 North

4.1.2.1 Andersen Air Force Base (AFB)

Surface Water

Andersen AFB does not contain any surface water resources Impervious areas on Andersen AFB amount to 1,766 ac (714.7 ha), or 11.47% of the total Andersen AFB area of 15,400 ac (6,233 ha). Storm runoff from impervious surfaces is currently directed via concrete lined culverts to underground injection control wells, which are permitted and regulated by GEPA (Andersen AFB 2008).

Groundwater

Andersen AFB overlies the northern portion of three groundwater subbasins: the Finegayan subbasin under the western third of the base; the Agafa Gumas subbasin under the central portion of the base, which includes Northwest Field; and the Andersen subbasin under the eastern portion of the base. Approximately 100 dry wells were drilled 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) has prevented extensive groundwater contamination (Navy 2009).

Nearshore Waters

Important nearshore waters around Andersen AFB include Tarague Basin. Use of this area is primarily recreational; more information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline off Andersen AFB is mainly composed of a relatively narrow margin of beach interspersed with

basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (COMNAV Marianas 2001b).

Nearshore waters around Andersen AFB are classified as M-1 (GEPA 2001). At Andersen AFB, the marine environment supports a rich diversity of species associated with the coral reef complex including fishes, corals and other invertebrates, and algae. The Andersen AFB Marine Resource Preserve was designated in 1993 to conserve and manage important seed stock resources for recreational, commercial, and other marine species. GovGuam established the Pati Point Marine Preserve in 1999 (Air Force 2002).

Wetlands

There are no known wetland areas on Anderson AFB (Andersen AFB 2008).

4.1.2.2 Finegayan

The Finegayan area consists of Naval Computer and Telecommunications Station (NCTS) Finegayan and Finegayan South, both of which are located in the northwest portion of Guam. A discussion of each area follows.

NCTS Finegayan

Surface Water

There are no surface water resources in the Finegayan project area. Impervious areas on NCTS Finegayan amount to 132 ac (53.4 ha), or 5.5% of the total NCTS Finegayan area of 2,415 ac (977 ha).

Groundwater

The Finegayan Subbasin of the NGLA is overlain by the Finegayan project area. The description of the NGLA in Section 4.1.1.31 is applicable to Finegayan's groundwater resources as well.

Nearshore Waters

Nearshore waters at Finegayan front Haputo Beach. Use of the Haputo area is primarily recreational. More information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline is composed of a beach interspersed with basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (USGS 1992 in Anderson AFB 2008).

Nearshore waters at Finegayan are classified as M-1. However, sampling conducted at Tanguisson Point in association with the 2008 Water Quality Monitoring and Assessment Report under the CWA determined that one or more designated uses for this water quality classification were not being met and that a Total Maximum Daily Load limitation was needed (GEPA 2008a).

Wetlands

There are no known wetland areas within NCTS Finegayan (COMNAV Marianas 2001b).

South Finegayan

Surface Water

There are no surface water resources in the South Finegayan project area. Impervious areas on South Finegayan amount to 8.7 ac (3.5 ha), or 3.0% of the total South Finegayan area of 290 ac (117 ha).

Groundwater

The Finegayan Subbasin of the NGLA is overlain by the South Finegayan project area. The description of the NGLA in Section 4.1.1.31 is applicable to Finegayan's groundwater resources as well.

Nearshore Waters

There are no nearshore waters at South Finegayan as the project area is located between 1 and 2 mi (1.6 – 3.2 km) from the ocean.

Wetlands

There are no known wetland areas within South Finegayan (COMNAV Marianas 2001b).

4.1.2.3 Non-Department of Defense (DoD) Land

In northern Guam, the non-DoD land consists of the former Federal Aviation Administration (FAA) parcel and the Harmon Annex, both of which are located in the northwest section of Guam. A discussion of each area follows.

Former FAA Parcel

Surface Water

There are no areas of surface water in the former FAA parcel project area. Impervious areas at the former FAA parcel amount to 30 ac (12.1 ha), or 4.4% of the total former FAA parcel area of 680 ac (275 ha).

Groundwater

The former FAA parcel project area overlies the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to groundwater resources in the former FAA parcel.

Nearshore Waters

Nearshore waters at the former FAA parcel front Haputo Beach. Use of the Haputo area is primarily recreational. More information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline is composed of a beach interspersed with basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (USGS 1992 in Anderson AFB 2008).

Nearshore waters at the former FAA parcel are classified as M-1. However, sampling conducted at Tanguisson Point in association with the 2008 Integrated Water Quality Monitoring and Assessment Report under the CWA determined that one or more designated uses for this water quality classification were not being met and that a Total Maximum Daily Load limitation was needed.

Wetlands

There are no known wetland areas at the former FAA parcel (USFWS 2009).

Harmon Annex

Surface Water

There are no areas of surface water in the former Air Force Harmon Annex (herein referred to as Harmon Annex) project area. Impervious areas on the Harmon Annex amount to 13 ac (5.3 ha), or 4.0% of the total Harmon Annex area of 326 ac (132 ha).

Groundwater

The Harmon Annex project area overlies the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to the groundwater resources in the Harmon Annex area.

Nearshore Waters

There are no nearshore waters located at the Harmon Annex as the project area is located approximately 0.5 to 2 mi (0.8 to 3.2 km) from the ocean.

Wetlands

There are no known wetland areas within the Harmon Annex (USFWS 2009).

4.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA). This section provides a detailed description of the water resource environment that would be impacted by the proposed roadway improvement project. Figure 4.1-6 presents a map of the surface waters and affected watersheds in each region of the proposed roadway projects. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.2. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

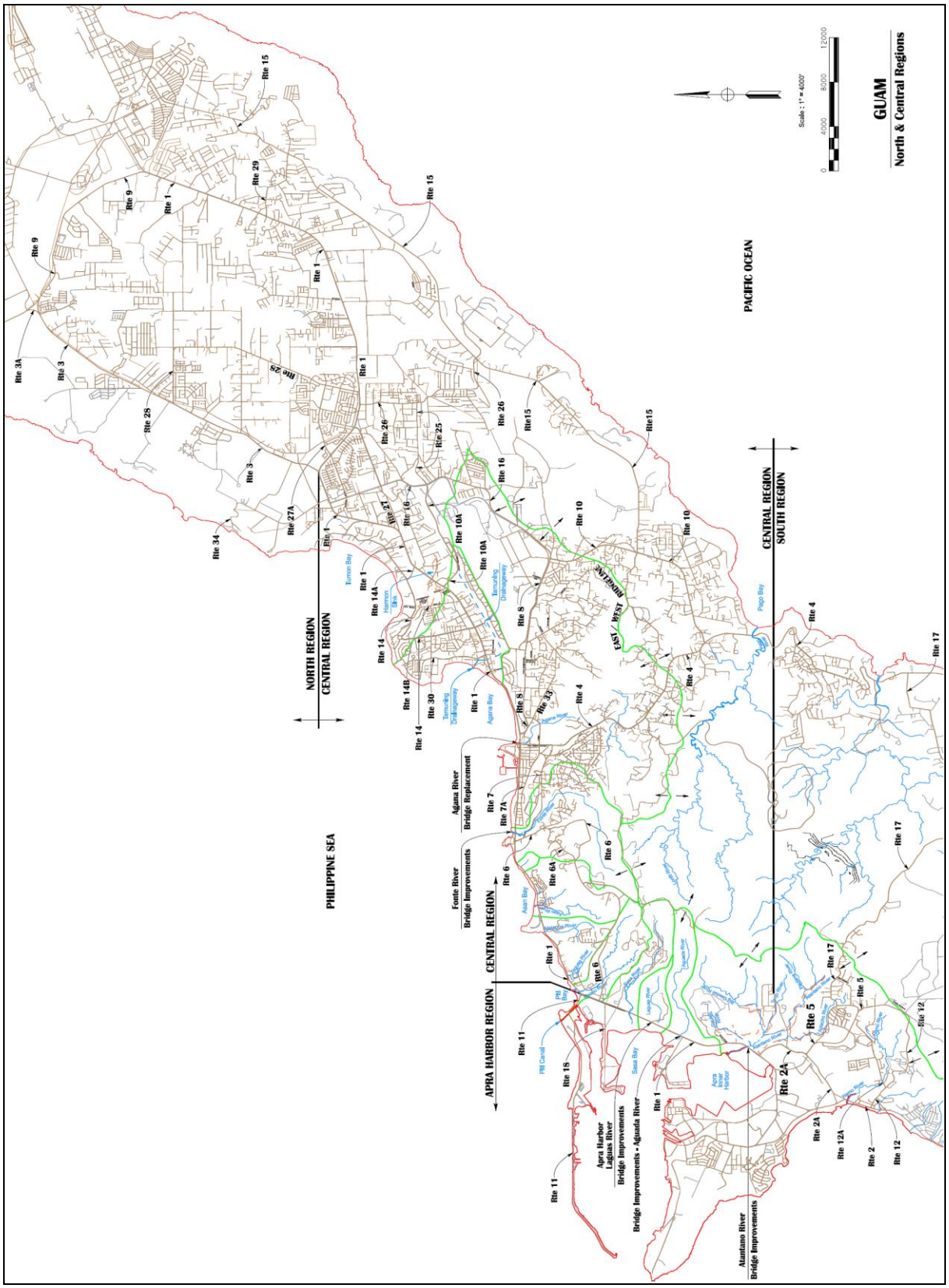


Figure 4.1-6. Significant Surface Waters and Watersheds within Roadway Project Limits

Proposed Guam Road Network (GRN) projects in the north region include improvements along Routes 1, 3, 9, and 28. In general, the roadways in this area are well maintained with good runoff and drainage characteristics. Roads are crowned without curbs enabling sheet flow to vegetated swales or strips along the roadside as shown in Figure 4.1-7 (Route 9) and Figure 4.1-8.

Figure 4.1-7. Typical Roadway Surface along Route 9

Figure 4.1-8. Grass Swale along Route 1 in North Area

Surface Water

The north region has no perennial streams because of the porosity of its coralline rock formation. Rainfall percolates rapidly to the freshwater groundwater aquifer below. Road surfaces in this area are relatively flat, and heavy precipitation generally flows by sheets into swales, then into depressions/retention basins, where it percolates into the ground or is channeled into stormwater wells. Dry injection wells that use the

porous limestone bedrock to assist in stormwater migration into the groundwater aquifers below are located throughout the area. The subsoil is composed of highly porous limestone covered with a soil layer generally less than 2 ft (0.6 m) thick. Percolation rates are high, generally from 8 ft (2.4 m) to 24 ft (7.3 m) per day. Because of the high permeability of the limestone substrate, no perennial streams exist on the northern end of the island. Because the runoff from roadways in this area generally sheet flows off the pavement to grassy swales or flat strips of grass, the runoff from the roadway is generally filtered prior to its conveyance to offsite drainages. No impaired water bodies are identified on the federal 303(d) list of impaired water bodies in this area. There are no coastal resources or coastal barriers in the vicinity of the roadway projects in this area, nor is there any surface waters listed as "National Wild and Scenic Rivers." The affected environment for wetlands (marine and terrestrial) in this area is discussed in the Biological Resources sections of this EIS/OEIS.

The Federal Emergency Management Agency (FEMA) has mapped flood hazard areas throughout the island for the National Flood Insurance Program (NFIP) and has designated the areas on Flood Insurance Rate Maps (FIRMs). Figure 4.1-9 and Figure 4.1-10 display FIRM Map 6600010125D for the western (Routes 3 and 28) and eastern (Routes 1 and 9) portions of the north region, respectively. As shown, various depressions are located throughout the area and have been designated as Flood Hazard Zone X (areas of less than 1.1-ft [0.3-m] depth or areas with less than 1 square mi (mi^2) [259 ha] of contributing drainage area).

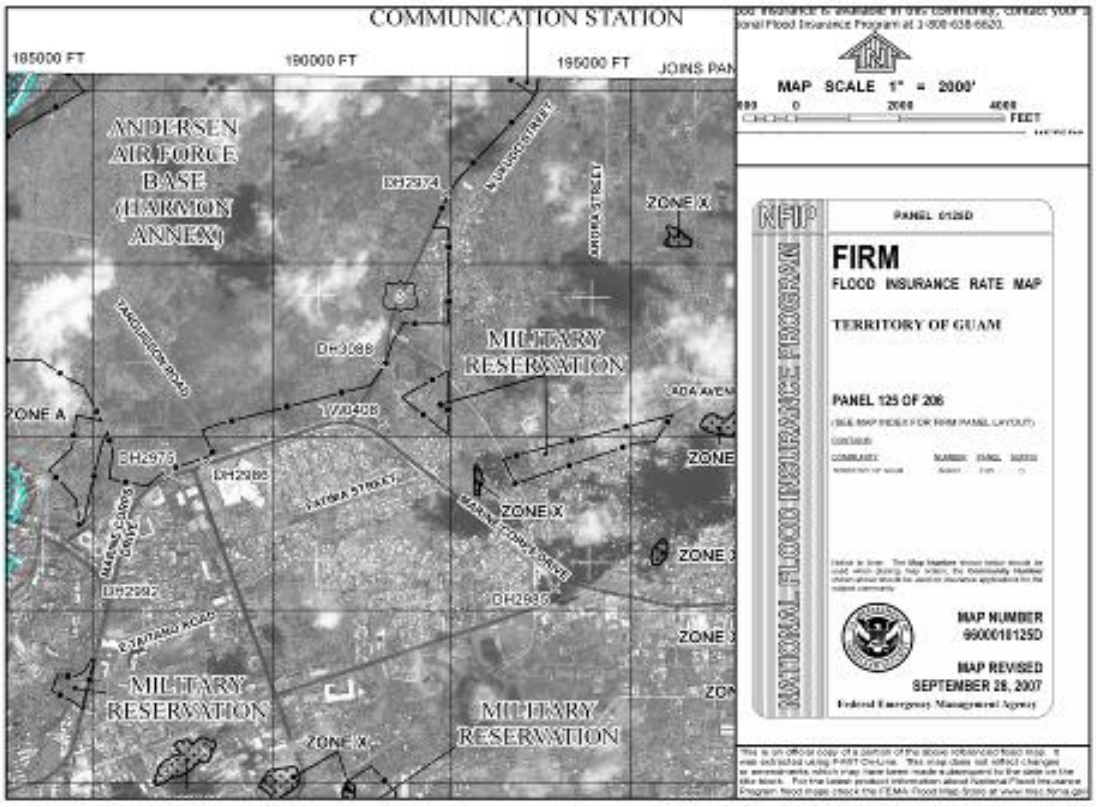


Figure 4.1-9. FEMA Map – North Area – West Side

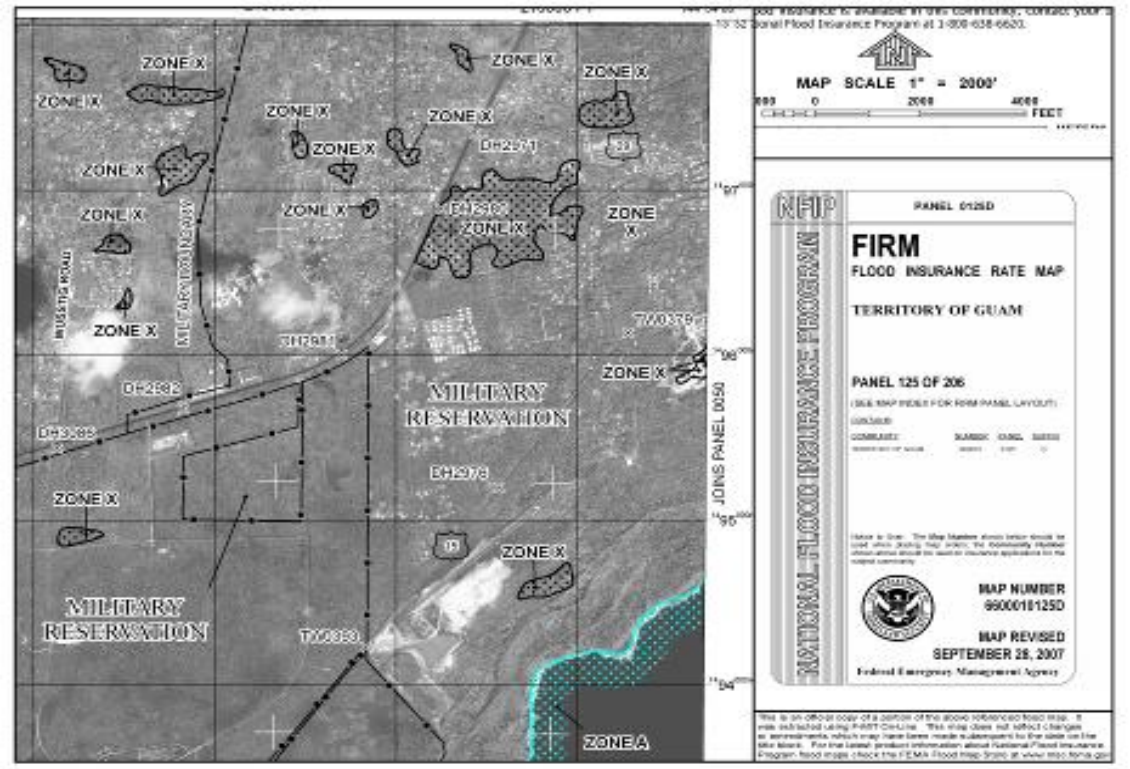


Figure 4.1-10. FEMA Map – North Area – East Side

Groundwater

The north region includes the Northern Limestone Plateau, which is characterized by exposed rock referred to as Mariana limestone. The Mariana limestone consists of a high percentage of clay and fragmented and worn rocks. Here the groundwater is contained within the NGLA. The NGLA serves as the primary source of potable groundwater for the island. Rainfall in this area percolates rapidly through the limestone to the groundwater lens. The subsoil is composed of highly porous limestone covered with a soil layer generally less than 2.0-ft (0.6-m) thick. Percolation rates are high, generally from 8 ft (2 m) to 24 ft (7 m) per day; therefore, rainfall and surface water runoff in this area percolates rapidly through the limestone to the groundwater lens below. The overall groundwater quality of the NGLA is "good;" however, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells and groundwater well influence by surface water or raw sewage from leaking sewer pumps or sewer pipes. GEPA is facilitating the assessment, planning, and pollution control activities required improving water quality that is compliant with local standards. The GEPA has formulated draft guidance to determine the source of potential "groundwater under the influence of surface water". In 2006, the NGLA was found impaired by bacteria, nutrients, chlorides, and toxic contaminants. There is very limited groundwater production in the unconfined aquifer underlying the southern half of the island; consequently, very limited groundwater quality data are available for this area.

4.1.3 Central

4.1.3.1 Andersen South

Surface Water

The Andersen South project area does not contain any surface water resources. Impervious areas on Andersen South amount to 132 ac (53.4 ha), or 6.4% of the total Andersen South project area of 2,061 ac (834 ha).

Groundwater

The Andersen South project area is underlain primarily by very permeable limestone in the Yigo Subbasin within the larger NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to Andersen South's groundwater resources. Water levels in Andersen South wells indicate the presence of para-basal water at higher elevations due to a basement of less permeable volcanic rock, unlike other areas of the NGLA. In southern Guam, most surface water drainage features (e.g., streams and rivers) begin as seeps or springs where groundwater surfaces.

Of the approximately 37 MGd (140 million liters per day [mld]) of water withdrawn from the NGLA, 2.5 MGd (95 mld) is pumped by Andersen AFB; Andersen AFB receives this water from wells located in Andersen South. Water is currently supplied from wells located in the MARBO Annex, stored, disinfected and fluoridated, then pumped to Andersen AFB. The nine production wells are located at Andersen South Annex and the Tumon area and draw water from the NGLA, Yigo Subbasin. Water is currently supplied to Andersen AFB from seven of the nine off-base water production wells. Two wells, Marbo Well No. 2 and Tumon Maui Well, are currently not operational due to the detection of volatile organic compounds (VOCs) in the groundwater at concentrations that exceed USEPA MCLs for drinking water. Other active drinking water wells are either upgradient of or a sufficient distance away from contaminated areas, and are not at risk of contamination. An analysis of chloride concentrations in Andersen AFB water supply wells at Andersen South indicates that chloride is increasing in approximately half of the wells and concentrations in several wells exceed the Secondary MCL (NAVFAC Pacific 2008).

The Agency for Toxic Substances and Disease Registry (Agency) evaluated past exposure to contaminants in the affected production wells and determined that drinking this water would not harm individuals or increase their likelihood of developing adverse health effects. The Agency also concluded that it does not expect any public health effects, now or in the future, as a result of individuals drinking water from the Andersen AFB water supply or any other wells on Guam. Several reasons for this include: 1) the military's remediation actions are further reducing contamination at the base; 2) dispersion (i.e., natural mixing of contaminated with uncontaminated water) dilutes chemical contaminants to concentrations well below levels of public health concern; and 3) the mixing of drinking water in the base's distribution system further dilutes the levels of any contaminants in the water before the water reaches the taps. On the basis of its evaluation of available environmental information, the Agency concluded that exposures to contaminants in groundwater, surface soil, and local plants and animals harvested for consumption are below levels that would cause adverse health effects. The Agency has categorized the base as "no apparent public health hazard" because of the Air Force's education efforts, access restrictions and monitoring programs at Andersen AFB (NAVFAC Pacific 2008).

Nearshore Waters

Located inland, the Andersen South project area does not contain any nearshore waters.

Wetlands

There are no known wetland areas within Andersen South (USFWS 2009).

4.1.3.2 Non-DoD Land

In Central Guam, the non-DoD land includes the area referred to as the Route 15 project area, which is located between the ocean and Andersen South, on Guam's central east shore.

Surface Water

The Route 15 project area does not contain any surface water resources. Impervious areas on the Route 15 parcel amount to 71 ac (28.7 ha), or 3.5% of the total Route 15 project area of 2,031 ac (822 ha).

Groundwater

Like much of northern Guam, Route 15 land overlies Mariana Limestone, which is part of the NGLA. The description of the NGLA in Section 4.1.1.3 is applicable to the Route 15 project area groundwater resources.

Nearshore Waters

The Route 15 project area is located along the eastern coast of Guam along Pagat Point. Nearshore waters along the Route 15 project area parcel are classified as Tier I beaches and are mostly inaccessible to the public because they either are under private or military control, have limited access due to environmental constraints or because they do not contain public beaches (GEPA 2008a). Nearshore waters in this area are classified as M-1 and fully support the designated uses of this water quality classification (GEPA 2008a).

Wetlands

There are no known wetland areas within potentially-impacted non-DoD land (USFWS 2009).

4.1.3.3 Barrigada

The Barrigada project area consists of the Navy Barrigada and the adjacent Air Force Barrigada. Both areas are located just east of the central portion of Guam, away from the ocean. A discussion of each area follows.

Navy Barrigada

Surface Water

The Navy Barrigada project area does not contain any surface water resources. Impervious areas on the Navy Barrigada amount to 5 ac (2.0 ha), or 0.4% of the total Navy Barrigada project area of 1,418 ac (574 ha).

Groundwater

The Navy Barrigada project area is also underlain primarily by very permeable limestone in the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to the Navy Barrigada groundwater resources.

Nearshore Waters

Located more than 1 mi (1.6 km) inland, the Navy Barrigada project area does not contain any nearshore waters.

Wetlands

The 2001 Integrated Natural Resources Management Plan (INRMP) indicates the presence of several small man-made ponds in the vicinity of the Nimitz Golf Course (COMNAV Marianas 2001b). These and other potential wetland areas were investigated in 2007 (NAVFAC Marianas, unpublished data) and some were found to lack wetland vegetation and/or hydrology. Two wetland areas, BARR-03 and BARR-04, were identified and are discussed under Air Force Barrigada. In addition, areas north and east of the Nimitz Golf Course are part of an additional investigation to verify presence of existing wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS for this proposed project.

Air Force Barrigada

Surface Water

The Air Force Barrigada project area does not contain any surface water resources. Impervious areas on the Air Force Barrigada amount to 8 ac (3.2 ha), or 1.9% of the total Air Force Barrigada project area of 430 ac (174 ha).

Groundwater

The Air Force Barrigada project area is also underlain primarily by very permeable limestone in the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.3 is applicable to the Air Force Barrigada groundwater resources as well.

Nearshore Waters

Located inland, the Air Force Barrigada project area does not contain any nearshore waters.

Wetlands

There are delineated and NWI-indicated wetland areas on and adjacent to Air Force Barrigada (NAVFAC Marianas unpublished data, USFWS 2009). The delineated areas consist of BARR-03 and BARR-04 (Figure 4.1-11). BARR-03 is a wetland located close to the southern end of the Nimitz Golf Course and is a sinkhole depression surrounded on three sides by a relatively steep limestone ridge. BARR-04 is located at the edge of the Communications Annex property and is a sinkhole wetland that slopes gradually down to the southwest (NAVFAC Marianas 2009). Counting these two areas (BARR-03 and BARR-04), the delineated and NWI-indicated areas within or adjacent to Air Force Barrigada total approximately 5.4 ac (2.2 ha). The NWI-indicated potential wetland areas may represent historical data, as recent informal observation by biologists did not detect any obvious wetland areas (Table 4.1-2). In addition, the areas indicated on the NWI maps are currently devoted to agricultural activities and do not reflect a typical wetland condition; thus, the NWI-indication may no longer be current and no wetlands are present. In addition, this area is part of an additional investigation to verify presence/absence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS.

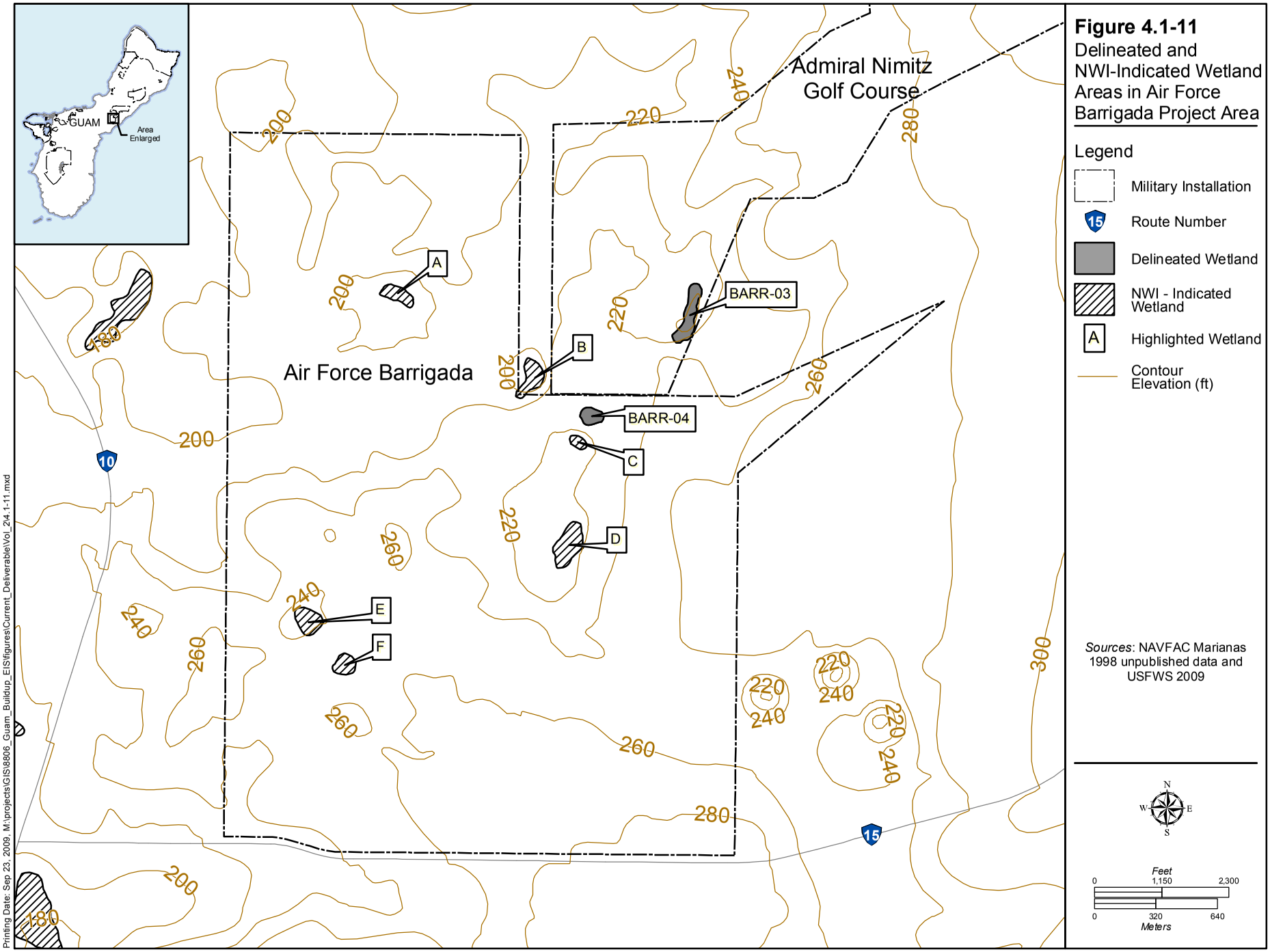

GUAM
Area Enlarged
Admiral Nimitz Golf Course
Air Force Barrigada
A
B
C
D
E
F
BARR-03
BARR-04
180
200
220
240
260
280
300
10
15
Figure 4.1-11
Delineated and NWI-Indicated Wetland Areas in Air Force Barrigada Project Area
Legend
Military Installation
Route Number
Delineated Wetland
NWI - Indicated Wetland
Highlighted Wetland
Contour Elevation (ft)
Sources: NAVFAC Marianas 1998 unpublished data and USFWS 2009
N
W
E
S
Feet
0
1,150
2,300
0
320
640
Meters
Printing Date: Sep 23, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\4.1-11.mxd

Table 4.1-2. Summary of Delineated and NWI-Indicated Wetland Areas in and adjacent to Air Force Barrigada

Wetland Area	*Size (ac/ha)*
BARR-03[a,b]	1.0/0.4
BARR-04[a]	0.4/0.2
A[1]	0.6/0.2
B[1]	0.8/0.3
C[1]	0.2/0.1
D[1]	1.2/0.5
E[1]	0.7/0.3
F[1]	0.5/0.2
Total	5.4/2.2

Notes: [a] Delineated wetland area
[b] Wetland area located adjacent to Air Force Barrigada
[1] NWI-indicated potential wetland area
Source: NAVFAC Marianas unpublished data, 1998 and USFWS 2009.

4.1.3.4 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.3.

The central region covers a relatively large area of the island that encompasses two different hydrologic regimes – the northern broad sloping limestone plateau in the north area and the southern mountainous region composed of eroded volcanic formations in the south area. Descriptions of affected water resources have therefore been split into the northern and southern parts of the central region. Roadway projects located in the north central area include improvements along Routes 1, 8, 8A, 10, 15, 16, 26, and 27. Roadway projects in the south central area include improvements to several bridges along Route 1 along the west side of the island. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

The hydrologic regime within the northern Central Region exhibits characteristics very similar to those of the north region, with few streams and several sinks, the largest of which is referred to as the Harmon Sink. This sink has been mapped as a Flood Hazard Zone AE (locations where the 100-year water surface has been determined) by FEMA on FIRM Map Panel 6600010084D and crosses Route 1, as shown in Figure 4.1-12, with a high water elevation of 93 ft (28 m) above mean sea level. In general, the sink acts as an outlet for local stormwater runoff, including street drainage (Figure 4.1-13, where the sink is located adjacent to Route 1). Here, Route 1 is curbed with drainage flowing into a storm drain system outletting to the sink. Downstream of the Harmon Sink and south of Route 10A, Route 1 follows the Tamuning Drainageway (located along the east side of Route 1) that drains southward toward Agana Bay. This flow path has been designated as a floodway by FEMA, crossing Route 1 immediately south of Route 30 (Figure 4.1-14). In this location, Route 1 is curbed with roadway runoff conveyed through a storm drain system that outlets into the Tamuning Drainageway (with no apparent treatment prior to discharge) west of the highway (Figure 4.1-15 and Figure 4.1-16). There are no impaired water bodies listed in the federal 303(d) list for the northern central region of the island. In general, new development in this area is

required to treat surface water runoff from impervious surfaces by utilizing Best Management Practice (BMP) treatment schemes, such as detention basins that allow settleable solids to settle out prior to entering a storm drainage system, to protect surface water. Other roadways in this area are curbed and convey concentrated flow to low points in the street that connect directly to some of the sinks located in the vicinity, as exhibited in Figure 4.1-17 and Figure 4.1-18 along Route 16 where flow from the street (see Figure 4.1-17) flows directly to an adjacent sink (see Figure 4.1-18) that is also designated as flood hazard zone X on the FEMA FIRMs. There are also some areas in the center of the island that have not been recently developed; therefore, they lack the detention basins or other treatment BMPs to control sedimentation and non-point pollution runoff, such as along Route 27 (Figure 4.1-19) where inadequate drainage along the pavement edge has created subsidence and cracking in the paved areas. There are no coastal resources or coastal barriers in the vicinity of the roadway projects in the north central area, nor are there any surface waters listed as "National Wild and Scenic Rivers". The affected environment for wetlands (marine and terrestrial) for roadways in this area is discussed under the Biological Resources sections of this EIS/OEIS.

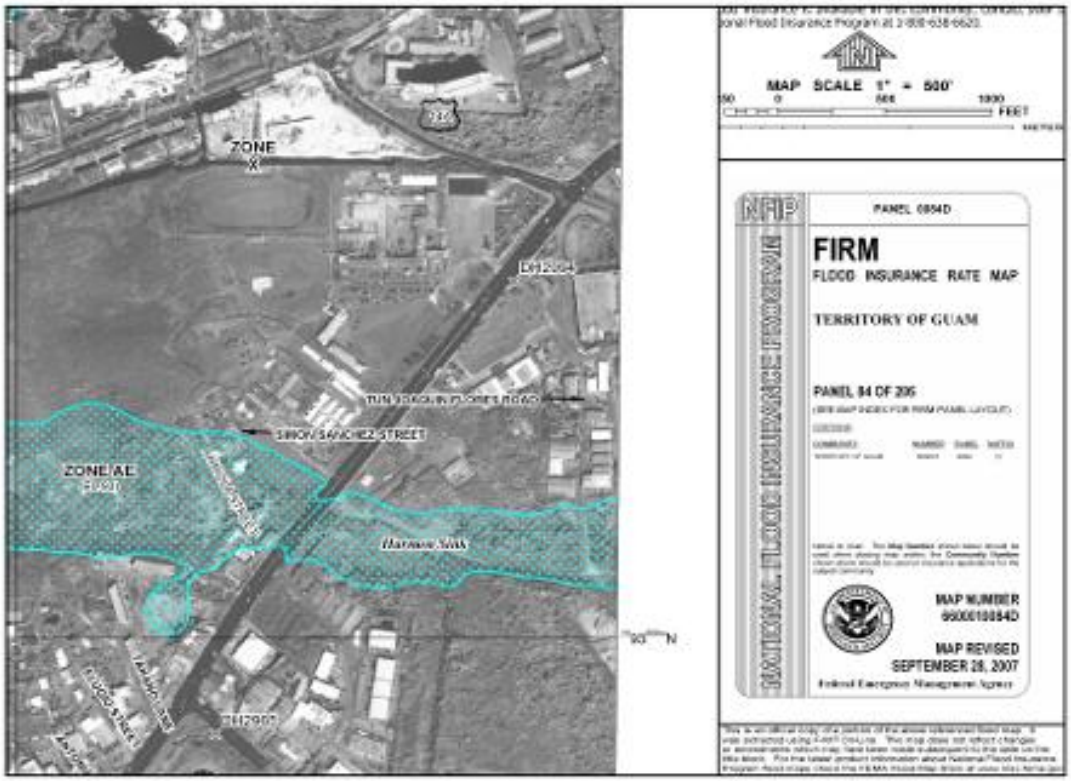


Figure 4.1-12. FEMA Map – Harmon Sink

Figure 4.1-13. Harmon Sink at Route 1

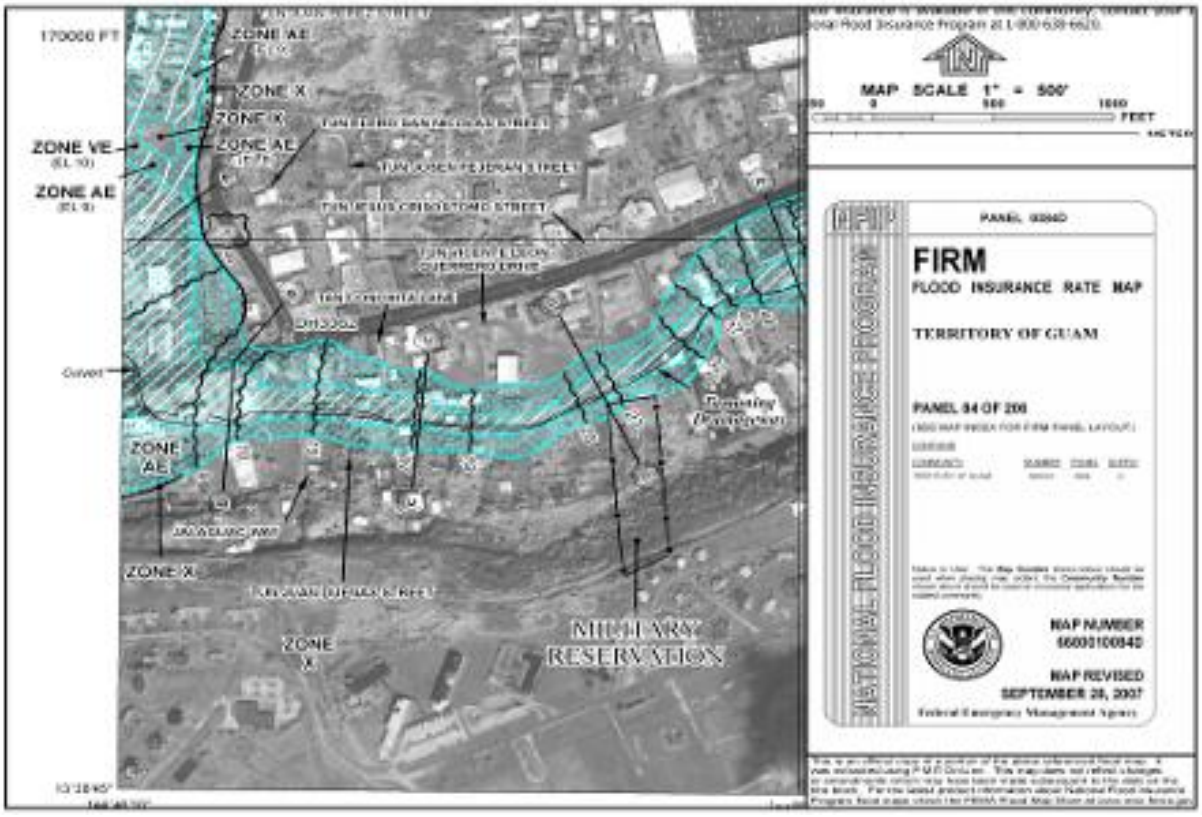


Figure 4.1-14. FEMA Map – Tamuning Drainageway

Figure 4.1-15. Tamuning Drainageway Outlet

Figure 4.1-16. Tamuning Drainageway Downstream Channel

Figure 4.1-17. Route 16 – Curb Outlet at Low Point to Sink

Figure 4.1-18. Sink Adjacent to Route 16

Figure 4.1-19. Route 27 Asphalt Damage

Proposed GRN projects within the southern part of the central region are generally on the west side of the island where the hydrologic regime is characterized by eroded volcanic formations with streams that are short with steep gradients and drainage areas of less than 3 mi^2 (777 ha) each. These streams are generally deeply channeled within the volcanic slopes that outlet into shallow fringing coral reefs at the mouths of the streams. Route 1 is located very close to the mouths of several of these streams that outlet into several bays connected to the Philippine Sea or Apra Harbor. These include (1) the Agana River that outlets into Agana Bay; (2) the Fonte River that outlets into Hagatna Bay; (3) the Asan River with two tributaries that outlet into Asan Bay; (4) the Matgue, Taguag, and Masso Rivers that outlet into Piti Bay; (5) the Sasa, Laguas, and Aguada Rivers that outlet into the Sasa Bay Marine Preserve; and (6) the Atantano River that outlets into the Apra Inner Harbor. The Agana, Fonte, Asan, and Masso Rivers are designated as floodways by FEMA. Other rivers are designated as Flood Hazard Zone X areas with minimal flooding potential. The floodways of the Agana, Fonte, Asan, and Masso River crossings along Route 1 are shown in Figures 4.1-20, 4.1-21, 4.1-22, and 4.1-23.

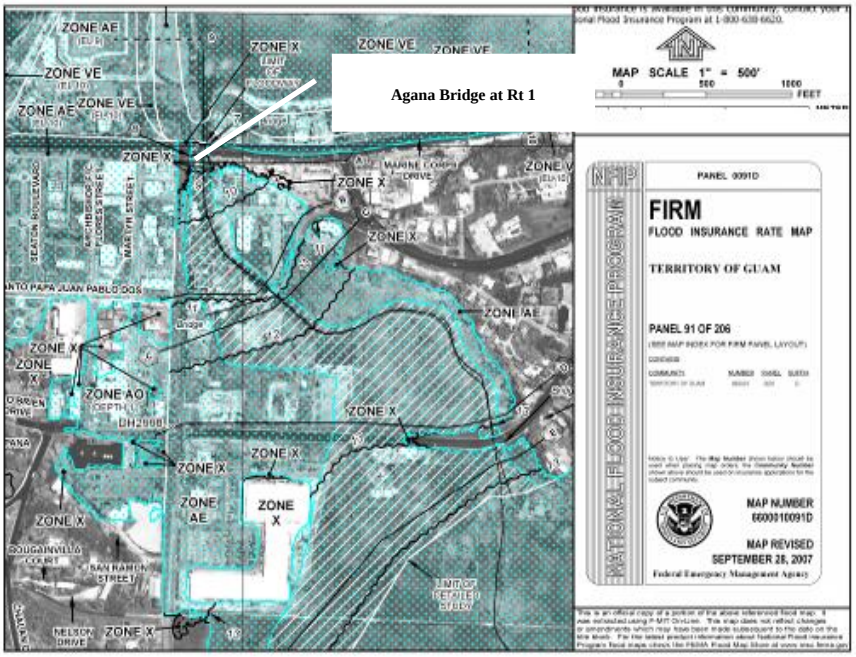


Figure 4.1-20. FEMA Map of Agana Floodplain

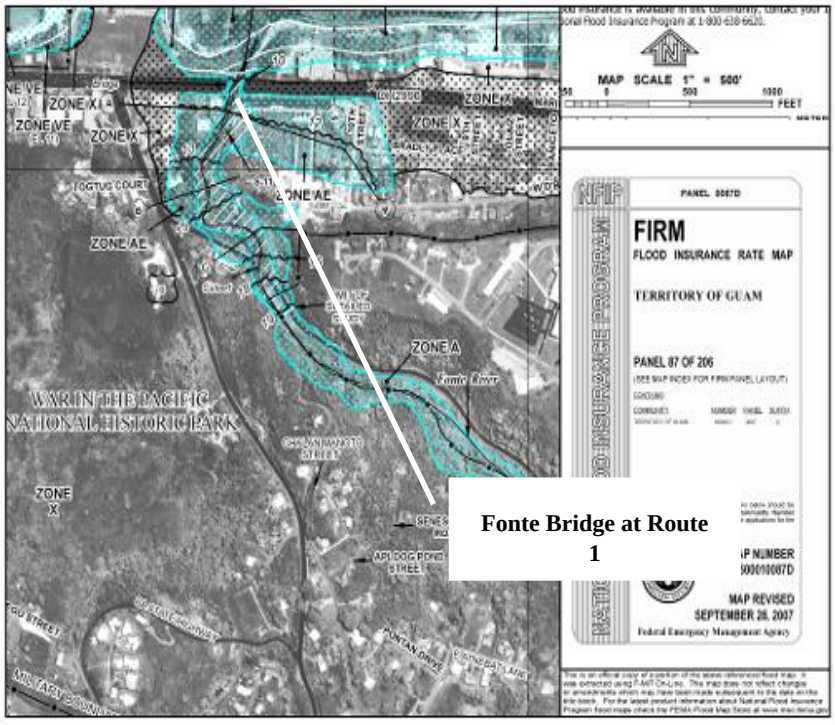


Figure 4.1-21. FEMA Map of Fonte Floodway

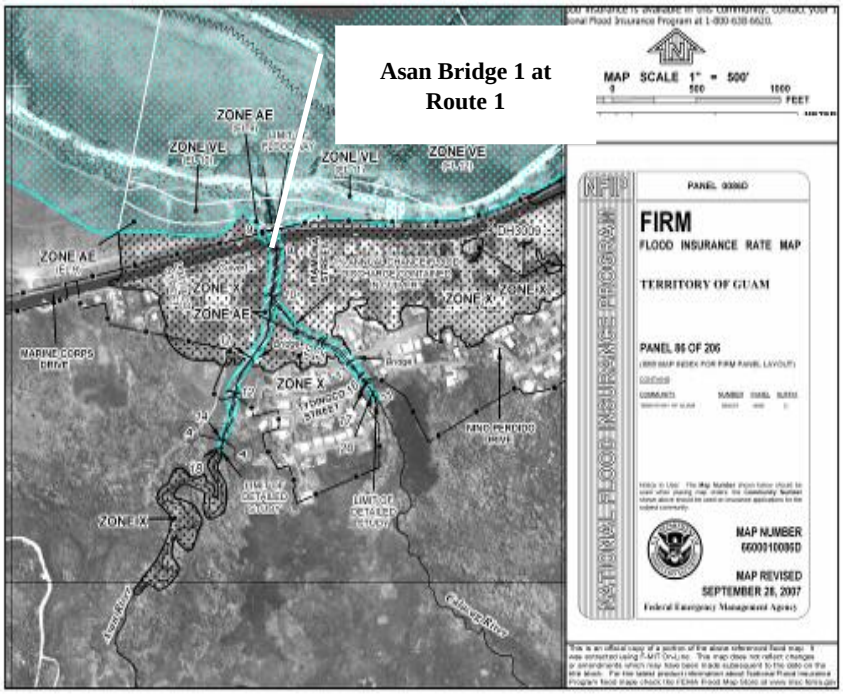


Figure 4.1-22. FEMA Map of Asan Floodway

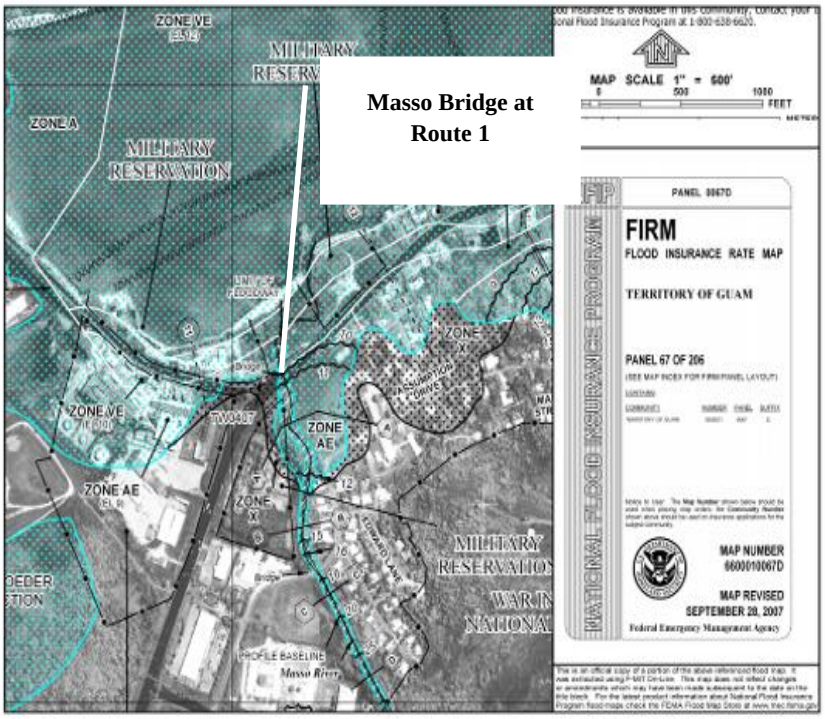


Figure 4.1-23. FEMA Map of Masso Floodway

Field investigations indicate the following issues for the various bridges:

- Agana Bridge – This concrete structure spans 42 ft (13 m) over the Agana (Hagatna) River for a length of 87 ft (26 m) under Route 1 and shows signs of decay through severe cracking, delamination, and spalling of concrete. Erosion along the abutments was apparent on the upstream side of the bridge.
- Fonte Bridge – This five-span concrete-frame structure spans 78 ft (24 m) over the Fonte River for a length of 100 ft (30 m) under Route 1. Hairline vertical cracks are located on the pier walls with some delamination, spalling, and exposed rebar shown in some of the piers on the downstream side.
- Asan Bridge #1 – This four-barrel concrete box culvert spans 48 ft (15 m) over the Asan River for a length of 68 ft (21 m) under Route 1. Spalling of concrete is apparent with exposed rebar at several locations. The downstream channel is unlined and shows little erosion along the vegetated embankments.
- Asan Bridge #2 – This two-barrel concrete box culvert spans 30 ft (9 m) over the Asan River for a length of 106 ft (32 m) under Route 1. Erosion is evident at the corners of the upstream and downstream headwalls.
- Masso Bridge – This three-barrel concrete box culvert spans 30 ft (9 m) over the Masso River for a length of 87 ft (32 m) under Route 1. Debris is dense downstream of the culvert, causing an apparent backwater effect on the culvert. Erosion has occurred along the concrete floor, and minor cracking is apparent in the interior and exterior walls.
- Sasa Bridge – This single-span box-girder bridge spans 46 ft (14 m) over the Sasa River for a length of 82 ft (25 m) under Route 1. While the bridge is in good condition, significant debris was visible throughout and upstream of the structure most likely due to utility lines crossing underneath the bridge.
- Laguas Bridge – This single-span box-girder bridge spans 46 ft (14 m) over the Laguas River for a length of 81 ft (25 m) under Route 1. The bridge exhibits moderate cracking and spalling in the beams and scour in the north abutment. The bottom of the channel upstream of the bridge had been removed of vegetation, increasing erosion potential along the channel bottom.
- Agueda Bridge – This three-barrel concrete box culvert spans 27 ft (8 m) over the Agueda River for a length of 81 ft (25 m) under Route 1. Downstream obstructions have produced backwater effects upstream of the culvert, since at the time of inspection, the culvert openings were inundated. Erosion was apparent at the upstream wingwalls.
- Atantano Bridge – This three-span cast-in-place concrete T-beam structure spans 46 ft (14 m) over the Atantano River for a length of 81 ft (25 m) under Route 1. Abutment settlement, cracking of the pier walls and deck and spalling at the deck corners is apparent. Vegetation along the channel embankment is thick with some apparent erosion under the high water mark, leaving the embankments unlined at several locations. Here the embankment exhibits relatively steep slopes which could lead to additional erosion along the upstream segment.

As shown in Figure 4.1-19 through Figure 4.1-23 , Route 1 parallels the coastline from Apra Harbor northward to Agana Bay. Along this section of roadway, several locations are designated within FEMA Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or riprap slope protection. Figure 4.1-24 and Figure 4.1-25 show areas along Route 1 within the coastal flood zone and where coastal erosion control has been used along the embankment in the form of riprap revetment. The only waterbody

within this area listed as impaired on the federal 303(d) list is the Agana River, which is listed for bacteria. The Agana River, also referred to as the Hagatna River, drainage basin extends from the Hagatna Swamp to Agana (Hagatna) Bay and is subject to flooding during moderate to heavy rain. The flooding is primarily attributed to the limited capacity of the Agana River due to the small capacity of the river and relatively flat topography. Flooding that is a natural occurrence on the Agana River has become a greater problem because of recent development in the watershed, especially in the downstream watershed area of the Hagatna Swamp (located immediately east of Route 1). During high flows, flood waters exceeding the storage capacity of the swamp fan out over the flat basin floor in a north-northwest direction toward the downtown area of Hagatna. The estimated flow at which flooding and subsequent damage occur is approximately 900 cubic feet per second. The capacity of the bridge under Route 1 is estimated to be approximately 2,700 cubic feet per second (Figure 4.1-26). Erosion along the upstream side of the bridge is readily apparent and should be addressed in the future to reduce downstream sediment deposition that is a continual issue along the shoreline. Sediments have been found to contain heavy metals, such as copper and zinc, in Agana (Hagatna) Bay. There are no areas subject to the Coastal Barrier Act in the vicinity of the roadway projects in this area, nor is there any surface waters listed as "National Wild and Scenic Rivers". Coastal resources within this area include (1) Agana Bay, located at the outlet of the Agana River and Tamuning Drainageway; (2) Asan Bay, located at the outlet of the Asan River; and (3) Piti Bay, located at the outlet of the Masso and Taguag Rivers. These areas are within the Coastal Zone Management Program (GEPA 2000) and fall under Section 309 of the CZMA which evaluates and regulates dredging activities within the harbors and bays of Guam. The affected environment for wetlands (marine and terrestrial) in this area is discussed under the Biological Resources sections of this EIS/OEIS.

Figure 4.1-24. Coastal Erosion Protection along Route 1

Figure 4.1-25. Coastal Erosion Protection along Route 1

Figure 4.1-26. Agana River Bridge at Route 1 - Upstream

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.1.4 Apra Harbor

4.1.4.1 Harbor

Apra Harbor is the largest U.S. deepwater port in the western Pacific and the busiest port in Micronesia. The harbor is the only deep lagoon on Guam and is enclosed on its north and northwest sides by the Glass Breakwater and on its southwest by Orote Peninsula. There are four distinct areas of the harbor: (1) Outer Apra Harbor, deep water with direct access to the Philippine Sea at Orote Point, (2) GovGuam-dredged Commercial Port, (3) Sasa Bay located north of Polaris Point, and (4) Inner Apra Harbor. The Outer Harbor extends from Polaris Point and the Ship Repair Facility (SRF) wharves north and westward to Orote Island and the tip of the Glass Breakwater. GovGuam commercial port is located at the northeast extent of the outer harbor. The Inner Harbor extends from Abo Cove northward to Polaris Point and the SRF wharves. More detailed information on Apra Harbor is provided in Volume 2, Chapter 14, Marine Transportation.

Surface Water

Four rivers flow into Apra Harbor (Atantano, Sasa, Laguas, and Aguada), with one emptying into Inner Apra Harbor (Atantano River), and the other three emptying into Sasa Bay (Figure 4.1-27).

Groundwater

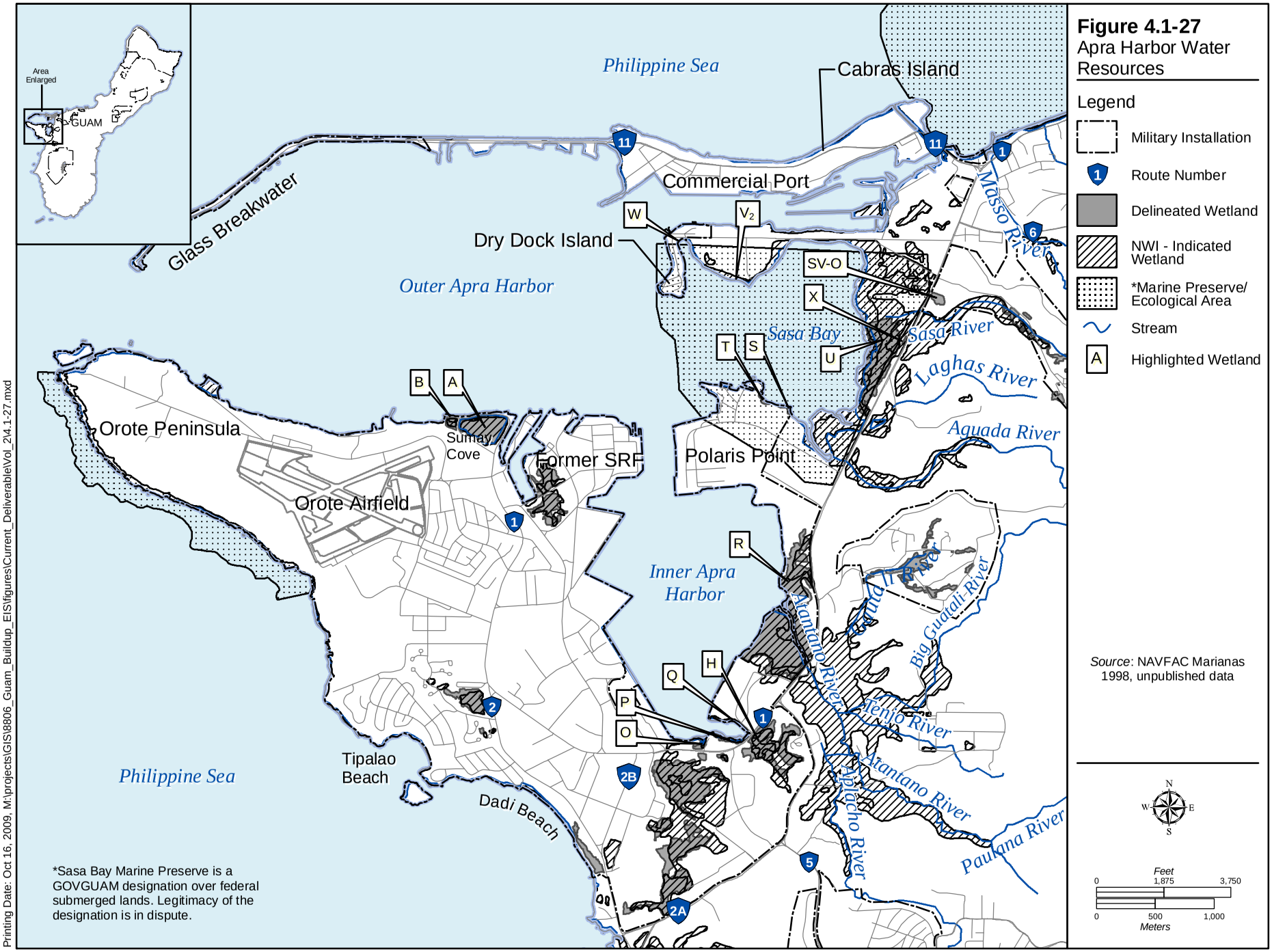
Apra Harbor is located over 4 mi (7 km) west of the NGLA and is not located within the groundwater protection zone (GEPA 2001).

Nearshore Waters

Nearshore Water Quality

At or near Apra Harbor, ship repair, petroleum, oil and lubricants (POL) transfer and storage, and electricity generation have been ongoing for years, while an oil refinery had been operating nearby in the 1970s. The Navy re-supplied nuclear submarines and other surface ships at Apra Harbor, operated dry cleaning and printing plants, treated building materials with preservatives, transferred munitions and weapons, etc. Many of these activities continue and are now carefully regulated to control pollutants but this was not the case before environmental protection laws and regulations were passed beginning in the 1970s. Industrial activities currently located near or within harbor areas include vehicle and ship repair/maintenance, marine cargo handling, power production, and fuel transfer and storage.

Outer Apra Harbor is a deep (>100 ft [30 m]) lagoon characterized by little variation in temperature, salinity, pH and nutrients, while particulates (total suspended solids, turbidity and chlorophyll) are more variable. Water quality conditions within the Outer Harbor are representative of well-mixed open coastal waters showing little spatial variation in temperature, salinity and pH. Surface water flow is generally westward but will vary as a function of wind direction. By contrast, subsurface waters tend to flow in an easterly direction. In general, currents within the harbor are primarily wind driven during trade wind conditions, and characterized by an opposing two-layer flow pattern. This two-layer flow results from the movement of the surface layer out of the harbor (westward) being balanced by an inward moving (eastward) deeper layer. Outhouse Beach, Family Beach, and Port Authority Beach on Cabras Island in northern Apra Harbor are impaired due to bacteria, with >10% of samples exceeding GWQS. Outer Harbor waters appear to have little influence from terrestrial runoff as indicated by low nutrient concentrations and particulate levels (USACE 2007).



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In November 2008, a Finding of Violation was issued for Apra Harbor Wastewater Treatment Plant for noncompliance with NPDES permitting specifications (NPDES Permit No. GU0110019). According to the Finding, required self-monitoring reports submitted by the Navy demonstrated that, since at least April 2005, established effluent limitations were exceeded on numerous occasions for both outfalls 001 and 002, including those established for copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids (USEPA 2008).

Marine Sediment

Marine surveys conducted in the Inner Apra Harbor in 2003 (COMNAV Marianas 2006) reported an "extreme permanent sediment load" in the water column that accounts for very little or no colonization of the harbor bottom. Sediment accumulation is attributed to accelerated soil erosion in the Sasa Watershed and shoreline erosion of the Inner Apra Harbor shoreline. Underwater visibility during the marine surveys was generally <10 ft (3 m) and frequently <1 ft (0.3 m). When ships are underway in the inner harbor, visibility is reduced to zero over substantial sections of the inner harbor. The resuspended sediment settles very slowly due to a very fine particle size (COMNAV Marianas 2006).

Marine Sediment Quality

Sediment quality investigations in Inner and Outer Apra Harbor were conducted at three locations at Apra Harbor in 2006. The sites were being considered as potential locations for berthing an aircraft carrier. The three sites were: 1) former Charlie Wharf located at Polaris Point east of the Inner Apra Harbor Channel in Outer Apra Harbor, 2) northern coastline of the former SRF area, located west of Inner Apra Harbor Channel entrance in Outer Apra Harbor, and 3) Sierra Wharf on the western edge of Inner Apra Harbor (NAVFAC Pacific 2006). The Charlie, Sierra and SRF Wharf Sediment Characterization Study was conducted to facilitate selection of an appropriate site for construction of a new deep water wharf in Apra Harbor, Guam. This reconnaissance level effort was performed consistent with guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991). The purpose of the study was to delineate the distribution and magnitude of chemicals of potential concern within the material to be dredged from these three potential wharf sites. Subsequent to the 2006 sediment study, the aircraft carrier berthing alternatives were limited to the two Outer Apra Harbor areas on either side of the Inner Apra Harbor Channel, as described in Volume 4 of this EIS/OEIS. Although Sierrra Wharf is no longer a viable alternative for the aircraft carrier berthing, wharf improvements and dredging in this area are required to support the proposed Marine Corps amphibious training escort ships, as described in Chapter 2, Volume 2 (this volume) of this EIS/OEIS..

Charlie Wharf is a term used in the sediment characterization report to describe the northern shoreline area of Polaris Point adjacent to Bravo Wharf. However, there is no wharf present at the site though remnants of a wharf or mooring are present in the water. This area is the preferred location for the aircraft carrier wharf described in Volume 4 of this EIS/OEIS. Water depths in this area range from -20 to -80 ft (-6 to -24 m) mean lower low water (MLLW). The SRF site is the alternative site for the aircraft carrier wharf described in Volume 4 of this EIS/OEIS. Water depths in this area range from -20 to -73 ft (-6 to -22.3 m) MLLW, with the exception of a shallow reef that lies immediately north of the site. Sierra Wharf is a 1,986 ft (605 m) long wharf and water depths in this area range from -20 to -40 ft (-6 to -12 m) MLLW.

Sediment core samples were collected at multiple locations within the dredging footprints for the three dredging areas (Figure 4.1-28). The number of samples and the compositing of samples within geographic areas were consistent with common practice for USACE dredging permit applications for Hawaii and Guam dredging projects. Within nine geographic areas (Table 4.1-3), the core samples were composited

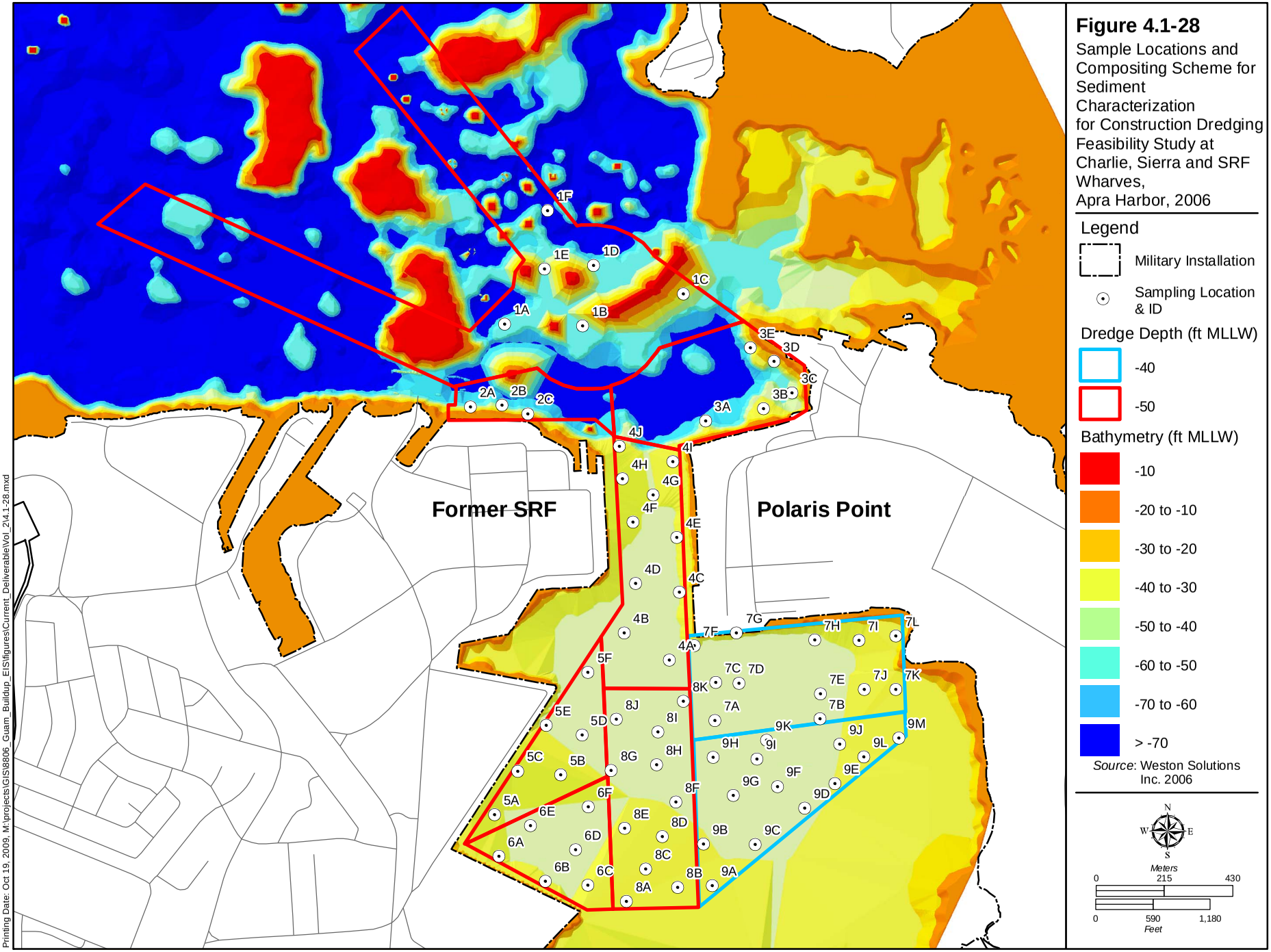

Figure 4.1-28

Sample Locations and Compositing Scheme for Sediment Characterization for Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves, Apra Harbor, 2006

Legend

- Military Installation
- Sampling Location & ID

Dredge Depth (ft MLLW)

- -40
- -50

Bathymetry (ft MLLW)

- -10
- -20 to -10
- -30 to -20
- -40 to -30
- -50 to -40
- -60 to -50
- -70 to -60
- > -70

Source: Weston Solutions Inc. 2006

N W E S

Meters
0 215 430

0 590 1,180
Feet

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Table 4.1-3. Sediment Sampling Summary Table

Analyte	*ER-L/ ER-M*	*Composite*							
		Outer Apra Harbor			*Inner Apra Harbor*				
		1	*2*	*3*	*4*	*5*	*6*	*8*	*9*
TOC (%)		0.13	0.17	0.5	0.16	0.64	0.66	0.72	0.75
Arsenic	8.2/70	3.76	3.76	7.55	4.14	6.80	7.52	**8.76**	**10.10**
Cadmium	1.2/9.6	0.27	0.15	0.10	0.08	0.06	0.04J	0.03J	0.06
Chromium	81.0/370	11.50	13.30	53.90	15.3	57.30	77.00	77.10	**98.3**
Copper	34.0/270	4.85	23.60	17.90	12.4	19.60	29.20	33.00	48.1
Lead	46.7/218	4.08	18.60	8.71	9.35	2.57	3.42	6.20	12.6
Mercury	0.15/0.71	0.04	0.12	0.05	0.1	0.02	0.03	0.05	0.1
Nickel	20.9/51.6	4.91	5.41	**21.50**	**5.42**	**27.70**	**39.10**	**38.30**	**47.8**
Silver	1.0/3.7	<0.025	<0.025	<0.025	<0.025	0.03J	0.04J	0.05	0.06
Zinc	150/410	6.96	24.80	26.80		20.20	26.80	32.30	
Total PAH	4022/ 44792	34.00	1115.10	129.30		29.40	73.80	57.70	
Arochlor 1260	-	<10	22.2	<10		<10	<10	<10	

Legend: **BOLD**= Concentration exceeds ER-L; <= Below method detection limit; J= Analyte detected at concentration below the reporting limit and above method detection limit. Reported value is estimated.
Source: NAVFAC Pacific 2006.

and the composited samples were analyzed. Composites 1 (six sample locations) and 2 (three sample locations) were representative of the area to be dredged for aircraft carrier turning basin and berthing at the SRF area (see Figure 4.1-28); Composites 1 (six sample locations) and 3 (five sample locations) are representative of the area to be dredged for aircraft carrier turning basin and berthing at Charlie Wharf (Polaris Point); and Composites 4 (ten sample locations), 5 (six sample locations), 6 (six sample locations), 7 (12 sample locations), 8 (11 sample locations) and 9 (13 sample locations) (see Figure 4.1-28) are representative of the proposed dredged area at Sierra Wharf (NAVFAC Pacific 2006).

The following paragraphs summarize the results from each of these sampling areas. Refer to the source document for additional details and data (NAVFAC Pacific 2006). The results of the sediment quality analysis indicate that, with the exception of Area 3 adjacent to Charlie Wharf (see Figure 4.1-28), sediments in Outer Apra Harbor (Areas 1 and 2) were coarser-grained and comprised predominantly of a gravelly sand. In Area 3 and all the Inner Apra Harbor Areas, material was predominantly composed of a finer-grained, silty clay material.

Chemical analyses were conducted according to USEPA and American Society for Testing and Materials standards. The results were compared to Effects Range-Low (ER-L) and Effects Range-Median (ER-M) values, and regulatory levels or total threshold limit concentration values (TTLC). The ER-L value represents the concentration below which adverse effects rarely occur and the ER-M value represents the concentration above which adverse effects frequently occur. Samples or study areas in which many chemicals exceed the ER-M values and exceed them by a large degree may be considered more contaminated than those in which none of the sediment quality guidelines (SQGs) were exceeded. Samples in which ER-L concentrations are exceeded, but no ER-M values are exceeded, may be given intermediate ranks. The effects range values are helpful in assessing potential significance of elevated test results related to biological impacts. The ER-L and M values were developed from a large data set of benthic organism effects. ER-L represents the lower 10^{th} percentile of observed effects concentration and ER-M represents the 50^{th} percentile of the observed effects concentrations. These values are useful in identifying sediment contaminants but actual biological testing would be conducted as part of the testing

required for ODMDS disposal. General chemistry parameters (i.e., total organic carbon (TOC), ammonia, sulfides, oil and grease and total recoverable petroleum hydrocarbons) do not have ER or TTLC values.

In general, sediment contamination was low throughout all the areas sampled. Special handling of dredged material would not be required and it is likely that the dredged material would meet the testing requirements for ocean disposal. None of the composite samples exceeded any of the ER-M values. Three (Composites 1, 2 and 4) of the nine samples did not exceed any of the ER-L values. There were minor exceedences of the ER-L values in the remaining six composites for nickel (Composites 3, 5, and 6), copper (Composites 7 and 8), and arsenic (composite 8). Nickel occurs naturally in the environment and these exceedances are not expected to classify the dredged material as unsuitable for ocean disposal.

Other analytes detected at levels lower than the ER-L included polyaromatic hydrocarbons and Arochlor-1260 (polychlorinated biphenyl (PCB) in Composite 2 and tributyltin in Composite 4. All other analytes (e.g., PCBs (aroclor and individual congeners), chlorinated pesticides, organotins, phenols, phthalates were non-detect or reported at less than the laboratory detection limits. Composite 3 had the lowest ammonia level and Composite 6 had the highest. Composite 2 had the lowest total sulfides levels and Composite 7 had the highest (NAVFAC Pacific 2006).

The results from this study, when compared to other recently conducted dredged material evaluations in Apra Harbor, provide sufficient information to suggest the sediments would be deemed suitable for ocean disposal or upland placement, assuming a preferred beneficial use option was not available and that no special handling of dredged material would be required.

Additional sediment and bioassay/bioaccumulation testing was conducted on Apra Harbor sediments in the project area in 2007 as part of the Tier III Analysis Evaluation to support various construction and dredging projects that were proposed in the harbor. The tiered approach is consistent with federal procedures to implement requirements in the CWA § 404(b)(1) Guideline for evaluation of potential contaminant-related impacts associated with the discharge of dredged material in fresh, estuarine, and saline (near-coastal) waters. The tiered approach involves four levels of testing, which are summarized below.

Tier I - Involves an examination of existing information to determine (1) whether or not there is "reason to believe" that the material needs to be tested for potential adverse effects, and (2) identification of any contaminants of concern relative to testing in later tiers. Material may be excluded from further testing if there is reasonable assurance that (1) it is not a carrier of contaminants, or (2) it is adjacent and similar to the disposal site material, and dispersal of the discharge can be controlled. Some limited testing may be necessary to confirm such exclusions.

Tier II - Is concerned solely with sediment and water chemistry. Tier II provides useful information through screening tools, but not all possible determinations can be reached at this tier. It presently consists of (1) measuring dissolved contaminants, (2) evaluation of state WQS compliance using a numerical mixing model, and (3) an evaluation of theoretical bioaccumulation potential for nonpolar organic chemicals.

Tier III - Employs well-defined, nationally accepted bioassays including: (1) water column laboratory toxicity tests, (2) whole sediment laboratory toxicity tests, and (3) whole sediment bioaccumulation tests. Appropriately sensitive organisms are recommended, including benchmark species for evaluating the sensitivity of regional species. Summaries of test conditions and test acceptability criteria for all recommended bioassay species are also provided. Toxicity testing emphasizes acute responses, generally survival. Water column toxicity evaluations consider mixing of the dredged material at the discharge site.

Benthic bioaccumulation testing provides for the determination of bioavailability through 28-day exposure tests. Tier III testing will usually provide sufficient information for use in the overall decision-making process for compliance with the Guidelines.

Tier IV - Is only used in special cases, where results from tests in earlier tiers are insufficient to determine the potential adverse effects of the material to be discharged. Tier IV, like Tier III, uses toxicity and bioaccumulation tests, however: (1) toxicity tests may involve field (rather than laboratory) exposures, different end-points (e.g., chronic rather than acute), different species, or longer laboratory exposures; (2) bioaccumulation tests may involve field (rather than laboratory) exposures using transplanted or resident organisms, or longer laboratory exposures. Tier IV can also include benthos studies.

For this evaluation samples were collected from the outer harbor near Kilo Wharf and in the inner harbor near Sierra and X-Ray Wharves. The samples were analyzed for grain size, bulk sediment chemistry and toxicity. Samples collected in the vicinity of Sierra Wharf under the Tier III testing program overlapped with areas proposed for dredging under the Marine Corps relocation to Guam. Specifically, Composites C, D and E of the Tier III testing program were located in the area proposed for dredging for the Marine Corps relocation to Guam and are considered representative of the material proposed for dredging. The results of the Tier III testing program for these composite samples are described in detail in the following paragraphs.

The results of the grain size analysis indicated that sediments in the vicinity of Sierra Wharf ranged from 42.4 to 87.1 percent fine-grained materials throughout the site.

The samples collected in the various proposed project areas were composited and submitted for bulk chemistry analyses and compared to NOAA ER-L and ER-M values. Analytes included, metals (including tribultyl tin [TBT]), PCBs, pesticides and polyaromatic hydrocarbons (PAHs).

The results of the bulk chemistry analyses on the samples collected from Sierra Wharf contained detectable concentrations of metals, total PCBs, pesticides and PAHs. The results of the bulk chemistry analysis of Composites C, D and E samples are summarized in Table 4.1-4.

Table 4.1-4. Results of 2007 Apra Harbor Bulk Sediment Chemistry Analysis Sampling Summary

Analyte	*ER-L*	*ER-M*	*Comp C*	*Comp D*	*Comp E*
METALS (ppm)					
Arsenic (As)	8.2	70	7.9	7.7	8.5
Cadmium (Cd)	1.2	9.6	0.3	0.2	0.4
Chromium (Cr)	81	370	48.1	42.6	92.7
Copper (Cu)	34	270	59.5	27.9	37.6
Lead (Pb)	46.7	218	91.0	9.2	91.0
Mercury (Hg)	0.15	0.71	0.25	0.08	0.25
Nickel (Ni)	20.9	51.6	18.6	19.2	23.7
Zinc (Zn)	150	410	69.0	25.5	144.4
TOTAL PCBs (ppb)	22.7	180	276.1	11.3	155.5
PESTICIDES (ppb)					
4,4' DDD	2	20	<1	<1	125.0
4,4'-DDE	2.2	27	5.0	<1	58.8
Total DDTs	1.58	46.1	5.0	0.0	183.8
PAHs (ppb)					
Acenaphthene	16	500	1.58J	<1	3.67J
Acenaphthylene	44	640	9.4	2.45J	43.8
Anthracene	85.3	1100	20.1	5.8	72.9

Analyte	*ER-L*	*ER-M*	*Comp C*	*Comp D*	*Comp E*
Benz[a]anthracene	261	1600	24.8	11.4	208.0
Benzo[a]pyrene	430	1600	159.2	22.0	1050.6
Benzo[b]fluoranthene	-	-	148.0	21.4	983.0
Benzo[e]pyrene	-	-	79.6	16.3	566.2
Benzo[g,h,i]perylene	-	-	79.8	19.3	465.6
Benzo[k]fluoranthene	-	-	156.0	21.1	925.7
Chrysene	384	2800	35.2	18.0	390.3
Dibenz[a,h]anthracene	63.4	260	20.6	6.1	146.3
Fluoranthene	600	5100	18.9	11.8	106.6
Fluorene	19	540	<1	<1	3.2J
Indeno[1,2,3-c,d]pyrene	-	-	107.5	24.1	655.2
Naphthalene	160	2100	3.2J	<1	<1
Phenanthrene	240	1500	6.8	2.6J	13.6
Pyrene	665	2600	69.4	14.5	317.6
Total Detectable PAHs	4022	44792	984.4	202.4	6171.5

Composite C

The Composite C sample was predominantly fine-grained material consisting of 26.3% silt and 33.1% clay (Table 3-2). The coarse-grained fraction consisted of 9.2% gravel and 31.5% sand. The sediment was classified as an inorganic fat clay (CH).

The sample contained 0.64% TOC. Oil and grease and TRPH were not detected in the sample.

Only three metals were detected at concentrations slightly above their ER-L values, including copper (measured concentration of 59.5 milligrams per kilogram (mg/kg), with an ER-L of 34 mg/kg), lead (measured concentration of 91.0 mg/kg, with and ER-L of 46.7 mg/kg) and mercury (measured concentration of 0.25 mg/kg, with and ERL of 0.15 mg/kg). All remaining metals were detected below ER-L values, with concentrations ranging from 0.3 mg/kg for cadmium to 69.0 mg/kg for zinc. All individual PAHs were measured at concentrations below their ER-L values. Total detectable PAHs were calculated at a concentration of 984.4 µg/kg, well below its ER-L value of 4,022 µg/kg. Only one chlorinated pesticide was detected; 4,4'-DDE was measured at a concentration of 5.0 µg/kg which was above its ER-L value of 2.2 µg/kg but well below its ER-M value of 27 µg/kg. Twenty-one individual PCB congeners were detected. Total PCBs (276.1 µg/kg) was calculated at a concentration above its ER-M (180 µg/kg). Aroclor 1254 and Aroclor 1260 had concentrations of 36.9 µg/kg and 76.6 µg/kg, respectively. TBT was measured at a concentration of 7.2 µg/kg (no sediment quality guidelines).

Composite D

The Composite D sample was composed predominantly of fine-grained material (67.1%) with 26.7% silt and 40.4% clay (Table 3-2). The remaining 32.9% coarse-grained material consisted of 6.5% gravel and 26.4% sand. The sediment was classified as an inorganic fat clay (CH).

TOC in the sample was 0.60%. Oil and grease and TRPH were not detected in the sample. None of the metals' concentrations were above their respective ER-L values. Concentrations of metals ranged from 0.08 mg/kg for mercury to 42.6 mg/kg for chromium. Several PAHs were measured, but all were at concentrations below their respective ER-L values. Total detectable PAHs were below the ER-L value (4,022 µg/kg) with a concentration of 202.4 µg/kg. Six individual PCB congeners were measured, but were at concentrations below the MRL and total detectable PCBs were calculated at a concentration of 11.3 µg/kg, below its ER-L value of 22.7 µg/kg. The concentration of TBT was determined to be 3.5 µg/kg. Chlorinated pesticides and Aroclor PCBs were not detected in the sample.

Composite E

The composite E sample consisted 51.9% fine-grained and 48.2% coarse-grained material.

The fine-grained fraction consisted of 21.1% silt and 30.8% clay; the coarse-grained fraction consisted of 10.2% gravel and 38.0% sand (Table 3-2-1). The sediment was classified as an inorganic fat clay (CH).

The sample contained 0.52% TOC. Oil and grease and total recoverable petroleum hydrocarbon were not detected in the sample. Cadmium (0.4 mg/kg) and zinc (144.4 mg/kg) were detected at low concentrations below their respective ER-L values. All remaining metals were detected at concentrations slightly above their respective ER-L values; no metals were detected above their respective ER-M values. The PAHs, benzo[a]pyrene, chrysene and dibenz[a,h]anthracene were detected above their ER-L values with concentrations of 1,050.6 µg/kg, 390.3 µg/kg and 146.3 µg/kg, respectively. Total detectable PAHs were also calculated above the ER-L value with a concentration of 6,171.5 µg/kg. The DDT derivatives, 4,4'-DDE and 4,4'- DDD were detected above their ER-M values at concenctrations of 58.8 µg/kg and 125.0 µg/kg, respectively. Total detectable DDTs, therefore, were also above the ER-M value (46.1 µg/kg) with a concentration of 183.8 µg/kg. Sixteen individual PCB congeners were detected and two Aroclors(Aroclor 1254 [33.5 µg/kg] and Aroclor 1260 [49.0 µg/kg]) were detected. Total detectable PCBs were calculated at a concentration of 155.5 µg/kg, above the ER-L value of 22.7 µg/kg but below the ER-M value of 180 µg/kg. TBT was the only organotin detected, having a concentration of 11.2 µg/kg. Phenols were not detected in the P-436E composite sample.

Toxicity Testing of Composites C, D and E

Solid phase toxicity tests were conducted on elutriate samples derived from Composites C, D and E project sediment and site water. This test determines the bioavailability of chemicals in sediment by exposing test organisms directly to sediment suspended in solution. Results from these tests showed no toxic effect to test organisms. Based on the results of these bioassay tests, the proposed dredged material was recommended as suitable for ocean disposal.

Solid phase toxicity tests were conducted on project sediments Composites C, D and E. Results from these tests showed no toxic effect to test organisms exposed to Composites D and E sediment. Toxic effects were observed in amphipods (A. abdita), but not marine polychaetes (N. arenaceodentata), exposed to Composite C sediment. Based on the results of these bioassay tests, proposed dredged material from Composite D and E areas were recommended as suitable for ocean disposal. Proposed dredged material from the Composite C area was technically not suitable for ocean disposal based on criteria outlined in the Ocean Testing Manual (USEPA and USACE 1991). However, it was recommended that this material be considered for ocean disposal because it only failed to meet the limiting permissible concentration (LPC) requirements by one percentage point in one SP test (i.e., survival of amphipods was 70% and was 21% lower than survival in control sediment, 91%).

Bioaccumulation potential tests were conducted on tissues from organisms exposed to composite project area sediments. Elevated tissue concentrations in Composites D and E were compared to Environmental Residual Effects Database (ERED) and critical body residue data. All comparisons to contaminant concentrations in tissues from organisms exposed to project composite sample sediments were below published relevant effect levels. In addition, none of the chemicals in project area composite samples that were measured above concentrations in tissues from reference test organisms have a tendency to biomagnify in marine food webs, with the exception of PCBs in the areas of Composites C and E. Based on the results of the BP tests on tissues from organisms exposed to project sediments the proposed dredged material was recommended as suitable for ocean disposal.

Implications to Current Sediment Quality

Generally speaking, contaminant concentrations obtained under the most recent sediment testing program conducted within the areas proposed for dredging for the Marine Corps relocation to Guam were similar to or less than those obtained during the Tier III study. Nickel was the only sediment contaminant concentration that was substantially higher in the most recent sediment testing program. Since the material from the Tier III testing program was either deemed suitable for ocean disposal or recommended to be considered for ocean disposal it is likely that, based on the most recent bulk chemistry testing results, the material proposed for dredging under the Marine Corps relocation project would also be suitable for ocean disposal and would not require any special handling. However, there will be additional sampling and analysis within the dredged area to support the USACE permit application and the dredged material management plan.

Wetlands

The wetland areas of the Waterfront Annex and Fleet and Industrial Supply Center (FISC) were originally delineated and mapped in 1998 (NAVFAC Marianas 1998). In March, May, and September 2007, biologists revisited the wetlands areas delineated in 1998 and found that the 1998 boundaries have not changed in most locations (NAVFAC Marianas 2009).

Based on the original 1998 survey and the recent 2007 survey, there are approximately 343 ac (139 ha) of wetlands in 48 separate wetlands within and adjacent to Apra Harbor and Naval Base Guam. These wetlands range in size from 0.04 to 88.73 ac (0.02 to 35.90 ha). In addition, there is a large 100-ac (40.5-ha) wetland complex in Camp Covington. Figure 4.1-27 presents the approximate locations of potential wetland areas and delineated wetland areas as delineated in 2007 (NAVFAC Marianas 1998, 2009) in accordance with the 1987 Wetland Delineation Manual (USACE 1987) and as indicated by USFWS NWI maps (USFWS 2009). The 2007 wetland delineations have not been certified by the USACE.

Of the wetland areas presented in Figure 4.1-27, certain wetland areas (those designated with an alpha code) are discussed in site-specific detail due to their proximity to the proposed action alternatives. The other wetland areas, while in the project area, are not discussed in detail as they are not likely to be directly or indirectly impacted under the proposed action alternatives. Wetland areas adjacent to Apra Harbor are discussed in the following paragraphs; those located on Naval Base Guam are discussed in Section 4.1.4.2, Wetlands.

Wetlands A and B (see Figure 4.1-27) are located on the southern shore of Outer Apra Harbor. Wetland A is a 17.88-ac (7.23-ha) lacustrine, limnetic, permanent open water, diked/impounded wetland. Wetland B, separated to the west of Wetland A by a roadway berm, is a 1.97-ac (0.79-ha) palustrine, open water, permanent, diked/impounded wetland (NAVFAC Marianas 1998, 2009).

Wetlands O, P, Q, and R are located on the southern and eastern shores of Inner Apra Harbor. Wetland O, located at the southernmost extent of Inner Apra Harbor, is a 1.65-ac (0.67-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal water regime wetland. Wetland P, located along the southern shore of Abo Cove, is a 2.00-ac (0.81-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal regime wetland. Wetland Q, located along the northern shore of Abo Cove is a 2.53-ac (1.02-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal regime wetland. Wetland R, commonly known as the Atantano Wetlands, is located along the eastern shore and inland of Inner Apra Harbor and consists 88.73 ac (35.90 ha) of various wetland types. The Atantano Wetlands encompass the mouth of the Atantano River, which drains the Guatali, Tenjo, and Alpacho Rivers, and have been cited as containing the best developed and most mature mangrove swamp on Guam. The most

dominant classification is estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland, consisting of 54.75 ac (22.16 ha) (NAVFAC Marianas 1998, 2009).

Wetlands T, S, U, W, and V2 are located along the shores and inland of Sasa Bay. Wetland T, located inside the southern shore of Sasa Bay, consists of 1.09 ac (0.44 ha) of estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland S, located just east of Wetland T, consists of 1.45 ac (0.59 ha) of estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland U is located in and adjacent to the eastern shoreline of Sasa Bay and consists of 37.80 ac (15.30 ha) of predominantly estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland W, located at the top of a small inlet in the north of Sasa Bay, consists of 0.24 ac (0.10 ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland V2 is located along and adjacent to the northern shore of Sasa Bay and consists of a 3.23-ac (1.31-ha) of predominantly estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland (NAVFAC Marianas 1998, 2009).

The aforementioned delineated highlighted wetlands located in and adjacent to Apra Harbor total 158.57 ac (64.16 ha) and represent a range of wetland classifications. Table 4.1-5 presents a summary of the delineated wetland areas located in and adjacent to Apra Harbor. In addition, areas south of Apra Harbor extending just past the existing landfill and along Apra Harbor up to Agana Bay are part of an additional investigation to verify presence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS.

Table 4.1-5. Summary of Wetland Areas in and Adjacent to Apra Harbor

Wetland Area	*Size (ac/ha)*
A	17.88/7.23
B	1.97/0.79
O	1.65/0.67
P	2.00/0.81
Q	2.53/1.02
R	88.73/35.90
T	1.09/0.44
S	1.45/0.59
U	37.80/15.30
W	0.24/0.10
V2	3.23/1.31
Total	158.57/64.16

Sources: NAVFAC Marianas 1998, 2009.

4.1.4.2 Naval Base Guam

Surface Water

The Atantano River transitions to the Atantano Wetlands in Naval Base Guam on its way to Inner Apra Harbor. In addition, there is a large 100-ac (40.5-ha) freshwater pond that contains both open surface water and a wetland complex in Camp Covington. Impervious areas on Naval Base Guam amount to 504 ac (204 ha), or 14.7% of the total Naval Base Guam area of 3,429 ac (1,388 ha).

Groundwater

Like the surrounding areas of south Guam, the low permeability of the aquifer materials preclude groundwater being pumped in any usable quantities, and Naval Base Guam is located over 4 mi (7 km) west of the NGLA.

Nearshore Waters

The south and west facing shores of the peninsula include beaches and rocky shoreline, and nearshore waters, including Tipalao Bay, Agat Bay, and Dadi Beach, that are used for recreation. Recent studies have shown that nearshore waters may be contaminated from chemicals found at the Orote Landfill. The Navy and GEPA are engaged in ongoing investigations and discussions to determine what actions are required to ensure protection of human health and the environment (GEPA 2006).

Wetlands

In addition to the overall wetlands discussion presented in Section 4.1.4.1, Apra Harbor, there are three wetland areas located on Naval Base Guam that warrant discussion: Wetlands H, X, and SV-O. Wetland H is located east of Abo Cove, on the inland side of Marine Drive and is part of the larger (100 ac [40.5 ha]) open surface water and wetland complex located in Camp Covington. Wetland H is approximately 24.7 ac (10 ha) and contains both estuarine and palustrine systems. Wetland X is located just to the east of Wetland U and Marine Drive. This small, 0.10 ac (0.04 ha) palustrine, emergent, persistent, seasonal water regime wetland extends parallel to Marine Drive along a Navy pipeline easement. Wetland SV-O, located at the southwestern corner of the FISC perimeter fence line and Marine Drive, is a 2.02 ac (0.82 ha) palustrine, emergent, persistent, seasonal water regime wetland (NAVFAC Marianas 1998, 2009). In addition, this area is a part of an additional investigation to verify presence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS

The aforementioned delineated highlighted wetlands located on Naval Base Guam total 124.80 ac (50.09 ha). Table 4.1-6 presents a summary of the delineated wetland areas on Naval Base Guam.

Table 4.1-6. Summary of Wetland Areas on Naval Base Guam

Wetland Area	*Size (ac/ha)*
H	100.00/40.5
X	24.7/10.00
SV-O	0.10/0.04
Total	**124.8/50.09**

Source: NAVFAC Marianas 1998, 2009

4.1.4.3 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.4.

The proposed GRN projects within the Apra Harbor Region include improvements along Routes 1, 2A, and 11. The large harbor at Apra covers more than 3 mi^2 (777 ha), and the Navy's Inner Apra Harbor encompasses approximately 1.4 mi^2 (263 ha). Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

Sasa Bay, which is the outlet for the Sasa, Laguas, and Aguada Rivers (that cross under Route 1 immediately upstream of the harbor [Figure 4.1-29]), is located along the shoreline of the large harbor. The Atantano River flows into the Inner Harbor, crossing under Route 1 immediately upstream of the inner harbor (Figure 4.1-30). Route 1 in this area is crowned with roadway runoff sheet flowing off the

pavement to swales that outlet into the rivers crossing the road to the harbor. FEMA Floodplain Mapping indicates that much of the Harbor is within FEMA Flood Zone A, defined as a 100-year flood hazard zone with no base flood elevations determined (Figure 4.1-31). Route 11 is the main entry to Apra Harbor, which is also shown to be within the flood zone. The Commercial Port Bridge along Route 11 crosses the Piti Canal at the edge of the flood zone. Figure 4.1-32 and Figure 4.1-33 display the downstream side of the bridge crossing where the canal is within the tidal zone. Here, the downstream canal is concrete lined for a short distance, where it transitions to riprap lining. Slight downstream erosion along the embankments has occurred. Route 11, located at the entry to Apra Harbor, is well protected from coastal erosion by grouted riprap revetment, as shown in Figure 4.1-34. The harbor is within the coastal zone and falls under the Coastal Zone Management Program (GEPA 2000) developed as part of the CZMA, Section 309, which evaluates and regulates dredging activities within the harbors and bays of Guam. It is not considered to fall within the Coastal Barrier Resources of 2000. There are no "National Wild and Scenic Rivers" in this area. The affected environment for wetlands (marine and terrestrial) in this area is discussed under the Biological Resources sections of this EIS/OEIS.

Figure 4.1-29. Route 1 at Laguas River Bridge

Figure 4.1-30. Route 1 at Atantano Bridge

Figure 4.1-31. FEMA Map of Apra Harbor Floodplain

Figure 4.1-32. Route 11 Bridge over Piti Canal

Figure 4.1-33. Piti Canal Downstream of Route 11

Figure 4.1-34. Coastal Erosion Protection along Route 11

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.1.5 South

4.1.5.1 Naval Munitions Site

Surface Water

Numerous rivers are located within NMS (Figure 4.1-35). The Fena Reservoir watershed and the Lost River watershed occupy the southern half and northern half, respectively, of NMS. All rivers flowing out of NMS merge outside of its boundary to the east into the Talofofo River, which flows to Guam's southeast coast where it empties into Talofofo Bay. With a size of 23 mi^2 (59.6 km^2), the Talofofo River watershed is the largest watershed on Guam and is partially regulated at the upper end of the drainage by the Fena Reservoir that also acts as a sediment trap and diversion for the island's drinking water supply (COMNAV Marianas 2008). Impervious areas on NMS amount to 548 ac (221.8 ha), or 6.34% of the total NMS area of 8,645 ac (3,499 ha).

Water Availability

The Fena Reservoir watershed is located in the western sector of the Talofofo River drainage area. It is composed of the Imong, Sadog Gago, Almagosa, and Maulap Rivers. Total drainage area at the Fena Reservoir dam spillway is 5.9 mi^2 (15.3 km^2) (Yeung 2004). It is a relatively hilly to very steep, undeveloped watershed, except for the Navy's munitions storage area. The watershed is composed of grass-covered hills and barren "Badlands" that drop into densely vegetated jungle ravines and gullies. The western part is a limestone karst terrain with a thin granular clayey cover. While it is probable that wetlands associated with the reservoir margin occur wherever water backing up behind the dam inundates a broad or low-sloping shore, much of the shoreline of lower Fena Reservoir consists of steep cliffs.

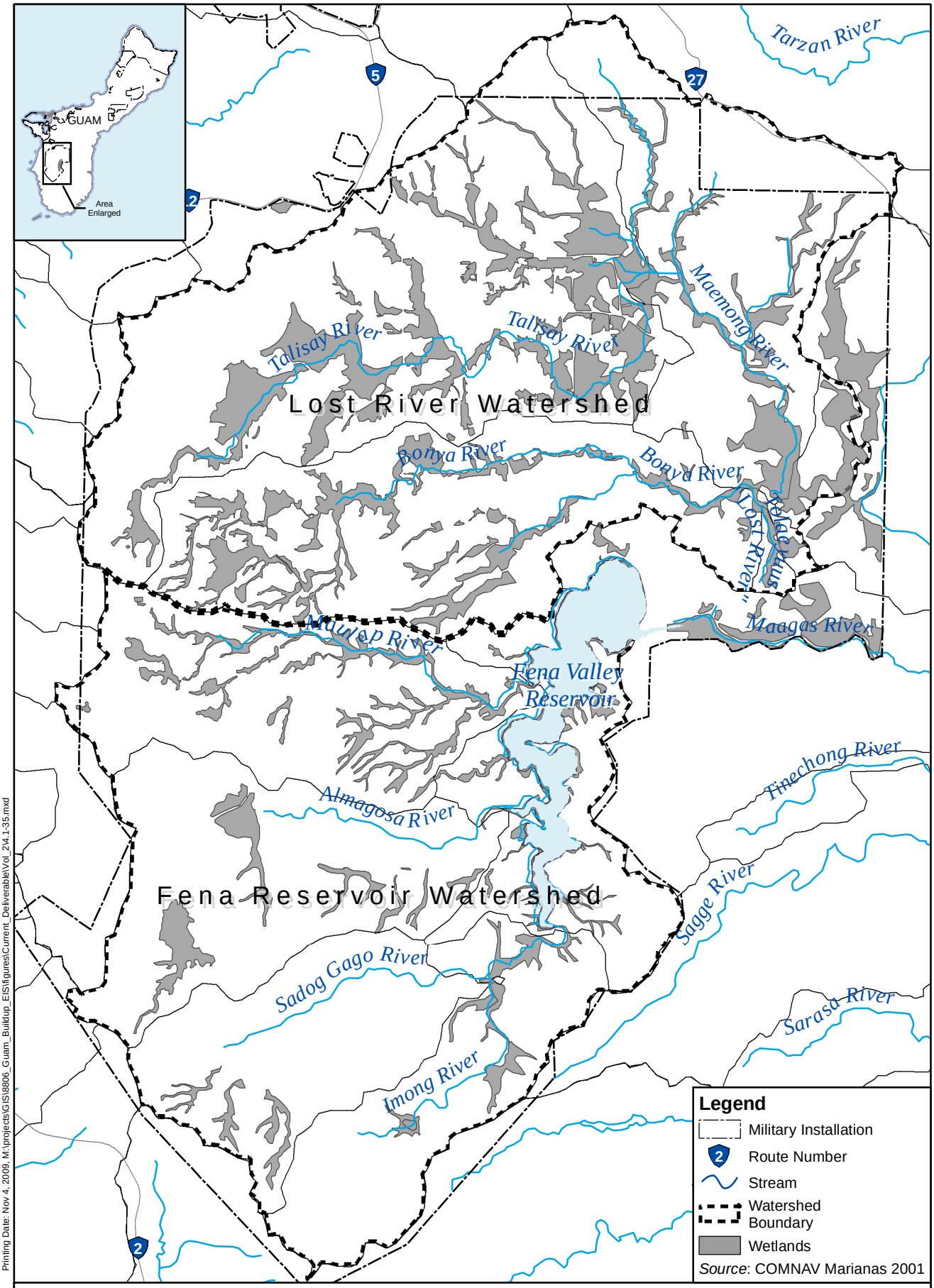

Figure 4.1-35
Fena Reservoir and Lost River Watersheds

Sediment influx to the reservoir has reached levels whereby the Navy has contracted with the Division of Forestry and Soil Conservation, Guam Department of Agriculture to reforest portions of the watershed that drain into the reservoir. GWQS designate the upper, lower, and southeastern portions of the watershed as S-1, S-2, and S-3, respectively. Both S-1 and S-2 designations protect recreational uses, including swimming, and all stages of aquatic life. The marine waters into which the Talofofo waters are discharged are designated as M-2, which is fully protective of recreation and marine aquatic life.

Four of the streams (Imong, Sadog Gago, Maulap and Almagosa) have relatively steep gradients and flow into Fena Reservoir. Built in 1951, the Fena Reservoir has a capacity of approximately 7,050 acre-feet (8,696,000 m^3) of water, which, along with surface water redirected from Almagosa and Bona springs, is pumped to the Fena Water Treatment Plant and then into Navy and municipal distribution systems, that is the major source of potable water for naval activities and meets approximately 30% of Guam's current water requirements (NAVFAC Pacific 2008).

The Lost River watershed is located to the north of the Fena Reservoir watershed and is composed of several streams that converge with the Maagas River before meeting the Talofofo River east of NMS (refer to Figure 4.1-35). These include the Bonya, Talisay, and Maemong flowing to the Tolaeyuus. The Tolaeyuus River in northern NMS is known as the Lost River where it disappears underground in karst terrain near where it joins the Maagas River below Fena Reservoir and resurfaces again. The Lost River is located in a basin bounded by the natural stream banks to east and west, by the limestone cliff to the north, and by an existing low-head sheet pile dam at its southern end.

The lower Talofofo watershed is composed of deeply weathered volcanic derived sediments with thicker sections of alluvial deposits near the lower sections (Ward et al. 1965). The Talofofo Valley is a wide flat river bottom, with jungle or wetland vegetation throughout. Dense jungle covers much of the adjacent hillsides. Sections of the bottom land are used for agriculture.

Water Quality

Water quality from Fena Reservoir and springs is generally high, requiring minimum treatment and chlorination for domestic use. Threats to NMS water quality include sedimentation from accelerated erosion and fecal material contamination from deer, feral animals,, and other animals (Navy 2009).

The Fena Valley Reservoir contains low alkalinity (or "soft") water that has a slightly alkaline pH, is low in minerals, and contains a significant amount of organic matter. Turbidity tends to be high, especially in the rainy season when measurements may exceed 40 Nephelometric Turbidity Units. The Imong River is a significant source of sediment in the reservoir due to the susceptibility of soil within the river watershed to erosion. Surveys in 1973, 1979, and 1990 indicated that approximately 9.1 mg (34.4 million liters [ml]) of reservoir capacity is lost each year due to sedimentation. Anthropogenic contaminants originating from pesticides, herbicides, and fertilizers have been detected in the reservoir at levels less than regulatory limits (Navy 2009).

Fena Reservoir is facing eutrophication due to persistent conditions of low dissolved oxygen, causing frequent phosphate release from sediment in the reservoir. During the dry season, mixing in the reservoir is very limited resulting in anoxic conditions mobilizing phosphorous previously bound in the sediments. Also, runoff during wet season further increases the nutrient load in the reservoir that leads to even greater biological productivity. The nutrient imbalance caused by the eutrophication of Fena Reservoir needs to be further studied and best management practices must be implemented to preserve the ecology of the reservoir (Navy 2009).

Water quality tests were conducted in the Lost River area in February 1995. A single water quality sample was obtained from the Lost River at the project site to characterize a typical condition, and for comparison with Fena Reservoir water. Water quality was generally good, with low suspended solids concentration and turbidity. All metals, with the exception of antimony, were non-detectable or below maximum levels stipulated for drinking water under Safe Drinking Water Act regulations. Antimony occurs naturally in soils, groundwater, and surface water. It is also associated with automotive batteries, explosives, and flame retardants. The sample registered antimony concentrations of 0.017 mg/L; the Safe Drinking Water Act-mandated level is 0.006 mg/L. Antimony was not detected in Fena Reservoir raw water at surface and mid-depths, and was 0.001 mg/L at the bottom (Navy PWC 1996).

Groundwater

Groundwater in the NMS project area is found in low permeability volcanic rocks or older limestone which produces an elevated water table that in places intersects the ground surface through springs (e.g., Bonya Spring). The low permeability of these geologic formations does not support municipal quantities of groundwater extraction like the NGLA. There currently is no pumping of the groundwater found at NMS. The low permeability of the aquifer material and the ready supply of surface water make any future use of groundwater unlikely (Gingerich 2003).

Nearshore Waters

There are no nearshore waters located near NMS due to its interior location on Guam.

Wetlands

A total of 129 wetlands, totaling 1,469 ac (594 ha), have been mapped at NMS. All of the wetlands are classified as palustrine, except for the Fena Reservoir, which is classified as surface water (COMNAV Marianas 2008). Wetland studies in portions of NMS, particularly the northern portion, are ongoing. Wetlands in the Fena Reservoir watershed perform an important ecological function as they retain sediment that may otherwise be deposited into Fena Reservoir. The extensive wetlands downstream of Fena reservoir and around Fena reservoir (central and to the east) and the potential magazine areas are part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. The results of the investigation will be incorporated into the Final EIS.

A recent wetland investigation conducted in accordance with the 1987 Wetland Delineation Manual (USACE 1987) delineated wetlands in the project area (NAVFAC Marianas 2009). From that report, this discussion focuses on the wetland areas located in the vicinity of the project area. As shown in Figure 4.1-36, the wetland areas of note are delineated wetland areas 32, 33, 51, 52, 53, and 56. These wetland areas are located adjacent to magazine storage area options and are summarized in Table 4.1-7.

Table 4.1-7. Summary of Wetland Areas in the Vicinity of Magazine Storage Options, NMS

Wetland Area	*Size (ac/ha)*
32	9.5/3.8
33	61.7/25.0
50	27.5/11.1
51	67.2/27.2
52	2.7/1.1
53	4.7/1.9
56	77.2/31.2

Sources: NAVFAC Marianas 2009.

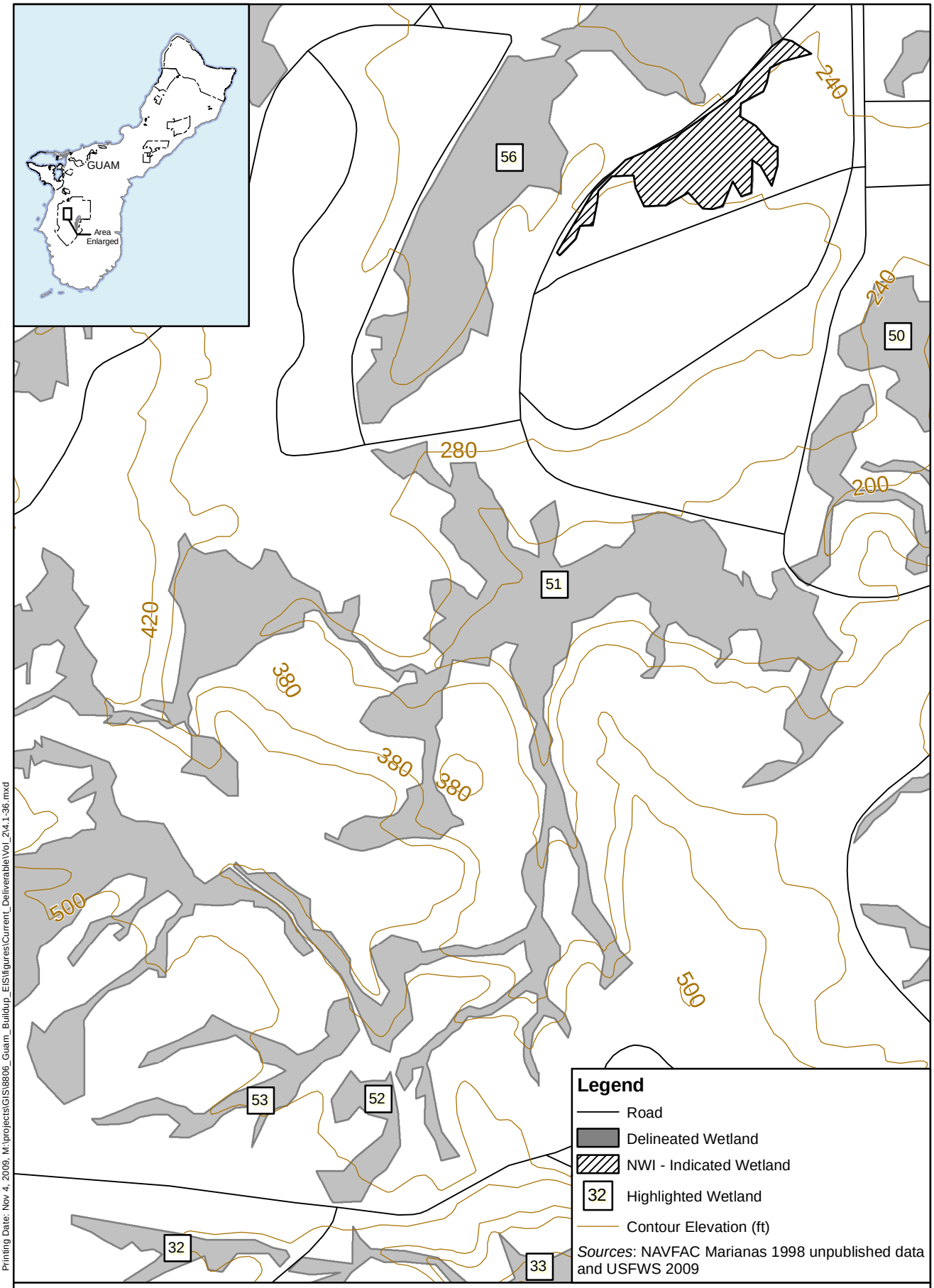

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Figure 4.1-36
Wetlands Located in the Vicinity of Magazine Storage Options, NMS

4.1.5.2 Non-DoD Land

This section provides a description of the water resources found in and adjacent to potential Access Road Alternatives A and B. Unless noted otherwise, this discussion is applicable to all three potential access road areas.

Surface Water

The potential access road alternatives all cross through the Fena Reservoir and Lost River watershed; therefore, the general surface water discussion for NMS is applicable to the non-DoD land. Refer to Section 4.1.5.1. Alternatives A and B do no cross any surface water resources as they are an existing hiking trail and unimproved road, respectively.

Groundwater

Groundwater beneath the two potential non-DoD access roads is found in low permeability volcanic rocks or older limestone. The low permeability of these geologic formations does not support municipal quantities of groundwater extraction like the NGLA. The low permeability of the aquifer material and the ready supply of surface water make any future use of groundwater unlikely (Gingerich 2003).

Nearshore Waters

There are no nearshore waters located adjacent to the non-DoD land access roads due to their interior location on Guam.

Wetlands

There are no known wetland areas located within the potential access road footprint (refer to Figure 4.1-7).

4.1.5.3 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.5.

The proposed GRN projects within the South Region include improvements along Route 5 (pavement strengthening only) and Route 12 (relocation of military access point). These routes are within the upper reaches of the Antantano River and Namo River watersheds located along the southwest portion of the island. The Antantano River flows westerly into the Inner Apra Harbor, while the Namo River flows westerly to Agat Bay. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

The hydrologic regime is characterized by eroded volcanic formations with short streams and steep gradients in the upper portions of the watersheds and drainage areas of less than 3 mi^2 (777 ha) each. These streams are deeply channeled within the volcanic slopes that outlet into the shallow fringing coral reefs at the mouths of the streams. These receiving water bodies are not listed as impaired on the federal 303(d) list of impaired water bodies. In accordance with FEMA FIRMs, the road improvement areas are located outside of any floodplains. The roads are generally crowned in this area with no curbs so that runoff sheet flows to adjacent swales located along the road.

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

4.2.1 Approach to Analysis

4.2.1.1 Methodology

The environmental consequences of each alternative and the no-action alternative are presented in this section. Available literature was used to assess existing conditions and to establish a baseline for the assessment, as described in the affected environment section (Volume 2, Chapter 4, Section 4.1.1). The methodology for identifying, evaluating, and mitigating impacts to water resources has been established based on federal and GovGuam laws and regulations as described in Volume 2, Chapter 4, Section 4.1.1.

The environmental consequences evaluation for water resources includes a qualitative and quantitative analysis of surface water, groundwater, nearshore waters, and wetlands to the extent possible given available project data. Environmental impact assessments were made and compared to baseline conditions, items of public concern, and significance criteria to determine the magnitude of potential impacts to water resources. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS; however, potential impacts associated with the NMS Access Road Options A and B are addressed in this volume.

The proposed action analysis is separated into two main activities: construction and operations (consisting of non-training and operations). Each of these activities has potential impacts. The analysis of potential impacts considers both direct and indirect impacts. Direct impacts are those that may occur during the construction phase of the project and cease when the project is complete or those that may occur as a result of project operations following the completion of construction. Indirect impacts are those that may occur as a result of the completed project or those that may occur during operations but not as a direct result of the construction or operational action.

Sustainability Requirements and Goals

Implementation of the proposed action would be consistent with Navy policy in compliance with laws and executive orders whereby DoD entities are required to reduce demand for indoor water by as much as 20% and outdoor water use by 50% by the end of fiscal year 2015. Outdoor water use would include consumption for landscape management and equipment washing. Concurrent with these mandates is the Navy/Marine Corps policy to pursue and facilitate Leadership in Energy and Environmental Design

(LEED) Silver certification for their facilities. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development.

Water resource sustainability is addressed in two categories: minimize water demand and maximize the quantity and quality of groundwater recharge. Elements identified to achieve minimum water use are:

- Water Conservation - identify and specify appropriate minimum water demand fixtures and devices
- Irrigation - minimize use of irrigation systems and water
- Grey Water Use - evaluate options for use of grey water for irrigation. Greywater is non-industrial wastewater generated from domestic processes such as dishwashing, laundry, and bathing.
- Rainwater Harvesting - investigate harvesting, storage, and distribution systems

The quantity and quality of groundwater recharge is addressed in the existing Unified Facility Code Low Impact Development (LID) Manual, which would be followed. This manual includes specific Integrated Management Practices to be considered and included in the drainage design of the proposed action sites. In addition, NPDES permitting requirements, LEED goals, and recent laws (e.g., the Energy Independence and Security Act of 2007), mandate certain drainage quantity and quality performance standards. Thus, the proposed action includes incorporating post-construction drainage quality, quantity, and velocity dissipation measures to approximate (or improve upon) pre-construction conditions at the property line.

Best Management Practices

In many sections of the water resource analysis contained in this EIS/OEIS, the reader will find implementation of BMPs as an impact-reducing measure for both construction and operation activities. Thus, it is important to note a few things about BMPs, and in particular stormwater-related BMPs, in this section of the EIS/OEIS. Choosing an effective stormwater BMP is one of the key challenges to ensuring maximum protection for receiving waters. As part of this, having access to studies of BMP performance helps make better decisions to ensure not just BMPs, but rather, *effective BMPs* are selected and implemented.

For example, research on BMP treatment system performance from available monitoring data drawn from the International Stormwater Best Management Practices Database (BMP Database 2009) investigated whether there are any differences in treatment performance based on BMP category (e.g., detention basin, media filter, wetland basin, etc.). The study analyzed the average influent and effluent concentrations of BMPs for various constituents. Of note, suspended solid concentrations (of particular concern during construction) decreased most notably through the implementation of detention pond and media filter BMPs. Conversely, these same BMP categories were not effective removers of total nitrogen or total phosphorus, whereas wetland basin BMPs were (Geosyntec Consultants 2008).

BMP treatment success percentage (by concentration) is just part of the BMP effectiveness story; there are many factors to consider. As part of the BMP decision process, a wide variety of factors must be considered, including pollutant removal potential, stormwater volume reduction, installation considerations, capital costs, maintenance costs, hydrologic regime, and other factors. In particular, there are three important areas to consider when attempting to evaluate a BMP's potential performance: concentration, volume, and total load (USEPA 2009b). Choosing the right BMP for the right area is critical; thus, a sufficient understanding of the site-specific concentration, volume, and total load factors is necessary.

In developing a list of potential BMPs for actions analyzed in this EIS/OEIS (Table 4.2-1), the aforementioned key considerations and areas have been and will continue to be identified and refined. While the list of potential BMPs in Table 4.2-1 is general, they cover the wide-range of potential needs for BMP measures to reduce potential impacts stemming from proposed action analyzed in this EIS/OEIS. Table 4.2-1 also identifies the applicable action phase (construction and/or operation) and region on Guam where each listed BMPs would likely be most effective. This list presents those BMPs already in use at DoD installations on Guam and/or identified by GovGuam (Navy 2008, CNMI and Guam 2006). A notable BMP is the preparation and implementation of a SWPPP. As described in SWPPPs, BMP implementation includes performing frequent visual inspections and benchmark monitoring to determine BMP effectiveness. Monitoring results are then analyzed in relationship to the identified water quality objectives and if the benchmarks were not being reached, the BMPs would be modified. In this manner, the effectiveness and applicability for selected BMPs (specific to unique situations on Guam) can be measured and then altered, as necessary, to minimize potential impacts to water resources on Guam.

Table 4.2-1. Stormwater BMPs

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
1	Erosion Control Plan (ECP)	●	●	●	●	●	●	Per 10 Guam Code Annotated (GCA), Chapter 47, an ECP is required before any properties can be cleared and graded to eliminate and/or minimize nonpoint source pollution within Guam's waters such as fertilizers, pesticides and other polluting substances carried by sediment.
2	Stormwater Management Plan (SWMP).	●		●	●	●	●	In compliance with the federal CWA under section 401 the proposed action would require a SWMP. A SWMP is a document that describes the minimum procedures and practices used to reduce the surface flow and subsequent discharge of pollutants to storm drainage systems.
3	Stormwater Pollution Prevention Plan (SWPPP)		●	●	●	●	●	DoD facilities are required to comply with the SWPPP during day to day operations, to ensure that stormwater remains free of contaminants. A SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. It requires development of pollution prevention measures, including BMPs, to reduce and control pollutants in stormwater discharge.
4	Water Quality Monitoring Plan (WQMPs)	●	●	●	●	●	●	WQMPs may be required to evaluate the effectiveness of any number of different environmental permits and/or performance standards. Monitoring plans are formulated to identify ambient or control conditions at a particular site and to capture deviations from those conditions resulting from a project or operations of a facility.
5	Check Dam	●	●	●	●	●	●	Small barriers or dams constructed of stone, bagged sand or gravel, or other durable material across a drainage way. The purpose is to reduce erosion in a drainage channel by restricting the velocity of flow in the channel.

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
6	Diversion Dike/Swale	●		●	●	●	●	A temporary diversion dike is a berm or ridge of compacted soil, located in such a manner as to channel water to a desired location. The purpose is to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet or to intercept sediment laden water and divert it to a sediment trapping device, and to direct runoff to a sediment trapping device, thereby reducing the potential for erosion and off site sedimentation.
7	Level Spreader	●	●	●	●	●	●	A non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope. The purpose is to convert concentrated flow to sheet flow and release it uniformly over a stabilized area.
8	Perimeter Dike/Swale	●		●	●	●	●	A temporary ridge of soil excavated from an adjoining swale located along the perimeter of the site or disturbed area built to prevent off site storm runoff from entering a disturbed area and to prevent sediment laden storm runoff from leaving the construction site or disturbed area.
9	Sediment Basin	●	●	●	●	●	●	A barrier or dam constructed across a drainage way or at other suitable locations to intercept sediment laden runoff and to trap and retain the sediment to protect drainage ways, properties, and rights-of-way below the sediment trap from sedimentation.
10	Sediment Trap	●	●	●	●	●	●	A sediment control device formed by excavation and/or embankment to intercept sediment laden runoff and retain the sediment in order to protect drainage ways, properties, and rights-of-way below the sediment trap from sedimentation.
11	Silt Fence	●		●	●	●	●	A barrier of geotextile fabric installed on the contours across a slope used to intercept sediment laden runoff from small drainage areas of disturbed soil to reduce runoff velocity and effect deposition of transported sediment load.
12	Storm Drainage Inlet Protection	●		●	●	●	●	A temporary, somewhat permeable barrier, installed around inlets in the form of a fence, berm or excavation around an opening, trapping water and thereby reducing the sediment content of sediment laden water by settling to prevent heavily sediment laden water from entering a storm drain system through inlets.
13	Straw Bale Dike	●		●	●	●	●	A temporary barrier of straw, or similar material, used to intercept sediment laden runoff from small drainage areas of disturbed soil to reduce runoff velocity and effect deposition of the transported sediment load.
14	Vegetated and Lined Waterways	●	●		●	●	●	A natural or man-made channel of parabolic or trapezoidal cross-section that is below adjacent ground level and is stabilized by suitable vegetation or concrete, stone, or other

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
								permanent material to intercept and convey runoff to stable outlets at non-erosive velocities.
15	Rock Outlet Protection	●	●	●	●	●	●	A section of rock protection placed at the outlet end of the culverts, conduits, or channels to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.
16	Erosion Control Blankets	●	●	●	●	●	●	Erosion control blankets (geotextiles) are porous fabrics (filter fabrics, road rugs, synthetic fabrics, construction fabrics, or simply fabrics) placed to minimize or prevent erosion on exposed soils.
17	Stabilization with Vegetation, Sod, Mulch, or Topsoil	●	●	●	●	●	●	Providing erosion control protection to a critical area for an interim period or establishing grasses with other forbs and/or shrubs to provide perennial vegetative cover on disturbed, denuded, slopes subject to erosion to provide temporary and/or permanent erosion and sediment control.
18	Low Impact Development (LID)		●	●	●	●	●	LID is a design technology that makes use of innovative methods to capture stormwater that would otherwise flow into nearby watersheds using a combination of retention devices and vegetation to allow stormwater to be retained and managed at the source, rather than relying on downstream efforts to control the flow of water and contaminants. The purpose is to improve the quality of receiving waters and stabilize flow rates of nearby streams by reducing water pollution and increasing groundwater infiltration.
19	Stormwater Ponds (Retention/ Detention)		●		●	●	●	Practices that have a combination of permanent pool and extended detention capable of treating the water quality volume treatment.
20	Stormwater Wetlands		●		●	●	●	Practices that include significant shallow marsh areas, and may also incorporate small permanent pools or extended detention storage to achieve the full water quality volume treatment.
21	Infiltration Practices		●	●	●			Practices that capture and temporarily store the water quality volume before allowing it to infiltrate into the B and/or C soil horizons. Runoff that discharges directly into limestone areas requires treatment via another approved management practice.
22	Filtering Practices		●	●	●	●	●	Practices that capture and temporarily store the water quality volume and pass it through a filter bed of sand, organic matter, soil, or other media.

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
23	Open Channel Practices		●		●	●	●	Practices explicitly designed to capture and treat the full water quality volume within dry or wet cells formed by check dams or other means, or within the channel itself through a slow velocity and relatively long resistance time.
24	Minimizing Exposure		●	●	●	●	●	Minimize the exposure of manufacturing, processing, and material storage areas to rain and run-off by locating these industrial materials and activities inside or protecting them with storm resistant coverings.
25	Preventive Maintenance		●	●	●	●	●	A preventive maintenance program involving regular inspection, testing, maintaining, and repairing of all industrial equipment and storage systems prior to or during normal use.
26	Spill Prevention and Response Procedures	●	●	●	●	●	●	Written procedures for cleaning up spills or leaks, notifying the appropriate personnel, and following the reporting procedures.
27	Routine Facility Inspections		●	●	●	●	●	Qualified facility personnel must regularly inspect all areas of the facility where industrial materials or activities are exposed to stormwater for ongoing good housekeeping, spill control equipment, and outdoor storage.
28	Employee Training		●	●	●	●	●	Training must be given to all employees who work in areas where industrial materials or activities are exposed to stormwater, and must include spill response, good housekeeping, and material management practices.

Note: *The DoD* and GovGuam are working on an amendment to the Stormwater Management Manual; many of these BMPs are taken from the 2006 Manual and may be further refined in the amendment.

The hydrologic regime at a specific site is also critical on Guam when deciding which BMPs are most appropriate. The northern broad sloping limestone plateau has little surface runoff, high infiltration rates, and concerns about groundwater contamination (i.e., impacts to the NGLA) while the southern mountainous region composed of eroded volcanic formations is dominated by surface runoff, erosion concerns, and has little groundwater storage. In the limestone dominated areas (northern and portions of central Guam) BMPs for operation impacts would need to focus on channeling runoff to temporary storage and filtration (BMP #23) and a comprehensive removal of contaminants prior to allowing stormwater recharge (BMP #22) to the sensitive NGLA. In the volcanic dominated areas (southern and parts of central Guam), BMPs for operation impacts would need to focus on minimizing erosion (BMP #s 7 and 18), removal of suspended sediment (BMP #s 9, 21, and 24), and reduction in peak flow (BMP #20) to surface waters.

As part of this EIS/OEIS, the Navy is also preparing a stand-alone LID study and complementary comprehensive drainage study to determine stormwater runoff quantities and qualities under the action alternatives. The two studies will work in tandem, using such resources as USEPA (2009b) to identify and implement LID planning utilizing a variety of natural and built features that reduce the rate of runoff,

filter out pollutants, and facilitate the infiltration of water into the groundwater basins. This LID planning will ultimately provide the foundation for the basis of design for permanent stormwater infrastructure. Potential LID measures are identified in following sections.

4.2.1.2 Determination of Significance

Surface Water

Surface water issues include:

- Water quality
- Flooding
- Flow path alterations

Surface water quality impacts are evaluated by examining the potential increase of contamination including chemicals, heavy metals, nutrients, and/or sediments in the surface water as a result of the proposed action. The analysis is performed by comparing existing water quality data with possible increases in water quality contaminants in the surface water. Potential impacts to surface water quantity and velocity are analyzed by examining changes in drainage volumes and patterns associated with the proposed action.

For construction activities, some of the key effects include stormwater discharges which may contain elevated sediment concentrations and spills and leaks of chemicals such as lubricants, fuels, or other construction materials that may increase pollutant loading in the surface water. In addition, direct construction or alteration of stream channels or reservoirs may cause erosion, sedimentation, and increased contamination potential. If flow paths or patterns are altered, additional studies, such as instream flow analysis, would be conducted to ensure the human uses and/or biological services are preserved.

Operational effects include stormwater discharges which may increase erosion rates, the volume of sediment loading to the surface water as well as increase contaminants from vehicle maintenance, household discharge, privately-owned vehicles, and animal waste. Contamination of surface water from leaks or spills of hazardous, or otherwise regulated materials, is also a potential impact. Increased water usage may reduce the water availability in the reservoirs and/or reduce instream flows. Increased impervious areas may increase the runoff and increase the potential for flooding. Development in the floodplain could result in potential damage from flooding. Diversion of water courses for municipal water consumption may impact the ecological services that the resource provides.

Groundwater

Groundwater impact concerns include water quality and water quantity. Groundwater quality is assessed by examining the potential risk of a hazardous or regulated waste release, as well as approximating the amount of additional stormwater and associated non-point source pollution that enter the groundwater.

Potential groundwater impacts associated with construction activities include spills, leaks, and sedimentation having direct impacts to stormwater runoff that can contribute to groundwater contamination, well as direct contamination of groundwater resources through percolation.

The possible impacts connected with operational activities include increases of impervious areas, waste-generating activities, storage of potential contaminants, and landfill leaching. The direct impacts include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. In addition, the increased water usage may increase the depletion of groundwater

resources (Volume 6, Chapter 3, Section 3.1.2, Potable Water). The potential impacts include decreases in groundwater recharge from increased impervious areas and saltwater intrusion from increased aquifer pumping.

Nearshore Waters

The nearshore water impact analysis focuses on water quality. Recreational nearshore issues are addressed in Volume 2, Recreational Resources. The potential increases of contamination including chemicals, heavy metals, nutrients, and/or sediments in nearshore waters as a result of the proposed action are assessed by comparing existing water quality data with the projected changes in water quality.

Potential impacts associated with construction activities include construction spills and leaks that may discharge to nearshore waters, an increase in stormwater discharge that may increase non-point source pollution, and physical impacts to nearshore waters from dredging.

Operation effects include potential non-point source and point-source pollution. The point-source pollution consists of chemicals, heavy metals, nutrients, and/or sediments that may runoff from the increase in impervious, urban areas. The point source pollution would be related to direct discharges to the nearshore waters such as wastewater effluent.

Wetlands

The wetland impact areas of concern include:

- Pollutants
- Loss of area
- Loss of functionality

The potential for pollutants to impact a wetland was evaluated by examining the risk of hazardous materials leaking or spilling and their proximity to the wetlands. The loss of area was assessed by the total amount of delineated wetland area that would be directly removed either in loss of area or function as a result of the proposed action. The wetland functionality refers to the ability of the wetland to trap sediment and nutrients, receive and retain water, maintain wildlife habitat (both flora and fauna), and provide recreational uses. The impacts to wildlife habitat associated with wetlands are addressed in Chapter 10, Terrestrial Biological Resources.

For construction activities, the effects associated with activities in close proximity to any designated wetland or activities in the wetlands themselves are considered. Runoff from nearby construction sites may contain increased chemicals, heavy metals, nutrients, and/or sediment that could adversely affect those wetlands. Wetland impacts could result from changes in land uses and/or spills or leaks from construction operations and equipment. Loss of functionality can also occur if construction operations occur directly within the designated wetlands. Loss of wetland area would occur if the proposed action involves the direct removal of wetlands.

The effects associated with operations include an increase in potential spills and leaks from hazardous materials that may be stored in close proximity to designated wetlands. An indirect impact to existing wetlands may occur by altering (i.e., diverting or restricting) the surface water flowing into the wetlands. Indirect impacts to wetlands could also occur as a result of altered sedimentation of watercourses or drainage conveyances connected to wetland areas.

Significance Criteria

The following factors are considered in evaluating impacts to water resources:

- Reducing availability or accessibility of water resources
- Noncompliance with all applicable water quality standards, laws, and regulations
- Increasing risk associated with environmental hazards or human health
- Decreasing existing and/or future beneficial use
- Increasing risk of flooding
- Depletion, recharge, or contamination of a usable groundwater aquifer for municipal, private, or agricultural purposes
- Reducing the amount of wetlands available for human use or ecological services
- Long-term increased inundation, sedimentation, and/or damage to water resources

If an activity is deemed as having an impact, the activity then can be evaluated to determine if the impact is significant or insignificant. For a significant impact, a determination is made as to whether the impact can be mitigated to less than a significant impact.

4.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to water resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These included:

- Describing water quality with respect to public health requirements, drinking water regulations, and applicable water quality standards
- Estimating quality and quantity of stormwater runoff to be generated by increased impervious surface, methods of contaminant removal, methods of runoff redirection to recharge the aquifer, and groundwater under the direct influence of surface water
- Accidental or intentional contamination of groundwater
- Capacity of water resources to meet agricultural needs
- Stormwater management controls to prevent pollution during construction and subsequent operations
- Construction that could potentially cause runoff and pollute the beaches and destroy marine life
- Effects of training and dredging on sedimentation stress for the coral reefs and other marine life
- Identifying ways to monitor and mitigate indirect impacts from sediments on coral reefs

4.2.2 Alternative 1

4.2.2.1 North

Andersen AFB

Construction

Surface Water. Under Alternative 1, proposed munitions storage (12 new munitions storage magazines and support facilities) and airfield (North Ramp, South Ramp, North Gate, and Access Road) construction activities at Andersen AFB would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, construction-specific BMPs would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. General construction BMPs are presented in Table 4.2-1. In addition, roadway-specific BMPs as

identified in the Commonwealth of the Northern Mariana Islands (CNMI) and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, construction activities at Andersen AFB would include surface water protection measures that would also serve to protect groundwater quality. These BMPs would reduce the pollutant loading potential into stormwater and thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to groundwater.

Nearshore Waters. Though construction activities under Alternative 1 on Andersen AFB would be >0.5 mi (0.8 km) from the coastline, the entire island of Guam is classified as a coastal zone under the CZMA. Alternative 1 would have no direct impact to the nearshore waters surrounding Andersen AFB, although there would be a potential for indirect impacts (e.g., potential increase in sediment reaching nearshore waters) to occur. These indirect impacts would be lessened through the implementation of BMPs as referenced in the surface water discussion. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on Andersen AFB. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in no impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) and new SUA airspace would have no impact to water resources as flight operations are not expected to affect water resources. However, the potential impacts from the storage, use, and disposal of materials used to support proposed flight operations is analyzed in this section.

Surface Water. Under Alternative 1, the increase in impervious area at Andersen AFB would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event to minimize potential impacts to surface water quality. Stormwater flow paths would continue to mimic pre-development flows through area topography. Examples of stormwater infrastructure LID measures are described below.

Alternative 1 would incorporate the concept of LID in the final planning, design, and permitting of the stormwater runoff and drainage design. The goals of LID are too closely match the post-development topography and stormwater runoff hydrology to the pre-development status. The intent of LID is to control non-point source runoff through the implementation of plant-soil-water and man-made, where appropriate, mechanisms that protect and sustain the ecological integrity of the receiving water bodies and wetlands. In areas of karst geology such as Andersen AFB, LID techniques must also protect groundwater quality. LID designs focus on small scale, close to the source stormwater management, where such techniques can achieve the water quality goals. LID technologies are well suited to reduce stormwater runoff loadings for a variety of potential contaminants including sediment, nutrients, and heavy metals. LID practices at the planning level are in conformance with USEPA non-structural Pollution Prevention strategies.

It is anticipated that several LID techniques would be used during the final planning, design, and permitting of Alternative 1. These measures could include a series of integrated management practices (IMPs) to match as closely as possible the "pre-/post-" hydrologic conditions in the development areas. The IMPs reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. The projects may incorporate downspout disconnections, re-vegetation, and bio-retention to reduce pollutant loads and stormwater volumes. Additional appropriate measures are expected to be included such as the use of bio-retention cells, bio-retention strips, oil/water separators, a combination of bioswales and vegetated swales, and detention/retention basins.

As part of LID planning, areas for vehicle parking may use pervious paving designs when practicable. The potential use of such paving systems would be balanced with the requirement to avoid percolation of contaminated stormwater into groundwater; this protection of groundwater would have the highest priority when considering such paving designs. Drainage swales instead of stormwater conveyance piping systems are also being considered as a way to reduce the quantity and velocity of stormwater while simultaneously improving stormwater quality. The combination of LID technologies and compliance with federal and GovGuam regulations would reduce potential impacts to the storm drainage system and nearby receiving water bodies. With the implementation of LID measures to reduce impacts, stormwater flow paths would continue to mimic area topography and no diversion or restriction of surface water flow would occur.

Alternative 1 would potentially increase the amount of POLs, hazardous waste, pesticides, and fertilizers being stored, transported, and utilized on the proposed facilities. Increasing the storage, transportation, and use of these substances would increase the potential for releases to receiving waters. The stormwater runoff would continue to have the potential to have elevated contaminants such as sediment, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations (see Table 3.1-1, Volume 8). SWPPPs and Stormwater Management Plans (SWMPs) are documents designed to identify ways to reduce the potential impacts associated with potential pollution sources, and potential erosion and sedimentation impacts, respectively. In addition, the Oil Pollution Act (OPA) mandates the implementation of the Spill Prevention, Control, and Countermeasure (SPCC) Plan that is used to prevent and control potential leaks and spills. Implementation of the required plans and permits with their associated protective measures would minimize potential impacts of runoff, spills and leaks. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that no significant impacts to receiving water bodies would result from Alternative 1. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to surface water.

Groundwater. Following construction, the existing procedures governing these recharge activities would continue to be followed to ensure that no extensive groundwater contamination would occur. Specifically, the provisions of the SWPPP and associated erosion control activities would ensure that the surface water flowing into the groundwater recharge wells would be of acceptable quality. As a high percentage of rain falling on Andersen AFB eventually infiltrates to the NGLA, the increase in stormwater runoff could result in a quicker flowpath time to the recharge wells; however, the increased potential for higher evaporation rate associated with the increase in impervious surface would likely mostly cancel the reduction in infiltration times except during the most intense rainfall events. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed, such as increased runoff, could potentially result in indirect impacts that could alter nearshore water quality including sedimentation, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These indirect effects would be minimized by complying with all applicable orders, laws and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the Northern Watershed Restoration Strategy. The intent of these documents is to encourage federal and non-federal agencies, other organizations and interested citizens to work in a collaborative manner to restore priority watersheds. For example, under the Northern Watershed Restoration Strategy, the major focus of the restoration strategy for the northern watershed is the documentation, investigation, and eventual reduction of potential contaminant sources located in the northern watershed. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at Andersen AFB would result in no impacts to wetlands.

Finegayan

Under Alternative 1, construction and operational activities would occur at NCTS Finegayan and South Finegayan. Therefore, this analysis evaluates potential impacts at both locations.

As part of the overall study of the potential Marine Corps relocation to Guam, the Navy has recently awarded a contract to prepare a comprehensive drainage study to determine the pre- and post-development hydrology of the potential Main Cantonment site at Finegayan. The study will determine the stormwater runoff quantities and qualities that would be need to be accommodated at the site under construction scenarios. This characterization of stormwater runoff will allow LID planning to proceed, utilizing a variety of natural and built features that would reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water to the ground. Upon completion of the study, the relevant information will be incorporated into this EIS/OEIS to enhance the level of site-specific detail with respect to potential stormwater impacts and associated LID measures to reduce potential impacts.

NCTS Finegayan

Construction

Surface Water. Under Alternative 1, proposed cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater

subbasins. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Alternative 1 on NCTS Finegayan is adjacent to the coastline, and the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential for impacting nearshore water quality. Specifically, Alternative 1 has the potential for impacting nearshore water quality if large quantities of sediment loaded runoff enters the large sink holes in the main cantonement or concentrated flows are directed toward the cliff edge above the Haputo Beach and conservation area. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on NCTS Finegayan. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 1, the total amount of impervious area at NCTS Finegayan would increase by 809 ac (327 ha). This increase from 5.5% to 39% impervious area, for a total of 941 ac (381 ha), would result in an associated increase in stormwater discharge intensities and volume. This increase would be primarily accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to reduce potential impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Examples of stormwater infrastructure LID measures are described below.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 1 at NCTS Finegayan would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 1. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at NCTS Finegayan, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality.

Under all alternatives, groundwater production is expected to increase by a total of no more than approximately 16.2 MGd (61.7 mld), from the Gana, Mangilao, Andersen, Agafa-Gumas, Finegayan, and Yigo-Tumon subbasins (NAVFAC Pacific 2008). When this increase is added to existing pumping rates, the new projected pumping rate of 54.7 MGd (207 mld) would still be less than the sustainable yield of 80.5 MGd (304.7 mld). The Navy recently initiated a study to re-evaluate the sustainable yield of the NGLA. The results of the re-evaluation will be incorporated into future versions of the EIS/OEIS.

Water resource managers would continue to proactively monitor groundwater chemistry data to ensure increased pumping does not adversely affect military or non-military sources of drinking water. Careful monitoring of the chloride concentrations in the subbasins and the capability to shift pumping to wells further from impacted subbasins if high chloride concentrations are detected would reduce any potential negative impacts on the groundwater resource. Implementation of aforementioned sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in no impacts to wetlands.

South Finegayan

Construction

Surface Water. Under Alternative 1, proposed housing/community support construction activities at South Finegayan would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed housing/community support construction activities at South Finegayan would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Alternative 1 on South Finegayan is located well-away from the coastline; however, the entire island of Guam is classified as a coastal zone under the CZMA. Potential impacts to nearshore waters would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on South Finegayan. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 1, the total amount of impervious area at South Finegayan would increase by 290 ac (117 ha). This increase from 3.0% to 100% impervious area, for a total of 290 ac (117 ha), would result in an associated increase in stormwater discharge intensities and volume. This area would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present). However, an increase to 100% impervious area for South Finegayan is assumed for this analysis and represents the maximum environmental adverse impact scenario. This increase would result in an associated substantial increase in stormwater discharge intensities and volume for South Finegayan. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 1 at South Finegayan would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water

bodies, and the underlying groundwater resources would result from Alternative 1. Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations (see Table 3.1-1, Volume 8), including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at South Finegayan, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. There are no known wetland areas near the proposed operational areas. Therefore, operations associated with Alternative 1 at South Finegayan would result in no impacts to wetlands.

Non-DoD Land

Non-DoD land in the north consists of former FAA parcel and the Harmon Annex for Alternative 1. For each alternative evaluated, the amount of non-DoD land varies, yet for the purpose of this resource area the proposed activities at non-DoD land are the same for all action alternatives. The former FAA parcel would be a part of the main cantonment as described in the Finegayan sub-section above and the Harmon Annex would be used for housing/community support.

Construction

Surface Water. The potential impacts to surface water on non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction activities would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Surface Water. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. The potential impacts to groundwater on non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Groundwater. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. The potential impacts to nearshore waters adjacent to non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Nearshore Waters. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in the non-DoD land project area. Therefore, construction associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

Operation

Surface Water. The operational phase of Alternative 1 at the former FAA parcel and Harmon Annex would include the development of approximately 680 ac (275 ha) and 326 ac (132 ha), respectively, resulting in 100% impervious surface for both parcels. While these areas would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present), an increase to 100% impervious area for these two parcels is assumed for this analysis and represents the maximum environmental adverse impact scenario. This increase would result in an associated significant increase in stormwater discharge intensities and volume for both parcels. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Implementation of Alternative 1 on non-DoD land would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, in Volume 8), as well as include the implementation of BMPs, Plans, and LID. The combination of LID technologies, residential pollution control measures, and compliance with federal and GovGuam regulations and implementation of BMPs and stormwater management plans would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 1. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 on non-DoD land, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in the non-DoD land project area. Therefore, operations associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

4.2.2.2 Central

Andersen South

Two site plans have been developed for the training range complex and supporting facilities at Andersen South, reflecting slight differences in configuration. In general terms from a water resources impact perspective, potential impacts from implementing either alternative would be nearly identical. Thus, the following impact analysis addresses potential impacts from these alternative plans as the same for water resources under both construction and operation activities.

Construction

Surface Water. Under Alternative 1, proposed construction activities for non-fire training facilities (consisting of MOUT Complexes, Maneuver Training Areas, Advanced Motor Vehicle Operators Course, two landing zones, fencing, and gates) at Andersen South would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, construction activities for non-fire training facilities at Andersen South would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to groundwater.

Nearshore Waters. Implementation of Alternative 1 at Andersen South would occur > 0.5 mi (0.8 km) from the coastline, yet the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential to impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to nearshore waters.

Wetlands. No known wetlands are located in or near the construction areas associated with Alternative 1 on Andersen South. Therefore, construction activities associated with Alternative 1 at Andersen South would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Operation

This analysis assumes that proposed aviation training activity (flight operations) associated with the two new landing zones at Andersen South would have no impact to water resources as flight operations are not expected to intersect water resources.

Surface Water. The operational phase of proposed non-fire training operations of Alternative 1 at Andersen South would result in a minor increase in the area of impervious surface as a result of training buildings and complexes, which would result in an associated relatively minor increase in stormwater

discharge intensities and volume. This increase would be minor and would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Alternative 1 would include the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed training activities would include vehicle movement, foot traffic, amphibious warfare exercises, the use of pyrotechnics, and simulated weapons firing. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from munitions and explosives of concern (MEC). In addition, the low volume use of pyrotechnics during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas including instruction and procedures for the use of Guam is included in COMNAV Marianas Instruction 3500.4 (Marianas Training Handbook [COMNAV Marianas 2000]). This guidance identifies specific land use constraints to enable protection of environmental resources during military training, and would be followed during training activities. Implementation of Alternative 1 at Andersen South would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, in Volume 8), as well as the implementation of BMPs and LID measures. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at Andersen South, proposed non-fire training operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. The increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn, a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a developed site would no longer reach the groundwater basin directly below the now-developed area, through the implementation of BMPs and LID measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic

compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to nearshore waters.

Wetlands. No delineated wetland areas are located near the proposed operational areas.Therefore, operations associated with Alternative 1 at Andersen South would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Non-DoD Land

Construction

Surface Water. Under Alternative A for the training range complex, proposed construction, including ranges, range control buildings, access roads, bridges, fences, and gates on non-DoD land (Route 15 lands) in the central area, would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. Furthermore, the movement of nearly 323,000 cubic yards (CY) (247,000 cubic meters) of soils to relocate a 1.7-mi (2.8-km) segment of Route 15, and the associated importing of 65,000 CY (50,000 cubic meters) of soil for the range complex would increase the potential for soil to reach drainages during transport, potentially leading to a increase in sediment loading in surface waters. To minimize these potential impacts, general construction BMPs (Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with this alternative would result in less than significant impacts to surface water.

Under Alternative B for the training range complex, construction impacts to surface water would be similar to those described above for Alternative A; however, Alternative B would require 1.7 million cy (1.3 million cubic meters) of fill, considerably greater than Alternative A. Conversely, the amount of road construction would be less under Alternative B as Route 15 would not be relocated. While there are differences between the two alternatives, with the application of BMPs and impact-minimization measures as described for Alternative A, potential impacts under Alternative B would be similar to those described under Alternative A. Therefore, construction activities associated with Alternative B on Route 15 lands would result in less than significant impacts to surface water.

Groundwater. Training range complex construction activities on non-DoD land (Route 15 lands) in the central area would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Route 15 lands would result in less than significant impacts to groundwater.

Nearshore Waters. Proposed firing range complex construction activities on non-DoD land (Route 15 lands) in the central area would be adjacent to the coastline, and the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential to impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water

quality. Therefore, construction activities associated with Alternative 1 on Route 15 lands would result in less than significant impacts to nearshore waters.

Wetlands. No known wetlands are located in or near the construction areas associated with Alternative 1 on non-DoD land in the central area. Therefore, construction activities associated with Alternative 1 on Route 15 lands would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Operation

Surface Water. The operational phase of Alternative 1 on non-DoD land in the central area would result in a minor increase in the area of impervious surface as a result of training buildings and complexes, which would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be minor and would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Alternative 1 would include the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed training activities would include the use of explosives and weapons firing. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from MEC. Standard range maintenance activities and range management BMPs (e.g., lead mining) would reduce the potential for lead or other contaminants to reach receiving water bodies. In addition, the low volume use of explosives during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of explosives, ammunition, and pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Implementation of Alternative 1 on non-DoD land in the central area would be in compliance with all federal, GovGuam, and military orders, laws, and regulations, including COMNAV Marianas Instruction 3500.4 (see Table 3.1-1 in Volume 8), as well as the implementation of BMPs and LID. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. The increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a developed site would no longer reach the groundwater basin directly below the now developed area , through the implementation of BMPs and LID

measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with the SWMP and all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy.

As shown in Figure 2.3-16 in Volume 2, Chapter 2, the Surface Danger Zone (SDZ) associated with the training range complex would overlap nearshore waters by 4,439 ac (1,796 ha) and 6,003 ac (2,429 ha), respectively. There is a very small chance that an expended projectile would fall outside of the range footprint, within the SDZ. There would be an even smaller chance for an expended projectile to fall within the nearshore water portion of the SDZ. Due to its larger size, there would be a slightly greater chance for an expended projectile to fall within the nearshore water SDZ associated with Alternative B. However, due to the small number of potential projectiles that could fall into the nearshore SDZ and the relatively small size of the projectiles, potential impacts to nearshore water quality from these projectiles would be negligible under both alternatives for the training range complex. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to nearshore waters.

Wetlands. No delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Barrigada

Navy Barrigada

Alternative 1 would not occur at Navy Barrigada; there would be no construction or operations at this location. Therefore, Alternative 1 at Navy Barrigada would result in no impacts to water resources.

Air Force Barrigada

Alternative 1 would not occur at Air Force Barrigada; there would be no construction or operations at this location. Therefore, Alternative 1 at Air Force Barrigada would result in no impacts to water resources.

4.2.2.3 Apra Harbor

Harbor

This discussion of potential impacts to water resources at Apra Harbor focuses on potential impacts to nearshore waters and wetlands specific to Apra Harbor, with a focus on potential impacts from proposed dredging activities. Potential impacts to surface water resources and groundwater resources are discussed under Naval Main Base.

Construction

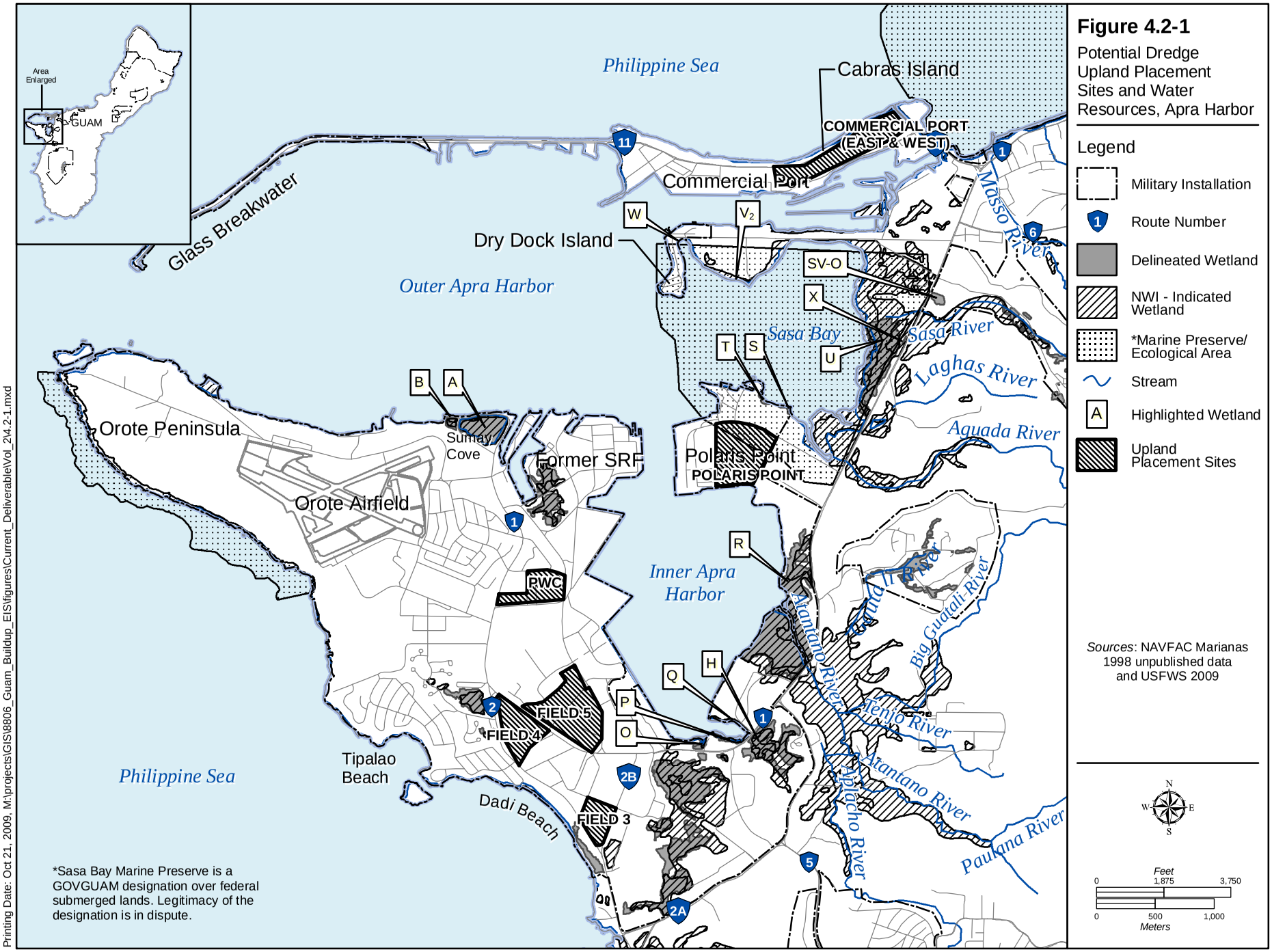
Nearshore Waters. Under Alternative 1, proposed wharf improvements may disturb existing lead and PCB-containing material potentially in the wharfs. Prior to starting improvements, the wharf would be inspected for such materials; any discovered materials would be removed in accordance with all applicable regulations to ensure that there would be no impacts to water resources. Wharf improvements at Victor/Uniform Wharves to support amphibious assault vehicle ships and high speed vessels would involve the replacement of sheetpile bulkheads and other upgrades required to meet seismic and typhoon design standards. Localized and temporary increases in turbidity and total suspended solids are anticipated as a result of in-water wharf repair activities, including the placement (driving) of sheetpiles. Similarly, wharf strengthening at Sierra/Tango Wharves, in order to support escort combatant ships, would also have temporary localized impacts on nearshore waters from in-water construction work. Upon completion of construction, water quality is expected to return to pre-construction conditions and would not be significant.

Under Alternative 1, the placement of precast concrete sections below the water line and the paving of the intertidal areas would result in localized impacts to nearshore water quality from resuspended sediment; however, these localized impacts would be minimized by implementing BMPs. Assuming an extreme tidal range of 3.5 ft and the additional 3 ft proposed to extend below mean low water, the approximately square footage of paved intertidal area for each ramp would be approximately 712.7 ft^2 and 150 ft^2 for a total paved intertidal area of 862.5 ft^2. Upon completion of construction, water quality is expected to return to pre-construction conditions. The remaining construction activities would be limited to the upland area and would be conducted in accordance with all applicable stormwater and erosion and sediment control regulations. As a result, they are not anticipated to have any impact on nearshore waters.

The proposed upgrades to Papa/Oscar Wharves to support U.S. Coast Guard (USCG) relocation would not require demolition or replacement of the support structure. Wharf improvement contractors would ensure that construction debris generated by nearshore and above water construction work would not enter or impact navigable waters. All applicable local, state and federal certifications and permits would be obtained prior to construction, including: Department of Army permit under Section 10 of the Rivers and Harbors Act, Section 404 of the CWA and GEPA, and Section 401 WQC.

Contaminated runoff or spills and leaks would have the potential to be transported, or directly released, to nearshore waters during construction activities in and adjacent to Apra Harbor. However, the OPA that mandates the implementation of the SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. As discussed in the above sub-section, Surface Water, all federal, GovGuam, and military orders, laws, and regulations, as well as protective measures such as the implementation of BMPs and the LID Plan, would be followed, which would also serve to reduce potential impacts to nearshore waters.

Under Alternative 1, the total dredged volume from Inner Apra Harbor (adjacent to Sierra and Tango Wharves) would be approximately 508,900 CY (386,000 cubic meters), including the overdredged material. Dredging would cover an area of approximately 0.2 mi^2 (0.5 km^2) and would remove approximately 5 ft (1.3 m) of substate including overdredged material deepening the area from -35 ft (-11 m) to -40 ft (-12 m). There is a potential to utilize dredged materials for beneficial purpose(s), including landfill cover, road base, backfill, beach re-nourishment, etc. Beneficial reuse is preferred and would be examined on a case-by-case basis. However, for the purposes of this analysis, the EIS/OEIS conservatively assumes that all dredged sediments would be placed at one of five potential upland sites at Naval Base Guam (Figure 4.2-1) for dewatering and reuse, or placed in a USEPA-approved Ocean



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Dredged Material Disposal Site (ODMDS) for Guam, or a combination of the two approaches (i.e., ocean disposal and upland placement). If a portion of the dredged sediments are utilized for beneficial reuse, then potential impacts at either of the analyzed disposal options would be reduced by an associated percentage. The receiver of any dredged material for a beneficial use would be responsible for any disposal or reuse. The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ODMDS, 100% disposal upland, 100% beneficial reuse, and 20-25% beneficial reuse/75-80% ocean disposal. The following sections present an analysis of the potential impacts to nearshore waters from proposed dredging activity.

Physical Impacts to Nearshore Waters from Dredging. Nearshore water quality would be temporarily impacted by turbidity and sediment generated during the dredging process. Dredged materials would be transported to existing upland disposal sites for dewatering or disposed of at an offshore site, if available and the dredged material is determined to be suitable.

Due to the fine-grained quality of the sediment, mechanical dredging using a traditional clamshell bucket would be used for analysis because it represents the maximum adverse environmental impact scenario in terms of water quality impacts. However, the use of an enclosed (i.e., environmental) bucket may required by permitting agencies to reduce the resuspension of sediments. Bucket dredges usually excavate a heaped bucket of dredged material, but during hoisting turbulence washes away part of the load. Once the bucket clears the water surface, additional losses may occur through rapid drainage of entrapped water and slumping of the material heaped above the rim of the bucket. The fit and condition of the bucket, the hoisting speed, and the properties of the sediment also influence loss of material (SAIC 2001).

The primary physical impact from mechanical dredging involves a disturbance to the marine environment that generally leads to re-suspension of sediments and increases in turbidity that could adversely affect marine corals and filter-feeding invertebrates. Selection and operation of the type of dredge as well as the type of sediment being dredged affect the degree of adverse impacts during dredging. Sediment loss to the water column reduces the efficiency of the dredging process, increases the size of the residual sediment plume, and compounds the impacts to the marine environment. The source of the suspended sediment plume is the sediment loss that occurs throughout the dredging process. The mechanical disturbance applied to the sediment, the ambient currents, and the composition of the sediment determines the magnitude of this loss (SAIC 2001).

The nature, degree, and extent of sediment re-suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, operational procedures used; and finally the characteristics of the receiving water in the vicinity of the operation, including seawater density, turbidity, and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing. The relative importance of the different factors would vary significantly from site to site (SAIC 2001).

Even under ideal conditions, substantial losses of loose and fine sediments would usually occur. Sediment loss during a typical mechanical bucket dredging operation occurs throughout the water column from the following specific sources: impact of the bucket on the seabed; material disturbance during bucket closing and removal from the bed; material spillage from the bucket during hoisting; material washed from the outer surfaces of the bucket during hoisting; leakage and dripping during bucket swinging; aerosol formation during bucket re-entry; and residual material washed during bucket lowering (SAIC 2001).

Based on limited measurements, it appears that, depending on current velocities, the uncontrolled turbidity plume downstream of a typical clamshell operation may extend approximately 990 ft (302 m) at the surface and 1,650 ft (503 m) near the bottom. Maximum concentrations of suspended solids in the

surface plume should be <0.5 ppt in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Average water-column concentrations should generally be <0.1 ppt. The near-bottom plume would probably have a higher solids concentration, indicating that re-suspension of bottom material near the clamshell impact point is probably the primary source of turbidity in the lower water column. The visible near-surface plume would probably dissipate rapidly within an hour or two after the operation ceases (SAIC 2001).

A primary influence on the plume is the composition of the sediment. If the sediment is sand, for instance, material released to the water column quickly settles out. Fine grained, silty sediment produces higher turbidity and would remain suspended in the water column while being subject to advection and diffusion, resulting in a larger plume footprint. It has been demonstrated that elevated suspended solids concentrations are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation (SAIC 2001). Sediment grain size analyses conducted for a Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves indicates that sediments in the area of the navigation channel and proposed turning basin consists primarily of sand and gravel with silty sediments being found along the proposed berthing areas (NAVFAC Pacific 2006).

The fine grain size of the material to be dredged at Sierra Wharf indicates that resuspended sediment would be slower to settle out of the water column when compared to Outer Harbor sediments. Mobile marine life would be able to avoid the sediment plume; however, sessile species would likely be removed by the dredging action and could become smothered during sediment settling.

Dredging of Inner Apra Harbor and subsequent handling of the dredged materials would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE and WQC from the GEPA. These permits would stipulate procedures and mitigation requirements. Elevation of 1 Nephalometric Turbidity Unit or 10% total suspended solids (TSS) over ambient conditions represents an exceedance of water quality standards for the project area, which is designated as M-2 or an area of "Good" water quality. Historically, the use of silt curtains and other potential mitigation measures have been implemented during dredging operations in Apra Harbor in order to protect corals and filter-feeding invertebrates by limiting the lateral dispersion of the dredged sediments. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the CVN berthing study and a detailed summary is included in Appendix D of Volume 9 (Ericksen 2009). Input parameters utilized for the model included: dredging production rate, percent bucket loss (TSS load), current patterns, sediment grain size distribution, water depth, and dredge location. The effects of silt curtains on TSS was also considered based on data collected during the previous dredging of Alpha-Bravo wharves. For that dredging project, TSS and turbidity was monitored both inside and outside of the silt curtain for 145 days. The results of the monitoring determined that the average TSS levels outside of the silt curtain were only 10% of the level inside the curtain (i.e., silt curtains retained 90% of the material inside). Possible maximum adverse environmental conditions were simulated by approximating the highest 10% TSS levels recorded outside of the silt curtain during the Alpha-Bravo dredging project, during strong trade wind conditions. Model runs were completed for nine different locations throughout the project area. The results of the modeling were that surface turbidity plumes exceeding background levels of 3 mg/L were generally predicted to occur only directly at the dredge site. Bottom plume concentrations exceeding the background levels of 3 mg/L typically extended 262 to 394 ft (80 to 120 m,) from the dredge site. The plumes rapidly dissipated following dredging.

Under Alternative 1, similar controls would be implemented to prevent sediments from migrating beyond the action area, including silt containment, and frequent monitoring during construction to ensure the

effectiveness of suspended sediment containment would be performed. Any exceedances of water quality standards would result in the interruption of the construction activities until the TSS levels returned to acceptable levels. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the action area.

Chemical Impacts to Nearshore Waters from Dredging. Resuspended sediment plumes may have chemical impacts on water quality by increasing the biological oxygen demand of the water column that could affect marine organisms, both on the seabed and in the water column as a result of a decrease in dissolved oxygen (DO). In addition, since contaminants have a tendency to adhere to sediment particles, a portion of the chemical burdens in the sediment would be released into the water column.

DO reduction due to dredging is a function of the amount of resuspended sediment in the water column, the oxygen demand of the sediment, and the duration of resuspension (LaSalle et al. 1991). Studies have indicated wide variations in DO levels associated with dredging from minimal, or no measurable reduction, to large reductions in DO levels (USACE 1998). The release of organic rich sediments during dredging or dredged material disposal can result in the localized removal of oxygen from the surrounding water. The resuspension of this material creates turbid conditions and decreases photosynthesis. The combination of decreased photosynthesis and the release of organic material with high biological oxygen demand can result in short-term oxygen depletion to aquatic resources (Nightingale and Simenstad 2001b in NOAA 2008). According to Herbich (2000), elevated suspended solids concentrations, and subsequent impacts on DO levels, are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation.

Contaminants are sequestered in the TOC fraction of sediments (USEPA 2003a in NOAA 2008, USEPA 2003b in NOAA 2008, USEPA 2003c in NOAA 2008). Dredging and disposal causes resuspension of the sediments into the water column and the contaminants that may be associated with the sediment particles. The disturbance of bottom sediments during dredging can release metals (e.g., lead, zinc, mercury, cadmium, copper), hydrocarbons (e.g., PAHs), hydrophobic organics (e.g., dioxins), pesticides, pathogens, and nutrients into the water column and allow these substances to become biologically available either in the water column or through trophic transfer (Wilbur and Pentony 1999 in NOAA 2008, USEPA 2000 in NOAA 2008, Nightingale and Simenstad 2001b in NOAA 2008).

Sediment grain size analyses conducted for a Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves indicates that sediments in the area of Sierra Wharf consists primarily of fine grained materials with relatively high amounts of TOC ($\leq$ 0.17 % dry weight) (NAVFAC Pacific 2006). As a result, these sediments have a higher potential to temporarily release contaminants to the water column and reduce DO when resuspended by dredging. Ambient water quality conditions are expected to return shortly after the completion of dredging, however, based on historical practices, controls would be implemented to prevent sediments from migrating beyond the action area, including silt containment and frequent monitoring of effectiveness of suspended sediment containment. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the action area.

Physical Impacts of Ocean Disposal of Sediment. There is the possibility that an ODMDS would be available for the placement of dredged material generated by this project should the dredged material pass chemical testing parameters for ocean disposal. A detailed discussion of the ODMDS is contained in the EIS for the ODMDS designation (USEPA 2009a).

There are a number of physical water quality effects resulting from the ocean disposal of dredged material. These effects include elevated suspended material concentration during hopper dumping, resuspension of sediments by currents, and a change in dredged sediment characteristics (size distribution

or sorting coefficient) versus adjacent unaffected areas. The extent of suspended materials concentrations increase during and after hopper dumping at open water disposal sites has been studied by transmissometer. NOAA (1974; 1975b,c in Navy 2004) showed that the suspended material concentration returned to ambient levels in both surface and near-bottom waters in under one hour.

As part of the Ocean Current Study conducted by Weston (NAVFAC Pacific 2007), the distribution of sediment during disposal activities was modeled using SSFATE. The modeling of a single disposal event predicted coarse grained material to settle to the seafloor within 32 hours of the disposal event, with gravel material settling directly beneath the disposal site and sand material being deposited within 4.1 nautical miles (nm) (7.6 km), nearly radially, of the disposal site. Only a small percentage of the fine-grained material settled within the time limits of the model, with silt and clay deposits predicted over the entire area (219 square nm [nm^2] [752 km^2]).

As the current data would suggest, the footprint of material deposited on the seafloor is elongated toward the northeast having a width of 6.5 nm (12.0 km) and a length of 8.1 nm (15.0 km). This is most evident in the disposal of fine-grained material that would tend to stay in suspension the longest. At the proposed ODMDS, the footprint of deposits thicker than 0.04 inch (1 millimeter) is contained within a bathymetric depression, in depths of approximately 8,530 ft (2,600 m) at the disposal site and shoaling at the northwestern, northeastern and southeastern edges of the footprint to about 7,220 ft (2,200 m).

The possibility of resuspension of dumped sediments has been studied at open water disposal sites (SAIC 1980, 1989) as part of the disposal area monitoring system monitoring. Generally, these studies have found that ocean disposal mounds sited within depositional areas at proper depth were quite stable even during storm events. As a result, there would be no significant impacts to nearshore waters from the disposal of dredged material at an ODMDS.

Chemical Impacts of Ocean Disposal of Sediment. As part of monitoring studies of disposal sites in Long Island Sound (CT/NY), chemical measurements suggested that only minor and transient alterations in the water column occurred during hopper discharges. As expected the redox potential (Eh), pH, turbidity, DO, suspended or volatile solids all showed some seasonal variation in concentration but no consistent patterns relative to disposal site proximity were noted (NOAA 1974 in Navy 2004; 1975a,b,c,d,e in Navy 2004; 1976a,b in Navy 2004). The DO concentration in near-bottom waters only decreased 30%, returning to pre-disposal levels in less than 40 minutes (NOAA 1975b in Navy 2004). The pH was reduced very slightly after a hopper discharge but returned to pre-placement values in less than 30 minutes. Surface turbidity in the barge wake quickly disappeared. Suspended and volatile solids increased dramatically in near-bottom waters following a hopper dump but returned to background values in less than 33 minutes (NOAA 1975c in Navy 2004). Occasionally there were transient and slight increases in TOC within 1 mi (1.6 km) of the disposal buoy (NOAA 1975b in Navy 2004). Water column currents aid in the dissipation of any chemical effect. Given relatively high currents in the water column over the proposed ODMDS, the chemical effects of hopper discharge are expected to disperse rapidly and the ambient conditions return shortly after disposal.

Dredged material disposal is expected to produce temporary and localized impacts at the proposed ODMDS, including increased turbidity and decreased light transmittance due to the suspension of sediments (finer-grained silts and clays). The degree of suspension of sediments from dredged material disposal depends on four main variables; size, density and quality of the dredged material; method of disposal; hydrodynamic regime of disposal area; and ambient water quality and characteristics of the disposal site. During suspension and settling, changes in physical and chemical conditions may lead to the desorption of particulate-bound contaminants into the water column. Potential toxicity and

bioaccumulation could potentially result from biologically available, desorbed heavy metals and anthropogenic organics. Dissolved contaminants may in turn be sequestered from the water column by mechanisms such as the re-adsorption (onto sediment particles which eventually settle out of the water column), precipitation processes, redox transformations, uptake by aquatic life, degradation, and volatilization. The release of organic-rich sediments during disposal into environments adapted to low nutrient conditions can also result in eutrophication effects such as the localized confiscation of oxygen in the surrounding water column.

All material would be tested for the presence of contaminants as well as the potential for toxicity and bioaccumulation prior to dredging using national testing guidance (USEPA and USACE 1991). Numerical modeling may be conducted using chemistry concentrations of proposed dredged material to determine the diluted concentration of potential contaminants in the water column. These modeled results would be compared to water quality criteria to determine suitability for ocean disposal. Only dredged material deemed suitable under these protocols would be permitted for disposal at an ODMDS. Screening of the dredged material would ensure that no significant effects to water quality would result from the ocean disposal of the dredged material at the ODMDS.

Overall, potential impacts on water quality from suitable dredged material permitted for ocean disposal at the ODMDS site are expected to be transient and localized (i.e., contained within the overall boundary of the disposal site) within four hours of the initial disposal activity (USEPA 2009a). Significant dilution is expected to mitigate any potential impacts caused by sediments remaining in suspension beyond the boundary of the disposal site for longer than four hours. With the implementation of potential mitigation measures as identified in Section 4.2.2.6, construction activities associated with Alternative 1 at Apra Harbor would result in less than significant impacts to nearshore waters.

Impacts of Upland Placement Site Placement to Nearshore Waters. During most rainfall events, stormwater runoff from within the upland placement facilities is not expected; however, during extended periods of intense rain, infiltration rates may be exceeded and temporary discharge of stormwater may occur. Stormwater runoff could flow to the Inner Apra Harbor, Outer Apra Harbor or the Pacific Ocean, depending on the upland placement site chosen. In NAVFAC Pacific (2005), the stormwater effluent constituents of concern identified were ammonia as nitrogen, copper, cyanide, mercury, total sulfide, and tributyltin. Predicted concentrations of these analytes, except tributyltin, would require dilution at the discharge point to attain the GEPA chronic marine standards. Total sulfide concentrations would require the greatest dilution (a factor of 9). Based on the analysis, GEPA chronic marine WQS would be met at 9.5 ft (2.9 m) from the discharge point. According to GEPA (GEPA 2001), mixing zones (i.e., dilution of effluent at receiving water as treatment) may be permitted during the NPDES permit process on a case-by-case basis after analysis of the nature of the effluent. A mixing zone that provides a 9:1 dilution would reduce all contaminant concentrations to below GWQS.

The potential impacts associated with Polaris Point upland placement site are addressed in *Final Environmental Assessment Inner Apra Harbor Dredging, Guam* (Navy 2003). This document stated there would be no significant impact to nearshore waters. It stated that there would be a return flow and runoff from the upland placement site to the Inner Apra Harbor. The length of the mixing zone associated with contaminants, except ammonia-N would be less than 10 ft (3 m). To meet the Guam marine WQS for ammonia-N, a mixing zone of approximately 1,400 ft (427 m) would be required. Management controls for discharge would include controlling weir height and water retention, and water quality monitoring. Discharges would be temporary and not anticipated to disrupt the use of the water body. The potential impacts associated with upland placement sites, Field 3 and Field 5 are discussed in *Environmental*

Assessment Alpha-Bravo Wharves Improvement, Apra Harbor Naval Complex, Guam, Mariana Islands (Navy 2006). This document states that there would be minor construction phase impacts to nearshore waters, yet the GWQS would be met.

The dredged material would be dewatered in accordance with USACE and Guam permitting requirements. Therefore, with the implementation of mitigation measures as identified in Section 4.1.2.4, construction activities associated with Alternative 1 would result in less than significant impacts to nearshore waters.

Wetlands. During dredging activities, there is the potential for sediment to increase turbidity in the vicinity of harbor wetlands. The nearest wetlands to the dredging operations in Inner Apra Harbor are the Atantano Wetlands located approximately 2,000 ft (610 m) east of the nearest extent of proposed dredging operations (Figure 4.2-2). Other wetland areas (Wetland Areas O, P, and Q) located in the south/southeastern portion of Inner Apra Harbor are located approximately 3,600 ft (1,098 m) at their nearest extent to proposed dredging operations (see Figure 4.2-2).

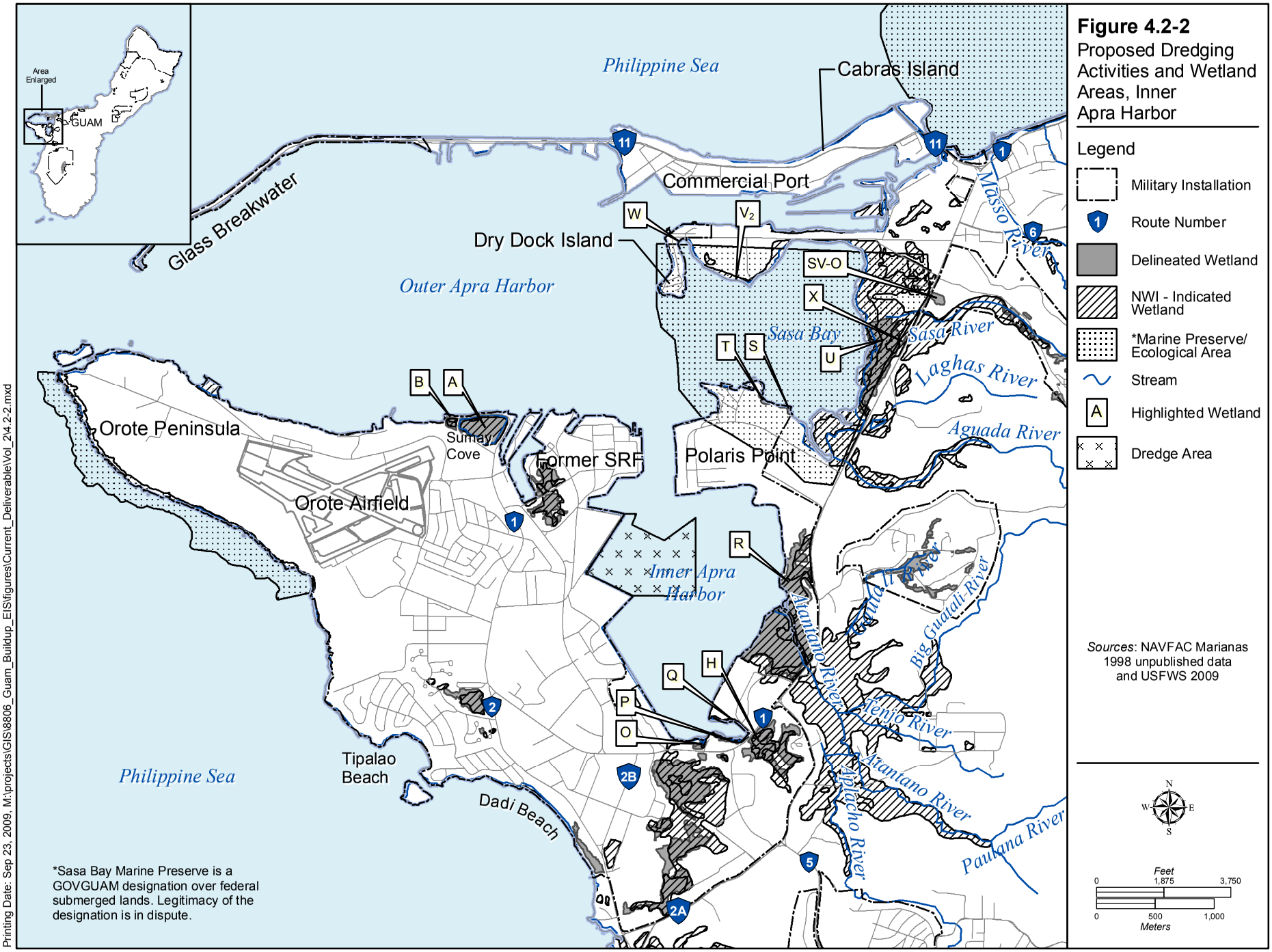
Silt curtains and other potential mitigation measures would be used, consistent with past dredging operations in Apra Harbor, to protect sensitive areas including wetlands. While no direct impact (i.e., loss of wetland area) would occur, activities associated with Alternative 1 could temporarily impact the function of the wetland areas. For example, dredge activities could introduce additional sediment into the water column which could then (depending on the currents) be transported to wetland areas where it could settle out in the wetland area. However, these potential impacts would be lessened due to the implementation of dredging BMPs and associated potential mitigation measures, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Inner Apra Harbor is generally westward, away from the wetland areas). Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to wetlands.

Operation

Nearshore Waters. Due to the frequency and duration of the amphibious task force visits, the ships require more shoreside utility support than is currently provided. There would be utility, infrastructure and wharf improvements at Victor, Uniform and Sierra Wharves to allow the ships to turn-off all onboard utility systems and rely entirely on shoreside systems for wastewater and bilge oily waste treatment system. A new bilge oily waste treatment system facility would be constructed at Victor Wharf but serve other wharves including Sierra and Uniform Wharves. As a result the increase in bilge oily waste would have no impact on nearshore water quality as it would be properly treated and disposed of.

The landing craft air cushion vessels and amphibious assault vehicles would be washed on wash racks. While the final design of the wash system is pending, the facility would include sedimentation, oil/water separator/filter pressure buster pumps and pressure, and filters. The wastewater from the system would then be discharged into the sanitary sewer. Therefore, operations associated with Alternative 1 at the Apra Harbor area would result in less than significant impacts to nearshore waters.

Wetlands. The construction and operation water treatment systems would not affect wetland areas in Inner Apra Harbor. Therefore, operations associated with Alternative 1 at the Apra Harbor area would result in no impacts to wetlands.



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Naval Base Guam

Construction

Surface Water. Under Alternative 1, proposed construction of the embarkation facility, landing craft air cushion vessel parking area, medical/dental complex, MWDK relocation area, and USCG cutter support facilities would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts.

The closest proposed construction activity in support of waterfront functions would be located more than 1,500 ft (457 m) from any of the four streams that flow into Apra Harbor. Due to the lack of close proximity to the streams, implementation of Alternative 1 is not anticipated to directly impact these streams. However, during the construction phase of the proposed project, there is a potential to increase the amount of sediment in the runoff that could eventually flow into area streams. The sediment can transport other constituents such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. In addition, there is an increased potential for leaks and spills of POLs or other contaminants from equipment. To minimize these potential impacts, construction-specific BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. Proposed construction activities would not occur within the 100-year flood zone.

Under Alternative 1, dredged material would be placed in upland placement facilities, bounded by confinement dikes or structures to enclose the disposal area, thereby isolating the dredged material from its surrounding environment. Five potential upland placement facilities have been identified at Naval Base Guam, none of which would be located on a surface water feature (refer to Figure 4.2-1). Upland placement facilities would consist of a fully diked area located above the water line and out of wetland areas. Following placement of dredged material, the sediments would be allowed to consolidate, settle, and dewater. Water would evaporate or percolate into the ground.

Water generated from mechanically dredged material (i.e., effluent) would not require discharge because infiltration rates of the foundation soils are greater than effluent production rates (NAVFAC Pacific 2005). To facilitate rapid infiltration, trenches would be constructed to allow water to reach foundation soils. The exterior slope of the dredge upland placement facility berms would be seeded with grass to minimize erosion. Based on recent Inner Apra Harbor maintenance dredged material placement experience that used the same dredging and dredged material handling methods, little water would accumulate in the upland placement sites. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to surface water.

Groundwater. Although the project area at Naval Base Guam is located over 4 mi (7 km) west of the NGLA, spills and leaks from POLs or hazardous materials would have the potential to impact groundwater quality in the project area. The BMPs and follow-on measures and plans identified under the surface water discussion would also serve to protect groundwater quality in the area. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to groundwater.

Nearshore Waters. During construction operations under Alternative 1 at Naval Base Guam, contaminated runoff or spills and leaks could be transported to or directly released to nearshore waters. However, the OPA that mandates the implementation of the SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. As discussed in the above sub-section, Surface Water,

all federal, GovGuam, and military orders, laws, and regulations, as well as protective measures such as the implementation of BMPs and the LID Plan, would be followed, which would also serve to reduce potential impacts to nearshore waters. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to nearshore waters.

Wetlands. Known wetland areas are at least approximately 250 ft (76 m) from the construction areas associated with Alternative 1 at Naval Base Guam and even further from potential dredged material upland placement sites (see Figure 4.2-1); therefore no direct impacts to wetlands would occur during construction activity. Potential indirect impacts are not likely due to implementation of surface water BMPs. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in no impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) associated with the Orote Landing Zone at Naval Base Guam would have no effect on water resources. Consequently, no impact analysis of flight operations on water resources was conducted.

Surface Water. Under Alternative 1, the total amount of impervious area at Naval Base Guam would increase by approximately 16 ac (6 ha) from 14.7% to 15.2% impervious area, for a total of 520 ac (211 ha). This increase of 0.5% impervious area would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Furthermore, stormwater would be pre-treated to remove contaminants prior to discharge into the harbor, as detailed in a design-phase plan that would cover the entire project area.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. Alternative 1 at Naval Base Guam would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment.

Implementation of Alternative 1 at Naval Base Guam would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), as well as the implementation of BMPs and LID. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at Naval Base Guam, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect local groundwater quality. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in no significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic

compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in no impacts to wetlands.

4.2.2.4 South

Naval Munitions Site

Construction

Surface Water. Under Alternative 1, proposed munitions storage and non-fire training construction activities at the NMS would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to surface water.

Groundwater. Although southern Guam is volcanic rock with low permeability, spills and leaks from POLs or hazardous materials have the potential to impact local groundwater basins. Under Alternative 1, construction activities would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures would reduce the pollutant loading potential into stormwater and, thus, groundwater. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 1 would occur more than 1 mi (1.6 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to nearshore waters.

Wetlands. Based on the original conceptual drawings for the magazines under Option 1 (Parsons Road Area) and Option 2 (High Road Area) direct impacts (fill) of wetland areas would have occurred. In the course of analyzing potential impacts, the EIS/OEIS team recognized this potential impact and also the potential opportunity to shift the footprint of the magazines slightly to avoid wetland areas. After considering this potential change in design, planners determined it was possible to shift the magazines slightly to avoid direct impacts to Wetland Area 52 and the NWI-indicated wetland area (Figure 4.2-3). This revision resulted in avoiding 0.68 ac (0.28 ha) and 0.04 ac (0.01 ha) of direct impacts to wetland areas under Option 2 and 1, respectively. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the FEIS.

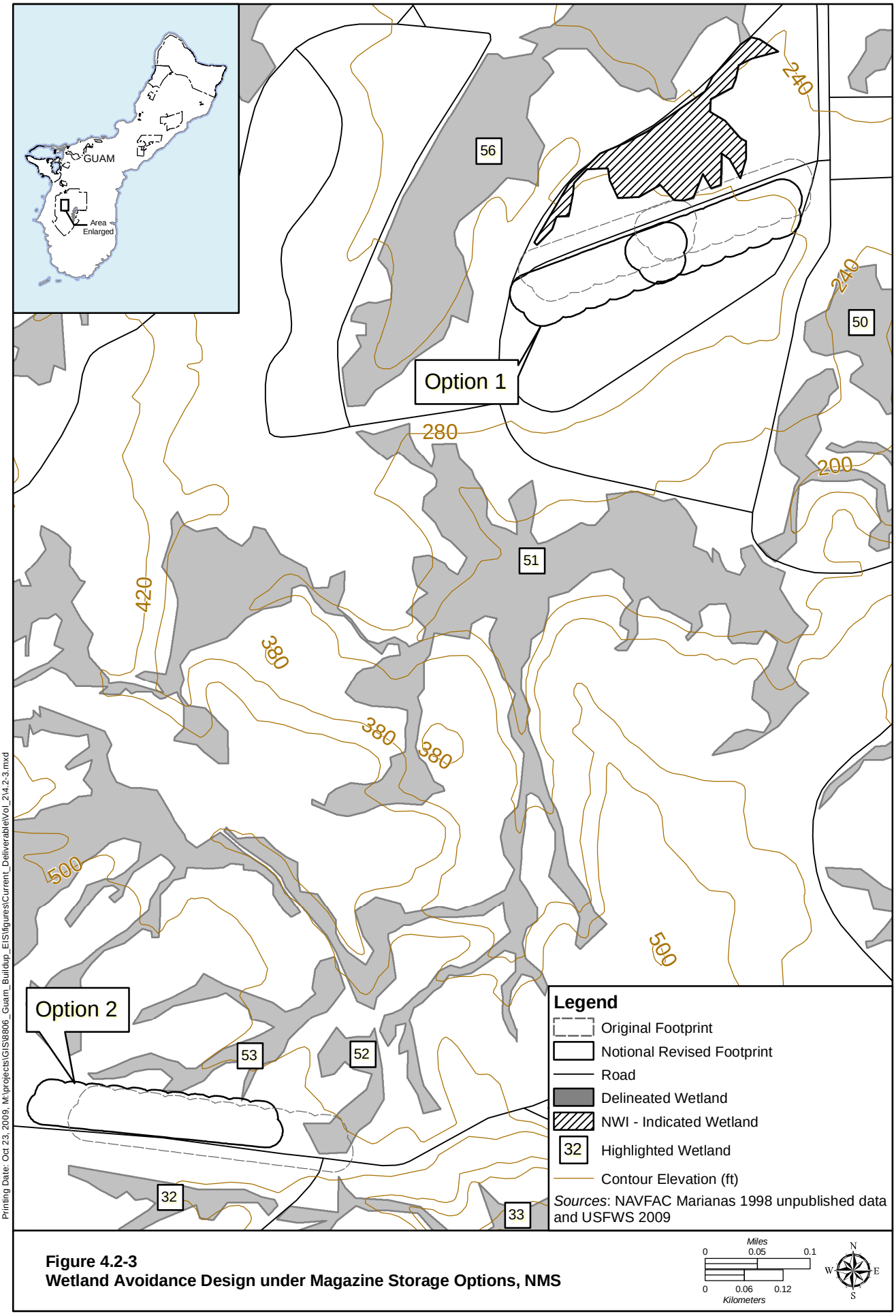

Figure 4.2-3
Wetland Avoidance Design under Magazine Storage Options, NMS

During construction, indirect impacts to nearby wetland areas (i.e., 32, 33, 52, 53, 50, 51, and 56) would be minimized by incorporating site-specific appropriate BMPs (see Table 4.2-1) which would reduce the potential for construction impacts to these wetland areas. Therefore, Alternative 1 at NMS would result in less than significant impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) with the four new landing zones at NMS would have no effect on water resources. Consequently, no impact analysis of flight operations on water resources was conducted.

Surface Water. No live fire maneuver training would occur at NMS and the majority of the maneuver training area is located south and downgradient of Fena Reservoir. The grass-covered magazines would not alter existing stormwater runoff volumes due to their surface cover consistency with the surrounding vegetation. Stormwater flow paths would continue to mimic pre-development flows through area topography. In addition, the Navy plans to conduct a Watershed Assessment of Fena Reservoir, which would include a follow-on watershed management plan. The results of the assessment and elements of the watershed management plan will be incorporated into future interations of this EIS/OEIS.

Alternative 1 would be implemented in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed foot, wheeled, and tracked vehicle traffic near and through numerous surface water drainage feature crossings throughout the southern portion of NMS has the potential to result in localized, temporary impacts to surface water quality. To avoid excess sediment entering into stream channels, buffer zones would be established to prohibit training within 100 ft (30 m) of the stream channel except at designated crossings. Upon completion of transit through the stream crossing, any localized impacts to water quality would dissipate and revert to pre-disturbance conditions. There would be no anticipated long-term impairment to surface water drainage feature function due to the localized, temporary, and BMP-governed nature of operations in and around the surface water crossings.

Proposed training activities would also include the use of explosives. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from MEC. In addition, the low volume use of explosives during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of explosives and pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Implementation of Alternative 1 at Andersen South would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4, as well as the implementation of BMPs. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. As noted in the baseline section, the increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a to-be-developed site would no longer reach the groundwater basin directly below the developed area, through the implementation of BMPs and LID measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. At NMS, the increase in impervious area would be minor, and LID measures would ensure that stormwater flow paths would continue to mimic pre-development flows, thus reducing the potential impact on groundwater recharge and surface base flow. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to nearshore waters.

Wetlands. Post-construction, wetland areas would potentially be subject to localized, temporary impacts from training traffic (i.e., foot traffic). However, existing training protocols encourage the avoidance of wetland areas. Vehicle traffic would avoid wetland areas during training activities. While short-term minor impacts to wetlands could occur from personnel operations, impacts would be less than significant due to the transient and low-impact nature of the activity. Surface water quality measures identified above would reduce the potential for contaminants from explosives and pyrotechnics from impacting wetland quality of function.

Both magazine storage alternatives would be constructed with earthen vegetated covers. This would reduce the potential for a change in surface water hydrology in the area as the resulting cover would be similar to surrounding vegetation and thus, minimize the potential for indirect impacts to adjacent wetlands. In addition, transient training operations would not alter the water flow to wetland areas; therefore, no indirect operational impacts to wetland areas are anticipated. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to wetlands.

Non-DoD Land

Construction

Under Alternative 1, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

Surface Water. Under Access Road Alternative A, general construction BMPs (Section 4.1, Volume 1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts.

Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Although southern Guam is volcanic rock with low permeability, spills and leaks from POLs or hazardous materials during access road construction activities associated with Access Road Alternative A would have the potential to impact local groundwater basins. Under Alternative 1, access road construction activities would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 1 would occur more than 1 mi (0.7 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by construction activities associated with Alternative 1, Access Road Alternative A as no delineated wetland areas are located in the existing roadway. Therefore, access road construction activities associated with Alternative 1 on non-DoD lands would result in no impacts to wetlands.

Operation

As part of proposed operations, under Access Road Alternative A the existing trail would be improved (paved) and receive about the same level of use as it does currently. However, under Aceess Road Alternative B, the trail would not be improved but the trail would get more use. However, the additional use under Alternative B would result in no impacts to water resources. Therefore, the following operation impact analysis focuses on potential operation impacts associated with Access Road Alternative A.

Surface Water. The operational phase of Alternative 1 on non-DoD lands would result in a minor increase in stormwater runoff due to changing the land cover to a more impervious surface for the improved road. This alteration would result in an associated nearly negligible increase in stormwater discharge intensities and volume. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Implementation of Alternative 1 would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the Surface Water section above during operations, which would

therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Operations would comply with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be directly affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. No changes in surface hydrology are expected, and thus, indirect impacts to wetlands are not anticipated. Therefore, operations associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

4.2.2.5 Summary of Impacts

With the implementation of potential mitigation measures (Section 4.2.2.6 below) to compensate for direct impacts resulting from the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Increases in stormwater would be managed by stormwater infrastructure and aside from the potential for constructing six stream crossings on non-DoD land, no construction would occur in a flood zone; therefore, there would be no increase in flooding risk. Stormwater flow paths would continue to mimic area topography. Through the development and implementation of site-specific BMPs (Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. During the dredging process, BMPs would be implemented to prevent pollutants from entering the water. Dredged material upland placement areas would be constructed and operated in accordance with all permit requirements. Project-related materials and equipment would be cleaned of pollutants prior to use in the water. A complete list of BMPs typically required by USACE dredging permit conditions is provided in Volume 7. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, with the implementation of impact avoidance and minimization measures, Alternative 1 would result in less than significant impacts to water resources.

4.2.2.6 Potential Mitigation Measures

The dredging of Inner Apra Harbor and subsequent handling of the dredged material would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE and WQC from the GEPA. These permits would stipulate procedures and mitigation requirements in addition to BMPs noted above. Examples of potential mitigation measures (from USACE 2001 and Palermo et al. 2008) include:

- Install physical barriers such as silt curtains or pneumatic (bubble) curtains.

- Dredge within seasonal windows to avoid impacts to larval coral and other sensitive aquatic species during peak spawning periods
- Avoid dredging during rough sea conditions to minimize turbidity curtain failures
- Prohibit barge overflow during dredging operations
- Limit dredging rates
- Monitor water quality

During the dredging process, potential mitigation measures as identified above would be implemented to prevent sediments from migrating beyond the action area, including silt containment measures and frequent monitoring of effectiveness of suspended sediment containment. The sedimentation controls and potential mitigation measures would prevent significant impacts to nearshore waters.

A detailed description of resource protection measures potentially required by regulatory mandates is in Volume 7. A more detailed explanation of potential regulatory permitting requirements is also available in Volume 8 (refer to Table 3.1-1).

4.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 differs from Alternative 1 (Volume 2, Chapter 2, DOPAA) in the area of the main cantonment. For Alternative 2: the main cantonment, housing/community support, and non-fire training facility areas would be configured such that all facilities would be located on one contiguous parcel of land extending from NCTS Finegayan, through the former FAA parcel, and to South Finegayan. By placing all facilities on one contiguous parcel, the amount of area disturbed during construction would be slightly less than under Alternative 1, resulting in slightly less impacts to water resources under Alternative 2. However, this difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 2 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.3.1 North

Andersen AFB

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at Andersen AFB would result in less than significant impacts to water resources.

Finegayan

Under Alternative 2, construction and operational activities would occur at NCTS Finegayan and South Finegayan. Therefore, this analysis evaluates potential impacts at both locations.

NCTS Finegayan

Construction. Although some of the specific main cantonment laydown components are different and the area of development at NCTS Finegayan would be slightly larger, the proposed cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan under Alternative 2 are similar for those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be similar to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at NCTS Finegayan would result in less than significant impacts to water resources.

Operation. Under Alternative 2, the total amount of impervious area at NCTS Finegayan would increase by 2,104 ac (851 ha). This increase from 5.5% to 92.5% impervious area, for a total of 2,236 ac (905 ha) would result in an associated increase in stormwater discharge intensities and volume. However, this increase would be primarily accommodated by stormwater infrastructure and include the incorporation of LID capable of conveyance and storage of runoff associated with the 100-year storm as described under Alternative 1.

Proposed operational activities at NCTS Finegayan under Alternative 2 are similar for those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be similar to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at NCTS Finegayan would result in less than significant impacts to water resources.

South Finegayan

Construction. The area of development and the proposed construction activities at South Finegayan under Alternative 2 are identical to those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at South Finegayan would result in less than significant impacts to water resources.

Operation. The proposed operational activities under Alternative 2 at South Finegayan are identical to those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Construction

The area of development and the proposed construction activities on non-DoD land (the former FAA parcel) under Alternative 2 are identical for those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, except no construction and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components on non-DoD land (the former FAA parcel) under Alternative 2 are identical to those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, except no operations and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on non-DoD land would result in less than significant impacts to water resources.

4.2.3.2 Central

Andersen South

Construction

The proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are identical to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Navy Barrigada

Alternative 2 would not occur at Navy Barrigada; there would be no construction or operations at this location. Therefore, Alternative 2 at Navy Barrigada would result in no impacts to water resources.

Air Force Barrigada

Alternative 2 would not occur at Air Force Barrigada; there would be no construction or operations at this location. Therefore, Alternative 2 at Air Force Barrigada would result in no impacts to water resources.

Non-DoD Land

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 on Route 15 land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would

be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on Route 15 land would result in less than significant impacts to water resources.

4.2.3.3 Apra Harbor

Harbor

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.3.6, construction activities associated with Alternative 2 at Apra Harbor would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, Alternative 2 at the Apra Harbor would result in less than significant impacts to water resources.

Naval Base Guam

Construction

The proposed construction activities at Naval Base Guam are the same all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Naval Base Guam would result in less than significant impacts to water resources.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at the Naval Base Guam would result in less than significant impacts to water resources.

4.2.3.4 South

Naval Munitions Site

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at NMS would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Under Alternative 2, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, non-DoD land. Therefore, with implementation of mitigation measures as identified in Section 4.2.3.6, access road construction activities associated with Alternative 2 on non-DoD land would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on non-DoD land would result in no impacts to water resources.

4.2.3.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor , there would be no reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial useThrough the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 2 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 2 would result in less than significant impacts to water resources.

4.2.3.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 2 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.5, Potential Mitigation Measures.

4.2.4 Alternative 3

Alternative 3 is only slightly different from Alternative 1 (refer to Volume 2); the main difference is that the proposed cantonment, housing/community support, and non-fire training facility areas would also configured such that all facilities would be spread out between NCTS Finegayan, South Finegayan, the Navy Barrigada, and the Air Force Barrigada. By constructing the facilities over several areas, the amount of area disturbed during construction would be slightly more than under Alternative 1, resulting in slightly greater impacts to water resources under Alternative 3. However, this small difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 3 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.4.1 North

Andersen AFB

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at Andersen AFB would result in less than significant impacts to water resources.

Finegayan

Construction

The area of development and the proposed construction activities at NCTS and South Finegayan under Alternative 3 are identical to those associated with Alternative 2; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 2. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components at NCTS and South Finegayan under Alternative 3 are identical to those associated with Alternative 2; therefore, potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 2. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Alternative 3 would not occur on non-DoD land (the former FAA parcel and the Harmon Annex); there would be no construction or operations at these locations. Therefore, Alternative 3 on non-DoD land (the former FAA parcel and the Harmon Annex) would result in no impacts to water resources.

4.2.4.2 Central

Andersen South

Construction

Proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Navy Barrigada

Construction

Surface Water. Under Alternative 3, proposed cantonment, housing/community support, and non-fire training facility construction activities at Navy Barrigada would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 3.1-1, Volume 1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3, construction activities at Navy Barrigada would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 3 at Navy Barrigada would occur more than 0.5 mi (0.8 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore,

construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 3 at Navy Barrigada. This will be verified as part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 3, the total amount of impervious area at Navy Barrigada would increase by 377 ac (153 ha). This increase from approximately 0.35% to 27.4% impervious area, for a total of 382 ac (155 ha), would result in an associated increase in stormwater discharge intensities and volume. This increase would be primarily accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 3 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 3 at Navy Barrigada would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 3. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3 at Navy Barrigada, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The

project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 3 at Navy Barrigada as no delineated wetland areas are located near the proposed operational areas. All currently known delineated and potential wetland areas are located at least 1,200 ft (366 m) and across varying topography (i.e., hills and depressions) from the project area associated with Alternative 3. This will be confirmed as part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in no impacts to wetlands.

Air Force Barrigada

Construction

Surface Water. Under Alternative 3, proposed cantonment, housing/community support, and non-fire training facility construction activities at Air Force Barrigada would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3, construction activities at Air Force Barrigada would include surface water protection measures would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 3 at Air Force Barrigada would occur less than 0.5 mi (0.8 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. Implementation of Alternative 3 would result in direct impacts to Wetland Area BARR-04, a 0.4 ac (0.16 ha) sinkhole wetland (Figure 4.2-4). The Navy would strive to avoid directly impacting, to the greatest extent possible, this wetland area in the design and implementation phases of Alternative 3 at Air Force Barrigada; however, for the purposes of this analysis at this time, it is assumed direct impacts would occur. During construction, indirect impacts to other nearby down-gradient wetland areas (i.e., BARR-03) would be minimized by incorporating site-specific appropriate BMPs (Volume 1, Section 4.1) that would reduce the potential for construction impacts to these wetland areas. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

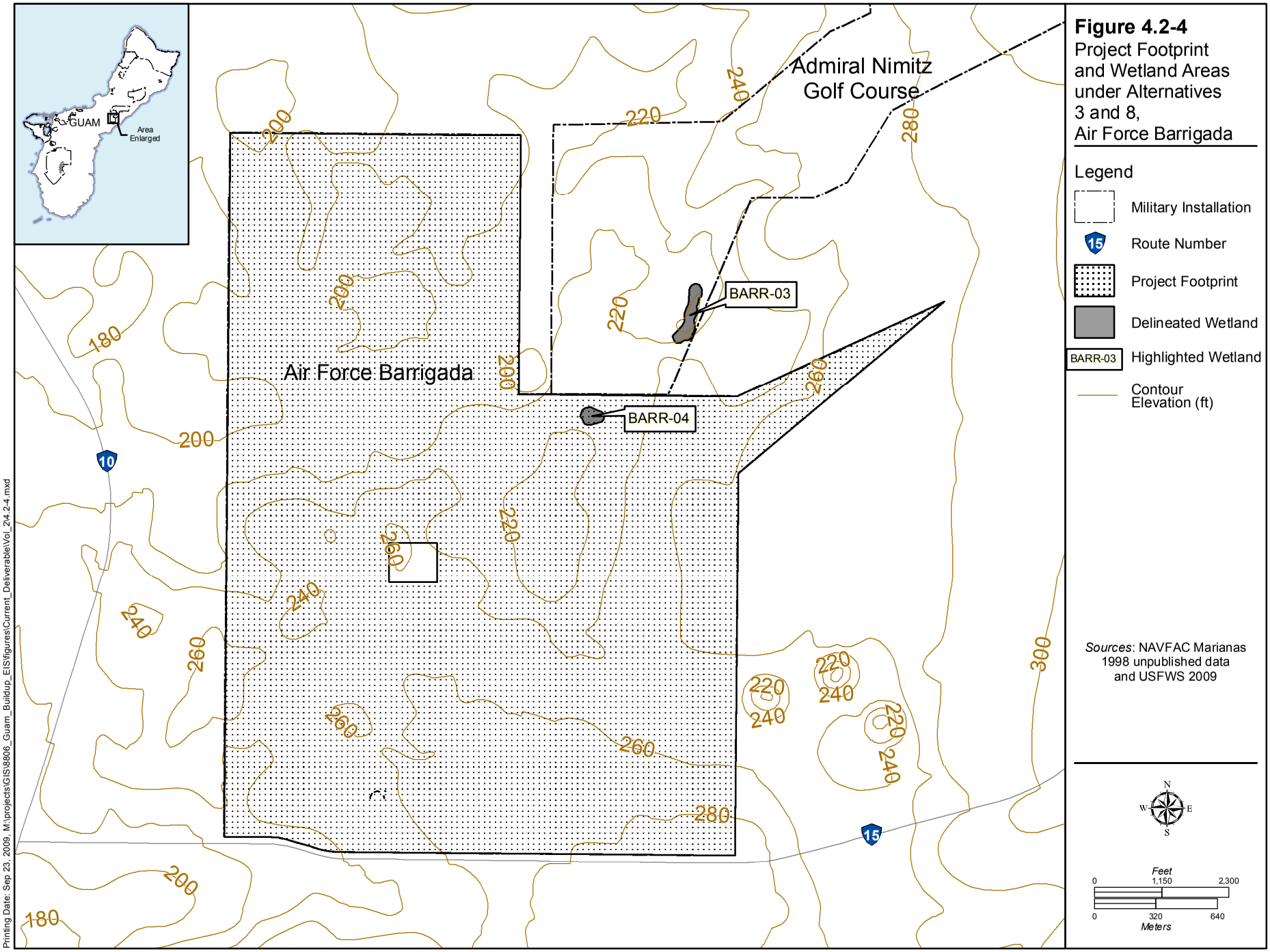

Figure 4.2-4
Project Footprint and Wetland Areas under Alternatives 3 and 8, Air Force Barrigada

Legend

- Military Installation
- Route Number
- Project Footprint
- Delineated Wetland
- BARR-03 Highlighted Wetland
- Contour Elevation (ft)

Sources: NAVFAC Marianas 1998 unpublished data and USFWS 2009

N W E S

Feet
0 1,150 2,300
0 320 640
Meters

Aside from BARR-03 and BARR-04, the NWI-indicated wetland areas are not considered official wetland areas; they just indicate the potential for wetland type areas. As observations by wetland biologists did not indicate wetlands in these areas and the areas are currently devoted to agriculture activities, this analysis concludes that these potential wetland areas do not exist. Therefore, with implementation of the mitigation measures identified in Section 4.2.4.6, construction activities associated with Alternative 3 would result in less than significant impacts to water resources.

Operation

Surface Water. Under Alternative 3, the total amount of impervious area at Air Force Barrigada would increase by 430 ac (174 ha). This increase from 1.9% to 100% impervious area, for a total of 430 ac (174 ha) of impervious surface would result in an associated significant increase in stormwater discharge intensities and volume for Air Force Barrigada. This area would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present). However, an increase to 100% in impervious area for Air Force Barrigada is assumed for this analysis and represents the maximum environmental adverse impact scenario. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 3 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 3 at Air Force Barrigada would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants.

The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 3. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3 at Air Force Barrigada, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and

regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 3 at Air Force Barrigada as following construction, no delineated wetland areas would be located near the proposed operational areas. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in no impacts to wetlands.

Non-DoD Land

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 on Route 15 lands would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 on Route 15 lands would result in no impacts to water resources.

4.2.4.3 Apra Harbor

Harbor

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with the implementation of mitigation measures as described in Section, 4.2.4.6, construction activities associated with Alternative 3 at Apra Harbor would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, Alternative 3 at the Apra Harbor would result in less than significant impacts to water resources.

Naval Base Guam

Construction

The proposed construction activities at Naval Base Guam are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated Alternative 3 at Naval Base Guam would result in less than significant impacts to water resources.

4.2.4.4 South

Naval Munitions Site

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at NMS would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Under Alternative 3, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, the proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1, non-DoD land. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.4.6, access road construction activities associated with Alternative 3 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 on non-DoD land would result in less than significant impacts to water resources.

4.2.4.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor, Wetland Area BARR-03 at Air Force

Barrigada, there would be no reduction in the amount of wetlands on Guam. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Through the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 3 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 3 would result in less than significant impacts to water resources.

4.2.4.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 3 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.6, Potential Mitigation Measures. In addition, to compensate for the potential filling of Wetland Area BARR-04, the Navy would first attempt to avoid impacts; if avoidance is not possible, then the Navy would minimize potential impacts. Potential impacts would then be mitigated, through restoring temporarily disturbed wetland areas and monitoring stream segments to determine and mitigate any loss of aquatic functions. Compensation for the unavoidable fill of the wetland area would be accomplished by creating new wetlands, restoring or enhancing existing wetlands or preserving existing wetland areas on Guam to, at a minimum, replace the area filled. The Navy would also obtain a USACE permit for actions within wetland areas and would comply with the permit requirements. If this alternative is chosen, the Navy understands that a LEDPA determination must be made as part of the permitting process.

4.2.5 Alternative 8

Alternative 8 differs from Alternative 1 (refer to Volume 2, Chapter 2) in that the main cantonment, housing/community support, and non-fire training facility areas would be configured such that all facilities would be spread out between NCTS Finegayan, the former FAA parcel, South Finegayan, and the Air Force Barrigada. By constructing the facilities over several areas, the amount of area disturbed during construction would be slightly more than under Alternative 1, resulting in slightly greater impacts to water resources under Alternative 8. However, this difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 8 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.5.1 North

<u>Andersen AFB</u>

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Andersen AFB would result in less than significant impacts to water resources.

Finegayan

Construction

The area of development and the proposed construction activities under Alternative 8 are identical to those under Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components at NCTS and South Finegayan under Alternative 8 are identical to those associated with Alternative 1;therefore, potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Proposed construction activities at the former FAA parcel under Alternative 8 are the same as those described under Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, except no construction and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at the former FAA parcel would result in less than significant impacts to water resources.

Operation

Proposed operational activities at the former FAA parcel under Alternative 8 are the same as those under Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, except no operations and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the former FAA parcel would result in less than significant impacts to water resources.

4.2.5.2 Central

Andersen South

Construction

The proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would

be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Alternative 8 would not occur at Navy Barrigada; there would be no construction or operations. Therefore, Alternative 8 at Navy Barrigada would result in no impacts to water resources.

Construction

The proposed construction activities at Air Force Barrigada under Alternative 8 are the same as those described under Alternative 3; potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 3. Refer to Section 4.2.4.2. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to water resources.

Operation

The proposed operations at Air Force Barrigada under Alternative 8 are the same as those described under Alternative 3; potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 3. Refer to Section 4.2.4.2. Therefore, operations associated with Alternative 8 at Barrigada would result in less than significant impacts to water resources.

Non-DoD Land

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8, would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 on non-DoD land in the central area would result in less than significant impacts to water resources.

4.2.5.3 Apra Harbor

Harbor

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, construction activities associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the Apra Harbor would result in less than significant impacts to water resources.

Naval Base Guam

Construction

The proposed construction activities at Naval Base Guam are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Naval Base Guam would result in less than significant impacts to water resources.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Naval Base Guam would result in less than significant impacts to water resources.

4.2.5.4 South

Naval Munitions Site

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at the NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at the NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same

as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the NMS would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Under Alternative 8, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, the proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, Non-DoD Land. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, access road construction activities associated with Alternative 8 on non-DoD land would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 on non-DoD land would result in no impacts to water resources.

4.2.5.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor, Wetland Area BARR-03 at Air Force Barrigada, there would be no reduction in the amount of wetlands on Guam. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Through the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 8 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 8 would result in less than significant impacts to water resources.

4.2.5.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 8 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.5, Potential Mitigation Measures.

4.2.6 No-Action Alternative

4.2.6.1 Surface Water

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing surface water conditions as presented in Section 4.1 would remain.

The identified surface water availability and quality concerns for Guam (e.g., construction-related discharges, sewage overflows, animal waste, and sediment erosion) would continue to exist. These threats to surface water would continue to be monitored by federal and Guam agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, surface water quality is expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to surface waters is reduced. Not relocating the Marines from Japan to Guam would not change the ongoing water quality concerns or protection actions for surface waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to surface water.

4.2.6.2 Groundwater

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing groundwater conditions as presented in Section 4.1 would remain.

The identified groundwater availability and quality concerns for Guam (e.g., saltwater intrusion, leaky septic systems) would continue to exist. These threats to groundwater availability and quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur in order to protect groundwater resources. Monitoring for saltwater intrusion and coordination amongst water users, as well as potential designations for groundwater resources is expected to ensure there is a dependable, safe supply of groundwater for Guam users. Not relocating the Marines from Japan to Guam would not change the on-going groundwater availability and quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to groundwater.

4.2.6.3 Nearshore Waters

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing nearshore conditions as presented in Section 4.1 would remain.

The identified nearshore water quality concerns for the marine waters of Guam (copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids) would continue to persist. These threats to nearshore water quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur to protect nearshore waters. In time, nearshore water quality is expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to nearshore waters is reduced. Not relocating the Marines from Japan to Guam would not change the on-going nearshore water quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to nearshore waters.

4.2.6.4 Wetlands

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing wetland conditions as presented in Section 4.1 would remain.

The identified primary threats to wetlands on Guam (feral ungulates, human disturbance, invasive plants species, sedimentation, and erosion) would continue to occur. These threats to wetland area and function are of concern and are therefore monitored by federal and Guam agencies to protect wetland areas. Not relocating the Marines from Japan to Guam would not change the on-going threats or protection actions for wetlands on Guam; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to wetlands.

Summary of Impacts Tables 4.2-2, 4.2-3, 4.2-4, and 4.2-5 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 4.2-6 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 4.2-2. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: SI-M. Direct impact (fill) of 0.4 ac (0.16 ha) wetland area	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: SI-M. Direct impact (fill) of 0.4 ac (0.16 ha) wetland area
Operation			
• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-3. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI
Operation	
• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants • GW: LSI. Increase in localized recharge rates and pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants • GW: LSI. Increase in localized recharge rates and pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-4. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: LSI. Potential for temporary changes in hydrology and pollutant loading	• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: LSI. Potential for temporary changes in hydrology and pollutant loading
Operation	
• SW: NI • GW: NI • NW: NI • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-5. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI
Operation	
• SW: LSI. Negligible increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-6. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: SI-M. Potential minor increase in construction-related runoff and sedimentation; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in water column; direct, permanent impact to 0.02 ac (<0.01 ha) of intertidal area • WL: LSI: potential for temporary disturbance from dredging operations
Operation		
• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants; minor, transient increases in turbidity at crossings • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: negligible, transient disturbances	• SW: LSI. Increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Implementation of the action alternatives would have the potential to impact the quality and quantity of stormwater runoff, during both the construction and operational phases of the project. Construction and range training activities would have the potential to cause erosion and sedimentation which could degrade surface water quality. In addition, the action alternatives would increase the potential for leaks and spills from contaminants. These potential impacts would be reduced through the combination of site-specific

BMPs (Table 4.2-1), LID measures, and monitoring programs. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual would be included in the planning, design, and construction of all roadways. Increases in stormwater would be managed by stormwater infrastructure and no construction would occur in a flood zone; therefore, there would be no increase in flooding risk. Stormwater flow paths would continue to mimic area topography. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. With the implementation of BMPs and potential mitigation measures for the dredging of Apra Harbor, fill of wetlands, and fill of jurisdictional waters of the U.S, impacts to nearshore waters and wetlands would be less than significant. The action alternatives would be implemented in compliance with all federal, local, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4, as well as the implementation of BMPs, LID, and monitoring.

4.2.7 Summary of Potential Mitigation Measures

Table 4.2-7 summarizes the potential mitigation measures.

Table 4.2-7. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Surface Water			
Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species, • No barge overflow during dredging operations • Dredging rate limitations, • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring
Wetlands			
• None identified with implementation of identified potential dredging mitigation measures	• None identified with implementation of identified potential dredging mitigation measures	• Preserving existing areas • Compensate for the fill of the 0.4 ac (0.16 ha) wetland area by creating new wetlands or restoring, enhancing or preserving existing wetland areas to, at a minimum, replace the area filled • Mitigate temporary disturbance impacts by monitoring of stream segments to determine and mitigate potential loss of aquatic functions	• Preserving existing areas • Compensate for the fill of the wetland area by creating new wetlands or restoring, enhancing or preserving existing wetland areas on Guam to, at a minimum, replace the area filled • Mitigate temporary disturbance impacts by monitoring of stream segments to determine and mitigate potential loss of aquatic functions

4.2.8 Least Environmentally Damaging Practicable Alternative (LEDPA) for Waterfront Functions

Section 404 of the Clean Water Act (CWA) requires approval by the USACE for discharge of dredged or fill materials into waters of the United States. Proposed projects affecting jurisdictional areas under the CWA must identify the *least environmentally damaging practicable alternative* (LEDPA) as part of the environmental evaluation process. Permitting decisions are based on guidelines ("404(b) (1) Guidelines") developed jointly with the EPA that are now part of the Code of Federal Regulations (40 CFR 230).

Specifically, § 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the U.S., which include wetlands, shall be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Furthermore, an alternative is considered practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

A Section 404 Permit would be applied for and obtained prior to construction. This analysis is to show that the screening and selection process used in the development of this EIS/OEIS has identified the LEDPA consistent with the Section 404(b) (1) guidelines. For those projects in Sections 4.1.2 (North) and 4.1.3 (Central) areas within Guam, the Section 404 permitting process is not applicable since there are no jurisdictional wetlands involved with these projects. Section 404 permitting is applicable to the proposed projects within Apra Harbor.

As previously discussed, the analysis and selection of reasonable alternatives for: 1) ship berthing for amphibious task force ships and their associated amphibious vehicles and boats, 2) LCAC/AAV laydown area, and 3) the USCG berthing were based on consideration of the following criteria:

- Operational Efficiency
  - Meets general purpose requirements of the amphibious task force
  - Meets operational/navigational characteristics, e.g. sufficient depth
  - Must have contiguous location of berths for the ships that carry the amphibious vehicles
- Minimize dredging
- Minimizes other unavoidable environmental impacts including minimizing impacts to coral reefs.

Section 2.5.1.2 of this Volume, along with Table 2.5-2, provides an overview of the location, purpose, and construction/improvement details for the berth improvements in western Inner Apra Harbor. The rationale for siting all proposed waterfront facilities at Apra Harbor is that it is the only on-island DoD harbor. The Navy's general purpose wharves that are suitable to meet the requirements of the amphibious task force needs are located on the western side of Inner Apra Harbor. Specific purpose berths have ship specific accommodations tailored to the vessels they support, e.g. submarine berthing or supply ship berthing that would not be equipped either at the berth and/or in the landside support facilities to accommodate the amphibious task force ships and associated vehicles and boats or the USCG vessels. The presentation below discusses the three proposed waterfront functions and the alternatives dismissed.

4.2.8.1 Ship Berthing for Amphibious Task Force Ships and Associated Amphibious Vehicles and Boats

The selected location for berthing the amphibious task force and associated amphibious vehicles and boats alternatives, Victor, Uniform, Sierra, and Tango Wharves satisfies the operational efficiency criterion. These general purpose wharves have been used before by the amphibious task force. The

criteria to minimize environmental impact is met by placing the combatant escort ships in the area of the Sierra/Tango Wharves since this area has deeper water than the Victor/Uniform area thereby reducing the volume of dredging needed to support the combatant escort ships.

Dredging is required to deepen the depth of the Sierra/Tango wharves from -35 ft to -38 ft MLLW (-10.7 to -11.0 m) to accommodate the escort combatants' ships berthing needs of -34 ft (10 m) depth. Approximately 508,877 CY (389,064 m^3) of dredged material would be removed. The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane attached to clamshell buckets to retrieve the sediment and deposit it on a scow (barge). Mechanical dredging using a traditional clamshell bucket is used for this EIS/OEIS analysis because it represents the maximum environmental adverse impact in terms of water quality impacts. It is likely that this method would be used for the proposed dredging; however, the decision would not be made until the final design. The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, and 20-25% beneficial reuse/75-80% ocean disposal. Under the 100% upland placement scenario, five upland placement sites on Navy land have been identified for potential use in support of the proposed dredging action. These sites are referred to as Field 3, Field 4, Field 5, PWC Compound and Polaris Point and are described in Appendix D (Volume 9). Fields 3 and 5 and Polaris Point have been proposed for other dredging projects and have been addressed in a NEPA document. Field 4 and PWC Compound sites are addressed in this EIS/OEIS. Two of the alternative sites, Polaris Point and Field 5 sites, each have sufficient capacity to accommodate all of the anticipated dredged material from the proposed action. Used in combination with ODMDS and beneficial reuse, only a portion of the candidate sites would be required to accommodate the dredged material. Upland placement of the dredged material is planned to contain all of the mechanically-removed dredged material and does not involve an effluent discharge of slurry water from the upland placement sites. The term "upland disposal" is a common phrase used to describe the placement of the dredged material in an upland site while the material is allowed to dry and become easier and more cost effectively handled for beneficial re-use.

The project area is designated as M-2 or area of "Good" water quality. Historically, the use of silt curtains and other potential mitigation measures have been implemented during dredging operations in Apra Harbor in order to protect corals and filter-feeding invertebrates by limiting the lateral dispersion of the dredged sediments. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *CVN Capable Berthing Study* and a summary is included in Section 4.2. and in Appendix D of Volume 9 (Ericksen 2009). The results of this modeling are that turbidity impacts would be temporary and limited to the project area. Use of turbidity control measures such as turbidity curtains would be beneficial to controlling the impacts from suspended solids. Detailed discussion of Tier III sediment testing results consistent with 404(b)(1) guidelines is presented in Section 4.1 These 2007 test samples included samples representative of the areas to be dredged under this action. The overall results of the toxicity and bioaccumulation tests were that the materials were suitable for ocean disposal. Further, the most recent testing noted above resulted in concentrations of contaminants equal to or lower than the 2007 results with the exception of nickel. Inner Apra Harbor has been dredged previously with the approval of GEPA and no water quality impacts from other contaminants that would exceed GEPA water quality standards are expected. Additional testing of sediments in support of the water quality certification process and dredged material management plan would be obtained.

The Victor and Uniform Wharves are general purpose contiguous wharves with a sufficient depth alongside the wharf of 32 ft (9.7 m) to accommodate the amphibious force vessels and no dredging is required. All of the wharves require above and below water repairs. The wharf restoration would likely be

conducted by using a barge in the water. Wharf improvement contractors would ensure that construction debris does not enter or impact navigable waters. The Victor/Uniform and Sierra/Tango berthing alternatives are available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of the overall project purpose. Construction at either combined wharf location would not result in dredging or filling of any wetlands.

Other alternatives considered but dismissed were specific use wharves or other general purpose wharves. Alpha/Bravo Wharves at Polaris Point east of the Inner Apra Harbor channel entrance are specific use wharves designated for the nuclear submarines and the submarine tender. X-Ray Wharf, in the southern portion of the Harbor, is designated as the supply wharf with large warehouses, including frozen and cold storage, conveniently located adjacent to the wharf to support these operations. The northwest area and associated wharves (Lima, Mike, Oscar, and Papa) are leased to GEDCA for ship repair.

All of Inner Apra Harbor is considered Essential Fish Habitat for bottomfish (see Figure 11.1-5), crustaceans (see Figure 11.1-6), and pelagic fish (see Figure 11.1-7) in all life forms from larval to adult but unlike Outer Apra Harbor is relatively devoid of marine life (COMNAV Marianas 2006). Section 11.1 provides detailed discussion on EFH in Inner Apra Harbor.

No impacts to corals from dredging are expected as the closest area to the Inner Apra Harbor where corals occur on the seafloor is in the outer reaches of the entrance channel of the Inner Apra Harbor which is approximately 1,500 feet (457 m.) from the proposed dredge area. In this area corals present include *P. rus* and *P. cylindrica* (Navy 2005).

4.2.8.2 Amphibious Craft (LCAC/AAV) Laydown Area

For the LCAC/AAV laydown area, space availability, noise impacts, and water spray damage to adjacent land uses are critical considerations to land use planners. There is 404(b) involvement with this project activity as it involves the construction of two new concrete ramps into the water similar to what is observed at marina boat ramps. Construction of the LCAC/AAV laydown area provides the best solution for reducing noise impacts to surrounding areas since there is sufficient distance from the Alpha/Bravo Wharves and CSS-15 personnel and no impacts on submarine berthing operations around the Tender are anticipated. No dredging or filling of wetlands would occur with the implementation of this project activity.

The other alternative considered but dismissed is located in the inlet where the Dry Dock is moored (see Figure 2.5-5). The AAV laydown would be located adjacent to EOD facilities on Navy land and the LCAC laydown area would be on land currently leased by GEDCA. The reasons for dismissal of this site alternative were noise interference with EOD operations and the need for dredging at the entrance to the inlet. In addition, proximity to Big Blue Reef and the desire to avoid any potential impacts to coral ecosystems was sufficient for dismissal.

4.2.8.3 USCG Berthing

There were three locations considered for the USCG berthing. The Oscar/Papa wharves (Ship Repair Facility) were selected primarily due to fewer disadvantages when compared to the other two alternatives (see Table 2.5-6). The USCG berth using the entire length of the Oscar and Papa Wharves (1,079 ft. [328.88 m]) meets the operational efficiency needs for the USCG vessel and, having sufficient depth, no dredging is required. Wharf upgrades include repair of the concrete bulkhead, a new fender system, and mooring hardware. There would be repairs to the concrete bulkhead, but the repairs would not require demolition or replacement of the support structure. Portions of the work may have to be conducted from

the water on a barge moored at the wharf. Precautions would be required to prevent construction material or waste from entering the Harbor.

Placing the USCG berthing area at the Oscar/Papa wharves meets the environmental criterion in comparison to other alternatives as it is further away from Big Blue reef than one of the other alternatives and avoids the Sasa Bay Preserve that is adjacent to the third alternative.

The other two alternatives considered but dismissed in the site selection process (Figure 2.5-9) were the Big Blue location and the Reserve Craft Beach on Dry Dock Island. These two were dismissed from further consideration in this EIS/OEIS due to a number of functional concerns. These concerns included such mission requirements as AT/FP capability; quality of access; existence of waterfront facilities or capability to development such facilities; relationship to Apra Harbor; environmental concerns, particularly site contamination concerns; and physical size and layout.

Based on the above discussion, the selected locations for the three waterfront functions are consistent with the application of the 404(b) guidelines minimizing environmental impacts to the extent possible and being the LEDPA. The selected sites are existing wharf sites that would be improved/repaired to meet mission requirements. Avoidance of building new wharf sites as alternatives for the proposed project functions would result in less environmental impact than the alternatives chosen for the waterfront projects. Impacts to the aquatic ecosystem would be avoided and minimized to the greatest extent possible. Best management practices and compensatory mitigation would be provided as described in Volume 7, and at the end of each chapter in this Volume. Once final impacts through complete design are identified, a final mitigation plan would be prepared.

4.2.8.4 Wetlands-Onshore Impacts

The onshore impacts to wetlands are discussed in Sections 4.2.2, 4.2.3, 4.2.4, and 4.2.5 for Alternatives 1, 2, 3, and 8, respectively and are summarized in Table 2.6-4. There would be no direct filling of wetlands under Alternatives 1 and 2 but there would be direct filling of 0.4 ac (0.16 ha) wetlands under Alternatives 3 and 8. As noted in Section 4.2.4, the Navy would attempt to avoid impacts to Wetland Area BARR-04 at Air Force Barrigada (see Figure 4.2-4), but if avoidance is not possible, then the Navy would minimize and mitigate potential impacts and comply with USACE permit requirements. There would be no dredging of wetlands under any of the alternatives. Under all alternatives, temporary increase in turbidity and sedimentation would also occur in wetlands during construction activity, and transient minor increases in turbidity would occur under operation during training activities in NMS. Therefore, activities associated with Alternatives 1 and 2 would result in less than significant impacts to wetlands and with Alternatives 3 and 8 would result in significant impacts to wetlands mitigable to less than significant.

Indirect impacts to coastal wetlands as a result of the release of sediment into the water column to increase turbidity in the vicinity of wetlands may occur during dredging under all alternatives. As noted in Section 4.2.2.3 for Alternative 1, the nearest wetlands to the dredging operations in Inner Apra Harbor are the Atantano Wetlands located approximately 2,000 ft (610 m) east of the nearest extent of proposed dredging operations (see Figure 4.2-2). Other wetland areas (Wetland Areas O, P, and Q) located in the south/southeastern portion of Inner Apra Harbor are located approximately 3,600 ft (1,098 m) at their nearest extent to proposed dredging operations (see Figure 4.2-2). Construction activities in Apra Harbor would be the same for all action alternatives. These potential impacts would be lessened due to the implementation of dredging BMPs and associated potential mitigation measures, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Apra Harbor is generally westward, away from the majority of wetland areas in Apra Harbor and Sasa Bay). Therefore,

construction activities associated with all action alternatives would result in less than significant impacts to wetlands.

4.2.8.5 LEDPA Summary for Potential Impacts to Wetlands and Jurisdictional Waters Under All Alternatives in Volume 2

Table 4.2-8 presents a summary for all of the potential impacts of the alternatives in Volume 2 that may occur, both directly and indirectly, to jurisdictional wetlands and waters of the U.S.

Table 4.2-8. Summary of Potential Impacts to Wetlands and Jurisdictional Waters of the U.S. under All Alternatives to Support LEDPA Discussion

Volume	*Alt.*	*Component (Figure 2.9-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
Marine Corps-Guam (Vol. 2)	1	Dredging	-	ND	●	-	Inner Apra Harbor
	1	NMS Access Road Alternative A	No impacts				
	1	NMS Access Road Alternative B	No impacts				
	2	Dredging (1)	-	ND	●	-	Inner Apra Harbor
	2	NMS Access Road Alternative A	No impacts				
	2	NMS Access Road Alternative B	No impacts				
	3	Dredging	-	ND	●	-	Inner Apra Harbor
	3	NMS Access Road Alternaqtive A	No impacts				
	3	NMS Access Road Alternative B	No impacts				
	3	Air Force Barrigada	0.3/0.12	-	-	●	sink hole wetland
	8	Dredging	-	ND	●	-	Inner Apra Harbor
	8	NMS Access Road Alternative A	No impacts				
	8	NMS Access Road Alternative B	No impacts				
	8	Air Force Barrigada	0.3/0.12	-	-	●	sink hole wetland

Legend: ND = not determined; temporary impacts not quantified. TBD = to be determined upon completion of on-going study. - = no impact, ● = impact. Four rivers are the Sagge, Sarasa, Malaja, and Ugum Rivers

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CHAPTER 5. AIR QUALITY

5.1 AFFECTED ENVIRONMENT

This section discusses the affected air quality environment by first providing a definition of air quality and an overview of regulations, definitions of stationary and mobile sources, greenhouse gases, and air quality information specific to Guam (monitoring programs, climate) in Section 5.1.1. The following four sections then provide information on ambient air quality conditions in each of the four regions of influence (ROIs) on Guam – North, Central, Apra Harbor, and South – and sensitive receptors in each ROI (Sections 5.1.2 through 5-1.5).

5.1.1 Definition of Resource

Air quality is defined by ambient air concentrations of specific pollutants of concern with respect to the health and welfare of the general public. Air quality can be affected by air pollutants produced by mobile sources, such as vehicular traffic, aircraft, or non-road equipment used for construction activities; and by fixed or immobile facilities, referred to as "stationary sources." Stationary sources can include combustion and industrial stacks and exhaust vents. Potential air quality effects on Guam would occur from both construction and operational activities associated with implementation of the proposed action and associated alternatives.

5.1.1.1 Regulatory Overview

The United States (U.S.) Environmental Protection Agency (USEPA), under the requirements of the 1970 Clean Air Act (CAA), as amended in 1977 and 1990 (Clean Air Act Amendments [CAAA]), has established National Ambient Air Quality Standards (NAAQS) for six contaminants, referred to as criteria pollutants (40 Code of Federal Regulations [CFR] 50): carbon monoxide (CO), nitrogen dioxides (NO_2), ozone (O_3) (with nitrogen oxides [NO_x] and volatile organic compounds [VOCs] as precursors), particulate matter (PM) (PM_{10}—less than 10 microns in particle diameter; $PM_{2.5}$—less than 2.5 microns in particle diameter), lead (Pb), and sulfur dioxide (SO_2).

The NAAQS include primary and secondary standards as listed in Table 5.1-1. The primary standards were established to protect human health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Typical sensitive land uses protected by the primary standards are public accessible areas used by these populations, such as residences, hospitals, libraries, churches, parks, playgrounds, schools, etc. Secondary standards set limits to protect the environment, including plants and animals, from adverse effects associated with pollutants in the ambient air. A description of the criteria pollutants and their health and environmental impacts is presented in Volume 9, Appendix I, Section 2.1 National Ambient Air Quality Standards.

Areas where concentration levels are below the NAAQS for a criteria pollutant are designated as being in "attainment." Areas where a criteria pollutant level equals or exceeds the NAAQS are designated as being in "nonattainment." Based on the severity of the pollution problem, nonattainment areas are categorized as marginal, moderate, serious, severe, or extreme. Where insufficient data exist to determine an area's attainment status, it is designated as either unclassifiable or in attainment.

Table 5.1-1. U.S. National and Guam Ambient Air Quality Standards

Pollutant and Averaging Time	*Primary Standard*[1]	*Secondary Standard*[1]
Carbon Monoxide		
1-Hour Maximum[2]	35 ppm	None
8-Hour Maximum[2]	9 ppm	
Nitrogen Dioxide		
Annual Arithmetic Mean[3]	100	100
Ozone		
8-Hour Average[4]	0.075 ppm	0.075 ppm
Particulate Matter[5]		
PM_{10}		
24-Hour Average[6]	150	150
$PM_{2.5}$		
Annual Arithmetic Mean[3]	15	15
24-Hour Average[7]	35	35
Lead		
Quarterly Arithmetic Mean[8]	1.5	1.5
Rolling 3-Month Average[9]	0.15	0.15
Sulfur Dioxide		
Annual Arithmetic Mean[3]	0.03 ppm (80 µg/m^3)	—
3-Hour Maximum[2]	—	0.5 ppm (1300 µg/m^3)
24-Hour Maximum[2]	0.14 ppm (365 µg/m^3)	—

Legend: — = not available; ppm = parts per million.
Notes:
[1] All concentrations in micrograms per cubic meter of air (µg/m^3), except where noted.
[2] Not to be exceeded more than once a year.
[3] Not to be exceeded during any calendar year.
[4] Standard attained when 3-year average of annual 4th-highest daily maximum 8-hour concentration is below 0.075 ppm.
[5] PM_{10}: particulate matter diameter of 10 microns or less; $PM_{2.5}$: particulate matter diameter of 2.5 microns or less.
[6] Not to be exceeded more than once per year on average over 3 years.
[7] Standard attained when the annual highest 98th percentile of 24-hour concentration over 3 years is below 35 µg/m^3.
[8] The quarterly lead standard is not to be exceeded during any calendar quarter.
[9] Any three-month average exceeding 0.15 µg/m^3 within a three-year period will be considered a violation of the NAAQS. Final rule signed October 15, 2008.
Sources: 40 CFR 50 and Guam Environmental Protection Agency (GEPA) (2004).

The proposed action would occur in various areas of Guam. Many of the areas are currently designated as attainment areas for all criteria pollutants. However, two areas near power plants are designated as nonattainment areas for SO_2 (Figure 5.1-1), as follows:

- Piti: Portion of Guam within a 2.2-mile (mi) (3.5-kilometer [km]) radius of the Piti Power Plant
- Tanguisson: Portion of Guam within a 2.2-mi (3.5-km) radius of the Tanguisson Power Plant.

Both areas are designated nonattainment for SO_2 as a result of monitored and modeled exceedences in the 1970s prior to implementing changes to power generation facilities. According to 40 CFR Parts 80 and 86, in the 1990's both plants were rebuilt, upgrading their emission controls. Guam has submitted a redesignation request to EPA. That pending redesignation request shows that they are now in attainment. An emissions inventory shows that the power plants are the major source of SO_2 on Guam. Both plants are on the western side of the island. The Trade Winds blow persistently from east-to-west, further lessening the impact of the SO_2 emissions on the people of Guam from the power plants. Mobile sources, like cars, are a minor contributor to the SO2 emission budget.

Clean Air Act General Conformity

The 1990 amendments to the CAA (CAAA) require federal agencies to ensure that their actions conform to the State Implementation Plan (SIP) in a nonattainment area. Conformity to an SIP, as defined in the CAAA, means reducing the severity and number of violations of the NAAQS to achieve attainment of the standards. The federal agency responsible for an action is required to determine whether its action conforms to the applicable SIP. USEPA has developed two sets of conformity regulations—for transportation projects and non-transportation-related projects, respectively:

- Transportation projects developed or approved under the Federal Aid Highway Program or Federal Transit Act are governed by transportation conformity regulations (40 CFR Parts 51 and 93), that became effective December 27, 1993 and were revised August 15, 1997.
- Non-transportation projects are governed by general conformity regulations (40 CFR Parts 6, 51, and 93), described in the final rule for *Determining Conformity of General Federal Actions to State or Federal Implementation Plans*, published in the *Federal Register* on November 30, 1993. The General Conformity Rule (GCR) became effective January 31, 1994 and has not been updated.

As the proposed action components are non-transportation projects and would potentially involve activities in Piti and Tanguisson SO_2 nonattainment areas, the GCR applies to the proposed activities within the nonattainment areas. Therefore, a subsequent general conformity applicability analysis is required.

5.1.1.2 Stationary Sources

Stationary sources of air emissions at the various sites that could be affected by the proposed action include combustion turbines, boilers, generators, and fuel tanks. The CAAA set permit rules and emission standards for pollution sources of certain sizes. An air permit application is submitted by the prospective owner or operator of an emitting source in order to obtain approval of the source construction permit. A construction permit generally specifies a time period within which the source must be constructed. Permits should be reviewed for any modifications to the site or the air emissions sources to determine

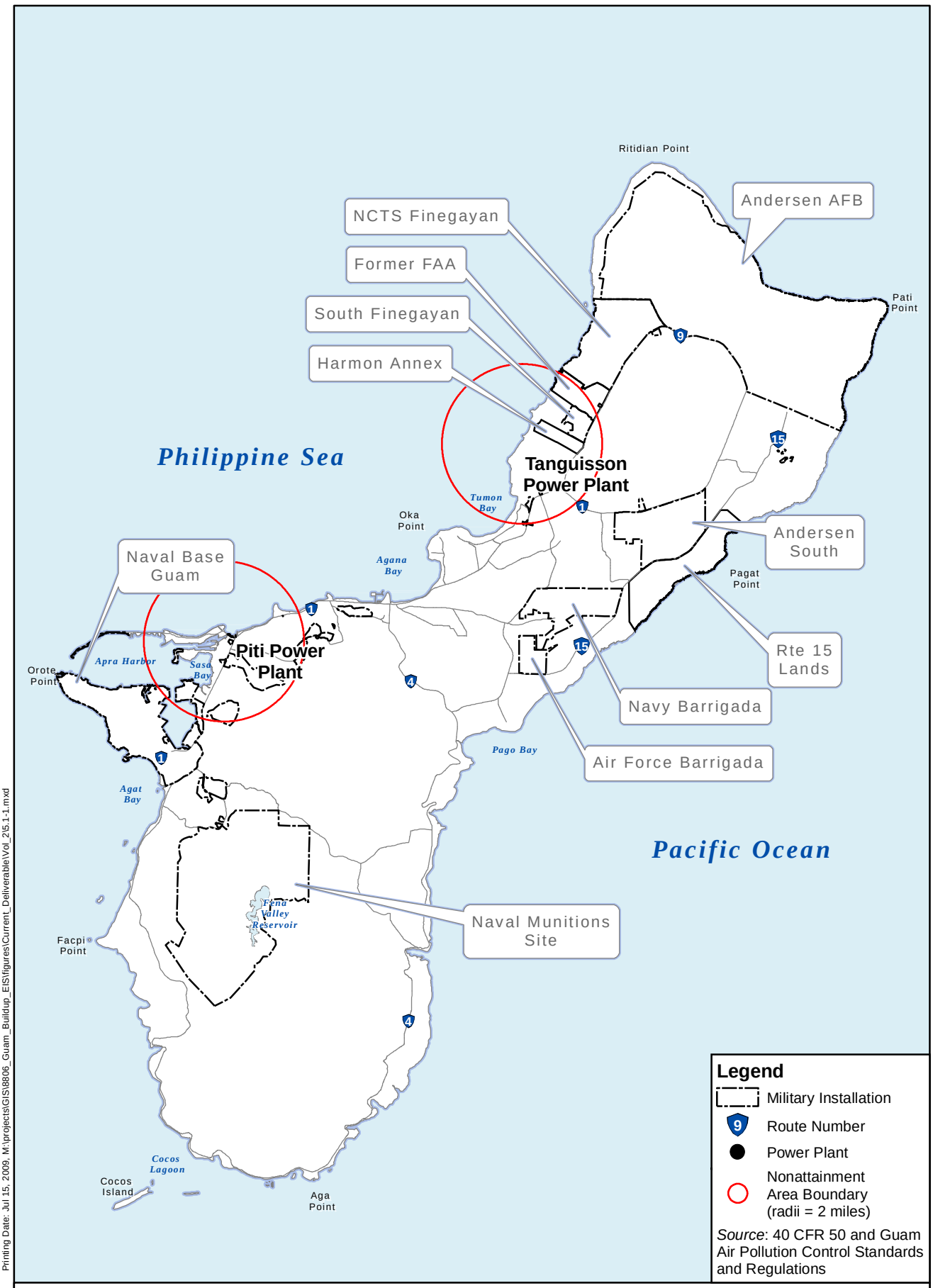


Figure 5.1-1
Guam SO_2 Non-Attainment Areas

permit applicability. USEPA oversees the programs that grant stationary source operating permits (Title V) and new or modified major stationary source construction and operation permits. The New Source Review (NSR) program requires new major stationary sources or major modification of existing major stationary sources of pollutants to obtain permits before initiating construction. The New Source Performance Standards (NSPS) apply to sources emitting criteria pollutants, while the National Emission Standards for Hazardous Air Pollutants apply to sources emitting Hazardous Air Pollutants (HAPs).

HAPs, also known as toxic air pollutants, are chemicals that can cause adverse effects to human health or the environment. The CAAA directed USEPA to set standards for all major sources of air toxics. USEPA established a list of 188 HAPs that includes substances that cause cancer, neurological, respiratory, and reproductive effects. The Title V major source thresholds for pollutant emissions that are applicable to Guam are:

- 100 tons per year (TPY) for any criteria pollutant
- 25 TPY total HAPs
- 10 TPY for any one HAP

USEPA also established Prevention of Significant Deterioration (PSD) regulations to ensure that air quality in attainment areas does not significantly deteriorate as a result of construction and operation of major stationary sources, and to allow future industrial growth to occur. A typical major PSD source is classified as anything with the potential to emit 250 TPY of any regulated pollutant in an attainment area. However, for several types of major source operations, including fossil fuel–fired steam electric plants of more than 250 million British Thermal Units (Btu) per hour heat input, 100 TPY is the major PSD source threshold.

Since Guam has two nonattainment areas for the SO_2 NAAQS, major new sources or major modifications to existing major sources located in nonattainment areas must meet the more stringent nonattainment NSR requirements.

The Guam Environmental Protection Agency (GEPA) has adopted the USEPA-established stationary source regulations discussed previously and acts as the administrator to enforce stationary source air pollution control regulations in Guam.

5.1.1.3 Mobile Sources

Typical mobile sources include aircraft, aircraft ground support equipment, on-road and non-road vehicles, and construction equipment. The emissions from these mobile sources are regulated under the CAA Title II that establishes emission standards that manufacturers must achieve. Therefore, unlike stationary sources, no permitting requirements exist for operating mobile sources.

Aircraft and Ground Support Equipment

USEPA has developed guidance to evaluate aircraft and associated ground support equipment operational emissions, which is provided in *The Procedures of Emission Inventory Preparation, Volume IV: Mobile Sources* (USEPA 1992). Aircraft engines emit pollutants during all phases of operation: climb, approach, and cruise. According to USEPA, only emissions emitted in the atmospheric mixing layer have a potential air quality impact on ground-level ambient concentrations. The mixing layer is the air layer between the ground and the height above which the vertical mixing of pollutants decreases significantly. The USEPA recommends that a default mixing layer of 3,000 feet (ft) (914 meters [m]) be used in aircraft emission calculations.

On-Road Vehicles

Criteria Pollutants

USEPA has established guidance for conducting localized CO concentration impact analysis for on-road vehicle operations within offsite sensitive neighborhoods. Vehicle CO exhaust is one of the major concerns for on-road vehicle operations. CO is considered a site-specific pollutant with higher concentrations found adjacent to roadways, especially near congested, signalized intersections. Mobile-source CO air quality impacts are typically evaluated through a micro-scale analysis of traffic-related emissions at selected intersections. A micro-scale analysis of localized traffic-related CO concentrations is performed using the procedures outlined by USEPA in *A Modeling Methodology for Predicting Pollutant Concentrations Near Roadway Intersections* (USEPA 1995) and *Mobile6 User's Guide* (USEPA 2003).

The modeling performed does not include reductions that would be achieved as a result of the Energy Independence and Security Act of 2007. The Energy Independence and Security Act includes several sections that address reducing petroleum/increasing alternative fuel use including:

- Only acquiring light-duty motor vehicles or medium-duty passenger vehicles that are "low greenhouse gas emitting vehicles," or demonstrating that cost-effective policies have been adopted to reduce petroleum consumption sufficiently to achieve a comparable reduction in greenhouse gas emissions.
- At least a 20% reduction in annual petroleum consumption and a 10% increase in annual alternative fuel consumption by 2015 from a 2005 baseline consumption level. Interim milestones will be established.
- Installation of at least one renewable fuel pump at each federal fleet fueling center by 2010.

Volume 6 (Section 7.2 Methodology) and Volume 9 (Appendix I, Section 3.3, Off Base On-road Vehicle Operational Emissions and Impact) provide greater detail on modeling procedures and present detailed results from the on-road vehicle related criteria pollutant emissions and CO concentrations predicted under various alternatives.

Mobile Source Air Toxics

The USEPA also regulates air toxics that include pollutants known or suspected to cause cancer and/or other serious health effects. Most air toxics originate from manmade sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). The CAA identified 188 air toxics. In 2001, USEPA identified a list of 21 Mobile Source Air Toxics (MSATs) and highlighted six of them as priority MSATs. Since 2001, USEPA has conducted an extensive review of the literature to produce a list of the compounds identified in the exhaust or evaporative emissions from on-road and non-road equipment, as well as alternative fuels. This list currently includes approximately 1,000 compounds, many of which are emitted in trace amounts.

In February 2007, USEPA finalized a rule to reduce hazardous air pollutants from mobile sources (*Control of Hazardous Air Pollutants from Mobile Sources*, February 9, 2007). The rule limits the benzene content of gasoline and reduces toxic emissions from passenger vehicles and gas cans. USEPA estimates that in 2030 this rule would reduce total emissions of MSATs by 330,000 tons and VOC emissions (precursors to O_3 and $PM_{2.5}$) by more than one million tons (USEPA 2009). In addition to controlling pollutants, such as hydrocarbons, particulate matter, and nitrogen oxides, USEPA's recent

regulations controlling emissions from highway vehicles and non-road equipment will result in large air toxic reductions.

Non-Road Vehicle and Construction Equipment

In contrast to operational activities, construction activities are usually of short duration and produce only temporary air quality effects. However, the cumulative impacts of large-scale construction activities occurring over many years could cause adverse localized and regional air quality effects. USEPA has specifically developed the NONROAD emission factor model to estimate construction equipment emissions (USEPA 2008). This model is used in association with construction activity data and equipment model and size data to predict construction period emissions.

5.1.1.4 Ambient Air Quality Monitoring

The local government of Guam has not collected ambient air quality data since 1991. Therefore, no existing ambient air quality data are available to represent current air quality conditions with respect to the criteria pollutants for which the NAAQS were established.

Historical data are available from 1972 through 1991, when ambient air quality data were collected at a number of sites through a USEPA-sponsored monitoring program. The monitored pollutants were total suspended particles, SO_2, NO_2, and NO_x. In 1991, PM_{10} was monitored in addition to total suspended particles.

In 1999, the Guam Power Authority (GPA) established a network of five stations to measure SO_2 for one year, from the fall of 1999 through the summer of 2000. None of these monitors were placed close to a major stationary source and the observed SO_2 concentrations at these stations were all far below the 24-hour SO_2 NAAQS.

Because of the lack of ambient monitoring data, the existing air quality conditions on Guam cannot be evaluated by a direct comparison of the ambient pollutant concentration levels with the NAAQS. Instead, the existing air quality conditions around each ROI were based on a summary of major emission sources within that ROI. The localized air quality condition can be correlated with the close proximity of major emission sources or areas with the level of emissions identified. In general, the greater the amount of emissions (in TPY) that a source emits, the greater air quality impacts it generates. Receptors close to major emission sources that have potential to emit a large quantity of emissions tend to have more air quality concerns than those located far from these sources. However, since the NAAQS are established based on a concentration level rather than an emissions level (in TPY), the emissions levels provided in this chapter provide a qualitative picture around local emission sources, but cannot be used as a quantitative indicator of the affected air quality environment in a specific ROI.

5.1.1.5 Climate

The climate on Guam is characterized as tropical marine. The weather is generally hot and very humid with little seasonal temperature variation. Guam has two seasons, the dry season (January–June) and the wet season (July–December). During the dry season, the prevailing winds from the east and northeast intensify and tend to blow emissions from major stationary sources located along the west shoreline (e.g., elevated emissions from Cabras Power Plant and other power plant stacks) towards the ocean. However, shoreline sea breeze circulations can modify the dominant wind, complicating the wind pattern along the western shoreline of Guam. Under a weak synoptic wind pattern during the wet season, the sea breeze circulation can introduce spatial and diurnal variation in the winds along the shoreline. The effects of the sea breeze circulation could increase the air quality impacts of the emissions from existing power plants

located close to the shoreline. Downwind sensitive receptor areas normally experience greater potential impacts from both stationary and mobile source emissions, particularly under conditions of low wind speed.

5.1.1.6 Greenhouse Gas Emissions

Greenhouse gases (GHGs) are compounds found naturally within the earth's atmosphere. These compounds trap and convert sunlight into infrared heat. In this way, greenhouse gases act as insulation in the stratosphere and contribute to the maintenance of global temperatures. As the levels of greenhouse gases increase at ground level, the result is an increase in temperature on earth, commonly known as global warming. The climate change associated with global warming is predicted to produce negative economic and social consequences across the globe through changes in weather (e.g., more intense hurricanes, greater risk of forest fires, flooding), expanding the range of some insect-borne diseases, and other effects discussed in Volume 9, Appendix I, Section 2.5 Greenhouse Gas Emissions.

The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The primary GHG emitted by human activities in the U.S. is CO_2, representing approximately 85% of total GHG emissions. The largest source of CO_2 and of overall GHG emissions is fossil fuel combustion. CH_4 emissions, which have declined from 1990 levels, result primarily from enteric fermentation (digestion) associated with domestic livestock, decomposition of wastes in landfills, and natural gas systems. Agricultural soil management and mobile source fuel combustion are the major sources of N_2O emissions in the U.S.

Because CO_2 emissions comprise approximately more than 85% of GHGs and CO_2 emission factors are readily available for many stationary and mobile sources, CO_2 was selected for this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) to represent GHG emissions, and the EIS/OEIS provides the estimated CO_2 quantities that would be generated under the proposed action.

The potential effects of the GHG emissions associated with the proposed action are by nature global and cumulative impacts, as individual sources of GHG emissions from individual actions are not large enough to have an appreciable effect on climate change. Therefore, the impact of proposed GHG emissions as they pertain to climate change is discussed in the context of the combined impacts as compared to the total amount of GHG emissions that the U.S. produces in Volume 7 of this EIS/OEIS.

5.1.2 North

Ambient air quality conditions around the northern region of Guam are affected by a combination of mobile sources including aircraft, aircraft ground support equipment, on-road and non-road vehicles, and construction equipment, and existing major stationary power plants located in the area. The population density in this area is higher compared to Apra Harbor area and southern regions of Guam.

5.1.2.1 Andersen Air Force Base (AFB)

Ambient air quality conditions around Andersen AFB are affected primarily by various operational activities occurring at the base and associated stationary and mobile emissions sources.

Stationary Sources

Andersen AFB is considered a major stationary source that requires a Title V operating permit. Andersen AFB is also classified as a major PSD source, based on the level of potential pollutants it may emit. The most recent 2007 actual stationary source emissions inventory is summarized in Table 5.1-2. The stationary source emissions include those from fuel tanks and fuel facilities.

Table 5.1-2. Andersen AFB—2007 Actual Stationary Source Emissions

Total Emissions (TPY)					
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*	*HAPs*
7.7	2.75	0.57	11.4	5.5	0.42

Note: Stationary sources include fuel tanks and fuel facilities.
Source: GEPA 2008.

Mobile Sources

Mobile source emissions are not considered in a Title V permit; however, they comprise a significant component of Andersen AFB's total emissions. Onsite mobile emission sources are aircraft, aircraft ground support equipment, and private- and government-owned on-road vehicles. The estimated mobile source emissions for the conditions existing in 2005 (most recent available data) are summarized in Table 5.1-3.

Table 5.1-3. Andersen AFB—2005 Mobile Source Emissions

Total Emissions (TPY)					
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*	*HAPs*
Aircraft and Ground Support Equipment					
260.8	79.5	16.8	72.6	22.8	0.0
On-Road Vehicles					
1.9	139.6	88.7	21.9	11.4	1.1
Combined Mobile Sources					
262.7	219.1	105.5	94.5	34.2	1.1

Source: PACAF 2006.

Given the temporary nature of construction equipment operations, construction-related mobile source emissions are not considered in the base-wide emissions inventory.

5.1.2.2 Finegayan

There are several on base housing parcels in Finegayan. Air quality conditions at Finegayan are affected predominantly by on-road mobile sources and aircraft operations around Andersen AFB, given limited exposure to other sources. At the Naval Computer and Telecommunication Station (NCTS), the Navy is currently permitted to operate three diesel emergency generators with a combined capacity of 7.5 megawatt (MW) and two 5.18 Million Btu per hour (MMBtu/hr) boilers fired using No. 2 oil. Total permitted emissions for the sources at NCTS Finegayan are presented in Table 5.1-4.

Table 5.1-4. NCTS Finegayan—Permitted Emissions

Permitted Annual Emissions (TPY)				
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
106.9	43.0	5.9	187.4	5.5

Source: GEPA Title V Permit No. FO-15A. (GEPA no date)

5.1.2.3 Non-Department of Defense (DoD) Land

In addition to the on-road mobile sources and aircraft operations around Andersen AFB, several major stationary emission sources are located within non-DoD land areas owned by GPA as listed in Table 5.1-5. GPA operates the following three major power facilities in the North, each of which requires a Title V operating permit:

- Tanguisson: two steam boilers
- Marbo: one combustion turbine and one black start generator (internal energy source used to restore a power station to operation)
- Yigo: one combustion turbine and one black start generator (internal energy source used to restore a power station to operation)

Table 5.1-5. GPA Power Stations—Existing Permitted Major Source Emissions

Station Name	*Permitted Annual Emissions (TPY)*				
	SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
Tanguisson (Unit #1 and #2)	8,795.0	236.5	391.1	1,927.2	10.9
Marbo	250.1	40.0	13.0	139.9	0.9
Yigo	255.3	40.9	6.0	133.0	0.6

Sources: GEPA Title V Permit Nos. FO-006 (Marbo), FO-009 (Yigo), FO-012 (Tanguisson) (GEPA no date).

The Tanguisson power plant provides power for Guam. The Marbo facility is operated to alleviate load shedding on Guam during outages of other power-generating facilities. Load shedding is an almost instantaneous cutting of power to customers and is used only in extraordinary situations, such as losing a major generating station or a large power line. The Yigo facility is used for peaking and emergency operations.

Sensitive populations on non-DoD land in north Guam are mostly located along major traffic routes such as Routes 1 and 3.

5.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

The primary roadways in the north region include Routes 1, 3, 9, and 15. Because there are no air quality monitoring stations on Guam, existing pollutant levels in the north region are not available. The island of Guam is in attainment for all criteria pollutants, with the exception of SO_2, at two specific locations on the island. One nonattainment area encompasses the area within a 2.2-mi (3.5-km) radius of the Piti Power Plant. The second SO_2 nonattainment area encompasses the area within a 2.2-mi (3.5-km) radius of the Tanguisson Power Plant (see Figure 5.1-1).

5.1.3 Central

The central region of Guam has the greatest population concentration, and therefore a comparatively high number of on-road vehicles travel the main traffic routes through the area, affecting ambient air quality conditions. Military aircraft and training vehicle activities at Andersen South also generate emissions. This population is also exposed to emissions resulting from existing major stationary power plants located in the area.

5.1.3.1 Andersen South

Ambient air quality conditions around Andersen South are affected primarily by the operational activities of mobile sources at Andersen South, including on-road vehicles and aircraft. No sensitive population is present at Andersen South.

5.1.3.2 Barrigada

Ambient air quality conditions around Navy Barrigada and Air Force Barrigada are affected primarily by mobile source emissions associated with the military operations at the base and aircraft operations at Guam International Airport. There are no sensitive populations at Navy Barrigada or Air Force Barrigada.

5.1.3.3 Non-DoD Land and Naval Hospital Guam

In addition to the on-road mobile sources and aircraft operations around Andersen South and Guam International Airport, several major stationary emission sources are located on non-DoD land nearby. GPA operates the following four major power facilities in this region, each of which requires a Title V operating permit:

- Tenjo: six medium speed diesel generators
- Manengon: two diesel generators
- Macheche: one combustion turbine and one black start generator (internal energy source used to restore a power station to operation)
- Dededo: two combustion turbines, four diesel generators, and one black start generator (internal energy source used to restore a power station to operation)

The Tenjo, Manengon, and Macheche facilities provide electricity for Guam. The Dededo facility is operated to alleviate load shedding on Guam during outages of other power-generating facilities.

Power Source Energy Services operates diesel generators to provide electricity for the Agana Shopping Center, considered to be a major stationary source that requires a Title V operating permit. The permitted emissions for the Agana Shopping Center and the four GPA facilities are summarized in Table 5.1-6.

Table 5.1-6. Non-DoD Power Stations—Existing Permitted Major Source Emissions

Station Name	*Permitted Annual Emissions (TPY)*				
	SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
Dededo	2,921.3	664.0	734.3	6,346.3	85.9
Tenjo	354.8	630.7	170.8	3,153.6	131.5
Manengon	54.2	76.0	5.1	170.0	8.1
Macheche	268.5	50.0	43.9	135.1	9.8
Agana Shopping Center	17.6	4.8	4.4	105.6	6.4

Source: GEPA Title V Permit Nos. FO-003 (Dededo), FO-008 (Tenjo), FO-005 (Manengon), FO-004 (Macheche), and FO-019 (Agana Shopping Center) (GEPA no date).

Sensitive populations on non-DoD land in central Guam are mostly located around the airport and along Tumon Bay and Agana Bay.

The Naval Hospital Guam operates three non-Title V permitted diesel-fuel–powered emergency generators (two 1 MW and one 75 kilowatt [kW]). The Naval Hospital facility is dedicated to support the hospital and does not provide capacity or supply to Guam. Also located at the Naval Hospital, but operated by Naval Facilities Engineering Command (NAVFAC) Marianas, are three 8.37 MMBtu/hr boilers fired with No. 2 oil and one 1.25 MW emergency diesel generator. Title V permitted annual emissions for NAVFAC Marianas operating sources are summarized in Table 5.1-7. There are some sensitive populations along Route 1 in the Piti/Nimitz Hill area.

Table 5.1-7. Naval Hospital Guam—Title V Permitted Emissions

Permitted Annual Emissions (TPY)				
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
111.6	4.0	1.6	15.7	0.4

Source: GEPA Title V FO-015B (GEPA no date).

5.1.3.4 Off Base Roadways

The primary roadways in the central region include Routes 1 and 4. Because there are no air quality monitoring stations in the central region, existing pollutant levels are not available.

5.1.4 Apra Harbor

Ambient air quality conditions around Apra Harbor and the Naval Base Guam are affected by a combination of on base mobile emission sources, including vessels and on-road vehicles, and major stationary power plants in the area. The population density in this area is relatively low as compared to central and north Guam.

5.1.4.1 Harbor

In addition to the mobile sources around Apra Harbor, there are several major stationary emission sources, including the GPA Cabras Power Plant in Piti Point area with two steam turbines and two slow speed diesel generators. In the same area, the Taiwan Electrical and Mechanical Engineering Services Power Plant operates a 40 MW combustion turbine known as Piti #7, and the Marianas Energy Company Power Plant operates two slow speed diesel generators, each rated at 44 MW (also known as Piti #8 and #9). Piti Power Plant also has two units #4 and #5 previously operated by GPA, but currently not in operation. Table 5.1-8 provides permitted emissions for each plant. All of these major power facilities require a Title V operating permit.

Table 5.1-8. Non-DoD Power Stations—Existing Permitted Major Source Emissions

Station Name	*Permitted Annual Emissions (TPY)*				
	SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
Cabras	17,577.5	1,140.6	1,364.0	12,341.8	877.8
Taiwan Electrical and Mechanical Engineering Services (Unit #7)	1,008.1	38.2	76.5	316.3	N/A
Marianas Energy Company (Units #8 and #9)	6,778.6	549.2	1,473.9	12,236.2	N/A

Sources: GEPA Title V Permit Nos. FO-002 (Cabras). Taiwan Electrical and Mechanical Engineering Services (Unit #7) and Marianas Energy Company (Units #8 and #9) emissions levels listed are based on the emissions rates in grams per second shown in Tenjo Permit Application for the Taiwan Electrical and Mechanical Engineering Services (Unit #7) and Marianas Energy Company (both Units #8 and #9 combined) units assuming 8,760 operational hours per year. No information was available for VOC emission rates for Taiwan Electrical and Mechanical Engineering Services (Unit #7), and Marianas Energy Company (Units #8 and #9).

5.1.4.2 Naval Base Guam

Naval Base Guam has two emergency generators (one 100 kW and one 125 kW, respectively). Additionally, the Navy's Orote Point Power Plant has several air permits with combined permitted emissions exceeding 100 TPY for both NO_x and VOC. The sources covered by these separate air permits under the Orote Point Power Plant are as follows:

- Three 6.6 MW emergency diesel generators that can operate up to 1,350 hours per year combined for all three units, one 300 kW black start emergency generator, a 196,000 cubic

yard (CY) (149,852.75 cubic meter [m^3]) sanitary landfill and shredder. Permitted emissions from these sources are included in a Title V permit and summarized in Table 5.1-9.

- One 10.5 MMBtu/hr boiler, one 6.3-MMBtu/hr boiler, and one 200 kW emergency generator.
- Various portable boilers and emergency diesel generators.

Table 5.1-9. Orote Point Power Plant Title V—Permitted Emissions

Permitted Annual Emissions (TPY)				
SO_2	*CO*	*PM_{10}*	*NO_x*	*VOC*
23.0	6.1	0.7	96.0	7.4

Source: GEPA Title V Permit No. FO-015F (GEPA no date)

5.1.4.3 Off Base Roadways

The primary roadways in Apra Harbor include Routes 1 and 2A. Because there are no air quality monitoring stations in Apra Harbor, existing pollutant levels are not available.

5.1.5 South

Compared with the other regions of Guam, the south has the lowest population density. Ambient air quality conditions are affected primarily by the comparatively few on-road vehicles traveling the main routes through the area. Military training activities at the Naval Munitions Site (NMS) also generate emissions, particularly PM emissions within the Annex. The population north of NMS is also exposed to emissions resulting from activities at Apra Harbor.

5.1.5.1 Naval Munitions Site

Military training activities at NMS generate emissions, in particular PM emissions within the Annex. There are no major stationary emission sources at NMS.

5.1.5.2 Off Base Roadways

The primary roadways in the south region include Routes 2 and 5. Because there are no air quality monitoring stations in the south region, existing pollutant levels are not available.

5.2 ENVIRONMENTAL CONSEQUENCES

environmental consequences assessment performed and discussed in this section involves multiple air quality analyses, including: (1) n incremental emissions analysis of criteria pollutants and GHGs (in terms of CO_2 emissions) with the potential to emit from additional training activities, including aircraft, ships and vehicles; (2) an incremental emissions analysis of criteria pollutants and CO_2 with the potential to emit from construction equipment and hauling truck emissions during the construction period; and (3) a CAA general conformity applicability analysis for direct and indirect SO_2 emission increases that would result from the proposed action within the two SO_2 non-attainment areas shown in Figure 5.1-1. CO_2 is not a criteria pollutant and therefore is not compared to criteria pollutant thresholds. The potential effects of CO_2 and other GHG emissions are by nature global and are based on cumulative impacts. Individual sources are not large enough to have an appreciable effect on climate change. Hence, the impact of proposed CO_2 and other GHG emissions is discussed in the context of aggregate impacts in Volume 7.

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-

Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

5.2.1 Approach to Analysis

5.2.1.1 Methodology

As described in Chapter 2, the proposed facilities associated with the relocation of Marine Corps units to Guam can be grouped together into one of four land use functions: Main Cantonment and Family Housing, Training, Airfield Operations, and Waterfront Operations. For the training function, the facilities can be further divided into three categories: firing ranges, non-fire maneuver ranges, and aviation training ranges. These proposed training facilities vary depending on the land use function, location, and quantity of non-DoD land to be acquired. Most project components that would affect potential air quality conditions remain the same for every alternative including:

- The scale of construction (Main Cantonment, Training Ranges, Waterfront)
- Airfield operations
- Waterfront operations
- Aviation training operations
- The scale of ground training

Therefore, predicted air emissions are similar for construction and operations between each of the four Main Cantonment alternatives, as well as the Training alternatives. The air emission sources associated with airfield, training, and waterfront operations can be characterized as mobile sources for which the criteria pollutant and CO_2 emissions are quantified. As some of the air quality effects from this action would have a combined effect in the ROI when added to the air quality effects of other proposed actions analyzed in this EIS/OEIS, the analysis results presented in here are also considered in the summary impacts analysis discussed in Volume 7, where applicable.

Construction Activities

The construction effort for all airfield, waterfront, and training alternatives is assumed to be the same, regardless of location. Therefore, the air emissions for these projects calculated for Alternative 1 are assumed to be representative of the other three alternatives (i.e., Alternatives 2, 3, and 8). Although the total building space does not vary by alternative for the main cantonment project component, the total size of earth disturbance under each alternative does vary slightly. As a result, the pollutant emissions associated with the main cantonment construction activity were estimated individually for each alternative.

Construction activities, including the operation of construction equipment, trucks, and workers' commuting vehicles, may have short-term air quality impacts. In estimating construction-related criteria pollutants and CO_2 emissions, the usage of equipment, the likely duration of each activity, and manpower estimates for the construction were based on the information described in Chapter 2 for future project-associated construction activities.

Estimates of construction crew and equipment requirements and productivity were based on the data contained in 2003 *RSMeans Facilities Construction Cost Data* (RSMeans 2003) and 2006 *RSMeans*

Heavy Construction Cost Data (RSMeans 2006). It is assumed for the emissions estimate purposes that major construction activities would start from 2011 through 2014 with minimal effort during 2010 for all projects except for the construction of main cantonment. The construction of main cantonment is assumed to occur from 2011 to 2016 based on the construction cost profile projected for the proposed action.

Estimates of construction equipment operational emissions were based on estimated hours of equipment use and the emission factors for each type of equipment, as provided by USEPA using the NONROAD emission factor model (USEPA 2008). National default model inputs for non-road engines, equipment, and vehicles of interest were also provided in the USEPA model (USEPA 2008), as were average equipment horsepower values and equipment power load factors. Since Guam is exempt from using low sulfur content fuel, the highest sulfur content (0.5 %) fuel input available in the NONROAD model was conservatively used to predict both SO_2 and PM emissions from diesel-powered equipment.

Since the operational activity data presented in RSMeans' cost data books are generated based on the overall length of equipment presence duration on site, an equipment actual running time factor (i.e., actual usage factor) was further employed to determine actual equipment usage hours for the purpose of estimating equipment emissions. The usage factor for each equipment type was obtained from Federal Highway Administration's Roadway Construction Noise Model User's Guide (Federal Highway Administration [FHWA] 2006). Emission factors related to construction-associated delivery trucks were estimated using the USEPA Mobile6 emission factor model (USEPA 2003), that provides a specific emission factor data base for various truck classifications. Similar to the construction equipment emissions estimate described above, the highest sulfur content (0.5%) fuel input available in the Mobile6 model was conservatively used to predict both SO_2 and PM emissions from diesel-powered vehicles. The crew's commuting vehicle emissions were estimated using the same Mobile6 model and assumed workers would travel approximately an average of 10 mi per day to the site using shuttle buses or vans.

The detailed methodology used to calculate these emissions is presented in Volume 9, Appendix I, Section 3.4, Construction Activity Emissions.

Operational Activities

Stationary sources that would be installed to run completed airfield, waterfront, training, and main cantonment facilities include furnaces, boilers, hot water heaters, and air conditioning systems, where applicable. These appliances would likely be powered by electricity generated by the new or upgraded existing power system on Guam. Therefore, potential air quality impacts from stationary source operational emissions are addressed in Volume 6 in the utility resources impact section.

Mobile source operational activities are part of each of the four alternatives. Operational elements that have potential to impact air quality include:

- Aircraft flight training operations at Andersen AFB, Northwest Field, Orote Airfield, Andersen South Airfield, and NMS
- Waterfront ship operations
- Ground vehicle operations at various ranges
- The emissions from aircraft landing and taking off at Andersen AFB and from various pattern training flights at Andersen AFB and other airfields were estimated using the methods and emission factors obtained from the following references:
- The Procedures of Emission Inventory Preparation, Volume IV: Mobile Sources (USEPA 1992)

- Aircraft engine emission factors developed by the Navy's Aircraft Environmental Support Office (AESO 1999 –2001)
- U.S Air Force Air Conformity Applicability Model (Version 4.3) (Air Force Center for Engineering and the Environment [AFCEE] 2005)
- Aircraft Noise Study for Guam Joint Military Master Plan at Andersen AFB (Czech and Kester 2008)
- The training flight sorties and flight hours defined around each airfield were based on information described in Chapter 2.3.1.5 of this volume.

The emissions from training ships were calculated using average power level correlated emission factors established for each naval vessel type and provided in *Southern California Range Complex EIS/OEIS* (Navy 2008). Tugboat emissions were calculated using emission factors, load factors, and power values related to diesel marine vessels obtained from *Current Methodologies and Best Practices in Preparing Port Emission Inventories* (USEPA 2006). Emission factors were multiplied by the estimated running hours for each training ship to predict annual total ship emissions within applicable ROIs.

Ground training vehicle exhaust emissions from trucks, high mobility multipurpose wheeled vehicles, and buses during training exercises were estimated with the same method used to predict construction vehicle emissions. The USEPA Mobile 6 emission factor model (USEPA 2003) was used to predict emissions factors associated with each type of training vehicle defined based on the average weight and fuel type. The emission factors were then multiplied by the annual vehicle running hours for each type of vehicle during the training periods within specific ROIs. Moreover, since majority of these training vehicles would maneuver on unpaved roads with potential to generate a great amount of fugitive dust, USEPA AP-42 was used to predict additional unpaved road fugitive dust emissions from training vehicles.

On base vehicle exhaust emissions from commuting vehicles and trucks during daily on base operations were estimated based on the forecasted daily trips through each main gate and average traveling distance at each base within specific ROIs in a similar way used for predicting ground training vehicle emissions.

The detailed methodology used to calculate these emissions is presented in Volume 9, Appendix I, Section 3.3.6, On Base Vehicle Operational Emissions.

5.2.1.2 Determination of Significance

Under CAA, aircraft, ships, motor vehicles, and construction equipment are exempt from air permitting requirements. Since the emissions from these sources associated with the proposed action and alternatives would occur in areas that are in attainment of the NAAQS for all criteria pollutants, with the exception of the two nonattainment areas for SO_2 that are handled separately, the GCR is not applicable. Nonetheless, the National Environmental Policy Act (NEPA) and its implementing regulations require analysis of the significance of air quality impacts from these sources as well as non-major stationary sources. However, neither NEPA nor its implementing regulations have established criteria for determining the significance of air quality impacts from such sources in CAA attainment areas.

In the GCR applicable to non-attainment areas, USEPA uses the "major stationary source" definition under the NSR program as the *de minimis* levels to separate presumably exempt actions from those requiring a positive conformity determination. Since the proposed action and alternatives would occur mostly in areas that have always been in attainment, the EIS/OEIS selected the "major stationary source" definition (250 TPY or more of any air pollutant subject to regulations under the CAA) from the PSD

program. The PSD is used as the criteria for locations that are in attainment for determining the potential significance of air quality impacts from these sources.

As noted above, neither the PSD permitting program or the GCR are applicable to these mobile sources and minor (i.e., non-major) stationary sources in attainment areas. Therefore, the analysis of construction and operational incremental emissions from these sources in attainment areas and the significance criteria selected (250 TPY) are solely for the purpose of informing the public and decision makers about the relative air quality impacts from the proposed action and alternatives under NEPA requirements. However, since the 250 TPY threshold is selected in the context of the *de minimis* threshold established in the GCR, which provides only an indication of potential significant impact, a formal concentration impact analysis should be conducted, where appropriate. For example, CO is a localized pollutant; if the 250 TPY threshold is exceeded for CO, a subsequent dispersion modeling for major emission contributing sources is conducted to further evaluate potential impact significance with respect to the NAAQS.

Some areas on Guam fall within one of the two SO_2 nonattainment areas. Under the GCR both direct and indirect emissions associated with all operational and construction activities from a proposed federal action must be quantified and compared to annual *de minimis* (threshold) levels for pollutants that occur within the applicable nonattainment area. Direct emissions are emissions of a criteria pollutant or its precursors that are caused or initiated by a federal action and occur at the same time and place as the action. Indirect emissions are emissions occurring later in time and/or further removed in distance from the action itself. Indirect emissions must be included in the determination, if both of the following apply:

- The federal agency proposing the action can practicably control the emissions and has continuing program responsibility to maintain control and the emissions caused by the federal action are reasonably foreseeable. Given the nature of the proposed action, foreseeable emissions that the Navy can practicably control are limited to emissions resulting from on-site operational and construction activities.
- The SO_2 emissions estimated for the activities associated with the proposed action from both stationary and mobile sources within two SO_2 nonattainment areas were compared with the 100 TPY *de minimis* level to determine impact significance for SO_2 emission increase.

Both of these situations apply and therefore indirect emissions were included in the determination. It should be noted that the above thresholds established for emissions comparison purposes are required to be used for all relevant emissions from the proposed action. The emissions quantification described in this section is only for disclosure purposes to evaluate individual action component air quality impact using the same thresholds. The overall air quality impacts, including the general conformity applicability requirements, are discussed in Volume 7, which addresses the combined effects from all project components under the proposed actions and presents a summary of the effects .

5.2.1.3 Issues Identified during Public Scoping Process

The following analyses focus on addressing potential air quality impacts within each ROI from implementing the proposed action and alternatives. As part of the analysis, concerns relating to air quality effects that were raised by the public, including regulatory stakeholders, during the scoping process were addressed. These include:

- Increases in vehicle and vessel emissions and disclosure of available information of health risks associated with vehicle emissions and other mobile source emissions

- Increases in construction-related emissions and impacts including emissions estimates of criteria pollutants and diesel PM from construction of alternatives
- Compliance with the GCR in siting project facilities.

5.2.2 Alternative 1

For the purpose of this evaluation, the construction effort for all airfield, waterfront, training facilities is assumed to be the same, regardless of location. Therefore, the estimate of air emissions calculated for Alternative 1 presented here for these facilities is assumed to be representative of the three other alternatives (Alternatives 2, 3, and 8). However, given the slightly different scale of main cantonment construction under each alternative, an estimate of air emissions associated with main cantonment construction was performed for each alternative. The operational components of all four action alternatives are considered to be the same (see Sections 2.3 through 2.5 in this volume), and therefore predicted operational emissions for Alternative 1 are also applicable to Alternatives 2, 3, and 8.

5.2.2.1 North

Andersen AFB

Construction

Additional runway and hangar space, as well as maintenance and administrative facilities for airfield operations, are planned for Andersen AFB. New air embarkation operations that are comparable to the existing Andersen AFB embarkation operations are planned under the proposed action. The construction activity estimate utilizes the airfield and vehicle pavement "prototype" elements provided in RSMeans 2003 handbook (RSMeans 2003) to provide data associated with airfield construction at Andersen AFB. The total construction emissions produced from potential construction equipment, and vehicle and paving activities occurring from 2011–2014 that are associated with airfield operations facilities construction are provided in Table 5.2-1. The proposed training facilities for airfield operations include the construction of new earth-covered magazine structures for the storage of ordnance and the construction of administrative areas. The air emissions from construction of airfield training facilities are also included in Table 5.2-1 and detailed in Volume 9, Appendix I, Section 3.4 Construction Emissions: Marine Corps Relocation – Guam. The air emissions from the construction of main cantonment facilities are presented in Table 5.2-2 and detailed in Volume 9, Appendix I, Section 3.4 Construction Emissions: Marine Corps Relocation – Guam.

Table 5.2-1. Training Field and Facility Annual Construction Emissions (2011-2014)

ROI	*Construction Activity*	*Total Annual Pollutant Emissions (TPY)*						
		SO_2	*CO*	PM_{10}	$PM_{2.5}$	NO_x	*VOC*	CO_2
North	Andersen AFB Airfield Operations	0.5	1.5	0.1	0.1	1.0	2.5	166.0
	Training Facilities (Volume2)	0.0	0.1	0.0	0.0	0.0	0.0	7.4
	C3 and Non-Firing Training Facilities	0.2	0.6	0.0	0.0	0.3	0.9	49.3
Sub Total		0.7	2.2	0.1	0.1	1.3	3.4	222.7
Central	C3 and Non-Firing Training Facilities	0.2	0.6	0.0	0.0	0.3	0.9	49.3
	Firing Training, Option A	0.4	1.6	0.1	0.1	1.0	0.5	138.9
	Firing Training, Option B	0.8	1.7	0.2	0.2	1.5	0.3	264.3
Sub Total		1.4	3.9	0.3	0.3	2.8	1.7	452.5
Apra Harbor	Waterfront Operations	1.1	0.8	0.0	0.0	0.5	0.4	80.1
South	Training Facilities	0.0	0.1	0.0	0.0	0.0	0.0	7.4

Table 5.2-2. Main Cantonment Annual Construction Emissions (2011-2016)

	Construction Activity	*Pollutant*						
	Total Annual Emissions (TPY)	SO_2	*CO*	PM_{10}	$PM_{2.5}$	NO_x	*VOC*	CO_2
Alternative 1, North	2011 (11%)	6.3	25.8	1.5	1.4	13.1	10.2	2,160.6
	2012 (18%)	10.3	42.2	2.4	2.3	21.4	16.6	3,535.5
	2013 (23%)	13.1	53.9	3.1	2.9	27.3	21.3	4,517.6
	2014 (23%)	13.1	53.9	3.1	2.9	27.3	21.3	4,517.6
	2015 (17%)	9.7	39.8	2.3	2.2	20.2	15.7	3,339.1
	2016 (8%)	4.6	18.8	1.1	1.0	9.5	7.4	1,571.3
Alternative 2, North	2011 (11%)	6.4	26.2	1.5	1.4	13.3	10.4	2,188.9
	2012 (18%)	10.4	42.9	2.5	2.3	21.7	16.9	3,581.9
	2013 (23%)	13.3	54.8	3.2	3.0	27.7	21.6	4,576.8
	2014 (23%)	13.3	54.8	3.2	3.0	27.7	21.6	4,576.8
	2015 (17%)	9.9	40.5	2.3	2.2	20.5	16.0	3,382.9
	2016 (8%)	4.6	19.1	1.1	1.0	9.6	7.5	1,591.9
Alternative 3, North	2011 (11%)	4.3	17.6	1.0	1.0	8.9	6.9	1,461.4
	2012 (18%)	7.0	28.8	1.7	1.6	14.5	11.4	2,391.3
	2013 (23%)	8.9	36.7	2.1	2.0	18.5	14.5	3,055.6
	2014 (23%)	8.9	36.7	2.1	2.0	18.5	14.5	3,055.6
	2015 (17%)	6.6	27.2	1.6	1.5	13.7	10.7	2,258.5
	2016 (8%)	3.1	12.8	0.7	0.7	6.5	5.0	1,062.8
Alternative 3, Central	2011 (11%)	2.3	9.3	0.5	0.5	4.7	3.7	776.6
	2012 (18%)	3.7	15.3	0.9	0.8	7.7	6.0	1,270.7
	2013 (23%)	4.7	19.5	1.1	1.1	9.9	7.7	1,623.7
	2014 (23%)	4.7	19.5	1.1	1.1	9.9	7.7	1,623.7
	2015 (17%)	3.5	14.4	0.8	0.8	7.3	5.7	1,200.1
	2016 (8%)	1.6	6.8	0.4	0.4	3.4	2.7	564.8
Alternative 8, North	2011 (11%)	5.2	21.3	1.2	1.2	10.7	8.4	1,769.0
	2012 (18%)	8.4	34.8	2.0	1.9	17.6	13.8	2,894.8
	2013 (23%)	10.8	44.5	2.6	2.4	22.4	17.6	3,698.9
	2014 (23%)	10.8	44.5	2.6	2.4	22.4	17.6	3,698.9
	2015 (17%)	8.0	32.9	1.9	1.8	16.6	13.0	2,734.0
	2016 (8%)	3.7	15.5	0.9	0.8	7.8	6.1	1,286.6
Alternative 8, Central	2011 (11%)	1.2	5.2	0.3	0.3	2.6	2.0	428.5
	2012 (18%)	2.0	8.4	0.5	0.5	4.3	3.3	701.2
	2013 (23%)	2.6	10.8	0.6	0.6	5.4	4.3	896.0
	2014 (23%)	2.6	10.8	0.6	0.6	5.4	4.3	896.0
	2015 (17%)	1.9	8.0	0.5	0.4	4.0	3.1	662.3
	2016 (8%)	0.9	3.7	0.2	0.2	1.9	1.5	311.7

Operation

Aircraft and helicopter engines emit criteria pollutants during all phases of operation whether climb out, approach, touch and go, ground control approach (GCA) Box, or cruise. Based on the estimated number of additional sorties on an annual basis (Czech and Kester 2008) and on base maintenance for the addition of new aircraft at Andersen AFB North Ramp field, the annual aircraft operational emissions were estimated using the emission factors provided by Aircraft Environmental Support Office. The aircraft

sortie emissions estimates are summarized in Table 5.2-3 and the detailed methodology used for the estimates is presented in Volume 9, Appendix I, Section 3.3 Aircraft Operational Emissions.

Table 5.2-3. Annual Increase in Aircraft Sortie Emissions at Andersen AFB

Activity	*Pollutant (TPY)*						
	SO_2	CO	PM_{10}	$PM_{2.5}$	NO_x	VOC	CO_2
Aircraft carrier Airwings	0.4	91.6	4.7	4.7	8.6	26.6	N/A
Based Aircraft LTO, touch and go, FCLP and GCA Box	1.8	106.1	17.1	17.1	33.3	35.6	3219.1
Based Aircraft Maintenance	0.4	29.7	3.5	3.5	6.8	10.2	1,258.0
Total Operation	2.6	227.4	25.3	25.3	48.7	72.4	4477.1

Note: CO_2 emissions are only available for MV-22 aircraft.

Aircraft flight emissions during training exercises below 3,000 ft (914 m) altitude within Andersen AFB airspace were also estimated based on the flight training forecasts provided earlier in this volume (Section 2.3). The aircraft training emissions are summarized in Table 5.2-4 and detailed in Volume 9, Appendix I, Section 3.3 Aircraft Training Emissions.

Table 5.2-4. Aircraft Training Flight Annual Emissions

Location	*Pollutant (TPY)*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	CO_2
North							
Northwest Field	0.1	0.5	0.4	0.4	2.4	0.1	428.8
Andersen AFB	0.1	1.1	0.6	0.6	3.2	0.3	339.8
Sub Total	0.2	1.6	1.0	1.0	5.6	0.4	768.6
Central							
Andersen South	0.1	0.5	0.5	0.5	1.9	0.1	107.4
Apra Harbor							
Orote	0.1	0.4	0.4	0.4	2.0	0.1	361.0
South							
NMS	0.3	1.4	1.8	1.8	10.6	0.1	1869.5

Note: CO_2 emissions are only available for MV-22, CH-46, and C-130 aircraft.

On base annual commuting vehicle emissions within Andersen AFB were estimated using the methodology described in Section 5.2.1.1 and are summarized in Table 5.2-5 and detailed in Volume 9, Appendix I, Sections 3.3 Training Vehicles Emissions and On Base Vehicle Operational Emissions.

Table 5.2-5. Vehicle Annual Emissions

Location	*Pollutant (TPY)*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	CO_2
Training Vehicle Emissions							
Central							
Andersen South	0.1	0.7	10.1	1.0	0.1	0.1	80.8
Guam Range Complex	0.1	0.9	14.0	1.4	0.1	0.1	64.7
Troop Transport	0.1	0.0	0.0	0.0	0.1	0.0	16.2
Sub Total	0.2	1.6	24.1	2.4	0.3	0.2	161.8
South							
NMS	0.0	0.0	0.5	0.1	0.0	0.0	2.3
On Base Commuting Vehicle Emissions							
North							
Finegayan	8.2	207.3	1.6	1.0	9.9	13.1	17,316.5
Andersen AFB	1.9	46.9	0.4	0.2	2.2	3.0	3,919.3
Sub Total	10.1	254.2	1.9	1.2	12.2	16.1	21,235.8
Central							
Andersen South	0.5	12.8	0.1	0.1	0.6	0.8	1,068.1
Barrigada	2.3	58.1	0.4	0.3	2.8	3.7	4,858.1
Sub Total	2.8	70.9	0.5	0.3	3.4	4.5	5,926.1
Apra Harbor							
Naval Base & Polaris Point	0.3	8.6	0.1	0.0	0.4	0.5	716.3
South							
NMS	0.1	0.8	0.0	0.0	0.0	0.1	77.6

Finegayan

Construction

In Finegayan, potential construction of the main cantonment would include bachelor housing, supply warehouses, maintenance facilities, various headquarters and administrative support facilities, community support facilities, some training areas, and open space. In order to streamline development of a construction estimate for the main cantonment, each individual item was assigned to one of 12 types of "prototype" elements, with complete construction estimates developed for a representative sample of each of these prototypes. The prototype elements include:

- Office
- Commercial
- Pre-Engineered Structures
- Industrial
- Hangar
- Warehouse
- Residential (Multiple Unit)
- Residential (Single-family Units)
- Site Preparation
- Utility and Road/Sidewalk Installation
- Vehicle pavement
- Aircraft pavement

The total air emissions resulting from potential construction equipment, vehicle, and paving activities occurring between 2011–2016 are summarized in Table 5.2-1 and air emissions from the construction of main cantonment facilities are presented in Table 5.2-2.

In addition to the main cantonment, command, control and communications (C3) and non-firing training facilities are also planned for the north in Finegayan as part of the Guam Military Relocation. The construction estimate for C3 and non-firing training assigns "prototype" elements, and also includes additional specific items, when needed, in the estimate. The prototype elements for C3 include:

- Battle Staff Training and Simulation
- Marine Air Ground Task Force Integrated Systems Training Center
- Combined Arms Staff Training

The prototype elements for non-firing training include:

- Obstacle Course, Confidence Course
- Hand-to-Hand Combat Pit
- Rappelling Tower
- Gas Chamber
- Combat Training Tank
- General Purpose Auditorium
- The Crew, Unit and Military Occupational Specialty Combat Skills elements

The total air emissions resulting from potential construction equipment, vehicle and paving activities occurring between 2011 to 2014 for C3 and non-firing training facilities in the north are shown in Table 5.2-1.

Operation

On base annual commuting vehicle emissions within Finegayan were estimated using the methodology described in Section 5.2. Other operational air emission estimates are considered with utility services and roadway development (see Volume 6).

Non-DoD Land

Construction

Non-DoD land would be a part of the main cantonment as described in Chapter 2, and therefore construction and operation emissions were not calculated separately for this area. Table 5.2-2 provides construction emissions for the main cantonment.

Operation

Tables 5.2-4 and 5.2-5 provide operation emissions for North.

The construction emissions and aircraft operational and flight emissions for North shown in Tables 5.2-1 to 5.2-4 are all below the significance criteria of 250 TPY for air pollutants, except for CO. The SO_2 emissions were also all below the 100 TPY *de minimis* level that is applicable to the Tanguisson nonattainment area. The CO annual emissions would exceed 250 TPY threshold in North primarily due to commuting vehicles traveling on base. As described in Section 5.2, an evaluation is warranted to further determine whether these site-specific vehicular CO emissions would result a potential exceedance of the CO NAAQS. The modeling analysis and associated results are described in Volume 6 for roadway

projects and no exceedances of CO NAAQS are predicted. Therefore, the potential CO impact is not considered significant although the 250 TPY threshold is exceeded in North.

5.2.2.2 Central

Andersen South

Construction

Live fire training range facilities are proposed for east of Andersen South at Route 15 in Central. The construction estimate used for firing training range elements utilizes the following prototypes:

- Overall site preparation – included for both Alternatives A and B
- Range Control and Maintenance Facilities.

The total air emissions resulting from potential construction equipment, vehicle and paving activities occurring from 2011 to 2014 for live fire training facilities in the central are shown in Table 5.2-1.

Operation

Aircraft flight operational emissions during training exercises within Andersen South airspace were also estimated based on the training forecasts described in Section 2.3. These emissions are summarized in Table 5.2-4.

Annual vehicle emissions during training exercises and on base commuting operations within Andersen South were estimated based on the training forecasts described in Section 2.3 and using the methodology described in Section 5.2.1.1.

Barrigada

Construction

No new construction is proposed in Navy Barrigada or Air Force Barrigada, and therefore no construction emissions are predicted for this area.

Operation

On base annual commuting vehicle emissions within Barrigada were estimated using the methodology described in Section 5.2.1.1. No other new operations are proposed in Navy Barrigada or Air Force Barrigada.

The construction emissions, aircraft operational and flight emissions, and vehicle emissions for Central shown in Tables 5.2-1, 5.2-4, and 5.2-5 are all below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA, as described in Section 5.2. The predicted SO_2 emissions are also below the 100 TPY *de minimis* level within the Piti and Tanguisson nonattainment areas.

Non-DoD Land

Construction

There would be no construction on non-DoD land in central Guam, as the area proposed for DoD use is limited to the Route 15 Parcel.

Operation

Annual vehicle emissions during training exercises within other areas in central Guam were estimated and are summarized in Table 5.2-5.

5.2.2.3 Apra Harbor

Harbor

Construction

The construction of facilities planned for the proposed waterfront operations at Apra Harbor include ship berthing and embarkation, Landing Craft Air Cushion/Amphibious Assault Vehicle laydown area, U.S. Coast Guard (USCG) relocation, military working dog kennel relocation, and a medical clinic. In addition to using construction elements similar to the prototype buildings previously discussed, specialty construction works associated with the waterfront construction elements are also considered, as listed below:

- Victor/Uniform Wharf
- Sierra/Tango Wharves
- Southwest of Victor Wharf
- Adjacent to Victor Wharf
- Landing Craft Air Cushion/ Amphibious Assault Vehicle
- USCG Relocation
- Military Working Dog Kennel
- Medical Clinic

The total air emissions resulting from potential construction, vehicle and paving activities associated with the construction of waterfront facilities that would occur from 2011 to 2014 in the Apra Harbor are summarized in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises around Orote Airfield were also estimated based on the training forecasts described in Section 2.3. These emissions are summarized in Table 5.2-4.

The annual vessel emissions during the training exercises around Apra Harbor were estimated based on the vessel travel distance and speed forecasted and the methodology discussed in Section 5.2. These emissions are summarized in Table 5.2-6 and detailed in Volume 9, Appendix I, Section 3.3.4 Marine Vessel Training Emissions.

Table 5.2-6. Training Vessel Annual Emissions

Type	*Pollutant (TPY)*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Ships Carrying Amphibious Vehicles	0.4	0.0	0.1	0.1	0.1	0.0	N/A
Amphibious Vehicles	2.8	2.8	6.2	6.2	4.8	0.4	N/A
Escort Combat Ships	0.2	0.9	0.0	0.0	0.4	0.1	N/A
Barges	0.2	0.8	0.1	0.1	4.2	0.1	N/A
Total	3.6	4.5	6.4	6.4	9.5	0.6	N/A

Legend: N/A = not available.

Naval Base Guam

Construction

Construction proposed in the Naval Base Guam area is discussed in the previous section (Harbor).

Operation

Annual commuting vehicle emissions within the base were estimated using the methodology described in Section 5.2. and are summarized in Table 5.2-4. The construction emissions, aircraft operational and flight emissions, on base commuting vehicle emissions, and vessel emissions for Apra Harbor shown in Tables 5.2-1, 5.2-4, and 5.2-6 are all below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA, as described in Section 5.2. The predicted SO_2 emissions are also below the 100 TPY *de minimis* level within the Piti nonattainment areas.

5.2.2.4 South

Naval Munitions Site

Construction

Additional airfield training is proposed at the NMS in the south. As described above in Section 5.2.2.1, proposed training facilities include the construction of new earth-covered magazine structures for the storage of ordnance and the construction of administrative areas. The total air emissions resulting from potential construction equipment, vehicle and paving activities occurring from 2011–2014 for airfield training facilities in the south are summarized in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises around NMS airfield were also estimated based on the training forecasts described in Section 2.3. These emissions are summarized in Table 5.2-4.

Annual vehicle emissions during training exercises within the NMS were estimated based on the training forecasts described in Sections 2.3 and using the methodology described in Section 5.2. and are summarized in Table 5.2-5. Annual commuting vehicle emissions within the NMS were estimated using the methodology described in Section 5.2. and are summarized in Table 5.2-5

The construction emissions, aircraft operational and flight emissions, and vehicle emissions for south Guam shown in Tables 5.2-1, 5.2-4, and 5.2-5 are all below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA, as described in Section 5.2.

5.2.2.5 Summary of Impacts

Air emissions associated with both construction and operational components of Alternative 1 would be well below the significance criteria of 250 TPY for all air pollutants except CO. However, a further CO dispersion modeling analysis described in Volume 6 shows that no exceedances of CO NAAQS would occur from roadway traffic under the proposed action. Therefore, the potential CO impact is not considered significant although the 250 TPY threshold is exceeded. The predicted SO_2 emissions would be below the 100 TPY *de minimis* level within the two nonattainment areas. Therefore, all project specific air quality impacts are considered less than significant for all areas for this action.

5.2.2.6 Potential Mitigation Measures

The predicted construction emissions (2011 to 2016) and operational emissions (2015 and after) for criteria pollutants within each ROI are all below the 250 TPY threshold or 100 TPY SO_2 threshold applicable for SO_2 nonattainment areas. Therefore potential air quality impacts under Alternative 1 are considered less than significant and emissions mitigation measures are not warranted.

5.2.3 Alternative 2 (Preferred Alternative)

The construction effort for all airfield, waterfront, and training projects is assumed to be essentially the same for Alternative 2 as for Alternative 1, as well as air emissions associated with operational components. The construction emissions associated with main cantonment facilities under Alternative 2 were calculated separately due to a slight difference in earth disturbance as compared to Alternative 1.

5.2.3.1 North

Andersen AFB

Construction

Emissions that result from the proposed installation of airfield operations facilities and aviation training at Andersen AFB for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-1. As discussed in Section 5.2.1, the majority of project components that would affect potential air quality conditions remain the same for each alternative and therefore the total predicted construction emissions are the same for all alternatives.

Operation

Annual aircraft and on base vehicle operational emissions for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2. and presented in Tables 5.2-3, 5.2-4, and 5.2-5.

Finegayan

Construction

Construction emissions resulting from the proposed main cantonment facilities were estimated using the same methodologies and procedures described in Sections 5.2.1.1 and 5.2.2.1 and are summarized in Table 5.2-2. The training facilities at Finegayan for C3 and non-firing training facilities as planned in Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-1.

Operation

Annual on base vehicle operational emissions for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

Non-DoD Land

Construction

Non-DoD land would be a part of the main cantonment as described in Chapter 2, and therefore construction and operation emissions were not calculated separately for this area. Construction emissions for the main cantonment for Alternative 2 are provided in Table 5.2-2.

Operation

Table 5.2-4 provides operation emissions for North, which is considered to be the same as for Alternative 1.

5.2.3.2 Central

Andersen South

Construction

Construction emissions that result from the proposed installation of training facilities for C3, non-firing training, and live fire training in central Guam near Andersen South for Alternative 2 are assumed to be the same as those for Alternative 1, which are discussed above and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during training exercises within Andersen South airspace and on base commuting vehicle emissions within Andersen South for Alternative 2 are assumed to be the same as those for Alternative 1, which are discussed in Section 5.2.2.2 and presented in Tables 5.2-3, 5.2-4 and 5.2-5.

Barrigada

Construction

Under Alternative 2, the placement of administration and maintenance facilities and housing is proposed within Navy Barrigada. No new activities would occur at Air Force Barrigada. As construction activity is assumed to be similar to Alternative 1, the same annual emissions during construction years are predicted under Alternative 2. These emissions are discussed in Section 5.2.2.1 and presented in Table 5.2-1.

Operation

Annual on base vehicle operational emissions for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

Non-DoD Land

Construction

There would be no construction on non-DoD land in central Guam, as the area proposed for DoD use is limited to the Route 15 Parcel.

Operation

Annual vehicle emissions during training exercises within other areas in central Guam for Alternative 2 are assumed to be the same as those for Alternative 1 and are summarized in Table 5.2-5.

5.2.3.3 Apra Harbor

Harbor

Construction

Emissions that result from the proposed installation of waterfront operations facilities at Apra Harbor for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises around Orote Airfield Harbor for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-4.

Naval Base Guam

Construction

Construction proposed in the Naval Base Guam area is discussed in the previous section (Harbor).

Operation

Annual on base vehicle operational emissions for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

5.2.3.4 South

Naval Munitions Site

Construction

Emissions that result from the proposed construction of aviation training facilities and non-firing ranges at the NMS for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.4 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises and on base commuting vehicle emissions around NMS for Alternative 2 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.4 and presented in Tables 5.2-4 and 5.2-5.

5.2.3.5 Summary of Impacts

All air emissions would be well below the significance criteria of 250 TPY for all air pollutants except for CO. However, a further CO dispersion modeling analysis described in Volume 6 shows that no exceedances of CO NAAQS would occur from roadway traffic under the proposed action. Therefore, the potential CO impact is not considered significant although the 250 TPY threshold is exceeded. The predicted SO_2 emissions would below the 100 TPY *de minimis* level within the two nonattainment areas. Therefore, all project specific air quality impacts are considered less than significant for all areas for this action. The overall air quality impacts are discussed in Volume 7, which addresses the combined effects from all project components under the proposed actions.

5.2.3.6 Potential Mitigation Measures

The overall construction emissions are anticipated to be slightly higher as compared to Alternative 1 because of slightly more earth disturbance associated with the main cantonment construction. The predicted construction emissions (2011–2016) and operational emissions (2015 and after) are combined with the emissions from other components of the proposed actions in Volume 7 to determine the cumulative potential air emissions impact significance using the impact thresholds described in Section 5.2.1.2. A CAA general conformity applicability analysis is also provided for the total combined emissions within the two SO_2 nonattainment areas in Volume 7. In addition, a discussion of whether mitigation measures for controlling emissions are necessary for Alternative 1, together with emissions

from other components of the proposed actions, is discussed in Volume 7, as the need for mitigation measures would ultimately be dependent on the combined air emissions.

5.2.4 Alternative 3

This alternative includes construction at NCTS Finegayan with portions of the military housing and quality of life services at Navy and Air Force Barrigada. As compared to Alternative 1, there would be a slight shift of emissions from the change in construction locations of these facilities among the affected ROIs. Therefore, the construction emissions, the construction effort for all airfields, waterfront, training and other non-firing training projects is assumed to be the same for Alternative 3 as for Alternative 1, as are air emissions associated with operational components.

5.2.4.1 North

Andersen AFB

Construction

Emissions that result from the proposed construction of airfield operations and training facilities at Andersen AFB for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-1.

Operation

Annual aircraft and on base vehicle operational emissions for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Tables 5.2-3, 5.2-4 and 5.2-5.

Finegayan

Construction

Emissions that result from the construction of training facilities for C3 and non-firing training facilities in Finegayan for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-1. Emissions from the construction of main cantonment facilities are summarized in Table 5.2-2.

Operation

Annual on base vehicle operational emissions for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

Non-DoD Land

Construction

Non-DoD land would be a part of the main cantonment as described in Chapter 2, and therefore construction and operation emissions were not calculated separately for this area. Construction emissions for the main cantonment for Alternative 3 are provided in Table 5.2-2

Operation

Table 5.2-4 provides operation emissions for North, which are considered to be the same as for Alternative 1.

5.2.4.2 Central

Andersen South

Construction

Emissions that result from the proposed construction of training facilities for C3, non-firing, and live fire training in central Guam near Andersen South for Alternative 3 are assumed to be the same as those for Alternative 1 that are discussed in Section 5.2.2.2 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during training exercises within Andersen South airspace and on base commuting vehicle emissions within Andersen South for Alternative 3 are assumed to be the same as those for Alternative 1, which are discussed in Section 5.2.2.2 and presented in Tables 5.2-3, 5.2-4 and 5.2-5.

Barrigada

Construction

Under Alternative 3, the placement of administration and maintenance facilities and housing is proposed within Navy Barrigada and Air Force Barrigada. Emissions from the construction of main cantonment facilities predicted under Alternative 3 are summarized in Table 5.2-2.

Operation

Annual on base vehicle operational emissions for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

Non-DoD Land

Construction

There would be no construction on non-DoD land in central Guam, as the area proposed for DoD use is limited to the Route 15 Parcel.

Operation

Annual vehicle emissions during training exercises within other areas in central Guam for Alternative 3 are assumed to be the same as those for Alternative 1.

5.2.4.3 Apra Harbor

Harbor

Construction

Emissions that result from the proposed construction of waterfront operations facilities at Apra Harbor for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises around Orote Airfield Harbor for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-3.

Naval Base Guam

Construction

Construction proposed in the Naval Base Guam area is discussed in the previous section (Harbor).

Operation

Annual on base vehicle operational emissions for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

5.2.4.4 South

Naval Munitions Site

Construction

Emissions that result from the proposed construction of aviation training and non-fire Ranges at the NMS for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.4 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises and on base commuting vehicle emissions around NMS for Alternative 3 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.4 and presented in Tables 5.2-4 and 5.2-5.

5.2.4.5 Summary of Impacts

All air emissions would be well below the significance criteria of 250 TPY all air pollutants except for CO. However, a further CO dispersion modeling analysis described in Volume 6 shows that no exceedances of CO NAAQS would occur from roadway traffic under the proposed action. Therefore, the potential CO impact is not considered significant although the 250 TPY threshold is exceeded. The predicted SO_2 emissions would below the 100 TPY *de minimis* level within the two nonattainment areas. Therefore, all project specific air quality impacts are considered less than significant for all areas for this action.

5.2.4.6 Potential Mitigation Measures

The predicted construction emissions (2011 to 2016) and operational emissions (2015 and after) for criteria pollutants within each ROI are all below the 250 TPY threshold or 100 TPY SO_2 threshold applicable for SO_2 nonattainment areas. Therefore potential air quality impacts under Alternative 3 are considered less than significant and emissions mitigation measures are not warranted.

5.2.5 Alternative 8

This alternative includes construction at NCTS Finegayan with portions of the military housing and quality of life services at Navy and Air Force Barrigada. There would be a slight shift of emissions among affected regions of influence as compared to Alternative 1 due to the change in the construction locations of the facilities. Therefore, the construction emissions associated with main cantonment facilities under Alternative 8 were calculated for this alternative. The construction effort for all airfields, waterfront, training and other projects is assumed to be the same for Alternative 8 as for Alternative 1, as are air emissions associated with operational components.

5.2.5.1 North

Andersen AFB

Construction

Emissions that result from the proposed construction of airfield operations facilities and aviation training facilities at Andersen AFB for Alternative 8 are assumed to be the same as those for Alternative 1 that are described in Section 5.2.2.1 and presented in Table 5.2-1.

Operation

Annual aircraft and on base vehicle operational emissions for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Tables 5.2-3, 5.2-4 and 5.2-5.

Non-DoD Land

Construction

Non-DoD land would be a part of the main cantonment as described in Chapter 2, and therefore construction and operation emissions were not calculated separately for this area. Construction emissions for the main cantonment for Alternative 8 are provided in Table 5.2-2.

Operation

Table 5.2-4 provides operation emissions for North, which is considered to be the same as for Alternative 1.

Finegayan

Construction

Emissions resulting from the construction of training facilities for C3 and non-firing training facilities in Finegayan for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-1. Emissions from the construction of main cantonment facilities are summarized in Table 5.2-2.

Operation

Annual on base vehicle operational emissions for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

5.2.5.2 Central

Andersen South

Construction

Emissions that result from the proposed construction of training facilities for C3, non-firing, and firing training near Andersen South for Alternative 8 are assumed to be the same as those for Alternative 1 that are discussed in Section 5.2.2.2 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during training exercises within Andersen South airspace and on base commuting vehicle emissions within Andersen South for Alternative 8 are assumed to be the same as

those for Alternative 1, which are discussed in Section 5.2.2.2 and presented in Tables 5.2-3, 5.2-4 and 5.2-5.

Barrigada

Construction

Under Alternative 8, the placement of administration and maintenance facilities and housing is proposed within Air Force Barrigada. There would be no construction in Navy Barrigada Emissions from construction activities associated with main cantonment facilities are predicted under Alternative 8 and summarized in Table 5.2-2.

Operation

Annual on base vehicle operational emissions for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

Non-DoD Land

Construction

There would be no construction on non-DoD land in central Guam, as the area proposed for DoD use is limited to the Route 15 Parcel.

Operation

Annual vehicle emissions during training exercises within other areas in central Guam for Alternative 8 are assumed to be the same as those for Alternative 1.

5.2.5.3 Apra Harbor

Harbor

Construction

Emissions that result from the proposed construction of waterfront operations facilities at Apra Harbor for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises around Orote Airfield Harbor for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.3 and presented in Table 5.2-4.

Naval Base Guam

Construction

Construction proposed in the Naval Base Guam area is discussed in the previous section (Harbor).

Operation

Annual on base vehicle operational emissions for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.1 and presented in Table 5.2-5.

5.2.5.4 South

Naval Munitions Site

Construction

Emissions that result from the proposed construction of aviation training and non-firing ranges at NMS for Alternative 8 are assumed to be the same as those for Alternative 1 that are described in Section 5.2.2.4 and presented in Table 5.2-1.

Operation

Aircraft flight operational emissions during the training exercises and on base commuting vehicle emissions around NMS for Alternative 8 are assumed to be the same as those for Alternative 1 and are described in Section 5.2.2.4 and presented in Tables 5.2-4 and 5.2-5.

5.2.5.5 Summary of Impacts

All air emissions would be well below the significance criteria of 250 TPY all air pollutants except for CO. However, a further CO dispersion modeling analysis described in Volume 6 shows that no exceedances of CO NAAQS would occur from roadway traffic under the proposed action. Therefore, the potential CO impact is not considered significant although the 250 TPY threshold is exceeded. The predicted SO_2 emissions would below the 100 TPY *de minimis* level within the two nonattainment areas. Therefore, all project specific air quality impacts are considered less than significant for all areas for this action.

5.2.5.6 Potential Mitigation Measures

The predicted construction emissions (2011 to 2016) and operational emissions (2015 and after) for criteria pollutants within each ROI are all below the 250 tpy threshold or 100 tpy SO_2 threshold applicable for SO_2 nonattainment areas. Therefore potential air quality impacts under Alternative 8 are considered less than significant and emissions mitigation measures are not warranted.

5.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. The current level of air emissions would remain unchanged.

5.2.7 Summary of Impacts

Tables 5.2-7, 5.2-8, and 5.2-9, and 5.2-10 summarize the potential impacts of each action alternative (Alternatives 1, 2, 3, and 8) associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 5.2-11 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

This evaluation assumed that the construction effort for all airfield, waterfront, and training associated projects would be essentially the same, regardless of location. Therefore, the estimates of air emissions associated with these construction activities calculated for Alternatives 1, 2, 3, and 8 are equal. However, the main cantonment-related construction emissions were estimated for each alternative given that there

are slight differences in the scale of earth disturbance among the four cantonment alternatives. The operational components of all four action alternatives are also considered to be the same and therefore the total predicted emissions for all action alternatives are also the same. The potential air emissions for the construction and operational components of Alternatives 1, 2, 3, and 8 are well below the significance criteria of 250 TPY except for CO, primarily due to on base vehicular trips. A further CO dispersion modeling analysis described in Volume 6 indicates that no exceedances of CO NAAQS would occur from roadway traffic under the proposed action. The potential CO impact is not considered significant although the 250 TPY threshold is exceeded. Therefore, Alternatives 1, 2, 3 and 8 would result in less than significant impacts to air quality resources. The no-action alternative would result in no impacts to air quality resources.

Table 5.2-7. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternatives 1, 2, 3, and 8
Construction
LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria
Operation
LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria

Legend: LSI = Less than significant impact.

Table 5.2-8. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternatives A and B
Construction
LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria
Operation
LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria

Legend: LSI = Less than significant impact.

Table 5.2-9 Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternatives A and B
Construction
LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria
Operation
LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria

Legend: LSI = Less than significant impact.

Table 5.2-10. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternatives A and B
Construction
LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria
Operation
LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria

Legend: LSI = Less than significant impact.

Table 5.2-11 Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria	LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria	LSI • Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria
Operation		
LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria	LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria	LSI • Less than significant adverse impacts to air quality. Operations emissions from all components would be well below significance criteria

Legend: LSI = Less than significant impact.

5.2.8 Summary of Potential Mitigation Measures

As the predicted air emissions would result in less than significant impacts for all alternatives for both construction and operation components of the proposed action, no mitigation measures are warranted.

CHAPTER 6. NOISE

6.1 AFFECTED ENVIRONMENT

The main sources of noise comprising the affected environment addressed in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) are related to military operations (airfield operations, aviation training, and ground training), civilian aviation noise, construction noise, and noise from civilian and military ground vehicular traffic. Military airfield operations are predominantly those activities associated with the main runways at Andersen Air Force Base (AFB). Aviation training involves aircraft operations occurring away from the airfield. Ground training encompasses many types of activities, but live-fire activities are emphasized in analyzing the noise environment because they generate more noise than other ground-based activities. Heavy equipment used during construction activities is the primary source of construction noise. Traffic noise relates to vehicle movements on roadways around the island. The Federal Highway Administration (FHWA) has conducted a study analyzing traffic and associated noise and the results of that study are summarized in Volume 6 of this EIS/OEIS. The following sections discuss the baseline noise environment to assess the potential effects of noise that would be generated in each geographical area of interest on Guam if the proposed DoD action is implemented.

6.1.1 Definition of Resource

Sound is the stimulation of auditory organs produced by sound waves transmitted through the air or other medium. Sound waves are small pressure fluctuation waves caused by vibrations. Human hearing generally covers fluctuations between frequencies of 20 and 20,000 hertz, with higher frequencies interpreted as having a higher pitch. Frequency is a measure of wave cycles per unit of time. Cycles per second is the standard unit of measurement for sound wave frequency and is expressed as hertz. Sound waves move outward in all directions from the vibration source, dissipating as the distance from the source increases (inversely proportional to the square of the distance to the source). High frequency sounds dissipate more quickly. Dissipation also occurs due to wind, ground cover, and temperature.

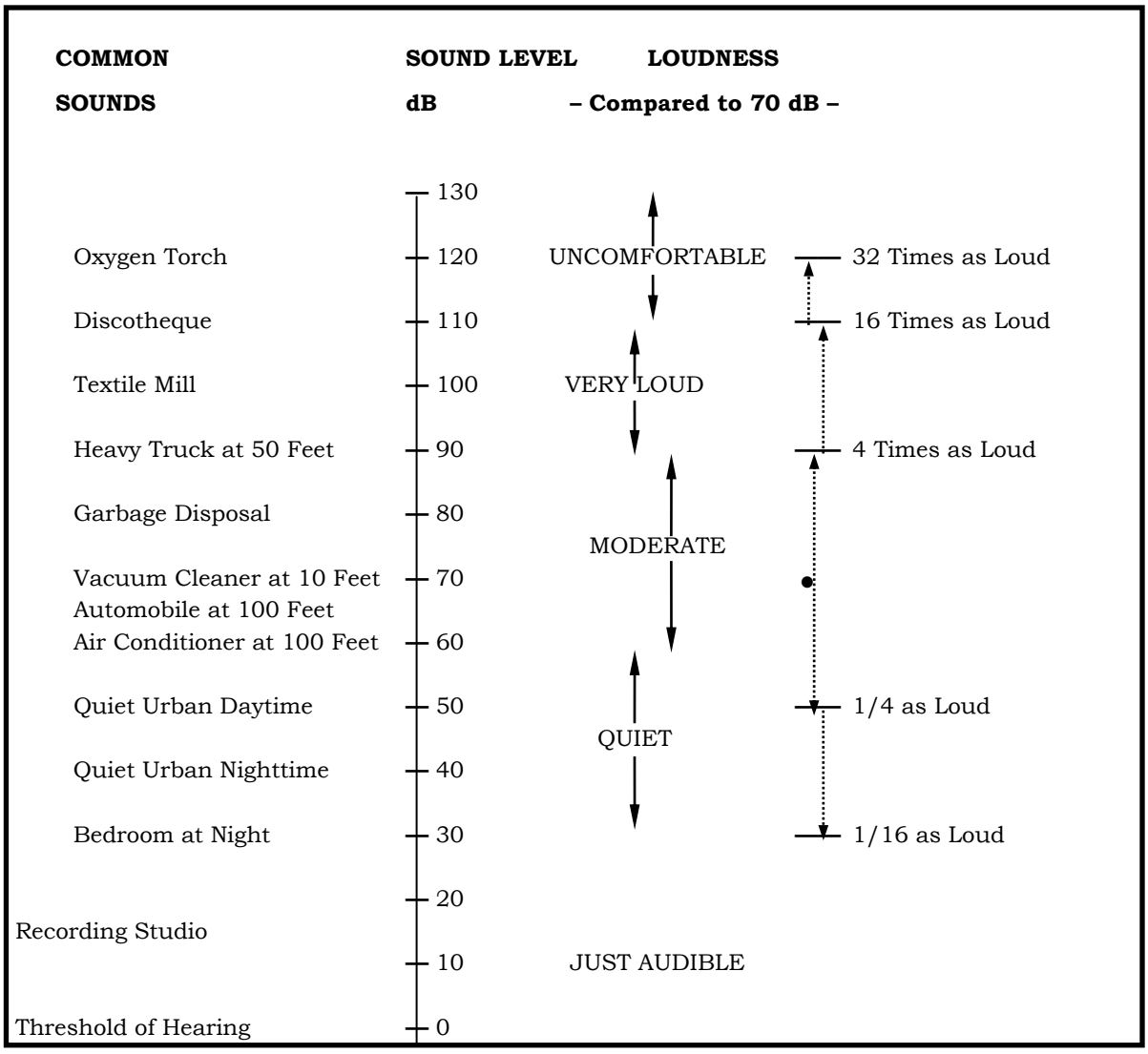
Loudness is the relative measure of the magnitude of a sound and is typically measured in decibels (dB). Decibels are the ratio of the intensity of the sound to a reference intensity based on atmospheric pressure. The dB is a logarithmic unit of measurement that expresses the magnitude of a physical quantity, like sound, relative to a specified or implied reference level. Since it expresses a ratio of two quantities with the same unit, it is a dimensionless unit.

Noise is unwanted or annoying sound and is not necessarily based on loudness. It comes from both natural and manmade sources. Noise can have deleterious effects on physical and psychological health, affect workplace productivity, and degrade quality of life. Military activities often involve the use of specialized equipment that cause noise, including aircraft, artillery, heavy vehicles, ships, and amphibious vehicles. The degree to which a sound is perceived to be noise may be influenced by the following factors:

- Frequency spectrum (300 to 4,800 hertz range has the highest potential for deleterious effects on humans)
- Intensity (loudness and frequency)
- Modulation (level of distortion)

- Time and place of occurrence
- Duration
- The individual's background

Figure 6.1-1 shows typical intensity levels for common sounds. Since sound level intensity is logarithmic, the decibel levels of multiple sources of sound are not additive. In fact, doubling a noise source would only generate a 3 dB increase. For example, a receptor under a flight path with one jet airliner 500 feet (ft) (152 meters [m]) overhead would experience 115 dB; if two jetliners passed side-by-side, the receptor would experience 118 dB not 230 dB.



Source: Harris 1979, FICON 1992.

Figure 6.1-1. Typical A-Weighted Sound Levels of Common Sounds

Frequency Weighting

A number of factors affect sound, as the human ear perceives it. These include the actual level of noise, the frequencies involved, the period of exposure to the noise, and changes or fluctuations in noise levels during exposure. In order to correlate the frequency characteristics from typical noise sources to the

perception of human ears, several noise frequency weighting measures have been developed. The most common frequency measures include the following:

- *A-weighted Scale.* Since the human ear cannot perceive all pitches or frequencies equally well, these measures are adjusted or weighted to compensate for the human lack of sensitivity to low-pitched and high-pitched sounds. This adjusted unit is known as the A-weighted decibel, or dBA. The dBA is used to evaluate noise sources related to transportation (e.g., traffic and aircraft) and to small arms firing (up to .50-caliber).
- *C-weighted Scale* – The C-weighted scale measures more of the low-frequency components of noise than does the A-weighted scale. It is used for evaluating impulsive noise and vibrations generated by explosive charges and large-caliber weapons (such as artillery, mortars). C-weighted noise levels are indicated by dBC.

Noise levels from one scale cannot be added or converted mathematically to levels in another weighting scale.

Noise Metrics

Because of continuous versus impulsive types of noise, variations in frequency and period of noise exposure, and the fact that the human ear cannot perceive all pitches and frequencies equally well, noise from military operations is measured using noise metrics that reflect different noise characteristics. Common metrics used in this EIS/OEIS noise analysis are as follows:

- Day-Night Sound Level (DNL) – This metric cannot be measured directly; rather, it is calculated as the average sound level in decibels with a 10 dB penalty added to the nighttime levels (10 p.m. to 7 a.m.). This penalty accounts for the fact that noises at night sound louder because there are usually fewer noises occurring at night so generally nighttime noises are more noticeable. The DNL noise metric may be further defined, as appropriate, with a specific, designated time period (e.g., annual average DNL, average busy month DNL). This metric is recommended by the United States (U.S.) Environmental Protection Agency (USEPA), used by most federal agencies when defining their noise environment, and applied as a land-use planning tool for predicting areas potentially impacted by noise exposure. Noise levels due to aircraft activities use the A-weighted scale and are expressed as dBA DNL. Explosives use the C-weighted scale and are expressed as dBC DNL.
- Maximum Sound Level (L_{max}) – The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level (L_{max}). L_{max} is given in units of dBA. The maximum sound level is important in judging the interference caused by a noise event such as participating in a conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event because it does not account for the length of time that the sound is heard.
- Sound Exposure Level (SEL) – This metric is a measure of the total sound energy and is a sum of the sound intensity over the duration of exposure. The SEL provides a convenient single number that adds the total acoustic energy in a transient event and it has proven to be effective in assessing the relative annoyance of different transient sounds.
- Equivalent Sound Level (L_{eq}) - Another way of describing fluctuating sound is to describe the fluctuating sound heard over specific periods as if it had been a steady, unchanging sound. For this condition, the "equivalent sound level," L_{eq}, may be computed. L_{eq} is the constant

sound level that, in a given situation and period (e.g., 1 hour, denoted by $L_{eq}(1)$, or 24 hours, denoted as $L_{eq}(24)$), conveys the same sound energy as the actual time-varying sound.

- Peak Sound Level – The metric PK 15(met) is the single event peak level that is likely to be exceeded only 15% of the time, i.e. 85% certainty the noise will be within this range. This metric accounts for statistical variation in received single event peak noise level that is due to weather. It is the calculated without frequency weighting (i.e., unweighted as opposed to A- or C-weighted).

Noise Standards and Guidelines

The Marine Corps employs two programs that address adherence to the Noise Control Act of 1972 and USEPA Guidance: the Range Air Installation Compatible Use Zone (Office of the Chief of Naval Operations Instruction [OPNAVINST] 3550.1) for air-to-ground operations at training areas, and the Air Installation Compatible Use Zone (OPNAVINST 11010.36A) for airfield operations. The Range Air Installation Compatible Use Zone and Air Installation Compatible Use Zone programs: 1) help military installations in determining noise generated by military training and operations, 2) evaluate how the noise from these operations may impact adjacent communities and associated activities, and 3) assist military planners assess existing and proposed land uses on an Installation. For ground training noise, the Marine Corps adheres to a guidance memo dated June 29, 2005 (Marine Corps 2005). In addition, Army Regulation 200-1 (Environmental Protection and Enhancement), Chapter 14 (Operational Noise) provides the guidance for evaluation of ground training noise at Marine Corps installations (Army 2007). Noise zones are used in land use planning around Marine Corps installations.

The following (and Table 6.1-1) describes these zones and the types of land use that are considered compatible within these zones (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 2009, Army 2007):

- *Zone I.* Includes all areas around a noise source in which DNL is less than 65 dBA or 62 dBC, or the PK 15(met) exceeds 87 dB. This area is usually suitable for all types of land use activities (e.g., homes, schools, and hospitals). Zone I on maps are simply areas that are neither Zone II nor Zone III. LUPZ contours are a subset of a Zone I area with noise levels between 57 db CDNL and 62 dB CDNL that are compatible, but noise complaints could increase on days of higher than normal range activities.
- *Zone II.* Consists of an area where the DNL is between 65 and 75 dBA or 62 and 70 dBC, or the PK 15 (met) is between 87 to 104. Exposure to noise within this zone is normally considered incompatible with noise-sensitive land uses and use of the land within the zone should normally be limited to activities such as industrial, manufacturing, transportation, and resource production (e.g., industrial parks, factories, and highways).
- *Zone III.* Areas around the noise source in which the DNL is greater than 75 dBA or 70 dBC, or the PK 15 (met) exceeds 104 are defined as Zone III. The noise level within this zone is considered incompatible with noise sensitive land uses such as churches, schools, parks, and playgrounds.

Table 6.1-1. Noise Zones and Compatibility Levels

Zone	*Small Arms/Aviation A-weighted DNL*	*Explosives Day Night Average C-weighted DNL*	*Small Arms PK 15 (met) Peak Unweighted*	*Compatibility with Residential/Noise Sensitive Land Uses*
I	<65 dBA	<62 dBC	87 dB	Compatible
II	65 to 75 dBA	62 to 70 dBC	87 to 104 dB	Normally Incompatible
III	>75 dBA	>70 dBC	>104 dB	Incompatible

Sources: USACHPPM 2009, Army 2007.

DoD uses A-weighted DNL noise levels for compatible land use planning around military air installations. Noise exposure levels are expressed as noise contours presented in five dBA DNL increments beginning at 60 or 65 DNL, depending on the installation, up to 85 dBA DNL. In accordance with OPNAVINST 11010.36A, land use compatibility is assessed through estimating and overlaying different noise level contours on land use maps and categorizing land uses as compatible, compatible with restrictions, or incompatible with noise zones. Table 6.1-2 shows typical land use compatibilities each noise contour level. For this EIS/OEIS, noise contours are used to describe the noise environment around Andersen AFB and noise zones around the other areas of Guam proposed for use by the Marine Corps.

Table 6.1-2. Land Use Compatibility in the Airport Environs by Noise Contours

Noise Zone	*I*	*II*		*III*	
Aviation A-weighted DNL	*<65 DNL*	*65-70 DNL*	*70-75 DNL*	*75-80 DNL*	*>80 DNL*
Land Use					
Commercial	Yes	Yes	Yes[2]	Yes[2]	No
Industrial	Yes	Yes	Yes	Yes[2]	Yes[2]
Open/Agricultural	Yes	Yes	Yes	Yes[2]	Yes[1]
Recreational	Yes	Yes	Yes	No	No
Residential	Yes	Yes[2]	No	No	No

Notes: [1] Open land acceptable
[2] With noise attenuation features

Noise contours for large caliber weapons and explosives (demolition activities and hand grenades) are developed using the C-weighted scale to determine the land use zones. Another analysis used for assessing explosive noise is complaint risk using PK 15 (met) peak noise levels as shown in Table 6.1-3.

Table 6.1-3 Large Caliber and Explosives Risk of Complaints Levels

Risk of Complaints	*Large Caliber Weapons/Explosives*
	PK15(met) dB Noise Contour
Low	< 115
Moderate	115 - 130
High	> 130

Construction Noise

Construction noise is generated by the use of heavy equipment on job sites and is short-term in duration (i.e., the duration of the construction period). Commonly, use of heavy equipment occurs sporadically throughout daytime hours. Table 6.1-4 provides a list of representative samples of construction equipment and associated noise levels, adjusted for the percentage of time equipment would typically be operated at full power at a construction site. Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment, impact devices (e.g., jackhammers, pile drivers).

The dB level of a sound decreases (or attenuates) exponentially as the distance from the source increases. For a single point source, like a construction bulldozer, the sound level decreases by approximately 6 dBs for each doubling of distance from the source. Sound that originates from a linear, or 'line' source, such as a passing aircraft, attenuates by about 3 dBs for each doubling of distance where no other features such as vegetation, topography, or walls absorb or deflect the sound. Depending upon their nature, the ability of such features to reduce noise levels may range from minimally to substantially.

Table 6.1-4. Samples of Construction Noise Equipment

Equipment Description	*Impact Device*[1]	*Acoustical Usage Factor*[2] *(%)*	*Actual Measured L_{max} @ 50 feet*[3] *(dBA, slow) (Samples Averaged)*	*Number of Actual Data Samples*[4] *(Count)*
All Other Equipment > 5 HP	No	50	N/A	0
Backhoe	No	40	78	372
Clam Shovel (dropping)	Yes	20	87	4
Compactor (ground)	No	20	83	57
Compressor (air)	No	40	78	18
Concrete Mixer Truck	No	40	79	40
Concrete Saw	No	20	90	55
Crane	No	16	81	405
Dozer	No	40	82	55
Dump Truck	No	40	76	31
Excavator	No	40	81	170
Front End Loader	No	40	79	96
Generator	No	50	81	19
Grader	No	40	N/A	0
Impact Pile Driver	Yes	20	101	11
Jackhammer	Yes	20	89	133
Pavement Scarifier	No	20	90	2
Paver	No	50	77	9
Roller	No	20	80	16
Scraper	No	40	84	12
Tractor	No	40	N/A	0
Vibratory Pile Driver	No	20	101	44

Notes:

1. Indication whether or not the equipment is an impact device
2. The acoustical usage factor refers to the percentage of time the equipment is running at full power on the job site and is assumed at a typical construction site for modeling purposes
3. The measured "Actual" emission level at 50 feet for each piece of equipment based on hundreds of emission measurements performed on Central Artery/Tunnel, Boston MA work sites
4. The number of samples that were averaged together to compute the "Actual" emission level

Source: USDOT 2006.

With the exception of safety standards for construction workers, the Marine Corps does not have a formal policy for management of construction noise. Construction noise is typically confined within an installation boundary, occurs during daylight hours, and is only present during the period of construction. There are no local requirements for construction noise that would apply to the proposed construction activities.

Transportation Noise

On a well-traveled highway, motor vehicles can be described as an acoustic line source. While the noise from an individual vehicle is transient in nature, the heavy use on most roadways makes the road a fairly continuous noise source. On Guam, the FHWA is the principal agency managing transportation noise.

The FHWA published a Roadway Construction Noise Model to predict noise levels adjusted from empirical data for construction operations to the actual distance of a receptor such as schools, churches, hospitals, and parks.

Under the Guam Department of Public Works (GDPW) policy, loudest hourly noise level L_{eq} (h) standards are established for traffic noise relative to land use activity categories, as summarized in Table 6.1-5.

Table 6.1-5. Guam Loudest Hourly Noise Standards for Transportation Noise and Land Use Activity

Activity Category	*L_{eq}[h] dBA*	*Description of Activity Category*
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, places of worship, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: FHWA 2009.

6.1.2 North

6.1.2.1 Andersen AFB

Airfield Operations

Andersen AFB Main Runway 06L/24R

The primary source of aircraft noise in the northern part of Guam is Andersen AFB, which supports Air Mobility Command flights for military personnel and their dependents. Andersen AFB is home to the 36th Wing, the 734th Air Mobility Support Squadron, Navy Helicopter Squadron 25 (HSC-25), and several other tenant organizations. Commercial aircraft may occasionally fly through Andersen AFB airspace, but only with permission from the Andersen AFB control tower (see Chapter 7, Airspace).

In 2006, there were 29,524 flight operations at Andersen AFB including departures, arrivals, overhead break arrivals, touch-and-go patterns, and ground-controlled approach patterns. The Air Force plans on increasing their use of the base as described in the recently completed Intelligence Surveillance, and Reconnaissance (ISR)/Strike EIS (PACAF 2006a). This action would be completed prior to implementation of the proposed action in this EIS/OEIS. For this reason, the baseline conditions assessed in this EIS/OEIS include the proposed increased Air Force operations, bringing the total number of annual airfield operations up to 68,139 by 2014. Of these 68,139 airfield operations, 18,951 are the based HSC-25 Squadron's MH-60S Knighthawk helicopters and 732 are transient operations generated by the air wing associated with the visiting aircraft carrier. The remainder is ISR/Strike and other local and transient operations as shown on Table 6.1-6.

Table 6.1-6. Baseline Flight Operations at Andersen AFB

Mission Group	*Aircraft Type*	*Current Operations (2006)*	*No-Action Alternative (2014)*
Based	Helicopter	18,951	18,951
	Jet	0	0
Visiting Aircraft Carrier Wing	Jet	602	602
	Propeller	52	52
	Helicopter	78	78
Transient ISR/Strike	Jet	NA	25,043
Other local and transient operations	Mix	9,841	23,413
Total		**29,524**	**68,139**

Source: Czech and Kester 2008.

Approximately 8% of airfield operations occur during the environmental nighttime hours between 10 p.m. and 6:59 a.m. Figure 6.1-2 shows existing noise contours at Andersen AFB. The majority of the area under the noise contours is located offshore to the northeast of the runway, but 14,787 acres (ac) (5,984 hectares [ha]) of land area are under the noise environment of Andersen AFB as defined by the estimated noise contours. Table 6.1-7 shows the number of acres onshore that are under each noise contour. Sensitive receptors of particular interest for noise analyses are schools, churches, hospitals, and parks. Under the existing noise contours, there is one school and several parks between the 60 and 65 dB DNL contour.

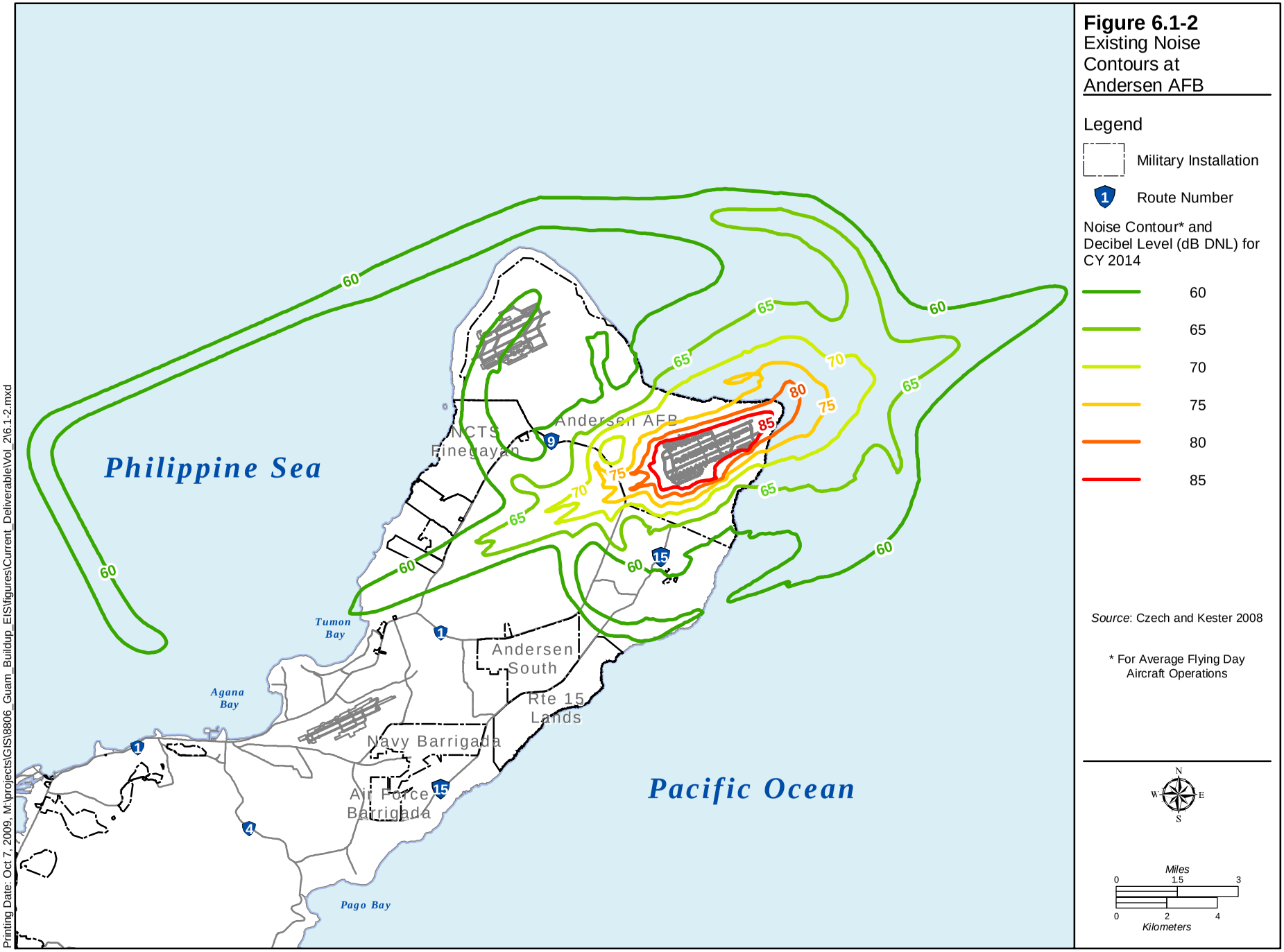
Table 6.1-7. Baseline (CY 2014) Noise Contour Acreage for Andersen AFB

Average Noise Level (DNL)	*Baseline (ac[ha])*
Within Andersen AFB	
60-65 dBA	2,981 (1,206)
65-70 dBA	968 (392)
70-75 dBA	1,848 (748)
75-80 dBA	1,143 (463)
80-85 dBA	945 (382)
>85 dBA	1,767 (715)
Total	9,652 (3,906)
Outside Andersen AFB	
60-65 dBA	6,940 (2809)
65-70 dBA	2,209 (894)
70-75 dBA	792 (321)
75-80 dBA	189 (76)
80-85 dBA	0 (0)
>85 dBA	0 (0)
Total	10,130 (4,100)
Total Onshore Acres	19,782 (8,005)

Source: Czech and Kester 2008.

Northwest Field (NWF)

Andersen AFB also has and operates aircraft on another runway, NWF. Noise sources in and around NWF include surface traffic and other ground-training activities. The south runway at NWF is used for fixed-wing aircraft operations and airborne operations, which include airdrop operations at a drop zone on the eastern end of the runway. The north runway is used for helicopter practice landings and airdrop operations at a drop zone on the eastern end of the runway.



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Aircraft operations and ground-training activities at NWF are infrequent. During periods of no flying activity, noise results primarily from temporary military encampments and maneuver training by Army National Guard and Army Reserve personnel (Andersen AFB 2000).

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. The level of aircraft operations at NWF is well below these thresholds (Andersen AFB 2000).

The number of aircraft involved in an operation, the length of the operation, and the distance from aircraft all directly affect the noise levels at locations of sensitive receptors. Based on the noise emission factor for the SH-60 helicopter, a single airborne helicopter will produce a peak pass-by noise level of about 94 dBA SEL at a distance of 100 ft (30 m) and about 75 dB at 1,000 ft (305 m). Two helicopters operating in the same general area at this distance may generate a combined noise level of up to 78 dBA, and three helicopters may generate a combined noise level of up to 80 dBA.

Aviation Training

For the purposes of this EIS/OEIS, aviation training includes related activities such as airlift operations, airdrops at landing zones, and other operations. While most aviation training is conducted in areas away from improved runways (i.e., at Andersen AFB), Familiarization/Instrument Training (FAM) and Field Carrier Landing Practice (FCLP) are two forms of aviation training that occur at improved runways.

The HSC-25 Squadron currently conducts FAM training at Andersen AFB. An improved airfield is required for autorotation and simulated engine-out approaches.

Approximately 77 airlift operations occur at NWF on Andersen AFB annually. Typical aircraft may include H-60, H-46, H-53, V-22, or C-130 variants and up to four of these aircraft can be used per operation. The sound levels from airlift operations involving a single helicopter reach up to 94 dBA SEL in the immediate vicinity of the operation (approximately 100 ft [30 m]). Two helicopters at this range produce SELs nearing 97 dBA and four aircraft operating in this defined area produce SELs nearing 100 dBA. However, the closest non-military land use area is over 1,640 ft (500 m) west of the airfield. No schools or hospitals occur in this zone. Scattered beachfront houses are located between the Pacific Ocean shoreline and the base boundary northwest of NWF. Receptors experience SELs of approximately 76 dBA for an operation with four helicopters due to the distance from the aircraft to the receptor.

According to Andersen AFB Tower personnel, less than seven FCLP operations were performed at Andersen AFB between January and December 2007 (an average of about one every 2 months), so FCLP operations were not modeled for any aircraft (Czech and Kester 2008).

Ground-Based Training

Ground-based training includes Exercise Command, Control and Communication, which provides primary communications training for command, control, and intelligence. It also provides critical interoperability and situation awareness information. Various facilities and infrastructure at Andersen AFB are used for this type of training. There are no live-fire activities and associated noise impacts currently occurring at Andersen AFB.

Force protection training includes Protect and Secure Area of Operations (Protect the Force). Force protection operations increase physical security of military personnel in the region to reduce their vulnerability to attacks. In combat environments, force protection includes offensive and defensive measures such as moving forces and building barriers, detection and assessment of threats, delay or denial

of access of the adversary to their target, appropriate response threats and attack, and mitigation of effects of attack. Ground Burst Simulators, smoke grenades, small arms blank ammunition, and 40 pound cratering charges are used as part the existing field training exercises (PACAF 2006b). In the region, NWF is the site for these training activities. Figure 6.1-3 shows the existing noise levels due to the detonation of the 40 pound cratering charges.

Noise sources associated with this ground-based training typically consist of operation of vehicles, generators, and other equipment, as well as human activity. Training events are intermittent, vary in duration, and are confined within the installation boundaries.

6.1.2.2 Finegayan

Airfield Operations

There are no airfields or airfield operations located at Finegayan.

Aviation Training

No aviation training is currently conducted at Finegayan.

Ground-Based Training

There is no current ground-based training occurring at Finegayan.

6.1.2.3 Non-DoD Land

Airfield Operations

There are no airfields or airfield operations located on non-DoD lands.

Aviation Training

No aviation training is currently conducted on non-DoD lands.

Ground-Based Training

There is no current ground-based training occurring on non-DoD lands in northern Guam.

6.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by FHWA.

Land uses along the project corridor that are noise sensitive include residential areas, schools, churches, parks, beaches, a golf course, and cemeteries. Sound levels measured at receptors along the project range between 54 and 73 dBA and were mostly in the middle to upper 60 dBAs; these measurements are considered typical for rural and/or suburban environments.

Regional Setting

Noise-sensitive land uses within the north region of Guam include multi- and single-family residences, parks, churches, schools, and outdoor recreational areas (e.g., golf courses).

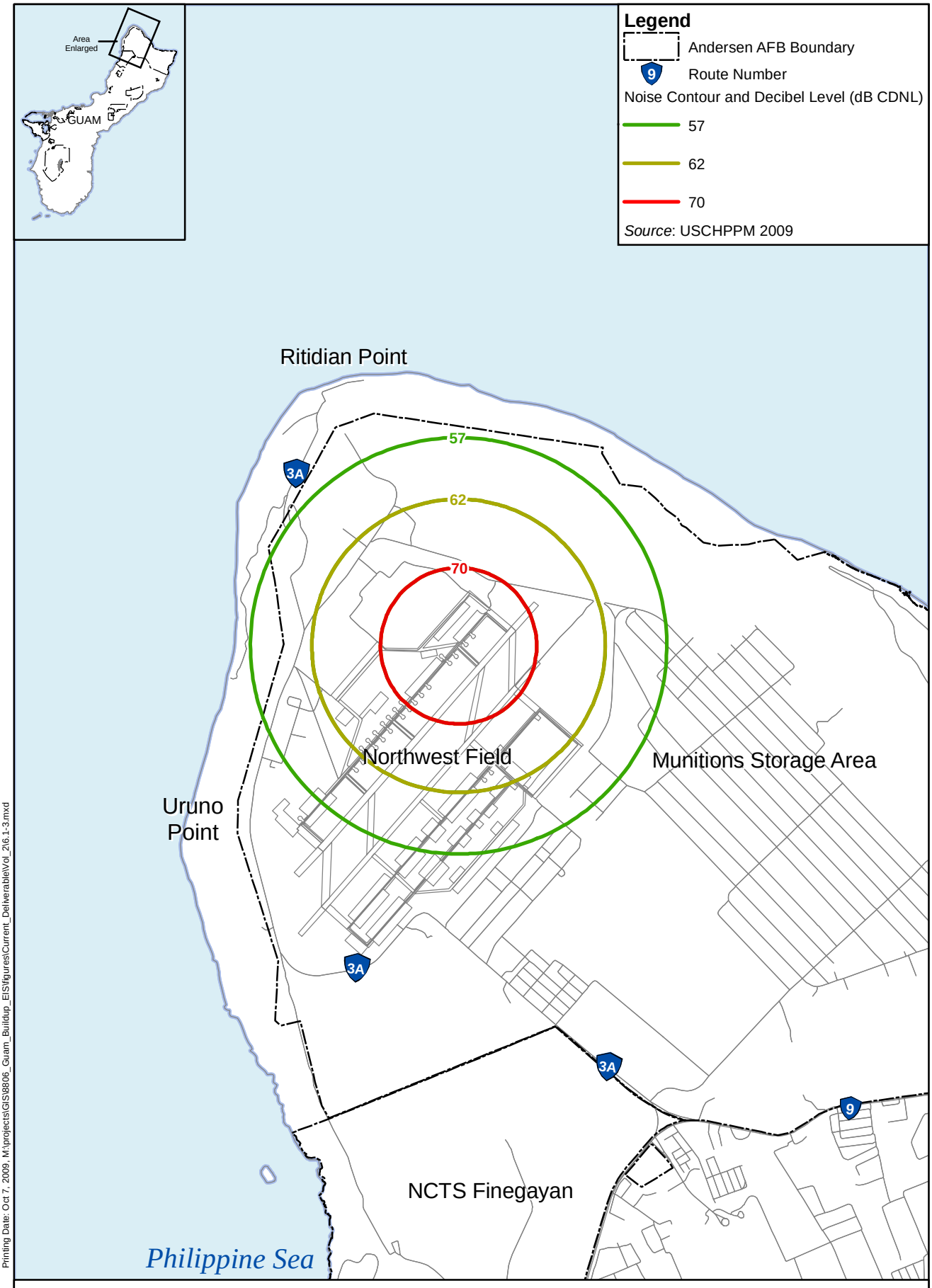

Figure 6.1-3
Existing Demolition Operational Noise Contours at Northwest Field

Project Setting

The road improvements within the north region of Guam would be along Route 3, Route 9, and the northern end of Route 1. The following noise-sensitive land uses are found along these routes:

- Route 3: Multi- and single-family residences, parks, a church, and Starts Golf Resort.
- Route 9: Predominately single-family residences with one multi-family residence, a church, and Mechanac Elementary School.
- Route 1: Predominately single-family residences, with a few multi-family residences, a church, and Dominican Catholic School.

Non-noise-sensitive land uses for all three routes consist of small commercial buildings, military, and undeveloped properties. Seven representative receptors were selected for noise measurements. They include three single-family residences, two multi-family residences, one school, and a military athletic training field. Existing sound levels were measured between 59 and 77 dBA, and they were primarily attributable to traffic. The results of these measurements are shown in Table 6.1-8 and Table 6.1-9.

6.1.3 Central

6.1.3.1 Andersen South

Airfield Operations

Currently, no airfield operations occur on Andersen South.

Aviation Training

Currently, no aviation training occurs on Andersen South.

Ground-Based Training

Andersen South open fields and wooded areas are used for basic ground maneuver training including routine training exercises, camp/tent setup, survival skills, land navigation, day/night tactical maneuvers and patrols, blank munitions and pyrotechnics firing, treatment and evaluation of casualties, fire safety, weapons security training, perimeter defense/security, and field equipment training. Vacant single-family housing and vacant dormitories are used for Military Operations on Urban Terrain (MOUT) training and small-unit tactics in support of vehicle and foot-based maneuver training. Noise generating activity associated with this training include vehicle use, use of breacher charges and pyrotechnics, and small arms firing. Although residential land use occurs along the Andersen South boundary, there are no noise issues as these operations are conducted at interior locations of the installation, away from the site boundary.

Table 6.1-8. Short-Term Noise Measurement Results

Site No.	*Street Address, City*	*Land Use*[1]	*Meter Location*	*Measurement Dates*	*Start Time*	*Measured L_{eq}, dBA*[2]	*Adjusted Peak-Hour L_{eq}, dBA*[3]	*Adjusted to Long-Term Site*
Central Region								
ST01	Fish Eye Park, Piti	REC	Park	March 24, 2009	9:57 a.m.	65.9	68.9	LT01
ST02	Asan Beach, Asan	REC	Beach	March 24, 2009	10:33 a.m.	61.3	64.3	LT01
ST03	Asan Park, Asan	REC	Park	March 23, 2009	6:04 p.m.	63.8	68.8	LT01
ST04	815 West Marine Drive, Agana	SFR	Front Yard	March 24, 2009	11:30 a.m.	72.3	76.3	LT01
ST06	Prince Park, Agana	REC	Park	March 24, 2009	11:27 a.m.	69	73	LT01
ST07	Tree City Park, Tamuning	REC	Park	March 24, 2009	1:53 p.m.	68.8	70.8	LT02
ST08	John F. Kennedy High School, Tamuning	SCH	Entrance	March 23, 2009	5:14 p.m.	63.6	66.6	LT02
ST15	678 Route 1, Yigo	SFR	Front Yard	March 25, 2009	2:19 p.m.	67.6	68.6	LT05
ST16	929 Route 1, Yigo	SFR	Side Yard	March 25, 2009	2:19 p.m.	65.7	66.7	LT05
ST17	Park, Yigo	REC	Park	March 25, 2009	1:23 p.m.	62.5	63.5	LT05
ST18	Condemned Condominiums, Dededo	MFR	Open Field	March 26, 2009	10:24 a.m.	61.5	63.5	LT06
ST19	Soccer Field, Harmon	REC	Open Field	March 26, 2009	11:16 a.m.	66.9	69.9	LT07
ST20	835 Route 16, Barrigada	SFR	Front Yard	March 31, 2009	4:04 p.m.	68.7	68.7	LT10
ST21	Army Sports Field Route 16, Barrigada	REC	Open Field	March 31, 2009	4:42 p.m.	67.8	67.8	LT10
ST23	184 Route 8, Barrigada	SFR	Front Yard	March 26, 2009	3:03 p.m.	72.4	75.4	LT08
ST25	Degracia Road and Route 10, Barrigada	SFR	Side Yard	March 27, 2009	10:29 a.m.	65.5	70.5	LT09
ST26	128B Route 10, Barrigada	SFR	Front Yard	March 27, 2009	10:29 a.m.	68.1	73.1	LT09
North Region								
ST10	Banyan Drive and South Finnegan, NCS	MFR	Open Field	March 23, 2009	4:20 p.m.	54.9	55.9	LT03
ST11	NCS Navy Campus, NCS	REC	Track	March 25, 2009	9:20 a.m.	55.9	56.9	LT04
ST12	145 Igaga, Agovesuer	MFR	Side Yard	March 25, 2009	9:20 a.m.	62.5	63.5	LT04
ST13	Nursery, Yigo	SFR	Side Yard	March 25, 2009	10:40 a.m.	71.8	74.8	LT05
ST14	Dominican Catholic School, Yigo	SCH	Play Area	March 25, 2009	10:40 a.m.	60.6	63.6	LT05

Legend: [1]- Land Use: SFR = single-family residence; MFR = multi-family residence; REC = recreation facility; SCH = school

Notes: [2]- All short-term measured noise levels were measured for a 20-minute period.

[3]- Measurements conducted during off-peak hours were adjusted to the peak-hour $L_{eq}(h)$ based on a comparison with long-term noise levels measured at a nearby measurement site listed in the last column.

Table 6.1-9. Long-Term Noise Measurement Results

Site No.	*Street Address, City*	*Land Use*[1]	*Meter Location*	*Measurement Dates*	*Start Time*	*Duration, Number of Hours*	*Measured Peak Hour L_{eq}, dBA*[2]	*Peak-Hour Time*
Central Region								
LT01	Asan Village, Asan	MFR	Rear Yard	March 23 – March 24, 2009	1:00 p.m.	24	64.0	7:00 a.m.
LT02	146 Ifilet Court, Liguan Terrace	SFR	Rear Yard	March 23 – March 24, 2009	2:00 p.m.	24	61.0	9:00 a.m.
LT05	122 Chicharica Court, Dededo	SFR	Rear Yard	March 24 – March 25, 2009	4:00 p.m.	24	59.0	3:00 p.m. & 6:00 p.m.
LT06	120 Calamento Court, Dededo	SFR	Rear Yard	March 25 – March 26, 2009	12:00 p.m.	24	63.0	6:00 a.m. – 7:00 a.m.
LT07	136 West Abois Court, Dededo	SFR	Rear Yard	March 25 – March 26, 2009	4:00 p.m.	24	62.0	4:00 p.m. – 5:00 p.m. & 7:00 a.m.
LT08	17A Mong, Toto Maiti	MFR	Rear Yard	March 26 – March 27, 2009	9:00 a.m.	24	64.0	7:00 a.m. & 4:00 p.m.
LT09	156 Adacao, Barrigada	SFR	Rear Yard	March 26 – March 27, 2009	1:00 p.m.	24	64.0	2:00 p.m.
LT10	101 Route 16, Barrigada	SFR	Front Yard	March 26 – March 27, 2009	4:00 p.m.	24	65.0	4:00 p.m.
North Region								
LT03	178 Route 3, Nis	SFR	Front Yard	March 23 – March 24, 2009	3:00 p.m.	24	68.0	7:00 a.m., 2:00 p.m., & 5:00 p.m.
LT04	1595 Aganton Gumas, Dededo	SFR	Front Yard	March 24 – March 25, 2009	3:00 p.m.	24	65.0	4:00 p.m. & 7:00 p.m.

Legend: [1]- Land Use: SFR = single-family residence; MFR = multi-family residence.
Notes: [2]- The highest measured hourly noise level recorded during the long-term measurement period.

The most intensive use at Andersen South currently occurs during exercises involving up to three Marine Corps companies utilizing Andersen South range for up to three weeks, which currently occurs twice a year. Blanks used in this training produce an estimated noise level of about 96 dBA at a distance of 500 ft (152 m) and about 90 dBA at a distance of 1,000 ft (305 m). Potential for community noise impacts would only arise with intense blank firing. For example, 1,400 blanks fired within an hour from the same approximate location produce an hourly L_{eq} of about 85 dBA at a distance of 750 ft (229 m), which would influence community DNLs in that vicinity. Such high intensity events, which may be distracting or annoying in nearby public areas, would be a rare occurrence at Andersen South. The noise impacts of existing and potential increased MOUT training at Andersen South was assessed in the Mariana Islands Range Complex (MIRC) EIS/OEIS (Navy 2009) and found that prolonged intense training activities occurring in close proximity to adjacent public lands for the duration of the event could elevate community noise levels, but is unlikely due to the infrequency of activities in these locations.

6.1.3.2 Barrigada

Airfield Operations

Currently, no airfield operations occur on Barrigada.

Aviation Training

No aviation training is currently conducted on Barrigada.

Ground-Based Training

Barrigada Communications Annex supports Field Training Exercises, MOUT training in unoccupied housing units, Explosive Ordnance Disposal/land demolition training. Open areas (former transmitter sites) provide command and control and logistics training; bivouac, vehicle land navigation, and convoy training; and other field activities. Small arms firing is the primary source of noise associated with this training. Land demolition training for location, excavation, identification, and neutralization of buried land mines involves teams locating inert land mines or Improvised Explosive Devices and then designate the target for destruction. Threats are neutralized using up to 2 pounds (lbs) (0.9 kilograms [kg]) simulated or live explosives. These operations are insulated to an interior location of the installation and are sporadic based on variable training conducted by various branches of the military. There is no current noise management issue associated with the existing ground operations at Barrigada.

6.1.3.3 Non-DoD Land

Airfield Operations

In this region, the primary source of aircraft noise comes from aircraft associated with Guam International Airport. The International Airport is operated by the Guam International Airport Authority, a public corporation and autonomous agency of Government of Guam. Located about 3.1 mi (5 km) northeast of Hagatna and approximately 4 mi (6.4 km) southwest of the proposed Andersen South Training Area. This airport handles nearly all of the commercial flights into and out of Guam and is the only civilian air transportation facility on Guam. Eight major airlines operate there, making it the hub of air transportation for Micronesia and the Western Pacific. There are 83 aircraft based at the field, mostly jet airplanes. Annual average aircraft operations average 108 per day, mostly commercial and air taxi (AirNav 2009).

Aviation Training

No aviation training is currently conducted on non-DoD lands.

Ground-Based Training

There is no current ground-based training occurring on non-DoD lands in central Guam.

Other Noise Sources

On the Route 15 lands, noise is generated from activities at the Guam International Raceway, which is Guam's only automobile raceway. The 250-acre parcel includes a 14 mi (39 km) dirt track, a 0.5 mi (0.8 km) asphalt "NASCAR" type track, a 1 mi (1.6 km) long off-road course, and a paved 2.25 mi (3.6 km) Formula Three track. Noise occurs in correlation with events, which include noise from vehicles racing and crowds. In 2009, more than 100 races and events are anticipated at the Raceway.

The events held most frequently are motocross and drag races. While not the majority of the racing that occurs at the Raceway, the stock car or "NASCAR" type racing likely produces the most noise disturbance. According to a study conducted on noise exposure levels at stock car racing events, an average noise level in the first row (20 ft/6 m from track) of a race is 106.2 dBA with a peak intensity of 109 dBA, while noise levels taken at 150 ft (46 m) from the track ranged from 96.5 to 104 dBA (Rose et al. 2008).

In addition to races, the Raceway hosts a number of special events every year including live music concerts, car shows, and driving schools. Some of these events are combined with races and draw attendances of over 5,000 people. Common music levels at larger venue outdoor concerts are usually 100 dBA from the mixer's position (Noise Council 1995).

6.1.3.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

The road improvements within the central region of Guam would be along Route 8, Route 10, Route 16, and Route 27 and all but the northern section of Route 1. The noise sensitive land use along these routes includes multi and single-family residences, parks, beaches, churches, and schools. The noise sensitive land use for each route is as follows:

- The noise sensitive land use along Route 1 is a mix of single- and multi-family residences along with beaches, parks, churches and a cemetery.
- The noise sensitive land use along Route 8 is an even mix of single- and multi-family residences as well as a few motels.
- The noise sensitive land use along Route 16 is predominantly single-family residences and athletic fields for the nearby military base, as well as a few multi-family residences.
- The noise sensitive land use along Route 10 is predominantly single-family residences and Louis Puntalan Middle School, as well as a few multi-family residences.
- The noise sensitive land use along Route 27 is predominantly single-family residences, an athletic field, a few multi-family residences, and Juan Guerrero Elementary School.

The non-noise sensitive land use for Routes 8, 10, 16, and 27 consist of small commercial buildings and military and undeveloped properties. Within the central region, non-noise sensitive land use along Route 1 consists of small retail business, restaurants, office buildings, big box stores, and the Micronesia Mall and is comparable to a well developed suburb. A total of 25 representative receptors were selected for noise measurements. They include 13 single-family residences, three multi-family residences, one school,

and eight recreational sites consisting of parks and beaches. Existing sound levels measured were between 55 and 75 dBA and primarily due to traffic along the various Routes. The results of these measurements are shown above in Tables 6.1-8 and 6.1-9.

Roadway Project Locations

Regional Setting

Noise-sensitive land uses within the central region include multi- and single-family residences, parks, churches, schools, cemetery, and outdoor recreational areas (e.g., parks, beaches).

Project Setting

The proposed road improvements within the central region would occur along Routes 8, 10, 16, 27, and all but the northern section of Route 1. The following noise-sensitive land uses found along these routes include multi- and single-family residences, parks, beaches, churches, and schools:

- Route 1: A mix of single- and multi-family residences, along with beaches, parks, churches, and a cemetery.
- Route 8: An even mix of single- and multi-family resentences, as well as a few motels
- Route 16: Predominantly single-family residences and athletic fields for the nearby military base, as well as a few multi-family residences.
- Route 10: Predominantly single-family residences and Louis Puntalan Middle School, as well as a few multi-family residences.
- Route 27: Predominantly single-family residences and an athletic field, as well as a few multi-family residences and Juan Guerro Elementary School.

Non-noise-sensitive land uses for Routes 8, 10, 16, and 27 consist of small commercial buildings and military and undeveloped properties. Non-noise-sensitive land uses along Route 1 within the central region are extensive, comprising small retail business, restaurants, office buildings, big box stores, and the Micronesia Mall. Twenty-five representative receptors were selected for noise measurements, including 13 single-family residences, three multi-family residences, one school, and eight recreational sites consisting of parks and beaches. Existing sound levels were measured between 55 and 75 dBA, and they were primarily attributable to traffic. The results of these measurements are shown above in Table 6.1-8 and Table 6.1-9.

6.1.4 Apra Harbor

6.1.4.1 Harbor

Airfield Operations

No airfield operations currently occur at the harbor area.

Aviation Training

Assault support is a component of aviation training that involves actions required to airlift personnel, supplies, or equipment into or within a battle area. The Marine Corps provides helicopter assault support for command and control, troop lift/logistics, reconnaissance, search and rescue, medical evacuation, reconnaissance team insertion/extraction, and helicopter coordination and control functions. During combat conditions, assault support provides the mobility to focus and sustain combat power at decisive places and times and the capability to take advantage of fleeting battlespace opportunities. There are three levels of assault support: tactical, strategic, and operational. Polaris Point Field and Orote Point KD range

provide temporary sites from which assault support training can occur. From these temporary sites, the Marine Expeditionary Unit commander provides assault support to forces training within the MIRC.

Ground-Based Training

Other ground based training, including explosive ordnance disposal training for land demolition operations occur at Inner Apra Harbor, Gab Gab Beach, Reserve Craft Beach, Polaris Point Field, Orote Point Airfield/Runway, Orote Point CQC House, and Orote Point Radio Tower. The small charges used in the training at these locations have not resulted in a noise impact to surrounding communities (COMPACFLT 2009).

Noise levels due to ground-based training activities at Apra Harbor were assessed in the MIRC EIS/OEIS (Navy 2009b). The MIRC EIS/OEIS concluded that no noise management issues are related to these activities. Marksmanship exercises are used to train personnel in the use of all small arms weapons for the purpose of self defense and security. Basic marksmanship operations are strictly controlled and regulated by specific individual weapon qualification standards. Small arms include, but are not limited to, 9mm pistol, 12-gauge shotgun, and 7.62 mm rifles. Small arms firing can produce peak noise levels of 90 to 100 dB at 500 ft (152 m) and 80 to 90 dB at 1,000 ft (305 m) for the most common types of small arms. While the use of these arms can produce received sound levels up to 90 dBA SEL at 50 ft (15 m) for each round fired, these sound-generating events are not continuous, which minimizes their contribution to hourly L_{eq} values or community DNLs.

6.1.4.2 Naval Base Guam

Airfield Operations

The airfield at Orote Point and the Orote Point Triple Spot location, a helicopter landing zone on the Orote Point Airfield Runway, are sporadically used for KC-130 touch-and-go operations. These locations also support personnel transfer, logistics, parachute training, and a variety of training activities reliant on helicopter transport (COMPACFLT 2009). No data exist for the number of operations, but so few operations occur that noise contours have not been developed. Because the usage is sporadic, the existing noise levels are best characterized by SELs at the time of operations versus an average noise level contour. The SEL for a KC-130 overhead at 1,000 ft (305 m) is 92.1 dBA.

Aviation Training

Parachute insertions and air assault operations are conducted to insert troops and equipment by parachute and/or by fixed or rotary wing aircraft to a specified area. Typical aircraft may include from one to four H-60, H-46, H-53, V-22, or C-130. 26 of these operations occur annually at Orote Point Triple Spot, Polaris Point Field, or the NMS breacher house. Aircraft do not remain in the same area for an extended period of time, and operation altitudes are typically greater than 1,500 ft (457 m) above ground level (AGL). At that operating height, peak sound levels from H-60 or H-46 aircraft are approximately 80 dBA.

Ground-Based Training

Naval Special Warfare (NSW) Direct Action is either covert or overt action directed against an enemy force to seize, damage, or destroy a target and/or capture or recover personnel or material. Training operations are small-scale offensive actions including raids; ambushes; standoff attacks by firing from ground, air, or maritime platforms; designation or illumination of targets for precision-guided munitions; support for cover and deception operations; and sabotage inside enemy-held territory. Units involved are typically at the squad or platoon level staged on ships at sea. They arrive in the area of operations by helicopter or small rubber boats across a beach. Twenty-two Direct Action operations occur annually. The

majority of these Direct Action operations (15) occur at the Orote Point Close Quarters Combat (OPCQC) House in the Apra Harbor Naval Complex. Noise from helicopter insertions is transient and of short duration. Combined with the distance between operational areas and adjacent public land use, there is no contribution to the community noise levels on adjacent non-military land or effects to other sensitive receptors from aircraft noise during these operations.

6.1.4.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by FHWA.

Regional Setting

Noise-sensitive land uses within the Apra Harbor Region include outdoor recreational areas (e.g., parks, beaches).

Project Setting

Proposed roadway improvements within the Apra Harbor Region would occur on Routes 11 and 2A. Land uses along these routes consist of military and undeveloped properties. Because these are non-noise-sensitive land uses, noise measurements were not conducted.

6.1.5 South

6.1.5.1 Naval Munitions Site

Airfield Operations

Currently, no airfield operations occur on south Guam.

Aviation Training

Aviation training in the south is currently limited to a landing zone at Naval Munitions Site (NMS) that is used in association with airborne raid-type training associated with an adjacent breacher house. The over flight of a SH-60 helicopter (typical aircraft for such training activities) can produce single-event pass-by noise levels approaching 94 dBA, SEL at 100 ft (30 m) from the source. At distances beyond about 2,500 ft (762 m), noise from such a source would be at or below typical background noise levels for a daytime urban area (COMPACFLT 2009). Such training is infrequent and at an interior location within the installation, resulting in no community noise effect.

Ground-Based Training

MOUT training in the south is conducted at NMS breacher house. A concrete structure is used to train forces in maintaining mobility in areas with man-made obstacles. Specifically, Marines are trained in forced entry, including in the use of small explosive charges. No live fire weapons are authorized at this training site. Noise is intermittent, infrequent, and at an interior location within the installation, resulting in no community noise effect.

Land demolition operations occur at NMS breacher house, NMS Detonation Range, Fire Break # 3, NMS Galley Building 460, and the Southern Land Navigation Area in the southern region of Guam.

Land demolition activities take place approximately 136 times annually, with 82 of the activities culminating in the use of explosives to neutralize mines or unexploded ordnance. These 82 activities all

occurred at the NMS Demolition Range, which is located approximately 4,100 ft (1,250 m) from the closest public boundary. Typical peak noise levels associated with detonations of up to two pounds net explosive weight (NEW) are approximately 155 dBA at a distance of 492 ft (150 m) from the source. The received peak levels at the installation boundary without taking noise attenuation from terrain shielding or a berm into account would be expected to be approximately 137 dB, with the respective SEL being lower, as this is an extremely brief event. While individuals or non-human sensitive receptors exposed to these noise events may be startled if they are unaware of the source of the noise, the brevity of these received levels and relative infrequency of activities would not result in DNL contours extending onto adjacent public lands. The MIRC EIS/OEIS assessed the impacts to human sensitive receptors as low to minimal (COMPACFLT 2009). A Sniper Range at NMS is approved for up to .50 caliber sniper rifle fire, which is internal to the installation and does not present a current noise management issue.

6.1.5.2 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Regional Setting

Noise-sensitive land uses within south region include single-family residences, parks, churches, schools, and cemeteries.

Project Setting

The proposed road improvements within the south region would occur along Routes 2, 5, and 1 south of Route 11. Land uses along these routes consist of single-family residences, schools, cemetery, commercial, and undeveloped properties. While there are noise-sensitive land use along these routes, the proposed improvements would not involve significant widening of the routes (i.e., existing shoulder is to remain undisturbed); therefore, noise measurements were not conducted.

6.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

6.2.1 Approach to Analysis

Potential noise-generating events associated with the various alternatives were identified and the potential noise was estimated on the basis of published military information on noise sources. These estimated noise levels were reviewed to determine if they would represent a significant increase in the current ambient noise level, have an adverse impact on a substantial population of sensitive receptors, or be inconsistent with any relevant and applicable standards.

6.2.1.1 Methodology

To derive the noise level contours, widely applied and accepted noise models were used for evaluating small arms ranges, large caliber ranges, and airfields.

Airfield noise was estimated using NOISEMAP, which is used to generate noise level contours in DNL around an airfield. The model uses the aircraft type and number; takeoffs, landings, touch and go, as well as closed patterns; and time of operation to depict noise levels at an airfield.

The minimal NEW identified in the model BNOISE2 (see below) is 0.02 lbs (0.009 kg); therefore, anything with a NEW of less than 0.02 lbs (0.009 kg) was not considered in the modeling for ground-operations noise. This includes small explosive charges (less than ¼ lb (0.13 kg) TNT) to be used at the breacher and trainer house, as well as blanks and pyrotechnics and stun grenades to be used in maneuver training (which generally have a NEW of 0.072 lbs [.327 kg]). Although detonations at the proposed demolition range (see Section 2.3.2.1) would be up to 20 lbs (9.1 kg), TNT and fragmentation grenades would be authorized at the proposed grenade house (see Section 2.3.2.1). These noise sources were not modeled because the ranges would be sited at interior locations of the installation and would be minor contributors to cumulative noise exposure based on the proposed use of the ranges (i.e., during daylight hours approximately 2-3 consecutive days per month). For live-fire training at the five proposed small arms ranges, noise was calculated using the Small Arms Range Noise Assessment Model (SARNAM, Version 2.6.2003-06-06). For the proposed hand grenade range, noise was calculated using the BNOISE2 modeling program updated BNOISE model (BNOISE2, Version 1.3.2003-07-03).

SARNAM inputs for the range configuration alternatives analyzed included the location and configuration of each range (including number of lanes, distance between firing point and target), approximate number of days the range is utilized annually, weapons to be fired at each of the ranges, percent of night firing, and the information on the range physical features (e.g., absorption material, backstop height, and distance parameters for barriers, baffles, etc.). Land and water data are entered into the model because there is greater sound reflection as sound propagates over water than when sound propagates over land.

BNOISE2 model inputs for the two alternatives for the hand grenade range included information on the location and configuration of the proposed grenade ranges, number of firing points, number of pits, and estimated use rates.

6.2.1.2 Determination of Significance

Noise impacts result from perceptible changes in the overall noise environment that increase annoyance or affect human health. Annoyance is a subjective impression of noise wherein people apply both physical and emotional variables. To increase annoyance, the cumulative noise energy must increase measurably. Human health effects such as hearing loss and noise-related awakenings can result from exposures to noise. For this volume of the EIS/OEIS, noise is evaluated for airfield operations, aviation training, ground-based training, construction, and traffic. Since the noise metrics vary between various noise sources, the significance criteria for each activity is provided. It is not anticipated that maintenance activities would noticeably contribute to the noise environment due to their intermittent nature and short duration. The threshold levels of significant impacts for noise are:

- Airfield operations: The increase of any incompatible sensitive noise receptors (residences, hospitals, libraries, etc.) under noise contours where the effects are unmitigable. This threshold is intended to capture areas where there would be "high annoyance" effects from operational noise, alongside health effects and complaints. In general, noise increases of less

than three dBA DNL is considered insignificant regardless of underlying land use. This criterion applies to the airfield noise environment.

- Aviation training: SELs are used to describe the noise events from aircraft flying overhead. The training activities are generally dispersed except at landing zones so each discreet flyover is characterized by SELs. Generally, SELs are used for comparing the noise levels of different aircraft. Speech interference and sleep disturbance are the most common impacts associated with aircraft overflights using SELs as the noise metric for impacts. However, SELs are considered supplemental noise metrics and are useful for characterizing specific events and enhancing the public's understanding of potential affects resulting from aircraft overflights. Threshold levels of significant impact for supplemental noise metrics have not been established and there is no accepted methodology for aggregating these values into a cumulative impact description (FAA 2000).
- Ground-based training: Noise associated with ground-based training is generated by live-fire exercises. In this case, the significance criteria would be whether the increase in noise creates an incompatible land use in Zones II and III.
- Construction: Noise resulting from construction activities usually last only during daylight hours for approximately eight hours per day. The USEPA generated permissive noise levels based upon L_{eq} for eight and 24 hour periods. Since daily construction durations are about eight hours, the limit for 365 days per year exposure is 75 dBA. The 24 hour standard is 70 dBA.

The significance criteria expressed in this section applies to human receptors but noise could also affect biological resources, land use and cultural resources. Please refer to the specific resource section for details about the noise impacts to these other resources.

6.2.1.3 Issues Identified during Public Scoping Process

Comments received during the scoping process from the public, including regulatory stakeholders, do not specifically mention concerns about increased noise pollution due to the proposed action in Apra Harbor. However, numerous comments expressed concern over the anticipated increase in noise from fixed-wing aircraft and helicopters over both land and water, including cumulative impacts with existing and future noise sources. There were also comments expressing concern regarding ground-based training noise impacts to humans and wildlife, including noise from live-fire training and military land vehicles. Some scoping comments requested noise abatement projects/programs be initiated to protect communities near bases from increased noise pollution.

6.2.2 Alternative 1

6.2.2.1 North

Andersen AFB

Construction

Alternative 1 involves the construction of various facilities needed to allow the Marine Corps to carry out the Air Combat Element (ACE) mission, Air Mobility Campus (AMC), and the north gate access road and associated facilities. The ACE would be located adjacent to the north ramp and the AMC would be located adjacent to the south ramp. New north access road and entry control point (ECP) and other related facilities would be located adjacent to Route 9. Facilities construction would produce noise impacts to the surrounding environment. To characterize construction activity noise levels, U.S. Department of Transportation data (2006) were used. Noise from construction activity varies with the types of equipment

used and the duration of use. During operation, heavy equipment and other construction activities generate noise levels ranging typically from 70 to 90 dBA at a distance of 50 ft (15.2 m). During facilities construction, use of heavy equipment commonly occurs sporadically throughout the daytime hours.

Generally, heavy equipment would generate the highest noise levels throughout the construction phase, but would be temporary in nature, and would diminish the farther sensitive noise receptors are from the construction site. Although some heavy equipment would be used throughout the construction process, the noisiest heavy equipment would be associated with site preparation up to and including installation of foundations. The types of equipment necessary for site preparation would be graders, pavers, dump trucks, and concrete mixers and their use would tail off as construction of the structures begin. Use of heavy equipment also depends on the construction schedule, and would not be permanent. A compressed schedule versus a long-term schedule would likely use more pieces of heavy equipment for longer daily periods raising noise levels, but the duration would be shorter. Assuming 20 pieces of heavy equipment that includes multiple graders, excavators, dump trucks and pavers, the noise levels would be about 91 dBA at 50 ft (15 m) from the source.

For the ACE and the AMC, construction would be well inside Andersen AFB and construction noise would attenuate to almost ambient noise levels at the nearest off-base recipient. The north access area would be located nearest sensitive receptors at a distance of about 500 ft (152 m). Since the proposed construction for this alternative would be approximately 500 ft (152 m) to the nearest receptor, the noise levels would attenuate down to about 71 dBA L_{eq}. However, because the closest facility is a one-story ECP (204.4 square feet [ft^2]) (18.99 square meters [m^2]), the amount of heavy equipment required should be much less than 20 pieces of equipment, the noise levels should also be considerably less than 71 dBA. Outdoor noise levels would also be reduced due to the effects of terrain and distance from the construction site. Temporary increases in truck traffic used to transport materials on- and off-site would also produce greater noise disturbance within and near the construction corridors. Again, this would produce temporary, localized noise for brief periods, but it would not create any permanent, adverse noise impacts to human health or the local environment.

Under the proposed action, construction would occur over a period of time, but would be temporary. During facilities and infrastructure construction, minimal to negligible impacts (both inside the installations and outside in adjacent communities) from construction noise are expected to result for the following reasons:

- Heavy equipment that would generate the highest noise levels would not be used consistently enough to exceed the USEPA level limit of 75 dBA for more than 1 hour beyond the boundaries of the installations.
- Terrain and distance from construction activities would lessen noise impacts to sensitive noise receptors outside the construction areas.
- Temporary increases in truck traffic (e.g., dump trucks, fill transports) within and near the construction corridors would produce localized noise for brief periods, but would not create any adverse noise impacts to human health, the neighboring community, or within the installations.

Under Alternative 1 for construction activities at Andersen AFB, the noise levels impacts would be considered less than significant.

Operation

Airfield Operations. Under this alternative, additional aircraft would be based at Andersen AFB by the Marine Corps. Table 6.2-1 lists the number and type of aircraft and whether they are rotary or fixed wing, and local or transient. The addition of these aircraft would generate an additional 25,510 sorties at Andersen AFB.

Noise levels at and around Andersen AFB would be affected by this proposed action. By 2014, the number of airfield operations around Andersen AFB would increase from 68,139 to 99,344 annually as shown in Table 6.2-1. This analysis quantified noise impacts around Andersen AFB by comparing baseline and projected DNL contours. Impact analysis requires identification of affected areas and land uses. According to the Federal Interagency Committee on Urban Noise, noise exposure greater than 65 DNL is considered generally unacceptable over public services or residential, cultural, recreational, and entertainment areas. This section evaluates the noise generated from this alternative and its potential effects to the noise environment. It also evaluates the effects of noise on surrounding land ownership or land status, population, general land use patterns, land management plans, and special use areas. Figure 6.2-1 shows the proposed noise contours for the 60, 65, 70 75, 80, and 85 dB DNL contours. A comparison to the proposed action and the no action 60 and 65 dB DNL noise contours is presented on Table 6.2-1.

Table 6.2-1. Baseline and Proposed Flight Operations at Andersen AFB

Mission Group	*Aircraft Type*	*Current Operations (2006)*	*No-Action Alternative (2014)*	*Proposed Action (2014)*	*Total (2014)*
Based	Helicopter	18,951	18,951	19,255	38,206
	Jet	0	0	4,564	4,564
Visiting Aircraft Carrier Wing	Jet	602	602	1,704	2,306
	Propeller	52	52	156	208
	Helicopter	78	78	234	312
Transient ISR/Strike	Jet	NA	25,043	0	25,043
Other local and transient operations	Mix	9,841	23,413	5,291	28,705
	Total	29,524	68,139	31,204	99,344

Source: Czech and Kester 2008.

The noise analysis included estimation of Potential Hearing Loss (PHL). This analysis focuses on residents. The only residents exposed to 80 dB DNL or greater would be on-base at Andersen AFB, and only those associated with dormitory Buildings 25003 and 25017. The methodology for determining PHL employs the Leq_{24} metric (USEPA 1982). The estimated PHL for the no-action scenario would be approximately 3 dB. The estimated PHL for the proposed action would be identical to the no action (Czech 2009). Thus, this alternative would introduce no change to the no action PHL and therefore considered less than significant.

Table 6.2-2 provides the amount of acreage that noise contours due to this alternative would extend over land. Under the proposed contours at Andersen AFB, there are no additional schools, churches, hospitals, or parks. However, there may be some additional residences affected. While there would be a probable increase in the number of complaints and people annoyed, no significant or adverse impacts to human health or hearing would occur. Therefore impacts would be considered less than significant.

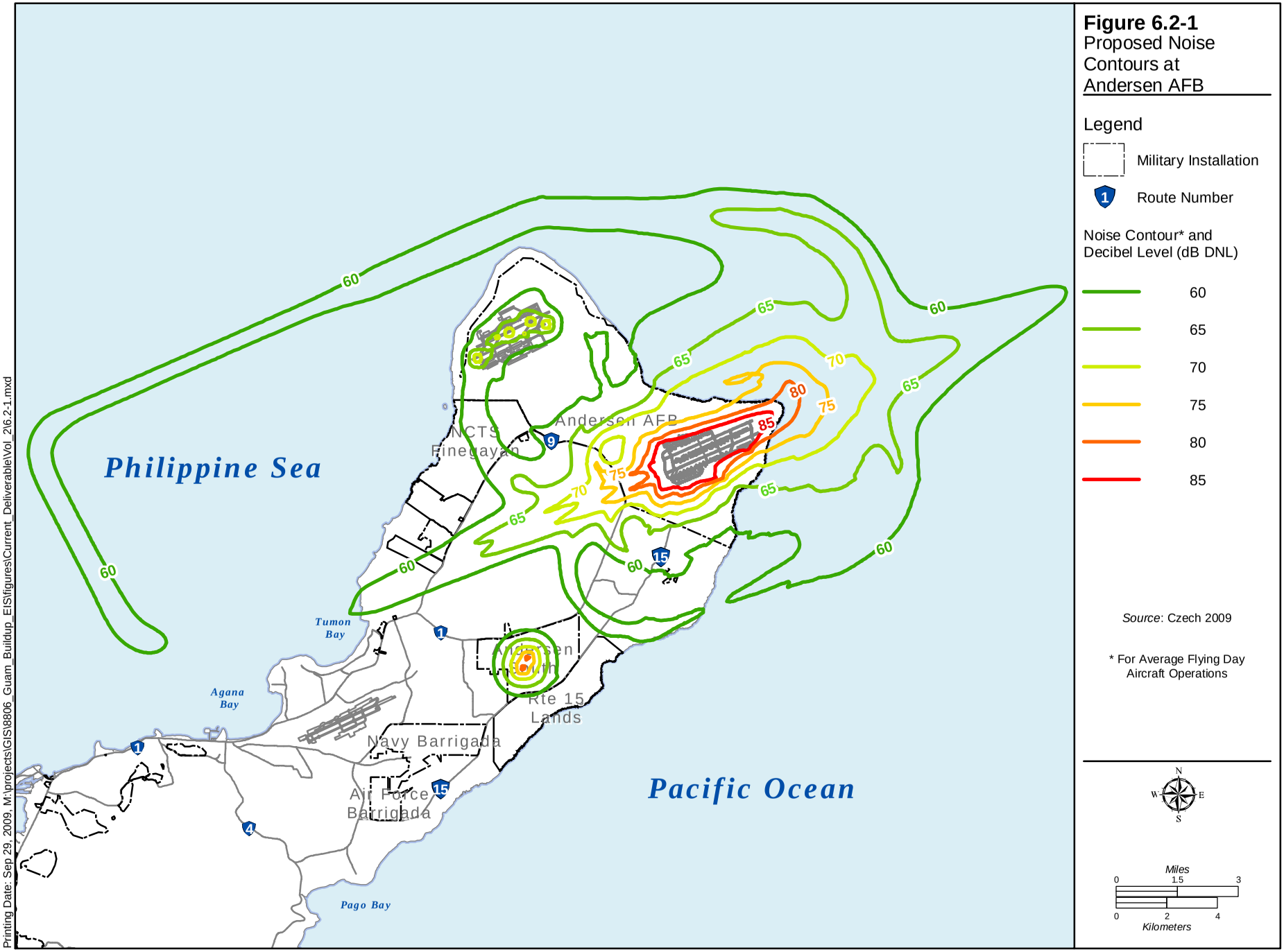

Figure 6.2-1
Proposed Noise Contours at Andersen AFB

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Table 6.2-2. Baseline and Projected Noise Contour Acreage for Andersen AFB and Vicinity (Onshore)

Average Noise Level (DNL)	*Baseline (ac [ha])*	*Proposed (ac [ha])*	*Change from Baseline (ac [ha])*	*Change from Baseline (%)*
Within Andersen AFB				
60-65 dBA	2,981 (1,206)	3,449 (1,396)	468 (189)	15.7
65-70 dBA	968 (392)	1,507 (610)	539 (218)	55.7
70-75 dBA	1,848 (748)	1,934 (783)	86 (35)	4.7
75-80 dBA	1,143 (463)	1,140 (461)	-3 (1)	-0.3
80-85 dBA	945 (382)	947 (383)	2 (<1)	0.2
>85 dBA	1,767 (715)	1,772 (717)	5 (2)	0.3
Total	**9,652 (3,906)**	**10,749 (4,350)**	**1,097 (444)**	**11.4**
Outside Andersen AFB				
60-65 dBA	6,940 (2809)	8,633 (3,494)	1,693 (685)	24.4
65-70 dBA	2,209 (894)	2,936 (1,188)	727 (294)	32.9
70-75 dBA	792 (321)	1,057 (428)	265 (107)	33.5
75-80 dBA	189 (76)	296 (120)	107 (43)	56.6
80-85 dBA	0 (0)	7 (3)	7 (3)	∞
>85 dBA	0 (0)	0 (0)	0 (0)	NA
Total	**10,130 (4,100)**	**12,929 (5,232)**	**2,799 (1,133)**	**27.6**
Total Onshore Acres	**19,782 (8,005)**	**23,678 (9,582)**	**3,896 (1577)**	**19.7**

Note: Acreages and hectares, including totals, may not correspond exactly due to rounding.

Aviation Training. On Guam, the specific types of aviation training required include:

- *Flight Crew Qualification*. This includes training flight crews in use of the aircraft such as familiarization training.
- *Aviation Support.* This category includes landing zone training, air traffic control training, and tactical air operations center training (e.g., airspace surveillance and management). This category also includes individual and crew training in air-ground support skill sets such as rappelling (Helicopter Insertion / Extraction [HIE] crew training), helicopter support team (External Lift air crew training), and related training events.

Aviation training would generate an estimated 2,246 sorties on Guam annually. Table 6.2-3 shows the types of training proposed, and the locations. Details regarding the number of operations proposed at the various locations around Guam are found later in the appropriate sections.

Table 6.2-3. Aviation Training Types, Total Required Sorties, and Locations

Training Type		*Facility/Airspace Requirements*	*Total Number of Sorties*	*Proposed Locations*
FAM	Familiarization and Instrument Flight	Improved airfield with air rescue available. FAM is a daylight operation. Instrument flight is day and night.	158	Andersen AFB North Ramp
FORM	Formation Flights	Designated military airspace. Day and night.	47	Guam SUA
CAL	Confined Area Landing	Ground space, helicopter landing zones in approximately 10 locations. Day and night.	375	NWF, Andersen South, NMS
TERF	Terrain Flights	One or more routes in military airspace over varying terrain for day and night flights at 50 to 200 ft above ground level.	100	South Guam and NMS

Training Type		*Facility/Airspace Requirements*	*Total Number of Sorties*	*Proposed Locations*
EXT	External Loads	Both unimproved and improved landing zones for day and night training in lifting and transporting loads external to the aircraft. Unimproved landing zones would be at remote sites. Ground access to site is needed to pre-position external loads. External loads cannot be carried across public roads or populated areas.	316	NWF, Andersen South, NMS, Orote
GTR	Ground Threat Reaction	Tactical flight maneuver area or route where ground based threat simulators (surface-to-air missile simulations, flares, lights, or electromagnetic radiation simulators) could be placed. Air routes similar to TERF. Day and night.	94	NMS
FCLP	Field Carrier Landing Practice	Simulated ship deck paved area. Day and night.	740	Andersen AFB North Ramp, NWF, Orote
TAC	Tactics	Routes over water or land of at least 50 nm (93 km), for chaff, flares, and .50 caliber machine gun engagements. Day and night.	94	Guam SUA
HIE	Helicopter Insertion and Extraction	Fast rope, rappelling, helo-casting, and parachute operations in improved fields, drop zones, and water operating areas. Day and night.	228	NWF, Andersen South
DM	Defensive Maneuvers	Airspace, routes similar to TERF, but would be at higher altitude. Day and night.	94	NMS

Source: NAVFAC Pacific 2009.

Noise levels around airports are expressed in terms of the DNL metric because it provides a reasonable approximation of the average noise level from aircraft traveling to and from a single location, the runways. On the other hand, training operations are not always fixed by going specifically to a certain centralized location. Consequently, a better approach to assess potential noise impacts is to use SELs for aircraft traveling overhead or laterally from an observer. Table 6.2-4 lists the aircraft proposed for this action and the associated SELs for cruising speeds at various altitudes. Operations applicable for using this noise metric are those where the aircraft is moving along a route or traversing through airspace such as formation flights, terrain flights, ground threat reaction, and defensive maneuvers.

Table 6.2-4. Sound Levels (SEL and L_{max} [dBA]) for Proposed Aircraft Associated with Marine Corps Relocation for Cruising Speeds

Altitudes (ft AGL)	*MV-22*		*CH-53*		*AH-1*		*UH-1*	
	SEL	L_{max}	*SEL*	L_{max}	*SEL*	L_{max}	*SEL*	L_{max}
100	108	104	106	106	98	97	106	97
250	96	96	101	98	94	89	100	89
500	92	89	98	91	91	83	96	83
1,000	88	82	94	85	87	76	91	76
KIAS	220		120		100		80	
Power Setting	Cruise		68% Q-BPA		LFO Lite 100 knots		100% RPM	

Legend: KIAS = knot indicated air speed; LFO = level flight operation; RPM = revolutions per minute.
Notes: Environmental conditions were assumed to be 80% humidity and 80° F. N/A indicates data not available.
Sources: Air Force 2002, Navy 2009a.

While the information is Table 6.2-4 is useful for assessing noise effects of aircraft passing by, these data do not accurately reflect noise associated with aviation training exercises such as hovering activities at landing zones (LZ). A better representation is provided in Table 6.2-5 for low-speed flights. However, these noise levels are modeled at the slowest speeds the models are capable of calculating. It is expected that noise levels in the hovering mode would be higher (Czech 2009).

Table 6.2-5. Single Event Maximum Noise Levels (L_{max}, dBA) for Low-speed Flights

Altitude (ft AGL)	*MV-22B*[1]	*CH-53E*[1]	*AH-1W*[1]	*UH-1N*[2]
	64 KIAS	*65 KIAS*	*65 KIAS*	*65 KIAS*
30	117	112	110	n/a
60	110	106	103	103
100	106	101	99	97
150	102	97	95	94

Notes:
[1]RNM Single Track Mode used for Lmax calculation
Receiver directly below flyover and at 5 feet AGL
Time spacing equal to 0.1 seconds
Modeled utilizing the appropriate slowest speed sound sphere available for each aircraft
[2]Modeled with MRNMAP single track flyover using Lmax metric mode
n/a = MRNMAP altitude limitations do not allow calculation down to 30 feet AGL.

Proposed exercises involving hovering maneuvers at LZs are confined area landing, external loads, helicopter insertion/extraction, and MAN-LFT. Familiarization and instrument flight and field carrier landing practice combines maneuvering, hovering, and landing, but are performed at developed airfields. Noise impacts of hovering aircraft would have considerably longer durations than those passing overhead. Hovering events can last a couple of minutes where the sound heard by a passing aircraft only lasts a few seconds. The number of minutes at a given altitude is necessary to calculate the SEL for hovering activities. A number of LZs are proposed in the training areas for this project and are described in detail in Chapter 2.

The north ramp at Andersen AFB would be used for FAM and FCLP training. These operations were not modeled in the Aircraft Noise Study (Czech and Kester 2008). The SEL at 1,000 ft (305 m) from these operations would be 93 dBA for a single CH-53 flying overhead. Noise contours for NWF are also shown on Figure 6.2-1.

NWF at Andersen AFB currently has two 10,000 ft (3,048 m) runways, with adjacent taxiways and is currently used for vertical and short field aviation landings. The airfield is in a state of disrepair as improvements have not been made since the 1970s. It is a remote site with no services or instrumentation. NWF is located approximately 3 miles (5 km) from the north ramp. Training activities expected at NWF include CAL, EXT, HIE, FCLP, and FAM.

The number and types of operations at the Andersen AFB north ramp and the NWF are presented in Table 6.2-6.

Table 6.2-6. Annual Sortie-Operations Specifications for NWF and Andersen AFB

Location and Type of Training	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*% Night*	*Night Sortie-Ops*	*% Below 3,000 ft (914 m)*	*Sortie-Ops Below 3,000 ft (914 m)*
	CH-53	*MV-22*	*AH-1*	*UH-1*					
Training Sites									
NWF									
CAL	20	60	30	15	125	10%	13	100%	125
EXT	20	60	0	15	95	10%	10	100%	95
HIE	24	72	0	18	114	10%	11	100%	114
FCLP	40	240	60	30	370	25%	94	100%	370
FAM	11	48	16	4	79	10%	8	100%	79
Andersen AFB (North Ramp)									
FCLP	20	120	30	15	185	25%	47	100%	185
FAM	22	96	32	8	158	10%	16	100%	158

Ground-based training would occur at the main cantonment area of Andersen AFB, but no live-fire or heavy maneuvering would occur. Therefore, no noise impacts would be expected for these activities. Marine Corps ground-based at NWF would include demolition activities similar to the activities the Air Force Silver Flag units conduct for cratering charges. Current operations detonate 40 pound (18kg) charges twenty-five times per year, but only one per any given day. The proposed action would add six more detonations to this total, but the training would be three charges per day twice per year. Figure 6.2-2 shows the noise contours associated with this activity. The noise levels would increase, but since the action only occurs twice per year, it would be considered less than significant.

Finegayan

Construction

Construction in Finegayan would be the main cantonment projects and produce noise levels as described above for Andersen AFB. Consequently, sensitive receptors would be much closer to the construction activities. Although the area across Route 3 is low density residential, sensitive receptors could receive higher than the 75 dBA L_{eq} EPA acceptable levels for residential during construction of the areas closest to Route 3. Though noise levels due to construction activities at Finegayan would result in adverse impacts to adjacent residences, best management practices, such as sequencing of equipment and sound barriers, would reduce impacts to less than significant levels.

Operation

Since there would be no airfield operations and resulting airfield noise at Finegayan, there would be no noise impacts.

Likewise, no aviation or ground-based training would occur at Finegayan, and there would be no noise impacts.

Non-DoD Land

Construction

Construction activities, and therefore noise impacts, on non-DoD lands for Alternative 1 would be similar to that at Finegayan. Similar to Finegayan, construction activities would occur throughout the area including at the border, therefore noise impacts would exceed 75 dBA. Best management practices would reduce impacts to less than significant levels.

Operation

The amount of acreage listed as projected acres outside Andersen AFB includes areas on non-DoD land which would be impacted by airfield operations at Andersen AFB.

No aviation training would occur at non-DoD lands and therefore no noise impacts would occur.

Ground-based training on Non-DoD lands would occur on the Former FAA lands, but no live-fire or heavy maneuvering would occur as shown as TRN on Figure 2.2-4. However, there would be an area designated for Engineering Equipment and Decontamination Training that would be used to practice grading, placement of fill, construction of drainage structures (e.g. earthen dams) and other similar activities. The area would be located over 4,000 ft (1220 m) from the nearest off-base residence along Route 3, but only about 500 ft (152 m) to the nearest on-base residence at the proposed BOQ. Activities would use standard construction equipment such as graders, excavators, tractors, etc. and the noise generated at the source would be about 91 dBA, similar to that described above for construction activities

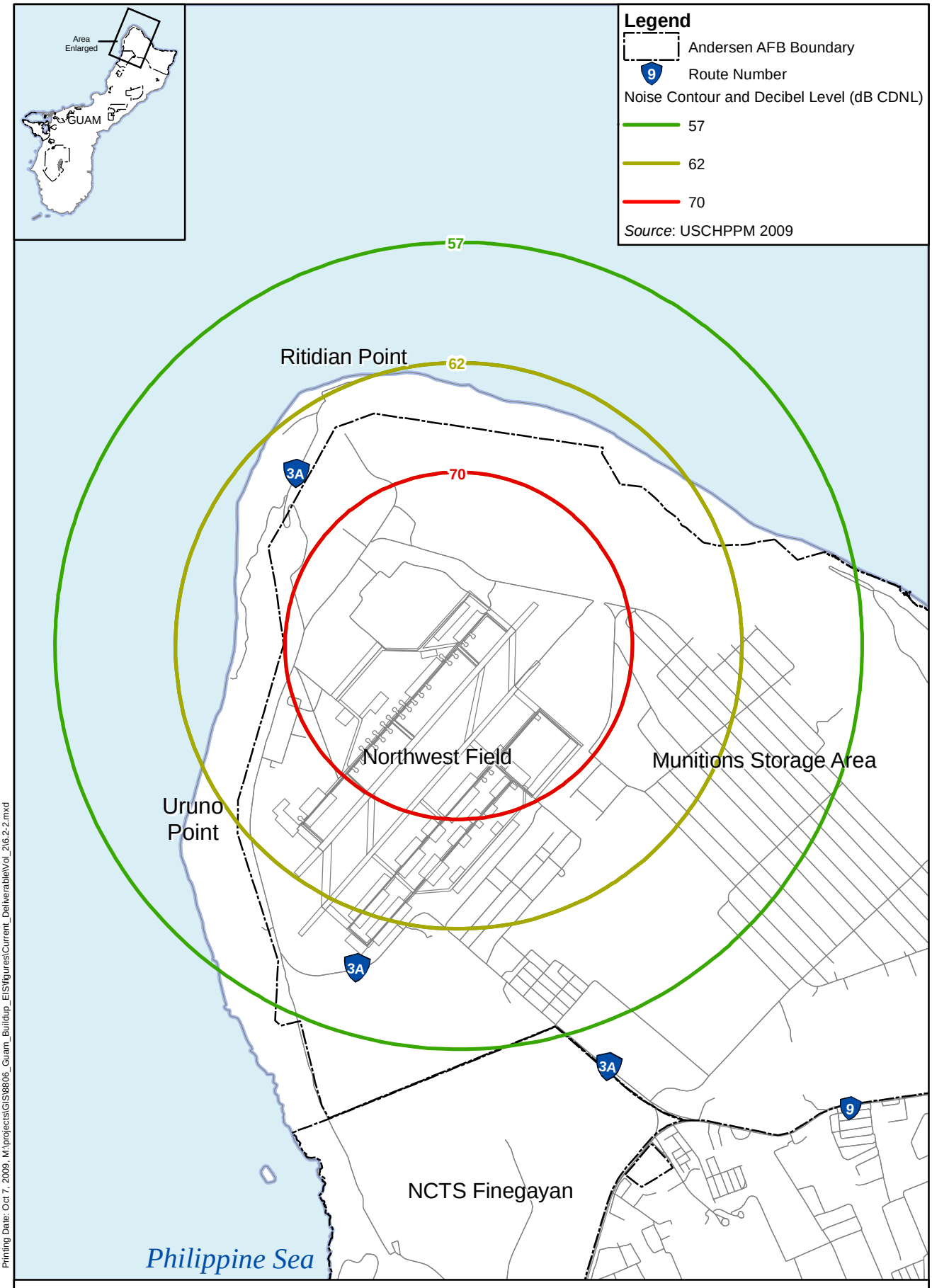


Figure 6.2-2
Projected Demolition Operational Noise Contours

at Andersen AFB. Because of the distance, the noise would attenuate down to approximately 71 dBA at the nearest on-base receptor. Noise levels would attenuate to about ambient levels at the nearest off-base receptor and be nearly unnoticeable. Therefore, noise impacts due to ground-based training activities on Non-DoD lands would be less than significant.

6.2.2.2 Central

Andersen South

Construction

Under the Alternative 1, construction activities at Andersen South involve building several live-fire and non-live fire ranges. Construction of these ranges would be well within the boundaries and noise levels would attenuate to below threshold levels. Noise impacts due to construction would be less than significant.

Operation

No airfield operations would occur at Andersen South, therefore there would be no noise impacts.

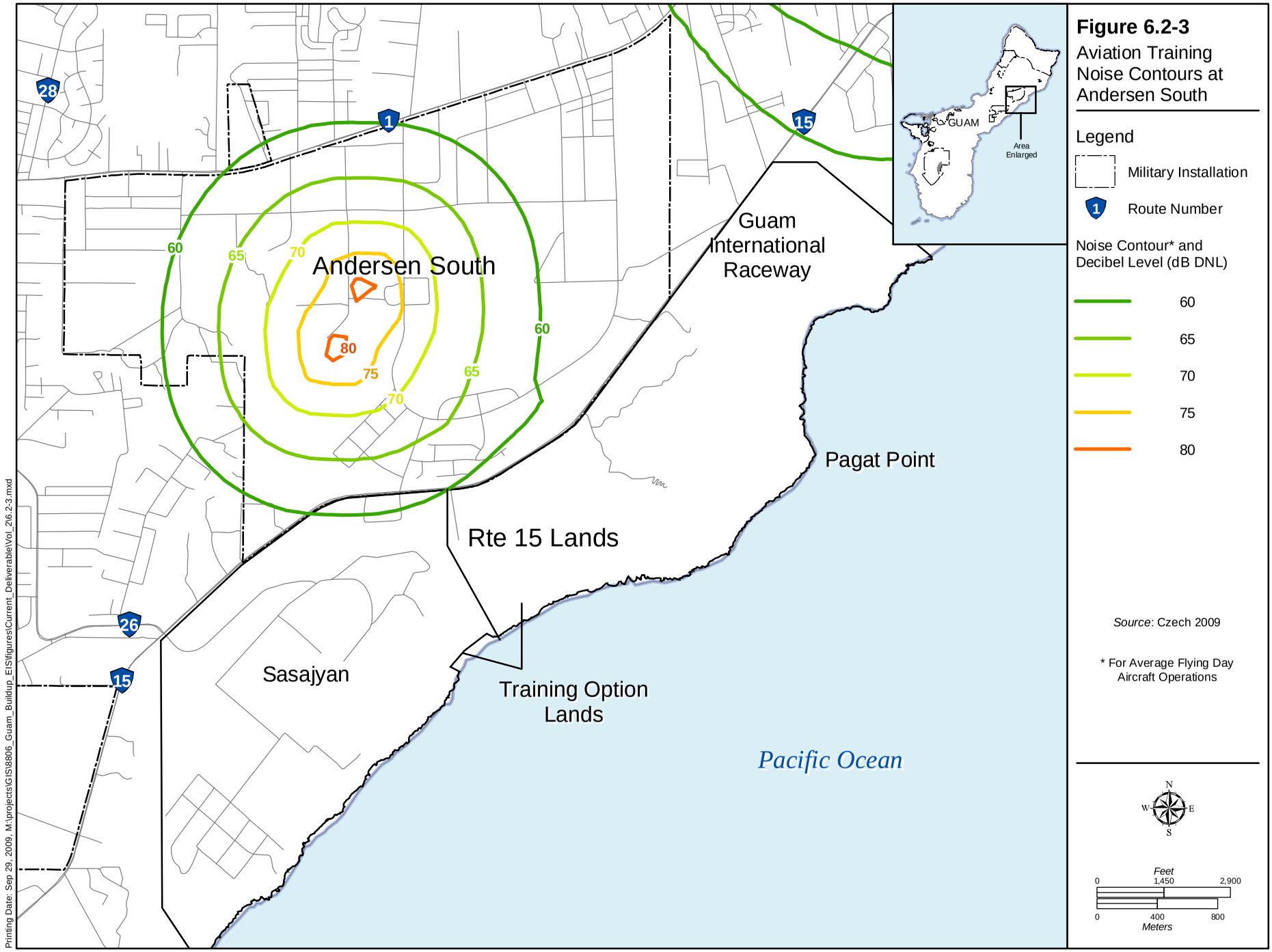
Aviation Training. Andersen South is a primary aviation training area comprising approximately 2,000 ac (809 ha) with no existing aviation training. Andersen South is located approximately 5 mi (8 km) from the north ramp. A maneuver area would be established in Andersen South and the associated aviation training facilities would support CAL, EXT, and HIE training exercises. In addition, sorties associated with the transport personnel from Andersen South north ramp to NMS or Andersen South for maneuver training is also estimated in Table 6.2-5 (as MAN-LFT). Similar to operations at NWF and Andersen AFB north ramp, operations for aviation training concentrated at LZs and the noise contours surrounding the LZs are shown on Figure 6.2-3.

Table 6.2-5. Annual Sortie-Operations Specifications – Andersen South

Location and Type of Training	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*% Night*	*Night Sortie-Ops*	*% Below 3,000 ft (914 m)*	*Sortie-Ops Below 3,000 ft (914 m)*
	CH-53	*MV-22*	*AH-1*	*UH-1*					
CAL	20	60	30	15	125	10%	13	100%	125
EXT	13	40	0	10	63	10%	6	100%	63
HIE	24	72	0	18	114	10%	11	100%	114
MAN-LFT	720	0	0	0	720	10%	72	80%	576

Ground-based Training. Possible noise exposure from Andersen South non-firing training would include new sources of ground-based noise in addition to ground-based noise from existing training at the site. This noise would include vehicle use in maneuver area training on existing roads, the convoy course, and the Advanced Motor Vehicle Operator's Course. The noise emitted by an automobile is due primarily to tire noise generated at the tire/road surface interaction. The noise characteristics of the types of vehicles to be used in the non-firing training at Andersen South are similar to those of standard commercial automobiles. The noise from an individual vehicle is transient in nature. Under this scenario, the noise exposure would be a function of the volume flow and average speed for each class of vehicle on the roadway. Most maneuver area training would occur within the core of the proposed maneuver area as noise setbacks would be established along the boundaries with urban interface. This would result in existing roads closest to the Andersen South boundary not being used in maneuver area training.

The breacher charges, pyrotechnics, and blanks used in maneuver and MOUT area training would be authorized at the internal locations of the installation. Fragmentation grenades that would be used at the


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Training Option Lands
Pacific Ocean
60
65
70
75
80
28
1
15
26
GUAM
Area Enlarged
Figure 6.2-3
Aviation Training Noise Contours at Andersen South
Legend
Military Installation
Route Number
Noise Contour* and Decibel Level (dB DNL)
60
65
70
75
80
Source: Czech 2009
* For Average Flying Day Aircraft Operations
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
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proposed hand grenade range are composed of 185 grams (g) (.185 kg) of Composition B explosive, which has a net NEW of 0.5 lbs (84 kg). Noise that would be generated by the proposed small arms and hand grenade training activity is characterized as impulsive noise, which is associated with a higher level of annoyance as compared to more continuous noise sources (such as traffic noise). Impulsive sound is of short duration (typically less than one second) and high intensity. It has abrupt onset, rapid decay, and often a rapidly changing spectral composition. Other sources of impulse sound include explosions, impacts, and the passage of supersonic aircraft (sonic booms). Two options would be considered for the location of the hand grenade range at Andersen South. Noise contours (C-weighted) and Complaint Risk Contours associated with breacher charges and the hand grenade range are shown for each option on Figure 6.2-4. Under Option 1 (co-located with Training Range Complex Alternative A), the LUPZ extends onto adjacent private lands and a small portion of Zone II overlies residences near the intersection of Jesse Dydasco Street and Route 15. Moderate noise complaint risk contours extend onto adjacent lands in all directions. Contours associated with Option 2 (co-located with Training Range Complex Alternative B) extend much farther east and encompass numerous residences in Zone II and a few in Zone III. Noise complaint risk would be moderate to high.

Under these conditions, the noise exposure levels associated with hand grenade range option 1 would not be incompatible with the residential noise sensitive land uses located adjacent to the proposed hand grenade ranges and therefore the noise impacts would be less than significant. Hand grenade range Option 2 would have areas exposed to noise levels considered incompatible with residential use and would be considered significant.

Barrigada

Construction

Under Alternative 1, facilities construction would not take place at Barrigada. Therefore, there would be no noise impacts from construction.

Operation

No airfield operations would occur at this location, therefore there would be no noise impacts.

Likewise, no aviation or ground-based training would occur on Barrigada, thus there would be no noise impacts.

Non-DoD Land

Construction

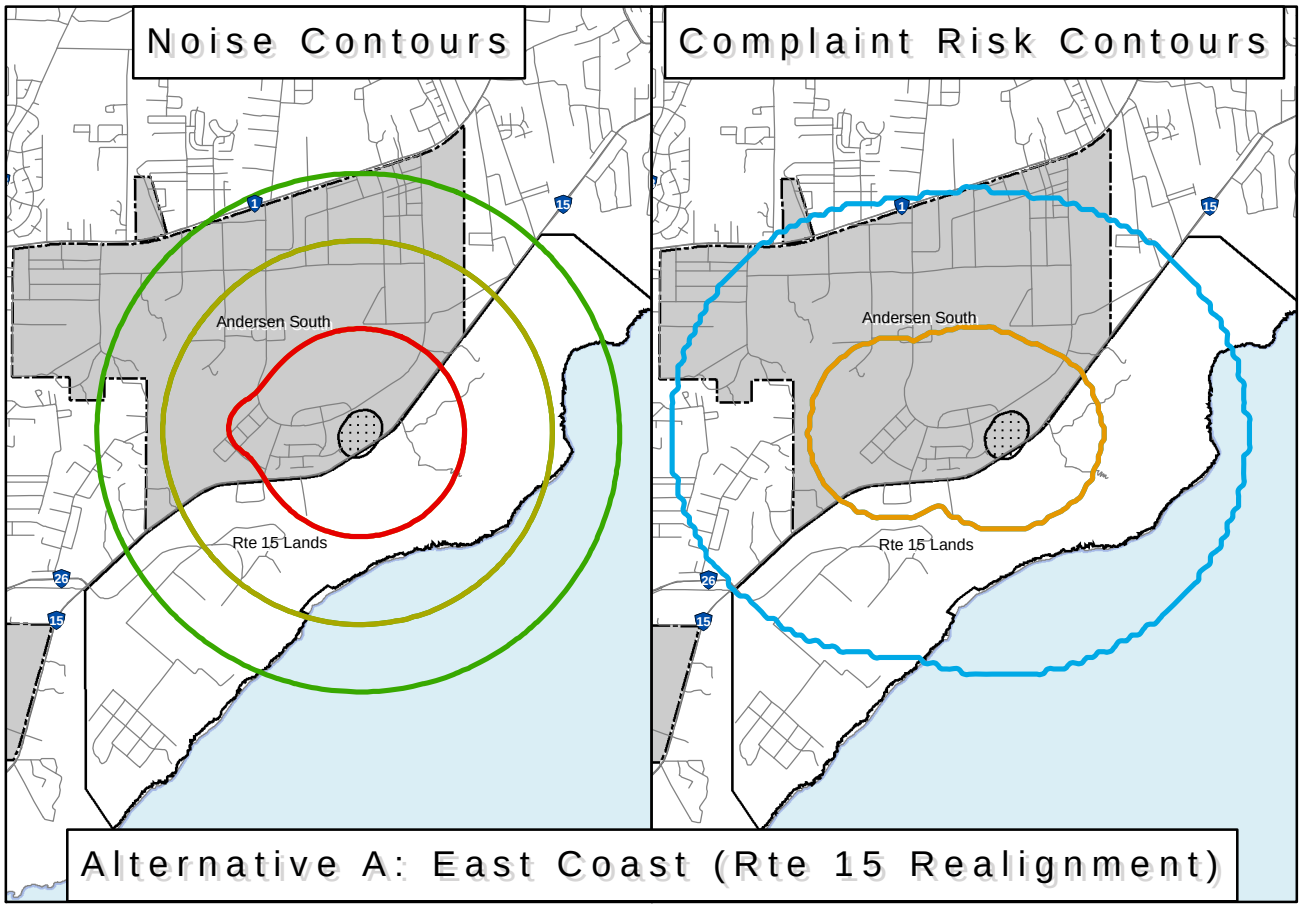
Under Alternative 1, range construction would take place at non-DoD land. Noise impacts from construction would be the same as those described for Andersen South and would be less than significant.

Operation

Airfield Operations. Alternative 1 would not alter flight operations currently occurring at Guam IAP so the noise impacts would remain the same and would be less than significant.

There would be no other airfield operations associated with the central region of Guam, so there would be no noise impacts.

In addition, no aviation or ground-based training would occur in non-DoD lands so there would be no airfield operations noise impacts at non-DoD lands.



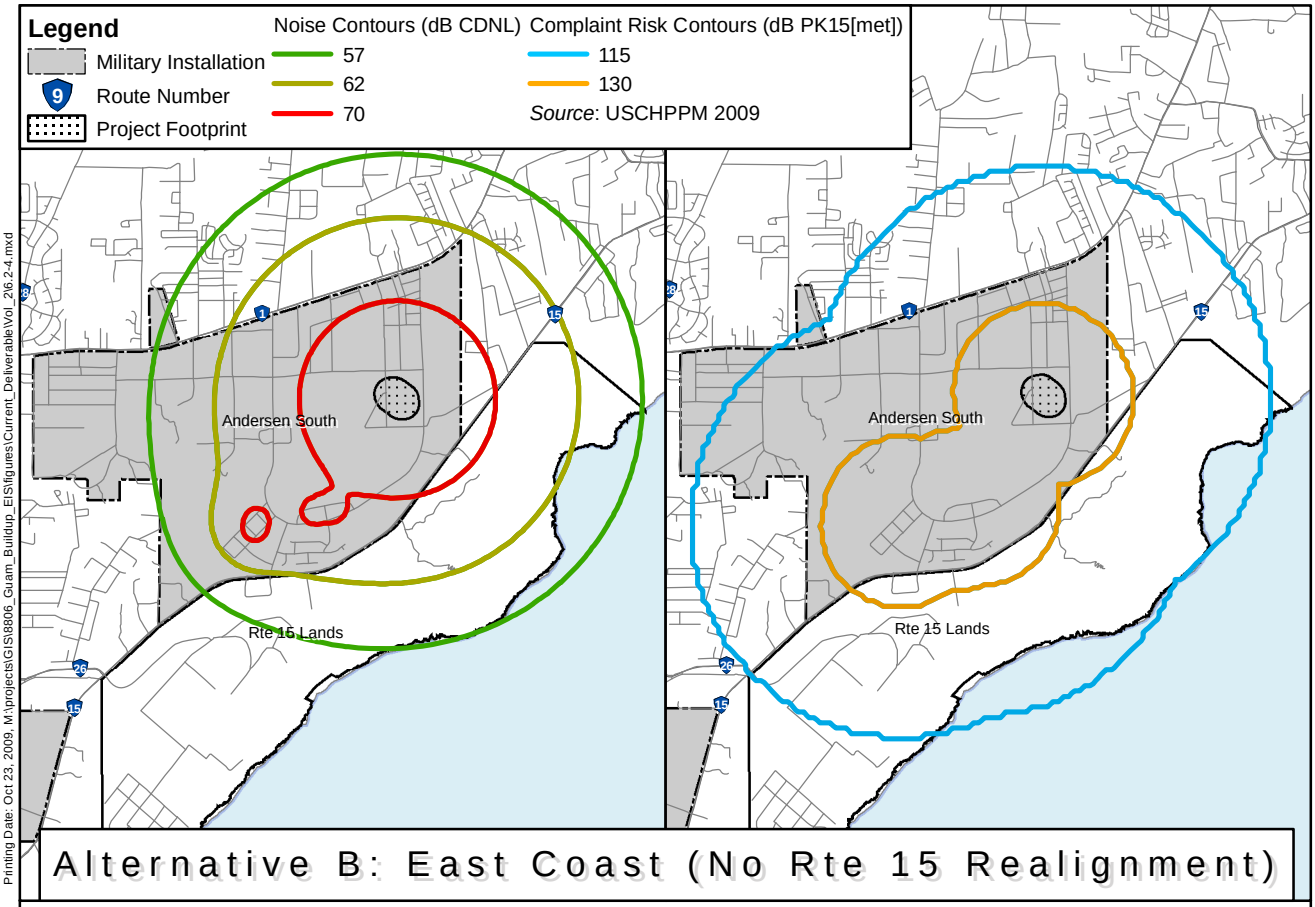


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Figure 6.2-4
Noise Contours and Complaint Risk Contours for the Breacher House and Hand Grenade Range

Feet
2,700 0 2,700
760 0 760
Meters

Route 15 Lands and Training Range Complex Alternatives. The main source of noise on non-DoD land resulting from implementation of the Alternative 1 would be the small arms noise generated at the proposed range complex. Small arms to be fired at these ranges would include 9 millimeter (mm) pistol, .45 caliber pistol, 5.56 mm rifle, and the .50 caliber machine gun. Because it is an inert training round, the 40 mm MK 19 TP to be authorized for use at the machine gun multipurpose range was also assessed as small arms munitions. Two alternatives were considered for the layout of the ranges.

There are two major noise sources generated from small arms munitions firing. The first is the muzzle blast from the firing of a bullet. The second is the noise from the bow shock wave (also known as ballistic wave) generated by the super-sonic bullet. The bow shock wave propagates out from the path of the bullet. The bullet from an M16 has an exit velocity of approximately 3,100 ft (945 m) per second, but decelerates quickly. After approximately 3,937 ft (1,200 m), it is no longer flying at supersonic speeds and the shock wave would likely end within 6,562 ft (2,000 m).

Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons, as would occur at the proposed ranges, would result in short periods of intense firing followed by longer periods of silence. There is increased annoyance associated with this noise exposure pattern. Under these conditions, the number of shots becomes less important than the dB level of the typical (average) shot. It has been found that small arms fire is usually not a concern unless the linear peak sound pressure level of individual shots is above 85 dB PK 15(met).

The results of the modeling of Range Complex Alternatives A and B are provided in Figure 6.2-5. Under the Alternative A, the Zone II noise contours extend approximately 13,100 ft (4,000 m) beyond the eastern boundary of Route 15 lands and Zone III contours extend to just under 330 ft (100m) beyond the eastern edges of the Route 15 land. Alternative B would generate a Zone II extending 2,00-4,000 ft (600-1,200m) east of the Andersen South and Route 15 lands and approximately 4,600 ft (1,400m) west of the Route 15 boundary. The Zone II contour would extend approximately 230 ft (70m) across Route 15 just to the west of Andersen South. Both alternatives encompass residential areas in Zone II which would be considered incompatible for such usage.

Best management practices available for reducing the noise impacts include limiting the use on .50 caliber on the machine gun range, using plastic .50 caliber rounds and constructing berms to contain the sound. The most effective BMP would be constructing the berms and would reduce noise levels 10-15 dB. Using BMPs could reduce the noise levels to less than significant levels.

6.2.2.3 Apra Harbor

Harbor

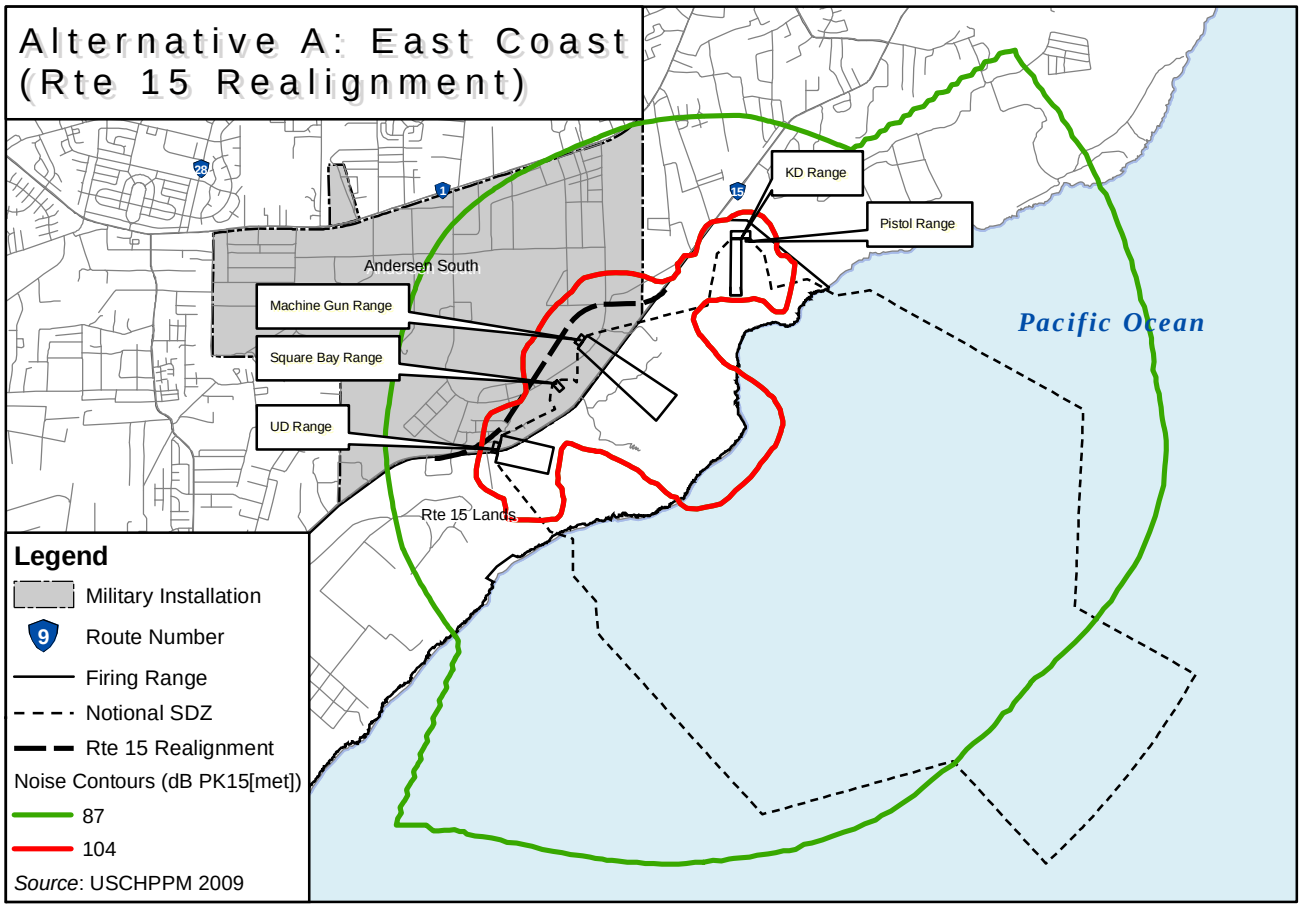
Construction

Alternative 1 would require general purpose Navy wharves to be repaired and upgraded and new facilities to be constructed to accommodate proposed usage increases by amphibious task forces. Repair and upgrade of these wharves would entail utilization of heavy equipment and barges for these construction projects. Refer to Volume 4 of this EIS/OEIS for detailed noise impacts from construction at Apra Harbor.

Operation

No *airfield operations* would occur at Apra Harbor, so there would be no noise impacts.

No impacts due to limited *aviation training* are expected at Apra Harbor.



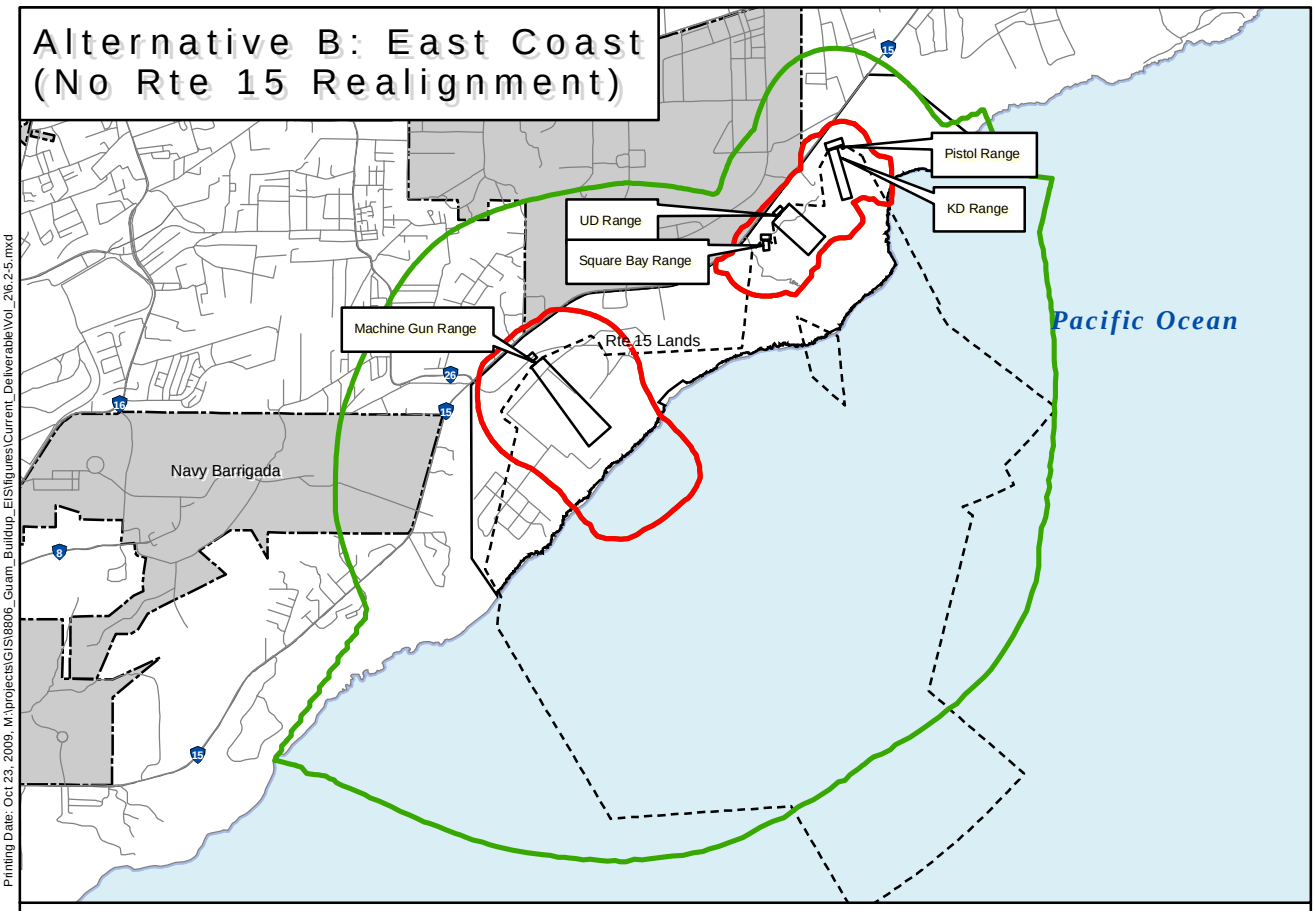


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Figure 6.2-5
Noise Contours for Route 15 Small Arms Ranges

Feet
2,750 0 2,750
790 0 790
Meters

N W E S

Ground-based training activities currently occur in Apra Harbor, but no additional live-fire or other exercises would take place. Therefore, there would be no additional noise impacts.

Vessel operations in the Inner Apra Harbor include tugs, barges, work boats, but the Landing Craft Air Cushion (LCAC) is by far the loudest. These vessels ride on a cushion of air generated by powerful engines driving fans elevating the vessel. LCACs generate noise levels of 98 dB Lmax at 200 ft (61m) underground run-up conditions and SELs up to 104 dBA at 40 knots (NSWC PCD 2008). Since the LCAC will operate at no-wake speeds, the ground run-up noise conditions prevail at the Inner Harbor. The nearest receptor would be residences approximately 3,000 ft (914 m). At this distance, the sound would attenuate down to 74 dB. This would be a less than significant impact because the operations only occur during MEU visits four times a year and the LCACs would be used to unload/load cargo only about 15-20 times per visit.

Naval Base Guam

Construction

Under Alternative 1, facilities construction would take place at Naval Base Guam. However, construction activities would be well away from any sensitive receptor so noise impacts would be less than significant.

Operation

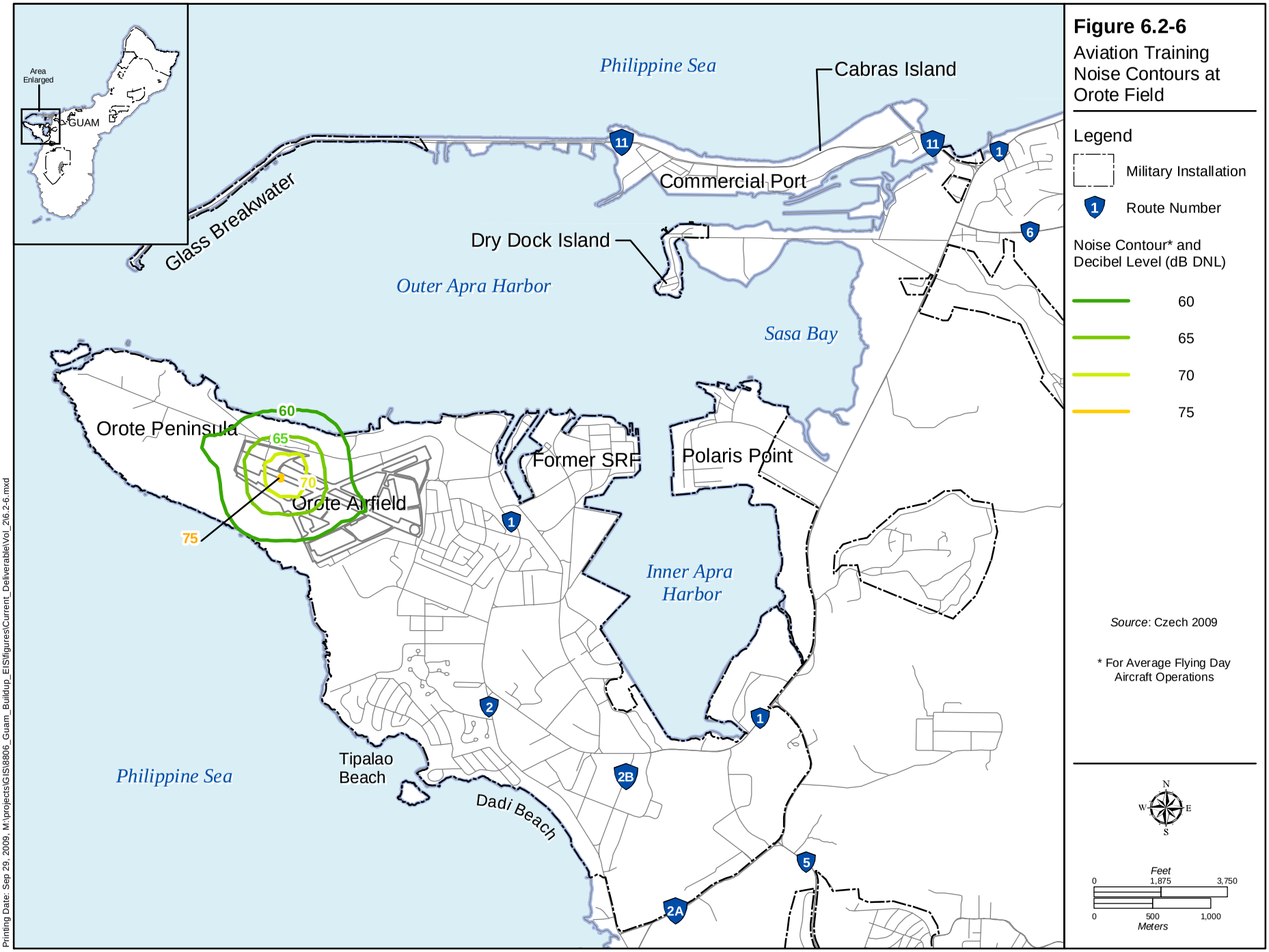
Airfield Operations. Orote airfield would be sporadically used for aviation training and discussed in the following section.

Aviation Training. Orote Airfield currently consists of improved expeditionary runways and taxiways used in field training exercises by helicopters and some fixed-wing aircraft. The airfield has no services or instrumentation and is constrained by Explosive Safety Quantity Distance arcs from Kilo Pier and associated munitions storage. Potential flight routes to and from prospective landing points can be made over water without crossing over habitation areas or roads. Triple Spot, an existing helicopter landing zone on the airfield runway, supports personnel transfer, logistics, parachute training, etc. Orote Airfield is located approximately 16 mi from north ramp. Aviation training operations occurring at Orote Field are EXT and FCLP as shown in Table 6.2-6. The noise contours associated with aviation training at Orote Airfield is shown on Figure 6.2-6. The noise levels would be very localized and would not impact any sensitive receptors so noise impacts would be less than significant.

Table 6.2-6. Annual Sortie-Operations Specifications for Orote Field

Location and Type of Training	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*% Night*	*Night Sortie-Ops*	*% Below 3,000 ft (914 m)*	*Sortie-Ops Below 3,000 ft (914 m)*
	CH-53	*MV-22*	*AH-1*	*UH-1*					
EXT	20	60	0	15	95	10%	10	100%	95
FCLP	20	120	30	15	185	25%	47	100%	185

Ground-based training activities currently occur at Orote Point, but no additional live-fire or other exercises are proposed in these areas. Therefore, there would be no additional noise impacts.



6.2.2.4 South

Naval Munitions Site

Construction

Construction activities for this alternative at NMS would be limited to a new munitions storage facility and utilities. The munitions storage facility would be at least 1250 ft (381 m) inside the boundary to comply with explosive safety quantity distance regulations. At this distance, 90 dBA at 50 ft (15 m) would attenuate to less than 65 dBA. Therefore, noise impacts would be less than significant.

Operation

No airfield facilities exist at NMS so there would be no noise impacts.

Aviation Training. NMS is an approximately 8,000-ac (324 ha) area that is primarily used for munitions storage and does not currently support aviation training. NMS is located approximately 16 mi (25.7 km) from the north ramp. Under Alternative 1, this area would be opened up for extensive Marine Corps training activities. Aviation training would entail CAL, EXT, and MAN-LFT and are shown in Table 6.2-7. The majority of the flights would be CH-53E ferrying personnel from Andersen AFB. Sound levels

Table 6.2-7. Annual Sortie-Operations Specifications for NMS

Type of Training	*Sortie-Ops by Aircraft Type*				*Total Annual Sortie-Ops*	*% Night*	*Night Sortie-Ops*	*% Below 3,000 ft (914 m)*	*Sortie-Ops Below 3,000 ft (914 m)*
	CH-53	*MV-22*	*AH-1*	*UH-1*					
CAL	20	60	30	15	125	10%	13	100%	125
EXT	13	40	0	10	63	10%	6	100%	63
MAN-LFT	192				192	10%	19	80%	154

1,000 ft (305 m) below a CH-53E would be about 93 dBA. TERF training would also occur at NMS, but modeling indicates that the noise levels due to TERF training are below 60 dB DNL and cannot be mapped because the mapping routines start at 60 dB. The noise contours associated with aviation training at NMS is shown on Figure 6.2-7. Aviation training noise levels would not impact any sensitive receptors so noise impacts would be less than significant.

Ground-based training activities currently occur at NMS, but no additional live-fire or other exercises are proposed in these areas. Therefore, there would be no additional noise impacts.

Non-DoD Land

Construction

Road construction is planned for non-DoD lands in south Guam, but the noise impacts would be short-term and less than significant.

Operation

No airfield operations would occur on non-DoD lands in south Guam so there would be no noise impacts.

No aviation training is planned to occur on non-DoD lands in south Guam and therefore there would be no noise impacts.

No ground-based training is planned to occur on non-DoD lands in south Guam so there would be no noise impacts.

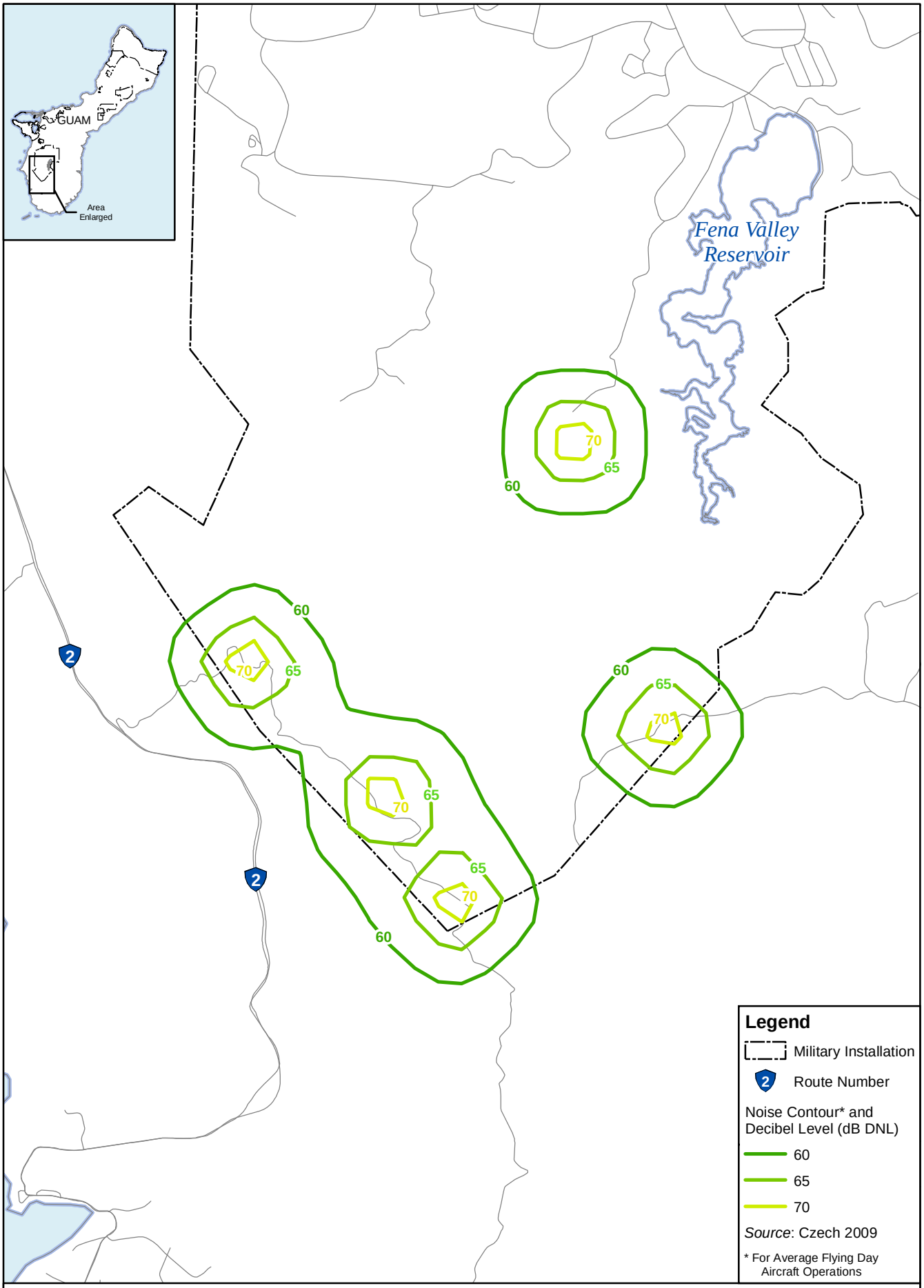


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Figure 6.2-7
Aviation Training Noise Contours at NMS

6.2.2.5 Summary of Impacts

Under Alternative 1, most of the impacts would be less than significant. For those potential noise impacts that may exceed acceptable noise levels, the use of best management practices such as project sequencing and sound barriers would reduce noise levels to less than significant levels.

6.2.2.6 Potential Mitigation Measures

Mitigation measures have not been identified for any of the activities or locations associated with the Alternative 1 since noise levels above casual receptors not permanently living or working under a noisy location would be within acceptable limits.

Because under Alternative 1, no residences would occur in the Route 15 area where the range complexes are proposed, and this alternative includes the establishment of a noise buffer interior to Andersen South for maneuver area and MOUT training, no additional mitigation measures would be required.

6.2.3 Alternative 2 (Preferred Alternative)

Impacts due to operations and training activities would be similar to Alternative 1 since the activities are similar for Alternative 2. The exception is construction and the resulting construction noise. Specifically, the noise impacts would vary slightly, as construction project locations are modified by this alternative, but the noise impacts would be the same as the Alternative 1.

6.2.3.1 North

Andersen AFB

Construction

Construction noise impacts from facilities construction under Alternative 2 would be similar to those described for Alternative 1.

Operation

All activities and locations would be the same as Alternative 1 so the potential noise impacts would be the same as described for Alternative 1.

Finegayan

Construction

Construction noise impacts from facilities construction under Alternative 2 would be similar to those described for Alternative 1, except the activities would extend farther north. Consequently, the potential noise impacts would be considered less than significant.

Operation

All activities and locations would be the similar to Alternative 1, except the training area described at the Former FAA site on Non-DoD lands would be located at the north end on Finegayan (shown as TRN of Figure 2.2-6), so the potential noise impacts would be the same as Alternative 1. The area designated for Engineering Equipment and Decontamination Training would be used to practice grading, placement of fill, construction of drainage structures (e.g. earthen dams), and similar activities. The area would be located over 2,000 ft (610 m) from the nearest off-base residence along Route 3 and about twice that distance to the nearest on-base residence at the proposed BEQ. Activities would use standard construction equipment such as graders, excavators, tractors, etc. and the noise generated at the source would be about 91 dBA, similar to that described above for construction activities at Andersen AFB.

Because of distance, the noise would attenuate down to approximately 59 dBA at the nearest off-base receptor and be imperceptible to on-base receptors. Therefore, noise levels due to ground-based training activities on Finegayan would be less than significant.

Non-DoD Land

Construction

Construction would be the similar to that described for Alternative 1 for non-DoD lands, except Harmon Annex would not be included in this Alternative.

Operation

All activities and locations would be similar to Alternative 1, except ground-based training would occur at the north end of Finegayan under this Alternative, so the potential noise impacts would be the same as described in Alternative 1.

6.2.3.2 Central

Andersen South

Construction

Construction noise impacts from facilities construction under Alternative 2 would be similar to those described for Alternative 1 for central Guam. Consequently, noise impacts due to construction would be less than significant.

Operation

All activities and locations would be the same as Alternative 1, so the potential impacts would be the same as Alternative 1.

Barrigada

Construction

Under Alternative 2, facilities construction would not take place at Barrigada. Therefore, there would be no noise impacts from construction.

Operation

All activities and locations would be the same as Alternative 1, so the potential impacts would be the same as Alternative 1.

Non-DoD Land

Construction

Under Alternative 2, facilities construction would not take place on non-DoD lands. Therefore, there would be no noise impacts from construction.

Operation

All activities and locations would be the same as Alternative 1, so the potential impacts would be the same as Alternative 1.

6.2.3.3 Apra Harbor

Harbor

Construction

Construction noise impacts from general facilities construction under Alternative 2 would be the same as Alternative 1.

Operation

All activities, locations, and impacts would be the same as Alternative 1.

Naval Base Guam

Construction

Construction noise impacts from general facilities construction under Alternative 2 would be the same as Alternative 1.

Operation

All activities, locations, and impacts would be the same as Alternative 1.

6.2.3.4 South

Naval Munitions Site

Construction noise impacts from facilities construction under Alternative 2 would be similar to those described for Alternative 1.

Operation

All activities and locations would be the same as Alternative 1 so the potential noise impacts would be the same as described for Alternative 1.

Non-DoD Land

Construction

Construction noise impacts from general facilities construction under Alternative 2 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.3.5 Summary of Impacts

The impacts would be the same as for Alternative 1, except for the construction and operations in Finegayan.

6.2.3.6 Potential Mitigation Measures

Mitigation measures have not been identified for any of the activities or locations associated with the Alternative 2 since noise levels above casual receptors not permanently living or working under a noisy location would be within acceptable limits.

6.2.4 Alternative 3

Noise impacts due to operations and training activities would be similar to Alternative 1 since the activities are similar for Alternative 3. The exception is construction and the resulting construction noise, consequently the noise impacts would vary slightly by location and are described below.

6.2.4.1 North

Andersen AFB

Construction

Construction noise impacts under Alternative 3 would be the same as Alternative 1.

Operation

All activities, locations, and potential noise impacts would be the same as Alternative 1.

Finegayan

Construction

Construction noise impacts from facilities construction under Alternative 3 would be the same as Alternative 2.

Operation

All activities, locations, and potential noise impacts would be the same as Alternative 2.

Non-DoD Land

Construction

Under this Alternative, no construction would occur on the Harmon Annex and the Former Federal Aviation Administration (FAA) properties, so there would be no impacts.

Operation

All activities, locations, and potential noise impacts would be the same as Alternative 2.

6.2.4.2 Central

Andersen South

Construction

Construction activities and potential noise impacts at Andersen South would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Barrigada

Construction

Construction noise impacts under Alternative 3 would be similar to those described above for Alternative 1, except the family housing and community support construction activities would occur on Navy Barrigada and Air Force Barrigada. Construction activities in the Barrigadas would generate noise levels at nearby residences and sensitive receptors exceeding 75 dBA. However, the use of best

management practices such as sound barriers and project sequencing would reduce the levels to less than significant.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Non-DoD Land

Construction

Construction would not occur on non-DoD lands in the central region of Guam. However, noise generated from construction activities on the Barrigadas would affect residences in non-DoD lands above 75 dBA. However, use of best management practices such as sound barriers and project sequencing would reduce the levels to less than significant.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.4.3 Apra Harbor

Harbor

Construction

Construction noise impacts from general facilities construction under Alternative 3 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Naval Base Guam

Construction

Construction noise impacts from general facilities construction under Alternative 3 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.4.4 South

Naval Munitions Site

Construction noise impacts from facilities construction under Alternative 2 would be similar to those described for Alternative 1.

Operation

All activities and locations would be the same as Alternative 1 so the potential noise impacts would be the same as described for Alternative 1.

Non-DoD Land

Construction

Construction noise impacts from general facilities construction under Alternative 3 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.4.5 Summary of Impacts

The impacts would be the same as for Alternative 1, except Non-DOD land in the north and Barrigada.

6.2.4.6 Potential Mitigation Measures

Mitigation measures have not been identified for any of the activities or locations associated with Alternative 3 since noise levels above casual receptors not permanently living or working under a noisy location would be within acceptable limits.

6.2.5 Alternative 8

Alternative 8 noise impacts due to operations and training activities would be similar to Alternative 1. The exception is construction project locations and the resulting construction noise, so the noise impacts would vary slightly by location and are described belowNorth

Andersen AFB

Construction

Construction noise impacts under Alternative 8 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Finegayan

Construction

Construction noise impacts under Alternative 8 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Non-DoD Land

Construction

Construction noise impacts under Alternative 8 would be similar to those described for Alternative 1, except no construction would occur on Harmon Annex. Construction activities would generate noise levels at nearby residences and sensitive receptors exceeding the 75 dBA. However, use of best management practices such as sound barriers and project sequencing would reduce the levels to less than significant.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.5.1 Central

Andersen South

Construction

Construction noise impacts under Alternative 8 would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Barrigada

Construction

Construction noise impacts under Alternative 8 would be similar to those described for Alternative 3, except the family housing and community support construction activities would occur all on Air Force Barrigada. Construction activities in Air Force Barrigada would generate noise levels at nearby residences and sensitive receptors exceeding 75 dBA. However, use of best management practices such as sound barriers and project sequencing would reduce the levels to less than significant.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Non-DoD Land

Construction

Construction would not occur on non-DoD lands in the central region of Guam. However, noise generated from construction activities on Air Force Barrigada would affect residences in non-DoD lands above 75 dBA. However, use of best management practices such as sound barriers and project sequencing would reduce the noise levels to less than significant.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.5.2 Apra Harbor

Harbor

Construction

All activities, locations, and potential impacts would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Naval Base Guam

Construction

All activities, locations, and potential impacts would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.5.3 South

Naval Munitions Site

Construction

All activities, locations, and potential impacts would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

Non-DoD Land

Construction

All activities, locations, and potential impacts would be the same as Alternative 1.

Operation

All activities, locations, and potential impacts would be the same as Alternative 1.

6.2.5.4 Summary of Impacts

The potential impacts would be the same as for Alternative 1.

6.2.5.5 Potential Mitigation Measures

Mitigation measures have not been identified for any of the activities or locations associated with the Alternative 8 since noise levels above casual receptors not permanently living or working under a noisy location would be within acceptable limits.

6.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the potential military relocation would occur. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no noise impacts associated with the proposed action and alternatives. However, implementation of the no-action alternative would not meet the mission, readiness, national security, and international treaty obligations of DoD.

6.2.7 Summary of Impacts

Table 6.2-8 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 6.2-9 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 6.2-10 and 6.2-11 summarizes the impacts at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives, respectively. A summary of potential noise impacts due to Other Training, Airfield, and Waterfront is provided in Table 6.2-12. A text summary follows the summary tables.

Table 6.2-8. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
LSI • Construction impacts would be less than significant in all areas; at Finegayan and on non-DoD lands, BMPs would reduce the impacts to less than significant.	LSI • Construction impacts would be less than significant in all areas; at Finegayan and on non-DoD lands. BMPs would reduce the impacts to less than significant. • No construction on Harmon Annex. Construction would extend farther north at NCTS Finegayan.	LSI • Construction impacts would be less than significant in all areas; at Finegayan, BMPs would reduce the impacts to less than significant. • Navy and Air Force Barrigada and adjacent non-DoD lands would receive greater than 75 dBA, but BMPs would reduce noise to less than significant levels.	LSI • Construction impacts would be less than significant in all areas; at Finegayan and on non-DoD lands, BMPs would reduce the impacts to less than significant. • Air Force Barrigada and adjacent non-DoD lands would receive greater than 75 dBA, but BMPs would reduce the impacts to less than significant levels.
Operation			
LSI • Noise impacts during the operational phase of Alternative 1 would be less than significant.	LSI • Noise impacts during the operational phase of Alternative 2 would be less than significant.	LSI • Noise impacts during the operational phase of Alternative 3 would be less than significant.	LSI • Noise impacts during the operational phase of Alternative 8 would be less than significant.

Legend: LSI = Less than significant impact.

Table 6.2-9. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
LSI • Construction impacts would be less than significant.	LSI • Construction impacts would be less than significant.
Operation	
LSI • During the operational phase, BMPs would be used to reduce noise impacts to less than significant levels.	LSI • During the operational phase, BMPs would be used to reduce noise impacts to less than significant levels.

Legend: LSI = Less than significant impact

Table 6.2-10. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
LSI • Noise impacts would be less than significant	LSI • Noise impacts would be less than significant.
Operation	
LSI • Noise impacts during the operational phase would be less than significant.	LSI • Noise impacts during the operational phase would be less than significant.

Legend: LSI = Less than significant impact

Table 6.2-11. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
LSI • Noise impacts would be short-term and less than significant.	NI • No construction.
Operation	
LSI • Noise impacts during the operational phase would be less than significant.	LSI • Noise impacts during the operational phase would be less than significant

Legend: LSI = Less than significant impact.

Table 6.2-12. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Construction impacts would be less than significant in all areas.	LSI • Construction impacts would be less than significant in all areas.	LSI • Construction impacts would be less than significant in all areas.
Operation		
LSI • Noise impacts during the operational phase would be less than significant.	LSI • Noise impacts during the operational phase would be less than significant.	LSI • Noise impacts during the operational phase would be less than significant.

Legend: LSI = Less than significant impact.

Noise levels associated with the proposed action and alternatives would increase locally by only one or two dB DNL around the Andersen AFB airfield. Aviation operations would raise noise levels locally, but

only as the aircraft fly overhead. The training is assumed to be somewhat dispersed, but when combined with ground training activities, such as maneuvering and live-fire training, the impacts could be localized.

Of particular concern would be the Air Force and Navy Barrigada areas where noise levels would be above compatible land use standards. Noise impacts due to construction noise are expected to exceed limits to off-base receptors because some of the projects would be located right up against the fence-line. However, construction noise would be short-term and only last during construction and BMPs would be employed to minimize impacts to a less-than significant level.

All of the Alternatives would have the same impacts because the operations part of this proposal would be identical for each alternative, except for noise from construction activities, where there are differences in activities in Former FAA, South Finegayan, Harmon Annex, and the Air Force and Navy Barrigadas.

Under the no-action alternative, there would be no buildup of Marine Corps aircraft, operations, construction or traffic. Though there would be no noise impacts associated with the no-action alternative, the purpose and need for the proposed action would not be met.

6.2.8 Summary of Potential Mitigation Measures

As there are no significant impacts under any of the alternatives, no mitigation measures are proposed for noise.

CHAPTER 7. AIRSPACE

7.1 AFFECTED ENVIRONMENT

7.1.1 Definition of Resource

7.1.1.1 Airspace

Management

Airspace management is defined as directing, controlling, and handling flight operations in the volume of air that overlies the geopolitical borders of the United States (U.S.) and its territories. In the U.S., airspace is a resource that is managed by the Federal Aviation Administration (FAA) with established policies, designations, and flight rules to protect aircraft on the airfield, en route, in Special Use Airspace (SUA) identified for military and other governmental activities, and in other military training airspace. The FAA Western Service Area (Renton, Washington) provides guidance and control of U.S. territory airspace in the Pacific that includes Guam and Commonwealth of the Northern Mariana Islands (CNMI). Guam Air Traffic Control, Guam Approach Control and Guam Departure Control manage air traffic in Guam. Andersen Air Force Base (AFB) also has tower controllers. For airspace outside of the U.S. and its territories, rules are agreed to by members of the International Civil Aviation Organization, an agency of the United Nations, that codifies the principles and techniques of international air navigation and fosters the coordination, planning and development of international air transport to ensure safe and orderly growth. The practices used to manage airspace consider how the airspace is designated, used, and administered to best accommodate the individual and common needs of the military, commercial organizations, and private aviation enthusiasts. Because of these multiple and sometimes competing demands, the FAA considers all aviation airspace requirements in relation to airport operations, federal airways (FAA air routes approved for use at different altitudes and provided on aeronautical charts available for pilots), jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements.

Classifications

National airspace is divided into two broad categories, *controlled* and *uncontrolled* airspace. The FAA provides a detailed description of the classifications in FAA Order 7400.2G. Within these two categories, there are a variety of classifications that determine flight rules, pilot qualifications, and aircraft capabilities required in order to operate within any section of the airspace. The specific classification of any area is determined by the FAA and is broadly based upon the following:

- Complexity or density of aircraft movements
- Nature of operations conducted within the airspace
- Level of safety required
- National and public interest

It is important that pilots, dispatchers and managers be familiar with the operational requirements of each of the various types of airspace in order to assess their impact on the ground activity underlying them and potential conflicts for agency aircraft operating above agency lands. It is also incumbent on both the pilot and the dispatcher to be familiar with all the points of contact regarding controlled and SUA. There is no "one call solves all" point of contact in airspace coordination. Each type of airspace has its own

designated unit that is responsible for controlling, scheduling and/or coordinating the use of the designated portion of the National Airspace System. It is important that pilots, dispatchers and managers be familiar with the operational requirements of each of the various types of airspace in order to assess their impact on the ground activity underlying them and potential conflicts for agency aircraft operating above agency lands. To describe how airspace is structured and managed, the explanation is grouped into major categories with sub-categories and definitions. Figure 7.1-1 shows the airspace classifications and features of each class of airspace are summarized in Table 7.1-1.

- *Class A Airspace (Controlled).* Class A Airspace Areas include airspace from 18,000 feet (ft) (5,486 meters [m]) above mean sea level (msl) up to 60,000 ft (18,288 m) msl, including the airspace overlying the waters within 12 nautical miles (nm) (22.3 kilometers [km]) of the coast of the 48 contiguous states, U.S. Territories, Alaska, and Hawaii. All operations within Class A airspace must be under instrument flight rules (IFR) and are under direct control of air traffic control (ATC). Class A airspace always starts at 18,000 ft (5,486 m) msl and it is not specifically charted or designated on commonly used maps. All flights in Class A airspace are under positive control.
- *Class B Airspace (Controlled).* This airspace surrounds the nation's busiest commercial airports. This is the most congested airspace and has the most complex mix of aircraft operations with everything from single engine trainers to high speed jet transports. At its core, it extends from the surface airspace areas to 10,000 ft (3,048 m) msl. The overall shape of Class B can be likened to an upside down wedding cake of several layers (Figure 7.1-1). Each layer is divided into sectors with the exact dimensions and shape individually tailored to meet local traffic and safety needs. The outer limit of Class B can extend to 30 nm (55.8 km) from the primary airport. ATC clearance is required to operate in Class B airspace areas. To increase safety, the airspace is designed to minimize the number of turns aircraft are required to perform as they descend to an airport, while still enabling other aircraft to safely transition the area. Class B airspace is charted on sectional charts, IFR Enroute Low Altitude Charts, and terminal area charts. Operations must be with air traffic clearance.
- *Class C Airspace (Controlled).* This airspace surrounds the busy airports of mid-sized cities with a large number of commercial flight operations as well as some military airports. An operating control tower at the primary airport and radar services are key components of Class C airspace. The overall shape is also that of an upside down wedding cake but there are only two layers. The inner ring has a radius of 5 nm (9.3 km) and is from the surface up to, but not including 4,000 ft (1,219 m) above airport elevation. The outer ring has a radius of 10 nm (18.5 km) and is from 1,200 ft (366 m) above ground level (AGL) to 4,000 ft (1,219 m) above airport elevation. A third ring with a 20 nm (37 km) radius exists in which air traffic control provides traffic separation services to pilots flying under visual flight rules (VFR) who voluntarily request this service. Radio communications must be established with ATC prior to entering Class C airspace but specific permission to operate within the airspace is not required as it is in Class A and B. Class C airspace is charted on sectional charts, IFR Enroute Low Altitude Charts, and in specific terminal area charts. Aircraft flight operations within Class C airspace should be viewed as complex and would normally require planning and coordination similar to that for operations in Class B airspace.

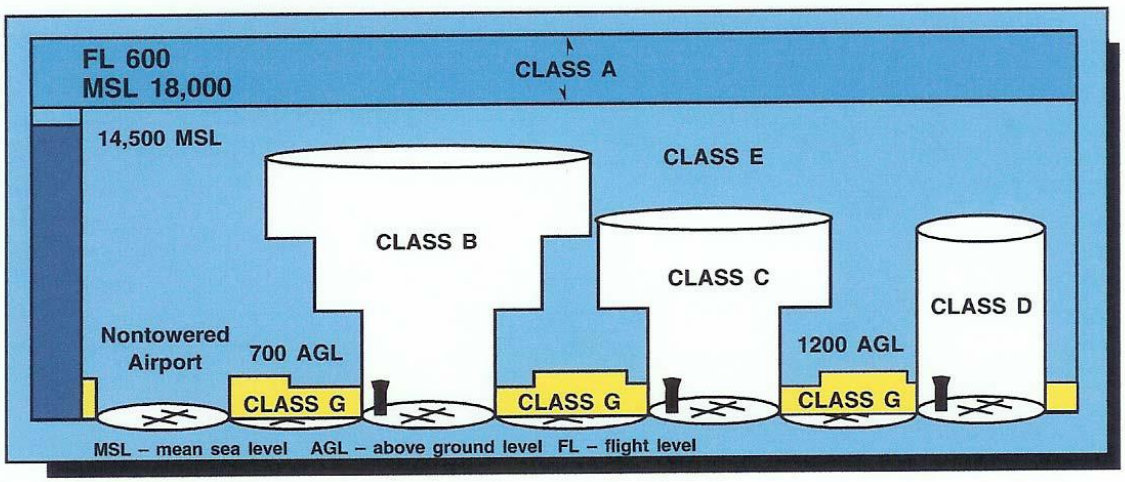

Figure 7.1-1. Airspace Classifications

Table 7.1-1. Airspace Features for Classes of Airspace

Airspace Features	*Class A*	*Class B*	*Class C*	*Class D*	*Class E*	*Class G*
Former Airspace Equivalent	Positive Control Area	Terminal Control Area	Airport Radar Service Area	Airport Traffic Area and Control Zone	General Controlled Airspace	Uncontrolled Airspace
Operations Permitted	IFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR	IFR and VFR
Entry Requirements	ATC Clearance	ATC Clearance	ATC Clearance for IFR. All require Radio Contact	ATC Clearance for IFR. All require Radio Contact	ATC Clearance for IFR. All require Radio Contact	None
Minimum Pilot Qualifications	Instrument Rating	Private or student certificate	Student Certificate	Student Certificate	Student Certificate	None
Two-way Radio Communications	Yes	Yes	Yes	Yes	Yes for IFR	No
VFR Minimum Visibility	N/A	3 statute miles	3 statute miles	3 statute miles	3 statute miles	1 statute mile
VFR Minimum distance from Clouds	N/A	Clear of Clouds	500’ below, 1,000’ above and 2,000’ horizontal	500’ below, 1,000’ above and 2,000’ horizontal	500’ below, 1,000’ above and 2,000’ horizontal	Clear of Clouds
Aircraft Separation	All	All	IFR, SVFR, and runway operations	IFR, SVFR, and runway operations	IFR and SVFR	None
Traffic Advisories	N/A	N/A	Yes	Workload permitting	Workload permitting	Workload permitting
Safety Alerts	Yes	Yes	Yes	Yes	Yes	Yes
Differs from International Civil Aviation Organization	No	Yes	Yes	Yes for VFR	No	Yes for VFR
Changes the Existing Rule	No	Yes for VFR	No	Yes	No	No

Legend: ATC= Air Traffic Control, SVFR= Special Visual Flight Rules

- *Class D Airspace (Controlled).* This airspace is applied to airports with operating control towers but where the traffic volume does not meet Class C or Class B standards. Traffic usually lacks the heavy jet transport activity but often includes a complex mix of general aviation, turbo prop and business jet traffic. Radar service is often available. The above airport elevation shape is a 5 nm (9.3 km) radius surrounding an operational control tower from the surface up to, but not including, 2,500 ft (762 m) AGL. Class D airspace may have one or more extensions to accommodate IFR traffic. Where radar service is available, air traffic control would provide separation service to IFR traffic and to participating VFR traffic. All traffic must maintain radio communication with the tower or have prior arrangements for operating within the Class D airspace. Class D airspace is charted on sectional charts and IFR Enroute Low Altitude Charts. Flight operations commonly involve Class D airspace and must be coordinated by the control tower. There are usually a large number of civilian and military flight training operations occurring in and around Class D airspace. It is also important to consider that radar service may not be available. A.P. Won Pat Guam International Airport (IAP) has Class D airspace extending upward from the surface to and including 2,600 ft (793 m) msl within a 4.3-mile (6.9 km) radius of the airport. Andersen AFB has Class D airspace extending upward from the surface to and including 2,600 ft (793 m) msl within a 4.3-mile (69 km) radius of the airspace.
- *Class E Airspace (Controlled).* Class E airspace exists primarily to assist IFR traffic. It includes all airspace from 14,500 ft (4,420 m) msl up to, but not including 18,000 ft (5,482 m) msl. It extends upward from either the surface or a designated altitude to the overlying or adjacent controlled airspace. Radar coverage may or may not be available and there are no requirements for VFR communications with ATC. Class E airspace below 14,500 ft (4,420 m) msl is charted on Sectional, Terminal, and IFR Enroute Low Altitude Charts. Aviation operations would routinely involve Class E airspace and should be coordinated with the applicable Air Route Control Center or Terminal Radar Approach Control both at Andersen AFB and Guam IAP. This would help to avoid conflicts with IFR traffic. As always, "see and avoid" is the recommended procedure. Currently the airspace surrounding Guam IAP and Andersen AFB includes Class D and Class E airspace. The Class E airspace is currently being redesigned and expanded effective May 2009. This FAA action removes, renames, and expands the Class E airspace areas serving Guam IAP. The change is necessary to accommodate IFR aircraft operations and enhances the safety and management of aircraft operations in the Northern Mariana Islands (Federal Register 2009).
- *Class F Airspace.* This is an international classification that is not utilized in the U.S. or Territories.
- *Class G Airspace (Uncontrolled).* Class G is uncontrolled airspace and includes all airspace not otherwise designated as A, B, C, D or E. It is virtually non-existent in the eastern U.S. but relatively large blocks of Class G can be found in some areas of the Pacific and Alaska. Operations within Class G airspace are governed by the principle of "see and avoid". Aviation operations in uncontrolled airspace should be approached with caution.

In addition to airspace classifications, there are a variety of terms utilized to identify operational structures, hazards, and unique areas within the airspace. "Controlled" and "uncontrolled" airspace are generic terms that broadly cover all airspace. These refer to the level of air traffic control required to operate within the airspace. Most controlled airspace has specific, predetermined dimensions whereas uncontrolled airspace can be of almost any size. Class G is the only class of uncontrolled airspace. Except

as noted in the following descriptions, the FAA normally is the controlling agency for each area of the National Airspace System, unless otherwise identified.

Special Use Airspace (SUA)

This special designation is designed to alert users about areas of military activity, unusual flight hazards, or national security needs, and to segregate that activity from other airspace users to enhance safety. While most SUA involves military activity, others involve civilian users such as the Department of Energy. SUA is established by the FAA. Detailed information regarding the process for establishing SUA and other types of airspace is contained in FAA Handbook 7400.2, Procedures for Handling Airspace Matters. The Department of Defense (DoD) flight information publication AP/1A contains detailed information about current SUA. There are six different kinds of SUA. Airspace requirements for the proposed relocation of Marines to Guam include some of these types of airspace and are defined below.

- *Restricted Areas (RA).* RAs are established in areas where ongoing or intermittent activities occur that create unusual, and often invisible hazards to aircraft such as artillery firing, aerial gunnery, practice bomb dropping and guided missile testing. Dimensions of the restricted area vary depending upon the needs of the activity and the risks to aircraft. RAs differ from prohibited areas in that most RAs have specific hours of operation and entry during these hours requires specific permission from the FAA or the controlling agency. In addition, there may be a separate scheduling agency who must also grant permission. Agency personnel must understand that hazardous flight activity is occurring in the RA when it is active.
- *Warning Area (WA).* WAs contain the same kind of hazardous flight activity as RAs but have a different title since they are located offshore over domestic and international waters. Examples of likely hazards include artillery firing, aerial gunnery, guided missile exercises and fighter interceptions. WAs generally begin 3 miles (mi) (5 km) offshore. Executive Order 10854 extends the application of the Federal Aviation Act of 1958, as amended, to the overlying airspace of those areas of land or water outside the U.S. beyond the 12-mi (20-km) offshore limit. It includes areas that the U.S. has appropriate jurisdiction or control under international treaty agreement. WAs overlying the territorial waters of the U.S. are under FAA jurisdiction. However, any airspace action, rulemaking or non-rulemaking that concerns airspace beyond the 12-mi (20-km) offshore limit requires coordination with the DoD and the adjacent state. Although VFR operations are permitted in warning areas, the FAA does not guarantee traffic separation and agency personnel should carefully weigh the risks of such operations.
- *Controlled Firing Areas.* Controlled firing areas contain civilian and military activities that, if not contained, could be hazardous to "non-participating" aircraft. These include rocket testing, ordnance disposal, small arms fire, chemical disposal, blasting, etc. Controlled firing areas are differentiated from military operations areas and RAs areas in that radar or a ground lookout is utilized to indicate when an aircraft might be approaching the area. All activities are then suspended. The FAA does not chart controlled firing areas because a controlled firing area does not require a nonparticipating aircraft to change its flight path. Agency personnel may find information about controlled firing areas from the nearest regional FAA headquarters.
- *Military Operations Areas.* A military operations area is an area of airspace designated for military training activities. They were established to contain certain military activities such as air combat maneuvers, intercepts, acrobatics, etc. Civilian VFR flights are allowed within a military operation area even when the area is in use by the military. Air traffic control would

separate IFR traffic from military activity. A clearance is not required for VFR operations. Military operations areas have a defined floor and ceiling that can range up to the floor of Class A airspace (18,000 ft [5,486 m] msl).

- *Alert Area.* Alert areas may contain a high volume of pilot training or an unusual type of aerial activity. There are no special requirements for operations within alert areas, other than heightened vigilance. All operations must be in compliance with Federal Aviation Regulations. The types of flying involved could be military, aircraft manufacturers or a high concentration of flights (i.e., helicopter activity near oil rigs). Alert area dimensions differ for each area and are depicted on sectional charts, IFR enroute charts, or terminal area charts.
- *Military Training Route.* Military training routes are designed for low-level, high-speed terrain-following training missions. These routes are provided for military training at speeds of more than 250 knots and at altitudes that range from ground level (surface) to 18,000 ft (5,486 m) msl, though most operations are conducted well below 10,000 ft (3,048 m) msl.

Other Kinds of Airspace

Due to the unique nature of military operations, training and testing requirements, other airspace for special military use has been developed outside the SUA program. These are:

- *Air Traffic Control Assigned Airspace (ATCAA).* ATCAAs were established to permit the continuation of flight activities above 18,000 ft (5,486 m) msl. From the standpoint of the "user," the ATCAA is combined into one piece of airspace, with 18,000 ft (5,486 m) msl acting as an administrative boundary between the lower altitude training and the higher altitude training. VFR aircraft are not permitted to enter most ATCAAs because they are not permitted to fly under VFR above 18,000 ft (5,486 m) msl. ATCAAs are not depicted on aeronautical charts.
- *Slow Routes.* Slow routes are slow speed, low altitude training routes are used for military air operations flown from the surface up to 1,500 ft (457 m) AGL at air speeds of 250 knots indicated airspeed or less and usually involve C-130 or helicopter type aircraft.
- *Low Altitude Tactical Navigation Areas.* Low altitude tactical navigation areas are large, clearly defined geographical areas wherein the Air Force practices random tactical navigation that typically ranges from surface to 1,500 ft (457 m) AGL. These areas are not charted.
- *Local Flying Area.* Most military facilities develop local flying areas within which they can conduct routine, non-hazardous training activity. These areas are normally developed in conjunction with local FAA controllers and airspace managers and are developed so they would not conflict with other airspace usage.
- *Air Refueling Routes.* Aerial refueling routes utilized by the military are located at high altitudes that pose no hazard to Air Traffic Control operations. However, there are VFR helicopter refueling tracks at low altitudes that do affect operations at lower altitudes. Some are published and some tracks are random within a military operations area or ATCAA.
- *Temporary Special Use Airspace.* The military and the FAA have the ability to create temporary military operations areas or temporary RAs to accommodate the specific needs of a particular military exercise. This information is available via either the Notice to Airmen (NOTAM) system or by direct contact with the FAA Regional Headquarters.
- *Cruise Missile Routes.* Cruise missile operations are conducted on selected IFR military training routes. They may be flown in excess of 250 knots and below 10,000 ft (3,048 m) msl. Cruise missiles may be accompanied by two chase aircraft escorts.

- *National Security Areas.* National security areas are areas where there is a requirement for increased security. Pilots are requested to voluntarily avoid flying through the depicted national security areas. When it is necessary to provide a greater level of security and safety, flights in national security areas may be temporarily prohibited under the provisions of the Federal Aviation Regulations Part 99.7.

Airways

Airways are established routes used by military aircraft, commercial aircraft, and general aviation aircraft. They are the flight paths on which aircraft travel through airspace similar to land highways. There are two types of airway route structures. Low altitude routes, or victor routes are those routes that are below 18,000 ft (5,486 m) msl. High altitude routes, or jet routes, are those routes that are above 18,000 ft (5,486 m) msl.

7.1.1.2 Air Traffic

Air traffic refers to movements of aircraft through airspace. Safety and security factors dictate that use of airspace and control of air traffic be closely regulated. Accordingly, regulations applicable to all aircraft are promulgated by the FAA to define permissible uses of designated airspace. The FAA also controls the use of airspace. These regulations are intended to accommodate the various categories of aviation, whether military, commercial, or private aviation enthusiasts. Guam is a major crossroads for published airways in the Pacific Region under the Oakland Oceanic Control with ten jet routes that intersect over the Nimitz Very High Frequency Omni-Directional Radio Range Tactical Air Navigation Aid for in-flight navigation located at the A.B. Won Pat Guam IAP: A450, G467, M501, R584, R585, G339, A597, B586, W21, and G205.

The FAA owns and operates the air traffic control system. The system of airspace designation makes use of various definitions and classifications of airspace to facilitate control. Controlled Airspace is a generic term that covers different classes of airspace. The controlling agency of any airspace is the FAA air traffic control facility that exercises control of the airspace when SUA is not active.

The regulatory context for airspace and air traffic varies from highly controlled to uncontrolled within Guam and the CMNI region. Less controlled situations include flight under VFR or flight outside of U.S. controlled airspace. Examples of highly controlled air traffic situations are flights in the vicinity of airports where aircraft are in critical phases of flight, either take-off or landing, and flight under IFR, particularly flights on high or low altitude airways.

SUA is specially designated airspace that is used for a specific purpose and is controlled by the military unit or other organization whose activity established the requirement for the SUA (FAA 2008b). SUA in and surrounding Guam includes RAs and WAs. There are also established ATCAAs within the region

7.1.2 Military Air Traffic

Existing SUA consists of W-517 and R-7201. W-517 is a WA that overlays deep ocean water located approximately 50 mi (80 km) south-southwest of Guam and provides a large expanse of SUA from sea surface to an unlimited altitude. W-517 is constrained by high altitude jet routes converging over Guam that run to the east and west of the WA. R-7201 is the RA surrounding Farallon de Medinilla (3 nm [5,560 m] radius) with altitudes from the surface to unlimited and encompasses 28 square nm (nm²) (51,856 square km [km²]). There are also open ocean ATCAAs within the Guam and CNMI region are used for military training activities, from unit level training to major Joint exercises. ATCAAs 1, 2, 3, 5,

and 6 as depicted in Figure 7.1-2 have been pre-assigned in agreements with Guam FAA, U. S. Naval Forces Marianas (COMNAV Marianas), and the Commander, 36th Wing, Andersen AFB. Guam FAA works with COMNAV Marianas and the Air Force 36th Wing Division to modify or configure new ATCAAs as required for training events. Pre-configured ATCAAs encompass 63,000 nm² from south of Guam to north-northeast of Farallon de Medinilla, from the sea surface to either Flight Level 300 (30,000 ft msl) or to an unlimited altitude. ATCAAs are activated for short periods to cover the timeframes of training activities.

Andersen AFB contains two airfields; one main, base proper airfield (North Ramp) and Northwest Field (NWF) airfield. Andersen AFB North Ramp has two parallel runways: one 11,185 ft (3,411 m) and one 10,558 ft (3,220 m) long, and NWF has two 10,000 ft (3,048 m) runways. Airspace over Andersen AFB North Ramp supports flight operations including takeoffs, landings and traffic pattern training of all types of aircraft up to and including B-52s, C-5s, C-17, and KC-135s. NWF is available for helicopter units and other aircraft that also use adjacent taxiways for vertical and short field aviation landings for Confined Area Landing, simulated amphibious ship helicopter deck landings, and insertions and extractions of small maneuver teams. NWF is in a state of disrepair as improvements have not been made since the 1970s. It is a remote site with no services or instrumentation. Aviation operational use is presently restricted to the May to October period, when crows are not nesting, with a 1,000 ft (305 m) minimum ceiling otherwise. NWF is located approximately 3 mi (5 km) from Andersen AFB North Ramp. Andersen AFB airspace is controlled by Air Force air traffic control at Andersen AFB North Ramp. There are five published approaches (precision and non-precision) (FIP 2008).

Orote Field located south of Apra Harbor was closed to all but emergency landings in 1946, but today the cross runway is used for C-130 touch-and-go flight training and for helicopter operations by Navy SEALs. The major runway runs from northwest to southeast and the secondary runway crosses the first and runs in a northeast to southwest direction.

Currently, the Navy is in the process of completing the Mariana Islands Range Complex (MIRC) EIS/OEIS (Navy 2009), which includes review and upgrades and modifications to the ranges (including SUA) for the Navy and other joint use military users (Air Force, Marines, and Army) in and around Guam. The MIRC EIS/OEIS covers the actions required to increase the use and modifications of existing airspace and ranges in the region of influence, while this EIS/OEIS covers those actions necessary for the move of Marines from Okinawa to Guam as discussed in Chapter 2. There is also a joint proposal for new and modified airspace requirements that is being developed that will include requirements for Air Force units operating from Andersen AFB use, future Navy use, and future joint military training events in the area.

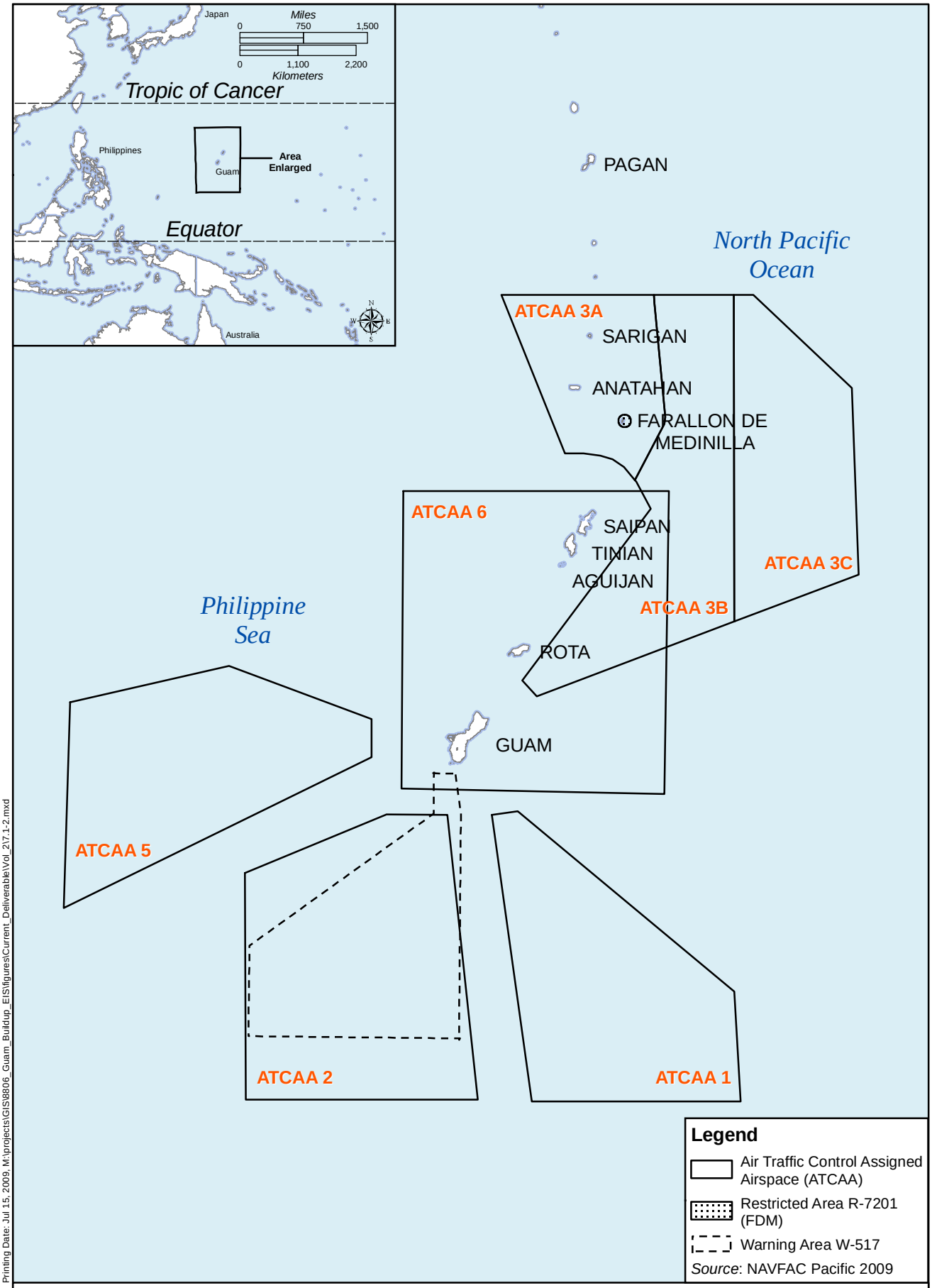

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Figure 7.1-2
Airspace in the Mariana Islands Range Complex

7.1.3 Civilian Air Traffic

Guam IAP (i.e., A. B. Won Pat IAP) is the only civilian air transportation facility on Guam. It is operated by Guam IAP Authority, a public corporation and autonomous agency of the GovGuam. Guam IAP contains two runways and facilities that were part of the now-closed Naval Air Station Agana. Eight major airlines operate out of the airport, making it the hub for air transportation for Micronesia and the Western Pacific. The airport's two parallel runways are oriented east to west; Runway 26 left (RW26L) and 06 right (RW06R); and Runway 26 right (RW26R) and 06 left (RW06L) are 10,015 ft (3,053 m) and 10,015 ft (3,052 m) in length, respectively. There are ten published approaches to the runways (precision and non-precision). These approaches begin approximately 10 nm (18.5 km) on a straight line extended from the end of the runways. Communications are provided by Guam Approach and Departure Control and Agana Tower. Departures are straight-climbing departures under Agana Departure Control. There are approximately 83 fixed-wing aircraft and one helicopter based at the airport (AirNav 2009). The closest civilian airport is Rota International Airport located approximately 49 nm (90 km) to the northwest. Air traffic that overflies Guam use routes published in the Enroute Charts for transiting Guam airspace (Figure 7.1-3).

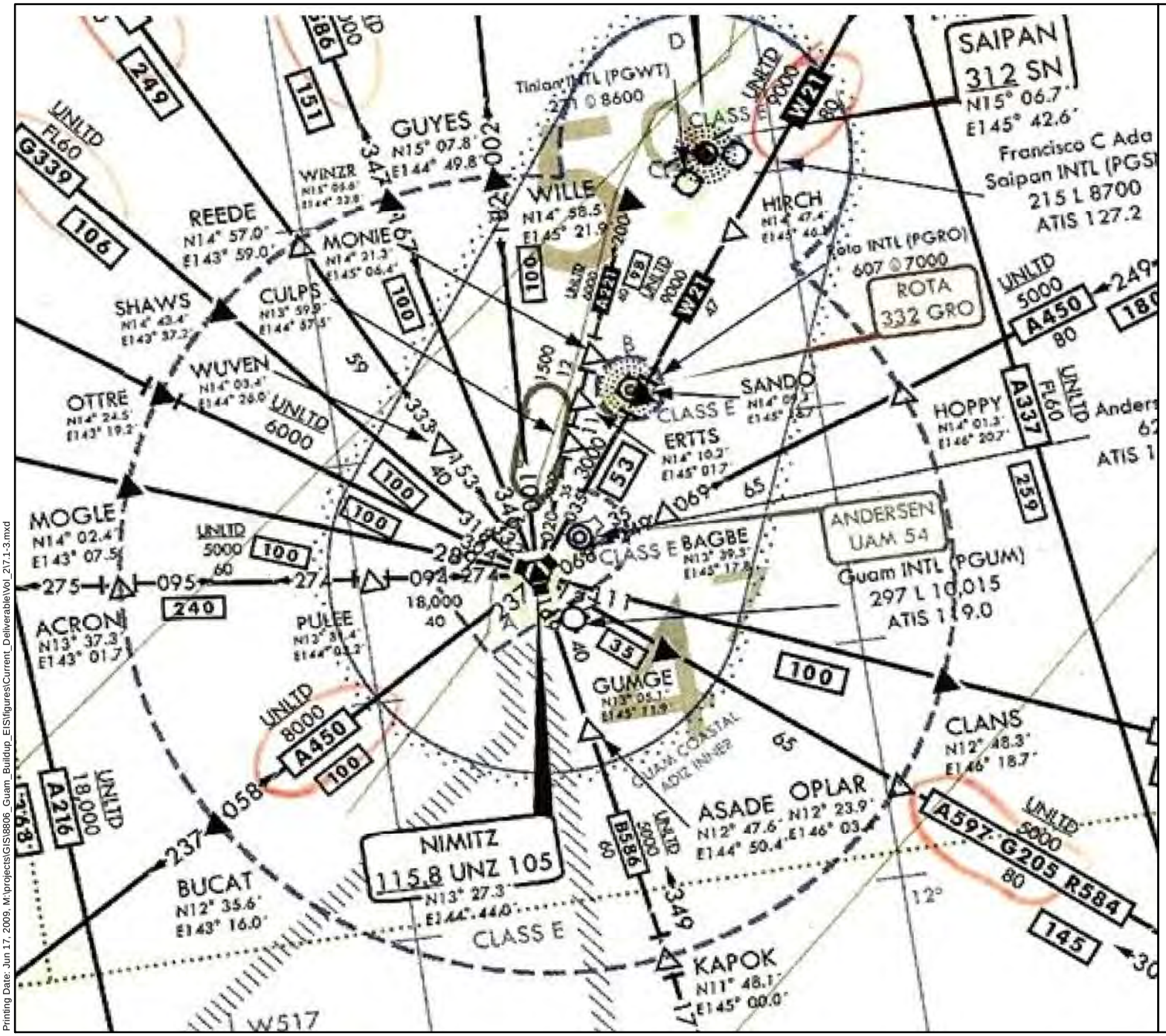

Figure 7.1-3
Guam Enroute Chart
Airspace

Source:U.S. Government
Flight Information Publication,
IFR Enroute High
Altitude-Pacific
Chart 14 Feb 2008

Printing Date: Jun 17, 2009. M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\7-1-3.mxd

7.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses the components of the proposed action that could affect existing airspace conditions and use. The components addressed include Aviation Training and the Training Range Complex. No effects to airspace are anticipated from construction and operations pertaining to the Waterfront functions and the Main Cantonment. Therefore, the multiple alternatives for the Main Cantonment, Training-Ammunition Storage, and Training-NMS Access Road are not discussed in detail. Although organized by the Main Cantonment alternatives, a full analysis of Airfield operations and airspace requirements associated with the Training Range Complex is presented beneath the respective headings. A summary of impacts specific to these alternatives is presented at the end of this chapter.

7.2.1 Approach to Analysis

7.2.1.1 Methodology

Impacts on airspace use were assessed by evaluating the potential effects of the proposed training activities on the principal attributes of airspace use, as described in Section 7.1. In the following paragraphs is a discussion of the impact categories and how they were assessed for this project:

- Impacts on controlled and uncontrolled airspace were assessed by determining if the project would reduce the amount of navigable airspace by creating new or expanding existing SUA or by introducing temporary flight restrictions or presenting an obstruction to air navigation.
- Impacts on SUA were assessed by determining the project's requirement either for new SUA or for modifying existing SUA.
- Impacts on enroute airways were assessed by determining if the project would lead to a change in a regular flight course or altitude or instrument procedures.
- Impacts on airports and airfields were assessed by determining if the project would restrict access to or affect the use of airports/airfields available for public use or if it would affect airfield/airport arrival and departure traffic flows.

Factors used to assess impacts on air traffic include consideration of an alternative's potential to result in an increase in the number of flights such that they could not be accommodated within established operational procedures and flight patterns; a requirement for airspace modification; or an increase in air traffic that might increase collision potential between military and non-participating civilian operations.

7.2.1.2 Determination of Significance

Based in part on FAA Order 1050.1E, Change 1, Environmental Impacts: Policies and Procedures (FAA 2008a) and FAA Order 7400.2G, Procedures for Handling Airspace Matters (FAA 2008b), an action is considered to have a potential significant airspace impact if it would result in any of the following:

- Reduce the amount of navigable airspace that would have adverse aeronautical impacts to non-participating users that could not be mitigated.
- Create an obstruction to air navigation.
- Assign new SUA (including Controlled Firing Areas, RAs, WAs, and Military Operation Areas) or require the modification of existing SUA that would have adverse aeronautical impacts that could not be mitigated.

- Change an existing or planned IFR minimum flight altitude, a published or special instrument procedure, or an IFR departure procedure or require a VFR operation to change from a regular flight course or altitude.
- Reduce public health and safety due to a change in aviation safety risk.
- Restrict access to or effects on the use of airports and airfields available for public use.
- Change commercial or private airfield or airport arrival and departure traffic flows.

7.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to Airspace issues identified, including regulatory stakeholders, during the public scoping meetings were addressed.

7.2.2 Alternative 1

7.2.2.1 Aviation Training and Airfield Functions

Andersen AFB

Under Alternative 1, there would be an increase of a total of 25 aircraft and 50 aircrews based at Andersen AFB. Aviation training would generate an estimated increase of 31,204 aircraft operations annually. This would be an approximately 46% increase in operations (refer to Chapter 6, Noise, Table 6.2-1). While the aircraft squadrons are proposed for basing at Andersen AFB North Field, there would be no change to any of the approach and departure patterns associated with airports and airfields at Andersen AFB under this alternative. To reduce the operationally undesirable simultaneous mix of fixed wing and rotary wing operations at Andersen AFB, flight training would primarily occur at sites other than North Field (NWF, Orote Airfield, Andersen South, and/or NMS). Existing ATC procedures would continue but would possibly need to be augmented with additional personnel for the increased flight activity. Some of the flight activities would be accomplished under VFR conditions and random routes that would not impact commercial or general aviation flying. Helicopters would follow the air traffic, general operating, and flight rules of Federal Air Regulations Part 91, and would not interfere with local general aviation flights. There are no low altitude enroute airways in the Guam region. There would be no change to IFR minimum flight altitudes, no special instrument procedures would be required, and VFR operations would not be required to change from a regular flight course or altitude. Proposed aircraft training would be accomplished using existing SUA training airspace along with VFR flight not requiring SUA. Existing WAs and ATCAAs would continue to be used for training of flight crews. No new airspace would be required under this alternative; however, there is an ongoing review of airspace requirements in the MIRC EIS/OEIS (Navy 2009) that would address future airspace needs from a joint DoD position that would include proposed airspace for future Air Force, Navy, Army and Marine Corps training. As no measurable change in airspace requirements or airspace management procedures would be required, no significant impacts would result from implementation of this alternative.

A. P. Won Pat Guam IAP

Under this alternative, there would be no reduction in the amount of navigable airspace. There would be no change to enroute airways or IFR procedures. There would also be no restrictions on access to and no effect on the use of the airport or airfield available for public use, nor would there be any effect on airport or airfield arrival and departure traffic flows due to the increase in military aircraft assigned to Guam. Aircrews for military participants and nonparticipating aircraft would be responsible for using see and avoid techniques to avoid hazards. The airport lies within Class D and Class E airspace, so aircraft

departure and arrival operations would be subject to air traffic control clearances and instructions, thus avoiding any direct adverse impacts on general aviation air traffic. No significant impacts would occur.

7.2.2.2 Firing Training

As noted in Chapter 2 under Alternative 1, there would be SUA established several miles to the southwest of the main runways at Andersen AFB (refer to Figure 2.3-10). The firing range training for the .50 caliber machine guns require the establishment of a Restricted Area (or SUA) from the surface to 3,000 ft (914 m) AGL. This would be located at either the Alternative A or B site for the Machine Gun Range on the east coast of Guam. The Restricted Area (or SUA) would overlie the proposed safety danger zone that would also extend overwater. Existing air traffic control procedures would continue with no change. Hazardous air training activities are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. NOTAMs and return of SUA to civilian FAA control when not in use for military activities would take place. Overall impacts to existing airspace structure, including IFR and VFR terminal operations, and VFR operations, routes and flyways are currently under review. It is anticipated that proposed R-7202 would have minimal impact on public use and/or charted private airports or IFR enroute operations. The offshore area involved with live fire effects is already regulated, and safety measures will be in place to resolve conflicts with inadvertent transit of watercraft. As such, no significant impacts to offshore use are anticipated. There would be no additional impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities.

Andersen AFB

None of the locations for firing training would impact airspace at Andersen AFB. Arrival and departures for Andersen AFB would not be impacted nor would any changes be needed. The Restricted Area (or SUA) would be active only during real time use of the firing range.

A. P. Won Pat Guam IAP

Under this alternative there would be no change to enroute airways or IFR procedures. There would also be no restrictions on access to and no effect on the use of the airport or airfield available for public use, nor would there be any effect on airport or airfield arrival and departure traffic. The Restricted Area (or SUA) would be in effect only when the firing range was in use. The Restricted Area (or SUA) associated with the proposed firing ranges under Alternative A would fall beyond the current Class D airspace surrounding the airport and there would be no changes to existing airspace. Under Alternative B, the Restricted Area (or SUA) would fall partially within the existing airport Class D airspace. Under this alternative, current Class D airspace would have to be modified to exclude the proposed Restricted Area. Under both alternatives, departures from Runway 6 (RW 06) would have to be modified to ensure that departing aircraft would be above 3,000 feet AGL or execute a right turn after departure. This would not cause any significant adverse impacts on general aviation air traffic since aircraft departures, arrivals, and traffic patterns would not change. Operations would continue to be subject to air traffic control clearances and instructions. Hazardous air training activities are communicated to commercial airlines and general aviation by NOTAMs, published by the FAA. There would be minimal impacts on the FAA's capabilities, no expected decrease in aviation safety, and no adverse effect on commercial or general aviation activities. No significant impacts are anticipated.

7.2.2.3 Summary of Impacts

Under Alternative 1, existing SUA would be used to conduct aircrew flight training. Flight training would be accomplished in W-517, ATCAAs, and overland with VFR random flights that do not need SUA. There would be no requirement for new SUA under this alternative for aviation training. Low level training routes and landing zones would be established over Guam following VFR rules and procedures and would not impact established flight paths. Establishment of the Restricted Area (or SUA) over the Training Range Complex would not impact FAA's capabilities, decrease aviation safety, or affect commercial or general aviation activities. Given that no appreciable change to existing airspace conditions would occur as a result of implementing this alternative, no significant impacts are expected.

7.2.2.4 Alternative 1 Potential Mitigation Measures

No mitigation measures would be required under Alternative 1.

7.2.3 Alternative 2 (Preferred Alternative)

7.2.3.1 Aviation Training and Airfield Functions

Under Alternative 2, there would be no differences in aviation training from Alternative 1.

Andersen AFB

Under Alternative 2, conditions would be the same as under Alternative 1 for Andersen AFB.

A. P. Won Pat Guam IAP

Under Alternative 2, conditions would be the same as under Alternative 1 for A. B. Won Pat IAP.

7.2.3.2 Firing Training

Under Alternative 2, conditions would be the same as under Alternative 1.

7.2.3.3 Summary of Impacts

Under Alternative 2, there would be no appreciable change to existing airspace conditions; therefore, no significant impacts are expected.

7.2.3.4 Potential Mitigation Measures

No mitigation measures would be required under Alternative 2.

7.2.4 Alternative 3

7.2.4.1 Aviation Training and Airfield Functions

Aviation training under Alternative 3 would be the same as under Alternative 1.

Andersen AFB

Alternative 3 would be the same as under Alternative 1.

A. P. Won Pat Guam IAP

Under Alternative 3, conditions would be the same as under Alternative 1.

7.2.4.2 Firing Training

Firing training would be the same as under Alternative 1.

Andersen AFB

Andersen AFB conditions under Alternative 3 would be the same as those identified under Alternative 1.

A. P. Won Pat Guam IAP

Alternative 3 conditions would be the same as those discussed under Alternative 1.

7.2.4.3 Summary of Impacts

Under Alternative 3, there would be no appreciable change to existing airspace conditions; therefore, no significant impacts are expected.

7.2.4.4 Potential Mitigation Measures

No mitigation measures would be required under Alternative 3.

7.2.5 Alternative 8

7.2.5.1 Aviation Training and Airfield Functions

Aviation training would be the same as identified under Alternative 1.

Andersen AFB

Under Alternative 8, the conditions would be the same as those under Alternative 1.

A. P. Won Pat Guam International Airport

Alternative 8 conditions would be the same as those discussed under Alternative 1.

7.2.5.2 Firing Training

Firing training would be the same as under Alternative 1.

Andersen AFB

Alternative 8 would be the same conditions as noted under Alternative 1.

A. P. Won Pat Guam IAP

Under Alternative 8, the conditions would be the same as those under Alternative 1.

7.2.5.3 Summary of Impacts

Under Alternative 8, there would be no appreciable change to existing airspace conditions; therefore, no significant impacts are expected.

7.2.5.4 Potential Mitigation Measures

No mitigation measures would be required under Alternative 8.

7.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. There would be no reduction in the amount of navigable airspace, or no assignment of new or modified SUA. Similarly, there would be no change to enroute airways or IFR procedures. There

would also be no restrictions on access to airports and no effect on the use of airports or airfields available for public use, nor would there be any effect on airport or airfield arrival and departure traffic flows. There would be no construction that could obstruct air navigation and no new air traffic that could affect aviation safety. The no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

7.2.7 Summary of Impacts

Tables 7.2-1, 7.2-2, 7.2-3, and 7.2-4 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 7.3-5 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

None of the alternatives would have significant impacts on airspace. Alternatives 1, 2, 3, and 8 would establish SUA for firing range surface danger zone (SDZ) that would minimally reduce available airspace up to 3,000 ft (914 m) AGL on an as needed basis. New SUA would be necessary to accommodate the firing range training but would not require any changes to existing arrival and departures from A. B. Won Pat Guam IAP or Andersen AFB. There are no enroute low-altitude airways, and no IFR procedures would need to change. Access to and the approach and departure patterns associated with the airports and airfields would not be restricted, nor would they be required to change. Well-established and understood aviation procedures and rules governing flight operations in both controlled and uncontrolled navigable airspace and SUA make future adverse impacts on public health and safety extremely unlikely. Aircrews for military participants and non-participating aircraft would be responsible for using see and avoid techniques to avoid hazards. NOTAMs and return of SUA to civilian FAA control when not in use for military operations would occur.

Table 7.2-1.Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternatives 1, 2, 3, and 8
Construction
NI • No impacts to airspace from construction.
Operation
NI • No impacts to airspace from operations.

Legend: NI = No impact.

Table 7.2-2. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternatives A and B
Construction
NI • No impact to airspace from construction
Operation
LSI • Minimal reduction in airspace up to 3,000 ft (914 m) due to firing range SDZ SUA • No interference with local general aviation flights • No measureable change in airspace requirements or airspace management procedures

Legend: LSI = Less than significant impact, NI = No impact.

Table 7.2-3. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternatives A and B
Construction
NI • No impact to airspace from construction
Operation
NI • No impact to airspace from operation

Legend: NI = No impact.

Table 7.2-4. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternatives A and B
Construction
NI • No impact to airspace from construction
Operation
NI • No impact to airspace from operations

Legend: NI = No impact.

Table 7.2-5. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • No impact to airspace from construction	NI • No impact to airspace from construction	NI • No impact to airspace from construction
Operation		
LSI • No interference with local general aviation flights • No new airspace for aviation training • No measureable change in airspace requirements or airspace management procedures	LSI • 46% increase in airfield operations • No interference with local general aviation flights • No new airspace for aviation training • No measureable change in airspace requirements or airspace management procedures	NI • No impact to airspace from operations

Legend: LSI = Less than significant impact, NI = No impact.

7.2.8 Summary of Potential Mitigation Measures

No mitigation measures would be required.

CHAPTER 8.
LAND AND SUBMERGED LAND USE

8.1 AFFECTED ENVIRONMENT

This affected environment section defines the resource through descriptions of land ownership, management and land use, beginning with Government of Guam (GovGuam) land, followed by federal land and submerged lands (both GovGuam and Department of Defense [DoD]). The remaining property is assumed to be private land.

Submerged lands refer to areas in coastal waters extending from the Guam coastline into the ocean 3 nautical miles (nm) (5.6 kilometers) [km]). The remainder of Section 8.1 focuses on existing land uses at, or adjacent to, other areas potentially affected by the proposed action and alternatives. As points of reference, primary land use constraints are mentioned (e.g., Explosive Safety Quantity Distance [ESQD] arcs), but details are provided in other resource chapters of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

Land use discussions include DoD and civilian existing and planned land uses, and land use planning guidance that direct future development. On Guam, the federal government controls approximately one third of the land; therefore, the federal government exerts a notable influence over Guam land use.

The region of influence (ROI) for land use is land and ocean in the Territory of Guam within 3 nm (5.6 km) off shore, which is the limit of state or territorial jurisdiction. Other than the use of existing shipping lanes, the designated Ocean Dredged Material Disposal Site (ODMDS) and training ranges described in the Mariana Islands Range Complex (MIRC) EIS (Navy 2009), no Marine Corps actions are proposed beyond the submerged lands boundary.

8.1.1 Definition of Resource

8.1.1.1 Land Ownership and Management- Island-wide

Landowners on Guam are the United States (U.S.) Government, GovGuam, and private citizens at approximately 35%, 20%, and 48% of the land, respectively (Bureau of Statistics and Plans 2009). Private land ownership on Guam is not restricted on the basis of nationality or residency and title can be held in fee simple, which means the owner has the right to control, use, and transfer the property at will. Federal, GovGuam, and private lands are shown on Figure 8.1-1. Govguam lands include land used by the government of Guam for government operations, the Chamorro Land Trust Lands, and the Ancestral Lands Commission managed lands. Additional information is provided in the Socioeconomics Impact Assessment Study, see Appendix F of this EIS/OEIS.

The lands that are non-federal and non-GovGuam lands are assumed to be privately held. The northern area is characterized by large federal land holdings and a large portion of the island's residences. The central section of Guam is the most developed and urbanized, and includes the core tourist area at Tumon Bay. The southern portion of Guam contains large areas of undeveloped land, due in part to the steep terrain.

The following subsections describe the management policies for non-federal land followed by a discussion of federal government lands and submerged lands.

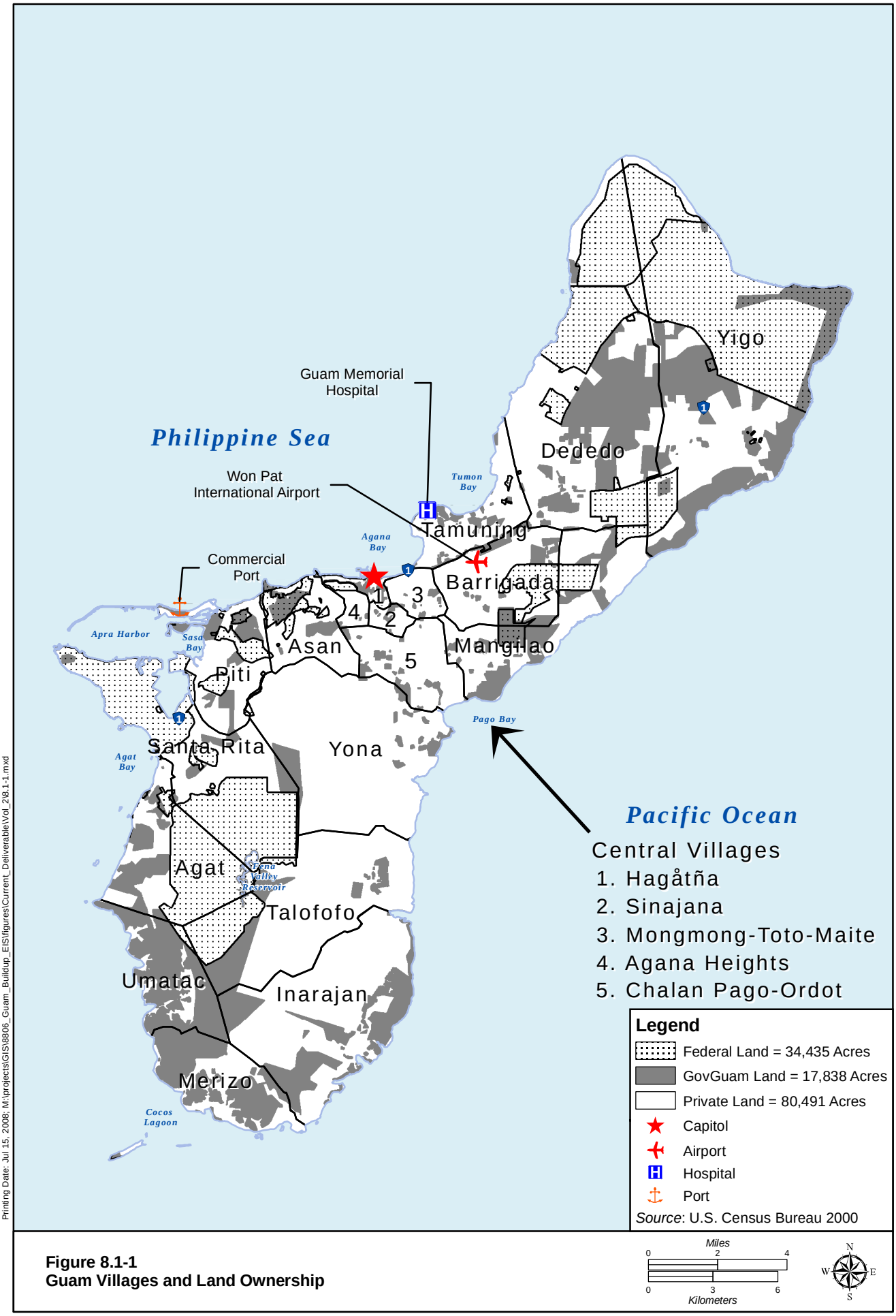

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Figure 8.1-1
Guam Villages and Land Ownership

Non-Federal Land Management

The Organic Act of 1950 (48 Code of Federal Regulations [CFR] §1421) made Guam an organized, unincorporated territory of the U.S., conferring U.S. citizenship on the people of Guam and establishing local self-government. It is "unincorporated" because not all provisions of the U.S. Constitution apply to the territory. Guam is an "organized" territory because the Guam Organic Act of 1950 organized the government much as a constitution would. The Guam Organic Act provides a republican form of government with locally-elected executive and legislative branches and an appointed judicial branch. Guam also has an elected representative to Congress. Policy relations between Guam and the U.S. are under the jurisdiction of the Office of Insular Affairs.

The Chamorro Land Trust Commission (CLTC) and Guam Ancestral Lands Commission (GALC) have the primary responsibility for managing Guam's public lands. Comprehensive land use planning is the responsibility of the Bureau of Statistic and Plans. Other entities including the Department of Agriculture and Department of Parks and Recreation have land management functions specific to a land classification. The Department of Land Management (DLM) provides administrative support to two important commissions that oversee zoning and seashore clearance permits, etc. These are the Guam Land Use Commission (GLUC) and Guam Seashore Protection Commission (GSPC). Federal lands are not subject to DLM management or control, but consistency with surrounding non-federal land uses is an important consideration for land use planning on federal and non-federal lands.

There are ownership classifications within GovGuam lands based on historical land ownership. The key categories are as follows:

- Spanish Crown lands were owned by the former Spanish Crown (government). These lands are not subject to ancestral or other private claims of ownership rights (JGPO 2008), but may be subject to indigenous rights claims.
- Ancestral lands are Guam lands, previously privately-owned by residents of Guam on or after January 1930, and subsequently condemned for public purposes by either the Naval GovGuam or the U.S. These lands have been released as excess public lands in accordance with local and federal authorities. The Guam Ancestral Lands Commission (GALC) (within the DLM) is responsible for making determinations of claims and transferring ownership to ancestral claimants (JGPO 2008).
- Guam public lands are former Spanish Crown lands and other lands designated for public purposes, transferred from the Naval GovGuam and U.S. Department of Interior to the GovGuam as part of the Guam Organic Act (includes lands under the control of the GALC and Chamorro Land Trust Commission (within the DLM) (JGPO 2008).

Coastal Zone

The Coastal Zone Management Act (CZMA) was promulgated in 1972 as a means to "…preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations" through "…the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and esthetic values as well as the needs for compatible economic development..." (16 U.S. Code [USC] § 1451-1466 [2005]). The CZMA is administered through local programs in cooperation with the federal government.

Federal consistency requirements of the CZMA mandate that federal activities comply to the greatest extent possible with applicable local management programs. Non-federal activities must comply fully

with local management programs if they require a federal permit or license, or if they receive federal funding (15 CFR Part 930). Land/submerged land under federal jurisdiction is excluded from the territorial coastal zone. According to CZMA, federal activities that affect any land or submerged land use or natural resource of a territory's coastal zone shall be carried out in a manner that is consistent to the maximum extent practicable with the enforcement policies of the federally-approved territorial Coastal Zone Management Program.

The CZMA is administered on Guam by the Bureau of Statistics and Plans through the Guam Coastal Management Program (GCMP). The coastal zone on Guam includes all non-federal lands on the island, as well as offshore islands and non-federal submerged lands within 3 nm (5.6 km). The Navy would prepare a coastal zone Consistency Determination (which would cover all proposed action including Marine Corps, Navy and Army actions discussed in other volumes of this EIS/OEIS). Volume 9, Appendix H contains the consistency determination assessment and correspondence.

Federal Land Ownership and Management

Federal Land Ownership

The federal lands that are used by DoD represent approximately 29% of Guam's (refer to Figure 8.1-1) total land area, not including submerged lands (Government Affairs Office 2007). Andersen Air Force Base (AFB) (located in northern Guam) is the operational center for the Air Force on Guam. The Navy's mission-critical operations occur around Apra Harbor in the southwest. Both military services own other parcels that are not contiguous with the principal operating centers.

DoD land control has decreased over the past three decades as a result of the Guam Excess Land Act of 1994 and Base Realignment and Closure (BRAC) recommendations. The Guam Excess Land Act released DoD property to GovGuam that was declared to be excessive to military requirements under the Guam Land Use Plan (GLUP) 1977. BRAC is a Congressional program that has decreased the number of bases operated by the U.S. military. The former Naval Air Station Agana was closed in 1995, and the Navy transferred or released ownership of it to GovGuam and other government agencies as a result of BRAC. In 1997, BRAC realigned Naval Base Guam, which included the release of surplus/excess Navy military property determined to be excessive in the Guam Land Use Plan. The previous Naval Facility, at Ritidian Point, was transferred to the U.S. Fish and Wildlife Service. Other DoD parcels also have been, or are currently in the process of being, transferred to GovGuam. In addition, the Navy outleased the Former Navy Ship Repair Facility located within the Apra Harbor Naval Base to GovGuam for utilization as a commercial shipyard facility.

DoD Land Management – Joint Region Marianas

The 2005 BRAC mandates included a directive to realign DoD installation management functions on Guam to the Commander of the U.S. Naval Forces in the Mariana Islands. Currently, all installations employ military, civilian, and contractor personnel to perform common functions in support of installation facilities and personnel. Installations execute these functions using similar processes. There is significant opportunity to reduce duplication of efforts and achieve greater efficiencies through economies of scale. Overall manpower and facilities requirements would be reduced. The resulting organization created by this realignment is Joint Region Marianas. The Navy and Air Force would maintain their distinct missions and retain operational command, but regional installation support would be managed by the Navy, including:

- Planning, programming, budgeting, and execution
- Delivery of installation support – policies, procedures, and contracts

A Navy Admiral would command Joint Region Marianas, and the Navy would control and manage all real estate assets currently held by the Navy as well as those of the Air Force. Joint Region Marianas implementation is anticipated by the end of 2009. This EIS/OEIS describes infrastructure, land ownership, and permitting as they exist prior to implementation. This change in DoD land management would occur even if the proposed action analyzed in this EIS/OEIS were not implemented.

Submerged Lands Ownership and Use

This section is a discussion of regional submerged lands use. The nearshore submerged lands discussion is presented in 8.1.3 and organized by specific geographic areas.

Submerged Lands Ownership

Territorial waters or submerged lands refer to coastal waters, together with the seabed beneath them and the airspace above them, over which a state claims sovereignty. For Guam, this area extends 3 nm (5.6 km) from the coastline into the ocean (Figure 8.1-2) (National Oceanic and Atmospheric Administration [NOAA] 2007). Although GovGuam has jurisdiction over the majority of submerged lands, the remainder of submerged lands are under federal jurisdiction, primarily for DoD use (see Figure 8.1-2). These DoD submerged lands border existing or past Navy and Air Force coastal land holdings and are managed by the Navy per Presidential Proclamation 4347 of 1975. The federal government has overarching authority over state and territorial waters to regulate navigation, power generation, national defense, and other activities from 0 to 12 nm (0 to 22.2 km) from shore, inclusive of submerged lands.

Exclusive Economic Zones of coastal countries (including territories) extend from 12 to 200 nm (22 to 370 km) beyond the ROI for the land use analysis in this EIS/OEIS. Other than the use of existing shipping lanes, the designated ODMDS, and training ranges described in the MIRC EIS/OEIS, no Marine Corps actions are proposed beyond the submerged lands boundary. The MIRC and ODMDS land ownership and use impacts are addressed under their respective EISs (Navy 2009, USEPA 2009). Shipping is addressed in Chapter 14 Marine Transportation of this Volume. The coastal nation has sovereign rights to exploring, conserving, and managing living and nonliving resources within the Exclusive Economic Zones.

Submerged Land Use (Island-wide)

Submerged land uses outside the harbor include shipping lanes, fish-aggregating devices that support recreational and commercial fishing, other recreational uses, and military training sites (see Figure 8.1-2). The USEPA designated (pending) ODMDS is located more than 9 nm (17 km) west of Apra Harbor and beyond the ROI for the land use discussion. The ODMDS EIS record of decision is anticipated in 2010. The recreational resources and natural resources affected environment of submerged lands is described in other chapters of this EIS/OEIS.

Marine Protected Areas

Guam's legislature has delegated the authority and responsibility of management and oversight for all aquatic and wildlife resources to the Guam Department of Agriculture, Division of Aquatics and Wildlife Resources (GDAWR). In May 1997, GovGuam created five marine preserves under Public Law 24-21 (see Figure 8.1-2). These five marine preserves are Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point, totaling over 10% of Guam's coastline. The sizes of the preserves vary, but all preserves extend from 33 feet (ft) (10 meters [m]) above the mean high tide mark to the 600 ft (183 m) depth contour. Federal submerged lands overlap with the Sasa Bay and Piti Bomb Holes marine preserves. The federal government does not acknowledge that the federal submerged lands can be

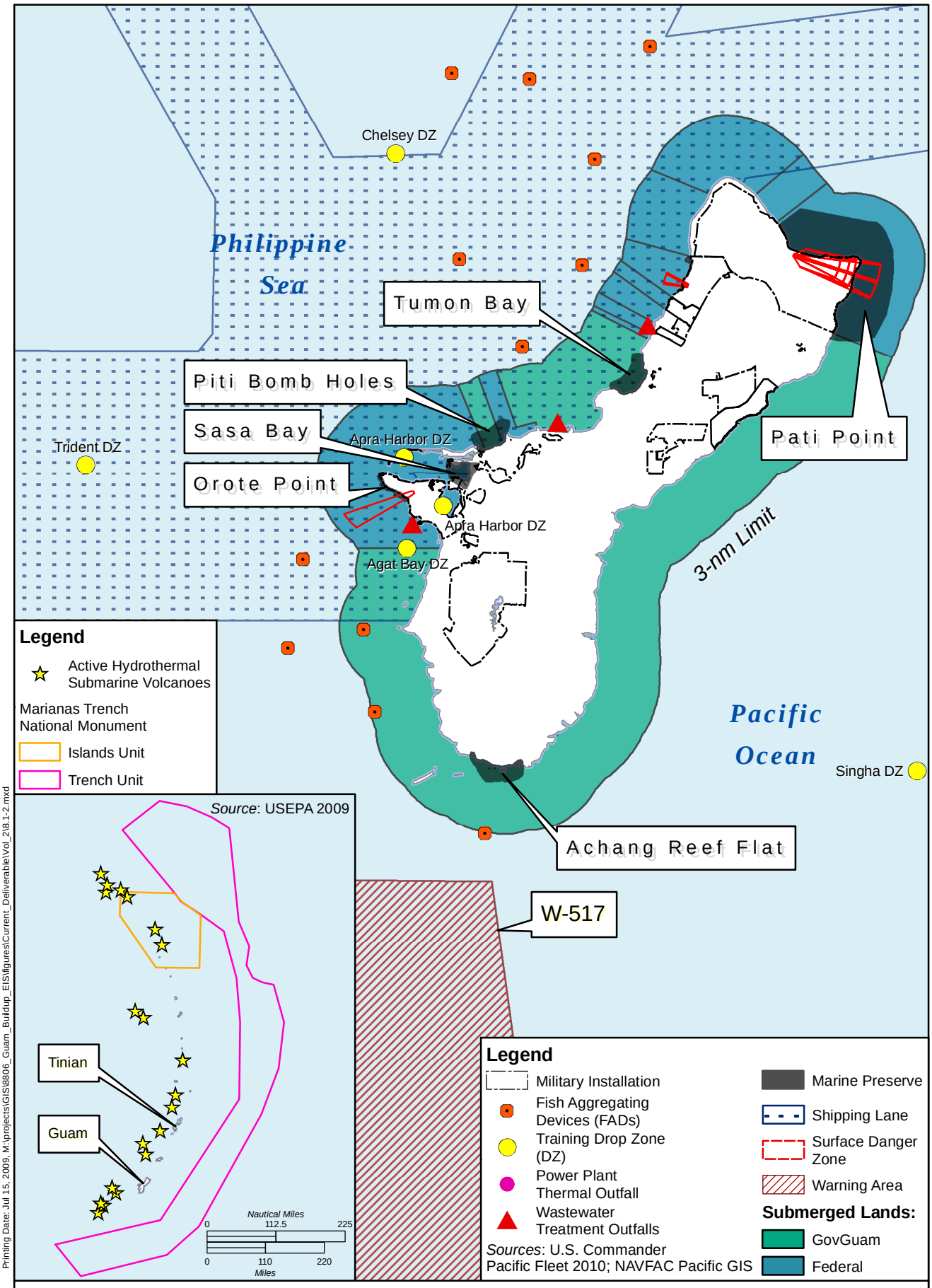

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Figure 8.1-2
Regional Land and Water Use

designated GovGuam marine preserves and is not bound to comply with land use constraints associated with the preserves.

Fish-aggregating devices are established around Guam to attract fish, and have become popular fishing spots. Locations are shown on Figure 8.1-2 and fishing is discussed in Volume 2, Chapter 9, Recreational Resources of this EIS/OEIS.

Military Training Areas

Military training areas in submerged lands around Guam support amphibious, anti-submarine, and special forces training. These training areas provide capability for water drop zones and amphibious landing sites, paratrooper insertion/extraction, explosive detonation sites for training in anti-mine warfare and underwater explosives used for obstacle removal, W-517 special use airspace, and surface danger zones associated with firing ranges on land as shown on Figure 8.1-2 (Navy 2009). A Notice to Mariners (NOTMAR) and Notice to Airmen (NOTAM) are issued when these facilities are in use and access is restricted. Additional training facilities are described in this section under specific geographic areas.

Marianas Trench Marine National Monument

The Marianas Trench Marine National Monument (the 'Monument') was established in January 2009 by Presidential Proclamation under the authority of the Antiquities Act (16 USC 431) (Navy 2009). The Monument consists of approximately 71,897 square nm (246,600 square km [km^2]) of submerged lands and waters of the Mariana Archipelago and was designated with the purpose of protecting the submerged volcanic areas of the Mariana Ridge, the coral reef ecosystems of the waters surrounding the islands of Farallon de Pajaros, Maug, and Asuncion in the Commonwealth of the Northern Mariana Islands (CNMI), and the Mariana Trench. The monument includes three units as follows (see Figure 8.1-2):

- Islands Unit - waters and submerged lands of the three northernmost Mariana Islands
- Trench Unit - Mariana Trench area
- Volcanic Unit - submerged lands of active hydrothermal submarine volcanoes

The Presidential Proclamation establishing the Monument includes the following language regarding military activities in the area:

1. The prohibitions required by the Proclamation shall not apply to activities and exercises of the Armed Forces (including those carried out by the U.S. Coast Guard [USCG]).
2. The Armed Forces shall ensure, by the adoption of appropriate measures not impairing operations or operational capabilities, that its vessels and aircraft act in a manner consistent, so far as is reasonable and practicable, with the Proclamation.
3. In the event of threatened or actual destruction of, loss of, or injury to a monument living marine resource resulting from an incident, including, but not limited to spills and groundings, caused by a component of the DoD or the USCG, the cognizant component shall promptly coordinate with the Secretary of the Interior or Secretary of Commerce, as appropriate. This requirement is for the purpose of taking appropriate response actions to mitigate any actual harm and, if possible, restore or replace the monument resource or quality.
4. Nothing in the Proclamation, or any regulation implementing it, shall limit or otherwise affect the Armed Forces' discretion to use, maintain, improve, manage, or control any property under the administrative control of a Military Department or otherwise limit the availability of such property for military mission purposes.

The Secretary of Commerce, through NOAA and the Interior, shall manage the Monument pursuant to applicable legal authorities and in consultation with the Secretary of Defense. Under the Proclamation, the Secretaries of the Interior and Commerce shall, within two years of the date of the Proclamation, prepare management plans within their respective authorities and promulgate implementing regulations that address any further actions necessary for the proper care and management of the objects identified in the Proclamation. In developing and implementing any management plans and any management rules and regulations, the Secretaries shall designate and involve as cooperating agencies the agencies with jurisdiction or special expertise, including DoD, the Department of State, and other agencies through scoping in accordance with the National Environmental Policy Act (42 USC 4321 et seq.), its implementing regulations and with Executive Order (EO) 13352 of August 26, 2004, Facilitation of Cooperative Conservation, and shall treat as a cooperating agency the Government of the CNMI, consistent with these authorities. The monument management plans shall ensure that the monument would be administered in accordance with the Proclamation.

According to the Proclamation, the management plans and their implementing regulations shall impose no restrictions on innocent passage in the territorial sea or otherwise restrict navigation, overflight, and other internationally recognized lawful uses of the sea, and shall incorporate the provisions of the Proclamation regarding Armed Forces actions and compliance with international law.

Ammunition Handling

Kilo Wharf is located near the Outer Apra Harbor entrance. It is the only DoD munitions wharf at Apra Harbor. Though it generates an explosive safety distance arc that overlaps the harbor traffic route, ship traffic is allowed to proceed through the arc under a Chief of Naval Operations (CNO) exemption. Depending on the quantity of explosives being handled at Kilo Wharf, recreational access to areas east of Kilo Wharf is restricted. Recreational access is addressed in another section. A NOTAM is issued when activities are restricted.

8.1.1.2 Land Use

GovGuam

Municipalities

Guam is divided into 19 municipalities, referred to as villages, and each one is governed by an elected Mayor. The villages are shown on Figure 8.1-1. The villages vary by size and population as shown on the figure. The northern area has the fewest number of villages, but has the greatest regional population (approximately 52%) on 34% of the land. The central area has the greatest number of villages on only 20% of the island. The south region has most of the regional land area (approximately 46%) and the smallest population at 16% (U.S. Census Bureau 2000). Most of the island remains in a relatively rural state with the urbanized areas concentrated around Tamuning and Hagatna. The southern portion of the island contains large expanses of undeveloped land, due in part to the steep terrain.

Guam Land Use Plan

Land use plans include goals, objectives, and maps to guide future development, and describe existing land uses at a point in time. Recognizing that community objectives and land use planning requirements change over time, plans are prepared to address development for a specific duration, such as 5 years or 10 years. The plans lay the foundation for zoning regulations. Federal lands are excluded from Guam land use planning unless there is anticipated release of federal lands. The Territory of Guam Master Plan that

was prepared for the Territorial Planning Commission in 1966 is the adopted land use plan for Guam (Figure 8.1-3).

Other plans have been developed such as the Guam Comprehensive Development Plan (1977) and *I Tano-ta* (Territorial Planning Council 1994). The 1977 Plan was valid for a planning period up to the year 2000, but the *I Tano-ta* was not adopted (Bureau of Statistics and Plans 2008). These plans provide valuable information on existing and planned land uses at various points in time.

Although the 1966 land use plan is the official land use plan, it has limited utility when describing existing land use and trends for future development. The Guam Mapbook (Bureau of Statistics and Plans 2008) is based on aerial photography and is a better resource for assessing current land use. The general land uses can be discerned from the photographs, such as:

- residential neighborhoods
- vacant lands – vegetated or disturbed, no modern manmade structures
- roads

The Bureau of Statistics and Plans prepared the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009). Figure 8.1-4 is the *North and Central Guam Land Use Plan* map from the final report. This plan has not been adopted by legislature, but represents the best available land use planning information and public input through a public hearing process. The land use designations are:

- Very Low Density Residential - generally less than one housing unit per acres.
- Residential – a range of residential development, including single-family homes and apartment buildings. Might include neighborhood –sized commercial development.
- Mixed Use - larger commercial centers serving large areas of the island that might include shopping malls, hotels, and office buildings.
- Dos Amantes Planning Area – the *Land Use Master Plan for the Dos Amantes Planning Area* (GALC 2005) identifies two land uses: Hotel and Resort, and Urban Center (refer to Figure 8.1-4). The zoning could include residential, commercial, industrial and tourist- resort land uses. The plan was not adopted by legislature.
- Village Center – a mix of residential, commercial, public facility, and open space at the scale and pattern that is consistent with Chamorro villages.
- Tourist/Resort – commercial facilities (hotels, golf courses, retail) to support the traveling public.
- Airport – Guam International Airport and adjacent industrial uses.
- Industrial – includes facilities to support manufacturing and processing, wholesaling, large storage, and mineral extraction.
- Agriculture – provides for agricultural uses intended to maintain the long-term viability of agricultural activities.
- Park/Open Space – encompasses existing and future parks, recreational, conservation, and natural open space and cultural resource areas.
- Federal Land – includes military use and federal parks. Land use designations listed above are not applied to federal land.

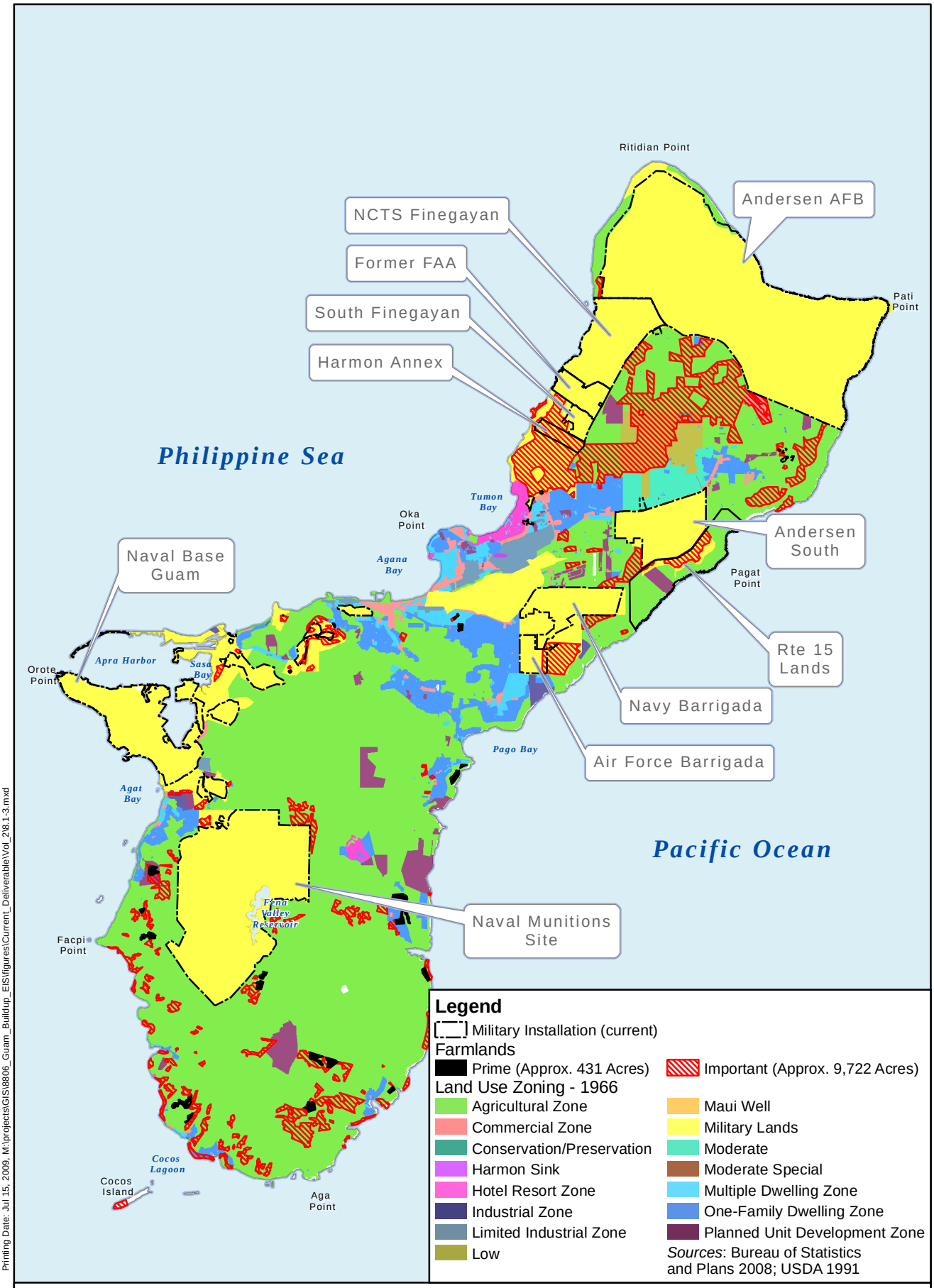

Figure 8.1-3
1966 Land Use Zoning and Prime Farmlands

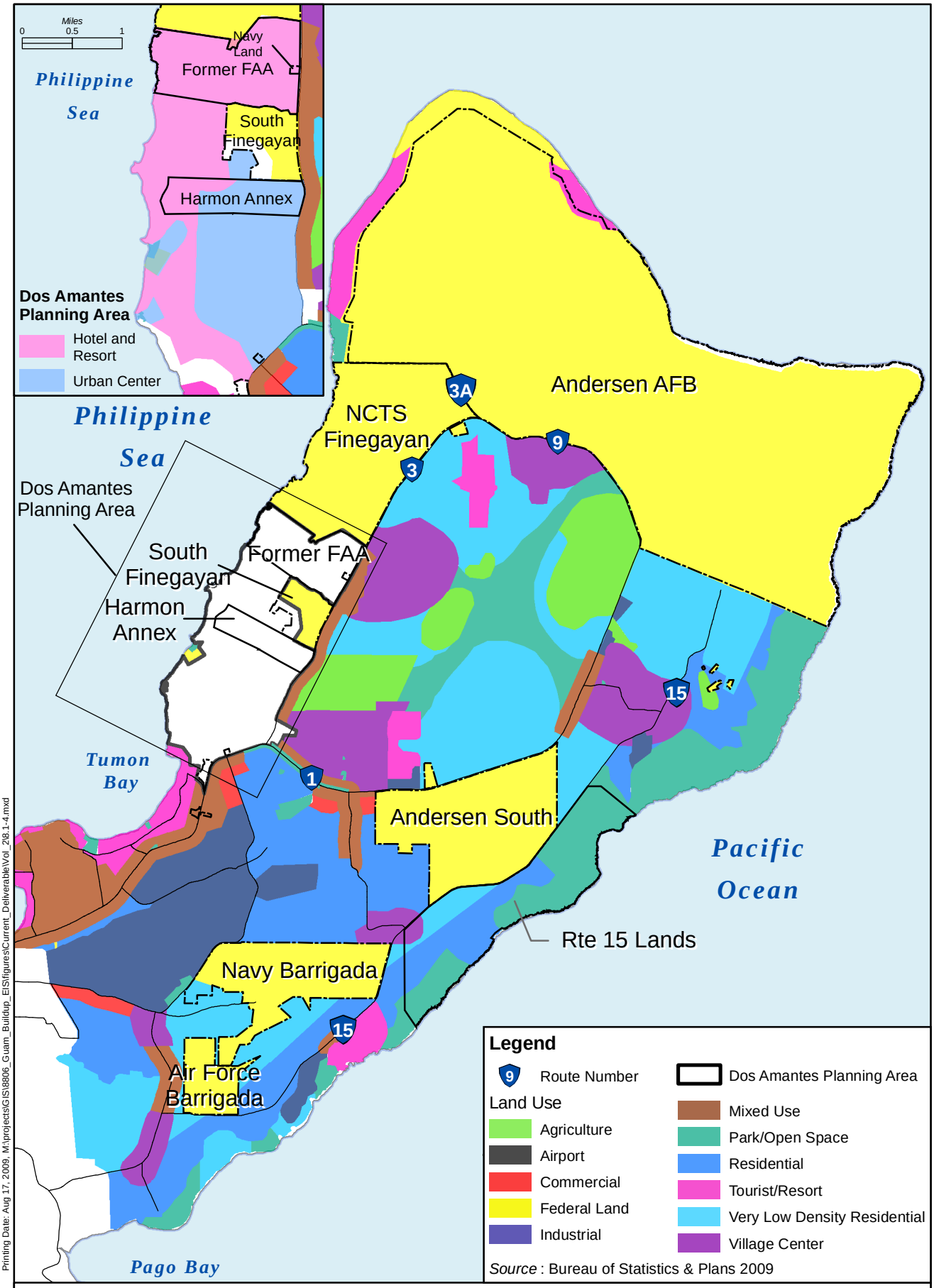

Figure 8.1-4
Land Use Map for North and Central Guam

The *North and Central Guam Land Use Plan* is intended to establish a general land use pattern to guide future land use development in the central and northern areas of Guam. It provides the basis for and is implemented by future zoning code development.

Based on the *North and Central Guam Land Use Plan* land use map (Figure 8.1-4); federal lands are predominantly bordered by residential land use. Park/Open space is designated along coastlines and within the area defined by Routes 3, 9 and 1. The Agriculture designation is limited to four non-contiguous areas between Routes 1 and 9. There are seven Village Center designated areas, three of which share part of a border with federal lands. Tourist/Resort areas are mostly along the coast with some exceptions like the area north of Andersen South and an area between Routes 3 and 9.

Guam Zoning

Zoning designations regulate the use, type, intensity and coverage for individual parcels or development project areas. Zoning regulations and permitting are not applicable to federal lands development. The zoning code is designed to be consistent with the overarching land use plans that are developed. The current zoning code for Guam contains regulations on land uses, heights, yards and building area, parking, signage, and administration of the code. The Zoning Code has been modified over the years since 1952. The zoning code establishes the following zoning districts (21 Guam Code Annotated [GCA] § 61201):

- "A" Rural Zone – This zone allows agricultural uses, single-family dwellings, duplexes, and uses considered accessory to these.
- "R1" One-Family Dwelling Zone – Primarily for single-family dwellings, this zone allows schools, churches, parks, and health services as conditional uses.
- "R2" Multiple Dwelling Zone – This zone allows duplexes and multi-family residential uses, as well as single-family dwellings and hotels.
- "C" Commercial Zone – In addition to typical commercial uses, this zone also allows single- and multiple-family dwelling units.
- "P" Automobile Parking Zone – This zone is intended for commercial and public parking and garages, as well as service vehicle storage.
- "M1" Limited Industrial Zone – This zone allows light manufacturing (drugs, cosmetics, food products), as well as auto repair facilities, warehouses and other similar uses. Packaging of fish or meat products, including fat rendering, is not allowed.
- "M2" Industrial Zone – The Heavy Industrial Zone allows all uses not specifically prohibited by law.
- "LC" Limited Commercial Zone – While the LC zone is listed in § 61201 as an established zone, the code does not contain regulations enumerating specifically allowed uses in this zone.
- "H" Hotel-Resort Zone – The Hotel-Resort Zone is geared toward tourism-related activities, and all associated uses are conditional in nature.
- "S-1" School Zone – Established for public schools and related facilities.
- "PF" Public Facility Zone – The Public Facility zone is intended for schools, police and fire stations, community centers, and other public or government facilities.

The Bureau of Statistics and Plans provided electronic versions of the 1966 zoning maps that are being reviewed by the DLM. These zones and their designations are represented in Figure 8.1-3, as provided by the Bureau of Statistics and Plans. There have been many changes to land use on Guam since 1966 that are not reflected in Figure 8.1-4.

Farmlands

Agricultural lands have been reduced by encroachment of residential development. Continued urbanization escalates land values, making it more difficult and expensive to sustain viable agricultural operations. Other factors affecting declining agriculture include shortages of water, inadequate labor supply, high cost, and local unavailability of agricultural inputs (Territorial Planning Council 1994). As the threat increases to prime agricultural land, the need for agricultural production also increases. Prime farmland, as defined by the U.S. Department of Agriculture (USDA), is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is available for these uses. It could be cultivated land, pastureland, forestland, or other land, but it is not urban, developed, or water areas. According to the Guam Land Conservation Act (5 GCA Government Operations, Chapter 65) prime agricultural land means any of the following:

1. Land which supports livestock used for the production of food and fiber and which has an actual carrying capacity equivalent to at least one animal unit per acre as defined by the USDA.
2. Land planted with fruit or nut-bearing trees, vines, bushes or crops which have a non-bearing period of less than five years and which would normally return during the commercial bearing period on an annual basis from the production of unprocessed agricultural plant production not less than two hundred dollars ($200) per acre (ac).
3. Land which has returned from the production of unprocessed agricultural plant products an annual gross value of not less than two hundred dollars ($200) per ac for three of the previous five years.

In addition to prime farmlands, land that does not meet the criteria for prime or unique farmland is considered to be "farmland of statewide importance" for the production of food, feed, fiber, forage, and oilseed crops. The criteria for defining and delineating these "important farmlands" are determined by the appropriate State agencies. Generally, this land includes areas of soils that almost meet the requirements for prime farmland, and that produce high yields of crops when treated and managed according to acceptable farming methods. One of the goals of the 1966 and subsequent (unadopted) land use plan is the protection of prime agricultural areas, as identified by the USDA, Natural Resources Conservation Service (formerly U.S. Soil Conservation Service). Federal lands do not have USDA farmland designations. Lands that are designated prime and important are generally not in production on Guam and local planning efforts may not seek to preserve all prime and important farmlands for agriculture.

There are farming activities on GovGuam, federal, and private lands that do not necessarily correspond to land use planning maps and USDA prime and important farmland designations.

There are farming activities on GovGuam, federal and private lands that do not necessarily correspond to land use planning maps and USDA prime and important farmland designations.

Figure 8.1-3 shows prime and important farmlands (USDA 1991). Military lands on Guam are not assigned a farmlands designation. The *North and Central Guam Land Use Plan* (Bureau of Labor and Statistics 2009) states a goal as follows: "Preserve agricultural lands and encourage expansion of market opportunities for local crops and products." One of the policies to support this goal is: "Policy LU-12-Consider measures to preserve agricultural lands through land use categories, zoning, restrictions on non-agricultural uses in farming areas, agricultural easements, right-to-farm ordinances and other measures."

There are farming activities on GovGuam, federal and private lands that do not necessarily correspond to land use planning maps and USDA prime and important farmland designations.

Non-DoD Parcels Relevant to Proposed Action

The non-DoD lands of potential interest to DoD are in the vicinity of South Finegayan on the west coast of Guam, south of NMS in southern Guam, and Andersen South near the east coast. Table 8.1-1 summarizes the characteristics of the non-DoD parcels of interest.

Table 8.1-1. Non-DoD Parcels of Interest

Parcel Name	*Owner*	*Current Use*	*Approximate Area (acre)*
West Coast			
Former Federal Aviation Administration (FAA) housing parcel, includes 5 acre Navy parcel	Private owners and GovGuam	Vacant (i.e., no modern manmade structures)	680[1]
Harmon	Multiple ancestral claimants, private owners and GovGuam	Vacant – but for a few abandoned buildings	326[1]
Piti/Cabras (Volume 6)	GovGuam	Vacant but for a few abandoned buildings	105 required, site has not been delineated
East Coast			
Route 15 lands, located east of Andersen South	Private owners and GovGuam. Possible ancestral lands claims	Vacant, isolated residences, International Raceway Park	1,100-1,800[2]
South			
Access road to NMS	Private land owners/GovGuam	Vacant, dirt path	2 alternatives (1.9)[1]

Sources: [1] TEC 2009, [2] NAVFAC Pacific 2009.

Former Federal Aviation Administration (FAA) land lies between NCTS and South Finegayan. The land was released by the federal government to GovGuam. Approximately, 5 ac (2 hectares [ha]) of land bordering Route 3 within the Former FAA area were retained by the Navy. The acreage calculations in the EIS/OEIS include the small parcel of Navy land within the Former FAA property.

DoD Parcels Relevant to Proposed Action

Non-contiguous DoD land holdings are dispersed throughout Guam. DoD land use (presented in Table 8.1-2) is organized into four regions of Guam: North, Central, Apra Harbor, and South, and DoD properties are shown on Figure 8.1-5. Table 8.1-2 also indicates whether the site would be improved under the proposed action.

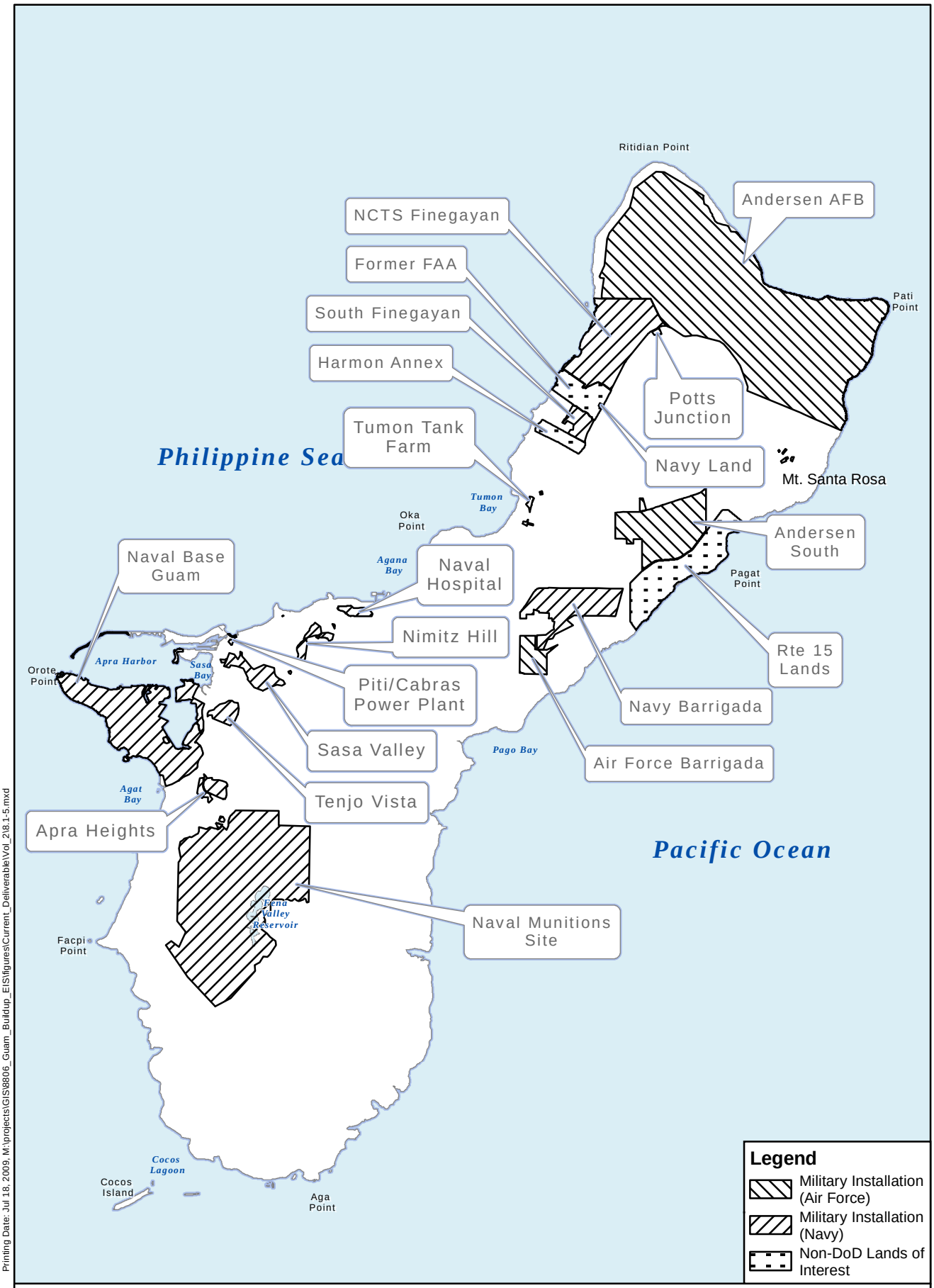

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Figure 8.1-5
DoD Land and Non-DoD Lands of Interest

Table 8.1-2. Summary of DoD Parcels

Parcel Name	*Military Service*	*Primary Land Uses*	*Approximate Area ac (ha)*	*Proposed Action?*
North				
NCTS Finegayan	Navy	NCTS headquarters and receivers, housing, community support, training	2,415 (977)	yes
South Finegayan	Navy	Family housing	290 (117)	yes
Mount Santa Rosa	Air Force	Radar antennas	18 (7)	no
Andersen AFB	Air Force	Airfield operations and training (Main Base and Northwest Field), headquarters, training, administrative, housing, community support, munitions storage	15,401(6,233)	yes
Potts Junction	Air Force	Vacant- no modern manmade structures	20 (8)	yes
Central				
Navy Barrigada	Navy	NCTS transmitters, Navy golf course, Guam Army National Guard	1,417 (573)	yes
Air Force Barrigada	Air Force	Next Generations Radar - weather radar	432 (175)	yes
Andersen South	Air Force	Urban warfare training	2,061(834)	yes
Naval Hospital	Navy	Hospital, bachelor and family housing and DoD high school	120 (49)	no
Nimitz Hill	Navy	Family housing	199 (81)	no
Tenjo Vista & Sasa Valley	Navy	Fuel storage, including 27 underground tanks	421 (170)	no
Apra Harbor				
Navy Base Guam	Navy	Industrial waterfront, Glass Breakwater, Polaris Point, fueling wharves, USCG, headquarters, administrative, bachelor and family housing, community support, supply, training, maintenance and warehousing	3,429[1](1,388)	yes
South				
Apra Heights/New Apra Heights	Navy	Family housing	242 (98)	no
Naval Munitions Site	Navy	Munitions storage, training	8,645 (3,499)	yes

Sources: [1]NAVFAC Pacific 2008b, TEC 2009.

Areas that are potential locations, or adjacent to potential locations, for proposed action improvements are discussed in further detail below.

The affected environment land use discussion focuses on areas on Guam that are relevant to the proposed action. The discussion is organized by geographic area.

8.1.2 North

The sources of land use information for northern Guam are as follows:

- Guam Mapbook (Bureau of Statistics and Plans 2008) - existing land use
- North and Central Guam Land Use Plan (Bureau of Statistics and Plans 2009) – trends in future lands use
- Land Use Master Plan for the Dos Amantes Planning Area (GALC 2005) – land use plan for specific project area located within the *North and Central Guam Land Use Plan* planning area
- Base maps provided by NAVFAC Pacific – existing military land use

- MIRC EIS/OEIS (Navy 2009) – military training facilities and use
- USDA Prime and Important Farmlands (USDA 1991) – farmlands
- Other references are cited as appropriate

8.1.2.1 Andersen AFB

Andersen AFB is one of the largest Air Force airfields comprising approximately 15,423 ac (6,242 ha) of federal government land on Guam. There is one primary access point to Andersen AFB, located at the intersection of Routes 1 and 9 near the eastern portion of the installation (Figure 8.1-6). A secondary gate, referred to as the Santa Rosa Gate, is on Route 15. Navy submerged lands are located along the entire northern Guam coastline adjacent to Andersen AFB. The Air Force does not operate a harbor or a marina; however, there are military recreational beaches designated along the northern coast at the western end of the Pati Point Marine Protected Area (Figure 8.1-6).

The *Andersen Air Force General Plan* provides the framework for siting programming and constructing the 36th Wing mission (Air Force 2005). One of the goals in the plan is to "…ensure that facilities and land uses are adaptable and can expand to accommodate new missions, weapons systems and training." The Air Force plans new facilities that are consistent with existing base land use plans, goals and objectives.

There are three main areas of Andersen AFB (see Figure 8.1-6) that are aligned east to west, these are the Main Base to the east, the Munitions Storage Areas (MSA) in the center, and NWF to the west.

Main Base

The predominant land use at Andersen Main Base (approximately 1,750 ac [708 ha]) is the airfield, which is bordered by industrial, maintenance, and aircraft operations facilities and infrastructure. Main Base also contains administrative facilities, headquarters, maintenance, housing, open space, and community support facilities. The development pattern of Main Base is low-density characterized by individual buildings with substantial setbacks. Most structures are two stories in height or less. Bachelor Housing is four stories. A land use plan developed by Andersen AFB for Main Base is shown in Figure 8.1-7.

There are two parallel runways aligned in the northeast-southwest direction: 1) Runway 06L/24R is 11,185-ft long (3,411-m) and 200-ft (61-m) wide, and 2) Runway 06R/24L is 10,558-ft (3,220-m) long and 200-ft (61-m) wide. North Ramp facilities are north of the runways and South Ramp south of the runways. A Navy helicopter squadron uses facilities on the North Ramp. Fixed-wing aircraft support is on the South Ramp. Sensitive-receptor land uses (e.g., hospitals, ballfields, schools, housing) are developed away from the airfield to the extent practical to minimize noise impact. Facilities exposed to elevated noise levels that are determined to represent a potential health risk are constructed or retrofitted with noise attenuating features.

Tarague CATM Range, also known as the Pati Point Range, generates an SDZ to the northeast that lies partially within Navy submerged land. The range consists of 21 ac (8.5 ha) and is used for the small arms range. The range supports training with pistols, rifles, machine guns up to 7.62 mm, and inert mortars up to 60 mm. Training is also conducted with the M203 40mm grenade launcher using inert training projectiles only. An Explosives Ordnance Disposal (EOD) site is located northeast of the small arms range.

MSA

Explosives handling and storage is the primary function of the MSA. Facilities in the MSA generate ESQD arcs in the center of Andersen AFB as shown on Figure 8.1-6.

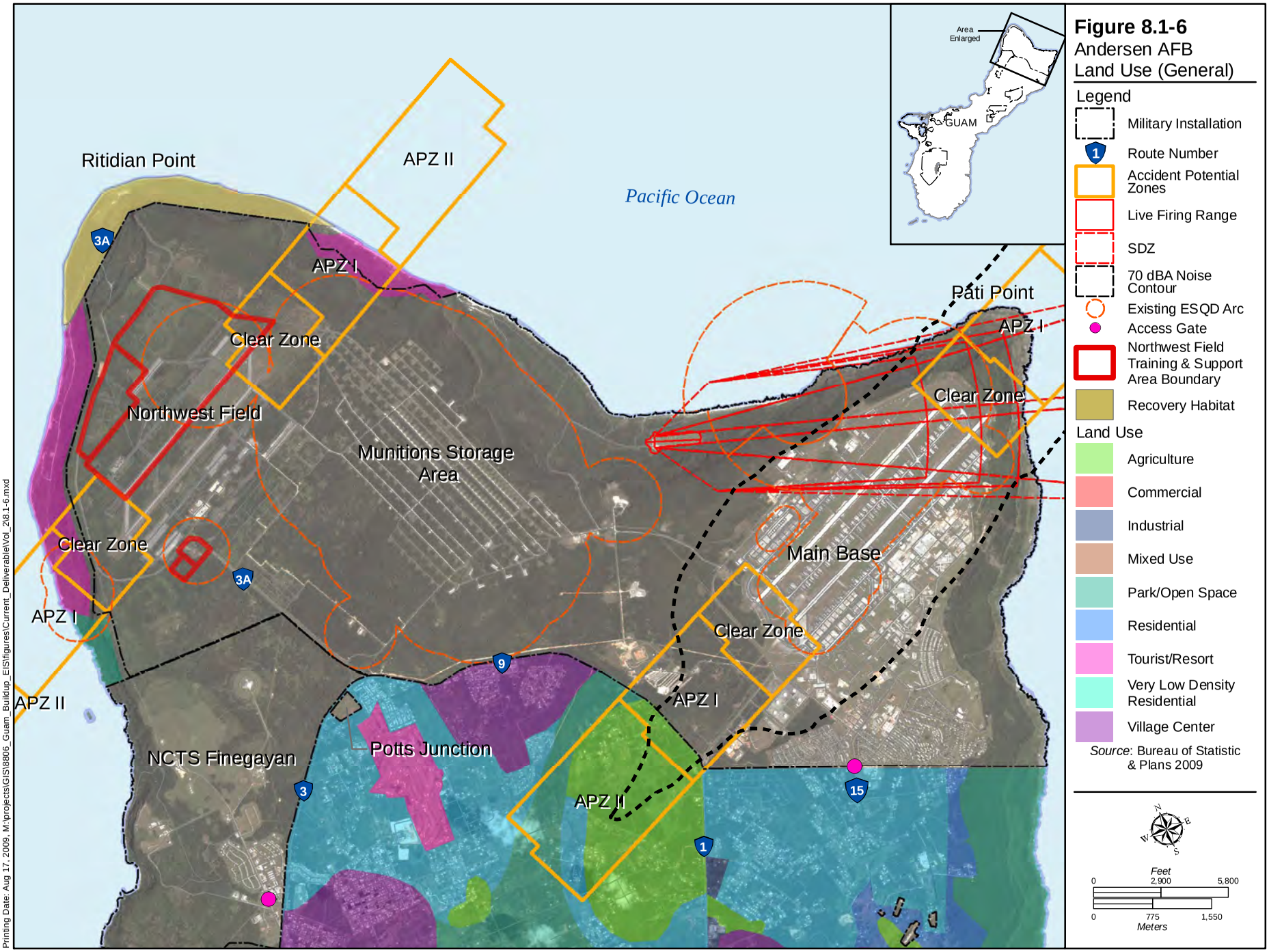


Figure 8.1-6
Andersen AFB
Land Use (General)

Legend

- Military Installation
- Route Number
- Accident Potential Zones
- Live Firing Range
- SDZ
- 70 dBA Noise Contour
- Existing ESQD Arc
- Access Gate
- Northwest Field Training & Support Area Boundary
- Recovery Habitat

Land Use

- Agriculture
- Commercial
- Industrial
- Mixed Use
- Park/Open Space
- Residential
- Tourist/Resort
- Very Low Density Residential
- Village Center

Source: Bureau of Statistic & Plans 2009

Feet
0 2,900 5,800
0 775 1,550
Meters

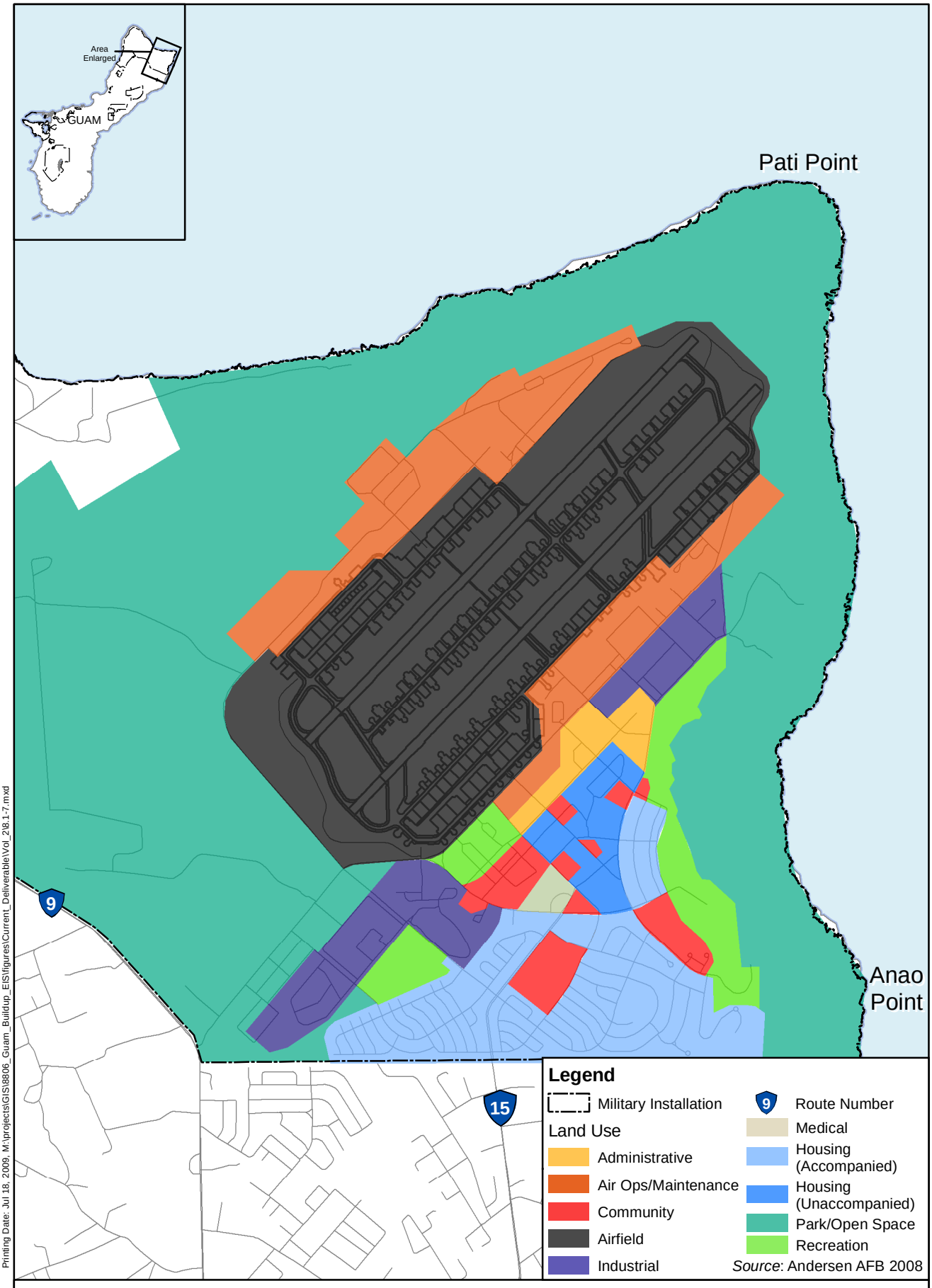


Figure 8.1-7
Andersen AFB Main Base Land Use Plan

The ESQD arcs restrict the construction of inhabited buildings and other non-munitions related activities.

Northwest Field (NWF)

NWF is approximately 4,400 ac (1,776 ha) and is located to the west of the MSA (Figure 8.1-8).

The base developed a NWF land use plan as shown in Figure 8.1-8. NWF is a World War II-era airfield. There are two paved expeditionary 10,000-ft (3,048-m) runways, with adjacent taxiways, and parking areas that have not been renovated since they were constructed in 1945. NWF serves as the primary maneuver training area available at Andersen AFB for field exercises and helicopter operations. The airfield is used for vertical and short field aviation landings. Approximately 280 ac (113 ha) of land are cleared near the eastern end of both runways for parachute drop training. The south runway is used for training of short field and vertical lift aircraft and often supports various types of ground maneuver training. Helicopter units use other paved surfaces for Confined Area Landing, simulated amphibious ship helicopter deck landings, and insertions and extractions of small maneuver teams.

About 3,562 ac (1,442 ha) of NWF are the primary maneuver training areas available at Andersen AFB for field exercises and bivouacs. Routine training exercises include camp/tent setup, survival skills, land navigation, day/night tactical maneuvers and patrols, blank munitions and pyrotechnics firing, treatment and evaluation of casualties, fire safety, weapons security training, perimeter defense/security, field equipment training, and chemical attack/response.

There are non-DoD lands along the north and west coast of Andersen AFB. These public and private lands are bordered by Andersen AFB and the Philippine Sea (including Navy submerged lands) and are isolated from other non-federal lands. Access to the private area, including public access to Department of Interior lands, is through Andersen AFB land under an agreement between the landowners and the Air Force. The private lands are developed at very low-density levels, with few permanent buildings. The uses associate with these parcels include gardening, swimming, fishing, social and recreation gatherings and similar outdoor activities. Prior to the events of 9/11, the area supported an eco-tourism type day-use facility known as Star Sand Resort and are designated in the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) for Tourism/Resort; however, this designation is incompatible with the post 9/11 limited access available across military property. NCTS Finegayan, Route 9 and the residential areas of Yigo and Dededo are located south of Andersen AFB. The *North and Central Land Use Plan* (Bureau of Statistics and Plans 2009) designates this area south of Andersen AFB primarily as Very Low Density Residential, but there is a Village Center, a Commercial area, Residential and Park/Open Space identified (Figure 8.1-4) along the Andersen AFB boundary. The Park/Open Space is along the eastern coastline.

No prime farmlands were identified adjacent to Andersen AFB. Important farmlands were identified at discrete areas along the southern boundary of Andersen AFB (refer to Figure 8.1-3).

Andersen AFB Land Use Constraints on Community

Aircraft operations at the Main Base airfield generate an Accident Potential Zone (APZ) at either end of the runway that extends northeast into the ocean and southwest into civilian land areas. Approximately 718 ac (290 ha) of land to the southwest of Andersen AFB and south of Route 9, in the Village of Yigo, are within an APZ. The civilian affected area is primarily open space, natural conservation area, and low-to-moderate density residential development. Of the 718 ac (290 ha) of APZ outside Andersen AFB, 140 ac (57 ha) contain single family homes at a density of 2-4 ac (0.8-1.6 ha) per unit. The area lies on the approach to Runway 06 and is considered an incompatible land use within the APZ (PACAF 2006).

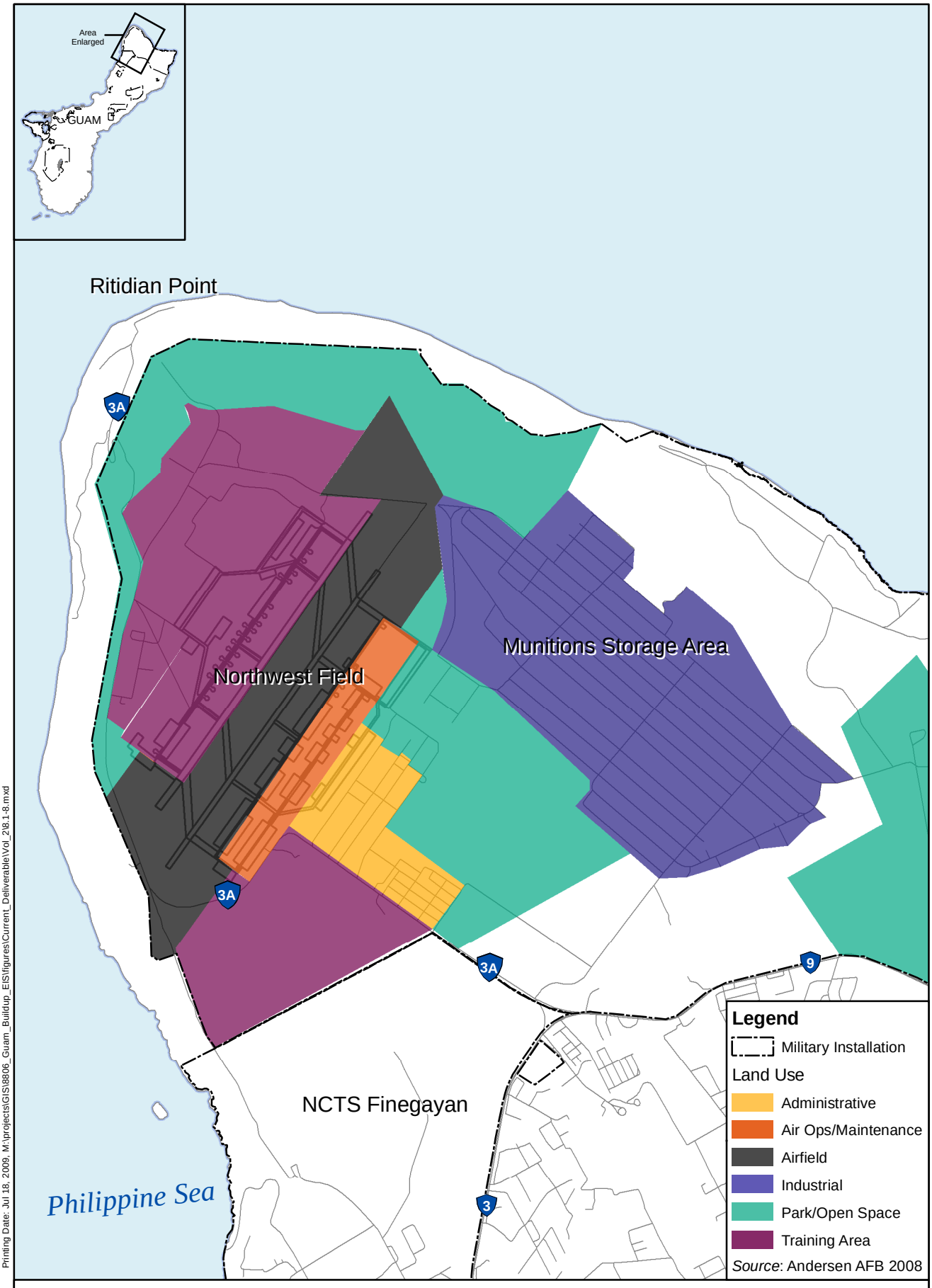


Figure 8.1-8
Northwest Field Land Use Plan

Baseline noise level contours generated by the Andersen AFB airfield include airfield activities associated with the planned Air Force Intelligence Surveillance, Reconnaissance (ISR) and Strike Capability study. The DoD uses A-weighted (dBA) Day-Night Sound Level (DNL) noise levels for compatible land use planning around military air installations. Noise exposure levels are expressed as noise contours presented in five dBA DNL increments beginning at 60 or 65 DNL, depending on the installation, up to 85 dBA DNL. All noise contours are presented in Volume 2, Chapter 6, Noise.

In accordance with Navy Instructions (Office of the Chief of Naval Operations Instruction [OPNAVINST] 11010.36A), land use compatibility is assessed through estimating and overlaying different noise level contours on land use maps and categorizing land uses as compatible, compatible with restrictions, or incompatible with noise zones. Noise levels greater than or equal to 80 dBA are used to identify populations at most risk of hearing loss, unless noise attenuation features are provided (Secretary of Defense 2009). More detail on noise assessment methodology and the various guidance documents are provided in the Volume 2, Chapter 6, Noise.

The 80 dBA contour does not contain civilian land. The noise levels decrease with distance from the airfield as described in Volume 2, Chapter 6, Noise. The 70 dBA contour does extend into civilian land, and the land use is characterized by low density residential development and open space. Based on aerial photographs, it appears there are approximately 60 residential-like structures within the 70 dBA. No schools or hospitals were identified within the 70 dBA contour (Bureau of Statistics and Plans 2008). The planned designated land uses within the contour and the vicinity are Village Center, Park/Open Space, Agriculture and Very Low Density Residential (Bureau of Statistics and Plans 2009). The impact of the baseline 70 dBA noise contour on land use was addressed in the ISR Strike EIS (PACAF 2006). No mitigation was proposed.

Aviation training occurs at Northwest Field (NWF) generally involving multiple aircraft per training event. No schools or hospitals are adversely impacted by the noise but there are beach houses along the shore north of NWF that are periodically exposed to approximately 75 dBa (Volume 2, Chapter 6 Noise). Ground-based training at NWF includes detonations, but the noise generated would not extend beyond the Andersen AFB border. More information on training noise can be found in Volume 2, Chapter 6.

8.1.2.2 Finegayan

NCTS Finegayan, South Finegayan, and Potts Junction are non-contiguous DoD parcels (Figure 8.1-9). The Finegayan parcels are separated by the Former FAA parcel, and located on the northeast coast of Guam. The Philippine Sea and Navy submerged lands are to the west. The two parcels are approximately 2,700 ac (1,093 ha) in total area. Both are directly accessed from Route 3. NCTS Finegayan is used for military communications facilities, housing, and community support.

<u>NCTS Finegayan</u>

Approximately 355 ac (144 ha) are reserved at NCTS Finegayan for communication operations, as shown on Figure 8.1-9). These areas are essential for the NCTS mission, which is to provide continuous global and universal communications services to fleet units, shore activities, other federal agencies and joint forces. These reserved areas provide facilities for headquarters and command center communications activities.

In addition to being a communications site, the installation provides limited housing and community support functions. Historically, the installation supported a large population of military personnel and their families. Existing facilities include retail centers, a swimming pool, child care center, playing fields, a chapel, bachelor quarters, family housing, a fire station, and administration. The use of these facilities

has declined, and functions are being relocated to other DoD areas because the military population in the area does not support the continued maintenance and staffing of the facilities. Many of the facilities are underutilized and scheduled for demolition or mothballing if a suitable reuse is not identified. The 252 ac (102-ha) Haputo Ecological Reserve Area (ERA) is within NCTS Finegayan on the west coast.

Training activities at NCTS Finegayan include a rifle and pistol small arms range, urban warfare training in abandoned buildings, and a parachute drop zone. The small arms ranges generate a Surface Danger Zone (SDZ) extending into the submerged lands area (Figure 8.1-9). Haputo Beach is used for small craft landings and over-the-beach insertions.

Finegayan is bounded to the north by Andersen AFB land that is vacant (i.e., no modern manmade structures) and private, vacant land on the coastline. Route 3 and residential uses are located to the east.

Vacant (i.e., no modern manmade structures) former FAA lands are adjacent and south of NCTS Finegayan. The lands south are within the Dos Amantes Planning Area, for which the master plan was not adopted, but the area was designated in the plan as Tourist/Resort and Urban Center (GALC 2005) (see Figure 8.1-4). No prime or important farmlands were identified adjacent to the site (see Figure 8.1-3). An area of important farmlands was identified east of NCTS Finegayan and Route 3; however the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) does not designate Agriculture adjacent to Route 3. East of Route 3, the land is designated very low density residential and Village Center (see Figure 8.1-4).

South Finegayan

South Finegayan was, and is used only for Navy family housing. South Finegayan is bounded on the north by the former FAA land (see Figure 8.1-9).

Route 3 and residential communities are located to the east. GLUP 77 is located adjacent and to the west. Areas to the west and south appear vacant (i.e., no modern manmade structures) and naturally vegetated. In the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) areas west and south are within the Dos Amantes Planning Area (see Figure 8.1-4). Lands east of Route 3 are designated Mixed Use in the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009). No prime farmlands are identified adjacent to the federal parcels. Important farmlands are designated south and west of South Finegayan. These important agricultural lands are not consistent with the Dos Amantes Master Plan, which designates the area for Hotel/Resort and Urban Center land uses.

Potts Junction

Potts Junction is an Air Force property located inland, east of Route 3 and NCTS Finegayan.

Access to the site is from Route 3. Historically, it was used for fuel storage, and the facilities have been removed from the site. The Air Force has not identified a future use for the site. The existing uses in the vicinity are residential. A vacant (i.e., no modern manmade structures) vegetated area is adjacent and southeast of the parcel. The adjacent and surrounding areas east of Route 3 are designated for residential land use.

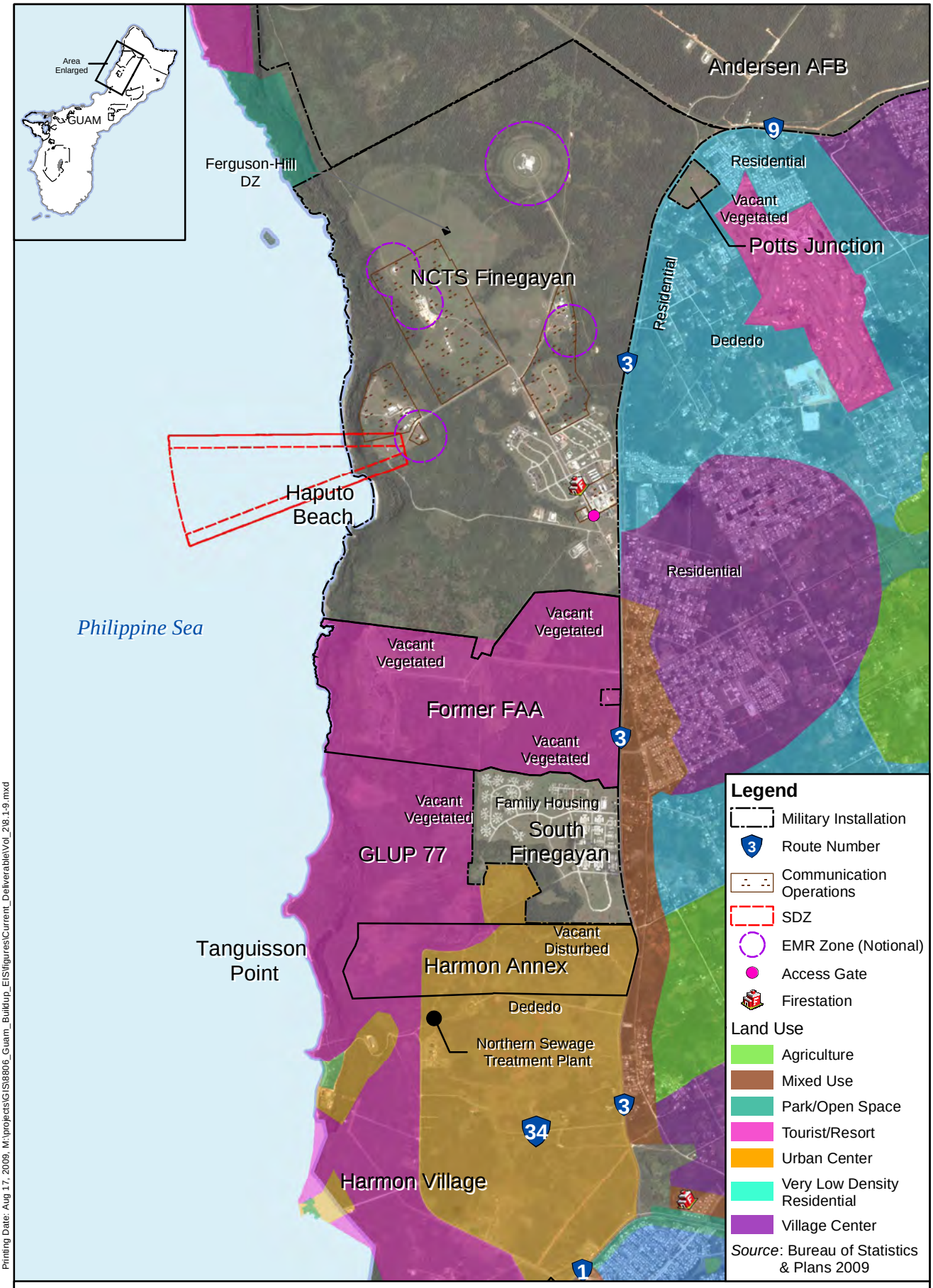


Figure 8.1-9
Finegayan & Potts Junction Land Use

8.1.2.3 Non-DoD

Former FAA Parcel

The Former FAA parcel is on the northeast coast of Guam and is controlled by GALC (approximately 520 ac [210 ha]) and seven members of one family (160 ac [64 ha]) (JGPO 2008). Prior to release, it was used by FAA for housing; ground disturbance is evident as shown in the Guam Mapbook (Bureau of Statistics and Plans 2008). The parcel is located south of NCTS Finegayan and extends east to west between the Philippine Sea coastline and Route 3. Navy submerged lands are along the entire coastline. On the southern boundary is the GLUP 77 parcel (non-DoD) and Finegayan South (DoD). The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) shows the Former FAA parcel within the Dos Amantes Planning Area. Mixed Use is designated for future use along eastern edge of Route 3. There are no prime or important farmlands identified on the 1991 USDA map where the site is still described as federal land. South of the site and west of the South Finegayan parcel is an area designated as important farmlands; however, the Dos Amantes land uses are Hotel/Resort and Urban Center (see Figure 8.1-3).

There is a 4.5 ac (2 ha) Navy parcel on Route 3 that was retained by DoD. It is adjacent to the Former FAA area. It was the former site of the National Weather Service Station and is no longer used. There are remnant structures and utilities in the area. The land use designation east of Route 3 is Mixed Use.

GLUP 77

The GLUP 77 parcel was identified as surplus federal land under the Guam Excess Land Act of 1994 and is currently being processed for transfer from the federal government to GovGuam. All of the released parcels were addressed in the Guam Land Use Plan of 1977, but the particular GLUP 77 parcel referred to in this EIS/OEIS is former Navy land in the vicinity of NCTS Finegayan. Over the years, it has been commonly referred to as the GLUP 77 parcel. The parcel has South Finegayan (federal land) to the east and the Philippine Sea to the west. Navy submerged lands are along the entire coastline of the parcel. Areas to the north and south are non-DoD. The area is mostly forested (NAVFAC Pacific 2007) but some areas of disturbance are evident in the Guam Mapbook (Bureau of Statistics and Plans 2008). The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designation is the Dos Amantes Planning Area (refer to Figure 8.1-4). GLUP 77 is located adjacent to DoD land boundaries and adjacent to non-DoD lands of interest. There are no prime farmlands identified at or adjacent GLUP 77, but there is an area of important farmlands on GLUP 77 and adjacent areas south (refer to Figure 8.1-3). As described above the Dos Amantes Plan area land uses are Hotel/Resort and Urban Center, not Agriculture.

Harmon

Harmon is non-DoD property that was released from federal land inventory as surplus federal lands under the Guam Excess Land Act 1994. It is located south of Navy GLUP 77 and Finegayan South, and was former Air Force land. The area of land being considered for acquisition or long-term leasing under the proposed action is less than the released Harmon lands; however, this EIS/OEIS refers to this parcel as the Harmon property. Route 3 and residential development are located to the east, and non-DoD land to the south and the west. The property of interest is located inland from the coastline. The land to the west and south of Harmon appears vacant (i.e., no modern manmade structures) and vegetated with some roadways as shown in the Guam Mapbook (2008). There are no prime farmlands identified at or adjacent to the Harmon area (see Figure 8.1-3), but the entire property is designated important farmlands.

The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) indicates the Harmon property is within the Dos Amantes Planning Area, with Hotel/Resort and Urban Center land use designations on the property (see Figure 8.1-4). The projected land use designations do not provide for agricultural uses. Mixed Use is designated along the eastern edge of Route 3 and further east there is an area designated for agricultural land use on important farmlands (see Figure 8.1-3).

8.1.2.1 Off Base Roadways

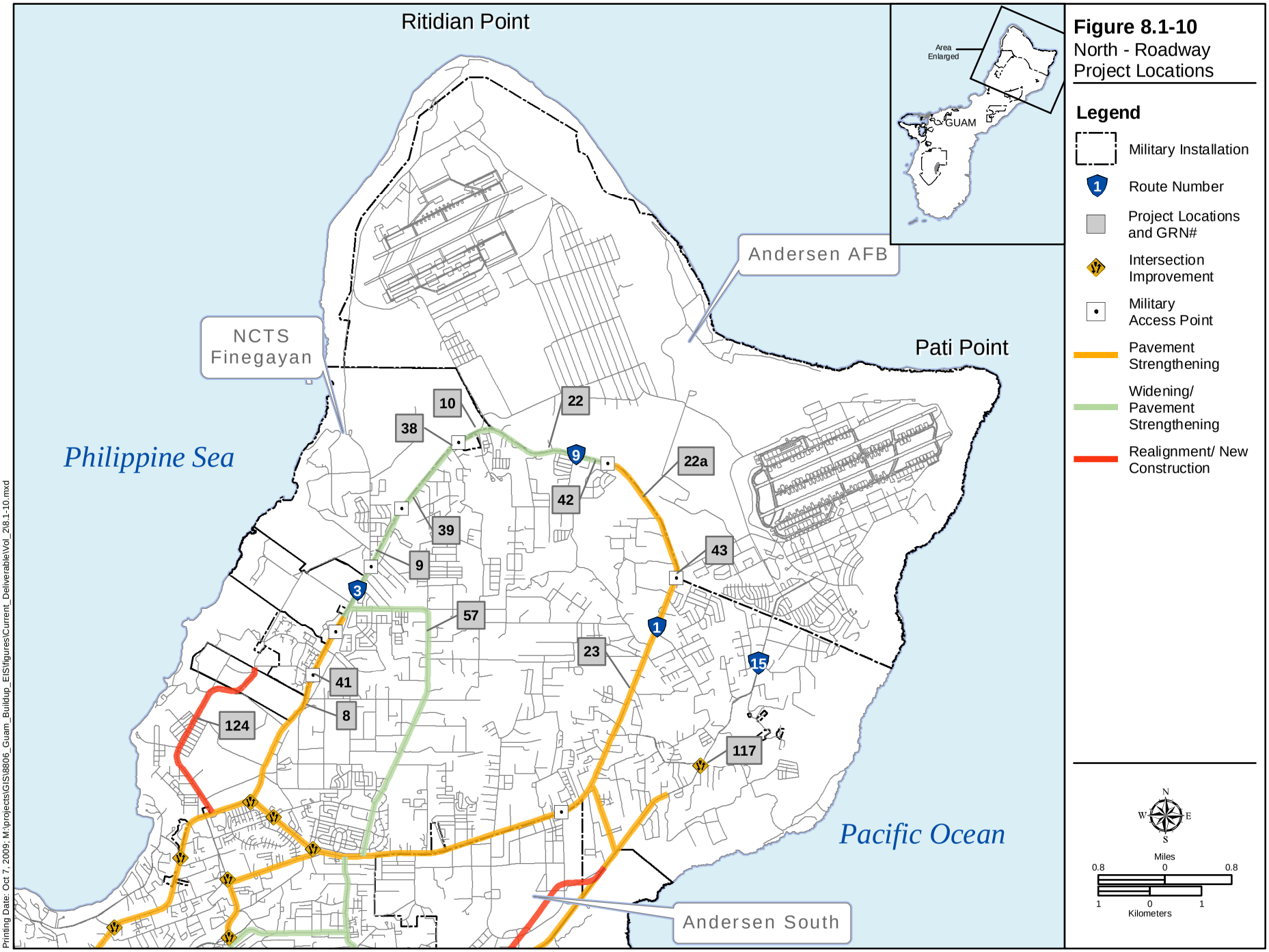
The proposed action includes on base roadway construction projects that would be implemented by DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA). Volume 6 of this EIS/OEIS describes the impacts of the roadway projects.

The proposed roadway improvement projects outside of the military lands and within the north region are located along existing Routes 1, 3, 9, 28, and 15, including a new road construction between Route 1 and Finegayan South, as summarized in Table 8.1-3. The locations of various proposed projects in the north region are shown in Figure 8.1-10.

Table 8.1-3. Proposed Guam Roadway Network (GRN) Projects in North Region

Route	*GRN#*	*Segment Limits*	*Pavement Strengthening*	*Intersection Improvements*	*Road Widening*	*New Road Construction*	*Military Access Point*
1	23	Chalan Lujuna to Route 9 (Andersen AFB)	X				
3	8	Route 28 to Route 1	X				
3	9	NCTS Finegayan to Route 28	X		X		
3	10	NCTS Finegayan to Route 9	X	X	X		
3	38	NCTS Finegayan (Commercial Gate)					MAP 2
3	38A	NCTS Finegayan (Commercial Gate)					MAP 2
3	39	NCTS Finegayan (Main Gate)					MAP 3
3	39A	NCTS Finegayan (Main Gate)					MAP 3
3	41	South Finegayan (Residential Gate)					MAP 5
3	41A	South Finegayan (Residential Gate)					MAP 5
9	22	Route 3 to Andersen AFB (North Gate)	X		X		
9	22a	Andersen AFB North Gate to Route 1 (Andersen AFB Main Gate)	X				
9	42	Andersen AFB (North Gate)					MAP 6
28	57	Route 1 to Route 3	X	X	X		
15	117	Route 15/29 Intersection	X				
Finegayan Connection	124	Route 1/16 Intersection to South Finegayan		X		X	

Legend: MAP= Military Access Point.
Note: Alternative 1 include all projects except #38, 39, and 41; Alternative 2 include all projects except #38A, 39A, and 41A; Alternative 3 include all projects except #38, 39A, 41A, and 124; Alternative 1 include all projects except #38, 39, and 41


Ritidian Point
Area Enlarged
GUAM
Andersen AFB
NCTS Finegayan
Pati Point
Philippine Sea
Pacific Ocean
Andersen South
10
38
22
9
22a
42
39
9
43
3
57
1
23
15
41
8
124
117
Figure 8.1-10
North - Roadway Project Locations
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
N
W
E
S
Miles
0.8
0
0.8
1
0
1
Kilometers
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Route 1, also called Marine Corps Drive, is a Trunk Highway that connects major population centers and traffic generators. Route 1 in the North Region is part of a loop road that connects to Routes 3 and 9; Routes 3 and 9 are classified as Minor Highways. Guam Road Network (GRN) #23 is the only roadway improvement project proposed along this segment of Route 1. Land uses adjacent to GRN #23 include urban residential and some commercial use in the southern portion, and agricultural/non-urban residential and DoD land in the northern portion. Vacant land is also found throughout the alignment. Various community facilities, including churches and schools and recreation facilities are found at the southern portion of the alignment. Guam Animals in Need and GovGuam facilities (Guam Power Authority [GPA] and a bus depot) are also located adjacent to the alignment in the southern portion. Land use designations within the project area, as shown in the North and Central Guam Land Use Plan, include park/open space, village center, industrial, and residential adjacent to the project area. No ocean uses are within the vicinity of Route 1 in the North Region.

Route 3 is part of a loop road connecting to Routes 1 and 9. Roadway improvement projects would involve pavement strengthening (GRN #8, 9, and 10), road widening (GRN #9 and 10), and MAP road projects (GRN# 38, 39, and 41). Land uses adjacent to these project areas are agricultural/non-urban residential and DoD lands (at South Finegayan and NCTS Finegayan). Large swaths of vacant land are located throughout the alignment. Main activity centers include South Finegayan, NCTS Finegayan, Ukudu High School, Finegayan Elementary School, and Alte Guam Golf Resort. The Potts Tank Farm is located at the northern end of GRN #9. Based on the *North and Central Guam Land Use Plan*, land uses along GRN #8, 41, and 9 on Route 3 are designated mixed use. In addition, land uses in the vicinity of GRN #39 are designated as village center and residential uses. No ocean uses are within the vicinity of Route 3.

Route 9 connects Routes 3 and 1 of the loop road. Two pavement strengthening projects (GRN #22 and 22a) and a MAP project (GRN #42) are proposed on Route 9. Land uses adjacent to these projects include DoD land (Andersen AFB) to the north, and agricultural/non-urban residential and some urban residential. Machanao Elementary School is located near GRN #42. Large swaths of vacant land are adjacent to the projects, including DoD and non-DoD lands. A sanitary landfill is located on DoD land north of GRN #22a. According to the *North and Central Guam Land Use Plan*, land uses in the vicinity of GRN #22a are designated as village center, residential, and park/open space. No ocean uses are within the vicinity of Route 9.

Route 28 is an east-west road connecting Routes 3 and 1 of the loop road. Road widening from two to four lanes, intersection improvement, and pavement strengthening is proposed for this segment of Route 28 (GRN #57). Land uses adjacent to the project include urban residential, agricultural/non-urban residential, and vacant land. The Dededo Quarry and Guam International Country Club and Golf Course are located near the southern end of the project. According to the *North and Central Guam Land Use Plan*, land uses within this area are designated as village center, residential, mixed use, and park/open space (Figure 8.1-4). No ocean uses are within the vicinity of Route 28. An intersection improvement is proposed at the Route 15/29 intersection. Route 15 is a major highway that runs north-south along the east coast of the island. This section of Route 15 connects Andersen AFB and Andersen South. Land use in the vicinity of the proposed intersection improvement is residential.

A new four-lane parallel road (GRN #124) is proposed between the intersection of Route 1 and 16 and South Finegayan to alleviate traffic on Routes 1 and 3, and the intersection of Routes 1 and 3. This new parallel road, called the Finegayan Connection, would provide alternative access for Route 16 traffic at Route 27. In addition, an intersection improvement at Routes 1 and 16 is also proposed. Land use in the

vicinity of this proposed parallel road is mixed use. with a large shopping center (i.e., Micronesia Mall) located near the intersection of Routes 1 and 16 and vacant land mixed with residential area (i.e., Dededo Community) along the segment of Route 3 between Route 1 and the Navy South Finegayan, which is DoD land. According to the *North and Central Guam Land Use Plan*, this area is part of the Dos Amantes Planning Area, where hotel/resort and urban center would be the major use of land (refer to Figure 8.1-4).

8.1.3 Central

The same references relied upon for the north area land use discussions apply to central Guam. This section introduces the land uses in the vicinity of the proposed roadway projects in the Central region. The roadway projects are described so as to limit the amount of affected environment addressed. Volume 6 of this EIS/OEIS describes the impacts of the roadway projects.

8.1.3.1 Andersen South

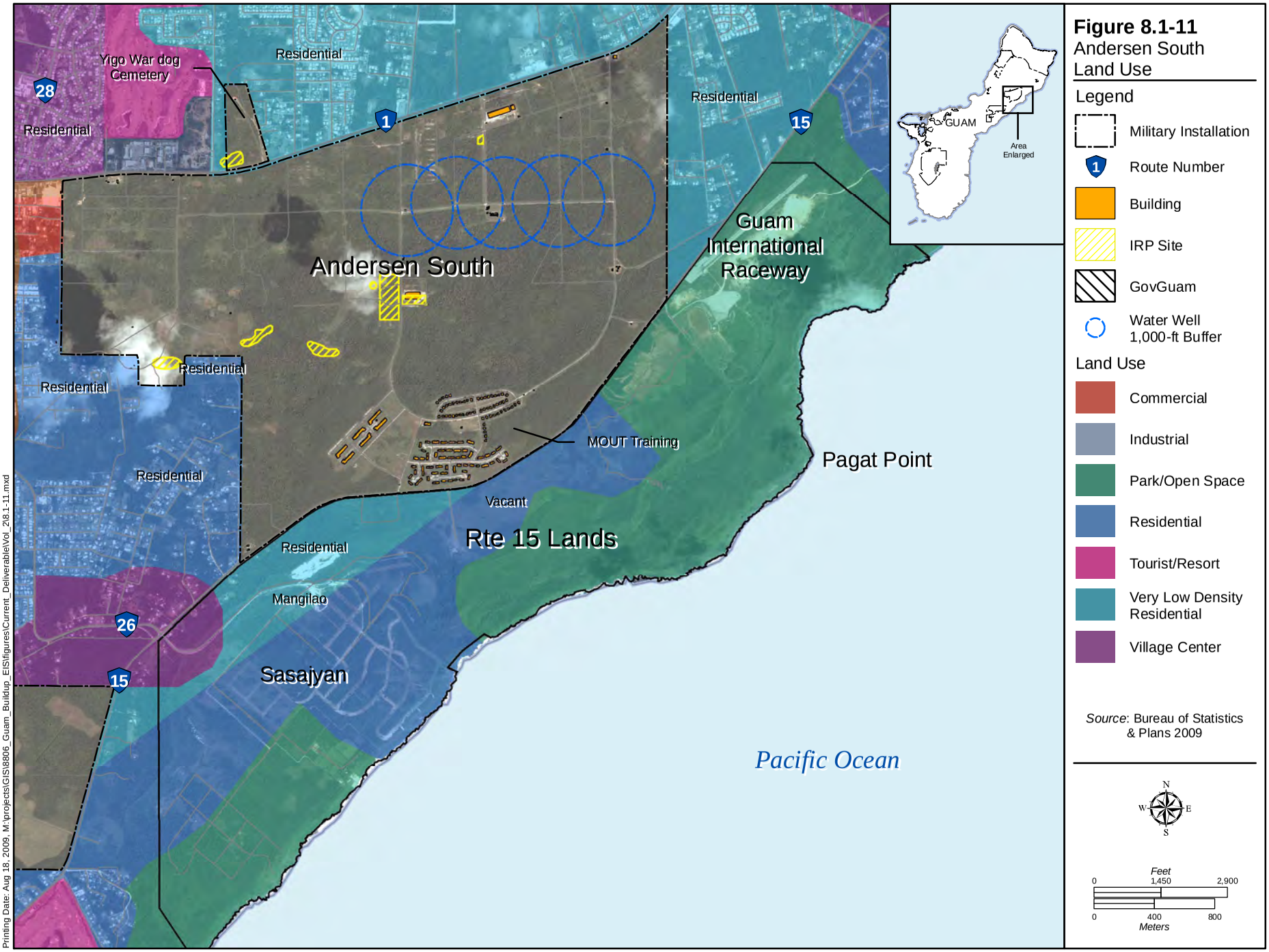
Andersen South is an Air Force property that encompasses approximately 2,060 ac (834 ha). The property is located inland of the Pacific Ocean coast (Figure 8.1-11) and west of Route 15. It is located south of Route 1, except for a small parcel (approximately 29 ac [12 ha]) that is the former site of the Yigo War Dog Cemetery. The dog remains have been relocated, but the area is still referred to as the Yigo War Dog Cemetery parcel. There is a water pump station on the site. Most of the site is vacant (i.e., no modern manmade structures) and naturally vegetated (Bureau of Statistics and Plans 2008).

The Andersen South area, located south of Route 1, consists of open fields, wooded areas, and vacant houses that have been used for humanitarian operations, staging, bivouac, equipment inspection, and small unit tactics. The most intensive use at Andersen South currently occurs during exercises involving up to three Marine Corps companies utilizing Andersen South range for up to three weeks, which currently occurs twice a year. Blanks used in this training produce an estimated noise level of about 96 dBA at a distance of 500 ft (152 m) and about 90 dBA at a distance of 1,000 ft (305 m). Military Operations in Urban Terrain (MOUT) training is conducted in abandoned housing areas. There are installation restoration (clean-up) sites and water production wells with wellhead clearance buffers in the area. Historically, the site was used for family housing and barracks, and includes a wastewater pump station, water booster pump station, water tanks and electrical substation that are not currently being used.

Andersen South includes an 80 ac (32 ha) parcel located in the northeastern area of the site that was deeded in 1992 from DoD to GovGuam for development of a Guam Public School System High School. There are conditions on the 30-year quit claim deed that limit the use to educational facilities and require no impact on the water lens or water wells in the vicinity. If conditions are not met, the land could revert back to the federal government (U.S. and GovGuam 1992). The school was never developed.

Historically, portions of the site were leased to civilians for crop production and one 10-acre lease is currently under lease in the western area of the property (Andersen AFB 2009). The lease can be terminated at Air Force discretion when a military use for the area is identified. There are no designated prime or important farmlands on Andersen South.

Residential development lies to the east, north and west of Andersen South, but not adjacent. Some of these residential areas appear to be low density (Bureau of Statistics and Plans 2008). The land use plan designation adjacent to the parcel is predominantly Very Low Density Residential (to the east and north) and Residential (to the southwest). Areas east of Route 15 are designated Very Low Density Residential and Residential with a small area of Park/Open Space in the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009). The adjacent areas to the northwest are designated for Commercial,



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Village Center and Industrial land uses in the *North and Central Guam Land Use Plan* (Bureau of Figure Statistics and Plans 2009) (refer to Figure 8.1-4). No prime farmlands were identified adjacent to the site, but there are important farmlands adjacent to the southern point of the parcel and east of Route 15. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) does not designate Agriculture land uses in the important farmlands area.

8.1.3.2 Barrigada

The Barrigada parcels are adjacent to each other and inland from the Pacific Ocean coast. Navy Barrigada is approximately 1,420 ac (575 ha). Its primary use is as a NCTS high frequency transmitter station. There is a large antenna field developed around an active transmitter facility. The areas reserved for communications operations are shown on Figure 8.1-12. The transmitters generate an electromagnetic radiation (EMR) arc. A DoD EMR and radio frequency study is in progress that would determine the required stand-off distances for future development (NAVFAC Pacific 2009). There is a Fleet Hospital warehouse and Army tenants at Barrigada, including Guam Army National Guard (GUARNG) (Figure 8.1-12). GUARNG has facilities in the northwest area near the site entrance off Route 8. They have requested additional land from the Navy for an expansion. An Army Reserve Battalion headquarters building is adjacent to the Guam Army National Guard facilities.

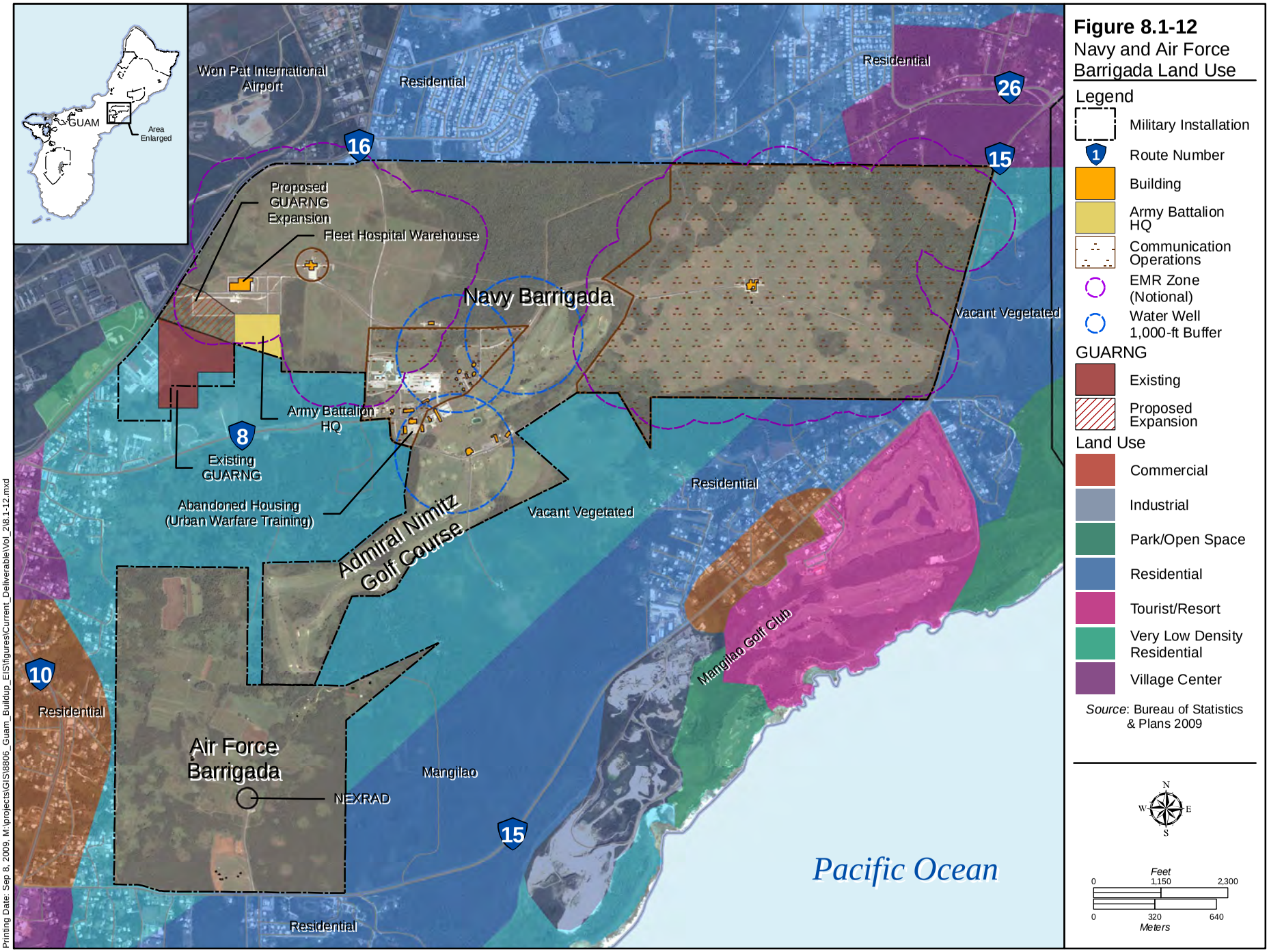
There are abandoned family housing units available for urban warfare training (refer to Figure 8.1-12). Open areas (former transmitter sites) provide command and control, and logistics training; bivouac, vehicle land navigation, and convoy training; and other field activities (Navy 2009).

In addition to EMR arcs, there are water wells with clearance zones and installation restoration (clean-up) sites that have been identified. The Navy Golf Course connects the Navy operational area and Air Force Barrigada. Air Force Barrigada is approximately 432 ac (175 ha). The parcel has a Next Generations Radar weather antenna in the center. The Next Generations Radar facility would remain at the site, but it does not preclude development of the remainder of the site.

The Barrigada parcels are generally bordered by residential neighborhoods and vacant (i.e., no modern manmade structures) land. Guam International Airport (i.e., A.B. Won Pat International Airport) is northwest, but not adjacent to Navy Barrigada. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designation for the adjacent surrounding land is Very Low Density Residential or Residential, except for an area of Commercial use at the northwest corner of Navy Barrigada and a small area of Village Center at the northeast. No prime farmlands were identified adjacent to the site, but important farmlands were designated east of Air Force Barrigada and adjacent to the eastern portion of Navy Barrigada to the north and south. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) does not designate Agriculture land uses in the important farmlands area.

8.1.3.3 Non-DoD Land

There are approximately 1,129 ac (457 ha) of non-DoD lands that are of interest located southeast of Andersen South and Route 15. GovGuam submerged lands border the eastern edge of property. The coast is characterized by a steep undeveloped cliff and access is difficult. There are multiple private landowners with possible ancestral lands claims as well as GovGuam parcels. Historically, portions of the property closest to Route 15 were federal lands and remnant roadways are evident in the Guam Mapbook (Bureau of Statistics and Plans 2008). The majority of the site appears to be naturally vegetated but there are individual residences and the Guam International Raceway (see Figure 8.1-11) located within the northern



part of the Route 15 property. There are natural and cultural resources that provide recreational and educational opportunities for the public.

The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designation for the area is Residential, Very Low residential and Park/Open Space (see Figure 8.1-4). No prime farmlands were identified at the site, but there are areas of important farmlands (refer to Figure 8.1-3). *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) does not designate Agriculture land use in the important farmlands area.

8.1.3.4 Off Base Roadways

The proposed roadway improvement projects within the central region are located along existing Routes 1, 8, 8A 10, 15, 16, 25, 26, and 27, and Chalan Lujuna Road, as summarized in Table 8.1-4. The location of various proposed projects in the central region is shown in Figure 8.1-13.

Table 8.1-4. Proposed GRN Projects in Central Region

Route	*GRN#*	*Segment Limits*	*Pavement Strengthening*	*Intersection Improvements*	*Road Widening*	*Road Realignment*	*Bridge Replacement*	*Military Access Point*
1	1	Route 1/8 Intersection		X				
1	2	Route 1/3 Intersection		X				
1	3	East of Route 4 (Agana Bridge)					X	
1	6	Route 27 to Chalan Lujuna	X	X				
1	7	Route 3 to Route 27	X	X				
1	13	Route 11 to Asan River	X					
1	14	Asan River to Route 6 (Adelup)	X					
1	15	Route 6 (Adelup) to Route 4	X					
1	33	Route 8 to Route 3	X	X				
1	35	Atantano, Laguas, Sasa, Fonte Bridges					X	
1	44	Anderson South (Main Gate)						MAP 8
7	113	Route 7/7A		X				
8	16	Tiyan Parkway/Route 33 (east) to Route 1	X		X			
8	17	Route 10 to Tiyan Parkway/Route 33 (east)	X	X	X			
8A	31	Route 16 to Naval Communication Area Master Station (NAVCAMS) Barrigada	X					
8A	48	Barrigada (Navy)						MAP 12
8A	74	Route 16 to NAVCAMS Barrigada	X		X			
10	30	Route 15 to Routes 8 and 16	X					
15	12	Smith Quarry to Chalan Lujuna	X					
15	32	Route 10 to Connector (Chalan Lujuna end)	X	X				
15	36	Route 15 Realignment				X		
15	46	Andersen South (Secondary Gate)						MAP 10
15	49	Barrigada (Air Force)						MAP 13
15	49A	Barrigada (Air Force)						MAP 13A
16	18	Route 27 to Route 10A	X					
16	19	Route 10A to Sabana Barrigada Drive	X	X				
16	20	Sabana Barrigada Drive to Route 8/10	X					

Route	*GRN#*	*Segment Limits*	*Pavement Strengthening*	*Intersection Improvements*	*Road Widening*	*Road Realignment*	*Bridge Replacement*	*Military Access Point*
16	47	Barrigada (Navy)						MAP 11
16	63	Route 10A to Sabana Barrigada Drive	X		X			
25	29	Route 16 to Route 26	X		X			
26	28	Route 1 to Route 15	X	X	X			
27	21	Route 1 to Route 16	X					
Chalan Lujuna	11	Route 1 to Route 15	X	X				

Notes: Projects for Alternatives 1 and 2 include all projects listed above, except GRN #63, 74, 47, 48, 49, and 49A.
Projects for Alternative 3 include all projects listed above, except GRN #20, 31, and 49A.
Projects for Alternative 8 include all projects listed above, except GRN #63, 74, 47, 48, and 49.

Projects along Route 1, running from south to north, include GRN #13, 14, 15, 3, 1, 33, 2, 7, 6, 44, and 35. Land use along Route 1 within the central region can be best described in three segments. Segment 1 is the arterial roadway that runs along the west coast of the island, passing through the municipalities of Piti, Asan, and east Hagatna. Pavement strengthening projects are proposed along this segment (GRN #13, 14, and 15). Land uses to the north of these projects are primarily beaches and parkland. South of the project, land uses are primarily agricultural/non-urban residential. Commercial uses are concentrated in the Hagatna portion of the project area. GRN #15 is adjacent to the Governor's Complex, the Gregorio Perez Marina, and Paseo de Susana Park. GRN #3 and 1 involve intersection improvements and are located on Route 1 at the intersections of Routes 4 and 8, respectively.

Land uses adjacent to these projects are commercial and recreation, including the Paseo de Susana Park and Padre Palomo Park. Segment 2 of Route 1 includes GRN #33, which involves pavement strengthening and intersection improvement, located on Route 1 from the intersection of Routes 8 and 16. This segment of the proposed improvement runs parallel to Agana Bay and then cuts inland through Tamuning north to the Dededo communities. Land uses in Hagatna are primarily commercial to the south and beach/parkland to the north. In Tamuning and Dededo, the primary land uses are commercial and industrial, with some adjacent urban residential. Several schools, large office buildings, hotels, and other commercial uses are found along the project corridor. Harmon Industrial Park and the Tumon Tank Field are located near the northern end of GRN #33. Segment 3 of Route 1 includes pavement strengthening projects (GRN #6 and 7), an intersection improvement project (GRN #2, 6, and 7), and a MAP project (GRN #44). Land uses adjacent to this segment are primarily urban residential to the north, agricultural/non-urban residential, and DoD land (Andersen South) to the south.

Route 8 is a major highway that runs in the east-west direction, connecting Route 1 on the west coast and Barrigada Navy Base and Route 15 on the east coast of the island. Proposed improvements on Route 8 include pavement strengthening projects (GRN #16, 17, 31, and 74) and a MAP at the Barrigada Navy Base (GRN #48). Road widening from four to six lanes is also proposed for GRN #16 and 17, and widening to provide a median is proposed for GRN #74. Primary land uses along Route 8 are commercial and residential mixed use at the area near the Route 1 intersection where roadway widening (GRN #16) is proposed. The Guam International Airport is situated along the north side of Route 8 where GRN #17 is proposed. Land along Route 8 where GRN #31 and 74 are proposed is vacant, but it is designated for residential use. Federal land (i.e., Barrigada Navy Base) is located at the end of Route 8. No ocean uses are within the vicinity of Route 8.

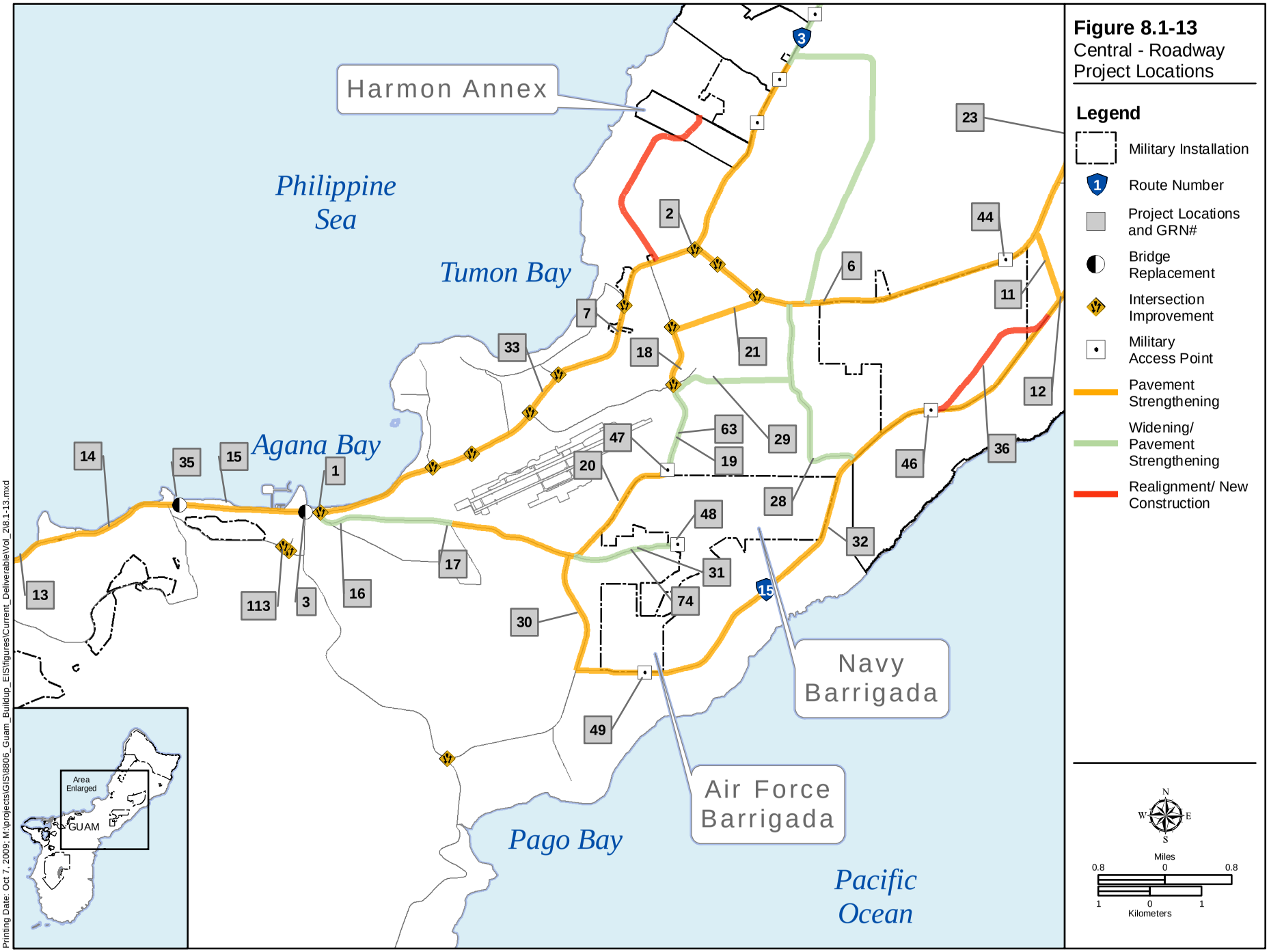

Harmon Annex
Philippine Sea
Tumon Bay
Agana Bay
Navy Barrigada
Air Force Barrigada
Pago Bay
Pacific Ocean
Area Enlarged
GUAM
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Figure 8.1-13
Central - Roadway Project Locations
Legend
Military Installation
Route Number
Project Locations and GRN#
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
N
W
E
S
Miles
0.8 0 0.8
1 0 1
Kilometers

Route 16 runs north and south, connecting Routes 8 and 1. Proposed improvements on Route 16 include pavement strengthening projects (GRN #18, 19, 20, and 63) and a MAP at the Barrigada Navy Base (GRN #47). Intersection improvements along GRN #18 and 19 would also be undertaken. Road widening from four to six lanes is also proposed for GRN #63. Primary land uses along Route 16 are low-density residential on the southern portion and commercial/industrial on the north part of the route. No ocean uses are within the vicinity of Route 16.

Routes 25, 26, and 27 are two-lane roadways that connect Routes 1 and 16. Pavement strengthening is proposed for all of these routes (GRN #29, 28, and 21). In addition, road widening from two to four lanes is proposed along Route 25 (GRN #29) and Route 26 (GRN #28). Primary land uses along Routes 25, 26, and 27 are low-density residential. No ocean uses are within the vicinity of Routes 25 and 26.

Route 10 runs north and south, connecting Routes 4, 18, and 8. A pavement strengthening project (GRN #30) is proposed on Route 10 between the Route 8 and 15 intersections. No ocean uses are within the vicinity of Route 10.

Route 15 is a main roadway running along the east coast (Pacific Ocean) of the island, connecting Route 10 from the south to Route 1 near the Andersen AFB gate. A pavement strengthening project (GRN #32) and three MAP projects (GRN #46, 49 and 49A) are proposed along this roadway. At the area south of Andersen South, Route 15 would be realigned onto the DoD land (GRN #36) to allow construction of the Firing Range that will be located east of the existing Route 15. Besides the DoD lands, primary land uses along Route 15 are residential and low-density residential. Tourist/resort uses, as well as agriculture, are located along the coastline off Route 15. No ocean uses are within the vicinity of Route 15.

The last roadway improvement project (GRN #11) within the Central Region is located along Chalan Lujuna Road, which connects Route 15 to Route 1 east of Andersen South. This project includes pavement strengthening and intersection improvements. Primary land uses along this roadway are residential and low-density residential. No ocean uses are within the vicinity of Chalan Lujuna.

8.1.4 Apra Harbor

Data sources relied upon for the north and central land use discussions are relevant to the Apra Harbor land use analysis, except the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) because it does not include Apra Harbor and areas south. The 1966 and the upadopted *I Tano'-Ta* (Territorial Planning Council 1994) land use plans were used to assess the trend in land use planning for areas adjacent to Naval Base Guam. Naval Base Guam at Apra Harbor covers approximately 6,200 ac (2,509 ha) and is located on the southwest coast of Guam. Operational facilities are primarily located at the waterfront. The base serves as the forward deployment and logistics hub for sea, land, and air forces operating in Asia and the Western Pacific. Naval Base Guam features multiple land uses with logistics and fleet support being the focus of operational activities. Access via water is from Outer Apra Harbor. Land access to the Naval Base Guam is directly from Marine Corps Drive and Route 2. Other Navy operational areas are accessed via secondary roads from Marine Corps Drive at intersections located north of the Naval Base Guam access. These other areas include Polaris Point, Drydock Island, and Glass Breakwater.

8.1.4.1 Harbor

Apra Harbor is the only deep draft harbor on Guam. The harbor is divided into Outer Apra Harbor and Inner Apra Harbor. Inner Apra Harbor is located south of Outer Apra Harbor (Figure 8.1-14). All ship traffic to and from the harbor uses the single entrance channel located at the western end of Outer Apra

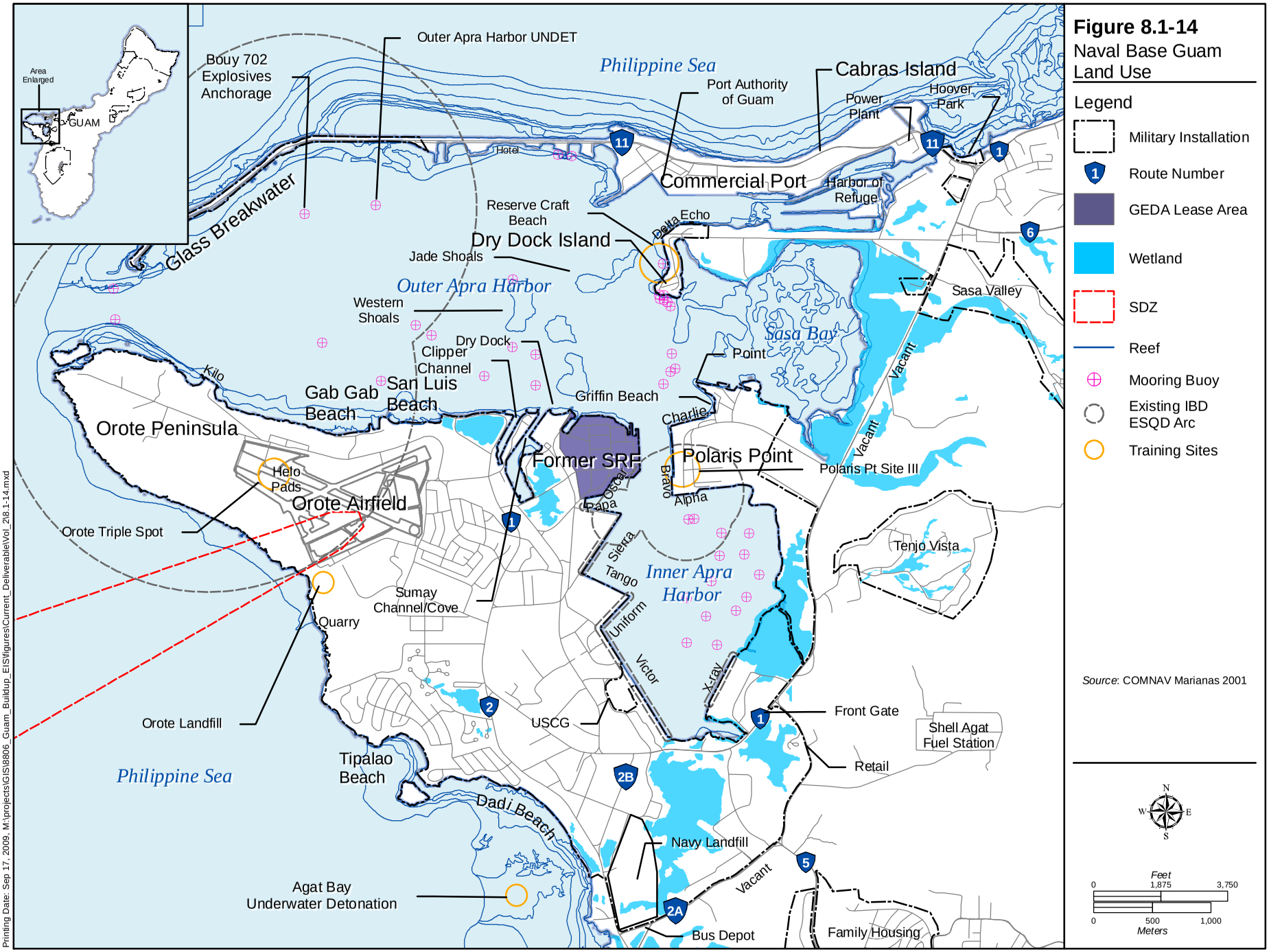

Figure 8.1-14
Naval Base Guam
Land Use

Legend

- Military Installation
- Route Number
- GEDA Lease Area
- Wetland
- SDZ
- Reef
- Mooring Buoy
- Existing IBD ESQD Arc
- Training Sites

Source: COMNAV Marianas 2001

N W E S

Feet
0 1,875 3,750
0 500 1,000
Meters

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Harbor. Access to Inner Apra Harbor is through a single channel from Outer Apra Harbor. Inner Apra Harbor is controlled by Commander Navy Region (COMNAV) Marianas and is restricted to military use, including ships from allied nations. Outer Apra Harbor is controlled by the Commander USCG Marianas Section and is shared by a wide variety of ships: commercial, military and recreational.

Land/Submerged Land Ownership and Management

The Navy controls and manages the majority of Apra Harbor submerged lands, except for a portion fronting Port Authority of Guam (PAG) facilities in the northeast corner of Outer Apra Harbor (as described in Section 8.1.2). The Navy property bordering the Harbor includes Orote Peninsula, Inner Apra Harbor, Dry Dock Island, and Glass Breakwater (refer to Figure 8.1-14). There is an exception at Victor Wharf in Inner Apra Harbor where the USCG controls a portion as shown on Figure 8.1-14. Sasa Bay Marine Preserve was designated by GovGuam, but is not acknowledged by the Navy because it was established within Navy submerged lands.

The Navy leases the Former Ship Repair Facility (SRF) area, located on the western side of the Inner Apra Harbor Channel, to the Guam Economic Development and Commerce Authority (GEDCA) who subleases it to Guam Shipyard. It is referred to as Former SRF because the Navy ship repair facility historically operated in the same area. The Former SRF area is not used efficiently and the Guam Shipyard does not require the entire leased area. There are numerous deteriorating buildings pending demolition. The current lease term expires in 2012. Future use of the SRF lands beyond 2012 is currently being reviewed by the Navy. The lease area is surrounded by Navy land/submerged land uses. Commanding Officer USCG is the Captain of the Port and controls Outer Apra Harbor. Navy Security zones extend outward from the Navy controlled waterfront and related military anchorages/moorings. Navy ship traffic and wharf assignments are managed by Navy Port Operations. The PAG serves a similar function for commercial vessels. Commercial vessels dock at the PAG's Commercial Port. Both entities track shipping traffic. The USCG has multiple missions, including port and waterways security and maritime safety. All watercraft, including recreational boats, are subject to federal rules and regulations that are enforced by the USCG.

For public health, security and anti-terrorism force protection reasons, the Navy imposes restrictions on non-DoD operations and establishes standoff distances from Navy facilities and ships, including Navy anchorages and buoys in Outer Apra Harbor. The arrival and departure of large vessels, such as an aircraft carrier, temporarily restricts ship traffic in Outer Apra Harbor.

Training- Land and Submerged Land

There are numerous training areas/facilities at Naval Base Guam as follows and shown on Figure 8.1-14 (Navy 2009):

- Inner Apra Harbor: military diving, logistics training, small boat activities, security activities, drop zones, and torpedo/target recovery training
- Gab Gab Beach: military and recreational activities. The western half of Gab Gab Beach is primarily used to support EOD and Naval Special Warfare training requirements. Activities include military diving, logistics training, small boat activities, security activities, drop zones, and anti-terrorism/force protection (AT/FP).
- Dry Dock Island: Reserve Craft Beach is a small beach area located on the western shoreline of Dry Dock Island. It supports both military and recreational activities. It is used as an offload area for amphibious landing craft, as well as for EOD inert training activities, military diving, logistics training, small boat activities, and security activities.

- Sumay Channel/Cove: recreational boat marina and an EOD small boat facility. It is used for insertion/extraction training for Naval Special Warfare and amphibious vehicle ramp activity, military diving, logistics training, small boat activities, and security activities.
- Clipper Channel provides insertion/extraction training for Naval Special Warfare, military diving, logistics training, small boat activities, security activities, and AT/FP. The Clipper Channel has the potential to support amphibious vehicle ramp activity.
- San Luis Beach is used for both military and recreational activities. San Luis Beach is used to support EOD and Naval Special Warfare training requirements. Activities include military diving, logistics training, small boat activities, security activities, and drop zones.
- Outer Apra Harbor supports frequent and varied training requirements for Navy Sea, Air, Land Forces, EOD, and Marine Support Squadrons including underwater detonations (explosive charges up to 10 to 20 pounds Net Explosive Weight (NEW) pending agency consultation are permitted at a site near Buoy 702), military diving, logistics training, small boat activities, security activities, drop zones, visit board search and seizures, and amphibious craft navigation.
- Kilo Wharf is used for munitions handling and is a training site with limited capabilities due to explosive safety constraints; however, when explosive constraints are reduced it is used for AT/FP training and Visit Board Search and Seizure activities.
- Polaris Point Field supports both military and recreational activities and beach access to small landing craft. Polaris Point Field supports landing zones (LZs), small field training exercises, temporary bivouac, craft laydown, parachute insertions (freefall), assault training activities, and EOD and Special Forces Training.
- Polaris Point Beach supports both military and recreational activities and beach access to small landing craft and Landing Craft Air Cushion. Polaris Point Beach supports military diving, logistics training, small boat activities, security activities, and drop zones.
- Polaris Point Site III is where Guam-homeported submarines and the submarine tender are located and is the primary site location for docking, training, and support infrastructure. Additionally, it supports torpedo/target logistics training.
- Orote Point Airfield consists of expeditionary runways and taxiways and is largely encumbered by the ESQD from Kilo Wharf. Orote Point Airfield runways are used for vertical and short field military aircraft. They provide a large flat area that supports Field Training Exercise, parachute insertions, emergency vehicle driver training, and EOD and Special Warfare training. The airfield is on the National Register of Historic Places.
- The Orote Point Close Quarter Combat Facility, commonly referred to as the Killhouse, is a small one-story building providing limited small arms live-fire training. Close Quarter Combat is one activity within MOUT-type training. It is a substandard training facility and the only designated live-fire Close Quarter Combat facility in the MIRC.
- The Orote Point Known Distance Range supports small arms and machine gun training (up to 7.62 millimeter [mm]), and sniper training to a distance of 500 yards (457 m). The Orote Point Known Distance Range is a long flat cleared area with an earthen berm that is used to support marksmanship. The Orote Point Known Distance Range is currently being upgraded to an automated scored range system. The range generates a SDZ over the Navy submerged land. There is restricted access to the area during training and a NOTMAR/NOTAM is issued.

- The Orote Point Triple Spot is a helicopter landing zone on the Orote Point Airfield Runway. It supports personnel transfer, logistics, parachute training, and a variety of training activities reliant on helicopter transport.
- Agat Bay supports deepwater Mine Countermeasure training, military dive activities, and parachute insertion training. Underwater detonation charges up to 20 pounds NEW are used. Hydrographic surveys to determine hazards for military approaches are periodically conducted in this area.
- Tipalao Cove provides access to a small beach area capable of supporting a shallow draft amphibious landing craft. It supports military diving activities and hydrographic survey training.
- Drop Zones in the offshore areas are used for the air-to-surface insertion of personnel/equipment (see Figure 8.1-14).
- The Piti and Agat Bay Floating Mine Neutralization Area lies north and south, respectively of Apra Harbor and supports EOD training, with underwater explosive charges up to 20 pounds NEW.

Inner Apra Harbor Assets and Uses

Access to Inner Apra Harbor is limited to military use. No recreational uses occur in Inner Apra Harbor. Port Operations controls the use of the wharves and moorings, but there are areas designated for specific types of operations. The following discussion is organized clockwise around Inner Apra Harbor beginning with Polaris Point (see Figure 8.1-14) and is based on the Waterfront Functional Plan of 2004 (NAVFAC Pacific 2004).

Submarines and the Submarine Tender (Class AS-40) are generally docked at Polaris Point, Alpha and Bravo Wharves, but can use other Inner Apra Harbor wharves as needed (see Figure 8.1-14). The AS-40 is typically berthed perpendicular (med–moored) to Alpha Wharf with the ability to nest submarines on either side. Alpha and Bravo Wharves were upgraded in 2008 and construction dredging was required. Munitions operations to support the submarines generate an ESQD arc, as shown on Figure 8.1-14.

The eastern portion of Inner Apra Harbor, between Alpha Wharf and X-Ray Wharf, is undeveloped and naturally vegetated (refer to Figure 8.1-14).

Supply ships that are not carrying fuel or munitions are docked in Inner Apra Harbor, with X-Ray Wharf being the location for onloading and offloading ship supplies. There are large temperature-controlled warehouses at X-Ray Wharf for food storage.

The entire length of the western side of the Inner Apra Harbor, including the Former SRF area, is developed with wharves as follows from south to north: Victor, Uniform, Tango, Sierra, Romeo, Papa, Oscar, Mike, and Lima.

Victor Wharf is the longest of the wharves and has six berths. The USCG operates from their compound on Victor Wharf. It owns 200 ft (61m) and lease another 250 ft (76m) (since 1971) and another 260 ft (79 m) (since 2006) along the wharf. There is an area adjacent to the wharf for USCG support facilities. Limited munitions operations are allowed at Victor Wharf and the ESQD arc is shown on Figure 8.1-13. The security compound, including the military working dog kennels, is south of the USCG support facilities.

Uniform Wharf is only suitable for small craft due to existing structural damage. Navy headquarters is located west and inland of Uniform Wharf. Two berths are located at Uniform Wharf.

Port Operations facilities, the Dive Locker and the hyperbaric chamber are located at Tango Wharf (Building 3169). Approximately 100 ft (31 m) of the wharf is reserved for emergency access.

Sierra and Romeo are general purpose wharves and have limited munitions handling capabilities that generate ESQD arcs as shown on Figure 8.1-14.

The Guam Shipyard lease area includes the following wharves: November, Mike, Lima, Oscar, Papa, and Quebec in Inner Apra Harbor, but only November and Mike Wharves are used. November Wharf is used to berth ships for pierside repairs and Mike Wharf is used to berth a floating crane.

All Inner Apra Harbor wharves, except Alpha and Bravo, are in substandard condition (NAVFAC Pacific 2004) but are used for ship berthing.

Inner Apra Harbor Dredge Depth

In 1945, the Inner Apra Harbor wharves, the ship repair facility, Polaris Point, and Glass Breakwater were constructed of fill material. The construction depth of the southern portion of Inner Apra Harbor fronting the wharves was -32 ft (-9.7 m) mean lower low water (MLLW) and depth in the northern portion was -35 ft (-10.7 m) MLLW. Maintenance dredging occurred in 1978 and 2003 (NAVFAC Pacific 2008a). In 2007, the construction depth of the Inner Apra Harbor Channel and an area south of the Inner Apra Harbor Channel was dredged to -40 ft (-12 m) MLLW to accommodate a new class of ship at Bravo Wharf.

Outer Apra Harbor Assets and Uses

In addition to ship traffic, Outer Apra Harbor is used for military training and recreational activities (e.g., Atlantis Submarine, SCUBA diving, sailing, jet skiing, and canoe paddling). The Outer Apra Harbor description is clockwise beginning in the northwestern end of Outer Apra Harbor. The Outer Apra Harbor is bordered by 2.8 mile (mi) (4.5-km) long Glass Breakwater (Navy property) to the north and Orote Peninsula to the south (refer to Figure 8.1-14). The Commercial Port is on the northeastern edge of the harbor. A civilian marina, Harbor of Refuge, is located at the eastern end. The Navy fueling wharves (Echo/Delta) are approximately 800 ft (244 m) south of the Commercial Harbor on Dry Dock Island. Training activities also occur on Dry Dock Island as discussed earlier in this section. Between Dry Dock Island and the "point" of land at Polaris Point is the GovGuam-designated Sasa Bay Marine Preserve. The "point" has a restaurant/bar and navigational aids. Between the "point" and the northern coast of Polaris Point is Griffin Beach, which is used for military recreation. There are ballfields and open space areas east of Griffin Beach. Along the northern coast of Polaris Point is remnant mooring dolphins and some Navy documents refer to the area as Charlie Wharf. No ships are moored in the area. There is a guard tower and other minor utility buildings at the Charlie Wharf area, but the modern manmade coastline is generally undeveloped. The interior of the Polaris Point area is vacant and landscaped. The other waterfront areas of Polaris Point are discussed under Inner Apra Harbor.

The Guam Shipyard finger piers located west of the Inner Apra Harbor Channel are not used. The dry dock, the former AFDB-8 named "Big Blue", is located at the northwestern edge of the Former SRF. Drydock Inlet and Sumay Cove Marina are located west of the dry dock. Gab Gab Beach is a recreational area on the northern coast of Orote Peninsula west of Sumay Cove. The DoD munitions wharf, Kilo Wharf, is located west of Gab Gab Beach near the entrance to Outer Apra Harbor (refer to Figure 8.1-14). The munitions operations at Kilo Wharf often require closure of the western portion of Gab Gab Beach for safety reasons. Access to Orote Point and Spanish Steps is also restricted. Kilo Wharf is the current berthing location for visiting aircraft carriers, which visit an average of three times per year, for a week's duration each time.

On the south side of the Naval Base Guam is the Orote ERA (ERA and recreational beaches, but no wharves or piers).

Outer Harbor Dredge Depth

The original construction depth for the Outer Apra Harbor shipping lane that is located north of the Inner Apra Harbor Channel has been estimated between -40 (-12 m) and -50 ft (-15 m) MLLW based on coral surveys (Volume H). No maintenance dredging has occurred for the area. The primary navigation channel aligned east-west in Outer Apra Harbor is deep, and no construction dredging has occurred to accommodate Navy or other ships. Kilo Wharf was constructed in 1989 in Outer Apra Harbor near the entrance channel with a construction depth of -45 ft (-13.7 m) MLLW. The wharf was extended and the construction depth modified to -47 ft (-14.3m) MLLW in 2008-2009 (COMNAV Marianas 2007).

ESQD Arcs

There are ESQD arcs associated with Alpha, Bravo, Kilo, Romeo, Sierra, and Victor Wharves, and specified mooring buoys, which allows them to be used for munitions operations up to a specified NEW. Kilo Wharf is the primary munitions wharf. ESQD arcs may encumber the navigation channel through Outer Apra Harbor, portions of Hotel Wharf at the Port Authority of Guam and recreational activities in the harbor depending upon the NEW. The arcs shown on Figure 8.1-14 are the Inhabited Building Distance arcs, within which buildings that are routinely inhabited are not permitted for safety reasons. Smaller diameter public transportation route ESQD arcs (not shown on Figure 8.1-14) are generated from the munitions operation site. The public transportation route refers to public street, road, highway, navigable stream, or passenger railroad, including roads on a military reservation used routinely by the general public for through traffic. Both arcs extend over the shipping channel in Outer Apra Harbor encumbering maritime traffic and recreational use when the munitions operations are occurring. On Orote Peninsula, there are other facilities that generate arcs because they are used for temporary or long-term munitions storage.

Navy Dredged Material Management

The Navy conducts dredging periodically in Apra Harbor to maintain construction depth and to accommodate new classes of ships. To date, the Navy's alternatives for dredged material management have been beneficial reuse and upland placement sites. A third alternative (ODMDS) is anticipated to be designated and available for use in 2010. The proposed action involves dredging in the area of Sierra Wharf.

Beneficial Reuse

Beneficial reuse projects are the preferred alternative for dredged material disposal. Some beneficial reuse Alternatives include beach replenishment, construction fill, and landfill cover. Specific projects and sites have not been specified for the dredged material generated by the proposed action. Land use impacts associated with these projects are not addressed in this EIS/OEIS. However, as beneficial reuse projects, such as land reclamation emerge, appropriate analysis would be conducted.

ODMDS

The USEPA has designated (pending) an ODMDS approximately 13 nm (25.4 km) west of Apra Harbor. The affected environment and impact assessment for the site is described in the ODMDS-specific EIS (USEPA 2009). From a submerged land use perspective, the ODMDS site was specifically selected to avoid existing submerged land uses, such as shipping lanes and fishing areas. As mentioned in the project description, the suitability of the dredged material for ODMDS disposal is demonstrated through physical,

chemical and biological testing, per USEPA Ocean Dumping Regulations (40 CFR Parts 220, 225, 227, and 228). Only dredged materials that meet the testing parameters are eligible for ODMDS disposal. Preliminary sediment characterization study results indicate that all or most of the dredged material is likely to be suitable for ODMDS disposal. A comprehensive analysis would be completed in support of the U.S. Army Corps of Engineers (USACE) permit. This EIS/OEIS assumes four scenarios: 100% disposal in the ODMDS, 100% upland disposal, 100% beneficial reuse and 15-20% beneficial reuse/75-80% ocean disposal.

Candidate Upland Placement Sites

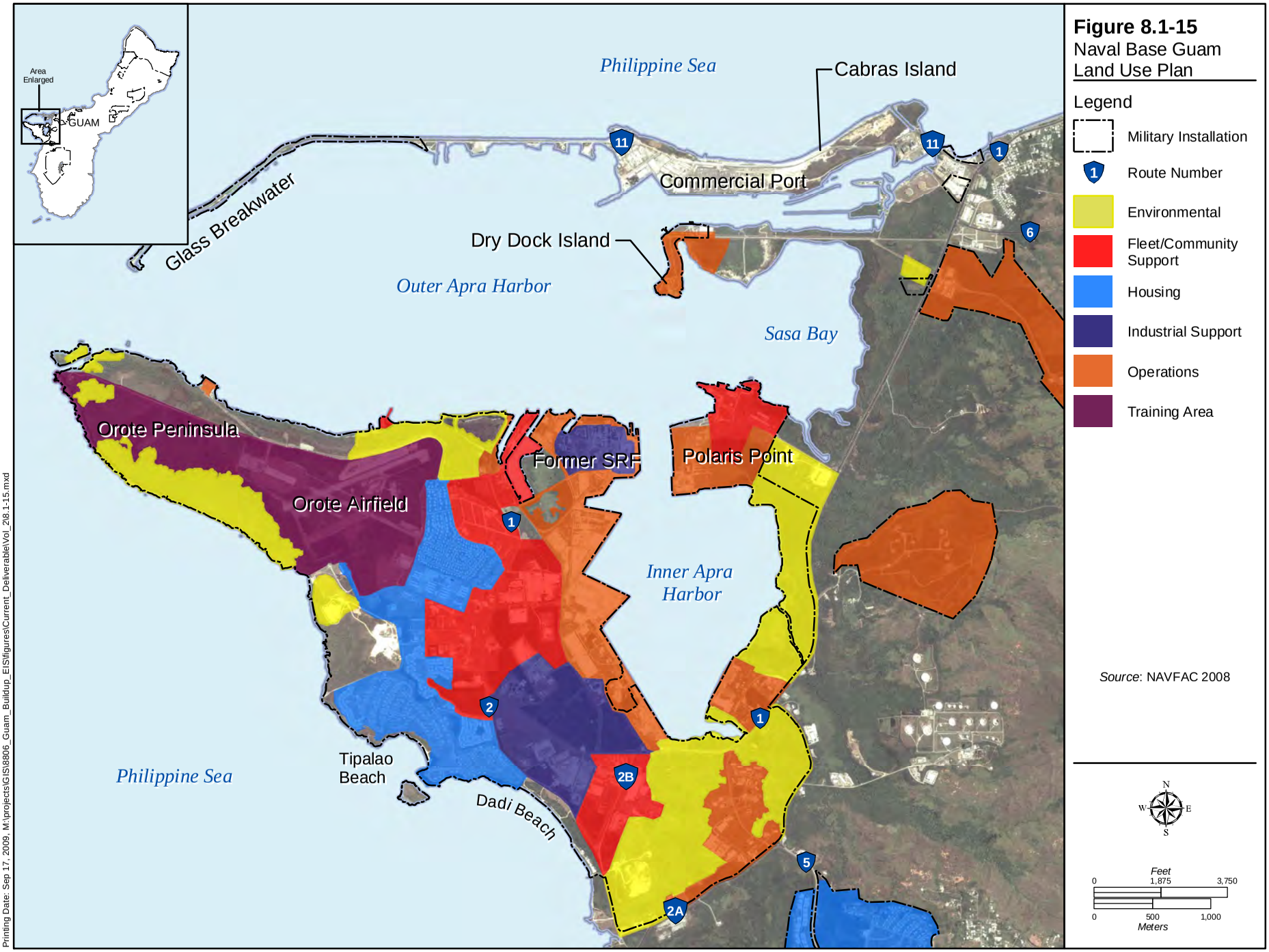
As described in Chapter 2, it is often necessary to store dredged material before it can be beneficially reused. In these cases, an upland placement site is needed. The existing upland placement sites on Guam are at, or soon to be at, maximum capacity. Establishing new upland placement sites can be difficult for the following reasons:

- There may be insufficient capacity at the upland placement facilities for stockpiling material.
- Priority would be given to containment of material that is unsuitable for ocean disposal.
- New upland placement facilities can be time-consuming to create, conflict with other land uses, and have their own environmental impacts.

Five potential new upland placement sites were identified (NAVFAC Pacific 2008b) to support proposed Navy dredging projects. The selection of a specific site for the proposed action dredged material has not been determined. The sites are Fields 3, 4, and 5, Public Works Center (PWC Compound) and Polaris Point. The sites are vacant (i.e., no modern manmade structures). Characteristics of the sites are described in Volume 9, Appendix D. Three of the sites, Fields 3 and 5 and Polaris Point, have been addressed in previous NEPA documents and will not be assessed in this EIS. Field 4 and PWC Compound sites are addressed in this EIS/OEIS.

8.1.4.2 Naval Base Guam

The Navy does not have zoning laws or codes, but there are functional relationships among land uses that guide development. In general, the working zone, which includes industrial, waterfront, operational and mission support functions (i.e., supply, maintenance), are distinct from the living areas that include housing and community support. Figure 8.1-15 shows the May 2008 land use plan for Naval Base Guam generated by Naval Facilities Engineering Command (NAVFAC) Marianas Asset Management Business Line (COMNAV Marianas 2008). "Operations" refers to waterfront operations (e.g., administration and wharves, submarine compound, supply facilities including fuel storage, and Camp Covington [construction battalion compound]). Industrial support includes ship repair, warehousing, and maintenance. Training areas are identified on Orote Peninsula. Environmental is a broad term referring to historical and archeological, natural resources, wetlands, and installation restoration (clean-up) sites. The wetlands delineated on the plan are not precise and are addressed in other chapters of this EIS/OEIS. The Base Commander, in consultation with base planners, would direct future development to be consistent with the objectives of the land use plan, which is subject to change. ESQD arcs are a major constraint on land use development, especially for Orote Peninsula. Naval Base Guam is more densely developed than Andersen AFB, but the building heights are similar.



Adjacent Land/Submerged Land Uses

The Navy Main Base has submerged lands in three directions: north, west, and south. The submerged land uses around Naval Base Guam have been described for the harbor. Military training sites are described in the previous sections. Recreational and commercial uses are described under other resource chapters.

Adjacent non-federal land is located to the east of Naval Base Guam. Marine Drive (Route 1) and Route 2A generally delineate the eastern boundary, except for the Dry Dock Island and Polaris Point portions of Naval Base Guam that are bordered by non-federal vacant (i.e., no modern manmade structures) and vegetated land. The land areas east of the adjacent roadways are vacant, except for a bus depot at the south boundary (refer to Figure 8.1-4). No prime or important farmlands were identified adjacent to Naval Base Guam (refer to Figure 8.1-3).

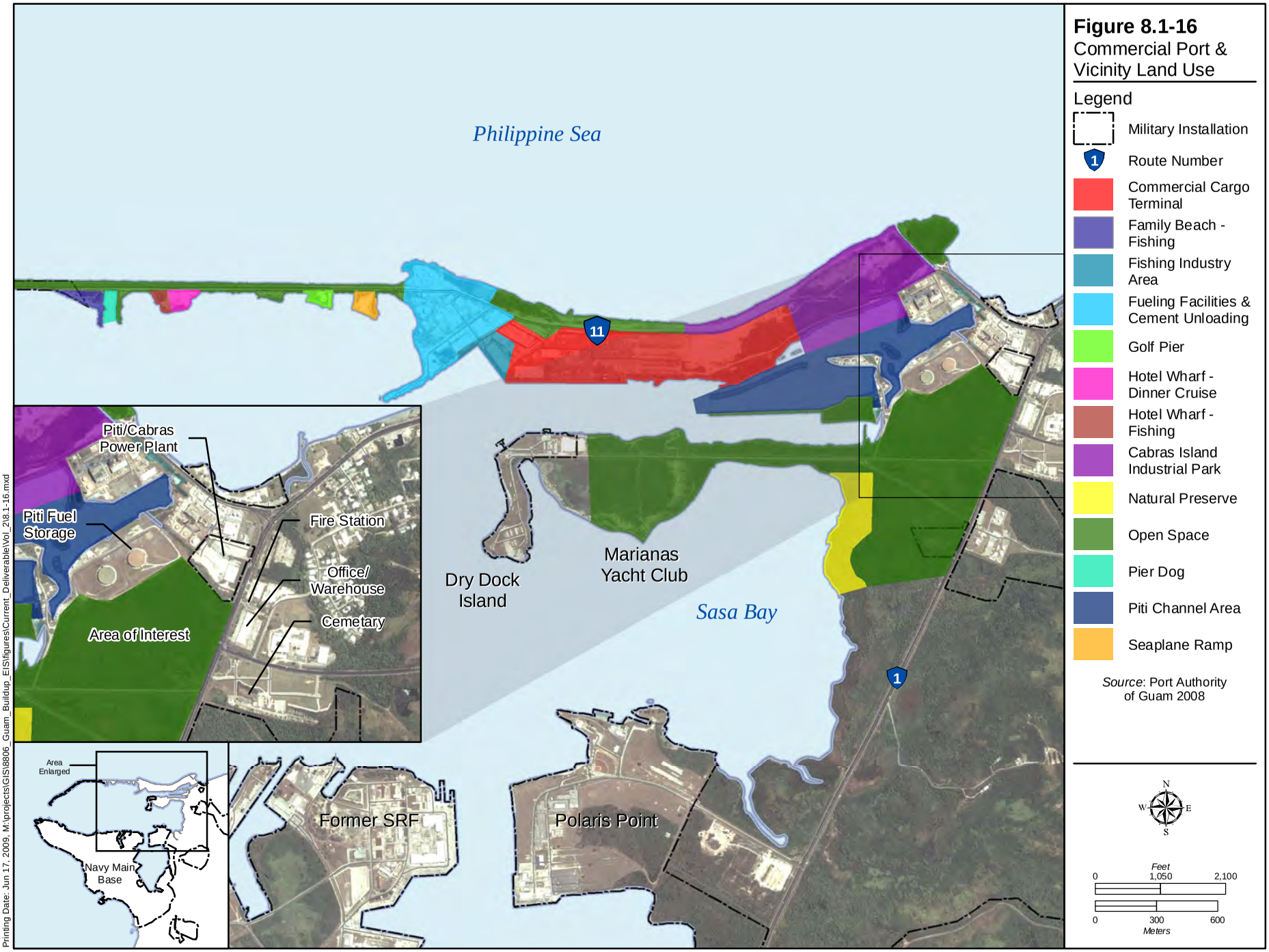
Port Authority Guam and Vicinity

A new power plant is proposed as one of the long-term power alternatives. It would be located within and adjacent to the existing Piti/Cabras Power Plant (Figure 8.1-16), as described in Volume 6 of this EIS/OEIS. The boundary of the parcel required has not been delineated, however assumptions were made based on existing roadways and property boundaries. The northeastern boundary is assumed to be the southern edge of the existing GPA power plant property. The northwest boundary is the Piti fuel storage facility. The eastern and southern boundaries are delineated by Route 1 (Marine Drive) and Route 18, respectively. There is a road leading to the Harbor of Refuge and a fuel storage facility along the west boundary. There are no important or unique farmlands identified at the site (refer to Figure 8.1-3). The area appears vacant (i.e., no modern manmade structures) and naturally vegetated with some areas of ground disturbance (GovGuam 2008).

The property is owned by GovGuam. Historically, the area and adjacent lands were federal land and were authorized to be transferred to PAG under the Brooks Amendment for port-related activities. The lands have been transferred to GovGuam, and the Port Authority of Guam Draft Master Plan Update 2008 identifies the area as open space (PAG 2008). Industrial uses are located northeast (power plant) and northwest (fuel storage tanks). Additional open space is located along Route 18 toward Dry Dock Island and south of the property near Route 18. East of Marine Drive (Route 1) is a cemetery, and GovGuam facilities including a fire station, warehouses and offices.

8.1.4.3 Off Base Roadways

The proposed roadway improvement projects within the Apra Harbor Region are located along existing Routes 1, 2A, and 11, including two pavement strengthening projects (GRN #24 and 26), one MAP project (GRN #50), one intersection improvement project (GRN #5), and a roadway rehabilitation project (GRN #4), as summarized in Table 8.1-5. In addition, three bridges along Route 1 would be replaced (GRN project number is listed in Central Region). The locations of various proposed projects in the Apra Harbor Region are shown in Figure 8.1-17.



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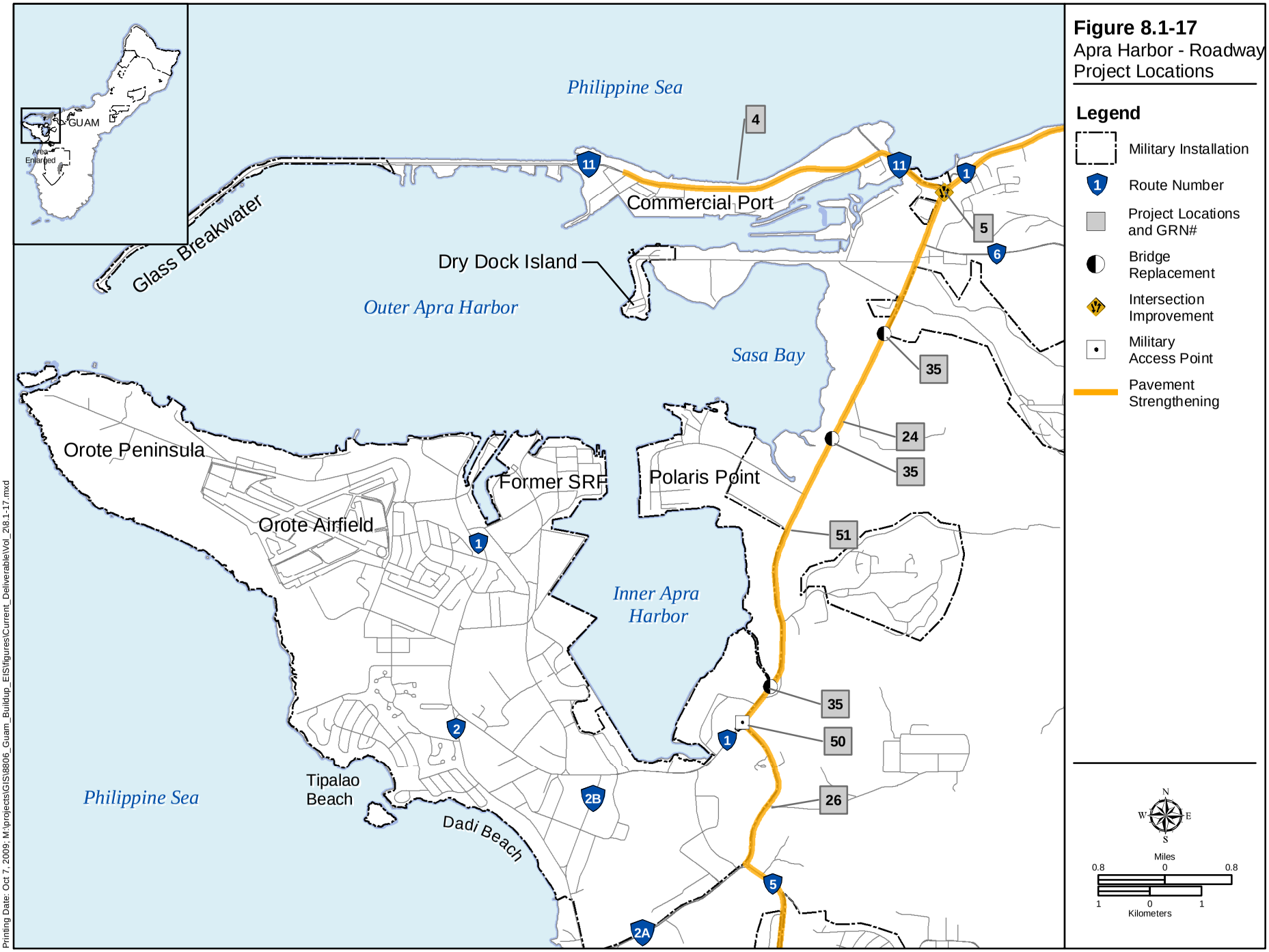

Figure 8.1-17
Apra Harbor - Roadway Project Locations

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Table 8.1-5. Proposed GRN Projects in Apra Harbor Region

Route	*GRN#*	*Segment Limits*	*Pavement Strengthening*	*Intersection Improvements*	*Rehabilitation*	*Bridge Replacement*	*Military Access Point*
1	24	Route 11 to Route 2A	X				
1	50	Naval Base Guam					MAP 14
2A	26	Route 1 to Route 5	X				
11	4	Port to Intersection with Route 1			X		
11	5	Route 1/11 Intersection		X			

Note: Roadway projects in the Apra Harbor Region are the same for Alternatives 1, 2, 3, and 8.

A pavement strengthening project (GRN #24) and a MAP project (GRN #50) are proposed along Route 1 within this geographic region. GRN #24 extends from the intersection of Route 11 to Route 2A. Land uses west of the project alignment include vacant land; conservation land, including the Sasa Bay Marine Preserve; and DoD lands, including Polaris Point and Apra Harbor Naval Complex. Land uses east of the project alignment include urban residential; public facilities, including Guam Public School System and General Services Administration facilities; Guam Veterans Cemetery; Sasa Valley Tank Farm; and commercial land uses near the southern terminus of the project. Ocean uses near the project include the Sasa Bay Marine Preserve. The project also crosses the Atantano, Sasa, and Aguada Rivers.

Route 2A is an inland roadway that connects Routes 1, 5, and 2. A pavement strengthening project is proposed on Route 2A from Route 1 to Route 5 (GRN #26). Land uses adjacent to the project include DoD land (i.e., Apra Harbor Naval Complex), vacant, agriculture/non-urban residential, urban residential, commercial, and industrial. Ocean uses are not near this project.

Route 11 is a roadway that connects Route 1 with the Commercial Port. A two-lane rehabilitation project from the Commercial Port on Cabras Island to Schroeder Junction (the intersection of Routes 11 and 1) (GRN #4) and the Schroeder Junction improvement (GRN #5) are proposed along Route 11. Land uses south of the projects include Kaiser Cement and GovGuam facilities (i.e., Port Authority of Guam [PAG] office building), the Commercial Port, Cabras Power Plant, and Piti Power Plant. Land use north of the project is primarily vacant beach land; Hoover Park is located near the northeastern terminus of the project. Ocean uses near the project include Amphitheater dive spot located in the Philippine Sea and the Piti Bomb Holes Marine Preserve at the northeastern terminus of the project. A thermal outfall from the power plants is located adjacent to the project area at the eastern end of Cabras Island.

8.1.5 South

The data sources used in describing Apra Harbor were also used in this discussion of South Guam land use affected environment. The relevant land area in the south is the Naval Munitions Site (NMS).

8.1.5.1 Naval Munitions Site

NMS is the largest DoD property on Guam at 8,645 ac (3,499 ha) and consists of the naval munitions area and the Fena watershed areas, 75% of which is within explosive safety arcs (Figure 8.1-18) (Navy 2009). It is located approximately 6 mi (9.6 km) south of Naval Base Guam. Vehicular access is provided by Route 1 and Route 5. Naval Munitions Command Detachment Guam is headquartered at NMS. The explosive storage and associated administrative facilities are located in the northern portion of the site.

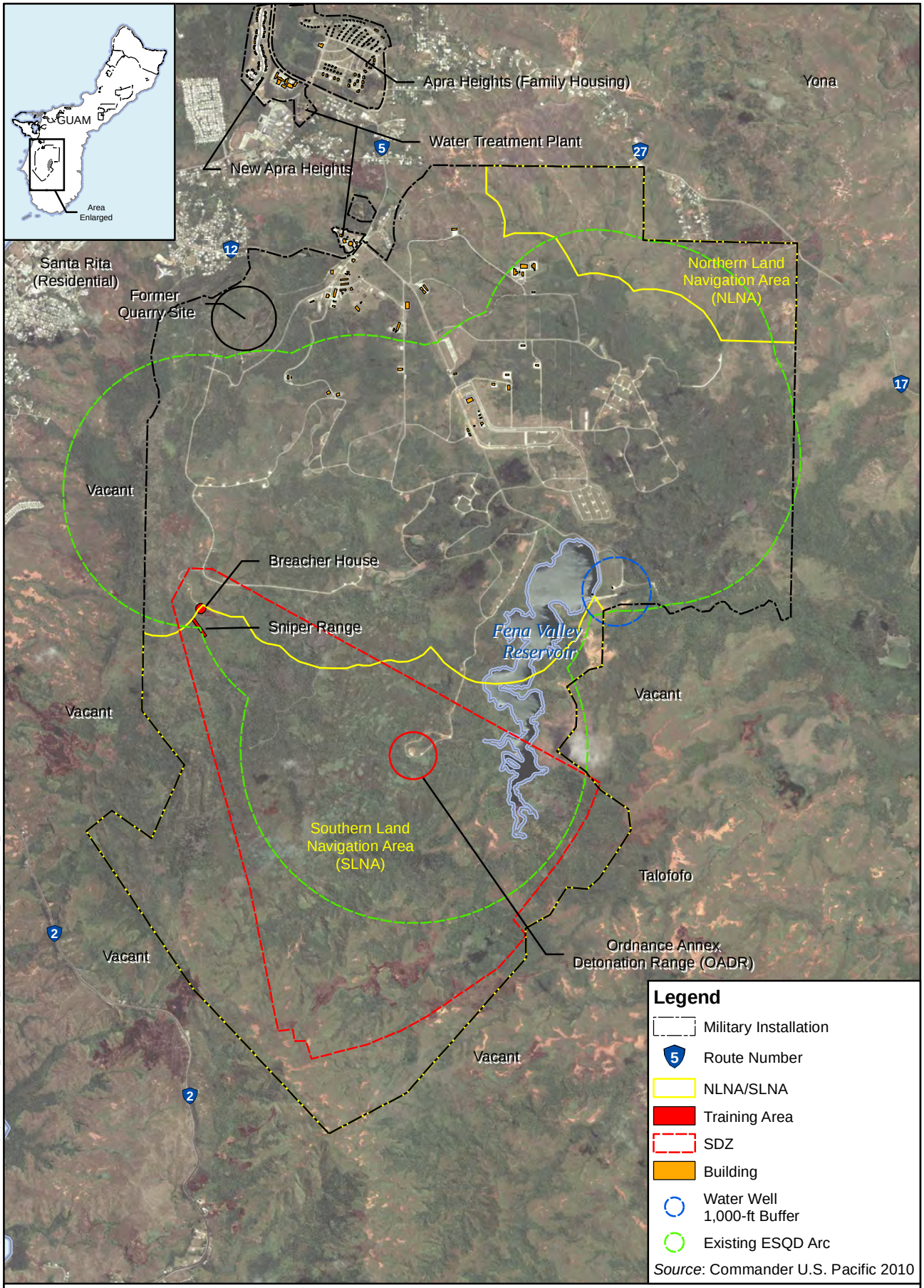

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Figure 8.1-18
Naval Munitions Site Land Use

NMS is the westernmost munitions supply point on U.S. soil and is a vital link to the munitions logistics system supporting the Navy's 7th Fleet.

There are training facilities at NMS that are described in the MIRC EIS/OEIS (Navy 2009) (see Figure 8.1-18) as follows:

- The breacher house is a concrete structure in an isolated part of NMS that is used for tactical entry using a small explosive charge. Live-fire is not authorized in the breacher house. An adjacent flat area allows for a helicopter LZ supporting airborne raid type events.
- The Emergency Detonation Site is located within a natural bowl-shaped high valley area within NMS and is used for emergency response detonations for up to 3,000 pounds (1,360 kg) of explosives. A flat area near Emergency Detonation Site allows for helicopter access. EOD activities are the primary types of training.
- The Sniper Range is an open terrain, natural earthen backstop area that is used to support marksmanship training. The Sniper Range is approved for up to .50 caliber sniper rifle with unknown distance targets.
- The northern land navigation area is located in the northeast corner of NMS where small unit and foot and vehicle land navigation training occurs.
- The southern land navigation area is located in the southern half of NMS where foot- land navigation training occurs.
- Air training activities occur at NMS, including combat search and rescue, insertion/extraction, and fire bucket training.
- Fena Reservoir is the largest freshwater body on Guam and the protected watershed encompasses approximately half (3,670 ac [1,485 ha]) of NMS. There are numerous streams flowing through the installation. There are unimproved roads at the southeast and southwest portions of the site that extend offsite.

Adjacent land use is rural except the residential areas northwest and north of NMS (Navy 2009). The same land use designation is shown at the northeast corner. Other adjacent areas are designated as Undeveloped. No prime or important farmlands were identified adjacent to NMS, except for a small area of important farmland on the southeastern boundary (refer to Figure 8.1-18).

8.1.5.2 Non-DoD Lands

Non-DoD areas of interest for the proposed action would be adjacent to NMS to the south or southeast and would be limited to an access road to the southern portion of NMS at one of three locations. The area, known as the Guam Territorial Seashore Park, appears largely vacant (i.e., no modern manmade structures) and vegetated with some unimproved roads (Bureau of Statistics and Plans 2008). The area is regulated by the Chamorro Land Trust. The area of important farmlands that is adjacent and southeast of NMS extends to the east. There is a discrete area of prime farmland located north of these important farmlands (refer to Figure 8.1-3).

A new power plant is proposed as one of the long-term power alternatives (Volume 6). It would be located within and adjacent to the existing Piti/Cabras power plant as described in Volume 6 of this EIS/OEIS. The boundary of the parcel required has not been delineated and assumptions were made based on existing land use boundaries. The northeastern boundary is assumed to be the southern edge of the existing GPA power plant property. Northwest is the Piti fuel storage facility. The eastern and southern boundaries are delineated by Route 1 (Marine Drive) and Route 18, respectively. There is a road leading to the Harbor of Refuge and a fuel storage facility along the west boundary. There are no important or

unique farmlands identified at the site (refer to Figure 8.1-3). The area appears vacant (i.e., no modern manmade structures) and naturally vegetated with some areas of ground disturbance (Bureau of Statistics and Plans 2008).

The property is owned by GovGuam. Historically, the area and adjacent lands were federal lands and are designated "military" (Territorial Planning Council 1994). The lands have been returned to GovGuam and the Draft Port Authority of Guam Master Plan Update 2007 identifies the area as Open Space (PAG 2008). Surrounding land uses are mixed. Industrial uses are located northeast (power plant) and northwest (fuel storage tanks). Sasa Bay Marine Preserve is naturally vegetated, vacant, and located south of the property of interest and Route 18. East of Marine Drive (Route 1) is a cemetery and GovGuam facilities: fire station, warehouses, and offices.

8.1.5.3 Off Base Roadways

Roadway improvement projects within the south region are located in the village of Santa Rita, including two pavement strengthening projects on Route 5 (GRN #25 and 27), a roadway modification on Route 2 (GRN #110), and a military access point (MAP) project on Route 12 (GRN #52), as summarized in Table 8.1-6. The locations of various proposed projects in the south region are shown in Figure 8.1-19.

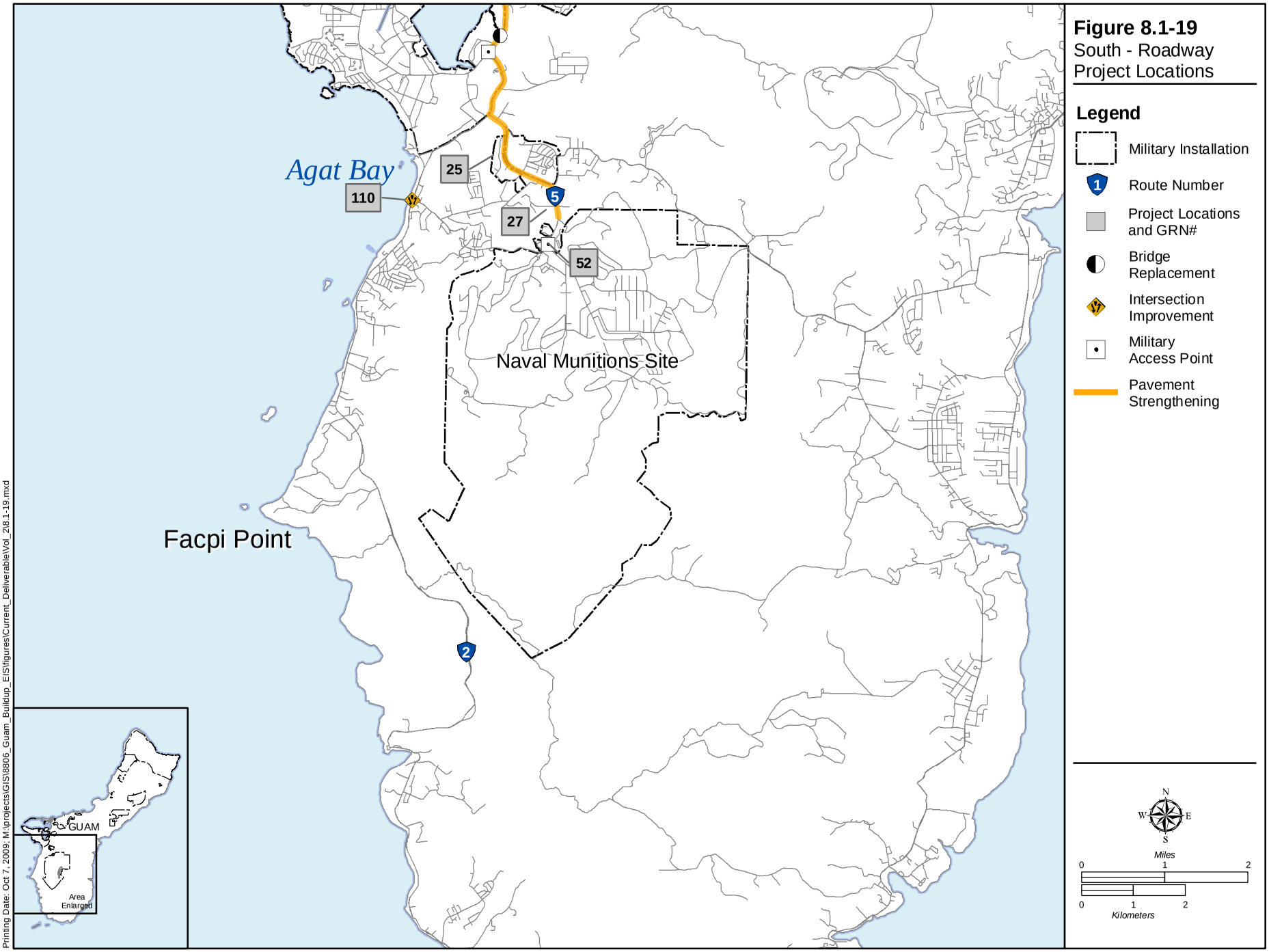
Table 8.1-6. Proposed GRN Projects in South Region

Route	*GRN#*	*Segment Limits*	*Pavement Strengthening*	*Intersection improvement*	*Military Access Point*
5	25	Route 2A to Route 17	X	X	
5	27	Route 17 to Naval Ordnance	X		
12	52	Naval Munitions Site			MAP 16
2	110	Route 2/12 Intersection		X	

Note: Roadway projects for Alternatives 1, 2, 3 and 8 include all projects listed above.

Route 5 is an inland roadway that connects Routes 2A and 12. GRN #25 and 27 on Route 5 are located within the communities of Apra Heights and New Apra Heights in the village of Santa Rita. The surrounding land uses include Navy Housing, the Apra Heights reservoir, vacant land, agricultural/non-urban residential land uses, and community facilities (i.e., Church of Jesus Christ of Latter Day Saints and McCool Elementary School). No ocean uses are within the vicinity of Route 5.

Route 12 is an inland roadway that connects to the intersection of Routes 2 and 2A. Route 2 runs along the west coast of the island adjacent to the Philippine Sea. Improvements within this area include relocation of MAP 16 in the village of Santa Rita (GRN #52) and intersection improvements to the Route 2/12 intersection (GRN #110). Surrounding land uses within the vicinity of these projects include agricultural/non-urban residential, Fena Water Treatment Plant, and NMS. Several beaches and tourist activities are located along the coastline on which Route 2 is located.


Agat Bay
110
25
27
5
52
Naval Munitions Site
Facpi Point
2
GUAM
Area Enlarged
Figure 8.1-19
South - Roadway Project Locations
Legend
Military Installation
1
Route Number
Project Locations and GRN#
Bridge Replacement
Intersection Improvement
Military Access Point
Pavement Strengthening
N
W
E
S
Miles
0
1
2
0
1
2
Kilometers
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8.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

8.2.1 Approach to Analysis

There are two components to the land use analysis: 1) land/submerged lands ownership and management, and 2) land/submerged land use. There are different criteria for assessing potential impacts under these two categories. Short-term impacts would be related to facility construction activities that would be located within the project footprint or on previously disturbed lands. No construction staging area has been designated away from the project site. These construction activities would have minimal and localized impacts on land use. All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

The potential indirect impacts that would be due to changes in land ownership and use are addressed under other specific resource categories such as traffic, noise, natural resources and recreation. Federal actions on federal lands are not subject to local zoning or land management regulations; however, consistency with surrounding non-federal land uses is an important consideration in land use planning. Coastal Zone Management Act consistency determination assessment is being prepared for all Guam proposed action and the correspondence will be included in the Final EIS/OEIS appendices.

8.2.1.1 Determination of Significance - Land Ownership/Management

The impact assessment methodology for land/submerged land ownership and management is not dictated by regulatory authority or permit requirements. The basic premise is that a release of federal lands/submerged lands to GovGuam or individuals have beneficial impacts on the new landowners. Conversely, the taking of land by the federal government may be considered an adverse impact on the entities that are losing ownership or control of their property. "Taking property" in this discussion refers to a situation where the property owner is legally required to sell property to the federal government. There may be some owners who are interested in selling or leasing land to the federal government and would perceive the federal acquisition or lease of their property as a beneficial impact. Other owners who do not want to sell their property (or relocate) are likely to consider the forced sale or relocation as an adverse impact even though they are properly compensated. Until the land negotiations are complete, the impact analysis assumes a significant impact on the individual landowner. There are exceptions to this significant impact for minor rights-of-way and easements for utilities. Mitigation for the taking of property that is not acceptable to the landowner may be a long-term lease agreement instead of purchase where the property returns to the owner on termination of the lease.

The comments received during the scoping period did not support an increase in federal land on island and the increase is considered an adverse impact by some members of the public (refer to Section 8.2.2 for a summary of issues raised during the scoping process). The impacts of the proposed island-wide increase in federal land are being addressed in the Land Acquisition Impact Study portion of the

Socioeconomic Impact Assessment Study that is being developed and will be available as part of the Final EIS.

There are no indirect impacts associated with changes in land ownership, except for those that would be discussed under other resource categories. For example, changes in land ownership may impact potential tax revenue to GovGuam, a potential indirect impact on socioeconomics.

Changes in land ownership may result in access restrictions to non-federally controlled land. This may be an adverse impact and is considered in the land ownership assessment.

8.2.1.2 Determination of Significance – Land Use

The land use impact analysis is based on operational impacts, except for dredging and dredged material disposal management. The assumption is that construction staging and equipment area would be located on DoD land. There would be no land/submerged land acquisition, or restrictions on public access during the construction phase. No farmlands would be lost and construction land use impacts would be temporary. The disturbed area would be situated on previously disturbed land or within the project footprint; therefore, there would be no potential adverse impacts to land use due to construction.

There are three criteria that are applied for assessing impacts on land and submerged land use:

- Consistency with Farmland Protection Policy Act (FPPA) of 1981 (not applicable to submerged lands).
- Consistency with current or documented planned land and submerged land use. Land use consistency includes impacts on access policies and loss of open space.
- Restrictions on access due to changes in land use.

Land Use Criterion 1: FPPA

The FPPA (Public Law 97-98, 7 USC 4201 and 7 CFR 658) is intended for federal agencies to: 1) identify and take into account the potential adverse effects of federal programs on the preservation of farmland land; and 2) consider alternative actions, as appropriate, that could lessen such adverse effects; and assure that such federal programs, to the extent practicable, are compatible with state, unit of local government, and private programs and policies to protect farmland. The FPPA addresses prime and important farmlands. Actions that are not consistent with this FPPA are considered to have an adverse impact and determination of significance is a qualitative assessment of the value of the farmland affected. DoD lands on Guam are not currently used or planned for agricultural use and there would be no FPPA impact associated with changes in DoD land use within the property boundary. The non-DoD lands proposed for acquisition could potentially be used for farming and the potential impacts are assessed.

Land Use Criterion 2: Consistency with current or documented planned land use

Land use plans are intended to guide future development. Potential adverse land use impacts would result from a proposed land use that is incompatible with the existing land use or planned land use or if vacant (i.e., no modern manmade structures) land and open space is developed. It is possible for land uses to be inconsistent, but not necessarily incompatible. For example, residential development next to a park is inconsistent, but compatible, while an industrial facility proposed within a residential area would likely be incompatible and inconsistent. Potential adverse impacts would also result if there are incompatible changes in use within submerged lands. Changes in access policies may result from changes in land use and adverse impacts would result if the access became more restrictive to the public.

The test for impact significance is less rigorous for existing DoD land and submerged land, where limited land availability may result in less than ideal land use changes. Federal actions on federal lands/submerged lands are subject to Base Command approval, but are not required to conform with State/Territory land use plans or policies. The proposed action alternatives of this EIS/OEIS have been developed in consultation with Base Command planners. As a result, there would be no anticipated significant impact to land use within DoD parcel boundaries. Land use changes on existing DoD land could be the basis for significant impacts to other resources (such as visual resources, noise, traffic, recreation, cultural and biological resources) within and beyond DoD land boundaries. Impacts to these resources and others are addressed in other resource chapters of this EIS/OEIS.

Proposed land uses on newly acquired lands would have an adverse impact if they are not consistent with the existing or proposed land use at that site. Similarly, a change in use within non-DoD submerged land could have an adverse impact. The test for significance is the degree of incompatibility and is qualitative. For example, proposed military housing would be consistent with existing or planned civilian residential communities and there would be no adverse impact to land use. A proposed industrial facility in an area that is designated for public park would be a significant impact, while the same facility in an area designated for heavy commercial land use would have no significant impact.

While a proposed land use under the action alternatives may be consistent with existing land use, there is potential for adverse impacts due to changes in land use intensity. For example, a training range that is used once per month may have an adverse impact if it were to be used daily. Potential adverse impacts associated with changes in land use intensity such as increases in marine traffic (Chapter 14), noise (Chapter 6), and unexploded ordnance (Chapter 18) are addressed under other resource area discussions of this EIS/OEIS. No significance criterion is established for land use intensity impacts. Noise from airfields or training may be a land use constraint and is discussed.

Land Use Criterion 3: Restrictions on access

Additional restrictions on public access would be a potential adverse impact. For example an increase in the setback distance from Navy ships for security purposes may restrict access to a SCUBA site. The test for significance is subjective and based on geographic area affected, the schedule or timing of the access restrictions (permanent or occasional), and the population affected.

Physical access restrictions can result if land acquisition by the federal government results in a pocket or island of non-federal land. This would be an adverse impact on the landowner(s) of the pocket of land. The significance of the impact is based on the extent to which the non-federal land is bordered by military land. Significant impacts result when the private property is surrounded by military property because there would be access restrictions and other potential land use limitations to the private property. Similarly, pockets of civilian land use within a DoD installation is an adverse impact on military land use.

Access restrictions have potential indirect impacts on other resources and are discussed in other chapters of this EIS/OEIS.

8.2.2 Issues Identified During Public Scoping Process

As part of the analysis, concerns related to land use and ownership that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. Many of the scoping issues raised regarding land use relate to other resource areas such as noise and recreation and are discussed under those chapters. The following are issues that were identified through the scoping process:

- No increases in federal land ownership (although there were some landowners interested to sell).
- No re-acquisition of lands that have been or are in the process of being released by the federal government.
- All land uses proposed on federal land would be consistent with GovGuam land use plans. Specifically, civilian housing should not be adjacent to industrial or training uses on the Base. Yigo and Dededo were areas of concern.
- Federal government would release South Finegayan and Andersen South.
- Current public rights-of-way would be retained.
- No further restrictions on submerged lands recreational use. Current restrictions have interfered with boat races and competitions in Outer Apra Harbor.

8.2.3 Alternative 1

Unlike other EIS/OEIS resource chapters, there is no discussion of construction impacts for land ownership and use. The assumption is the construction would occur within the project development footprint or on previously developed lands with no impact on land use beyond the project footprints described for operations. Construction would not require additional land acquisition or long-term leasing and would not require relocation of existing uses. Nearby land uses would not be altered during construction. The impacts of construction noise and traffic are addressed in other EIS/OEIS chapters. Land use and ownership changes are considered long-term operational impacts.

8.2.3.1 North

Andersen AFB

The proposed activities at Andersen AFB are the same for all action alternatives. No change in land or submerged land ownership is proposed at Andersen AFB and no new public access restrictions would be created. There are no farmlands at Andersen AFB; therefore, FPPA is not relevant.

The proposed activities are consistent with Andersen AFB land use plans and include: expansion of airfield activities at North Ramp, new embarkation facilities at South Ramp, new munitions storage buildings in the MSA, new access road and gate, aviation training at existing runways of North Ramp and NWF, and other non-firing training in NWF. There would be development in vacant (i.e., no modern manmade structures) areas that are adjacent to developed areas of similar use and consistent with the Andersen AFB land use plans. The Navy helicopter squadron operations buildings would be relocated a short distance from their existing facilities at North Ramp with no adverse impact anticipated. No other relocations of existing land uses are proposed.

Noise levels associated with proposed Andersen AFB airfield activities would not alter the noise contours appreciably. The proposed 80 dBA noise contour would not extend off-base into the civilian community.

Figure 8.2-1 shows the existing and projected affected areas. The on-base and off-base noise contours are similar and impacts would be less than significant. No land uses would need to be relocated and no planned land uses would be modified to avoid noise impacts. The increased use of NWF for training would result in higher noise levels but the noise impacts would be limited to Andersen AFB boundaries.

No new uses are proposed in submerged lands bordering Andersen AFB and no impacts to submerged lands use are anticipated.

Most of the proposed development would be interior of the base, except the proposed access gate that would create a new lighted intersection on Route 9. The new access road would be aligned along an

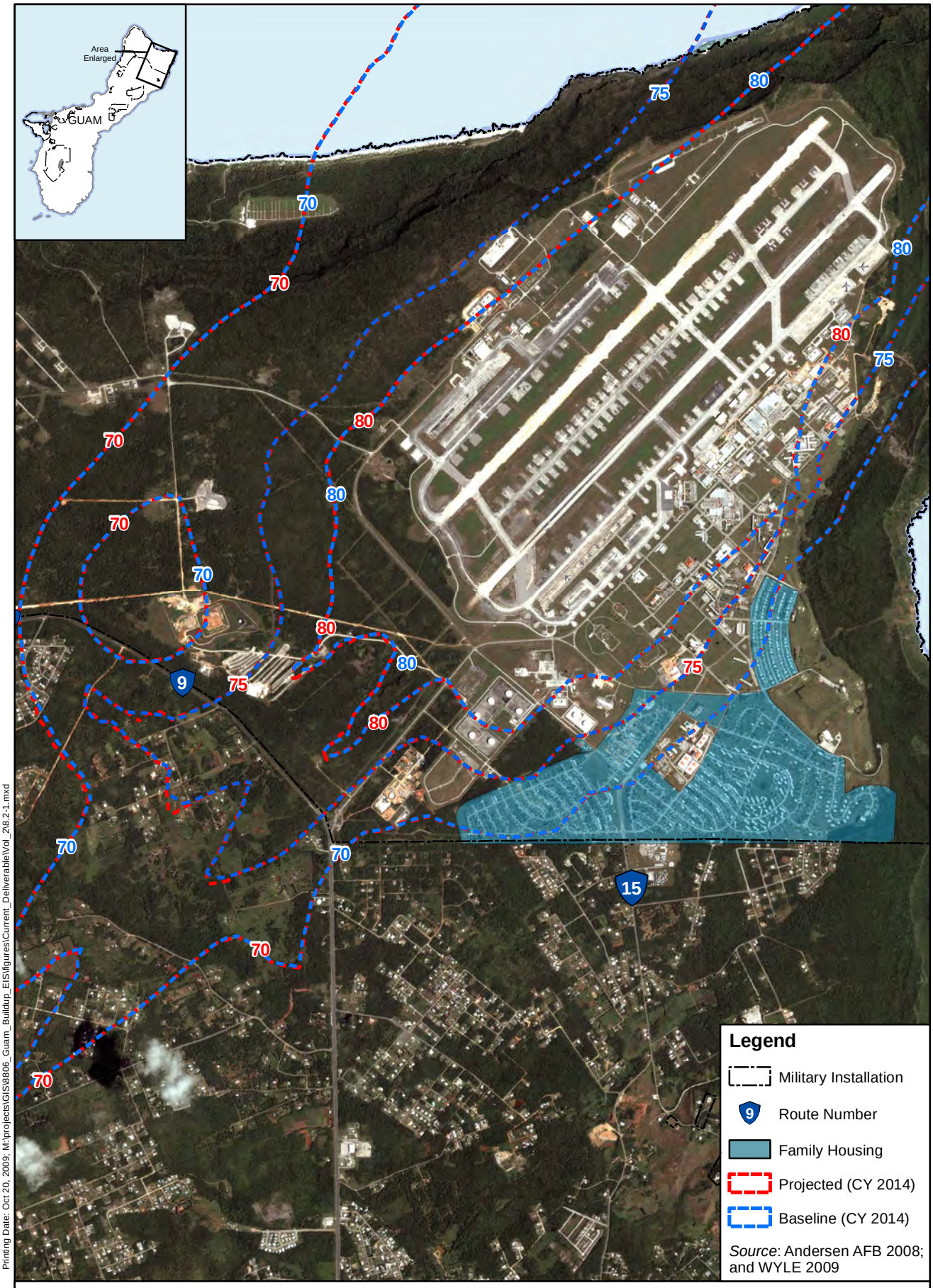


Figure 8.2-1
70 dBA Noise Contours

existing roadway that would be widened. The buildings proposed would also be on vacant (i.e., no modern manmade structures) land that has been disturbed. There is a landfill located adjacent to the site and no impact to or from the landfill use is anticipated. Natural resource, cultural resource and installation restoration (i.e., contamination clean-up) sites that are in the vicinity of the access road and truck inspection facility are discussed in other resource chapters. The loss of open space is an adverse impact, but is not significant because it is an underutilized area of the base. South of Route 9 and the proposed intersection, the area is designated for Village Center and Park/Open Space in the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009). A new access road and entry control gate is consistent with this adjacent use. The potential impacts on adjacent uses are related to traffic, which is addressed in Volume 2, Chapter 14, Transportation.

Under Alternative 1 no significant impacts to land/submerged land ownership or use are anticipated at Andersen AFB.

Andersen AFB Airfield Impact on Civilian Community

Under all action alternatives there would be more air traffic at the Andersen AFB airfield. There would be no change to the accident potential zones at the airfield. As described in Volume 2, Chapter 6 (Noise) and shown on Figure 8.2-1, the projected noise contours generated by airfield activities are not appreciably different from the baseline and no significant land use impacts are anticipated.

At NWF, aviation training noise would not impact land use beyond DoD boundaries. Ground training activities currently detonate 40 pound (18 kg) charges twenty-five times per year, but only one per any given day. The proposed action would add six more detonations to this total, but the training would be three charges per day twice per year. Figure 6.2-2 shows the noise contours associated with this activity. The noise levels would increase, but since the action only occurs twice per year, it would be considered a less than significant impact on land use.

Finegayan

NCTS and South Finegayan

NCTS Finegayan and South Finegayan are federally controlled, as is the submerged land off of the coast of NCTS Finegayan. No change in land or submerged land ownership is proposed at NCTS Finegayan or South Finegayan. There are no farmlands; therefore, FPPA is not relevant. No new access restrictions would be generated by the use of these exiting federal parcels.

The existing small arms range and associated SDZ would be eliminated. This represents a beneficial impact to submerged land use and public access. There would be no change to the existing communications facilities at NCTS Finegayan. Prior to the proposed military relocation, no long-term use was identified for the non-communications facilities at NCTS Finegayan. The buildings that cannot be reused in the redevelopment would be demolished. Vacant (i.e., no modern manmade structures) areas would be developed with a loss of open space. Open space would be incorporated in the design. The loss of open space is an adverse impact to the DoD base, but is offset by the facts that base commands have limited land and expanding missions to accommodate, and use of underutilized space on base decreases need for land acquisition or long-term leasing. The maximum height of the buildings would be six floors. Redevelopment of the area as a main cantonment area for the Marine Corps would be consistent with historical Navy use. The total area proposed for main cantonment development is approximately 1,380 ac (558 ha).

The potential impacts of the Overlay Refuge is discussed in Volume 2, Chapter 10, Terrestrial Biological Resources. No significant impact on land use is expected.

South Finegayan is used for military family housing and under Alternative 1, it would continue to be used for family housing. There would be more family housing units developed on land than was historically used for housing. No significant land use impact is anticipated under Alternative 1 at South Finegayan.

The intensity of land use at NCTS Finegayan and South Finegayan would increase over existing conditions. The impacts of the change in land use intensity are addressed in other resource chapters of this EIS/OEIS.

On the west side of Route 3, existing uses of adjacent non-federal lands are vacant (i.e., no modern manmade structures) lands that surround South Finegayan and are south of NCTS Finegayan. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) identifies the area as the Dos Amantes Planning Area that includes Hotel/Resort and Urban Center land use designations. The proposed land uses on federal land boundaries would be consistent with future development on adjacent properties.

East of NCTS Finegayan and Route 3 the existing and designated future land use is Very Low Density Residential, with the exception of the Village Center land use designation in the vicinity of the southeast corner of NCTS Finegayan.

South Finegayan is adjacent to vacant land to the north, west and south. Residential communities are east of Route 3. The land use designation for future development west of South Finegayan and along Route 3 is Mixed Use and further east beyond the Mixed Use is designated for residential use. The existing land uses and proposed land use designations for future development on adjacent properties are consistent with the proposed development under Alternative 1. No significant impacts are anticipated.

Potts Junction

No change in land ownership is proposed at Potts Junction. No new access restrictions would be generated. There are no farmlands; therefore, FPPA is not relevant. There are no submerged lands associated with Potts Junction because the parcel is inland.

Potts Junction was previously used for fuel storage and under Alternative 1 it would be used for utilities to support the main cantonment at NCTS Finegayan. See Volume 6 of this EIS/OEIS for the utilities impact assessment discussion.

Non-DoD Land

Former FAA

The acquisition of the Former FAA parcel would be a significant impact on land ownership if the landowner were forced to sell or relocate, or if access to the site would be restricted to authorized personnel. As the parcel would extend from Route 3 to the coastline, but development would not extend beyond the cliffline toward the ocean, no new restrictions on access would be generated. The Navy controls the adjacent submerged lands and no acquisition of submerged lands is proposed. No farmlands were identified at the site; therefore no impact on FPPA is anticipated. A beneficial land use impact would be the elimination of the existing gap between NCTS Finegayan and South Finegayan and the formation of a contiguous base.

The property is vacant (i.e., no modern manmade structures) but portions are disturbed as a result of historical FAA use. The Former FAA parcel and property south of the parcel is within the Dos Amantes Planning Area that would include residential, tourism, and commercial land uses. The proposed use of the

Former FAA parcel is for the main cantonment, primarily community support, and bachelor housing components, which are compatible with the Dos Amantes Plan land uses. Decontamination training at the Main Cantonment would not impact land use. The Dos Amantes Plan does not specifically call out the educational and recreational uses of open space at the site. The loss of open space at the parcel would be an adverse impact, but not a significant one, since there are plans for development of the area under the No Action Alternative. No impacts to the DoD submerged lands adjacent to the parcel are anticipated, and no significant impacts were identified relative to changes in land use under Alternative 1.

GLUP 77

None of the action alternatives propose acquisition or long-term leasing of GLUP 77; however, Alternative 1 does result in the parcel being bounded by federal land in three directions and the Philippine Sea to the west. This would create a pocket of non-federal land of the GLUP 77 parcel. Navy submerged lands are on the western boundary of the parcel. This pocket of non-DoD land represents an adverse land use impact on the future use of the GLUP 77 parcel. The degree to which the property would be surrounded is considered a significant, but mitigable impact. Access to the parcel would be provided, but the access road from Route 3 would likely be less direct than the current access. The proposed surrounding federal uses are family housing and community support, which would be consistent with proposed development of GLUP 77 as part of the Dos Amantes Planning area that includes Hotel/Resort and Urban Center land use designations. There are cultural and natural resources that draw recreational and educational use. The affected area (undeveloped or residential with low to moderate density) would be mitigated by providing a fenced right-of-way access to the parcel. In addition, future development of GLUP 77 would benefit from having utility infrastructure installed nearby. With respect to land and submerged land ownership, less than significant adverse impact is anticipated.

Harmon

The acquisition of the Harmon property would be a significant impact on land ownership and access to the public would be restricted. No acquisition of submerged lands is proposed and the parcel does not border the ocean. The submerged lands in the vicinity are Navy-owned. USDA designated important farmlands were identified at the site. The community planned land uses at the property and adjacent are not consistent with this agricultural land designation. The area is not currently used for agriculture. This is an example of soils suitable for agriculture that would not be used for agriculture, either under the proposed action or no action. No impact on FPPA is anticipated. Acquisition would create a pocket of non-federal land as described under the GLUP 77 discussion.

Under Alternative 1, the proposed use of the Harmon property would be military family housing. This proposed land use is consistent with the Dos Amantes Planning area that includes Hotel/Resort and Urban Center land use designations.. The development of vacant (i.e., no modern manmade structures) land represents a loss of open space and is an adverse impact. The impact would not be significant, since the Dos Amantes future Hotel/Resort and Urban Center land use designations are compatible with the proposed military family residential land use. The acquisition would not extend to the coastline and no impacts on submerged lands are anticipated.

8.2.3.2 Central

Andersen South

Andersen South is not on a coast; therefore, there are no submerged lands associated with it. No change in land ownership is proposed at Andersen South. and no pockets of non-federal land would be generated, once the U.S. Department of Education (DOE) land swap is completed with the Guam Department of

Education. There are no farmlands onsite; therefore, FPPA is not relevant. No significant impacts are expected.

Andersen South would be developed as a non-firing training range complex under Alternative 1. The majority of the site is vacant (i.e., no modern manmade structures). The abandoned buildings and vacant (i.e., no modern manmade structures) lands are presently used for non-firing training. A perimeter fence would restrict access to the site. Any agricultural leases that remain at the time of construction would be terminated by the Air Force. This would not be a significant impact because there are other lands available for agriculture.

The proposed land use at Andersen South is consistent with the existing use and no adverse impact is anticipated. An unimproved helicopter landing area would be sited in the area to minimize impact to other training uses. A perimeter fence would be constructed around Andersen South with a main gate and three range gates for access. There would be an increase in land use intensity under all action alternatives. The impacts of the change in land use intensity are addressed under other resource chapters of this EIS/OEIS.

The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designated the adjacent land uses as residential with some exceptions. Along the northern boundary are two discrete land areas designated: Village Center, and Industrial. On the western boundary is an area of Commercial use. The proposed development of a non-firing training area is consistent with proposed residential land use on adjacent property. Andersen South would largely remain open space, with new roadways and minor support facilities, except for the redeveloped MOUT training compound, which would be a cluster of low-rise buildings in the southern area of the site. The development would not impact water productions wells and transmission system onsite. The public high school would be sited to be compatible with the proposed training at the site.

Under Alternative 1, no significant impacts to land/submerged land ownership or use are anticipated at Andersen South.

Barrigada

The Navy and Air Force Barrigada parcels are contiguous federal lands. No change in land ownership is proposed and no new access restrictions would be generated. There are no farmlands onsite; therefore, FPPA is not relevant. The parcels are both landlocked; therefore, there are no associated submerged lands.

Alternative 1 would have no impact on existing or planned land use on either Barrigada parcel.

Non-DoD Land

Both training Alternatives A and B require acquisition of non-federal land located east of Route 15 and Andersen South. This would result in a significant but mitigable impact on land ownership, as described in the approach to analysis. Alternative B requires more land acquisition or long-term leasing than Alternative A. Access to property associated with either alternative would be limited to authorized personnel throughout most of the year. No pockets of non-federal land would be created, but there would be new restrictions on public access.

Access to historic sites, hiking trails and beach areas would require DoD approval and would be limited to periods of no training and subject to DoD approval. More specifics on access are provided in Volume 2, Chapter 12 (Cultural Resources) of this EIS/OEIS. No acquisition of submerged lands is proposed; however, the proposed firing ranges on the property would generate SDZ that extend into the submerged lands and access would be restricted during training. SDZs over navigable waters are controlled by USACE, which would publish a rule in the Federal Register per CFR Title 33 Navigation and Navigable

waters, Part 334, Establishment and Amendment Procedures in the Federal Register. In accordance with 33 CFR 334.480, designated areas encompassing the SDZs are restricted to navigation during periods when the ranges are in use. A NOTMAR /NOTAM is issued for every day the range is in use. The area would be monitored and if a vessel does enter the SDZ, firing must cease and the boat would be escorted out of the restricted area.

This added restriction to non-DoD submerged lands is considered an adverse impact to submerged lands use. Alternative B would encumber a larger area of submerged lands. Other EIS/OEIS chapters, including Volume 2, Chapter 9, Recreational Resources, discuss related impacts. No primary farmlands were identified at the site, but the area that was previously owned by the federal government, located along the east side of Route 15, is identified as important farmlands (refer to Figure 8.1-3). The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designates these important farmland area and all of the Route 15 property adjacent to Route 15 for residential and park/open space land use, not agricultural use. No significant impact to FPPA is anticipated because there are no prime farmlands, no existing farms identified, and the planned land use designation is not agricultural.

If firing range Alternative A is selected, then a portion of Route 15 would be relocated to within Andersen South and the southeast corner of Andersen South would be incorporated into the live-fire training complex. There would be no change to Route 15 alignment if Alternative B is selected. In both alternatives, Route 15 would be the boundary between non-firing and firing range complexes. No adverse impact to land use would result from the relocated Route 15 because the route would be through existing DoD land and abandoned housing that is proposed for demolition. The realignment of Route 15 may result in impacts to other resource areas, such as traffic, that are addressed elsewhere in this EIS/OEIS.

Alternatives A and B would require relocation of the International Raceway Park and residences, affecting multiple landowners. The majority of the site is undeveloped. There are natural and cultural resources that encourage educational and recreational activities in the area. These activities would be suspended during training. In addition to the residential land use designation on the Route 15 property, the *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designates areas along the coast for Park/Open Space. The Residential and Park/Open Space designations extend northeast and southwest of Alternatives A or B property boundaries. The land disturbance required for firing ranges is concentrated at the firing points and targets, and perimeter access road and fencing. The majority of the site would remain naturally vegetated open space and encompass the SDZs. Live munitions training is not consistent with the planned residential land use at or adjacent to the Route 15 alternatives. On the other hand, most of the area that is required to accommodate the SDZ would be undeveloped and remain open space. Although the impact to land use could be considered beneficial with respect to maintaining open space, the impact analysis conservatively assumes there would be an adverse, but not significant, impact to land use based on incompatibility of training ranges and planned designated residential land use in the vicinity.

There would be noise generated at the proposed firing ranges. There are two major noise sources generated from small arms munitions firing. The first is the muzzle blast from the firing of a bullet. The second is the noise from the bow shock wave (also known as ballistic wave) generated by the super-sonic bullet. The bow shock wave propagates out from the path of the bullet. The bullet from an M16 has an exit velocity of approximately 3,100 ft (945 m) per second, but decelerates quickly. After approximately 3,937 ft (1,200 m), it is no longer flying at supersonic speeds and the shock wave would likely end within 6,562 ft (2,000 m).

Firing noise from single shots merged in bursts, machine gun burst, and concurrent firing of multiple weapons, as would occur at the proposed ranges, would result in short periods of intense firing followed by longer periods of silence. There is increased annoyance associated with this noise exposure pattern. Under these conditions, the number of shots becomes less important than the dB level of the typical (average) shot. It has been found that small arms fire is usually not a concern unless the linear peak sound pressure level of individual shots is above 85 dB PK 15(met).

The results of the modeling of Range Complex Alternatives A and B are provided in Figure 6.2-5. As described in Chapter 6, Noise, there are different criteria applied to ground training. Three noise zones are described. Zone II consists of an area where the DNL is between 65 and 75 dBA or 62 and 70 dBC, or the PK 15 (met) is between 87 to 104. Exposure to noise within this zone may be considered incompatible with noise-sensitive land uses and use of the land within the zone should normally be limited to activities such as industrial, manufacturing, transportation, and resource production (e.g., industrial parks, factories, and highways).

Under the Alternative A, the Zone II noise contours extend approximately 13,100 ft (4,000 m) beyond the eastern boundary of Route 15 lands and Zone III contours extend to just under 330 ft (100m) beyond the eastern edges of the Route 15 land. Alternative B would generate a Zone II extending 2,000-4,000 ft (600-1,200m) east of the Andersen South and Route 15 lands and approximately 4,600 ft (1,400m) west of the Route 15 boundary. The Zone II contour would extend approximately 230 ft (70m) across Route 15 just to the west of Andersen South. Both alternatives encompass lands designated for residential and open space park land uses. The residential land uses would be incompatible with the nuisance noise generated at the firing ranges. Alternative A would impact less area designated for residential land use. Based on the Guam (Bureau of Stastics and Plans 2009) aerial photos there appears to be very low density residential structures in both alternatives, but fewer would be impacted under Alternative A. Most of the area is currently vacant.

Mitigation of such noise impacts are discussed further in Volume 2, Chapter 6 (Noise). While noise levels reach those considered incompatible with current land use, it is unlikely any civilians would be forced to relocate due to training operations, thus less than significant impact is likely.

Proposed training ranges on the west coast were eliminated from consideration because the proposed access restrictions would have significant adverse impacts on submerged lands use. There is less submerged lands activity on the east coast within the SDZ than the west coast, therefore the impact on submerged lands was minimized. The range complex development plan would be based on the minimal amount of land to be acquired to minimize the impact on land ownership and use. The restricted access to the Route 15 property would impact the educational and recreational activities, but limited access would be provided to the extent feasible, subject to DoD approval.

8.2.3.3 Harbor/Waterfront

No decision has been made in connection with the future reuse of the Former SRF lands to include continued leasing for commercial ship repair facility purposes beyond the current 2012 lease term expiration date. If the relocation of the USCG facility to within the current leasehold footprint was to occur during the current lease term, such action would be considered an adverse impact on the current lessee (and sublessee). This is a conservative assessment and assumes the lessee would prefer not to reduce the lease area, but does not evaluate the increase in efficiency that may result from consolidation of shipyard activities. The adverse impact would not be significant because: 1) the Navy is entitled to change the terms of the lease at lease renewal; 2) the sub-lessee would be able to continue ship repair operations with no reduction in capacity or service capability; and 3) existing access policies would be

retained. The current lease area is a pocket of non-federal land within the Navy Main Base and the reduced footprint would continue to have Navy land on all sides of the lease area with no adverse impacts on land use.

Existing buildings at the proposed USCG site would be demolished, some of which are being used by Guam Shipyard. The uses would be relocated and consolidated to facilities within the reduced lease footprint. Future DoD development at Former SRF would maintain the required AT/FP facility setback distances from civilian land uses with minimal impact on future development potential.

The military working dog kennel at Victor Wharf would be relocated to a place interior of the base (as discussed under Naval Base Guam). Relocations are typical of expanding bases. No significant impacts to land use are anticipated.

The proposed improvements to existing wharves under Alternative 1 in Inner Apra Harbor are consistent with the existing Navy harbor land uses. Dredging activities (from -35 MLLW to -38 MLLW at Sierra Wharf) in active Navy harbors are typical to support deeper draft ships and to maintain construction depth.

The Landing Craft Air Cushion/Amphibious Assault Vehicle (LCAC/AAV) laydown area is a new land use within Inner Apra Harbor. The vacant (i.e., no modern manmade structures) land is naturally vegetated. It would be developed with parking areas and support buildings representing a minor loss of open space to construct facilities typical of an active harbor. A new access road would also develop vacant (i.e., no modern manmade structures) land with minor impact on land use.

The support facilities at Victor Wharf and the cargo staging area would involve new uses on areas that have been disturbed by previous activities. There would be a minor loss of open space in the industrial area that is underutilized. No significant impacts to land use are anticipated.

No new training activities are planned in the submerged lands of Apra Harbor. Access to Inner Apra Harbor would continue to be restricted to authorized military ships. No projects are proposed in Outer Apra Harbor to support the Marine Corps relocation. There would be no significant impacts.

Naval Base Guam

The proposed projects at Apra Harbor are the same under all action alternatives. No submerged land acquisition is proposed. No farmlands are located on base; therefore FPPA is not relevant. No change to the access policy is proposed. All projects are proposed interior to the base, not in the vicinity of adjacent non-federal properties. All proposed projects and land uses are consistent with the Naval Base Guam land use plan. No significant impacts would occur.

There is adequate area for construction staging at the project sites. The proposed projects are sited to be consistent with the Navy Base Land Use Plan. The military working dog kennel would be located on vacant (i.e., no modern manmade structures) grassed land within the Industrial Support area of the base. The area is isolated from other facilities, which provides a suitable quiet environment for the dogs.

The Apra Harbor Medical/Dental Clinic would be appropriately sited on the edge of Fleet/Community Support area. The clinic site is vacant (i.e., no modern manmade structures), but previously developed as a public works site.

Use of Orote Airfield for helicopter landings is consistent with existing helicopter training that occurs on the airfield.

Dredged material management alternatives are described in Chapter 2 and Volume 9, Appendix D. No impact analysis is provided on beneficial reuse projects because there are no specific projects to be implemented. However, potential beneficial use projects are listed below. The USEPA designated ODMDS is beyond the Navy and territory submerged lands boundary. The potential impacts of the designation of the ODMDS are addressed in a separate EIS (USEPA 2009). The use of an EPA designated ODMDS would have no impact on submerged land use. The site was specifically selected to avoid submerged land use impacts (USEPA 2009). The ODMDS has sufficient capacity for the dredged material. Only sediment determined to be acceptable, through laboratory analysis, would be permitted by USACE to be disposed in the ODMDS.

The feasible upland placement sites are Fields 3, 4, 5, Public Works Center and Polaris Point as shown in Volume 2, Figure 2.5-3. Note that the PAG upland placement site is not retained in this impact analysis because it is not on Navy land. The landowner would be responsible for National Environmental Policy Act (NEPA) documentation for use of the site. One specific upland placement site or specific combination of sites is not provided in this EIS/OEIS; rather a range of sites is proposed. As noted in detail in Volume 9 Appendix D, there is sufficient capacity, with berm modification, in the Polaris Point and Field 5 sites individually to contain 100% of the total volume of the dredged material for any alternative selected for both Inner and Outer Apra Harbor dredging.

Beneficial Reuse

Between 1 to 1.1 million cubic yards (CY) of dredged material would be excavated from the Inner and Outer Apra Harbor for the proposed Navy and Marine Corps actions. The dredged material is expected to consist of a mixture of sediments including sand from the outer harbor and silts/clays from the inner harbor. Additionally, there will be coral fragments and other submerged rubble that would be included in the volume of dredged material.

Beneficial use of portions of this total volume would be possible and several potential local projects have been identified. These local projects include:

- *Support shoreline stabilization below Aircraft Carrier Wharf:* As part of the construction process, some fill would be used with the rip rap stone that would be placed along the shoreline and under the wharf to support the piles. Approximately 40,000 CY of quarry stone in addition to an estimated 20,000 CY of rip rap stone is envisioned for this stabilization purpose. It is possible that some of the rubble or some other suitable material from the dredged material could be used and mixed in below the quarry stone layer. Therefore, it is estimated that approximately 50% of the quarry stone amount or 20,000 CY of the dredged material could be used.
- *Fill of berms and backstops at proposed military firing ranges on Guam:* There are a number of berms and backstops that would be constructed as part of the development of new military firing ranges on Guam. The berms range in length from 35 to 255 ft (11 to 78 m); 7 to 56 ft (2 to 17 m) in width; and 3 to 7 ft (1 to 2 m) in height. Fill would be used to create these earthen mound structures. The volume within these berms and backstops has been calculated and equals an estimated 160,000 CY.
- *Port Authority of Guam (PAG) expansion program:* The PAG has prepared a Master Plan that includes a proposed 18-acre (7-ha) area for expansion of fast land to support new commercial port cargo handling in Apra Harbor. The potential in-water expansion project is a major endeavor that may be subject to cost, feasibility and ecological concerns and also require full environmental documentation by USACE and subsequent permit approval before

implementation. Up to 1.5 million CY of artificial fill would be needed to create this new land if this PAG expansion program comes to fruition. The Navy has a memorandum of agreement with PAG to provide fill from proposed dredging projects should the material be deemed suitable and the timing and logistics of both projects work out.

Given the potential availability of these upland beneficial use projects on Guam, the following four scenarios are possible for the disposal or placement of the proposed dredging projects in the inner and outer Apra Harbor:

- 100% beneficial use with all dredged material being used as artificial fill for the PAG expansion program (either direct waterfront placement or following placement at PAG upland placement site)
- 20-25% beneficial use of dredged material in berm construction and under wharf for shore and pile stabilization (assumes no PAG need and/or logistics/approval problems for use of fill) and 75 to 80 % ODMDS placement;
- 100% upland placement on existing Navy confined disposal facilities on base on Apra Harbor; and
- 100% placement in the Guam ODMDS.

All candidate upland sites are described, but only one of the upland sites would be required to accommodate the Sierra Wharf dredged volume (Volume 2, Figure 2.5-3). The upland placement sites are considered temporary (3 to 4 years), but could be reused for future dredging projects. The sites are all currently vacant (i.e., no modern manmade structures) and would be developed with bermed perimeters approximately 16 to 30 ft (5-9 m) in height. When the material is dry it can be beneficially reused or stockpiled temporarily. Based on preliminary sediment characterization (described in Volume 2, Chapter 4, Water Resources), the dredged materials would not require special treatment or handling and there is no anticipated long-term impact to land use. There would be no significant impact on future land use after the disposal site is removed.

The stockpiling of material in existing uplands placement sites is considered an adverse land use impact because developable land in an island environment is in short supply. Using developable land to stockpile material is not the best use of the land.

Upland placement sites appear as piles of wet sand within a grassed perimeter berm. From a land use perspective, upland placement sites do not preclude future use and would have no impact on adjacent uses. The stockpiling of material, including dredged material, tends to occur in operational, industrial, or remote areas primarily based on visual impact and ease of access. During construction of the upland placement facility and the dredging operations, there would be temporary impacts associated with on-base traffic on routes between the sites and the harbor.

Fields 3 and 5 and Polaris Point have been addressed in other NEPA documents. Though no significant land use impacts were identified, potential land use impacts associated with the sites are as follows:

- Polaris Point: The site is vacant (i.e., no modern manmade structures) and landscaped (grass). The land use designation at the site is Fleet/Community Support and Operations (refer to Figure 8.1-14). The recreational and operational uses at Polaris Point are outside the site boundaries. The upland placement site is temporary and would not preclude use of the areas for recreation in the future. No morale, welfare, and recreation (MWR) projects have been programmed in the area. The piles of drying dredged material would be compatible with the industrial and Fleet/Community Support land uses in the vicinity. A helipad is being

considered (not part of this proposed action) at the southern coast of Polaris Point, and no land use conflict is anticipated. There are minor remnant structures that would be removed. Water and sewer lines would be realigned. The Polaris Point site was considered for the Inner Apra Harbor maintenance dredging project. No adverse impacts to land use were identified in the *Final Environmental Assessment Inner Apra Harbor Maintenance Dredging, Guam, Department of Navy, October* (Navy 2003).

- Field 5: The potential environmental impacts of using Field 3 and Field 5 are addressed in the P-431, *Alpha-Bravo Wharves Improvements Environmental Assessment* (COMNAV Marianas 2006). Portions of Field 5 were used for the placement of dredged material from the P-431 project. 75% of the site was cleared of tangantangan forest for the P-431 project and the remainder would be cleared if Site 5 were selected for the proposed action. The proposed use is consistent with the Industrial Support land use designation (refer to Figure 8.1-14). Expansion of an existing upland placement site is consistent with the existing land use and surrounding operational uses. There is a sanitary sewer and overhead power line at Field 5 that would be relocated.
- Field 3: Field 3 is vacant (i.e., no modern manmade structures) and landscaped (grass). The land use designation at the site and vicinity is Fleet/Community Support (refer to Figure 8.1-14). The retail center buildings in the vicinity include the Exchange and the Commissary. The site is remote from the retail facilities and pedestrian retail traffic. The piles of drying material at the upland placement site would be compatible with retail facility and parking lots in the vicinity. No land use impact on existing facilities is anticipated. There is an underground water line along the boundary of Field 3 that would be relocated.
- Public Works Center (PWC): The PWC site is within the Navy's Operational land use designation (refer toFigure 8.1-14). The site was previously used as the PWC compound for the base and there are remnant structures and concrete pads that would be removed. There is a sewer line along the southern boundary that would be retained. The proposed use of the site is consistent with its Operations land use designation. A new Apra Medical/Dental Clinic is proposed on the eastern boundary of the site. The piles of drying material would have no impact on the medical/dental clinic land use.
- Field 4: Field 4 would require relocation of overhead power lines, and underground sewer and water lines. The proposed use is consistent with the Industrial Support designation on the Navy Land Use Plan. The site was reduced on the southern end to accommodate the relocation of the military working dog kennel from Victor Wharf. The two land uses are compatible.

No significant impact to land use would result from the use of any of the candidate upland placement sites. The use of the sites would be considered temporary. No long-term environmental impacts are anticipated at the sites, based on preliminary sediment sampling and analysis data. After the dried material is removed from the site, additional sampling would be conducted prior to the site being reused to ensure the environmental conditions were suitable for the specific land use proposed. No constraints on future land uses at former upland placement sites are anticipated.

Opportunities for beneficial reuse of the dredged material would be identified during design to reduce the amount of land required for upland placement. The upland placement sites were subject to a screening analysis that included potential impact to land use. Upland placement of dredged material would be minimized by disposing of suitable dredged material into the ODMDS. Only one of the candidate upland placement sites would be required to accommodate the entire Sierra Wharf dredged volume. The site

would be sized to meet the project requirements; therefore, only a portion of an upland placement site may be developed. This would minimize the impacts on the amount of vacant (i.e., no modern manmade structures) land being developed.

The impact on the GEDCA lease is unavoidable. The reduction in non-DoD land use is an adverse impact. This is a conservative assessment and assumes the lessee would prefer not to reduce the lease area, but does not evaluate the increase in efficiency that may result from consolidation of shipyard activities. The adverse impact would not be significant because: 1) the Navy is entitled to change the terms of the lease at lease renewal; 2) the sub-lessee would be able to continue ship repair operations with no reduction in capacity or service capability; and 3) existing access policies would be retained. The reduced lease footprint has the beneficial impact of increasing land use efficiency in the area.

No significant impacts to land or submerged lands ownership or use were identified under Alternative 1 at Apra Harbor and no mitigation is proposed. The projects proposed are all compatible with adjacent land uses.

8.2.3.4 South

NMS

NMS is Navy property. No submerged lands would be affected, and no farmlands are designated at NMS. The proposed munitions storage facilities and the maneuver training are consistent with the existing land uses. The storage facilities are sited to meet explosive safety criteria in the vicinity of other storage facilities in the northern portion of NMS. The ESQD arcs generated by the new storage facilities would not increase the existing encroachment on non-DoD property. There would be a less than significant impact associated with the loss of open space.

The proposed unimproved helicopter landing zone would be sited on vacant (i.e., no modern manmade structures) land in an area that meets explosive safety requirements.

Maneuver training areas exist at NMS, but intensity of use would increase in the SLNA (refer to Figure 8.1-18). The location for training is selected because it is in its natural undeveloped state and provides a realistic training experience. Except for a parking area, the training area would be maintained in the naturally vegetated open space state.

No significant impact to land use or ownership at NMS is anticipated.

Non-DoD

An access road is proposed for the southern portion of NMS through non-federal land, and would require an easement or other instrument to provide unrestricted access to the proposed access road. Two alternatives are proposed, improved and unimproved, but from a land ownership perspective there would be no difference between them. The federal acquisition of land represents an adverse impact assuming the landowner does not wish to sell their land. However, the area required is small relative to other land acquisitions under the proposed action and is considered a less than significant impact.

Alternative A is improved and Alternative B is unimproved. Both alternatives would have the same alignment. No prime or important farmlands would be impacted. There would be no significant impacts.

8.2.3.5 Summary of Impacts

All action alternatives have significant impacts on land ownership, because the approach to analysis assumes the forced sale of land by the federal government for the firing range complex and roadway improvements. Alternative 1 requires additional federal acquisition of non-DoD land for developing the

main cantonment area. Submerged lands would not change ownership. The new range complex would restrict land and submerged land access during training events, which would occur most of the year. As part of the alternatives considered and dismissed analysis, a range of land acquisition options was proposed. The goal was to minimize the area of land to be acquired, maximize the use of existing DoD facilities, and minimize the effects on submerged lands use, while maintaining operational effectiveness and minimizing impacts on other resource categories (i.e., biological resources). For example, developing firing ranges on the west coast in the north was considered and dismissed to avoid submerged land and land ownership impacts. The existing firing range and associated SDZ would be removed from the west coast, which would have a beneficial impact on submerged land use.

The less than significant impact for land ownership at Apra Harbor is based on the reduced GEDCA lease area for USCG relocation; however the lease would likely be negotiated anyway in 2012. There would only be an impact if the lease were terminated early, before 2012 as a result of the proposed action.

8.2.3.6 Potential Mitigation Measures

Businesses and residences would be relocated and financial compensation would be made to landowners. To mitigate significant impacts of forced land acquisition, DoD could consider entering into long-term lease arrangements with the affected landowners in those situations where such an arrangement could be feasible. No additional mitigation has been proposed for affected landowners releasing their land.

Though impacts regarding access to land parcel and roads were not considered significant, the following would further minimize impacts:

- Access to the Route 15 property for appreciation or study of cultural and natural resources would be granted on request when there are no conflicts with training operations.
- Access to the GLUP 77 parcel would be provided to minimize the impact creating a non-DoD pocket of land.
- Proposed access road would be shared with the public if such use does not conflict with military operations.

8.2.4 Alternative 2 (Preferred Alternative)

Alternative 2 is similar to Alternative 1 with one notable exception. The Harmon property would not be acquired under Alternative 2. There would be no pocket of federal land created around GLUP77.

8.2.4.1 North

<u>Andersen AFB</u>

Land use impacts to Andersen AFB and adjacent properties are as described under Alternative 1.

<u>Finegayan</u>

The land/submerged lands ownership and use impacts are as described for Alternative 1, except the area of NCTS Finegayan that would be developed would be approximately 421 ac (171 ha) greater than described for Alternative 1. There would be an additional loss of open space than that described in Alternative 1. The loss of open space is considered an adverse but not significant impact.

Land use impacts to Potts Junction and adjacent properties are as described under Alternative 1.

<u>Non-DoD Land</u>

Land use impacts to Former FAA and adjacent properties are as described under Alternative 1.

GLUP 77 would not be acquired under any of the action alternatives. Under Alternative 1, with the acquisition of Harmon property, a pocket of non-federal land surrounded by federal land would be created. Under Alternative 2, GLUP 77 would not be a pocket of non-federal lands. No significant impact to GLUP 77 land use is anticipated.

The Harmon property would not be acquired. There would be no land use impacts to the property and adjacent properties.

8.2.4.2 Central

Andersen South

Land use impacts to the Andersen South properties and adjacent properties are as described under Alternative 1.

Barrigada

Land use impacts to the Barrigada properties and adjacent properties are as described under Alternative 1.

Non-DoD

Land use impacts to Route 15 property and adjacent properties are as described under Alternative 1.

8.2.4.3 Apra Harbor

The land and submerged land ownership and use impacts are as described under Alternative 1. Mitigation measures are as described under Alternative 1.

8.2.4.4 South

Land use impacts to NMS are as described under Alternative 1.

8.2.4.5 Summary of Impacts

Land/submerged land ownership/use impacts under Alternative 2 are similar to impacts under Alternative 1.

8.2.4.6 Potential Mitigation Measures

Potential mitigation measures are as described under Alternative 1, except there would be no mitigation required for GLUP 77 surrounding land uses. There would be less land acquired which would minimize the impact, but overall there remains a significant mitigable impact associated with forced sale of land to the federal government.

8.2.5 Alternative 3

Alternative 3 differs from Alternatives 1 and 2 in that no land acquisition by the federal government is proposed for the main cantonment area. The Barrigada area that was not proposed for development under Alternatives 1 and 2 is proposed for development under Alternative 3. There would be land acquisition for the firing range complex as described under Alternative 1.

8.2.5.1 North

Andersen AFB

Land use impacts to Andersen AFB and adjacent properties are as described under Alternative 1.

Finegayan

The land/submerged lands ownership and use impacts are as described for Alternative 2.

Land use impacts to Potts Junction and adjacent properties are as described under Alternative 1.

Non-DoD Land

The Former FAA property would not be acquired and the existing gap between NCTS Finegayan and South Finegayan would remain. There would be no adverse or significant impacts associated with Former FAA property.

GLUP 77 impacts are as described under Alternative 2. No adverse impact to GLUP 77 land use is anticipated.

The Harmon property would not be acquired. There would be no land use impacts to the property and adjacent properties.

8.2.5.2 Central

Andersen South

Land use impacts to the Andersen South properties and adjacent properties are as described under Alternative 1.

Barrigada

The Navy and Air Force Barrigada parcels are contiguous federal lands. No change in land ownership is proposed and no pockets of non-federal land or changes to access policies would be generated. There are no farmlands; therefore, FPPA is not relevant.

Alternative 3 proposes family housing on underutilized vacant (i.e., no modern manmade structures) lands on both Barrigada parcels. No relocations would be required. There would be a change in the intensity of land use under Alternative 3. The proposed development would be on previously developed land that was historically used for Air Force family housing. The Next Generations Radar weather facility is the primary activity at the Air Force Barrigada site and can remain at the site with no significant impact to or from the proposed land use. There may be design restrictions on the housing units.

The family housing area proposed at Navy Barrigada would be on vacant (i.e., no modern manmade structures) land. Adjacent land uses within the parcel boundary are communication facilities, Army administrative facilities, and the Navy golf course. Civilian residential development is located adjacent and north. The proposed land use is compatible with the adjacent land uses. There may be limitations on the area available for development pending results of a study on EMR emissions from the communications facilities. No adverse land use impact would result from family housing development at Navy Barrigada.

There would be a loss of open space at both parcels that is considered an adverse impact. The impact is not significant because the property is within federal lands. The potential impacts of changes in land use intensity (i.e., traffic, noise) are addressed in other resource chapters.

The adjacent non-DoD land uses are residential. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) designates the area surrounding the both Barrigada parcels as Low Density Residential, except for a commercial area northeast of Navy Barrigada. The proposed land use is consistent with the adjacent land uses.

Non-DoD Land

Land use impacts to Route 15 property and adjacent properties are as described under Alternative 1.

8.2.5.3 Apra Harbor

The land and submerged land ownership and use impacts are as described under Alternative 1. Mitigation measures are as described under Alternative 1.

8.2.5.4 South

Land use impacts to NMS and adjacent non-DoD properties are as described under Alternative 1.

8.2.5.5 Summary of Impacts

Land/submerged land ownership/use impacts under Alternative 3 is similar to impacts under Alternative 1.

8.2.5.6 Potential Mitigation Measures

There would be less land acquired for main cantonment, thereby avoiding some of the impact associated with the land ownership criteria. There would still be significant, but mitigable impacts associated with the firing range complex land acquisition. There would be less than significant impacts due to loss of open space at Barrigada. All other mitigations are as described under Alternative 1.

8.2.6 Alternative 8

Alternative 8 is similar to Alternatives 1, 2 and 3 in that Main Cantonment is on the west coast and land acquisition is as described for Alternative 2. The unique aspect of this Alternative is the division of family housing and community support facilities between the east and west areas of Guam.

8.2.6.1 North

Andersen AFB

Land use impacts to Andersen AFB and adjacent properties are as described under Alternative 1.

Finegayan

The land/submerged lands ownership and use impacts are as described for Alternative 1.

Land use impacts to Potts Junction and adjacent properties are as described under Alternative 1.

Non-DoD land

The land acquisition is as described for Alternative 2.

The Former FAA property would be acquired with potential impacts as described under Alternative 1.

GLUP 77 impacts are as described under Alternative 2. The adjacent federal uses would be housing and community support. No adverse impact to GLUP 77 land use is anticipated.

The Harmon property would not be acquired. There would be no land use impacts to the property and adjacent properties. GLUP 77 parcel would not become a pocket of non-federal land.

8.2.6.2 Central

Andersen South

Land use impacts to the Andersen South properties and adjacent properties are as described under Alternative 1.

Barrigada

The Navy and Air Force Barrigada parcels are contiguous federal lands. No change in land ownership is proposed. No pockets of non-federal land or changes to public access would be generated. There are no farmlands; therefore, FPPA is not relevant.

Alternative 8 is similar to Alternative 3 in that the Air Force Barrigada parcel would be developed for housing and community support land uses. The impacts associated with development of the Air Force Barrigada parcel are as described under Alternative 3.

Unlike Alternative 3, but similar to the other action alternatives, Navy Barrigada would not be developed to support the proposed action. There would be no land use impacts.

Non-DoD Land

Land use impacts to Route 15 property and adjacent properties are as described under Alternative 1.

8.2.6.3 Apra Harbor

The land and submerged land ownership and use impacts are as described under Alternative 1.

8.2.6.4 South

Land use impacts to NMS and adjacent non-DoD properties are as described under Alternative 1.

8.2.6.5 Summary of Impacts

Land/submerged land ownership/use impacts under Alternative 8 is similar to impacts under Alternative 1.

8.2.6.6 Potential Mitigation Measures

The mitigation measures are as described for Alternative 1, except there would be less land acquired for main cantonment and there would be less than significant impacts associated with the loss of open space at Barrigada.

8.2.7 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam, though they may continue to train on Guam as they currently do. No additional training capabilities (beyond what is proposed in the MIRC EIS/OEIS [Navy 2009]) would be implemented for Guam to support the proposed action. The project objectives, including U.S.- Government of Japan agreements, would not be met. There would be no land acquisition or long term leasing, dredging, new construction or infrastructure upgrades associated with Marine Corps forces stationed on Guam.

8.2.7.1 North

No change in land or submerged land ownership would occur at NCTS Finegayan, South Finegayan, Potts Junction, Former FAA, GLUP 77 or Andersen AFB. There are no farmlands used or proposed for agricultural use; therefore, FPPA is not relevant. No of non-federal land or changes in public access would be generated by the use of these existing federal parcels. Vacant non-DoD lands are subject to

planned development; therefore the open space and vacant (i.e., no modern manmade structures) lands would be developed over time.

The programmed Air Force projects would proceed as planned. The Navy helicopter facilities at North Ramp would not be relocated. The Air Force would proceed to develop the air embarkation facility on South Ramp, but it would be smaller compared to the joint facility proposed under the action alternatives. The new access gate and truck inspection facility at Andersen AFB would be constructed to address existing traffic issues, but would not be a priority project. No adverse land or submerged lands ownership or use impacts were identified.

8.2.7.2 Central

Andersen South, Navy Barrigada and Air Force Barrigada land uses including training described in the MIRC EIS (Navy 2009) would continue. No significant land or submerged land ownership or use impacts were identified under the no-action alternative at Andersen South.

No land would be acquired by the federal government. No relocations of roads, businesses or residences would be required. Over time land would be developed in accordance with approved land use plans as open space and residential land uses. There would be no impact on access to the area on land or submerged land. No significant land or submerged land ownership or use impacts were identified under the no-action alternative at Route 15 property.

8.2.7.3 Apra Harbor

The training described in the MIRC EIS (Navy 2009) would continue. Inner Apra Harbor wharves would be repaired and upgraded as described under the proposed action, but improvements would support the Navy mission and occur over a longer time period.

The Guam Economic Development and Commerce Authority lease area would be reduced as planned during the planned renegotiation in 2012 with no impact to land ownership. Upland placement sites for dredged material would continue to be required to support periodic maintenance dredging and planned construction dredging.

8.2.7.4 South

NMS would continue to be used for munitions storage and training as described in the MIRC EIS (Navy 2009). New munitions storage facilities would be required, but the requirement would be met over a longer period of time. No new access roads to the southern portion of the NMS would be required and no land would be acquired.

8.2.7.5 Summary of No-Action Alternative Impacts

No change in land ownership and access would occur. The open space areas would remain undeveloped until other uses are proposed. The waterfront improvements would likely occur at a more gradual schedule as funding permits. The small arms range and SDZ at Finegayan would remain and the access restrictions on recreational use of DoD submerged lands would continue.

8.2.8 Summary of Impacts

Tables 8.2-1, 8.2-2, 8.2-3, and 8.2-4 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 8.2-5 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. The tables summarize the results of the land and submerged land ownership and land use impact analysis presented in previous sections by alternative. Adverse impacts and significant impacts shown on

the tables represent the maximum adverse environmental effect identified in all regions under each alternative. If an alternative had significant impacts in only one region for one criterion, then the criterion is scored as significant impact in the tables. A text summary is provided below.

Table 8.2-1. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
NI • There would be no impacts due to construction	NI • There would be no impacts due to construction	NI • There would be no impacts due to construction	NI • There would be no impacts due to construction
Operation			
LSI • Less than significant impact due to loss of vacant land/open space	LSI • Less than significant impact due to loss of vacant land/open space	LSI • Less than significant impact due to loss of vacant land/open space	LSI • Less than significant impact due to loss of vacant land/open space
SI-M • Significant impact to land ownership if forced sale of land at Former FAA and Harmon parcels to government for main cantonment* • Significant, but mitigable impact due to limiting access to GLUP 77	SI-M • Significant impact to land ownership if forced sale of land at Former FAA and Harmon parcels to government for main cantonment* • Significant, but mitigable impact due to limiting access to GLUP 77	NI • No impact to land ownership and management at Former FAA and Harmon parcels	NI • No impact to land ownership and management at Former FAA and Harmon parcels
NI • No impact to submerged lands ownership and management • No impact to FPPA	NI • No impact to submerged lands ownership and management • No impact to FPPA	NI • No impact to submerged lands ownership and management • No impact to FPPA	NI • No impact to submerged lands ownership and management • No impact to FPPA
BI • Beneficial impact to DoD submerged land use due to SDZ removal	BI • Beneficial impact to DoD submerged land use due to SDZ removal	BI • Beneficial impact to DoD submerged land use due to SDZ removal	BI • Beneficial impact to DoD submerged land use due to SDZ removal

* As described in the approach to analysis, assume forced sale of land to federal government is an adverse impact to the landowners, pending completion of land negotiations.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 8.2-2. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
NI • There would be no impacts due to construction	NI • There would be no impacts due to construction
Operation	
LSI • Less than significant impact to non-DoD land use because the firing range would be inconsistent with surrounding designated land uses • Adverse impact to non-DOD submerged lands use and restricted land access due to training ranges	LSI • Less than significant impact to non-DoD land use because the firing range would be inconsistent with surrounding designated land uses • Adverse impact to non-DOD submerged lands use and restricted land access due to training ranges
SI-M • Significant impact to land ownership if forced sale of land to federal government for firing ranges*	SI-M • Significant impact to land ownership if forced sale of land to federal government for firing ranges*
NI • No impact to submerged land ownership or management	NI • No impact to submerged land ownership or management

* As described in the approach to analysis, assume forced sale of land to federal government is an adverse impact to the landowners, pending completion of land negotiations.
Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 8.2-3. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • There would be no impacts due to construction	NI • There would be no impacts due to construction
Operation	
LSI • Less than significant impact to land use due to loss of open space	LSI • Less than significant impact to land use due to loss of open space

Legend: LSI = Less than significant impact, NI = No impact.

Table 8.2-4. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • There would be no impacts due to construction	NI • No construction
Operation	
LSI • Less than significant impact to land use due to land acquisition or long-term leasing for access road to NMS	LSI • Less than significant impact to land use due to land acquisition or long-term leasing for access road to NMS

Legend: LSI = Less than significant impact, NI = No impact.

Table 8.2-5. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • There would be no impacts due to construction	NI • There would be no impacts due to construction	NI • There would be no impacts due to construction
Operation		
LSI • Less than significant impact to land use due to loss of agricultural lease and open space	LSI • Less than significant impact to DoD land use from airfield noise encroachment	LSI • Less than significant impact if GEDCA lease is renegotiated prior to 2012 • Less than significant impact to land use due to loss of open space

Legend: LSI = Less than significant impact, NI = No impact.

The land use analysis assumes that all construction staging would be within the project footprint on land planned for development. No adverse land use impacts associated with construction are anticipated. This assumption applies to all alternatives. The analysis is generally based on operational use, with dredged material management activities in Apra Harbor being the exception.

The land use analysis assumes that all impacts would be long-term and direct. Short-term construction-phase impacts would occur within the project footprint on land planned for development. In the case of upland placement of dredged material, the construction impact would be within the upland placement sites construction area. Indirect impacts related to changes in land ownership/use are addressed in other resource chapters (e.g., noise, socioeconomics, biology). Other than financial compensation to landowners, no mitigation is proposed for changes in land ownership. The development plan is based on the minimal amount of land to be acquired to minimize the impact on land ownership. The impacts for all action alternatives are the same for Apra Harbor, Andersen AFB and NMS. All alternatives including the no-action alternative include acquisition of land for federal use. All alternatives, including the no-action alternative, could potentially reduce the footprint of the Guam Economic Development and Commerce Authority lease area at Apra Harbor. If the lease is negotiated prior to the 2012 scheduled re-negotiation date, a less than significant impact would result. The Navy would maintain building AT/FP setback distances from the civilian use in future construction; however this does not represent an impact as is standard building practice.

There would be no acquisition of submerged lands for federal use. When land or submerged land is acquired there are restrictions on access to or through the land that are associated with the acquisition and covered under the Land Ownership - Land and Submerged Land criteria. For those areas that are not acquired, but result in new access restrictions, the potential impact is adverse but less than significant. This is the case for all action alternatives where land on the east coast would be acquired for live-fire training and access to the adjacent GovGuam submerged lands would be restricted during training. Training ranges on the west coast were eliminated from further consideration because the restricted access policy would have significant impacts on submerged lands use. There is less submerged lands activity on the east coast within the SDZ than the west coast and the impact of the access restriction is not considered significant. Training would occur from 6:00 a.m. to 10:00 p.m., Monday through Friday (and on weekends if operationally required). The SDZ would potentially be accessible on weekends. A NOTAM would be issued to announce access limitations.

No prime farmlands would be impacted under any of the alternatives and the alternatives are consistent with FPPA.

Land use proposals on federal lands under all action alternatives are consistent with base land use plans; however, there is a loss of open space that is considered a less than significant adverse impact even if the proposed development area is not being used efficiently. The loss of open space is partially offset by the fact that increased utilization of federal land minimizes the need for land acquisition. Under the no-action alternative, DoD facility construction would occur resulting in the loss of open space; however the project construction would be more gradual and on a smaller scale. Some of the projects proposed under the various action alternatives would be constructed under the no-action alternative, but over a longer period of time.

A beneficial impact to DoD submerged lands was identified in the north with the elimination of the SDZ associated with the small arms range that would be relocated to the east coast.

Under all action alternatives, the training range complex land use is not consistent with adjacent existing (vacant and residential) and planned land uses (residential). With appropriate buffering, the proposed land use and the surrounding uses would be compatible. The impacts are not considered significant because the range facility development would be limited and the area encumbered by the SDZs would generally be retained as open space.

Under Alternative 1, the GLUP 77 parcel would be a pocket of non-federal land adjacent in three directions to federal land. No mitigation is proposed, but the impacts could be balanced by the beneficial impact of new utility infrastructure in proximity to GLUP 77 that would facilitate future use of the site. This impact is less than significant, but a fenced right-of-way with unrestricted access would be provided to the GLUP 77 parcel. No other action alternatives create this pocket of non-federal land at GLUP 77.

8.2.9 Summary of Potential Mitigation Measures

Table 8.2-6 summarizes the potential mitigation measures for each type of impact by alternative.

Table 8.2-6. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Land Ownership and Management			
• Long-term lease instead of forced sale for federal use of land	• Long-term lease instead of forced sale for federal use of land	• Long-term lease instead of forced sale for federal use of land	• Long-term lease instead of forced sale for federal use of land
• Recommend revision to community plans to address DoD land uses	• Recommend revision to community plans to address DoD land uses	• Recommend revision to community plans to address DoD land uses	• Recommend revision to community plans to address DoD land uses

CHAPTER 9. RECREATIONAL RESOURCES

9.1 AFFECTED ENVIRONMENT

9.1.1 Definition of Resource

Recreational uses of an area for the purposes of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) may include any type of outdoor activity in which area residents, visitors, or tourists may participate. Typically (though not exclusively) focused on weekends or vacation periods, such activities may include hiking, fishing, beachcombing, spelunking, and boating. Recreational opportunities and resources can be a very important component of an area's economy and the lifestyle of its residents. Recreational resources analyzed in this chapter are primarily assets pertaining to the physical geography of Guam, from the mountains to the oceans, and terrains in between; there are various man-made recreational resources in urban and semi-rural settings as well.

Recreational resources have been organized into the following categories with similar uses grouped in parentheses: *trails* (pedestrian hikes, mountain bike trails, "boonie stomping," or hiking through "boonies" of large areas of undeveloped forests and beaches); *historic and cultural attractions* (historic monuments, parks, and cultural sites); *scenic points* (vistas, lookouts, and overlooks); *dive spots* (snorkeling, *s*elf *c*ontained *u*nderwater *b*reathing *a*pparatus, or SCUBA diving, and free diving); *beaches and parks* (also including conservation areas, preserves, and refuges); *spelunking*, or cave exploration; *fishing*; and *others* (golf courses, hunting, sailing, resorts offering day uses, and marine activities not listed above, etc.). However, a particular resource may provide several recreational opportunities. For instance, a resource organized under *trail* may offer hiking as well as swimming, snorkeling, and picnicking at the trail terminus. Due to the volume of recreational resources available on the island of Guam, lists and descriptions are provided in Appendix G, Recreational Resources.

Many of Guam's recreational resources are managed by the Guam Department of Parks and Recreation (GDPR), which administers approximately 70 public parks and recreational facilities, including beach parks, community parks, skate parks, historic parks, baseball fields, a baseball stadium, a sports complex, tennis courts and a public pool. All other community centers and parks fall under the 19 village mayors on the island, who work closely with GDPR. GDPR also runs sports leagues and provides swimming and tennis lessons among others.

9.1.2 North

9.1.2.1 Andersen Air Force Base (AFB)

Recreational resources at Andersen AFB are subject to the same access requirements as other on base facilities and are therefore restricted to installation personnel and guests. The exceptions are granting hunting license and special access permit to the general public to control feral pig and deer population on base (Andersen AFB 2009). Recreational resources along the coastal area include scenic vistas, Guam National Wildlife Refuge (managed by the United States Fish and Wildlife Service [USFWS]), trails, beaches and parks, and Pati Point Marine Preserve (Figure 9.1-1 and Table 9.1-1). There are recreational resources at Routes 1 and 15, which include war memorials and the Palm Tree Golf Course.

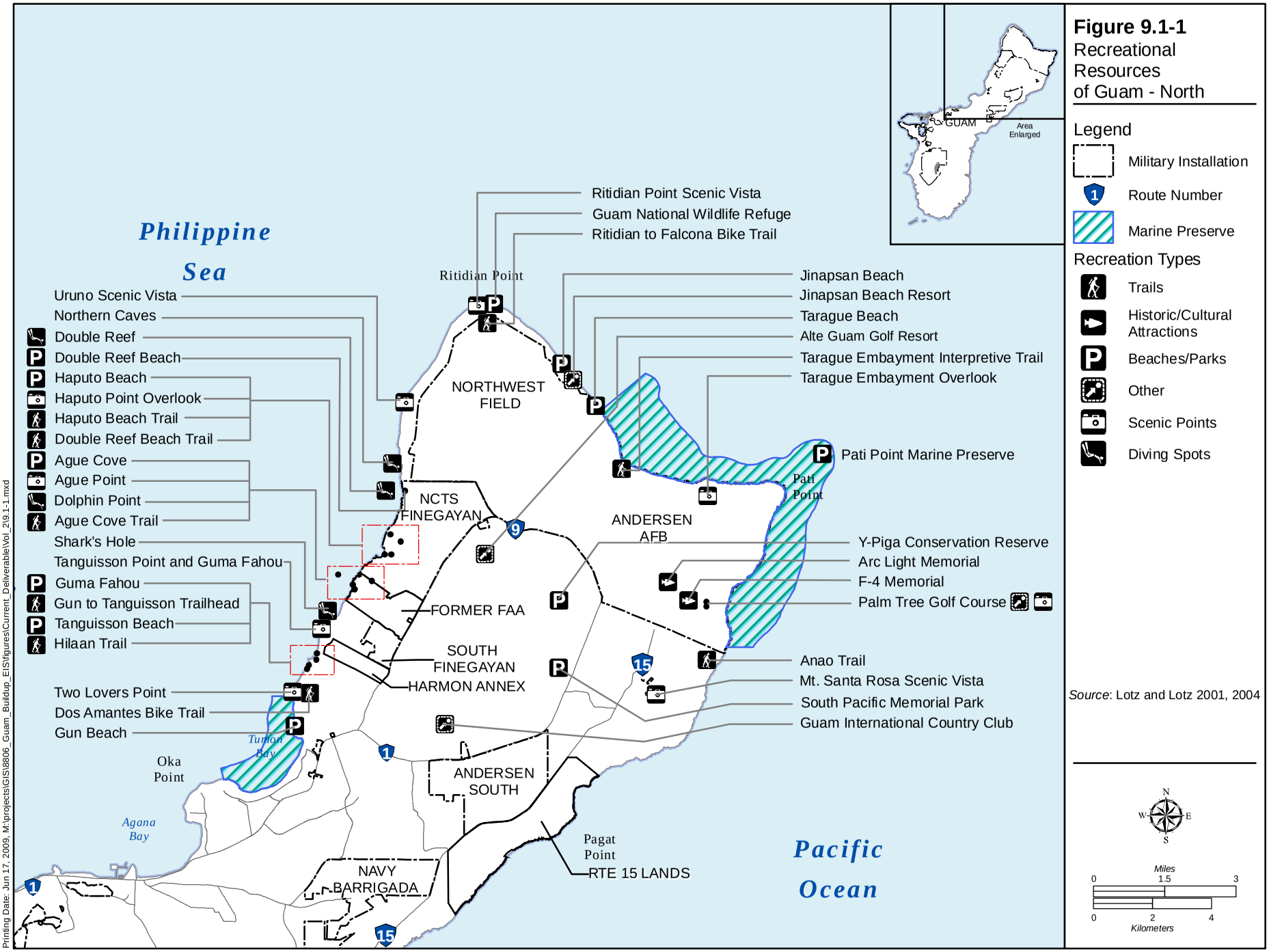


Figure 9.1-1
Recreational Resources of Guam - North

Table 9.1-1. Recreational Resources and Public Access on Andersen AFB

Recreational Resource	*Public Access*
Beaches (Tarague Basin)	
Tarague Beach; Sirena Beach; Scout Beach	Installation personnel and guests only
Pati Beach	Off-limits
Picnic Sites (Family and Individuals)	Installation personnel and guests only
Picnic Sites (Large Groups > 20)	Installation personnel and guests only
Camping Area (Tarague Basin)	
Tarague Beach Campsites; Sirena Beach	Installation personnel and guests only
Scout Beach Campsites	Area is open only to scouting groups
Water Sports	
SCUBA Diving and swimming (Tarague Beach and Sirena Beach)	Installation personnel and guests only
Game Hunting (Feral Pigs and Deer)	Installation personnel and guests only
Fishing (Shoreline Pole and Line)	Access generally open. Restricted public access requires hunting license and special access permit within manageable quotas
Land Crab/Traditional Plant Collecting	Installation personnel and guests only
Hiking Trails	Installation personnel and guests only
Nature Study Sites	Closed access requires special access permit through the installation natural resource planner or conservation officer
Scenic Drives/Overlooks	
Tarague Beach Road; Ritidian Point Overlook	Installation personnel and guests only
Interpretive Centers	Installation personnel and guests only

Source: Air Force 2003.

9.1.2.2 Finegayan

Recreational resources on Naval Computer and Telecommunications Station (NCTS) Finegayan are subject to the same access requirements as other on base facitilities and are therefore restricted to installation personnel and guests. Haputo Ecological Resource Area (ERA) is located in the northwestern portion of the base. Recreational resources in this area include hiking trails, swimming, snorkeling, and SCUBA diving (Lotz and Lotz 2001). Although presently restricted due to safety concerns, recreational hunting of feral pigs and deer has been allowed occasionally (Navy 2008). South Finegayan contains a latte stone site (refer to Figure 9.1-1). Table 9.1-2 lists current uses and accessibility of recreational resources available on NCTS Finegayan.

Table 9.1-2. Recreational Resources and Public Access on NCTS Finegayan

Recreational Resource	*Public Access*
Trails	
Haputo Trail; Double Reef Beach Trail	Installation personnel and guests only
Dive Spots	
Shark's Hole; Double Reef	Installation personnel and guests only
Beaches and Parks	
Guam National Wildlife Refuge	Installation personnel and guests only

Source: Lotz and Lotz 2001.

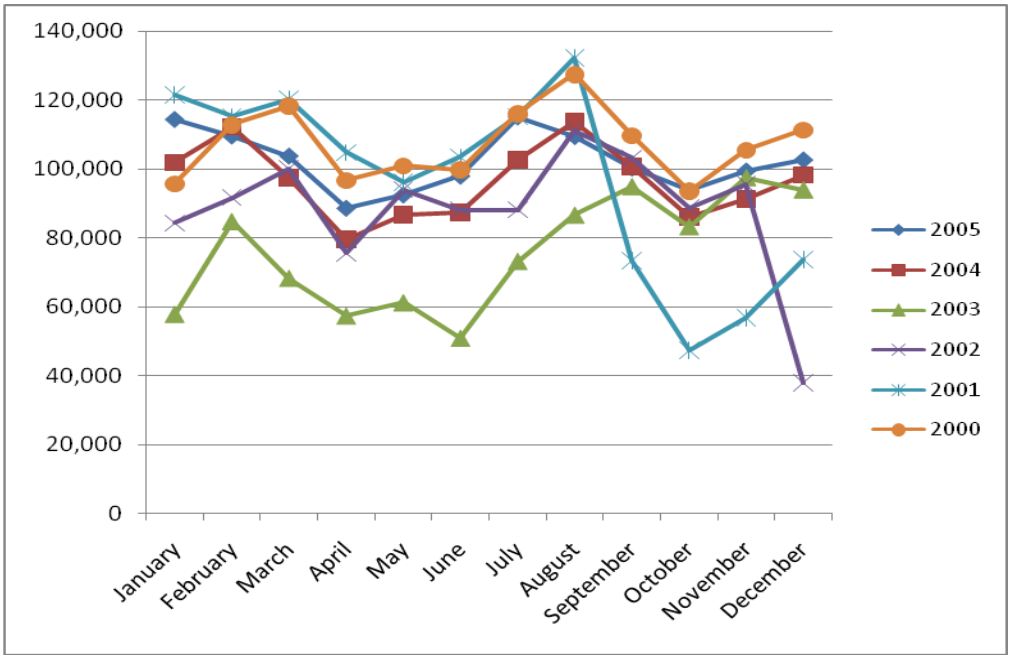
9.1.2.3 Federal Aviation Administration (FAA)

The former FAA housing parcel is mostly undeveloped with the exception of some apparent temporary use. There is a trail that traverses the property in the westward direction from the existing parking area on the parcel near Route 3. The parking area is likely used by persons who visit the site for jogging and/or

walking purposes in the mornings or evenings when the weather is relatively cooler. During site reconnaissance visits, it was noted that the number of cars at the parking lot ranged from 15 to 50 (TEC 2009). Currently, there are no access restrictions at the site.

9.1.2.4 Non-Department of Defense (DoD) Land

Notable recreational resources identified in the Dededo and Yigo villages are: trails, historic and cultural attractions, scenic points, dive spots, beaches and parks, and others (Table 9.1-2 and Figure 9.1-2). Island-wide, between 2000 and 2005 the average number of civilian and military visitors to Guam traveling by air and sea was 1.13 million persons per year (Bureau of Statistics and Plans 2006). As shown in Figure 9.1-2, higher volumes of visitors were recorded for July to March, except for January, with the highest visitor volumes experienced in August, July, and March (in respective order) during this period.



Source: Bureau of Statistics and Plans 2006.

Figure 9.1-2. Monthly Visitor Arrivals, Air and Sea, Guam: 2000 to 2005

At present, there is a series of trails connected to the Pagat Trail. The trails are open to the public and feature sinkholes, caves, and rugged limestone formations. On a popular weekend, visitors comprising tourists, local boonie stomp groups, and morale, welfare, and recreation activities generating from Navy Barrigada may attract as much as 60 hikers (Andersen AFB 2009). Visitors have been known to swim at the bottom of a sinkhole where there is a fresh water source (Lotz and Lotz 2001). The Guam International Raceway is also a popular location for recreation (see Appendix G for description of this and other recreational resources assessed in this chapter). Outside of the Guam International Raceway, off-roading is gaining popularity among the residents and the current military population on Guam.

9.1.2.5 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected

environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

Regional Setting

Recreational opportunities within the north region of Guam include trails, historic/cultural attractions, beaches/parks, scenic points, diving locations, and others (e.g., golf courses). These recreational opportunities include public and non-public facilities. Non-public facilities include those contained within lands identified as military installation (i.e., DoD). Access and use of these facilities within DoD lands is limited to installation personnel and their guests. Public recreational facilities are generally located on non-DoD lands or include marine preserves. Routes 1, 3, 9, and 15 provide regional access to recreation opportunities within the north region (Figure 9.1-3).

Project Setting

Most of the non-public recreational facilities located within the north region are contained on Andersen AFB, including the Northwest Field (NWF) area. These include beaches, wildlife reserves, scenic vistas, memorials, a marine preserve, and a golf course. Routes 3 and 9 provide the principal access to these facilities, although access is restricted beyond the base access gates. Public facilities are largely concentrated within the western segment of the north region in the vicinity of Dededo and Finegayan. These are largely comprised of beaches, trails, marine preserve, and scenic vistas. Route 3 provides the principal access to these facilities. A limited number of public facilities is located within the eastern segment of the North Region and include trails, scenic vistas, memorials, and a golf course. Routes 1, 29, and 15 provide principal access to these facilities.

9.1.3 Central

9.1.3.1 Andersen South

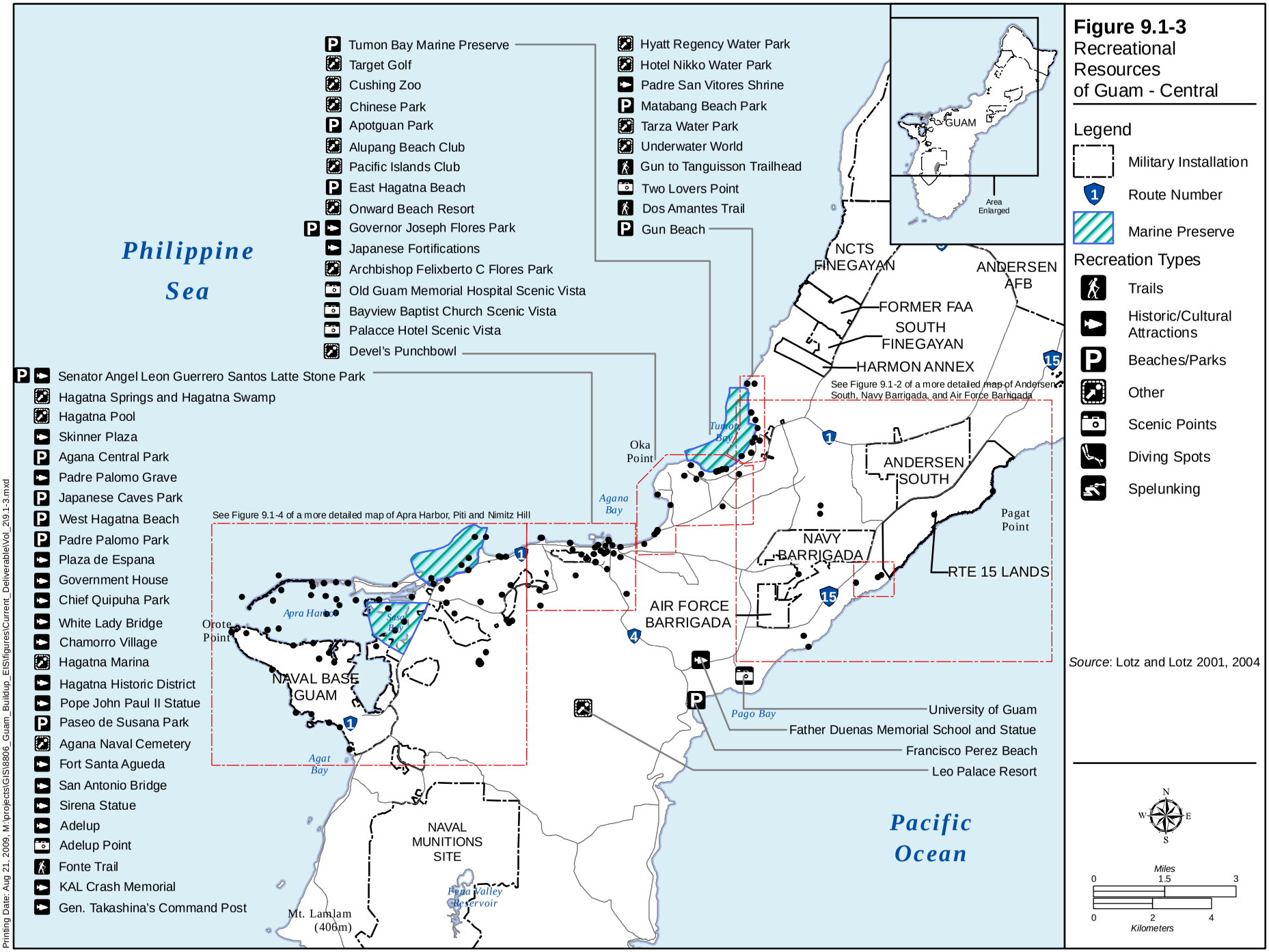
There are joggers and walkers who use the Andersen South roads in the mornings and evenings when the weather is relatively cooler; access is gained by using the existing base entrance situated along Marine Drive near the northeast corner of the Andersen South property. Currently, there are no access restrictions at the site. More than 30 cars were sighted during one of the site reconnaissance trips associated with the proposed project (TEC 2009).

9.1.3.2 Barrigada

The Admiral Nimitz Golf Course is located in NCTS Barrigada, which has active antennae fields as one of the primary base uses. The use of the championship 18-hole golf course is restricted to installation personnel and guests (Figure 9.1-4).

9.1.3.3 Non-DoD Land

Recreational resources are primarily concentrated along the coastal regions, along the western coast of Tumon-Tamuning, Hagatna, Sinajana, Agana Heights, and Asan villages and along the eastern coast Mangilao village. The western coast, particularly the Tumon-Tamuning and Asan villages contain marine recreational resources and historic/cultural attractions popularly visited by off-island tourists and resident population alike. Other notable recreational resources include: trails, scenic points, and others (Figure 9.1-4). Table 9.1-3 lists current uses and accessibility of public recreational resources on non-DoD in Central Guam. Refer to Appendix G for the descriptions of the recreational resources discussed in this and other sections of the chapter.



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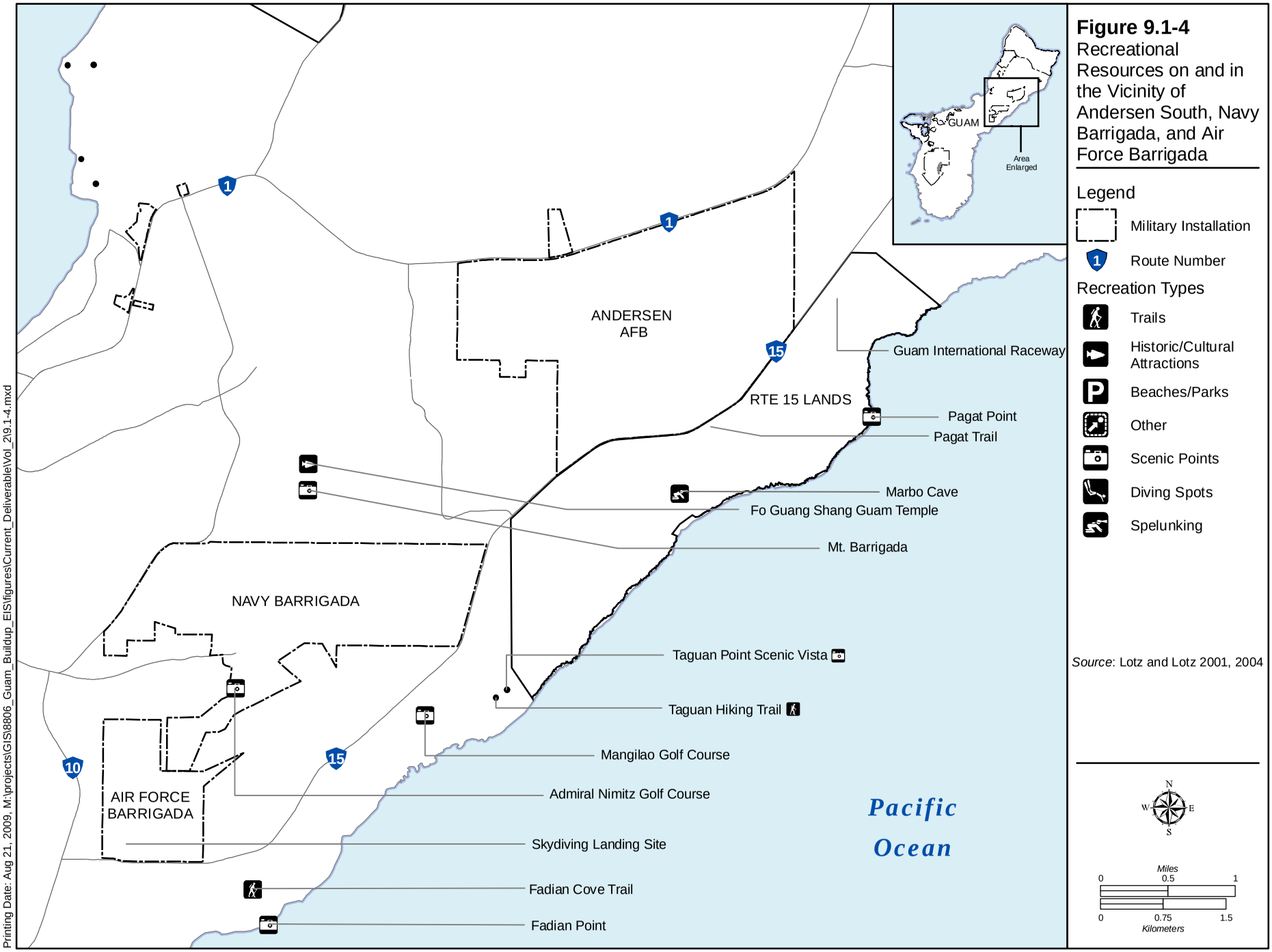

Figure 9.1-4
Recreational Resources on and in the Vicinity of Andersen South, Navy Barrigada, and Air Force Barrigada

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Table 9.1-3. Recreational Resources and Public Access on non-DoD Land in Central Guam

Recreational Resource	*Public Access*
Trails	
Fadian Cove; Taguan; Gun Beach to Tanguisson; Dos Amantes Biking and Hiking Trail	Open to public
Historic/Cultural Attractions	
Fo Guang Shang Guam Temple; Father Duenas Memorial School and Statue; War in the Pacific National Historic Museum; White Lady Bridge; Korean Air Lines Crash Memorial; Agana Naval Cemetery; Chief Quipuha Park; Chamorro Village; To'lai Acho; Sirena Statue; Plaza de Espana; Pope John Paul II Statue; Skinner Plaza; Hagatna Historic District; Padre Palomo Grave; Adelup Point; Government House; Japanese Fortifications; Padre San Vitores Shrine	Open to public
Scenic Points	
Bayview Baptist Church Scenic Vista; Top O' the Mar; Asan Bay Overlook; Two Lovers Point; Old Guam Memorial Hospital Scenic Vista; Palace Hotel Scenic Vista	Open to public
Dive Spots	
Asan Cut; Camel Rock	Open to public
Beaches/Parks/Marine Preserve	
Francisco Perez Beach; Asan Beach Unit; East Hagatna Beach; West Hagatna Beach; Agana Central Park; Padre Palomo Park; Paseo de Susana Park; Japanese Caves Park; Senator Angel Leon Guerrero Santos Latte Stone Park; Gun Beach; Matabang Beach; Ypao Park; Tumon Bay Marine Preserve; Apotguan Park; Archbishop Felixberto Flores Park; Chinese Park; Cushing Zoo	Open to public
Spelunking	
Marbo Cave	
Others	
Guam International Raceway; Mangilao Golf Course; Leo Palace Resort; Alupang Beach Club; Hagatna Springs and Hagatna Swamp; Hagatna Pool; Target Golf; Hotel Nikko Water Park; Hyatt Regency Water Park; Tarza Water Park; Under Water World; Pacific Islands Club; Onward Beach Resort; Hagatna Marina	Open to public

Source: Lotz and Lotz 2001.

9.1.3.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Regional Setting

Recreational opportunities within the central region of Guam include trails, historic/cultural attractions, beaches/parks, scenic points, diving locations, spelunking, and others (e.g., golf courses). These recreational opportunities include public and non-public facilities. Non-public facilities include those contained within lands identified as military installation (i.e., DoD). Access and use of these facilities within DoD lands is limited to installation personnel and their guests. Public recreational facilities are generally located on non-DoD lands or include public beaches. Routes 1, 10, 15, and 16 provide regional access to recreation opportunities within the Central Region.

Project Setting

Most of the non-public recreational facilities located within the central region are contained on Navy Barrigada and Air Force Barrigada. These are limited to a golf course and skydiving landing site. Routes 10 and 15 provide the principal access to these facilities, although access is restricted beyond the base access gates. Public facilities are largely concentrated within the western segment of the central region in the vicinity of Piti, Asan, Hagatna, Mongmong, and Tamuning. These are largely composed of beaches, trails, and scenic vistas. Route 1 provides the principal access to these facilities. Many public facilities are located within the eastern segment of the Central Region and include trails, scenic vistas, beaches, and a golf course. Routes 10 and 15 provide principal access to these facilities.

9.1.4 Apra Harbor

Piti and Nimitz Hill offer a wide variety of recreational resources, which includes: trails, scenic points, dive spots, beach activities, camping, picnic, fishing, sailing, and other marine activities (Figure 9.1-5). Table 9.1-4 lists current uses and accessibility of public recreational resources on non-DoD in Central Guam.

Table 9.1-4. Recreational Resources and Public Access on non-DoD Land in Piti/Nimitz Hill

Recreational Resource	*Public Access*
Trails	
Piti Guns; Asan Falls; San Carlos Falls; Lonfit Valley	Open to public
Scenic Points	
Mount Chachao Scenic Vista; Cabras Island Scenic Vista	Open to public
Dive Spots	
Glass Breakwater; Nichiyu Maru; Tokai Maru; S.M.S. Cormoran; Japanese Tugboat; Kitsugawa Maru; The Val; American Tanker; The Scotia; Western Shoals; Hourglass Reef	Open to public
Beaches and Parks	
Dog Leg Pier; Family Beach; Tepungan Beach; Port Authority Beach; Fish Eye Marine Park	Open to public
Fishing	
Piti Bomb Holes Preserve; Masso Reservoir; Sasa Bay Preserve	Open to public
Others	
Marianas Yacht Club; Devil's Punchbowl; Seaplane Ramp	Open to public

Source: Lotz and Lotz 2001.

9.1.4.1 Harbor

Recreational resources at Apra Harbor include: trails, dive spots, historic and cultural attractions, scenic points, sailing, beaches, and other marine activities (refer to Figure 9.1-5). Access to these activities are limited to installation personnel and guests (Table 9.1-5). Access is restricted to shelter military equipment and personnel, and facilitates training and operations. Apra Harbor is also the site of Orote Peninsula ERA.

Table 9.1-5. Recreational Resources and Public Access on Apra Harbor

Recreational Resource	*Public Access*
Trails	Installation personnel and guests only
Historic/Cultural Attractions	
Pan Am Clipper Landing Site, Orote Airfield, Sumay Village, War Dog Cemetery	Installation personnel and guests only
Scenic Points	Installation personnel and guests only
Dive Spots	
Old Fuel Piers, Shark Pit, Blue Hole and Crevice, Sponge Reef, Finger Reef	Installation personnel and guests only
Beaches and Parks	
Picnic Facilities: San Luis Beach, Fort San Luis, Gab Gab Beach	Installation personnel and guests only
Kayaking: Dadi Beach	Installation personnel and guests only
Marina: Sumay Cove Marina	Installation personnel and guests only

Source: Lotz and Lotz 2001.

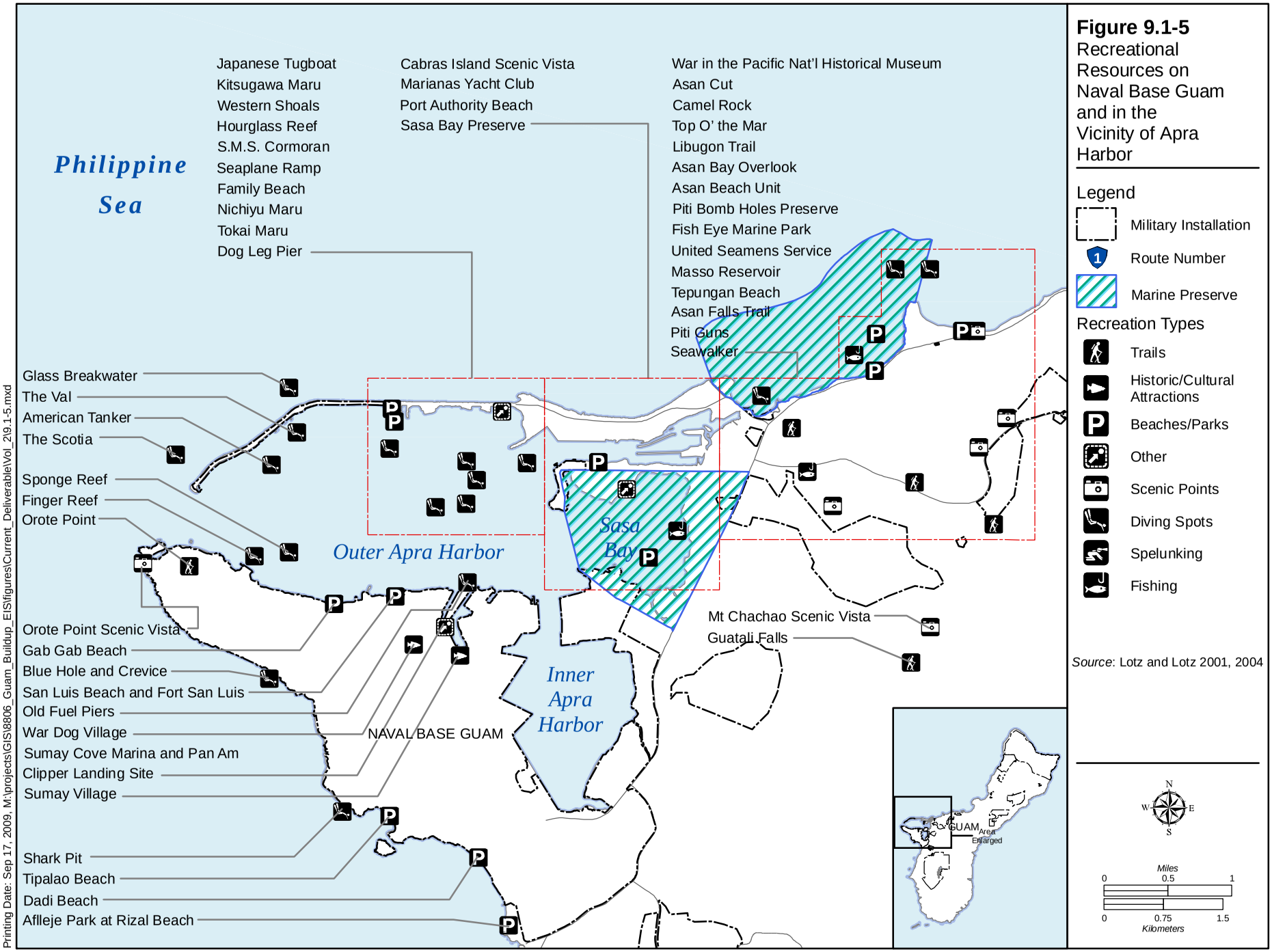

Figure 9.1-5
Recreational Resources on Naval Base Guam and in the Vicinity of Apra Harbor

Legend

- Military Installation
- Route Number
- Marine Preserve

Recreation Types

- Trails
- Historic/Cultural Attractions
- Beaches/Parks
- Other
- Scenic Points
- Diving Spots
- Spelunking
- Fishing

Source: Lotz and Lotz 2001, 2004

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9.1.4.2 Naval Base Guam

Naval Base Guam covers about 6,200 ac (2,509 ha) on the west-central coast of Guam, covering Apra Harbor and all of Orote Peninsula. Refer to Appendix G for descriptions of the recreational resources discussed in this and other sections of this chapter.

9.1.4.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Regional Setting

Recreational opportunities within the Apra Harbor Region include trails, historic/cultural attractions, beaches/parks, scenic points, diving locations, spelunking, fishing, marine preserves, and others (e.g., sailing). These recreational opportunities include public and non-public facilities. Non-public facilities include those contained within lands identified as military installation (i.e., DoD). Access and use of these facilities within DoD lands is limited to installation personnel and their guests. Public recreational facilities are generally located on non-DoD lands or include public beaches and parks. Routes 1 and 2A provide regional access to recreation opportunities within the Apra Harbor Region (Figure 9.1-5).

Project Setting

Most of the non-public recreational facilities located within the Apra Harbor Region are contained on the Apra Harbor Naval Complex. These generally include diving spots, trails, beaches and parks, and historic/cultural attractions. Routes 1 and 2A provide the principal access to these facilities, although access is restricted beyond the base access gates. Public facilities are largely limited to the Sasa Bay area and immediately northwest of Piti, which contain marine reserves and fishing areas. Routes 1 and 11 provide the principal access to these facilities.

9.1.5 South

9.1.5.1 Naval Munitions Site

Naval Munitions Site (NMS) is used as an ordnance storage magazine. Approximately 75% of the area is overlaid by explosive safety zones (Tomonari-Tuggle et al. 2005). Known recreational resources are: historic and cultural attractions, scenic points, fishing, and others (Figure 9.1-6). Access to the recreational resources are restricted to installation personnel and guests (Table 9.1-6). Access is restricted to shelter military equipment and personnel, and facilitates training and operations.

Table 9.1-6. Recreational Resources on Naval Munitions Site and Public Access

Recreational Resources	*Public Access*
Historic and Cultural Attractions	
Fena Massacre Site	Installation personnel and guests only
Scenic Points	
Japanese Lookout	Installation personnel and guests only
Fishing	
Fena Reservoir	Installation personnel and guests only
Others	
Deep Springs	Installation personnel and guests only

Source: Lotz and Lotz 2001.

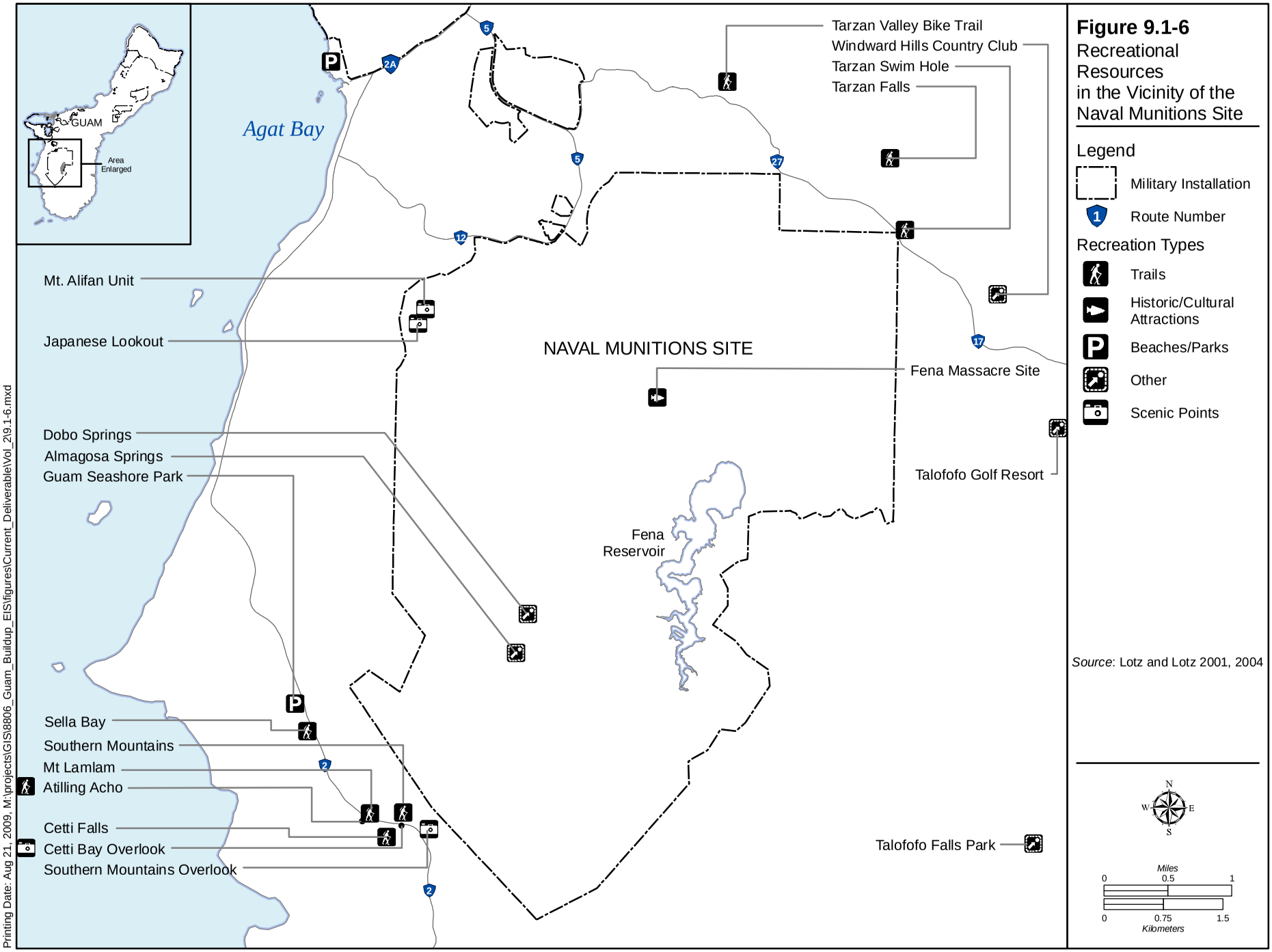

Figure 9.1-6
Recreational Resources in the Vicinity of the Naval Munitions Site

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9.1.5.2 Non-DoD Land

Non-DoD lands are composed of the villages of Agat, Inarajan, Merizo, Santa Rita, Talofofo, Umatac, and Yona. Recreational resources in these areas are: trails, historic and cultural attractions, scenic points, dive spots, beaches and parks, spelunking, etc. (Figure 9.1-7). Table 9.1-7 lists current uses and accessibility of public recreational resources on non-DoD in south Guam.

Table 9.1-7. Recreational Resources and Public Access on non-DoD Land in South Guam

Recreational Resource	*Public Access*
Trails	
Sella Bay Trailhead; Tarzan Valley Bike Trail; Atilling Acho; Cetti Falls; Umatac to Toguan Bay; Faha and Tinta; Priest's Pools; Mt. Lamlam; Southern Mountains trails; Mt. Schroeder; Mt. Sasalaguan; Ricky's Beach and Ylig Bay; Paicpouc Cove and Matala Beach; Inarajan Falls; Asiga; Waterfall Valley; Fintasa and Laolao Falls; Sigua Valley Bike Trail; Upper Sigua and Alutom Falls; Sigua River; Upper and Lower Sigua Falls; Lower Sigua Falls-Sinisa Falls-Tank Farm; Maguagua Falls; Mount Chacho and Mt. Tenjo; Guatali Falls; Tarzan Falls; Tarzan Swim Hole	Open to public
Historic/Cultural Attractions	
Gaan Point; Inarajan Village; Malesso Kombento; Merizo Bell Tower	Open to public
Scenic Points	
Cetti Bay Overlook; Fouha Bay Scenic Vista; Talofofo Bay Scenic Vista; Mt. Alifan Unit; Inarajan Scenic Vista; Pago Bay Overlook; Ylig Bay Scenic Vista; Ija Scenic Vista	Open to public
Dive spots	
The Amtrac; Hap's Reef; Pete's Reef; Japanese Zero; Fouha Bay; Nathan's Dent; Mana Bay Cut; Aratama Maru; Cocos Lagoon	Open to public
Beaches and Parks	
Nimitz Beach Park; Asquiroga Cove; Talofofo Beach Park; Talofofo Falls Park; Aflleje Park at Rizal Beach; Namo Falls Botanic Park; Togcha Beach; Salinas Beach; Ipan Beach; Umatac Bay Park; I Memorias Para I Lalahita; Agfayan Bay and Bear Rock; Saluglula Pool; Pauliluc Bay; Toguan Bay; Tagachan Beach; Merizo Pier Park; Ylig Bay; Achang Reef Flat Preserve	Open to public
Spelunking	
Gadao's Cave; Talofofo Caves	Open to public
Others	
Talofofo Golf Resort; Country Club of the Pacific; Windward Hills Country Club; Ipan Beach Resort; Cocos Island; Bangi Island; Anae Island; Agat Small Boat Harbor; Gef Pa'go	Open to public

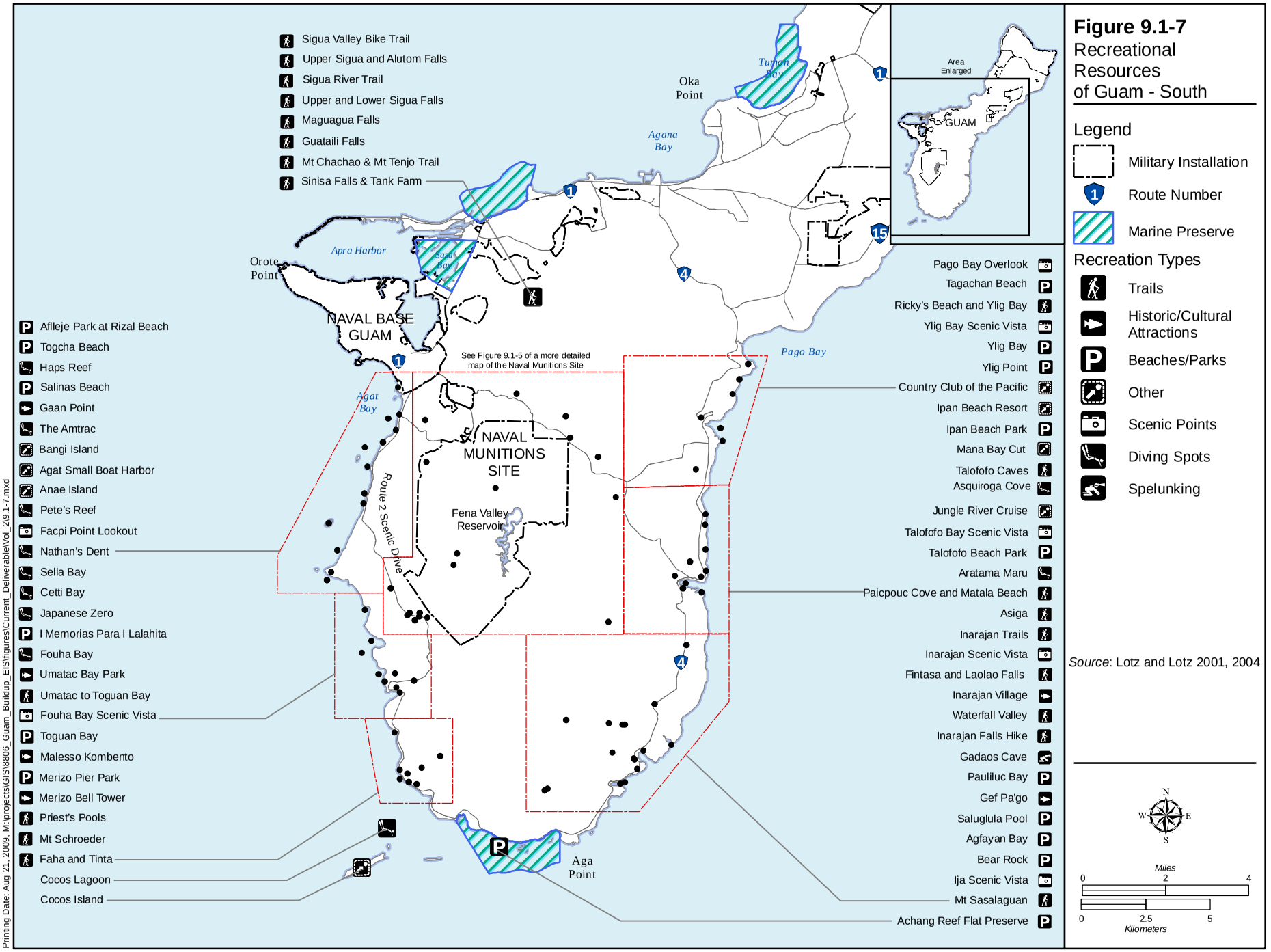
Source: Lotz and Lotz 2001.

9.1.5.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Regional Setting

Recreational opportunities within the south region include trails, historic/cultural attractions, beaches/parks, scenic points, and others. These recreational opportunities include public and non-public facilities. Non-public facilities include those contained within lands identified as military installation (i.e., DoD). Access and use of these facilities within DoD lands is limited to installation personnel and their guests. Public recreational facilities are generally located on non-DoD lands or include public beaches and parks. Routes 5, 12, 2, 4, and 17 provide regional access to recreation opportunities within the South Region. Routes 2 and 4 run mostly along the coastline of the South Region, making them the top scenic vista routes of the island.



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Project Setting

Most of the non-public recreational facilities located within the south region are contained on NMS. These generally include scenic vistas, historic/cultural attractions, and others (e.g., springs). Routes 12, 5, and 17 provide the principal access to these facilities, although access is restricted beyond the base access gates. Public facilities are largely limited to hiking trails, scenic vistas, and beaches/parks. Routes 2 and 17 provide the principal access to these facilities.

9.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

9.2.1 Approach to Analysis

9.2.1.1 Methodology

Information on recreational resources and public access on Guam was collected through stakeholder meetings in April 2007, Geographic Information System (GIS) data compiled and reviewed for this EIS/OEIS, literature review, personal communications, Guam Comprehensive Outdoor Recreation Plan Update (GovGuam 2006), and the limited visitor data that are available for a few specific locations on the island. A comprehensive recreational carrying capacity analysis—assessing the number of individuals who can be supported in a given area within natural resource limits without degrading the natural social, cultural, and economic environment (Global Development Research Center 2009)—was not conducted as part of this EIS/OEIS, but is suggested as a mitigation measure to better quantify potential impacts on recreation resources. Existing baseline data for conducting recreational resource impact analyses are somewhat limited because the Government of Guam (GovGuam), Department of Parks and Recreation does not collect visitor data (e.g. user counts, visitor satisfaction, user conflicts, visitor demands, etc.) for its recreational facilities (Department of Parks and Recreation 2009). Consequently, the analysis in this chapter relied considerably on information obtained through site reconnaissance and communications with natural resource planners at Andersen AFB and park rangers at National Park Service, which manages the War in the Pacific National Historical Park. The analysis of potential impacts to recreational resources is based on the long term (operational) effects – i.e., after construction has occurred and all buildings, facilities, and structures are in place.

9.2.1.2 Determination of Significance

For the purpose of this EIS/OEIS, the proposed action and alternatives would cause a significant impact on recreational resources if they:

- Would impede access to recreational resources;
- Would substantially reduce recreational opportunities;
- Would cause substantial conflicts between recreational users; or
- Would cause substantial physical deterioration of recreational resources.

9.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns that were mentioned by the public, including regulatory stakeholders, during scoping meetings in April 2007 were addressed. These included: the potential impact of the proposed action on civilian access to DoD facilities, recreation areas, Apra Harbor, and other locations, both in terms of construction and operations impacts.

9.2.2 Alternative 1

9.2.2.1 North

Andersen AFB

Construction

Construction activities associated with the proposed action would occur outside of Andersen AFB. Persons traveling to Andersen AFB may experience increased number of construction-related vehicles on roads. No direct impacts to its recreational resources are expected.

Operation

Recreational resources at Andersen AFB would generally experience a sharp increase in the number of users due to the increased population associated with the proposed action. Heavier uses of the recreational resources are expected during weekends, holidays, and school vacation days because most persons involved with the proposed action would otherwise be expected to be engaged with work and/or school. Table 9.1-1 shows the 1998 projection for a one-year carrying capacity for swimming at Tarague Beach and Sirena Beach to be 12,900 swimmers; these resources were already projected to experience 10,000 to 17,600 swimmers. This indicates that the waters at these beaches were experiencing near and/or overcapacity, not necessarily the beaches themselves (see Table 9.1-1). Utilization of these resources by the new permanent population would further congest the recreational resources at these and other beaches. Likely effects of increased users at recreational resources at Andersen AFB include reduced opportunities for space, and decreased time for activities. More people in the waters and at the beaches, longer waiting time at museums, etc., are some of the effects of the presence of additional users.

The general wear and tear of the amenities available and the conditions of the recreational resources would likely be accelerated due to the increased presence of potential users at Andersen AFB. Of particular concern is Tarague Beach, within which the environmentally sensitive Tarague Embayment is located. Heightened awareness and education about environmentally sensitive areas would contribute towards minimizing deterioration of resources.

To alleviate the potentially significant impact to the recreational resources at Andersen AFB, the Marine Corps Community Service (MCCS) is proposing a wide range of quality of life (QOL) facilities at the Main Cantonment site on NCTS Finegayan to meet the recreational demands of the Marines, their dependents and guests. Examples of proposed uses include: hobby shop, indoor physical fitness centers, indoor recreational resources (e.g. bowling, skating rink), youth center, theater, and recreational pavilion. By presenting comparable and/or alternate recreational options to the potential users near where the Marines inhabit on Main Cantonment, impacts to the recreational resources at Andersen AFB could be alleviated.

The proposed training activities by the Marines at the Andersen AFB and the Northwest Fields would involve the operation of one transient MV-22 Squadron, field carrier landing practice (FCLP), and field artillery missile (FAM) sorties. Recreational resources at the Tarague Basin—Tarague, Scout, Sirena,

Pati beaches, camping areas, and the resources defined in Table 9.1-1 of this Chapter—are situated in close proximity to the proposed training activities at Andersen AFB. The resultant noise generated from the proposed training activities does not trigger the significance criteria as defined in Section 9.2.1.2 of this Chapter for recreational resources. This notwithstanding, the noise generated from the proposed training activities would be consistent with the existing category of noise generated from the existing operations at the project locations.

Therefore, although the proposed action under Alternative 1 could result in significant impacts, impact-avoidance measures, such as providing QOL facilities near the Main Cantonment by the Marines, would help to reduce the level of impacts to less than significant.

NCTS Finegayan

Construction

Construction activities associated with the proposed action would occur at NCTS Finegayan. Although the existing recreational resources are situated outside of the proposed locations within the base, impacts through road detours, congestion due to the presence of construction-related vehicles, and controlled access would likely occur. The increased construction-related vehicles on roads may cause delay for persons attempting to gain access to the recreational resources at NCTS Finegayan; however, direct impacts to recreational resources is not expected.

Operation

Similar to Andersen AFB, the use of and access to recreational resources at NCTS Finegayan are restricted to installation personnel and guests. Recreational resources that may be directly impacted by the proposed action are Haputo ERA (Haputo Beach included) and Guam National Wildlife Refuge, which together offer a variety of resources such as diving, swimming, beachcombing, cultural resources, hiking, and etc. The 17,600 persons living on main cantonment and South Finegayan associated with the proposed action represent potential users of the recreational resources at NCTS Finegayan. The number of users of recreational resources would likely be greater on weekends, holidays, and school vacation days as most persons would otherwise be engaged at work or school on weekdays. Increased users at recreational resources would lead to reduced opportunity for space and time, leading to diminished user satisfaction. For example, persons who enjoy hiking in solitude may find the presence of additional users a nuisance.

To meet the demands of the Marines, dependents, and civilian workers, the MCCS is proposing a wide range of QOL facilities. Examples of proposed uses include: hobby shop, indoor physical fitness centers, indoor recreational resources (e.g. bowling, skating rink), youth center, theater, and recreational pavilion. By presenting alternate recreational options to the potential users, impacts to the recreational resources at NCTS Finegayan could be lessened.

The general wear and tear of the amenities available and the conditions of the recreational resources would likely be accelerated due to the presence of potential users at NCTS Finegayan. Of particular concern is the Guam National Wildlife Refuge. Heightened awareness and education about environmentally sensitive areas would minimize deterioration of resources. Therefore, Alternative 1 would result in less than significant impacts to recreational resources at NCTS Finegayan.

Former FAA Parcel

Construction

Construction activities associated with the proposed project, wherein family housing and community support facilities are planned, would likely inhibit access and the use of the trail at the former FAA parcel by joggers and walkers. The potentially adverse impacts to the access and the use of the trail would further be compounded by the fencing off the property and addition of gates, which would restrict access altogether. However, it is worth noting that the resource lost due to the proposed action is not unique to the region; comparable resources (e.g., jogging and walking trails) would be available in the adjoining properties.

Operation

Upon completion of construction activities, the use of the existing trail on-site would likely be lost, replaced instead with family housing and community support facilities. Therefore, Alternative 1 would result in impacts to the access and the use of the existing recreational resource at the former FAA parcel. However, it is worth noting that the resource lost due to the proposed action is not unique to the region; comparable resources (e.g., jogging and walking trails) would be available in the adjoining properties. Therefore, Alternative 1 would have less than significant impact on the recreational resource at the former FAA parcel.

Non-DoD Land

Construction

The existing recreational resources on non-DoD properties in north Guam are situated along the coastal areas southwest of the main cantonment and to the east of Route 15. The acquisition of the lands along Route 15 for training purposes by the Marines would result in eliminating access to, and therefore, the use of, the recreational resources situated in the affected area.

Operation

Implementation of the proposed action would result in nearly 17,600 potential users to the existing recreational resources. In addition to this direct population impact, additional in-migration to Guam would occur as a result of indirect and induced economic activity associated with the proposed action (see Volume 2, Chapter 16, Socioeconomic and General Services).

A surge in user population due to the implementation of Alternative 1 may lead to a reduction of recreational opportunities at existing facilities as more users would compete for recreational use (e.g., competing for picnic shelters, long queue at memorial sites, etc.). Residents of Guam recreational users (including the existing military population) would be competing for available recreational opportunities along with tourists from off-island, as well as residents of Guam; this competition is likely to worsen during weekends, holidays, and months of July to March, which experience heavier tourist traffic (Bureau of Statistics and Plans 2006).

The general wear and tear of the amenities available and the conditions of the recreational resources would likely be accelerated due to the presence of potential users. Heightened awareness and education about environmentally sensitive areas would contribute towards minimizing deterioration of resources.

To meet the demands of the Marines dependents, and civilian workers, the MCCS is proposing a wide range of QOL facilities. Examples of proposed uses include: hobby shop, indoor physical fitness centers, indoor recreational resources (e.g. bowling, skating rink), youth center, theater, and recreational pavilion.

By presenting alternate recreational options to the potential users, impacts to the recreational resources on non-DoD lands in north Guam could be lessened.

There are several recreational resources that the public would lose the access to, and the use of the features if the proposed action were implemented: Guam International Raceway, Marbo Cave, Pagat Trail and associated trails near it, cultural gathering activities (*suruhana*), and off-shore fishing near Marbo Cave. Implementation of Alternative 1, regardless of the Training Complex Alternatives A or B, would cause the cessation of the present activities at all the resources mentioned because the Known Distance (KD) Range Complex is proposed in that location. The loss of Guam International Raceway land and use would be an adverse impact. Therefore, Alternative 1 would result in significant impacts to recreational resources.

9.2.2.2 Central

Andersen South

Construction

Construction activities associated with the proposed project would inhibit access and the use of the Andersen South roads by joggers and walkers by fencing off the property and the addition of gates. However, the resource lost due to the proposed action is not unique to the region; comparable resources (e.g., jogging and walking trails) would be available in the adjoining properties.

Operation

Upon completion of construction activities, the access to, and the use of the existing trail at Andersen South would be lost—a significant impact. However, the resource lost due to the proposed action is not unique to the region; comparable resources (e.g., jogging and walking trails) would be available in the adjoining properties. Therefore, Alternative 1 would have less than significant impact on the recreational resource.

Barrigada

Construction

The construction activities associated with the proposed action occur outside of the recreational resource areas at Barrigada. The increased construction-related vehicles on roads may cause delay for persons attempting to gain access to the recreational resources at Barrigada; however, direct impacts to recreational resources are not expected.

Operation

The sole recreational resource at Navy Barrigada features one of two golf courses available to installation personnel and guests on Guam—Admiral Nimitz Golf Course. Golf courses on-base tend to offer lower fees than public and private courses: Nimitz Golf Course offers a tee time fee ranging from $30 to $49, weekdays and weekends, respectively, while public/private golf courses off-base charge from $70 to $160 for weekends and weekends (Guam Golf Net 2009). The new permanent population associated with the proposed action would potentially increase the number of golf course users at Navy Barrigada. An increase in the number of golfers could potentially lead to reduced availability of tee times at the golf course. To alleviate the impact to the recreational resource, the MCCS is proposing a wide range of QOL facilities at the Main Cantonment site on NCTS Finegayan to meet the recreational demands of the Marines, their dependents and guests. By presenting comparable and/or alternate recreational options to

the potential users near where the Marines inhabit on Main Cantonment, impacts to the recreational resources at Navy Barrigada would result in less than significant impacts.

Non-DoD Land

Construction

The existing recreational resources on non-DoD properties in central Guam are primarily situated along Tumon Bay and Agana Bay, Hagatna, the coastal areas east of Route 15. The increased construction-related vehicles on roads may cause delay for persons attempting to gain access to the recreational resources on non-DoD lands; however, direct impacts to recreational resources are not expected.

Operation

Within central Guam are the capital city of Hagatna and the tourism center at Tumon; together, a wide spectrum of recreational activities, from trails, to museums, to marine recreational resources, historic and cultural attractions, scenic vistas, and active recreational uses many beaches and parks. These areas are widely popular with tourists who visit Guam for the variety of marine uses offered, as well as recreational opportunities in a more cosmopolitan setting. Currently, users are comprised of the existing visitor population (residents and military) and visitors from off-island.

The addition of 17,600 potential users to recreational resources on non-DoD lands in central Guam would lead to the reduction of opportunities for space and time at existing facilities. Increase in users would lead to increased competition for opportunities at each recreational use. For instance, beaches at Tumon Bay would likely experience crowding as the result of more swimmers in the water and beachcombers on the esplanade; beaches popular with off-island tourists may become even more populous with local users. Similarly, growth in the number of swimmers and/or snorkelers at the Perez Beach may lead to conflicts between users/uses (e.g. conflicts between fishing and snorkeling at the same beach).

Features popular and unique to the region (e.g. outdoor concerts at Ypao Park, snorkeling at the beaches in Tumon Bay, water parks at hotels, day use resorts) would continue to attract users. An example which helps to illustrate this point is the War in the Pacific National Historical Park managed by the National Park Service. In 1998, the Park received 134,067 visitors, and in 2008, 187,005 visitors. In February 2009 alone, the Park received 20,801 visitors (National Park Service 2009).

The general wear and tear of the amenities available and the conditions of the recreational resources would likely be accelerated due to the presence of potential users. Heightened awareness and education about environmentally sensitive areas would contribute towards minimizing deterioration of resources.

To alleviate the potentially significant impact to the recreational resource, the MCCS is proposing a wide range of QOL facilities at the Main Cantonment site on NCTS Finegayan to meet the recreational demands of the Marines, their dependents and guests. By presenting comparable and/or alternate recreational options to the potential users near where the Marines inhabit on Main Cantonment, impacts to the recreational resources on non-DoD lands could be alleaviated. Therefore, Alternative 1 would result in less than significant impacts to recreational resources on non-DoD lands in central Guam.

9.2.2.3 Apra Harbor

Harbor

Construction

The construction activities associated with the proposed action occur outside of the recreational resource areas at Apra Harbor. The increased construction-related vehicles on roads may cause delay for persons

attempting to gain access to the recreational resources at Apra Harbor; however, direct impacts to recreational resources are not expected.

Operation

There are several dive spots and beaches/parks at Apra Harbor for exclusive use by installation guests and dependents. The proposed waterfront operation spans over most of the Inner Harbor and may inhibit access to recreational resources situated on in the adjacent area, namely San Luis Beach and Fort San Luis, Old Fuel Piers dive site, War Dog Cemetery, and Sumay Cove Marina. The Outer Apra Harbor hosts a multitude of sunken vessels from World War II and as a result, many dive spots exist today. The proposed dredging activities may cause displacement from recreational uses in the Outer Harbor. Users displaced from dive sites may elect to pursue resources around the proposed channel path, such as Glass Breakwater or Sasa Bay, but only persons with base privileges would be able to access the recreational resources on the Apra Harbor Naval Reservation to the south. Persons without base privileges may elect to pursue similar recreational features at Tumon and Tamuning or the southwest coast of Guam.

The resulting displacement and crowding at these locations would contribute towards a lessened level of satisfaction and enjoyment of recreational uses. Impacts such as delayed or unavailability of uses, crowding, and inadequate facilities (e.g., inadequate mooring facility for increased number of boats) are likely to result. For example, Sasa Bay is a wildlife preserve with little motorized boat traffic; East Agana is a prime jet ski area. There is a concern that some motorized boats may spill over into the bay. There is no official speed limit in the area, and there is a general concern that wave action generated by motorized boats can contribute to shoreline erosion (Marianas Yacht Club 2009a). Increased numbers of visitors to recreational resources are likely to lead to competition for space and recreational opportunity (e.g., kayakers and jet skiers vying for space/opportunity in the waters).

Although advanced notice of schedule operation times are made available to the public via notice to mariners (NOTMARs), schedules are subject to change up until the date of the operation. NOTMARs advise the public, fishermen, and divers in advance of ongoing military activities that may temporarily relocate civilian and recreational activities (COMPACFLT 2009). NOTMARs may be inadequate for marine recreational activities requiring advanced scheduling, such as sailing events. For instance, a recurring issue has involved the Navy informing the Marianas Yacht Club, which organizes events such as Japanese Regatta, to leave in the middle of the event because of incoming ships despite all permits in place (Marianas Yacht Club 2009b). There are positive attributes to the implementation of project components, however; clubs such as the Marianas Yacht Club and tourism companies offering dives expect to strengthen its membership numbers (Marianas Yacht Club 2009b).

To alleviate the potentially significant impact to the recreational resource, the MCCS is proposing a wide range of QOL facilities at the Main Cantonment site on NCTS Finegayan to meet the recreational demands of the Marines, their dependents and guests. By presenting comparable and/or alternate recreational options to the potential users near where the Marines inhabit on Main Cantonment, impacts to the recreational resources on non-DoD lands could be alleviated. Therefore, Alternative 1 would result in less than significant impacts to recreational resources at Apra Harbor.

Naval Base Guam

Construction

The construction activities associated with the proposed action occur outside of the recreational resource areas at the Naval Base Guam. The increased construction-related vehicles on roads may cause delay for

persons attempting to gain access to the recreational resources at Naval Base Guam; however, direct impacts to recreational resources is not expected.

Operation

Naval Base Guam features many water-related recreational resources (e.g. sailing, dive spots, fishing, beaches) popular with resident, military, and visitor populations alike. The availability of a wide range of water sports use may attract increased users to its resources. The project components would not impede access to the resources, but increased visitor load may mean more time spent on the road to reach the resources, thereby indirectly impeding access.

Implementation of this alternative would lead to the reduction of opportunities at existing facilities because a surge in visitor population would mean more users would be competing for the particular resource (e.g., more boaters competing for water space; jet skiers and divers competing for opportunity in the water).

Implementation of Alternative 1 would not necessarily displace public recreation activities or opportunities since comparable resources are readily available. However, components unique to a particular resource may not meet the visitor demands (e.g., Masso Reservoir offers fishing, camping, and hiking opportunities), resulting in displacement of users who visit specifically for its features.

The general wear and tear of the amenities available and the conditions of the recreational resources would likely be accelerated due to the presence of potential users. Heightened awareness and education about environmentally sensitive areas would contribute towards minimizing deterioration of resources.

Therefore, Alternative 1 would result in less than significant impacts to recreational resources on Naval Base Guam.

9.2.2.4 South

Naval Munitions Site

Construction

The construction activities associated with the proposed action occur outside of the recreational resource areas at NMS. The increased number of construction-related vehicles on roads may cause delay for persons attempting to gain access to the recreational resources at NMS; however, direct impacts to recreational resources are not expected.

Operation

Access to and use of the recreational resources are restricted to installation personnel and guests. The number of users to the resources may increase as the result of the proposed action. With the exception to the Fena Reservoir, which attracts fishing, most recreational resources at NMS are passive recreational resources (e.g., scenic point, Fena Massacre Site, Alma Gosa and Dobo Springs). Passive activities listed above, except fishing, do not warrant prolonged or extended stays as would by more active uses (e.g., hiking). Therefore, Alternative 1 would result in less than significant to recreational resources on NMS.

9.2.2.5 Summary of Impacts

In general, increased population due to the relocation of Marines and their dependents would create an adverse impact to recreational facilities on base, but this would be offset by the construction and operation of new facilities at the Main Cantonment. Impacts to recreational resources off base would be

significant due to the increase in civilian workers during the construction phase and the loss of recreational opportunities at the proposed Training Range Complex at Route 15.

9.2.2.6 Potential Mitigation Measures

The mitigation measures for recreational impacts may include the following:

- Prepare a Recreational Carrying Capacity Analysis Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions.
- DoD offer resources in form of time and donation or use of equipment to assist the volunteer conservation officer (VCO) at Andersen AFB.
- DoD collaborate with the Guam Division of Aquatic and Wildlife Resources (GDAWR) to establish outreach programs and docent programs for the five marine preserves and other environmentally sensitive areas on Guam.
- Marine Corps could provide for improvement and maintenance of Tanguisson Beach, along with the management of the coastline to the north of Hilaan that contains significant natural, cultural, scenic, and recreational resources.

9.2.3 Alternative 2 (Preferred Alternative)

9.2.3.1 North

Andersen AFB

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on Andersen AFB.

NCTS Finegayan

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on NCTS Finegayan.

Former FAA Parcel

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

9.2.3.2 Central

Andersen South

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Barrigada

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on Barrigada.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have significant but mitigable impacts to recreational resources on non-DoD lands in central Guam.

9.2.3.3 Apra Harbor

Harbor

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on Apra Harbor.

Naval Base Guam

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on Naval Base Guam.

9.2.3.4 South

Naval Munitions Site

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 2 would have less than significant impacts to recreational resources on the NMS.

9.2.3.5 Summary of Impacts

The summary of impacts resulting from Alternative 2 are similar to those described under Alternative 1.

9.2.3.6 Potential Mitigation Measures

The potential mitigation measures are the same as those proposed under Alternative 1.

9.2.4 Alternative 3

9.2.4.1 North

Andersen AFB

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources on Andersen AFB.

NCTS Finegayan

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources on NCTS Finegayan.

Former FAA Parcel

Construction

No components of the proposed action under Alternative 3 are planned at the former FAA parcel. No impacts to the existing trail use on-site are anticipated.

Operation

No components of the proposed action under Alternative 3 are planned at the former FAA parcel. No impacts to the existing trail use on-site are anticipated.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

9.2.4.2 Central

Andersen South

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Barrigada

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources on Barrigada.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have significant but mitigable impacts to recreational resources on non-DoD lands in central Guam.

9.2.4.3 Apra Harbor

Harbor

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources at Apra Harbor.

Naval Base Guam

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources on Naval Base Guam.

9.2.4.4 South

Naval Munitions Site

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 3 would have less than significant impacts to recreational resources on NMS.

9.2.4.5 Summary of Impacts

The summary of impacts resulting from Alternative 3 are similar to those described under Alternative 1.

9.2.4.6 Potential Mitigation Measures

The potential mitigation measures are the same as those proposed under Alternative 1.

9.2.5 Alternative 8

9.2.5.1 North

Andersen AFB

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have less than significant impacts to recreational resources on Andersen AFB.

NCTS Finegayan

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have less than significant impacts to recreational resources on NCTS Finegayan.

Former FAA Parcel

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

9.2.5.2 Central

Andersen South

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Barrigada

Construction

The effects would be similar to those described under Alternative 1.

Operation

The effects would be similar to those described under Alternative 1.

Non-DoD Land

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have significant but mitigable impacts to recreational resources on non-DoD lands in central Guam.

9.2.5.3 Apra Harbor

Harbor

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have less than significant impacts to recreational resources at Apra Harbor.

Naval Base Guam

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have less than significant impacts to recreational resources on Naval Base Guam.

9.2.5.4 South

Naval Munitions Site

Construction

The effects would be similar to those described under Alternative 1.

Operation

All components of this alternative, except for the location of family housing and community support facilities, are identical to Alternative 1. Therefore, Alternative 8 would have less than significant impacts to recreational resources on NMS.

9.2.5.5 Summary of Impacts

The summary of impacts resulting from Alternative 8 are similar to those described under Alternative 1.

9.2.5.6 Potential Mitigation Measures

The potential mitigation measures are the same as those proposed under Alternative 1.

9.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. There would be no change to existing conditions if the no-action alternative were implemented. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

9.2.7 Summary of Impacts

Table 9.2-1 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 9.2-2 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 9.2-3 and 9.2-4 summarize the impacts at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives respectively. A summary of potential recreation impacts due to Other Training, Airfield, and Waterfront is provided in Table 9.2-5. A text summary follows the summary tables.

Table 9.2-1. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
SI-M • Reduction of recreational opportunities off base due to increase in the number of users seeking recreational resources from construction workers	SI-M • Reduction of recreational opportunities off base due to increase in the number of users seeking recreational resources from construction workers	SI-M • Reduction of recreational opportunities off base due to increase in the number of users seeking recreational resources from construction workers	SI-M • Reduction of recreational opportunities off base due to increase in the number of users seeking recreational resources from construction workers
Operation			
LSI • Some on base resources may already be at or over capacity (Tarague Beach) • Reduction of recreational opportunities due to increase in the number of users seeking recreational resources on base • Accelerated deterioration of resources • Diminished user satisfaction due to reduced recreational opportunities • Conflicts between users and uses	LSI • Some on base resources may already be at or over capacity (Tarague Beach) • Reduction of recreational opportunities due to increase in the number of users seeking recreational resources on base • Accelerated deterioration of resources • Diminished user satisfaction due to reduced recreational opportunities • Conflicts between users and uses	LSI • Some on base resources may already be at or over capacity (Tarague Beach) • Reduction of recreational opportunities due to increase in the number of users seeking recreational resources on base • Accelerated deterioration of resources • Diminished user satisfaction due to reduced recreational opportunities • Conflicts between users and uses	LSI • Some on base resources may already be at or over capacity (Tarague Beach) • Reduction of recreational opportunities due to increase in the number of users seeking recreational resources on base • Accelerated deterioration of resources • Diminished user satisfaction due to reduced recreational opportunities • Conflicts between users and uses

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact.

Table 9.2-2. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
SI-M • Loss of use of Guam International Raceway, fishing, trails, and gathering activities by *suruhana*	SI-M • Loss of use of Guam International Raceway, fishing, trails, and gathering activities by *suruhana*
Operation	
SI-M • Lost access and use of recreational resources (Guam International Raceway, Marbo Cave (spelunking and offshore fishing), Pagat Trail and associated trails, *suruhana* activities	SI-M • Lost access and use of recreational resources (Guam International Raceway, Marbo Cave (spelunking and offshore fishing), Pagat Trail and associated trails, *suruhana* activities

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 9.2-3. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • There would be no impacts to recreation.	NI • There would be no impacts to recreation.
Operation	
NI • There would be no impacts to recreation.	NI • There would be no impacts to recreation.

Legend: NI = No impact.

Table 9.2-4. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • There would be no impacts to recreation.	NI • There would be no impacts to recreation.
Operation	
NI • There would be no impacts to recreation.	NI • There would be no impacts to recreation.

Legend: NI = No impact.

Table 9.2-5. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Congestion due to the presence of construction vehicles.	LSI • Congestion due to the presence of construction vehicles.	LSI • Displacement of users during dredging.
Operation		
LSI • Noise generated from proposed training activities does not trigger significance criteria and is not inconsistent with noise from existing operations.	LSI • Noise generated from proposed training activities does not trigger significance criteria and is not inconsistent with noise from existing operations.	LSI • Diminished user satisfaction due to displacement; • Conflicts between users and uses; • Reduction of recreational opportunities.

Legend: LSI = Less than significant impact.

Adverse impacts to existing recreational resources would be expected due to the sudden and dramatic increase in population on Guam. An increase in users to a wide range of recreational resources discussed in the affected environment of this chapter would occur. The increase in users would lead to competition

for recreational opportunities; this affects not only popular tourist sites visited by off-island tourists, but installation-specific facilities as well. Due to Guam's year round tropical/holiday weather, most of the already popularly visited recreational resources are anticipated to attract an increased flow of users. Because most persons relocating would be primarily occupied with employment and/or school, the degree of recreational resource uses is likely to be higher on weekends, holidays, and vacation months, mirroring the public school calendar year. As the heavier volume of visitors to the island occurs from July through March (except for January), competition for recreational opportunities is likely to be greater during these months as well.

Military recreational users, off-island visitors, and Guam residents would be competing for recreational use island wide. Increased users at existing recreational facilities would likely lead to conflicts between recreational users; examples include competition between surfers and swimmers for space at a popular beach park; between kayakers and snorkelers; spelunking and underwater cave swimmers; hikers and bike trail riders. Such conditions may already exist; the spike in recreational users may exacerbate the condition beyond current levels. Further, increased user numbers will likely cause an increase in the use of existing recreational facilities such that substantial physical deterioration of the facilities would occur. MCCS is planning for additional recreational facilities on Guam to meet the demands of the Marines and their dependents relocating to the area; this would serve to minimize impacts from increased demand resulting from implementation of the proposed action. Negotiatons related to land acquistion of the raceway would mitigate impacts to loss of recreational services.

9.2.8 Summary of Potential Mitigation Measures

Table 9.2-1. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Island-wide			
• Prepare a Recreational Carrying Capacity Analysis Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions. • DoD would offer resources in time and donation or use of equipment to assits the volunteer conservation officer at Andersen AFB • DoD collaborate with the GDAWR to establish outreach programs for 5 marine preserves	• Prepare a Recreational Carrying Capacity Analysis Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions. • DoD would offer resources in time and donation or use of equipment to assits the volunteer conservation officer at Andersen AFB • DoD collaborate with the GDAWR to establish outreach programs for 5 marine preserves	• Prepare a Recreational Carrying Capacity Analysis Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions. • DoD would offer resources in time and donation or use of equipment to assits the volunteer conservation officer at Andersen AFB • DoD collaborate with the GDAWR to establish outreach programs for 5 marine preserves	• Prepare a Recreational Carrying Capacity Analysis Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions. • DoD would offer resources in time and donation or use of equipment to assits the volunteer conservation officer at Andersen AFB • DoD collaborate with the GDAWR to establish outreach programs for 5 marine preserves

CHAPTER 10. TERRESTRIAL BIOLOGICAL RESOURCES

10.1 AFFECTED ENVIRONMENT

This chapter describes the plant and animal species and habitats that occur in terrestrial and wetland environments potentially impacted by the proposed action. The region of influence (ROI) encompasses the lands that support terrestrial biological resources (i.e., individual species, their habitats, and areas of habitat connectivity) that may be affected directly or indirectly by the proposed action. The ROI varies depending on the type of disturbance and the resource being considered. Construction, operations, and/or training activities have the potential to impact biological resources. Potential activities that may cause impact include, but are not limited to, ground-disturbing activities, noise, operational movement (e.g. vehicle traffic), and biosecurity mitigation. Site-specific ROIs are discussed for the following project areas: Andersen Air Force Base (AFB), Naval Computer and Telecommunications Site (NCTS) Finegayan, former Federal Aviation Administration (FAA) Parcel, South Finegayan, Harmon Annex, Andersen South, Route 15 lands, Air Force Barrigada, Navy Barrigada, Naval Base Guam, Cabras Parcel, Naval Munitions Site (NMS) and associated proposed access road, and Guam-wide roadways proposed for improvements (Figure 10.1-1).

10.1.1 Definition of Resource

The analysis focuses on species and vegetation communities crucial to the functions of biological systems, of special public importance, or that are protected under federal or local law or statute. For the purposes of this document, terrestrial biological resources are divided into three categories: *vegetation communities*, *wildlife*, and *special-status species*. Special-status species include those species listed under the Endangered Species Act (ESA), candidates for ESA listing, and those listed as threatened or endangered by Guam law. Species mentioned in this section are described using the common name when there is an accepted English common name. Scientific names are provided in Appendix G. If available, the Chamorro name is provided in parentheses when the species is first mentioned in the text.

10.1.1.1 Vegetation Communities

The vegetation of Guam was initially described by Fosberg (1960). A comprehensive flora was published a decade later (Stone 1970), and an update to Fosberg (1960) was published in 1998 (Mueller-Dombois and Fosberg 1998). These authors demonstrated that the flora of Guam is unique, with 21% of its native vascular plants endemic to the Mariana Islands.

Donnegan et al. (2004) completed a forest inventory and for Guam and they estimated that approximately 48 percent of the island was forested which consisted of 44,404 ac (17,970 ha) classified as limestone forest, with most found in northern Guam, and 19,129 ac (7,741 ha) classified as volcanic forest, with most found in southern Guam. Other vegetation or cover types included 44,455 ac (17,991 ha) of savanna and 23,956 ac (9,695 ha) of urban land.

Guam's vegetation types can be grouped into the following general plant communities: primary limestone forest (intact and never cleared), disturbed limestone forest (secondary, dominated by non-native species), halophytic/xerophytic scrub (adapted to grow in salt-laden air and dry conditions), scrub forest, tangantangan forest, strand, ravine forest, coconut groves, ironwood or Australian pine forest, savanna, wetlands, and developed.

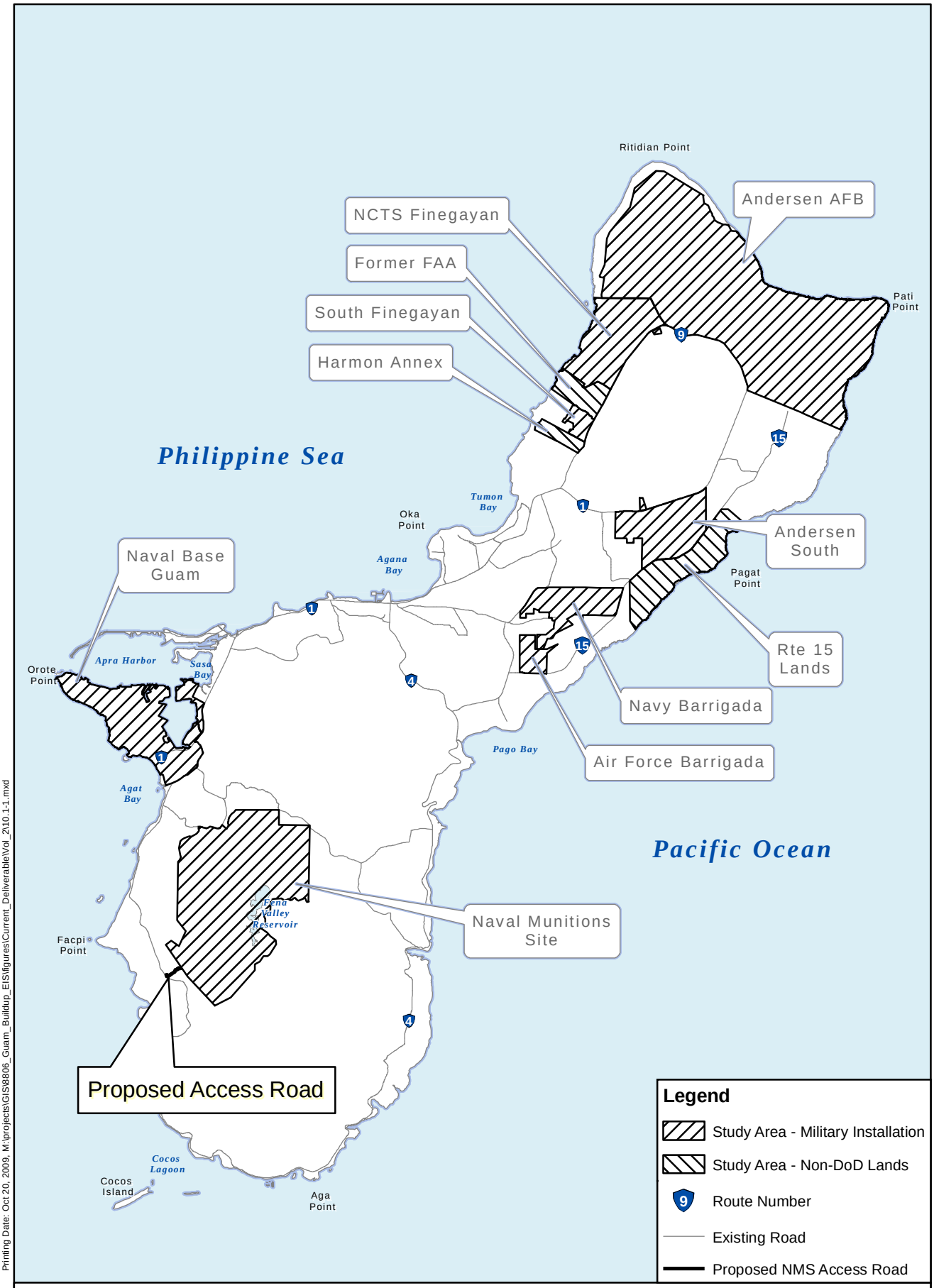


Figure 10.1-1
Biological Resources Study Areas - Guam

Intact limestone plant communities are floristically diverse, containing both native and non-native woody plants, ferns, and herbaceous plants adapted to shallow and excessively drained shallow limestone soils. Historically, the undisturbed limestone forest of Guam was a tall, closed canopy forest dominated by very large native breadfruit (called dugdug in Chamorro) and fig (nunu) trees with a maximum height of 60-70 feet (ft) (18-21 meters [m]). In areas of typhoon blowdowns, denser understory vegetation is dominated by ferns, herbaceous vegetation, and small shrubby species (Quinata 1994).

Most relatively accessible areas on Guam have been disturbed by human activity, and more inaccessible areas in southern Guam have been disturbed by fire. These disturbed plant communities in limestone regions are sometimes called degraded, or secondary communities, and are often dominated by *Vitex parviflora* (hereafter called *Vitex*), a non-native medium-sized tree.

Vegetation surveys and mapping have been completed for the Department of Defense (DoD) and non-DoD lands under consideration for use in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). For some areas, mapping and associated vegetation naming occurred at different times using different categories. Island-wide vegetation mapping was completed in 2005 by the United States Forest Service (USFS) (USFS 2006), but the mapping had minimal ground-truthing and used only one category for limestone forest, as opposed to the more commonly accepted method of describing limestone forest with multiple categories based on their degree of disturbance. The island-wide mapping lacks the necessary detail for an accurate description of the smaller parcels proposed for use under the proposed action.

In the site-specific subsections to follow, vegetation categories and mapping for each parcel are described and presented based on the best available published data for that parcel, with some modifications based on observations during site-specific field surveys conducted in support of this EIS/OEIS. The published sources are the Integrated Natural Resources Management Plan (INRMP) for Guam Navy lands (Commander Navy Region [COMNAV] Marianas 2001), base-wide vegetation mapping for Andersen AFB (Andersen AFB 2008c), and mapping by the USFS (2006a). Although the USFS effort is a more recent vegetation mapping that includes Navy installations, it is island-wide and at a grosser scale; the level of detail is greater in the INRMP, which more accurately captures the complexity of the vegetation mosaic at a parcel-specific scale. Therefore, the more detailed mapping would be used in this document where it is available, for smaller parcels such as NCTS Finegayan, South Finegayan, and Navy Barrigada.

As a means of introduction to the vegetation communities present on Guam, a general description of the vegetation categories is provided below based on descriptions by Fosberg (1960) and modified in the 2001 Navy INRMP (COMNAV Marianas 2001), and with some additional modifications based on USFS (2006a). The vegetation types for recent mapping at Andersen AFB (2008c) are correlated to these vegetation types at the end of each description when their designated names are different.

Limestone Forest

This community type is a relatively undisturbed (never totally cleared) forest dominated by native species, sometimes called primary limestone forest to distinguish it from disturbed limestone forest (see next category). It is found on elevated limestone terraces, plateaus, and slopes and is present on Andersen AFB, NCTS Finegayan, Naval Base Guam, Navy Barrigada, Route 15 lands, and NMS. Primary limestone plant communities are floristically diverse, containing both native and non-native woody plants, ferns, and herbaceous plants adapted to shallow and excessively drained shallow limestone soils. In its most undisturbed state, these plant communities characteristically have a stratified canopy consisting of scattered, large trees, native breadfruit, and fig with a maximum height of 60-70 ft (18-21 m). The limestone plant community is further broken down into five classes by Fosberg (1960): *Artocarpus-Ficus*

forest, *Mammea* forest, *Cordia* forest, *Merrilliodendron-Ficus* forest, and *Pandanus* forest. Other dominant genera comprising both the upper canopy and mid-canopy layers include *Aglaia*, *Neisosperma*, *Premna*, *Tristiropsis*, *Elaeocarpus*, *Intsia*, *Pisonia*, and *Claoxylon*. Mid-canopy layers may be 30-45 ft (9-14 m) in height. Smaller specimens of the above species, as well as individuals of *Guamia mariannae* (pai pai), *Cycas circinalils* (= *micronesica*), Indian mulberry, and limeberry, are often present as a shorter understory layer.

Vegetation types at Andersen AFB that are considered to correspond to primary limestone forest for the purposes of this EIS/OEIS are: *Eugenia* forest, mixed limestone forest-plateau/primary, mixed limestone forest-toe slope/primary, and *Neisosperma* forest (only *Neisosperma* is mapped separately in this EIS/OEIS).

Disturbed Limestone Forest

The disturbed sub-type of the limestone vegetation community is sometimes referred to as degraded limestone forest or secondary limestone forest. Disturbed limestone forests are dominated by woody species of relatively short stature (no canopy), or they have a canopy of non-native *Vitex*. The floristic composition represents subclimax seral stages following human induced disturbance, such as land clearing. The canopy of disturbed limestone forest is more open, allowing abundant sunlight to reach the forest floor. The majority of the woody biomass in the disturbed limestone forest is usually derived from non-native species, primarily tangantangan, limeberry, papaya, and others. Some areas of disturbed limestone forest are also dominated by larger non-native trees, such as African tulip tree. Vegetation types at Andersen AFB that are considered to correspond to disturbed limestone forest for the purposes of this EIS/OEIS are mixed limestone forest-plateau/secondary, *Hibiscus* scrub, mixed shrub, *Ochrosia* edge, *Vitex*-closed canopy, and *Vitex*-open canopy.

Halophytic/Xerophytic Scrub

The halophytic/xerophytic scrub sub-type of the limestone vegetation community is a unique plant community that exists on limestone terraces and cliff edges. The presence of drying winds, exposure to salt spray, and excessively drained limestone soils result in a microclimate that supports a stunted, wind-pruned plant community. The floristic composition may either be simple or complex and comprised of a few or many species. Vegetation types at Andersen AFB that are considered to correspond to halophytic/xerophytic scrub for the purposes of this EIS/OEIS are: mixed limestone forest-foreslope, *Hibiscus*-*Ochrosia* scrub, and mixed limestone forest-toe slope.

Shrub/Grasslands (Scrub Forest)

These are variable secondary thickets and partially cultivated scrub resulting from long-continued human disturbance, usually on argillaceous limestone. They may include small areas of coconut grove, bamboo clumps, patches of scrub or scrub forest, home sites, and small cultivated areas. The vegetation type at Andersen AFB that is considered to correspond to shrub/grasslands for the purposes of this EIS/OEIS is mixed herbaceous scrub.

Tangantangan

This community typically occurs on limestone and is dominated by the introduced small tree, tangantangan. The vegetation type at Andersen AFB that is considered to correspond to tangantangan for the purposes of this EIS/OEIS is *Hibiscus-Leucaena*.

Strand

Strand plant communities are limited to narrow strips in coastal areas within Naval Base Guam and NCTS Finegayan. Strand vegetation is adapted to excessively drained soils and salt spray from the adjacent coastal waters. Many of the beach areas are occasionally inundated with salt water during storm events, which imposes a controlling influence on all biota. Vegetation types at Andersen AFB that are considered to correspond to strand for the purposes of this EIS/OEIS are: back strand/rock, back strand/sand, fore strand/sand, and strand/rock.

Ravine Forest

Fosberg (1960) classified the forest vegetation in valleys and ravines in southern Guam as ravine forests. Although the floristic composition of the ravine communities is sometimes similar to limestone communities, these forests are generally located on volcanic soils or on argillaceous limestone soils, and are quite variable in floristic composition. Plant communities are often defined by the variability in soil moisture, which can be substantial in this varied topography. Species present often include sea hibiscus, pandanus, fig, *Glochidion mariannensis* (chosga), *Premna obtusifolia*, breadfruit, *Neisosperma oppositifolia*, *Ochrosia mariannensis*, and Alexandrian laurel. Due to their proximity to freshwater streams in southern Guam, these plant communities contain many species of cultivated plants. Epiphytes and common woody climbers are also present. Some areas of ravine forest are disturbed and these are usually dominated by non-native woody species with a more open canopy. *Vitex*, *Cananga odorata*, and Indian mulberry are common components of disturbed ravine forest on Navy lands. The open understory is occupied by various non-native grasses, vines and weeds. Swamps are delineated as ravine communities and these are often present on argillaceous limestone soils on bottomlands, and also in depressional areas. Sea hibiscus and pandanus are the most common woody species associated with these communities.

Coconut Grove

These planted communities are inclusive within limestone, ravine, and strand communities.

Casuarina Forest

Ironwood or Australian pine tolerates dry and salty conditions, and often occurs as a savanna habitat. In some locations, it forms a sparse woodland with little understory. Ironwood also occurs in exposed areas and in narrow bands at some locations along the coast.

Savanna

Savannas, which are defined as grasslands with scattered trees or clumps of trees, cover extensive areas in southern Guam. Savannas are predominantly found on volcanic soils and are maintained by periodic human-ignited burning. Plants are adapted to the acidic and high aluminum content of the highly weathered volcanic soils. Fosberg (1960) recognized five savanna plant communities: sword grass (*Miscanthus)* community; *Dimeria* community, erosion-scar community; reed (*Phragmites)* community; and weed community. The *Miscanthus* community is dominated by Pacific Island silvergrass, which can reach 10-15 ft (3-4.6 m) in height. Because it is a bunch grass, as much as 30-40% of the ground surface is exposed mineral soil. The *Dimeria* community is dominated by the shorter grass species, *Dimeria chloridiformis*. Woody shrubs and trees are uncommon. The erosion-scar community has sparse plant growth, the result of top soil erosion from water and wind. The exposed sub-soil usually has a very low pH and lacks organic matter and many essential plant nutrients. *Gleichenia linearis* (a fern) is one of few plant species that can tolerate the low pH and lack of nutrients. The *Phragmites* community, dominated

by the reed *Phragmites karka*, usually indicates the presence of higher soil moisture resulting from seeps. The savanna weed community usually indicates recent disturbance in which the community is dominated by non-native pioneer plant species. Disturbance can be the result of fire, grazing, cultivation, or clearing.

Wetlands

Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, including marshes, swamps, and similar areas. Areas described and mapped as wetland communities may include small streams, shallow ponds, and pond or lake edges. The recurrent excess of water in wetlands imposes controlling influences on all biota (plants, animals, and microbes). Stone (1970) referred to Fosberg's (1960) wetlands as marshes. Fosberg (1960) described seven subtypes of the wetland plant communities based on their dominant floristic composition. He defined swamps as supporting plant communities with a predominance of woody species (designated as ravine communities for the purpose of this vegetation classification), and marshes as supporting herbaceous plant communities.

Marshes are generally located in low places along the coast, along streams, in depressions and sinkholes with argillaceous limestones, or in poorly drained areas with volcanic soils. Marshes may be inundated with fresh water, or brackish water if near the ocean. Swamps are generally located along rivers, especially near the coast, or near sea level (along river valleys if inland), and are usually designated as ravine communities rather than wetland communities. Most marshes are floristically simple, with only a few plant species being dominant. The most common marsh species, *Phragmites karka*, a tall reedy perennial grass, often forms a dense monocultural plant community. *Scirpus littoralis*, a perennial bulrush that grows from rhizomes, also forms dense stands along stream banks and in estuaries. The large golden leatherfern can also dominate some marshes. Other florisitic components of wetland plant communities can include sedge (*Cyperus* spp.), *Paspalum vaginatum*, and para grass.

Developed Land (Urban/Alien)

These are human-occupied or otherwise highly disturbed areas that include lawns and other landscaped areas and impervious surfaces such as buildings, roads, and parking lots.

10.1.1.2 Wildlife

For the purposes of this document, this category includes all common animal species, with the exception of those identified as listed, proposed for listing, or candidates under the federal ESA, and those species listed by Guam. The wildlife category includes invertebrates, fish, amphibians, reptiles, mammals, and birds, including native bird species protected under the Migratory Bird Treaty Act (MBTA). Assessment of a project's effects on migratory birds places an emphasis on "Species of Concern" as defined by Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*.

To address the importance and problems associated with the introduction of non-native species to Guam and their impacts on native species, the wildlife discussion is subdivided into native and non-native species. EO 13112, *Invasive Species*, addresses responsibilities and initiatives of the Federal government for controlling invasive species, therefore these species are included as a significant component in of wildlife in this EIS/OEIS. Brief descriptions and life history information for wildlife species of special interest can be found in Volume 9, Appendix G.

A major factor in the current occurrence and distribution of all wildlife, including ESA- and Guam-listed species is the presence of the brown treesnake (BTS). The BTS impacts the economy, human health, and island ecology of Guam. This species was inadvertently introduced around 1949 from cargo that originated in New Guinea. There are numerous economic and safety considerations with the BTS, as

summarized by Fritts and Leasman-Tanner (2001). Since the snakes were introduced, they have been known to climb power poles and short circuit transformers resulting in an estimated outage in one out of three days, with more than 1,600 snake-caused outages occurred from 1978-1997 at costs of up to several million dollars per year. In addition, because the BTS is known to prey on eggs and birds, it has impacted the poultry industry and small farmers (most eggs for general consumption have to be imported). Regarding human health, BTS are a mildly venomous species, which has resulted in approximately 1 in 1,000 emergency room visits.

BTS were known to occur on Guam in the 1950-1980s but they were not seen as a threat as this is the first instance of a predatory snake arriving on an isolated island. BTS hunt and live in trees, and are active at night. The result of this introduction is 17 of 18 native bird species were severely impacted, and 12 of the 18 species were likely extirpated from the wild on Guam due to the direct impact of the BTS (Wiles et al. 2003). As a result of these impacts, Guam Department of Aquatic and Wildlife Resources (GDAWR) took into captivity the endemic Guam flightless rail and Guam Micronesian kingfisher to form the basis of a captive breeding program.

Efforts to control the BTS are mostly limited to preventing BTS from leaving Guam in cargo, by ship or air. DoD has collaborated with other partners and participated in the development of BTS-specific trapping techniques, BTS detection using sniffer dogs, fence design, and development of toxicants and delivery methods. While these efforts have had success, BTS originating on Guam have been found in Kwajalein, Pohnpei, Hawaii (Oahu), Diego Garcia, Spain, Alaska, Texas, Oklahoma, and CNMI (Rota, Tinian, and Saipan).

BTS has been determined as the greatest limiting factor to reintroduction and/or recovery of both Guam Micronesian kingfisher and Mariana crow on Guam (U.S. Fish and Wildlife Service [USFWS] 2005b, 2008a). Recovery plans for Mariana crow, Guam Micronesian kingfisher, Mariana fruit bat, Mariana swiftlet, Guam rail, and Mariana common moorhen call for BTS suppression and eradication. Unfortunately, over the last three decades, there has been limited funding for research on, 1) life history of BTS on Guam, 2) detection of snakes at low densities, and 3) heavy suppression over large geographic areas. In addition, there has not been a concentrated effort to eradicate the BTS island-wide. As a consequence, the few recovery efforts for ESA-listed species on Guam that have been attempted have been unsuccessful. The ultimate goal is to have Guam species successfully reproducing with individuals in the wild. Although habitat exists for these species, until BTS levels are controlled, recovery and/or reintroduction of ESA-listed bird species cannot occur. In addition, BTS numbers did not decrease after the loss of native birds because they eat a wide variety of prey. Now, the most abundant prey are introduced reptiles (e.g., skinks and geckos) that are common throughout the island.

10.1.1.3 Special-Status Species

ESA-Listed and Candidate Species

ESA-listed species are defined as those plant and animal species currently listed by the USFWS under the ESA as threatened, endangered, or proposed as such. Candidates are plant or animal species for which USFWS has sufficient information on file regarding biological vulnerability and threats to support a proposal that would list them as endangered or threatened under the ESA, based on the most recent candidate review (USFWS 2008c). Brief descriptions and life history information for ESA-listed species can be found in Volume 9, Appendix G.

Of the ESA-listed and candidate species on Guam, seven ESA-listed and four candidate species are known to currently or potentially occur, on lands proposed for use under the proposed action

(Table 10.1-1). Currently DoD lands are the primary location, and often the only location, for most ESA-listed species remaining on Guam. Two endangered species have been extirpated (no longer present in the wild) from the island but have captive populations on Guam: Guam Micronesian kingfisher and Guam rail. Two candidate species – Mariana wandering butterfly and Pacific sheath-tailed bat – have been extirpated from Guam but are found in the Commonwealth of the Northern Mariana Islands (CNMI). Two ESA-listed endangered species are considered extinct: the Guam subspecies of the bridled white-eye and the little Mariana fruit bat.

Table 10.1-1. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species on Guam

Group	*Common Name/Chamorro Name/Scientific Name*[1]	*Status*[2]	
		ESA	*Guam*
MAMMALS	**Mariana fruit bat/Fanihi**	T, CH	E
	†Little Mariana fruit bat/Fanihi	E	E
	×Pacific sheath-tailed bat/Payesyes	C	E
BIRDS	**Mariana crow/Aga**	E, CH	E
	†Guam bridled white-eye/Nossa	E	E
	‡Guam Micronesian kingfisher/Sihek	E, CH	E
	‡Guam rail/Koko	E	E
	Micronesian starling/Sali	-	E
	Mariana swiftlet/Chuchaguak	E	E
	Mariana common moorhen/Palattat	E	E
REPTILES	**Green sea turtle/Haggan bed'di**	T	T
	Hawksbill turtle/Hagan karai	E	E
	Micronesian gecko/Guali'ek	-	E
	Oceanic gecko/Achiek	-	E
	Pacific slender-toed gecko/Guali'ek	-	E
	Azure-tailed skink/Guali'ek Halom Tano'	-	E
	Slevin's skink/ Guali'ek Halom Tano'	-	E
	Snake-eyed skink /Guali'ek Halom Tano'	-	E
	Tide-pool skink /Guali'ek Kantun Tasi	-	E
	Moth skink/Guali'ek Halom Tano'	-	E
INVERTEBRATES	**Guam tree snail/Akaleha'**	C	E
	Humped tree snail/Akaleha'	C	E
	Fragile tree snail/Akaleha'	C	E
	×Mariana wandering butterfly/ -	C	-
	Mariana eight-spot butterfly/Ababbang	C	-
PLANTS	**Fire tree/Hayun lagu**	E	E
	No common name/Ufa-halomtano/*Heritiera longipetiolata*	-	E
	No common name /-/*Cyathea lunulata*	-	E

Notes: [1]Scientific names for all species with accepted common names are provided in Volume 9, Appendix G. **Bold** indicates present in the project areas; † = extinct; ‡ = extirpated in the wild, captive population established; × = extirpated on Guam but present in the CNMI.
[2] C = candidate, CH = critical habitat, E = endangered, T = threatened; Includes only nesting sea turtles;
Sources: Guam Division of Aquatic and Wildlife Resources (GDAWR) 2006; Andersen AFB 2008a; COMNAV Marianas 2008; USFWS 2008b, c.

Guam-Listed Species

Guam-listed species are those designated by legislative authority in the Territory of Guam as species that are endangered or threatened (i.e., not ESA-listed species). A total of 15 species listed as either threatened or endangered by Guam are known to occur on lands proposed for use under the proposed action (see Table 10.1-1). Brief descriptions and life history information for Guam-listed species can be found in Volume 9, Appendix G.

Critical Habitat, Overlay Refuge Lands, and Essential Habitat

Critical habitat is defined in section 3 of the ESA as, "…(i) the specific areas within the geographic area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species." Conservation describes the use of all methods and procedures necessary to remove an endangered or a threatened species from listing under the ESA.

In 1991, the USFWS first issued a proposal for critical habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher (USFWS 1991a). In 1993, the desire to create the Guam National Wildlife Refuge (NWR) was established by a Memorandum of Understanding with the USFWS, Navy, Air Force, and Government of Guam (GovGuam) (GovGuam et al. 1993). In 1994, Cooperative Agreements were signed between the Navy, Air Force, and USFWS to establish the Overlay Refuge (Air Force and USFWS 1994, Navy and USFWS 1994). The Cooperative Agreements defined the management and administrative roles and responsibilities of the Navy, Air Force, and USFWS for the Guam NWR. The 1994 Cooperative Agreements provide a commitment by the Navy, Air Force, and USFWS for a coordinated program centered on the protection of endangered and threatened species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with GDAWR, consistent with the national defense mission of the Navy and Air Force.

Excess military land at Ritidian Point was then transferred to USFWS under the federal excess property regulations for inclusion in the Guam NWR as the 376-ac (152-hectare [ha]) Ritidian Unit. The approximately 21,690 ac (8,778 ha) Guam Overlay Refuge are on lands administered by the Air Force and Navy (Figure 10.1-2 and Figure 10.1-3). The Overlay Refuge encompasses lands identified in recovery plans as essential habitat for the recovery of the Mariana fruit bat, Guam Micronesian kingfisher, Mariana crow, and Guam rail.

In October 2002, the USFWS again proposed critical habitat for the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat (USFWS 2002). The areas proposed as critical habitat were primarily on Overlay Refuge lands but included additional areas as well. On October 28, 2004, the USFWS designated 376 ac (152 ha) of land as critical habitat for the Guam Micronesian kingfisher, Mariana crow, and Mariana fruit bat on the Ritidian Unit of the Guam NWR in northern Guam (Table 10.1-1 and Figure 10.1-2; USFWS 2004).

Overlay Refuge lands were excluded from this designation including 10,838 ac (4,386 ha) of Air Force lands, 7,977 ac (3,228 ha) of Navy lands, and 2,989 ac (1,210 ha) of GovGuam lands in northern and southern Guam. Air Force lands were excluded under section 4(a)(3) of the ESA, as amended by Section 318 of the fiscal year 2004 National Defense Authorization Act, based on the Air Force's INRMP for Andersen AFB. Navy lands were excluded under section 4(b)(2) because the benefits of excluding these lands, including benefits to national security and existing management plans and conservation efforts, outweighed the benefits of designating them as critical habitat. GovGuam lands were excluded under section 4(b)(2) because the benefits of excluding these lands, including continued and improved cooperation between Guam and the USFWS and implementation of Guam's natural resource plan, outweigh the benefits of designating these lands as critical habitat.

For the purposes of this EIS/OEIS and based on discussion with the USFWS, the areas originally proposed as critical habitat in 2002 would be considered as 'essential habitat' for the recovery of ESA-

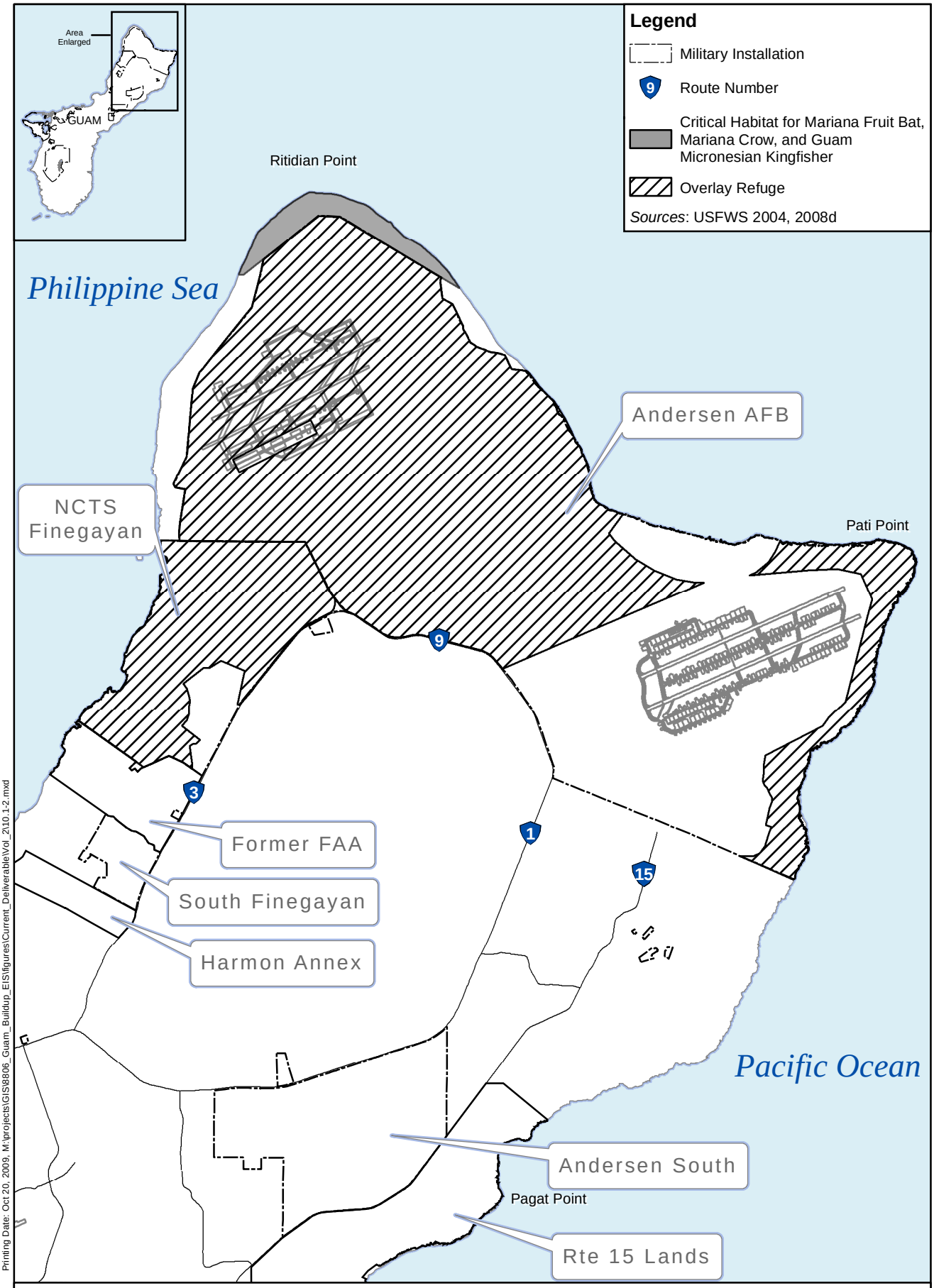


Figure 10.1-2
Overlay Refuge Lands and Designated Critical Habitat - Northern Guam

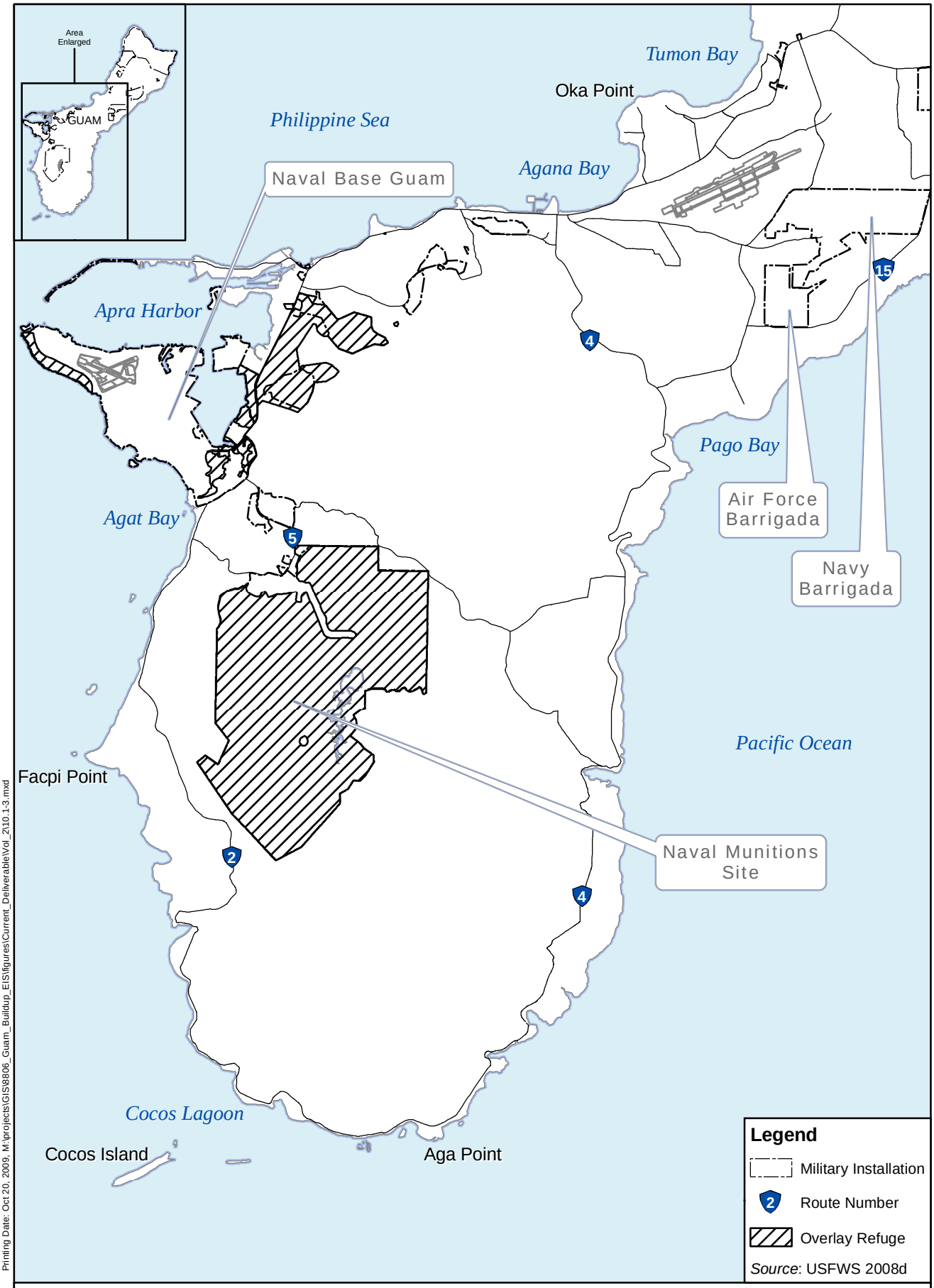


Figure 10.1-3
Overlay Refuge Lands - Southern Guam

listed species on Guam, particularly the Mariana crow, Guam Micronesian kingfisher, and Mariana fruit bat (Figure 10.1-4). These include approximately 24,802 ac (10,040 ha) of essential habitat for the Mariana fruit bat and Micronesian kingfisher, of which 77% is on DoD land, 2% is on non-DoD land being considered for use under the actions described in this EIS/OEIS, and 21% is on other non-DoD land not associated with the proposed projects. Mariana crow essential habitat includes lands also considered essential habitat for the fruit bat and kingfisher, but over a more limited area (refer to Figure 10.1-4) of approximately 23,004 ac (9,309 ha). For crow essential habitat, 83% is on DoD land and 17% is on non-DoD land not associated with the proposed project.

Recovery Plans

USFWS has published recovery plans for the ESA-listed species present on Guam. A brief summary of the delisting or downlisting criteria from these plans for the species that have essential habitat as defined in the recovery plans are outlined below.

- *Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan* (USFWS 1990a) – The little Mariana fruit bat is considered extinct and is not considered here. The recovery goal for the Guam Mariana fruit bat was to recover the subspecies to allow downlisting from endangered to threatened status. The plan specified increasing the fruit bat population to at least 2,500 while maintaining a minimum of 3 permanent colonies of 400 bats each. Control of BTS was considered important. Since the recovery plan was published, the Mariana fruit bat population throughout the Marianas (Guam and CNMI) was determined to be one subspecies and the species was downlisted to threatened status based on the archipelago-wide population. The current population of the subspecies is unknown because of the lack of recent surveys on most islands; however, based on surveys conducted from the 1990s the population of the subspecies may be up to several thousand individuals (Andersen AFB 2008e). Additional discussion and detail is provided in the Biological Assessment (BA) for the proposed action. Because of the age of the recovery plan and change in status, there are no valid recovery criteria currently in place for the Mariana fruit bat on Guam.
- *Revised Recovery Plan for the Sihek or Guam Micronesian Kingfisher (Halcyon cinnamomina cinnamomina)* (USFWS 2008a) – This subspecies currently exists only in captivity. To delist this subspecies, the plan specified the establishment of two subpopulations, one in northern Guam and one in southern Guam, each with at least 500 adults. The recovery plan estimated that the island of Guam could support a population of between 3,600 and 6,800 kingfishers based on available density estimates. Using the estimate of 63,833 ac (25,832 ha) of forested habitat specified in the recovery plan results in a maximum estimate of 17.7 ac (7.2 ha) of habitat required per kingfisher. Multiplying this by the target of 1,000 kingfishers in the recovery plan results in a requirement for 9,400 ac (3,804 ha) of habitat to achieve the delisting criteria. Control of BTS was considered important.
- Draft Revised Recovery Plan for the Aga or Mariana Crow (*Corvus kubaryi*) (USFWS 2005b) – To delist this species, the plan specified the establishment of three populations, one each on Rota, northern Guam, and southern Guam, each consisting of a minimum of 75 territorial pairs. The most recent estimate of the Rota population was 170 breeding pairs in 2004. The current population on Guam is two individuals, both males (Andersen AFB 2008d). To help achieve the recovery goal, priority recovery zones were proposed in northern and southern Guam. Based on a territory estimate of 1 pair per 54 ac (22 ha) obtained from studies on Rota, the required acreage on Guam to achieve the recovery goal of 150 pairs (75

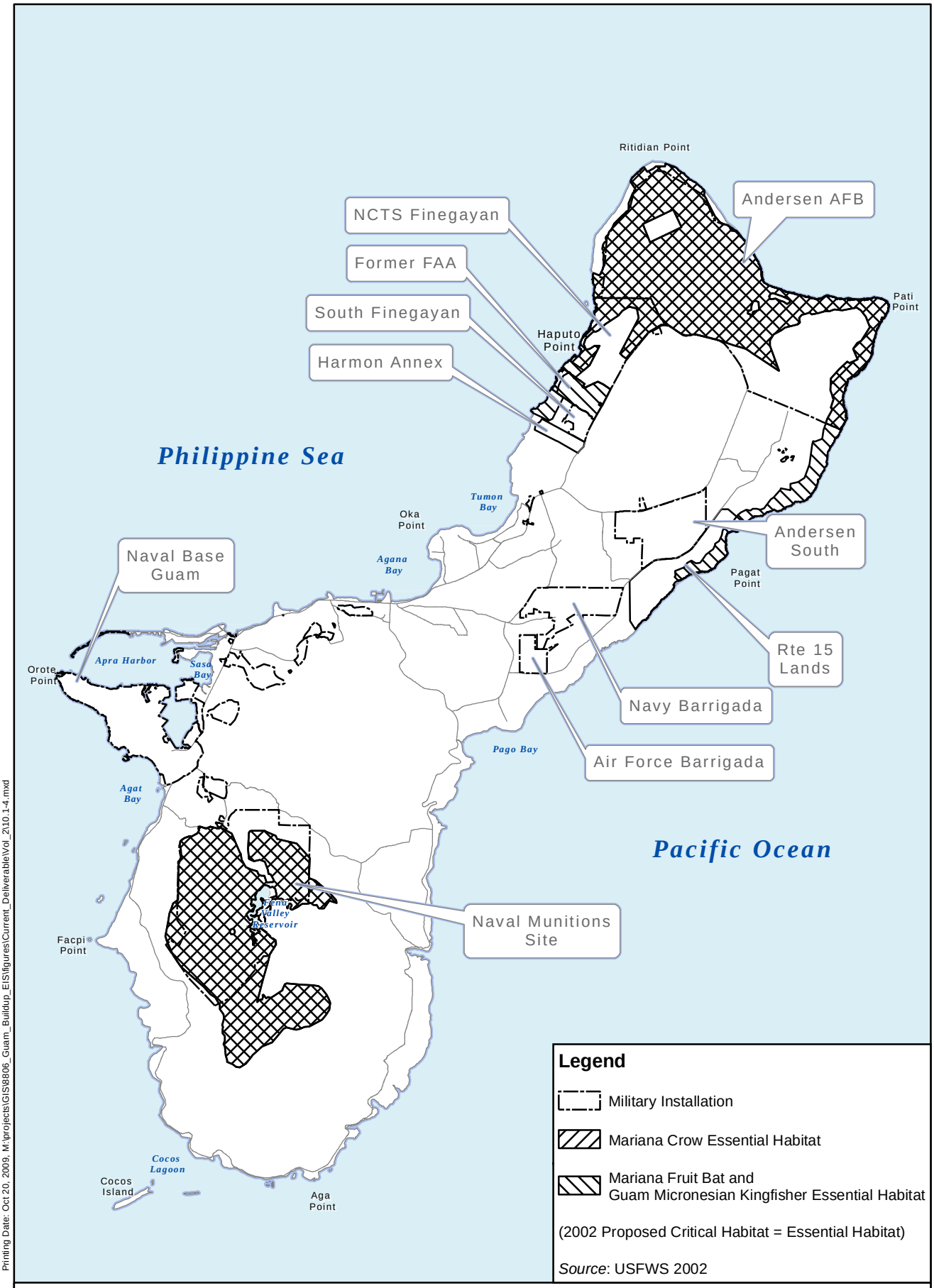


Figure 10.1-4
Essential Habitat for Guam Micronesian Kingfisher, Mariana Crow, and Mariana Fruit Bat

pairs in northern and southern Guam) would be 8,100 ac (3,278 ha). Control of BTS was considered important.

Native Forest Birds of Guam and Rota of the Commonwealth of the Mariana Islands Recovery Plan (includes the Guam rail) (USFWS 1990b) – Currently the Guam rail only exists in captivity. The recovery goal was to recover the species to allow downlisting from endangered to threatened status. The plan specified increasing the rail population to at least of 2,000 birds: 1,000 in Northern Guam and 1,000 in Southern Guam. Control of BTS was considered important

10.1.1.4 Study Areas and Survey Methods

For the purposes of this EIS/OEIS, the project area for biological resources has been divided into 13 study areas, including some smaller sub-areas (Table 10.1-2 and see Figure 10.1-1). The larger study areas were selected based on the site-specific ROIs and on the nature and physical extent of each project-specific component of the proposed action. Not all sites are being surveyed specifically for this EIS/OEIS because some sites have adequate existing studies and other sites have a low likelihood that a certain resource type would be present based on a thorough review of the studies and data available. Sites with the greatest likelihood of the presence of the various species have been surveyed.

Table 10.1-2. Project-specific Terrestrial Biological Resources Field Studies within Proposed Project Locations

*Project Location**	*Biological Resource*						
	Vegetation	*Tree Snails*	*Herps***	*Birds*	*Bat*	*Butterflies*	*Fresh water*
Andersen AFB		✓	✓	✓		✓	
NCTS Finegayan	✓	✓	✓	✓	✓		
Former FAA Parcel***	✓	✓	✓	✓			
South Finegayan	✓		✓	✓			
Andersen South	✓	✓	✓	✓		✓	
Route 15 Lands	✓	✓	✓	✓	✓	✓	
Navy Barrigada	✓	✓	✓	✓			
Air Force Barrigada			✓	✓			
Naval Base Guam	✓		✓	✓			
NMS	✓	✓	✓	✓	✓		✓
NMS Access Road	✓	✓	✓	✓			

Notes: *Refer to Figure 10.1-1 for project locations. **Herps = herpetological species, or surveys for reptiles and amphibians. ***Former FAA is in the vicinity of Harmon Annex; with similar vegetation types and disturbance regimes it is assumed that habitat and species found on the Annex would be similar to those found on Former FAA.

Data Sources and Survey Methods

Key sources of information for this section include the existing and recent draft INRMPs for Navy lands (COMNAV Marianas 2001, 2008); existing and draft INRMPs for Andersen AFB (Andersen AFB 2003, 2008a); Natural Resource Survey and Assessment Report (Naval Facilities Engineering Command [NAVFAC] Pacific 2007) and references therein; *Guam Comprehensive Wildlife Conservation Strategy* (Guam CWCS) (GDAWR 2006); and previous EISs, Environmental Assessments, Biological Assessments, and resulting USFWS Biological Opinions (BOs) for recent actions on military lands on Guam. Site-specific natural resources geographic information system (GIS) data for the ROI were obtained from NAVFAC Pacific, NAVFAC Marianas, and Andersen AFB as of September 2008.

In addition to existing biological resources data for the study areas, project-specific mapping efforts or surveys were conducted for vegetation and ESA- and Guam-listed species (see Tables 10.1-1 and 10.1-2). Survey methods are provided in detail in the *Natural Resources Survey Report* (NR Survey Report, in

preparation, estimated completion in November-December 2009). Biological surveys were not conducted for the Harmon Annex due to access limitations, but baseline data was extrapolated from past and current natural resource studies in adjacent parcels.

Species Evaluated

A total of 16 ESA-listed, Guam-listed, and candidate species may potentially occur within the study areas (see Table 10.1-1). Completed and on-going surveys/studies for these species are summarized in Table 10.1-1. Surveys for mammals, birds, reptiles, amphibians, invertebrates, and plants conducted for this EIS/OEIS documented all species encountered, not just listed or candidate species.

10.1.2 North

10.1.2.1 Andersen AFB

Vegetation Communities

Andersen AFB is located in a limestone geologic region which generally consists of limestone plateaus with abrupt cliffs and dropoffs toward the ocean. The underlying limestone may be strongly weathered into a karst formation. Terrestrial vegetative communities at Andersen AFB have been recently mapped and described in detail (Andersen AFB 2008c). Vegetation was mapped using the basic vegetation types of Fosberg (1960) but with modifications and expanded categories to fit more recent mapping efforts in Guam and on Andersen AFB. The basic vegetation communities include limestone forest, secondary limestone forest, coastal strand vegetation, mixed shrub, mixed herbaceous scrub, communities dominated by one or two species, and disturbed areas. Vegetation types for the general project areas from this recent mapping are shown in Figure 10.1-5 and Figure 10.1-6. Acreages of each vegetation community on Andersen AFB are listed in Table 10.1-3.

Table 10.1-3. Vegetation Communities at Andersen AFB

Vegetation Type	*ac (ha)*
Developed Land	4,501 (1,821)
Limestone Forest – Secondary (disturbed)	4,107 (1,662)
Limestone Forest – Primary	1,722 (697)
Vitex-Closed Canopy	851 (344)
Mixed Limestone Forest-Foreslope (Halophytic-Xerophytic Scrub)	834 (337)
Vitex-Sparse Canopy	807 (327)
Mixed Herbaceous Scrub	732 (296)
Hibiscus-Ochrosia Scrub	624 (252)
Coconut Forest	487 (197)
Hibiscus Scrub	431 (174)
Neisosperma Forest	286 (116)
Strand	186 (75)
Hibiscus-Leucaena	109 (44)
Casuarina Forest	102 (41)
Ochrosia Edge	38 (15)
Mixed Shrub	32 (13)

In East Andersen AFB, the North Ramp project area consists primarily of developed land, but there are small areas of mixed herbaceous scrub and mixed limestone forest- in the northern portion of the site. The South Ramp project area consists primarily of developed land, but there are small areas of *Ochrosia* edge and mixed herbaceous scrub habitats in the eastern portion of the site. The North Gate project area consists of mixed limestone forest, *Vitex*-dominated forest, and developed land.

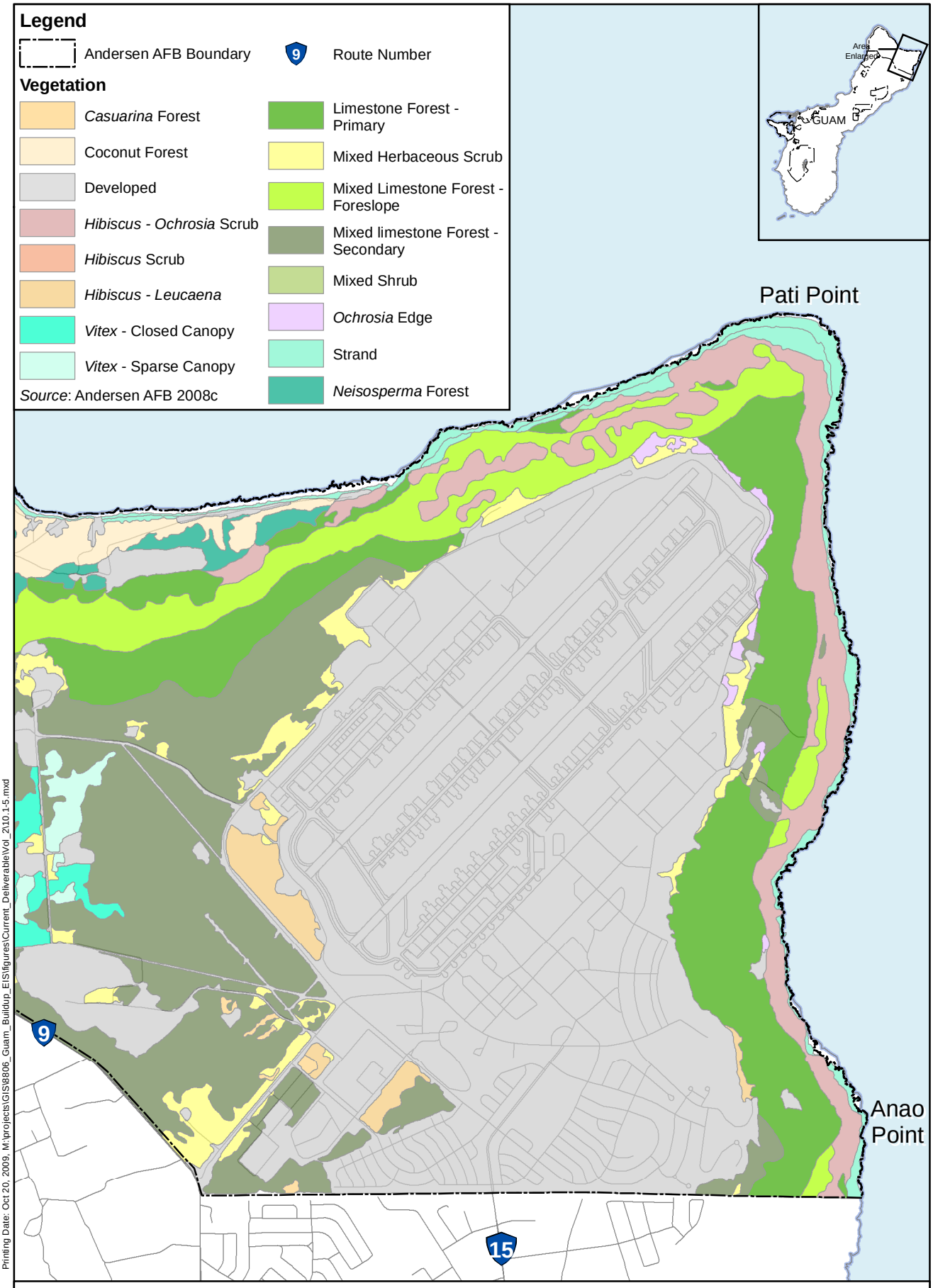


Figure 10.1-5
Vegetation Communities - Andersen AFB East

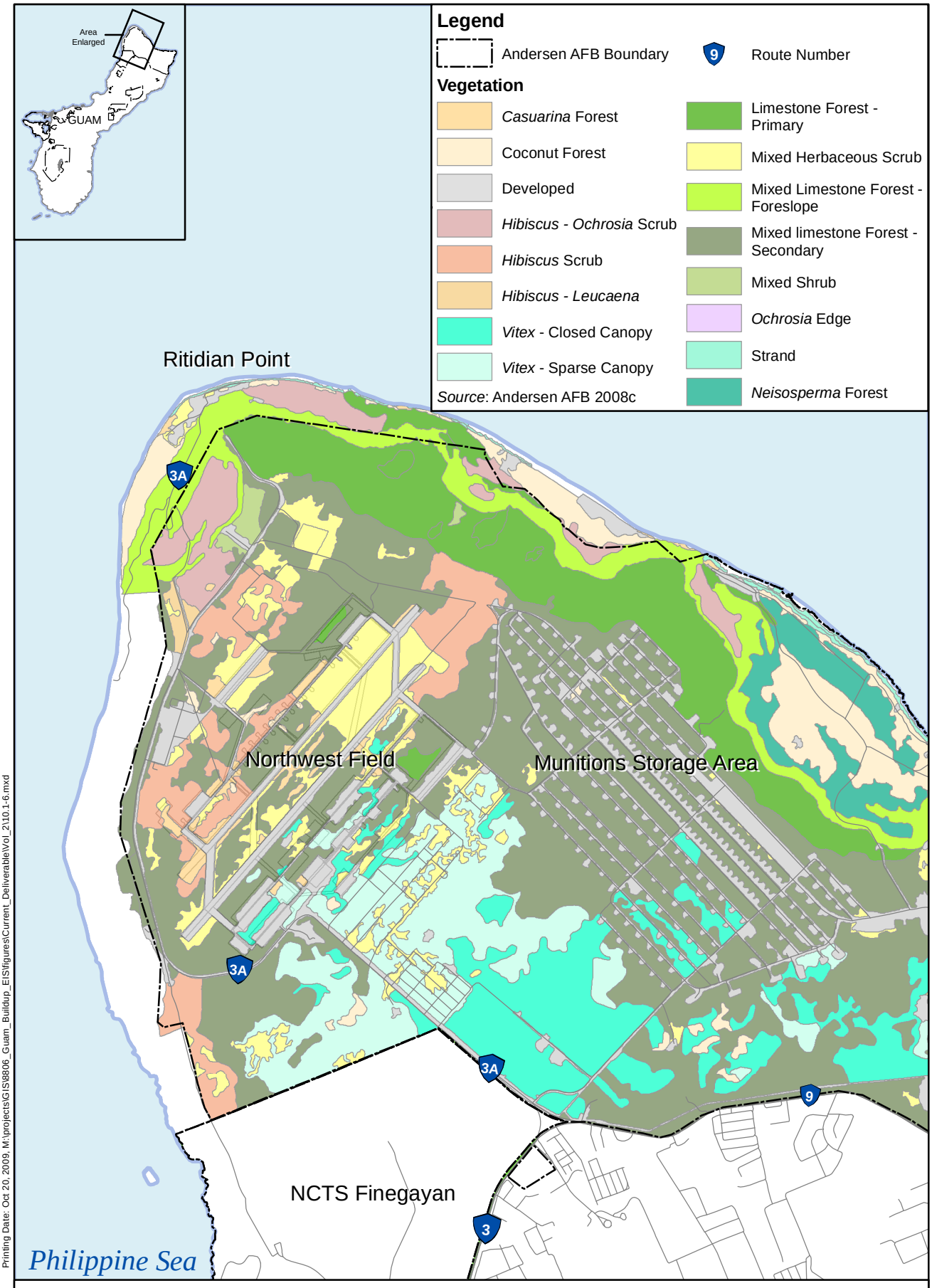


Figure 10.1-6
Vegetation Communities - Andersen AFB West

In West Andersen AFB, Northwest Field (NWF), the Munitions Storage Area (MSA), and surrounding areas consist primarily of mixed limestone forest, *Vitex*-dominated forest, mixed herbaceous scrub, mixed shrub, *Casuarina* forest, and developed land.

Tabernaemontana rotensis, considered a Species of Greatest Conservation Need (SOGCN) by GDAWR (2006), is a rare tree species whose distribution has been recently evaluated on Andersen AFB (University of Guam [UoG] 2007), including within the North Ramp, North Gate, and NWF project areas. Over 21,000 *T. rotensis* individuals were found in that study throughout Andersen AFB at 265 locations, primarily in the central portion of the base and near the limestone cliffs in the northwest and southeast corners (Figure 10.1-7 and Figure 10.1-8).

The UoG (2007) study reported that *T. rotensis* had a patchy distribution and was often associated with other native and rare species. In support of the Intelligence, Surveillance, Reconnaissance (ISR) Strike EIS/OEIS, additional surveys adjacent to the proposed North Ramp Air Combat Element (ACE) project area identified 15 locations of *T. rotensis*, with a total of approximately 1,000 saplings (Pacific Air Forces [PACAF] 2006a). No individuals of this species were identified in the commercial gate area in the ISR Strike EIS studies.

Cycas circinalis is a common endemic cycad species found in many limestone forests throughout Guam, including Andersen AFB, but it is also identified as a SOGCN because of the cycad scale insect that is devastating the species. Plant species that are federally or Guam-listed are discussed in the relevant subsections below.

Wildlife – Native Species

Birds

At least 13 seabird species occur at coastal islets, reef flats, and open oceans around Guam (Andersen AFB 2003). Black and brown noddies have been observed between Scout Beach and Pati Point (National Oceanic and Atmospheric Administration [NOAA] 2005) and brown noddies are known to frequent the flight line. Fairy (white) terns are common in the developed areas of Andersen AFB, including service areas such as the exchange, the flight line, and housing. The more common shorebirds include wintering birds such as Pacific golden plover, Mongolian plover, wandering tattler, gray-tailed tattler, whimbrel, and ruddy turnstone. One wading bird that may be seen at Andersen AFB is the Pacific reef heron, which forages on exposed reefs (Andersen AFB 2003). Other observed bird species include fork-tailed swifts at Pati Point and several groups of barn swallows at the main airfield (GDAWR 2000a). Migratory seabirds and shorebirds are not currently monitored at Andersen AFB (Andersen AFB 2008a). The only native bird species observed at Andersen AFB during forest transects and roadside point stations conducted in support of this EIS/OEIS were the yellow bittern, Micronesian starling, and Pacific golden plover (NR Survey Report in preparation). All of the aforementioned species are protected by the Migratory Bird Treaty Act (MBTA).

Reptiles

Ten reptile species, including two ESA-listed sea turtle species, are considered native to Guam (GDAWR 2006; see Special-status Species section below; refer to Chapter 11, Marine Biological Resources, for a discussion of sea turtles in the marine environment). Native terrestrial reptiles are generalized insectivores and widely distributed within appropriate major habitat types. These are all small lizards and none are ESA-listed, but Guam lists eight species as threatened or endangered (these are discussed below under Guam-listed species). The non-listed native reptiles include mutilating gecko, blue-tailed skink, and

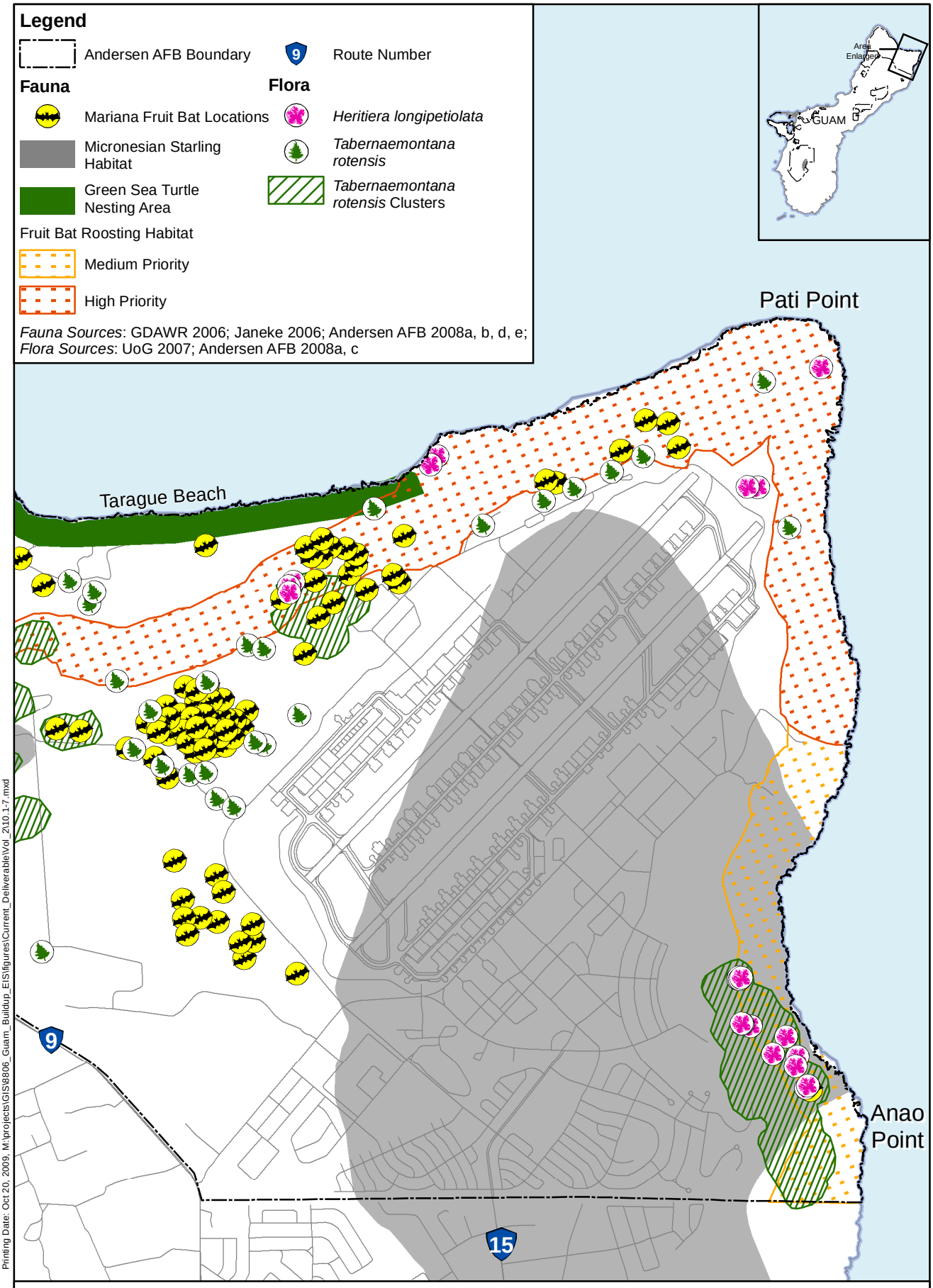


Figure 10.1-7
Occurrence of Special-Status Species - Andersen AFB East

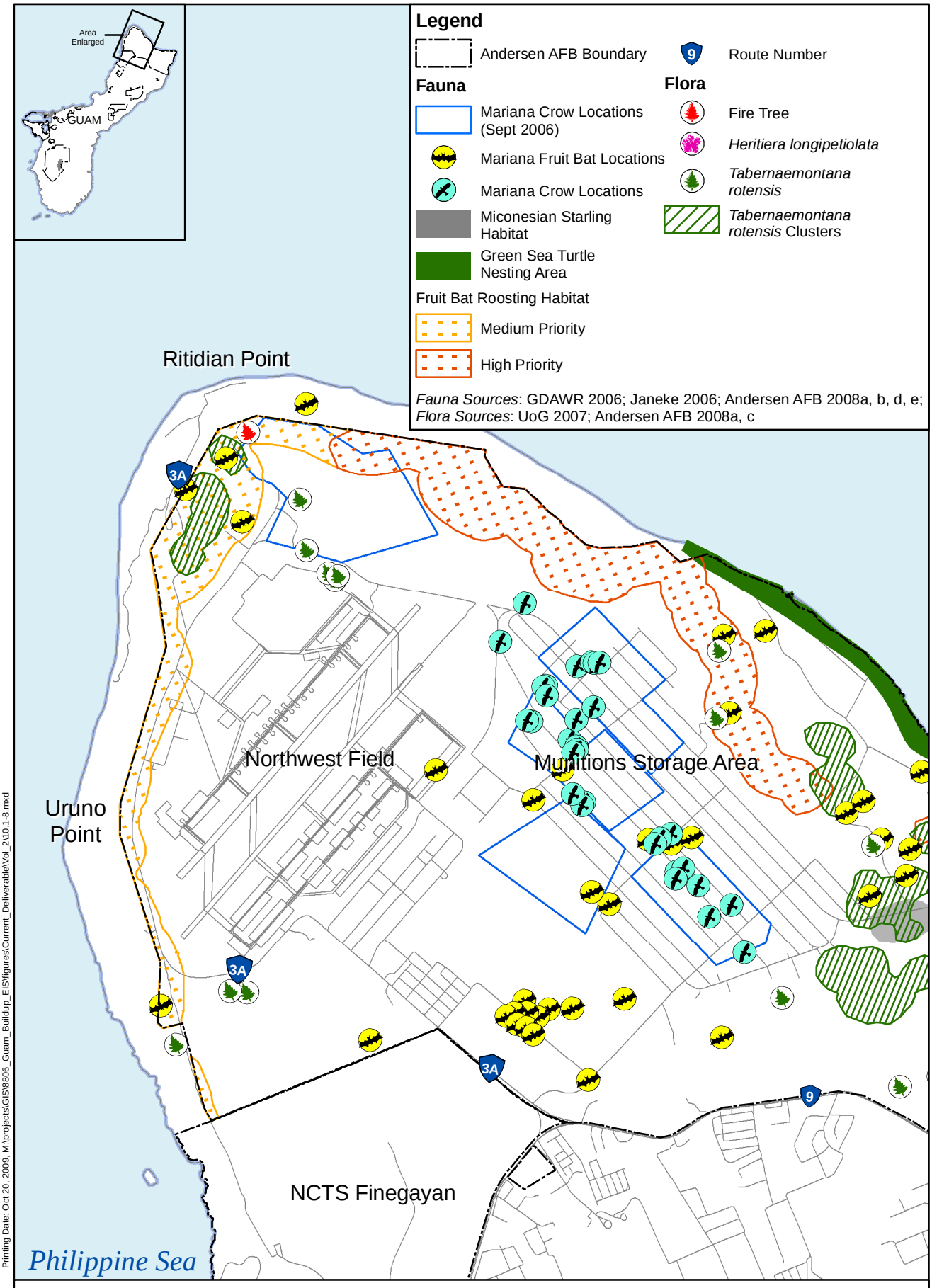


Figure 10.1-8
Occurrence of Special-Status Species - Andersen AFB West

mourning gecko. The blue-tailed skink and mutilating gecko were observed in forested areas at Andersen AFB during surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Invertebrates

Numerous native butterflies potentially occur on Andersen AFB including the blue-banded king crow, common emigrant, common mormon, crow eggfly, great eggfly, lesser grass blue, three-spot grass yellow, and tiny grass blue (Andersen AFB 2008a). Some butterflies may be limited by the herbivory on nurse plants by Philippine deer and other habitat degradation associated with feral pigs.

Native land hermit and coconut crabs are present in coastal areas at Andersen AFB. Coconut crabs are a prized human food item and are often overharvested. Coconut crab harvesting is regulated by permit on Andersen AFB. They may be hunted year-round, but the carapace of harvested crabs must have a minimum width of 3 inches (7.5 centimeters). Other threats to these species include introduced predators, such as rats, wild pigs, dogs, and monitor lizards (Andersen AFB 2008a).

Wildlife – Non-Native Species

Birds

Non-native bird species are generally the only birds that are seen frequently on Andersen AFB. These include black francolin, island collared dove, black drongo, and Eurasian tree sparrow. Because they are non-native, none of these species are protected by the MBTA. These species are found in open, grassland areas as well as the developed (or urbanized) areas of the base where the brown treesnake (BTS) is not as prevalent. Due to the presence of the BTS and its preference for preying on the adults, young, and eggs of many bird species, the forested areas of Andersen AFB are generally devoid of birds.

Reptiles and Amphibians

The BTS has had a profound effect on the both native and introduced faunal populations in Guam, and is widely regarded as being responsible for extirpating or limiting many bird species on Guam (Fritts and Rodda 1998). The peak density of BTS in favorable habitats was probably in excess of 40 per ac (16 per ha) in the 1980s, but by the mid 1990s the snake's populations on Guam seemed to have reached a dynamic equilibrium of approximately 20 per ac [8 per ha]) (Rodda and Savidge 2007).

The Air Force provides annual funding to support a BTS trapping program and other studies. In one study, dead mice injected with acetaminophen were distributed throughout the MSA as a control method, and a single 80-mg dose was found to be acutely toxic to BTS, resulting in 100% mortality within 24 hours (Savarie et al. 2001). Additional testing determined that the risk to non-target species (e.g., the fish crow, a species closely related to the Mariana crow, feral dogs, and coconut crabs) was very low, suggesting that acetaminophen mouse baits may at least reduce population sizes of the BTS, particularly when used in conjunction with trapping efforts (Johnston et al. 2002). Andersen AFB has base-wide instructions regarding procedures for BTS control and awareness (Andersen AFB 2006a). The base cooperates with USDA APHIS-Wildlife Services (USDA APHIS-WS) to conduct daily inspections with detector dog teams for all outbound cargo in order to help prevent the spread of BTS.

The curious skink, house gecko, cane toad, and blind snake were observed in forested areas of Andersen AFB. In particular, the curious skink has become a large part of the BTS diet, and therefore serves to maintain high numbers of BTS throughout Guam (Fritts and Leesman-Tanner 2008). Monitor lizards are also distributed throughout Guam, and they are present in forested areas on Andersen AFB (Andersen AFB 2008a).

Mammals

Philippine deer and pigs were introduced to Guam in the 1600s and 1700s by the Spanish and feral populations are still present throughout most of the island's undeveloped lands. Density estimates for Guam are 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) 474 (Knutson and Vogt 2002). Deer grazing on native tree seedlings is suspected to adversely affect native tree regeneration and cause erosion. Pigs dig up soil while foraging and wallowing which also causes erosion and creates openings for invasive weeds.

Control of both species is attempted through public hunting at Andersen AFB. Recreational gun and archery hunting are allowed in designated areas in portions of the NWF. However, due to chronic low-level poaching of the Mariana fruit bat, the USFWS 5-year review of the Mariana fruit bat recommended that this recreational hunting program be replaced with a sustained control program (USFWS 2007a).

In 1991, the Civil Engineer Squadron built an ungulate enclosure at Area 50, a 60-ac (24-ha) site containing native limestone forest, as an experimental area for removal of pigs and deer (PACAF 2006b). In 1998, removal of the BTS from this area was also undertaken. This enclosure area is currently not used and has fallen into disrepair.

Other introduced predators on native species include feral cats, dogs, rats, and the musk shrew. Reintroduction efforts in Area 50 and the MSA at Andersen AFB determined that cat predation was a major limiting factor to native species recovery efforts on Guam (Beuprez and Brock 1999). Various species of rats are a major obstacle to recovery of species on Pacific Islands (Atkinson 1985). The musk shrew may be a significant predator on native geckos and skinks (Fritts and Leasman-Tanner 2008), although it's numbers are kept low by snake predation.

Invertebrates

Predatory snails, such as the rosy wolf snail, and the predatory flatworm *Platydemus manokwari*, were introduced to control the giant African snail. They have directly affected Guam-listed and ESA candidate tree snail populations and are considered a serious threat to Partulid snail populations on Guam and CNMI (USFWS 2007c).

The Asian cycad scale is an unintended pest introduction to Guam, and has effectively eliminated the cycad *Cycas circinalis*, a dominant mid-level canopy species of limestone forests (Moore et al. 2005). In one permanent transect at Ritidian, *Cycas circinalis* declined from 686 individuals in 2004 (before the Cycad aulacaspis scale entered the habitat) to only 87 in January 2007 (UoG 2007). The cycad is also an important food source for the Mariana fruit bat and Mariana crow.

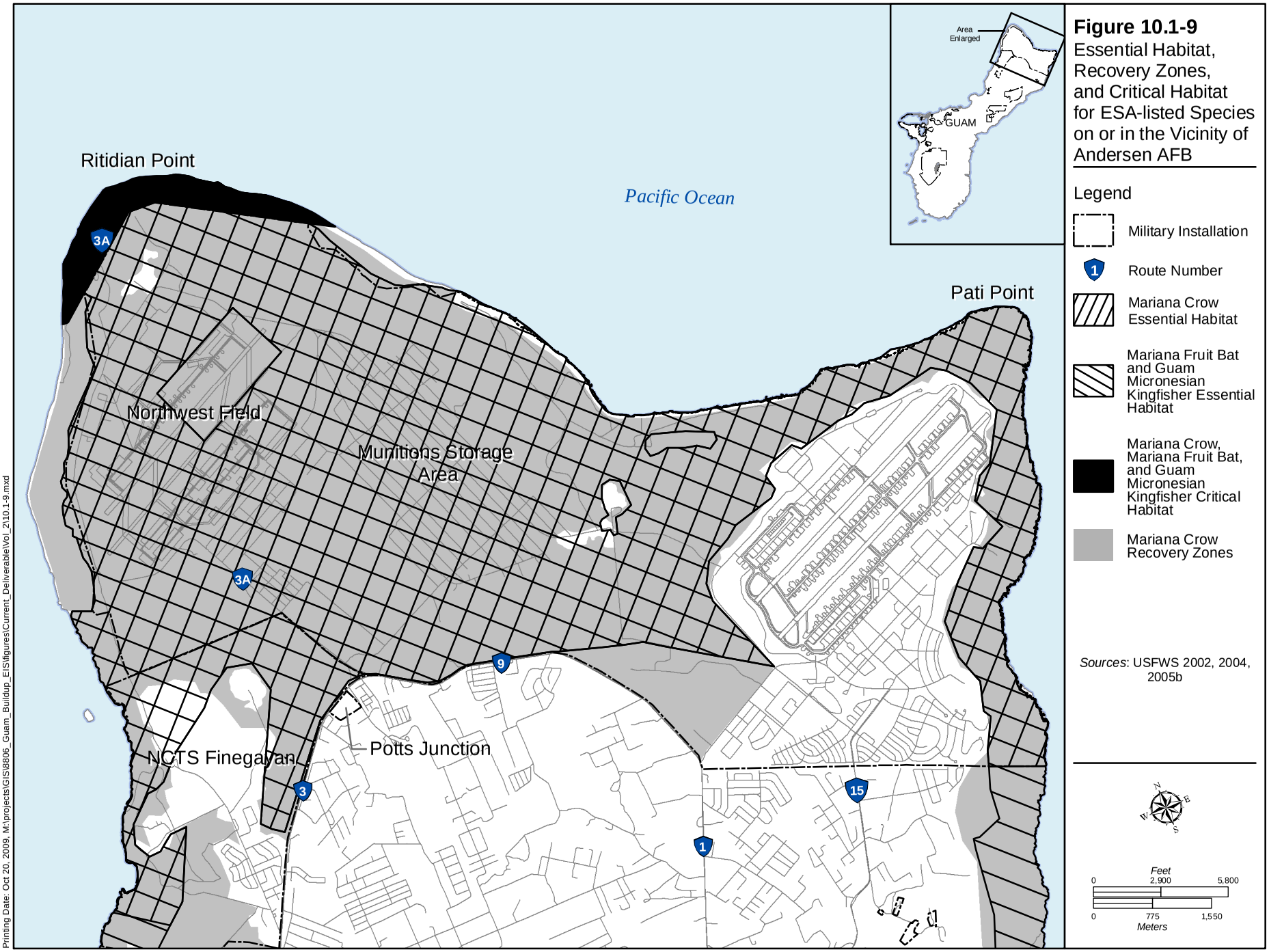
ESA-Listed Species and Critical Habitat

Twelve ESA-listed or candidate species have been observed, or suitable habitat is present, on Andersen AFB (Table 10.1-4). Most of Andersen AFB outside the cantonment and housing areas is within the Overlay Refuge (see Figure 10.1-2). Essential habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher, based on the 2002 proposed critical habitat ruling (USFWS 2002) and Mariana crow Recovery Zones (USFWS 2005b), include much of the installation outside of the cantonment and housing areas (Figure 10.1-9). These areas are predominantly limestone forests which are an important habitat for these threatened and endangered species.

Table 10.1-4. Known or Potential Occurrence of ESA-listed, Guam-Listed, and Candidate Species at Andersen AFB

Common Name	*Status*		*Habitat*	*Occurrence at Andersen AFB*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone forest, coastal forest, and coconut plantations	Average of 40 bats in 2007/08.
BIRDS				
Mariana crow	E	E	All forests with a preference for native limestone forest	Recent surveys indicate only 2-3 individuals remaining in the wild; recovery zone and essential habitat present
Guam Micronesian kingfisher	E	E	Forest and scrub with preference for native limestone forest	Extirpated but essential habitat present
Guam rail	E	E	Secondary habitats, some use of savanna and limestone forests	Extirpated but essential habitat present
Mariana swiftlet	E	E	Nests in caves; forages over grasslands and forests	Historically used swiftlet caves on Andersen AFB are currently unoccupied
Micronesian starling	-	E	All habitats but higher density in forests	1 small population, not more than several hundred
REPTILES				
Green sea turtle	T	T	Suitable beaches for basking and nesting	Nests at Tarague Beach
Hawksbill sea turtle	E	E	Suitable beaches for basking and nesting	No recorded activity since 1984
Moth skink	-	E	Forest areas with large tree trunks	Not found in recent project-specific surveys
Pacific slender-toed gecko	-	E	Forest edge	Not found in recent project-specific surveys
INVERTEBRATES				
Marianas eight-spot butterfly	C	-	Intact limestone forest with host plants	Several sporadic observations
Guam tree snail	C	T	Cool shaded forested areas with high humidity	Historically present in Tarague Basin, but none observed in 1989 survey
Humped tree snail	C	E	Cool shaded forested areas with high humidity	Historically present in Tarague Basin, but none observed in 1989 survey
Fragile tree snail	C	E	Cool shaded forested areas with high humidity	Historically present in Tarague Basin, but none observed in 1989 survey
PLANTS				
Fire tree	T	E	Limestone and ravine forests.	Only 1 mature tree remaining at NWF
Heritiera longipetiolata	-	E	Limestone forest	Small population of trees at Pati Point

Legend: C = candidate, E = endangered, T = threatened.
Sources: GDAWR 2006, USFWS 2006, Andersen AFB 2008a, Smith et al. 2008, NR Survey Report in preparation.



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Mariana Fruit Bat

The Guam population of the Mariana fruit bat is federally listed as threatened, recently downgraded from endangered (USFWS 2005a). Critical habitat for this species was designated in 2004 at the Ritidian Unit of the Guam NWR, which lies immediately to the northwest of Andersen AFB (USFWS 2004).

On Andersen AFB, individuals and small groups were observed roosting in both primary (mature and native-dominated) and secondary growth limestone forest cover (Janeke 2006). Figure 10.1-7 shows individual sightings at Andersen AFB from Janeke (2006) and others. Over the past several decades, the population of fruit bats in Guam has declined in number. The majority of the bats had been roosting at a single site on Pati Point on Andersen AFB since 1994, and an unknown number of solitary bats utilize the limestone and secondary forests of Guam. Fruit bats forage over the forests and coastal areas, and are occasionally sighted at Tarague Beach (Andersen AFB 2008d). At the Pati Point colony, there have been less than 100 bats since 2002, with only 20 to 60 individuals sighted since 2004 (USFWS 2006, NAVFAC Pacific 2007). This population has undergone dramatic short-term fluctuations in the past indicating that members of the colony may be able to migrate easily between Rota and Guam (COMNAV Marianas 2001). Surveys conducted from June 2007 through April 2008 recorded 31 to 54 individuals with an average of 40 (Andersen AFB 2008d). Inland from the beach area, the Tarague Basin is a major conduit for Mariana fruit bat travel between the main Pati Point colony and foraging areas in NWF, Ritidian Point, MSA, and portions of Andersen Main Base. Chronic, low-level poaching is suspected as contributing to the steady decline in fruit bat numbers on Guam (USFWS 2007a), in addition to BTS predation on young bats.

The 1990 recovery plan for the Mariana fruit bat identified the majority of Andersen AFB, except the housing and airfield areas, as essential habitat for the recovery of the fruit bat, and generally corresponds with the Overlay Refuge. This area includes large tracts of primary and secondary limestone forest which are known to contain roosting and foraging sites for fruit bats (USFWS 1990a). In 2002, the USFWS proposed critical habitat for this species on Andersen AFB which included this essential habitat (see Figure 10.1-9) (USFWS 2002); however, the final rule did not designate critical habitat - partly because Overlay Refuge lands were already being managed to benefit the Mariana fruit bat on the base (USFWS 2004).

Andersen AFB recently established a management plan for Mariana fruit bat that identifies important roosting and foraging habitat on base, and describes management activities to benefit the species (Andersen AFB 2008e; refer to Figures 10.1-7 and 10.1-8). Additional information about the species can be found in Appendix G.

Mariana Crow

This is a forest dwelling crow that is endemic to the Mariana Islands of Guam and Rota. Mariana crows utilize a wide variety of forested habitats including limestone, strand, ravine, agricultural forests, and secondary forests; all of which are present on Andersen AFB. However, their preference seems to be primary limestone forests. Mariana crow nests on Guam were found in 11 tree genera, and all but one are native tree species. Most nests are located high in fig or loquat trees (USFWS 2005b), all of which are abundant in primary limestone forests on Andersen AFB.

The Mariana crow survives on northern Guam in critically low numbers – only two crows are known to live in the wild on Guam. Of the 11 crows on Guam in 2006, all were located at Andersen AFB with 9 territories in the MSA, and 1 territory in the northern part of the base near the Guam NWR (USFWS 2006). Recent information indicates that Mariana crow numbers are continuing to decline on Guam and

Rota, and no female crows were observed on Guam in 2007 (Rodda 2007). Surveys conducted from June 2007 through April 2008, indicated that the Mariana crow population declined from an estimated ten individuals observed in 2006, all of which were originally trans-located from Rota, to two males (Andersen AFB 2008d).

Critical habitat was designated for the species in 2004 in the Ritidian Unit of the Guam NWR; however, no critical habitat occurs on Andersen AFB (Figure 10.1-9) (USFWS 2004). The Draft Revised Recovery Plan for the Mariana crow identifies recovery zones on Andersen AFB (Figure 10.1-9) (USFWS 2005b). The highest priority areas (Priority 1) for recovery of the crow on Andersen AFB include the northern (from Ritidian Point to Pati Point) and eastern (from Pati Point to Anao Point) coastal forests and the MSA. Each area contains large, relatively undisturbed tracts of forest, currently or historically utilized by crows, and are considered core areas for crow conservation in northern Guam. The northern and eastern coastal areas consist of mature and secondary limestone and strand forest, and contains areas utilized by Mariana crows as recently as the 1990s. The MSA area contains the remaining crow population on Guam (USFWS 2005b).

Priority 2 areas for recovery of crows include an area to the east of the MSA, the coconut plantation in the Tarague Basin, and the western area of Andersen AFB. The area to the east of the MSA primarily contains secondary limestone forest that has been heavily disturbed. However, crows have utilized the area as recently as the1990s. This area could provide additional habitat to a recovering crow population. The coconut plantation adjacent to Tarague Beach consists of large stands of coconut trees that were formally utilized for copra production. These coconut forests are not high quality crow breeding habitat, but they do provide good foraging habitat. The western area consists mostly of secondary forest with some mature limestone forest along the cliff lines (USFWS 2005b).

Crow recovery zones include an area in the mid-southern portion of Andersen AFB and NWF. Each of these areas is highly degraded and primarily composed of secondary forest or other disturbed habitats that are not widely utilized by crows. However, these areas do contain some patches of good quality limestone forest and have recovery potential. With appropriate management and reforestation efforts, they would provide additional habitat for a recovering crow population (USFWS 2005b).

Guam Micronesian Kingfisher

A Guam endemic subspecies of forest kingfisher, the Guam Micronesian kingfisher was considered "fairly common" and occurred throughout forested areas on Guam in 1945; but by 1988, they were believed to be extirpated from the wild (Wiles et al. 2003). A captive breeding program is currently underway. Kingfishers utilized a wide variety of habitats including limestone forest, strand forest, agricultural forest, secondary forest, edge habitats, and forest openings; however, mature forests with appropriate nest sites in cavity trees may be an important requirement for kingfisher reproduction (USFWS 2008a); all of these are abundant on Andersen AFB.

The USFWS proposed critical habitat for this species on Andersen AFB that included nearly the entire base, except the housing and airfield areas (USFWS 2002). However, the final rule did not designate critical habitat, partly because Overlay Refuge lands were already being managed to benefit this species (USFWS 2004). Based on the proposed critical habitat areas, 'essential habitat' does occur on base (refer to Figure 10.1-9).

Guam Rail

The flightless Guam rail was once distributed throughout Guam; however, in 1983 it was estimated that fewer than 100 individuals remained. By 1987, the Guam rail was considered extirpated from the wild

(Witteman et al. 1990). A captive breeding program on Guam by GDAWR is currently underway. Experimental releases occurred in a snake-free zone on Andersen AFB in 1998 and 2003. Although nesting attempts were observed (GDAWR 2006), the adult birds did not survive. Evidence indicated that feral cats were responsible for the eradication of the released population (Andersen AFB 2008a). The Guam rail utilized all habitats except wetlands; although it prefers open, scrubby habitats (USFWS 1990b). Open, scrubby habitat is common throughout the limestone plateau area of Andersen AFB.

Mariana Swiftlet

This species nests and roosts in caves, and leaves the caves to forage on small insects over a wide variety of terrain and vegetation. However, they seem to favor ridge crests and open grassy areas (USFWS 1991c), which are common habitats on Andersen AFB. Although the Mariana swiftlet is not currently present on Andersen AFB, caves on the base were historically used by swiftlets (Andersen AFB 2008a).

Green Sea Turtle

The green sea turtle nests on Guam beaches. Foraging and resting green turtles are often seen near Guam's well-developed seagrass beds and reef flats. Green turtle nesting on Guam is most prevalent at the northern and southern ends of the island. GDAWR surveys identified eight beaches as active nesting sites, including Tarague Beach on Andersen AFB (Gutierrez 2004). The highest incidence of sea turtle nesting in northern Guam has been reported at Tarague Beach, and the highest recorded activity (17 occurrences) at Tarague Beach was in 1993. However, most of these were recorded as false crawls (sea turtle nesting effort that was abandoned). In 2000, 16 crawls were counted on Andersen AFB beaches. In 2005, 11 occurrences of crawls, body pits, nesting, or hatchlings were documented at Tarague Beach. Most recently, the 2006 season recorded five occurrences of green turtles at Tarague Beach (Andersen AFB 2008b).

Hawksbill Turtle

Hawksbills nest sporadically in Guam. Historical records indicate a likely presence of this species in the coastal waters (Wiles et al. 1995, Gutierrez 2004). At Andersen AFB, there have been no hawksbill turtles on beaches since 1984, except for a dead individual reported in 1997 on Tarague Beach (Andersen AFB 2008b).

Marianas Eight-Spot Butterfly

This butterfly species, which is endemic to Guam and Saipan, has been observed at Andersen AFB. One specimen was collected on the base in April 1982 (GDAWR 2006). In 2006, a Mariana eight-spot butterfly was reported, along with its host plants *Procris pedunculata* and *Elatostema calcareum*, along a rocky pinnacle karst area near Pati Point (PACAF 2006a). Its current status at this location, and potential presence at other locations on Andersen AFB, is unknown (Andersen AFB 2008a). The current Guam-wide status and distribution of this species is unknown.

Tree Snails

The native Guam, humped, and fragile tree snails are candidate species for listing under ESA. In 1989, Hopper and Smith (1992) resurveyed a previously known site in the Tarague Basin for these snails and none were found. During focused tree snail surveys in 2008 in support of this EIS/OEIS, four partulid colonies were located, two at NCTS Finegayan (Pugua Point and Haputo Beach) consisting of fragile, Guam, and humped tree snails, and two at the NMS (Kitts Road area) consisting of just Guam tree snails. Of the four colonies, only the Haputo colony at NCTS Finegayan was previously known. The fragile tree

snail colony at Pugua Point is the only known colony on Guam and the status of the only other known colony on Rota is unknown (Smith et al. 2008).

Fire Tree

This is a large tree reaching 60 ft (18 m) or more in height, with an average trunk diameter of nearly 6 ft (2 m). It grows along limestone cliffs, usually in primary forest, but Fosberg (1960) reported that it also occurred in low numbers in late successional secondary forest. At the time of its listing as endangered in 1987, there were only two known native mature fire trees on Guam, located in limestone forest at Andersen AFB (Andersen AFB 2008a). In 2002, super typhoon Pongsona uprooted one mature tree. The second mature seed-bearing tree was above Ritidian Point in limestone forest on Andersen AFB. Subsequent to the typhoon, seedlings were observed around the felled tree, but it is currently unknown if any wild seedlings still exist. In 2000, 67 fire tree seedlings were planted in three locations: (1) Area 50, (2) the MSA, and (3) Tarague Beach. The number of outplanted seedlings that have survived is currently unknown (Andersen AFB 2008a). According to recent information, only 1 mature fire tree remains on Guam and it is at NWF on Andersen AFB (Adams 2009).

Guam-Listed Species

Fifteen Guam-listed threatened and endangered species are known to occur on Andersen AFB, or they may occur because suitable habitat is present (refer to Table 10.1-5). Species that are both Guam-listed and federally listed are discussed above.

Micronesian Starling

A subspecies endemic to Guam, Rota, Tinian, and Saipan, the starling was historically found throughout the island occupying all habitats, but it was more commonly found in forested areas nesting in cavities. As with the other Guam bird species, the principal cause of decline is believed to be predation by BTS. A 1981 survey determined that the starling on Guam was one of the most abundant species. It is now found at Andersen AFB in small numbers in the housing areas, forests north of the flightline, east of the golf course, and in an area south of the Naval Base Guam (refer to Figures 10.1-7 and 10.1-8) (Andersen AFB 2008a). The population is probably less than several hundred on Andersen AFB (GDAWR 2006).

Heritiera Longipetiolata

A Guam-listed endangered tree that is an uncommon endemic species found in primary limestone forest at Andersen AFB. It typically grows in crevices of rough limestone. In a recent study (UoG 2007), this species was documented as occurring at 265 locations on Andersen AFB, primarily in the central portion of the base, and near the limestone cliffs in the northwest, northeast, and southeast corners (Figure 10.1-10). The numbers and distribution of this species on Guam are not well known.

Skinks and Geckos

The Pacific slender-toed gecko was detected in recent natural resource surveys in northeastern NCTS Finegayan (NR Survey Report, in preparation), however it has not been documented in project-specific surveys on Andersen AFB. Habitat is present for the moth skink, but it was not found in recent project-specific surveys. The numbers and current distribution of these species on Guam are not well known.

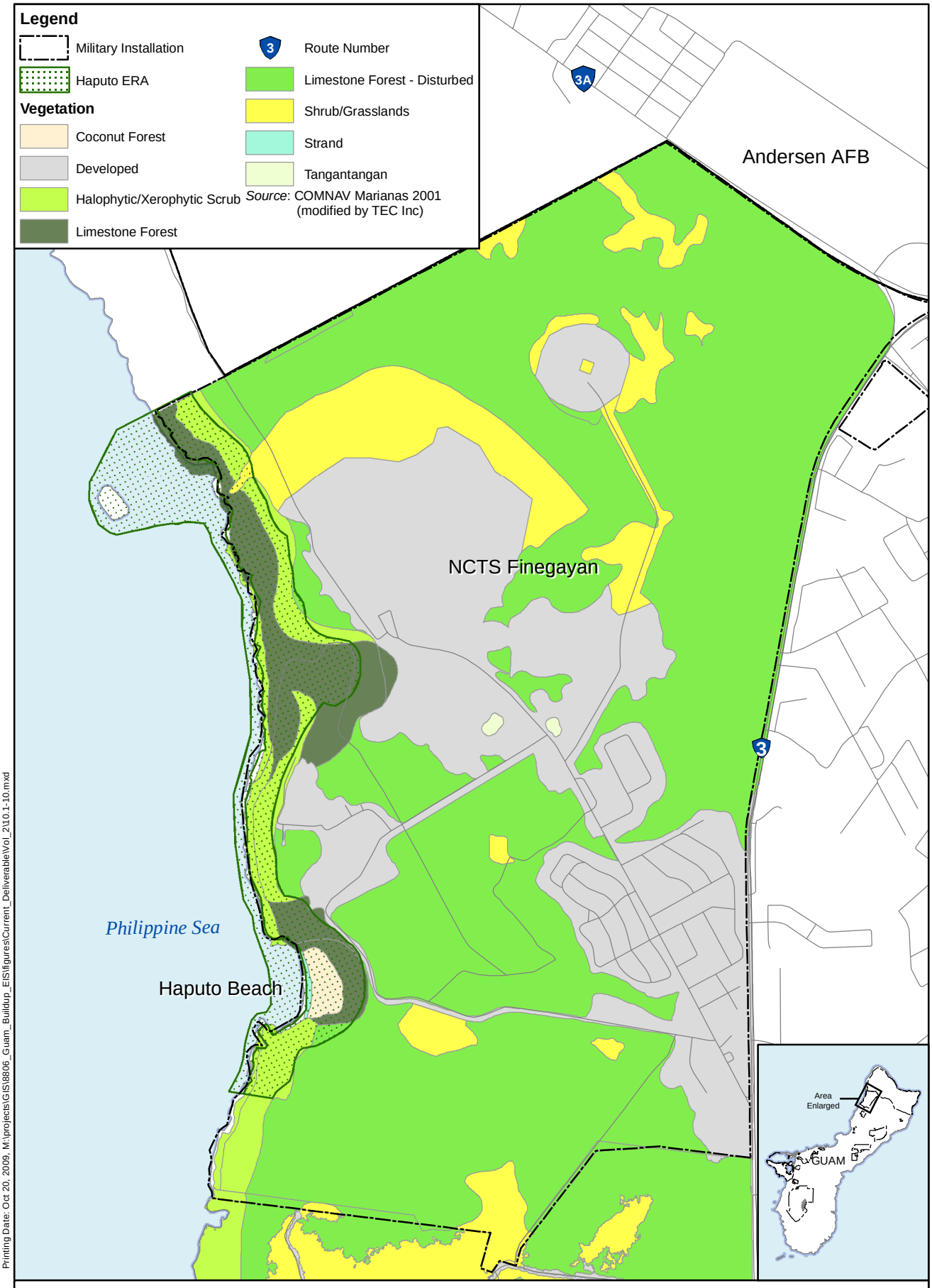

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Figure 10.1-10
Vegetation Communities - NCTS Finegayan

10.1.2.2 Finegayan

NCTS Finegayan

Vegetation Communities

The following terrestrial communities occur on NCTS Finegayan, including the Haputo Ecological Reserve Area (ERA): limestone forest, disturbed limestone forest, halophytic/xerophytic scrub, Tangantangan, shrub/grasslands, coconut forest, strand communities, and developed land. Figure 10-1-10 depicts the vegetation communities found within the NCTS Finegayan boundaries, which is based on the mapping within the 2001 INRMP (COMNAV Marianas 2001) with recent field-verified adjustments for conversion from disturbed limestone forest to shrub/grasslands. Acreages for each community are provided in Table 10.1-5.

Table 10.1-5. Vegetation Communities at NCTS Finegayan

Vegetation Type	*ac (ha)*
Limestone forest, disturbed	1,345 (544)
Developed Land	630 (255)
Shrub/grasslands	208 (84)
Halophytic/xerophytic scrub	110 (45)
Limestone forest	102 (41)
Coconut forest	8.8 (3.6)
Tangantangan	2.4 (1.0)
Strand	1.3 (0.5)

Within NCTS Finegayan is the Haputo ERA, established in 1984 as a mitigation measure for the construction of Kilo Wharf on Orote Peninsula (COMNAV Marianas 2001). The Haputo ERA includes submerged lands from the shoreline to a depth of 120 ft (37 m) at Double Reef. At Haputo Beach the marine lands stop at the reef edge. Inland, the ERA extends to the top of the limestone ridge along the length of the coast of NCTS Finegayan. The terrestrial unit of this ERA totals about 252 ac (102 ha), and the submerged lands total 72 ac (29 ha). As part of the management plan for this area, ungulate control is required.

Relatively intact limestone communities occupy limited areas along the cliff areas, along with halophytic-xerophytic scrub vegetation, primarily within or adjacent to Haputo ERA. The majority of the plateau area supports communities of disturbed limestone and urban/developed. Most of these areas contain a *Vitex* canopy and a mixed woody understory (with *Triphasia trifolia* being the most common understory species) containing openings dominated by non-native herbs, such as Siam weed. In the area where Haputo ERA extends eastward and a dirt road leads down (into the area), conditions are similar with a dominance of non-native woody vegetation (particularly *Annona reticulata*) extending to the west.

Below the plateau in the Haputo ERA, the limestone community is dominated in one area by *Merrilliodendron megacarpum*. This species is designated in the Guam CWCS as an SOGCN species. Only several other known colonies of *Merrilliodendron* are present on Guam, and these are located within the NMS in south-central Guam. The Haputo ERA *Merrilliodendron* forest provides habitat for at least two species of tree snails eligible for ESA listing (see discussion below for these species). At least one species has been observed on *Merrilliodendron* (NR Survey Report in preparation).

Near the sea in areas that are exposed to salt-laden winds and intense sun, *Pemphis acidula* is the most abundant component of this vegetation type; it often forms monotypic low-lying stands. A short distance landward of the *P. acidula* zone, other species appear, often in stunted forms. These include numerous

tree and shrub species such as beach naupaka, *Bikkia tetrandra*, and beach heliotrope (COMNAV Marianas 2001).

Wildlife – Native Species

A study of Haputo ERA was conducted shortly after it was established (USFWS 1986a). Based on that study, the shoreline and cliff line along NCTS Finegayan historically supported roosting and nesting sites for brown boobies and brown noddies, although probably in limited numbers. However, boobies and noddies are no longer found at NCTS Finegayan, likely due to predation and disturbance by BTS. Shorebirds observed in 1986 included the wandering tattler and common sandpiper. The common sandpiper is actually 'uncommon,' but a regular winter visitor to Guam and the Marianas. The Pacific golden plover was the only native bird species observed at NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation). The blue-tailed skink, mourning gecko, and mutilating gecko were the only reptiles observed in forested areas of NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation). Coconut crabs, land crabs, and hermit crabs were noted at the ERA after being incidentally caught or injured in traps set out for mammal surveys (USFWS 1986a). A 2001 study estimated the coconut crab population for Haputo ERA at 964 (USFWS 2001).

Wildlife – Non-Native Species

Abundant sign of ungulates, both feral pig and Philippine deer, was observed on the upper plateau area of NCTS Finegayan during recent vegetation surveys. Evidence of deer browse was particularly noteworthy in the northern portion adjacent to Andersen AFB, resulting in a very open understory. Pig damage was prevalent throughout, but was more intense in areas farther away from human activity. Ungulate impacts included extensive wallowing, scat, and bark rubbings. Extensive pig wallows and rooting of vegetation directly impacts native vegetation and causes secondary impacts such as facilitating invasive weed encroachment, reducing or eliminating recruitment of emergent tree species, erosion of essential top soil, and spreading of invasive species through ingestion and subsequent defecation of seed material. The effects of erosion from ungulate damage to the vegetation on the upper plateau can be found in the lower coastal forests and cliffs.

Black francolin, Eurasian tree sparrow, island collared dove, black drongo, and rock pigeon were observed at NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation). In addition, the BTS, curious skink, house gecko, and cane toads were observed in forested areas of NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

ESA-Listed Species and Critical Habitat

Ten ESA-listed or candidate species have been observed, or potential habitat is present, on NCTS Finegayan (Table 10.1-6 and Figure 10.1-11). Habitat for some species is only found at Haputo ERA.Two of these species, Guam Micronesian kingfisher and Guam rail, do not currently occur in the wild and are only found in captivity. Forested areas of the facility are within the Overlay Refuge lands (refer to Figure 10.1-2). Essential habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher are designated in the northern and eastern portions of the facility (refer to Figure 10.1-11) (USFWS 2002). Mariana Crow Recovery Zones cover most of the forested areas of the facility (refer to Figure 10.1-11) (USFWS 2005b). These areas are predominantly limestone forest which is an important habitat for these threatened and endangered species.

Table 10.1-6. Known or Potential Occurrence of ESA-listed, Guam-listed, and Candidate Species at NCTS Finegayan

Common Name	*Status*		*Habitat*	*Occurrence at NCTS Finegayan*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone forest, coastal forest, and coconut plantations	None currently occur, but essential habitat present
BIRDS				
Mariana crow	E	E	All forests with a preference for native limestone forest	None currently occur, but recovery zones and essential habitat present
Guam Micronesian kingfisher	E	E	Forest and scrub with a preference for native limestone forest	Extirpated but essential habitat present
Guam rail	E	E	Secondary habitats, some use of savanna and limestone forests	Extirpated but habitat present
Micronesian starling	-	E	All habitats but higher density in forests	Reported in the 1990s in southeast corner
REPTILES				
Green sea turtle	T	T	Suitable beaches for basking or nesting	Potential nesting at Haputo Beach
Moth skink	-	E	Forest areas with large tree trunks	Reported in the early 1990s at Haputo Beach area
Pacific slender-toed gecko	-	E	Forest edge	Detected in recent natural resource surveys in northeastern NCTS Finegayan
INVERTEBRATES				
Marianas eight-spot butterfly	C	-	Intact limestone forest with host species	Present at Hilaan Point but presence here unknown
Guam tree snail	C	T	Cool shaded forested areas with high humidity	Reported in 1989 and in 2007 at Haputo ERA
Humped tree snail	C	E	Cool shaded forested areas with high humidity	Reported in 1989 and in 2007 at Haputo ERA.
Mariana Islands fragile snail	C	E	Cool shaded forested areas with high humidity	Reported in 1989 and in 2007 at Haputo ERA.
PLANTS				
Fire Tree	E	E	Limestone and ravine forests.	Not known from the area but habitat present
Heritiera longipetiolata	-	E	Limestone forest	Not known from the area but habitat present

Notes: T = threatened, E = endangered, C = candidate.
Sources: Wiles et al. 1995; COMNAV Marianas 2001, 2008; GDAWR 2006; USFWS 2006; Smith et al. 2008; NR Survey Report in preparation.

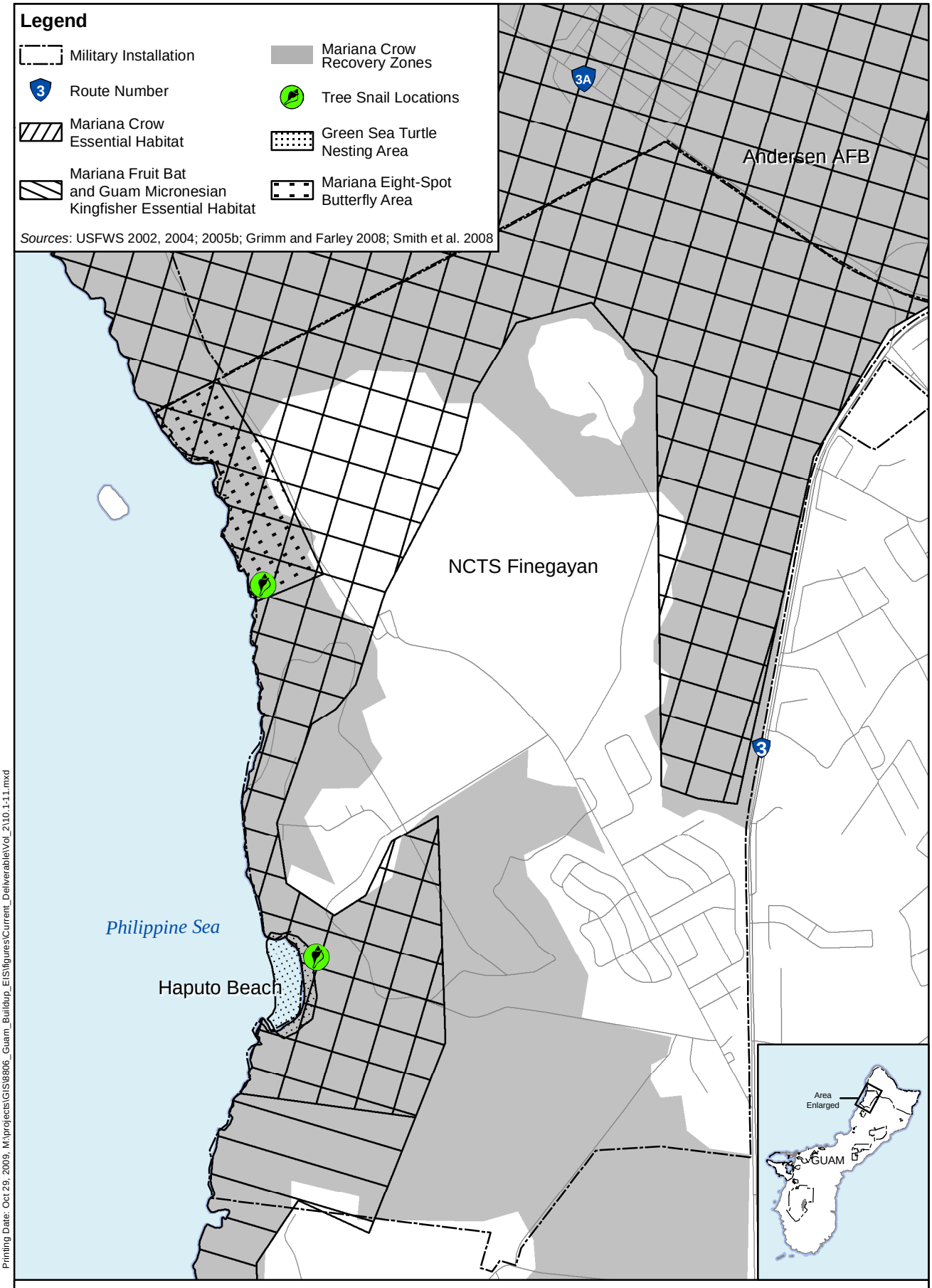

Figure 10.1-11
Occurrences of Special-Status Species and Essential Habitat and Recovery Zones for ESA-listed Species on or in the Vicinity of NCTS Finegayan

Mariana Fruit Bat. Currently, Mariana fruit bats are only occasionally observed at NCTS Finegayan. During morning observations on 10 nonconsecutive days in 2008, there were two sightings of Mariana fruit bats on NCTS, one below the cliff line in the northern section of the Haputo ERA near Falcona, and the other of an individual flying westward across Route 3A from Andersen AFB onto NCTS Finegayan (Brooke 2008). A single fruit bat was observed in March 2008 from an observation point at Double Reef Overlook at NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report, in preparation). There are no known roost areas for Mariana fruit bat at NCTS Finegayan but, based on the proposed critical habitat areas (USFWS 2002), essential habitat for the species does occur here (see Figure 10.1-11).

Mariana Crow. NCTS Finegayan was occupied by the Mariana crow as recently as the 1990s (USFWS 2005b). Priority 2 and 3 Recovery Zones for this species have been identified at NCTS Finegayan by the USFWS (USFWS 2005b) (see Figure 10.1-11). In addition, based on the proposed critical habitat areas (USFWS 2002), essential habitat for the Mariana crow occurs on NCTS Finegayan (see Figure 10.1-11).

Guam Micronesian Kingfisher. Kingfishers utilized a wide variety of habitats including limestone forest, strand forest, agricultural forest, secondary forest, edge habitats, and forest openings, but mature forests with tree cavities suitable for nesting may be an important requirement for kingfisher reproduction (USFWS 2008a); all of these habitat components are present on NCTS Finegayan. Based on the proposed critical habitat areas (USFWS 2002), essential habitat for the kingfisher occurs on NCTS Finegayan (see Figure 10.1-11).

Guam Rail. This bird species utilizes all habitats on Guam except wetlands. It prefers open, scrubby habitats and savanna and mature forest are deemed only marginal for Guam rail (USFWS 1990b). The preferred habitat type (disturbed limestone forest) is present at NCTS Finegayan. Specific areas of essential habitat were not defined for the Guam rail in the recovery plan (USFWS 1990b).

Green Sea Turtle. This sea turtle may utilize Haputo Beach at NCTS Finegayan and may nest there. Green sea turtles utilize offshore waters in the area for feeding, and are known to nest on other beaches in the area (Wiles et al. 1995). Intensive surveys have only been conducted for nesting attempts in 2007 and 2008; two suspected nest attempts and two false crawls were documented in April 2008 (presumably of green sea turtles, although this is not confirmed) (Grimm and Farley 2008).

Tree Snails. Three ESA candidate native tree snails (Guam tree snail, humped tree snail and fragile tree snail) were reported in 1989 when Hopper and Smith (1992) surveyed a site within the Haputo ERA. A recent survey found two colonies within Haputo ERA, one known historically at Haputo Beach and another further north at Pugua Point, but still within Haputo ERA (Smith et al. 2008). A heavy canopy cover (approximately 80%) was present at each site. The Pugua Point colony was small, with specimens of the Guam and fragile tree snails, with the latter being the most abundant and not observed on Guam since 1996. The Haputo colony, the only one known from previous studies, contained the Guam and humped tree snails. The Haputo ERA beach site is particularly important because it is the only known population of the humped tree snail on Guam. The density of snails at the Haputo ERA beach site has decreased significantly since 1996 (from a minimum of 4.7/m and a maximum of 17.2/m in 1996 to 2.2/m in 2008), possibly due to a change in forest structure (Smith et al. 2008).

Mariana Eight-spot Butterfly. This species has been historically observed at Andersen AFB and Hilaan Point (GDAWR 2006). There are 10 known populations on Guam with two populations reported for Tweed's Cove in Haputo ERA (USFWS 2007b).

Guam-Listed Species

Thirteen Guam-listed species have been observed, or their potential habitat exists, on NCTS Finegayan (see Table 10.1-6). Those species that are both federally listed and Guam-listed are discussed above.

Micronesian Starling. A small territory was reported in the 1990s at the southeastern corner of NCTS Finegayan (Wiles et al. 1995). However, this species is not discussed in the recent draft INRMP (COMNAV Marianas 2008) and was not observed during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation), and it may no longer be present on the installation.

Skinks and Geckos. The Pacific slender-toed gecko was detected in recent natural resource surveys in northeastern NCTS Finegayan (NR Survey Report, in preparation). Previously there had only been an undocumented report of the species from the area. The moth skink was documented in the early 1990s as occurring on the Haputo ERA (Wiles et al. 1995). However, it was not observed at NCTS Finegayan during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

South Finegayan

Vegetation Communities

Vegetation communities based on the 2001 INRMP (COMNAV Marianas 2001) at South Finegayan are listed in Table 10.1-7 and shown in Figure 10.1-12.

Table 10.1-7. Vegetation Communities at South Finegayan

Vegetation Type	*ac (ha)*
Developed Land	219 (89)
Limestone forest, disturbed	57 (23)
Shrub/Grasslands	12 (4.9)
Tangantangan	1.4 (0.6)

Wildlife – Native Species

The Pacific golden plover and yellow bittern were the only native bird species observed at South Finegayan during recent surveys in support of this EIS/OEIS. The blue-tailed skink and mourning gecko were observed in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Wildlife – Non-Native Species

Sign of ungulates, both feral pig and Philippine deer, was observed at South Finegayan during recent surveys. Soil and vegetation damage was moderate. Also, Eurasian tree sparrow, island collared dove, black drongo, rock pigeon, curious skink, house gecko, and cane toad were all observed in forested areas on South Finegayan during surveys in support of this EIS/OEIS (NR Survey Report in preparation).

USDA Wildlife Service conducts trapping and removal of the BTS on Navy property. These efforts include snake trapping around Navy housing.

ESA-Listed Species and Critical Habitat

No critical habitat, essential habitat, or Recovery Zones have been designated for ESA-listed species at South Finegayan, and it is not within Overlay Refuge lands.

Guam-Listed Species

No Guam-listed species are known to occur on South Finegayan.

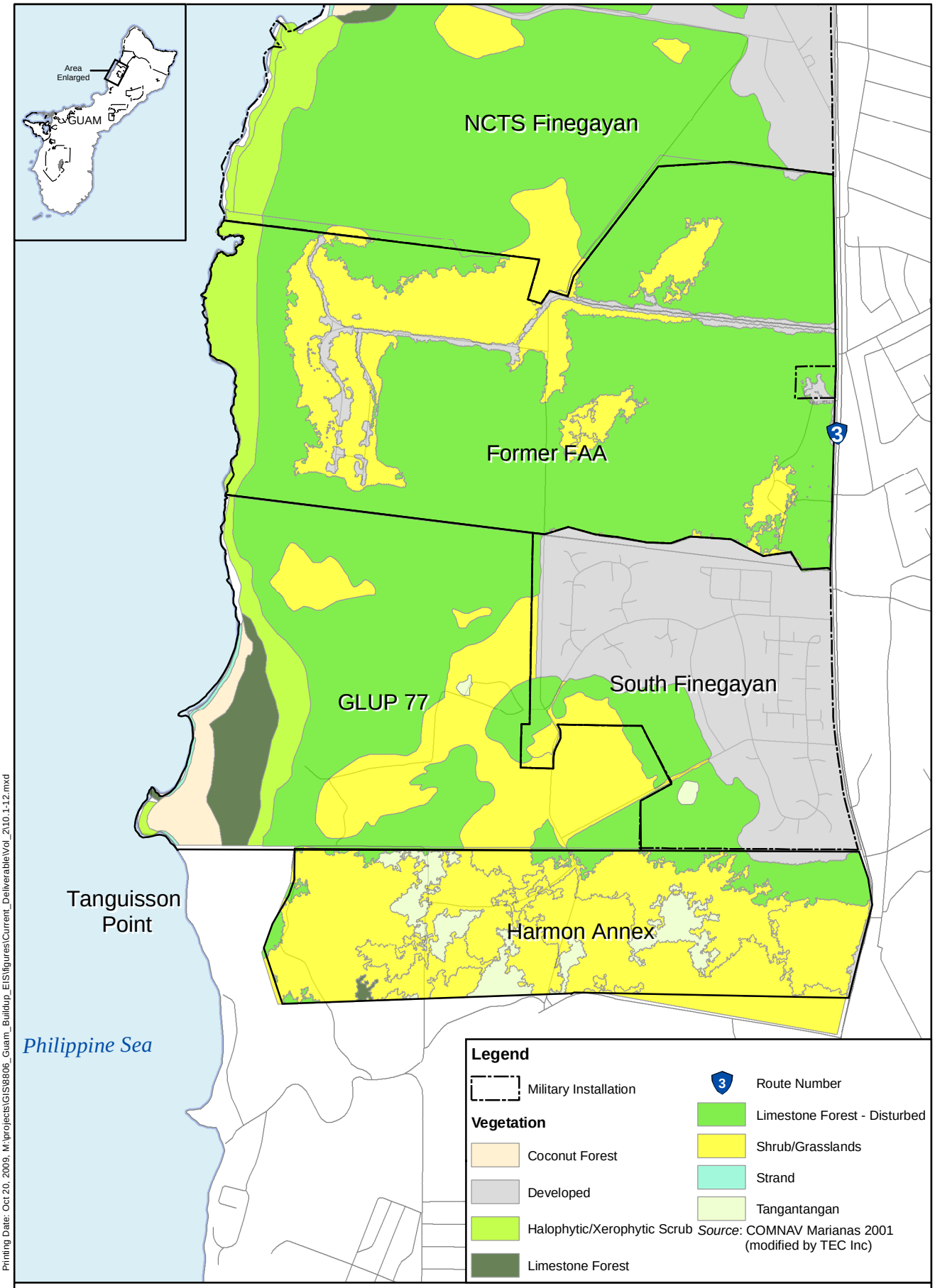

Figure 10.1-12
Vegetation Communities - Former FAA Parcel, South Finegayan, GLUP 77, and Harmon Annex

10.1.2.3 Non-DoD Lands

Vegetation Communities

The vegetation of the Former FAA Parcel was not mapped for the Navy INRMP (COMNAV Marianas 2001); however, the vegetation for the entire island of Guam, including these areas, has been mapped recently (but at a lesser level of detail for some community types) by the USFS (2006a). This recent vegetation mapping was modified to match the vegetation community types in the Navy INRMP and is also based on observations conducted in 2008 surveys. Vegetation communities on these lands are shown in Figure 10.1-13 and acreages are listed in Table 10.1-8. Vegetation communities shown do not include the coastal area of the former FAA parcel.

Table 10.1-8. Vegetation Communities at Former FAA and Harmon Annex Parcels

Vegetation Type	*Former FAA Parcel ac (ha)*	*Harmon Annex ac (ha)*
Limestone forest, disturbed	443 (179)	31 (13)
Shrub/Grassland	148 (60)	236 (96)
Developed land	25 (10)	3.9 (1.6)
Limestone forest, undisturbed	0	1 (0.4)
Tangantangan	0	32 (13)

Wildlife – Native Species

The Pacific golden plover and yellow bittern were the only native bird species observed at the former FAA parcel during recent surveys. No project-specific surveys were conducted at Harmon Annex, but species are likely to be similar to those found on the former FAA parcel. The blue-tailed skink and mourning gecko are reptiles that were observed in forested areas during recent surveys at the former FAA parcel in support of this EIS/OEIS (NR Survey Report in preparation). It is assumed that the Harmon Annex parcel would have similar wildlife based on the vegetation mapped by USFS (2006) and vegetation and habitat observed in the adjacent GLUP 77 parcel during project-specific surveys (NR Survey Report, in preparation).

Wildlife – Non-Native Species

Evidence of ungulate use, including both feral pig and Philippine deer, was prevalent on the former FAA parcel during recent surveys. Soil and vegetation damage was moderate. Eurasian tree sparrow, island collared dove, black drongo, rock pigeon, curious skink, house gecko, and cane toad were also observed on the former FAA parcel. Species occurrence and habitat conditions at Harmon are likely to be similar.

ESA-Listed Species and Critical Habitat

Four ESA-listed or candidate species have been observed, or habitat is present on some or a portion of these parcels (Table 10-1.9). While no critical habitat has been designated, a portion of the former FAA parcel is considered essential habitat for the Mariana fruit bat and Guam Micronesian kingfisher. In addition, recovery zones for the Mariana crow are designated within the former FAA parcel (Figure 10.1-13) (USFWS 2002). No listed species were observed during recent surveys. Based on the lack of designated habitat and vegetation types present, the Harmon parcel is unlikely to support the fruit bat, kingfisher, or crow. Habitat that could support the Guam rail is present.

Table 10.1-9. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species at the Former FAA and Harmon Annex Parcels

Common Name	*Status*		*Habitat*	*Occurrence at Former FAA and Harmon Annex Parcels*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone and coastal forests, coconut plantations	Does not currently occur, but essential habitat present at former FAA parcel
BIRDS				
Mariana crow	E	E	All forests, with a preference for native limestone forest	None currently occur, but recovery zone habitat present
Guam Micronesian kingfisher	E	E	Forest and scrub, prefers native limestone forest	Extirpated; essential habitat present at former FAA parcel
Guam rail	E	E	Secondary habitats, also savanna and limestone forests	Extirpated but habitat present throughout
REPTILES				
Pacific slender-toed gecko	-	E	Forest edge	Potential habitat present

Legend: T = Threatened, E = Endangered.
Sources: USFWS 1990b, 2006; Wiles et al. 1995; COMNAV Marianas 2001, 2008; GDAWR 2006.

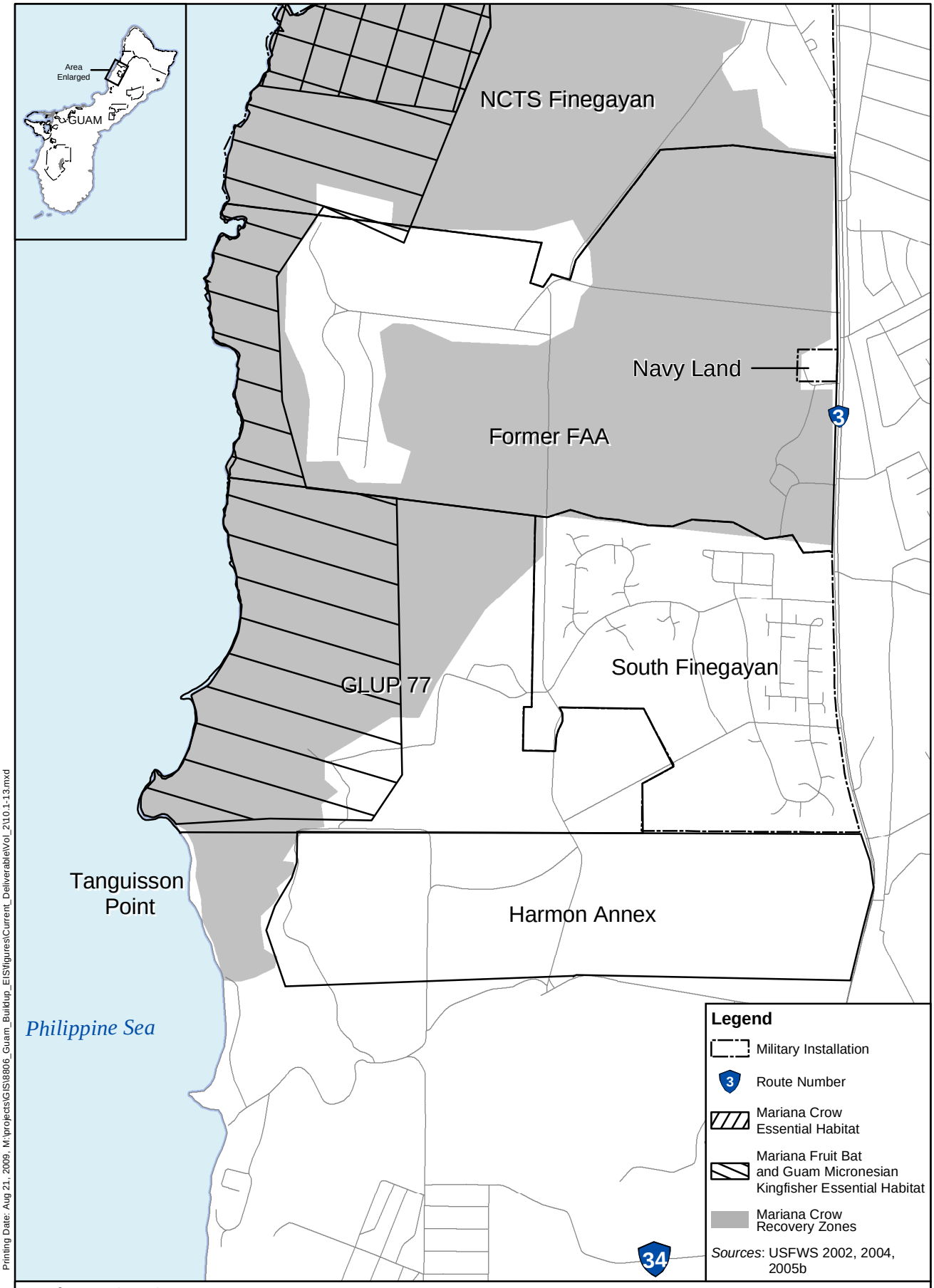

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Figure 10.1-13
Essential Habitat and Recovery Zones for ESA-listed Species on or in the Vicinity of the Former FAA Parcel, South Finegayan, GLUP 77, and Harmon Annex

Guam-Listed Species

Species that are both Guam-listed and federally listed are discussed above. There is habitat present for the Pacific slender-toed gecko which prefers forest edge habitat that is present on these parcels. The species

was not detected during recent surveys at the former FAA parcel (NR Survey Report in preparation). The Harmon Annex parcel would also be unlikely to harbor this species based on the similarity of vegetation and survey results from the nearby former FAA parcel and GLUP77 parcels (NR Survey Report, in preparation).

10.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

There are numerous proposed roadway projects in the north region. For the proposed Guam Road Network (GRN) projects, the areas evaluated are termed the Biological Resources Study Area (BRSA). The north region BRSA is shown in Figure 10.1-14.

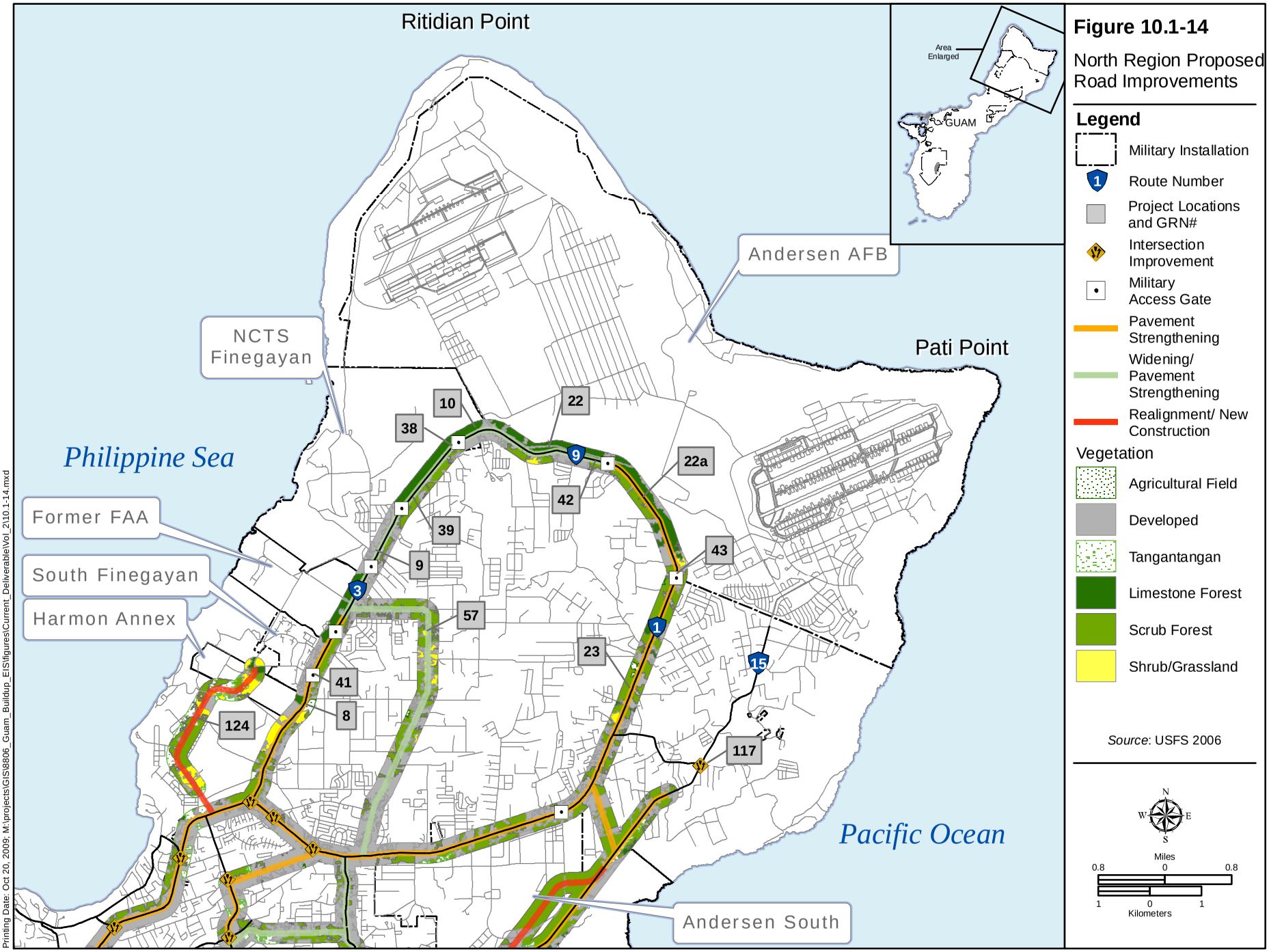
Vegetation Communities

Table 10.1-10 lists each vegetation community type within the area evaluated for each project, along with the acreage calculation for each type. Figure 10.1-15 shows the vegetation communities evaluated for GRN #8, 57, and 124. Similarly, Figure 10.1-16 depicts GRN #9, 10, 22, and 22A, and Figure 10.1-17 shows GRN #23. Vegetation includes maintained vegetated road shoulders (i.e., areas periodically mowed are considered urban cultivated), shrub and grasslands along the outer portions of the road shoulder, and developed areas. Depending on land use history and past surface disturbance along the roadways, the herbaceous scrub may transition into higher stature tangantangan and hibiscus thickets or degraded secondary limestone forests.

Table 10.1-10. Vegetation Communities within North Region BRSA for the Proposed GRN Projects (ac [ha])

GRN #	*Route*	*Limestone Forest, Disturbed*	*Mixed limestone Forest-Plateau/ Secondary*	*Vitex - Closed Canopy*	*Scrub Forest*	*Tangantangan*	*Mixed Herbaceous Scrub*	*Agricultural Field*	*Developed*
8	3	45 (18)	0	0	132 (53)	3.5 (1.4)	53 (22)	9.6 (3.9)	206 (83.4)
9	3	133 (54)	0	0	77 (31)	0	0	0	208 (84.3)
10	3	43 (17.6)	12 (4.9)	8.2 (3.3)	8.0 (3.2)	0	0	0	73 (29.6)
22	9	2.3 (0.9)	92 (37)	11 (4.8)	36 (14)	0	6.4 (2.6)	0	106 (43.1)
22A	9	12.3 (5.0)	118 (76)	4.9 (2.0)	75 (30)	0	15 (6.2)	0	89 (36)
23	1	14 (5.7)	4.6 (1.9)	0	216 (87)	0	8.3 (3.4)	7.1 (2.9)	213 (86)
57	28	10 (4.0)	0	0	205 (82)	0	37 (14)	1.6 (0.6)	420 (170)
124	Finegayan Connection	12 (5.0)	0	0	138 (60)	70 (28)	91 (36)	0	40 (16)
	Total	**272 (111)**	**227 (120)**	**24.0 (10)**	**887 (360)**	**74 (29)**	**211 (84)**	**18 (7.4)**	**1355 (549)**

As discussed earlier in this chapter for the different study areas, survey/mapping occurred at different times and using different vegetation categories for some areas. For GRN projects that expand into DoD parcels, vegetation categories and mapping for each parcel are described and presented based on the best


Ritidian Point
Area Enlarged
GUAM
Andersen AFB
NCTS Finegayan
Pati Point
Philippine Sea
Former FAA
South Finegayan
Harmon Annex
Andersen South
Pacific Ocean
10
38
22
22a
42
39
9
43
57
23
41
8
124
117
15
1
3
9
Figure 10.1-14
North Region Proposed Road Improvements
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Gate
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Vegetation
Agricultural Field
Developed
Tangantangan
Limestone Forest
Scrub Forest
Shrub/Grassland
Source: USFS 2006
N
W
E
S
Miles
0.8 0 0.8
1 0 1
Kilometers
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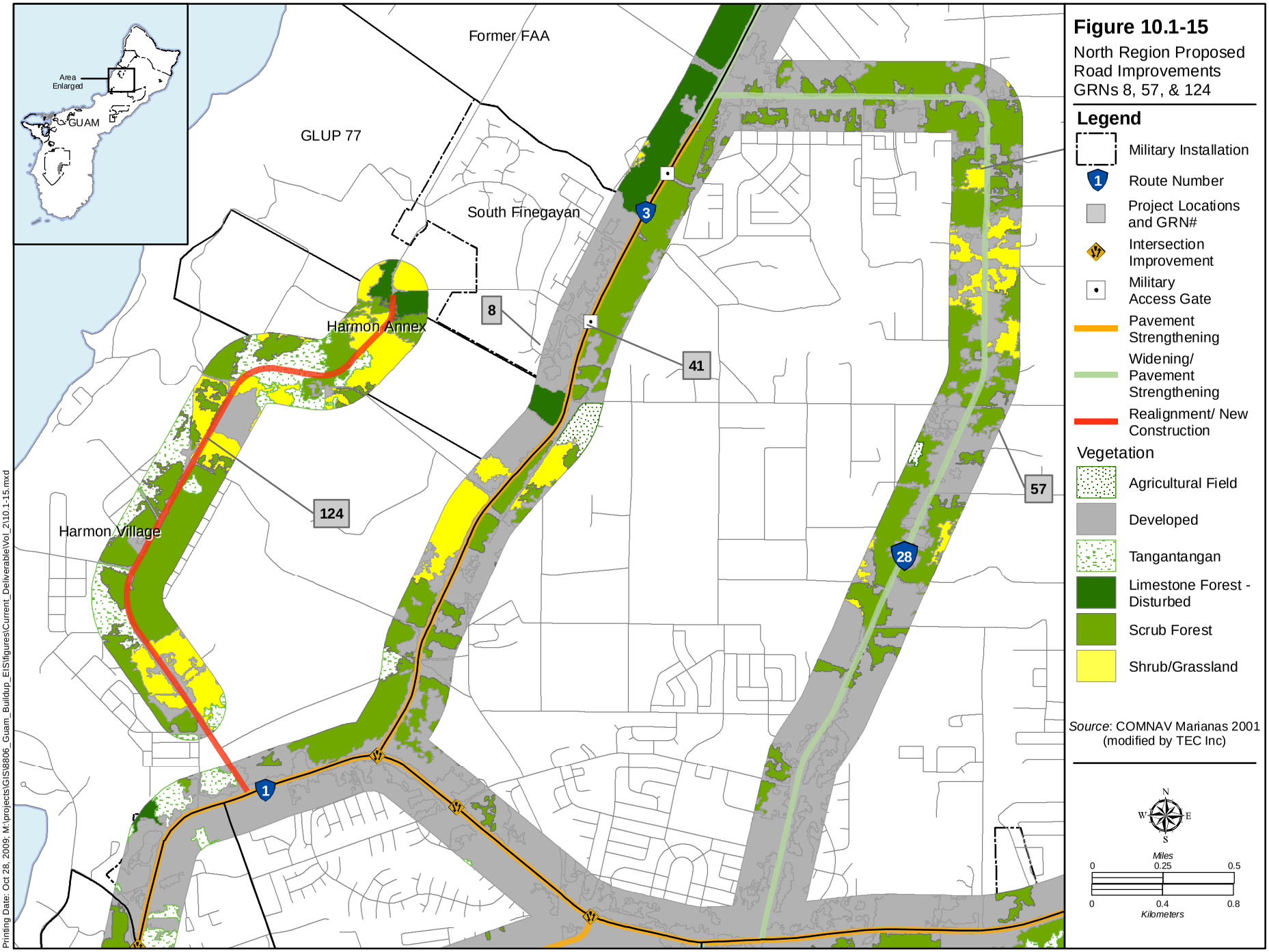
Area Enlarged
GUAM
Former FAA
GLUP 77
South Finegayan
Harmon Annex
Harmon Village
8
41
124
57
28
3
1
Figure 10.1-15
North Region Proposed Road Improvements
GRNs 8, 57, & 124
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Gate
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Vegetation
Agricultural Field
Developed
Tangantangan
Limestone Forest - Disturbed
Scrub Forest
Shrub/Grassland
Source: COMNAV Marianas 2001 (modified by TEC Inc)
N
W
E
S
Miles
0
0.25
0.5
0
0.4
0.8
Kilometers
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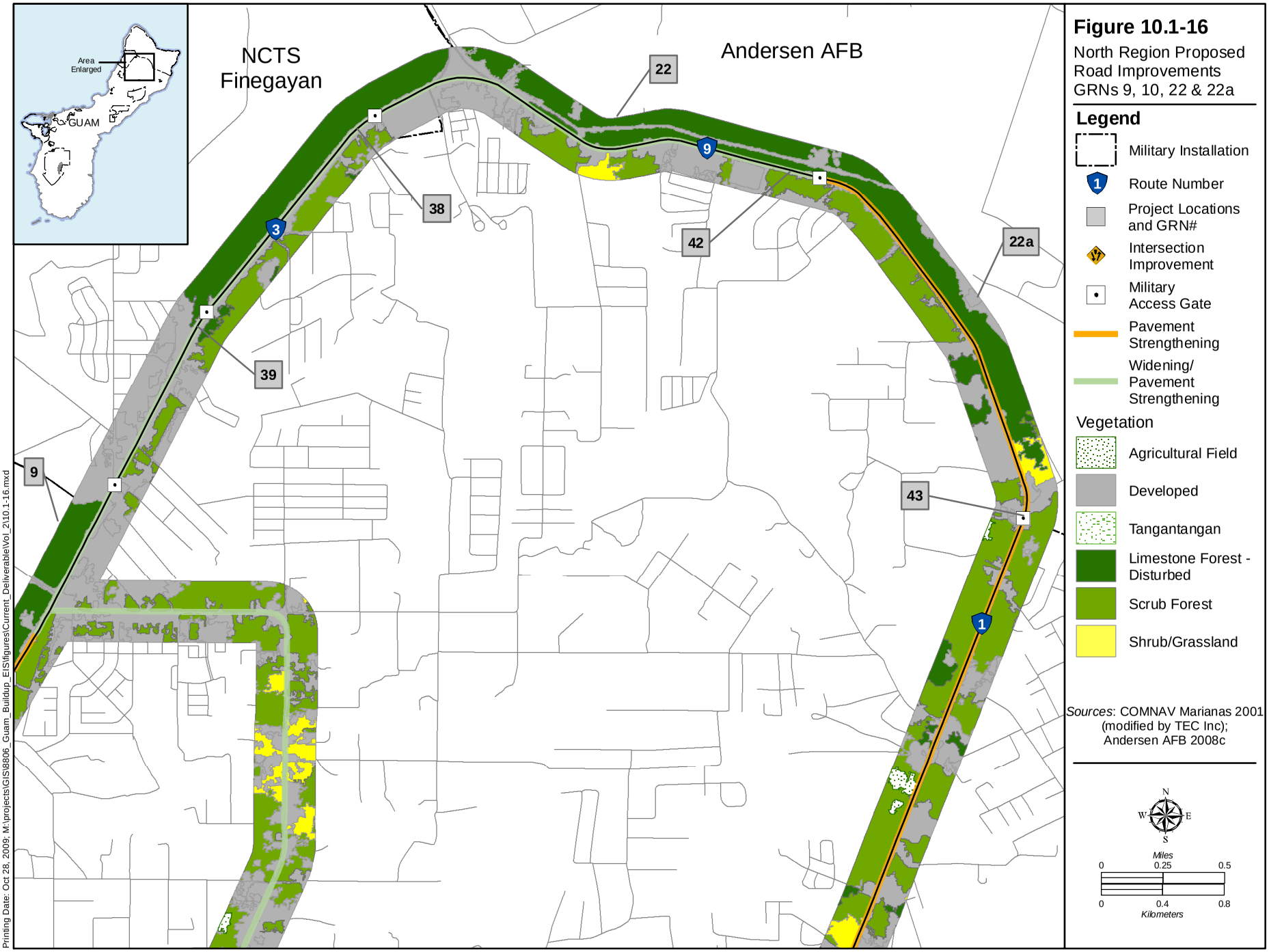
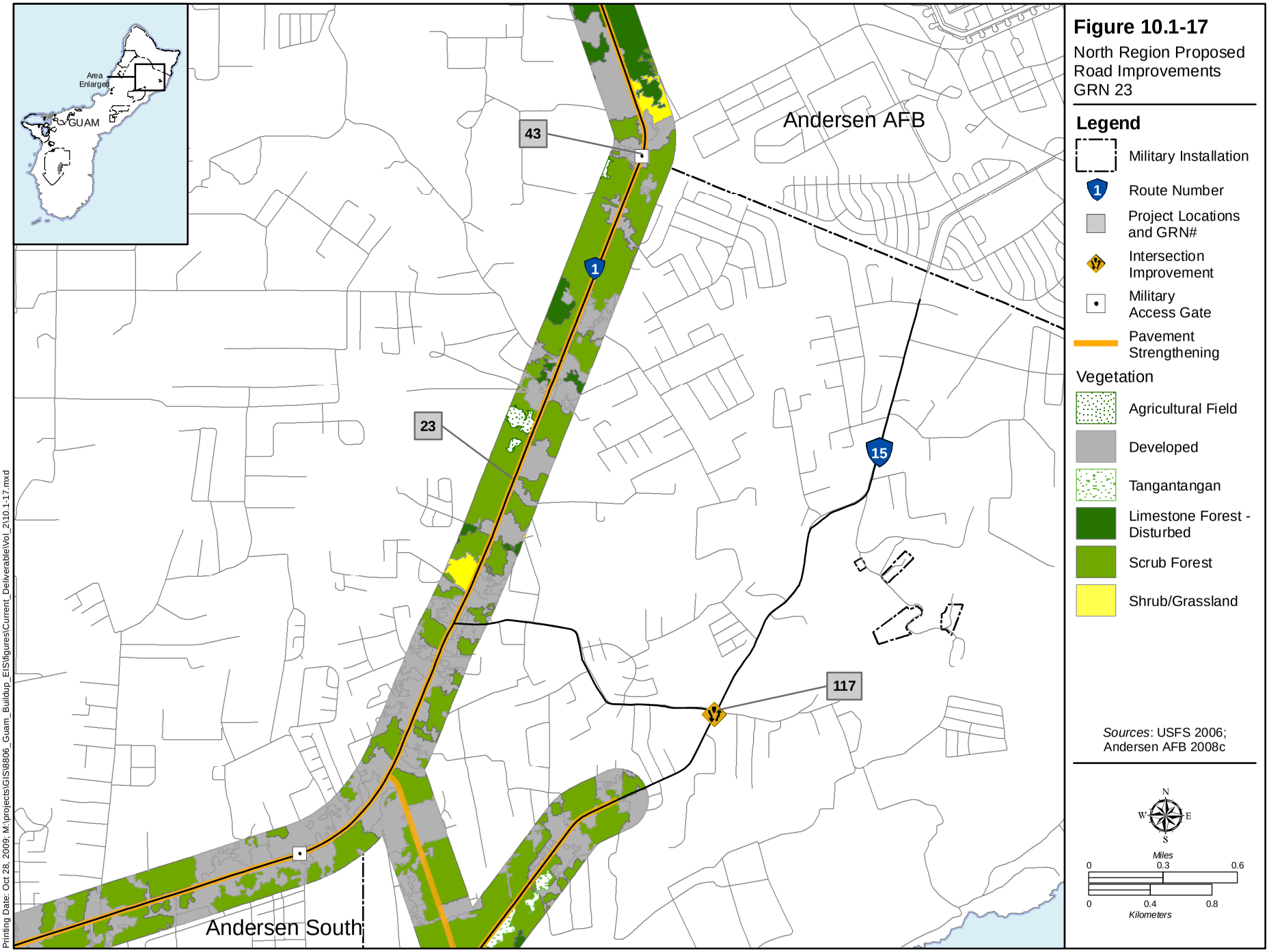

Area Enlarged
GUAM
NCTS Finegayan
Andersen AFB
22
38
9
42
22a
3
39
9
43
1
Figure 10.1-16
North Region Proposed Road Improvements
GRNs 9, 10, 22 & 22a
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Gate
Pavement Strengthening
Widening/ Pavement Strengthening
Vegetation
Agricultural Field
Developed
Tangantangan
Limestone Forest - Disturbed
Scrub Forest
Shrub/Grassland
Sources: COMNAV Marianas 2001 (modified by TEC Inc); Andersen AFB 2008c
N
W
E
S
Miles
0
0.25
0.5
0
0.4
0.8
Kilometers
Printing Date: Oct 28, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\10.1-16.mxd


Area Enlarged
GUAM
Andersen AFB
Andersen South
43
23
1
15
117
Figure 10.1-17
North Region Proposed Road Improvements GRN 23
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Gate
Pavement Strengthening
Vegetation
Agricultural Field
Developed
Tangantangan
Limestone Forest - Disturbed
Scrub Forest
Shrub/Grassland
Sources: USFS 2006; Andersen AFB 2008c
N
W
E
S
Miles
0
0.3
0.6
0
0.4
0.8
Kilometers
Printing Date: Oct 28, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\10.1-17.mxd

available published data for that parcel, with some modifications based on observations during recent field surveys (COMNAV Marianas 2001, Andersen AFB 2008c). The 2005 USFS (2006a) mapping effort represents the best available data for describing vegetation communities on non-DoD properties.

Tabernaemontana rotensis, considered a SOGCN by GDAWR, has been mapped recently on Andersen AFB (UoG 2007). This species was not recorded within the BRSA that overlaps onto Andersen AFB. The species is typically found in edge habitats of limestone forest areas, which do occur within some areas of the BRSA, however presence in these areas is unknown.

Wildlife – Native Species

Because of the presence of non-native predators and invasive plant species, the relatively intact forested areas within the BRSA do not currently support resident native bird species. However, these areas do contain potential forage for future recovery of native forest birds. On maintained road shoulders, Pacific golden plovers were observed foraging in mowed grass in November 2006 during their autumnal migration from their northern breeding grounds.

Based on the habitats present, the BRSA would support the blue-tailed skink and the mutilating gecko, but predation by BTS is a limiting factor. These species are described earlier in this chapter for other project areas in sections describing wildlife within the North Region.

Although numerous native butterflies potentially occur within the BRSA, the blue-banded king crow, a member of the subfamily Danainae (milkweed butterfly subfamily), has been observed most frequently. Other butterflies may be limited by the herbivory on nurse plants by Philippine deer and other habitat degradation associated with feral pigs.

Wildlife – Non-Native Species

Based on the habitat present, non-native bird species within the BRSA of the north region's proposed GRN projects may include the black francolin, Philippine turtle dove, black drongo, Eurasian tree sparrow, and semi-feral chickens associated with residences on the east side of Route 3 and the south side of Route 9.

Feral and domesticated cats and dogs, rats, Philippine deer, and feral pigs are known to inhabit roadway project areas in the North Region. Ungulate nighttime spotlight counts and daytime reconnaissance during field studies in support of the ISR/Strike EIS (Andersen AFB 2006b) noted the presence of "somewhat emaciated" feral cats and dogs and "collared" domestic cats and dogs. Ungulate impacts are well evidenced within the GRN project areas including extensive wallowing, scat, and bark rubbings. These types of impacts were readily observed during field reconnaissance for this EIS/OEIS and during earlier field studies (Andersen AFB 2006b) in support of the ISR/Strike EIS.

As discussed earlier in this chapter regarding non-native predator impacts on Guam, the extirpation, extinction, or severe population declines of Guam's native avifauna are attributed to the presence of BTS. Other introduced reptilian species that may occur within the BRSA include the curious skink and monitor lizard.

ESA-Listed Species

Six ESA-listed species are potentially present in the BRSA. Table 10.1-11 lists special-status species that are known to occur, or habitat is present, within northern Guam. and these species are described below.

Table 10.1-11. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species within North Region for Proposed GRN Projects

Common Name	*Status**		*Occurrence in the BRSA*
	ESA	*Guam*	
MAMMALS			
Mariana fruit bat	T	E	Few, if any, present; essential habitat present on DoD lands west of Route 3 and north of Route 9 on Andersen AFB; some foraging tree species present
BIRDS			
Mariana crow	E	E	Not currently present; essential habitat present and recovery zones on DoD lands west of Route 9 and North of Route 3 on Andersen AFB
Guam Micronesian kingfisher	E	E	Extirpated in the wild; essential habitat present on DoD lands west of Route 9 and North of Route 3 on Andersen AFB
Guam rail	E	E	Extirpated in the wild; suitable habitat is present
REPTILES			
Moth skink	-	E	Not found in Northern Guam in recent surveys; last reported occurrence is at Haputo Beach area
Pacific slender-toed gecko	-	E	Detected in recent natural resource surveys in northeastern NCTS Finegayan
INVERTEBRATES			
Mariana eight-spot butterfly	C	-	Not known to be present; forested habitat with host plants that typically occur on epikarst are absent
Guam tree snail	C	T	Currently not known from the area and not known to be present;limited habitat due to the lack of undisturbed understory

Legend: *E = endangered; T = threatened; C = candidate.
Sources: COMNAV Marianas 2001; GDAWR 2006; Andersen AFB 2008a.

Mariana Fruit Bat

Within the forested areas of the North Region BRSA for the proposed GRN projects, solitary bats may forage and roost in relatively intact forested areas. Colonial bats from the Pati Point colony may also forage on suitable tree species within these areas as well. Earlier in this chapter under discussions of biological resources within Andersen AFB and NCTS Finegayan. Approximately 280 ac (117 ha) of Mariana fruit bat essential habitat is within the BRSA for proposed GRN projects within the North Region.

Mariana Crow

Within the forested areas of the BRSA for the North Region proposed GRN projects, the intact forested areas are considered Mariana crow essential habitat. Currently, the remaining crows are confined to the interior portions of Andersen AFB and were last seen within NCTS Finegayan in the 1990s (USFWS 2005b). Approximately 280 ac (113 ha) of Mariana crow essential habitat and 435 ac (176 ha) of recovery zone area is within the BRSA for proposed GRN projects within the North Region.

Guam Micronesian Kingfisher

Edges between forest and shrub or herbaceous areas along road corridors may be important to Guam Micronesian kingfishers, and the BRSA extends into areas considered essential habitat on both NCTS Finegayan and Andersen AFB. Approximately 280 ac (113 ha) of Guam Micronesian kingfisher essential habitat is within the BRSA for proposed GRN projects within the North Region. This species is extirpated, only persisting in captive breeding programs.

Guam Rail

The Guam rail is extirpated and persists in captive breeding programs. This species is associated with open areas usually created by typhoons, which often removes patches of forest. Critical habitat has not

been proposed for the Guam rail; however, open areas within Andersen AFB may be considered important to the recovery of this species.

Tree Snails

The Guam tree snail is associated with closed canopy forests with undisturbed mesic substrates. Some of these areas are found within the BRSA; however, the presence of predatory flatworms within Guam's northern forests is a major limiting factor (USFWS 2007c).

Guam-Listed Species

Seven Guam-listed species have been observed, or their potential habitat exists, within north region for proposed GRN project. Those species that are both federally listed and Guam-listed are discussed above.

Skinks and Geckos

Neither the Pacific slender-toed gecko nor the moth skink were observed at the former FAA parcel during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation). BTS infestations within the northern Guam habitats are believed to be a limiting factor on the Pacific slender-toed gecko (Fritts and Leesman-Tanner 2008).

10.1.3 Central

10.1.3.1 Andersen South

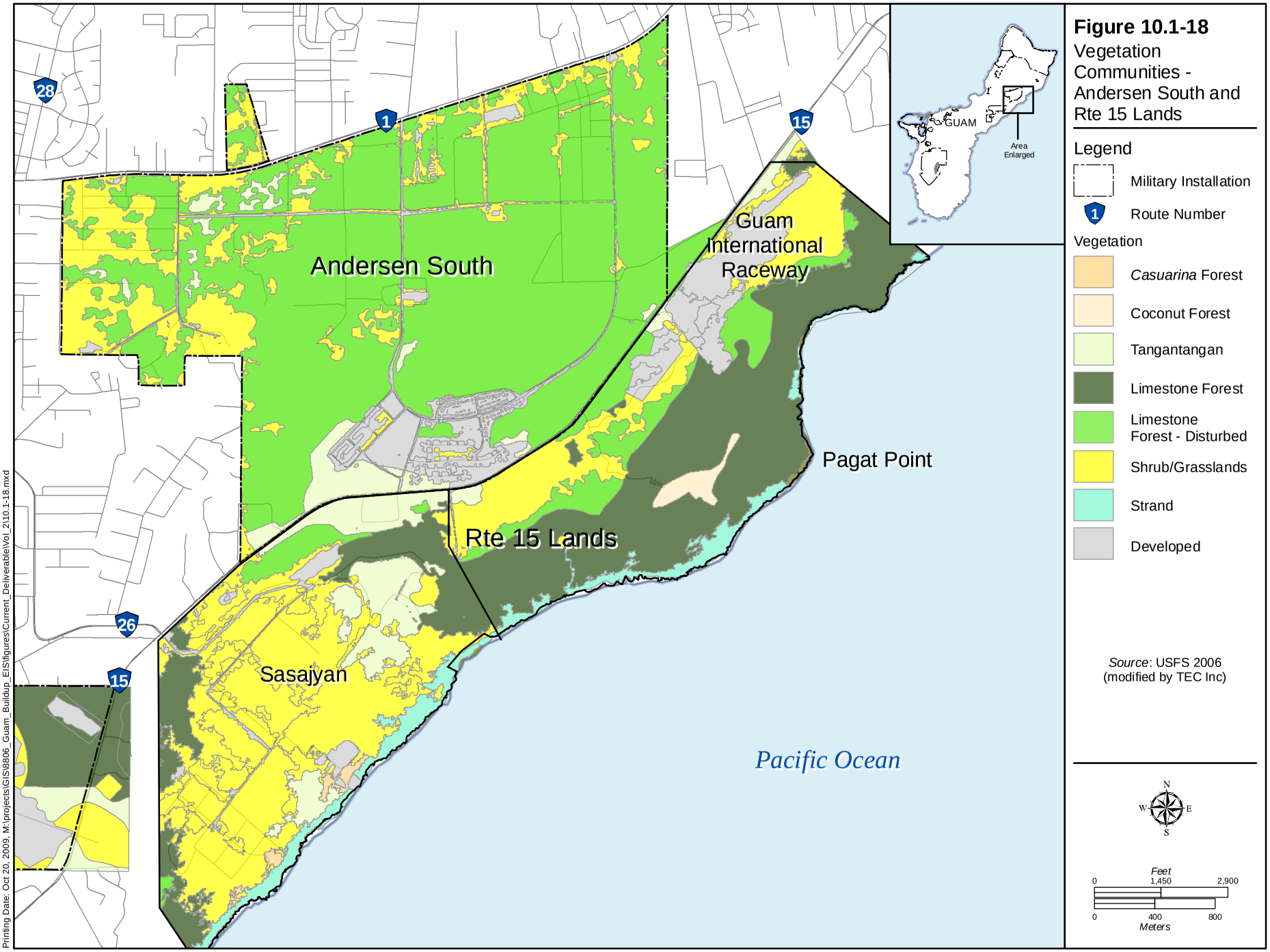
Vegetation Communities

Figure 10.1-18 depicts the cover types within the boundaries of Andersen South based on USFS (2006a) mapping, modified by project-specific field surveys, and acreages are provided in Table 10.1-12. Vegetation communities mapped by USFS (2006b) within Andersen South indicate significant land disturbance.

Table 10.1-12. Vegetation Communities at Andersen South

Vegetation Type	*ac(ha)*
Limestone Forest, disturbed	1,482 (600)
Shrub/Grasslands	443 (179)
Developed	54 (22)
Tangantangan	83 (34)

A reconnaissance survey was conducted in support of a Military Operations in Urban Terrain (MOUT) training Environmental Assessment by GDAWR and Navy biologists for the rare plant species *Tabernaemontana rotensis* in areas proposed for clearing and the species was not found (Marine Corps 2003). Recent surveys in support of this EIS/OEIS did not find any rare plant species at Andersen South (NR Survey Report in preparation). As indicated in the table, much of the area is dominated by disturbed limestone forest and shrub and grassland vegetation. While USFS (2006a) classified most of the vegetation as scrub forest, more recent field observations indicate that this site would be better characterized as open/disturbed limestone forest. Recent surveys also found that the southwest and southeast corners of the facility support more mature vegetation canopy layers, and in at least some locations these are dominated by native species. For example, the findings from a survey transect in the southwest corner of the site demonstrate that a limestone forest dominated with native species exists, including some large grand devil's claw and Marianas breadfruit and relatively low numbers of invasive plants. In a reconnaissance of the southeast corner, it was noted that the understory was heavily damaged by ungulates and conditions indicated a large feral pig population was present.


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
28
1
15
26
15
Figure 10.1-18
Vegetation Communities - Andersen South and Rte 15 Lands
Legend
Military Installation
Route Number
Vegetation
Casuarina Forest
Coconut Forest
Tangantangan
Limestone Forest
Limestone Forest - Disturbed
Shrub/Grasslands
Strand
Developed
Source: USFS 2006 (modified by TEC Inc)
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
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Wildlife – Native Species

The yellow bittern has been reported as occurring in the area by GDAWR (2000a). Also, the blue-tailed skink and mourning gecko were observed in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Wildlife – Non-Native Species

Sign of ungulates, both feral pig and Philippine deer, was observed at Andersen South during recent surveys (NR Survey Report in preparation). Soil and vegetation damage ranged from moderate to severe. Eurasian tree sparrow, island collared dove, black francolin, curious skink, house gecko, greenhouse frog, and cane toads were also observed in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

ESA-Listed Species and Critical Habitat

No critical habitat, essential habitat, or recovery zones for ESA-listed species has been designated at Andersen South, and no ESA-listed species have been reported or observed at Andersen South during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Guam-Listed Species

No Guam-listed species have been observed during recent surveys at Andersen South in support of this EIS/OEIS. Andersen South was not covered in the Air Force current and draft INRMPs prepared for the base (Andersen AFB 2003, 2008a).

10.1.3.2 Non-DoD Land

Vegetation Communities

Figure 10.1-18 depicts the vegetation communities within the boundaries of the Route 15 lands based on USFS (2006a) mapping and acreages are provided in Table 10.1-13.

Table 10.1-13. Vegetation Communities at the Route 15 Lands (ac [ha])

Vegetation Type	*North Parcel*	*South Parcel*
Limestone forest	423 (171)	144 (58)
Developed	234 (95)	36 (15)
Limestone forest, disturbed	120 (49)	33 (13)
Shrub/Grasslands	79 (32)	559 (226)
Strand	34 (14)	45 (18)
Tangantangan	21 (8.5)	137 (55)
Coconut Forest	19 (7.7)	0
Casuarina Forest	0	11 (4.5)

The parcels encompass large areas of limestone forest on the upper plateau at cliff edges and on the coastal bench below the cliff line. Some forests on the upper plateau are on rugged limestone terrain of sharp pinnacles and narrow fissures and, as a result, are minimally disturbed by ungulates. Substantial areas of disturbed limestone forest are also present. Some of these disturbed areas, particularly to the east of the racetrack, include small remnant "islands" of original limestone forest that have not been recently cleared, but are surrounded by cleared land allowing invasive, non-native species to encroach.

Wildlife – Native Species

The yellow bittern has been reported as occurring in the area by GDAWR (2000a). Also, the blue-tailed skink and mourning gecko were observed in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Wildlife – Non-Native Species

Sign of ungulates, both feral pig and Philippine deer, was observed in the area during recent surveys although soil and vegetation damage in the area was not severe as in other areas such as parts of nearby Andersen South (NR Survey Report in preparation). Wildlife species that currently occur in the area are non-native species that are common elsewhere on Guam such as Eurasian tree sparrow, island collared dove, black francolin, curious skink, house gecko, greenhouse frog, and cane toads as observed during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

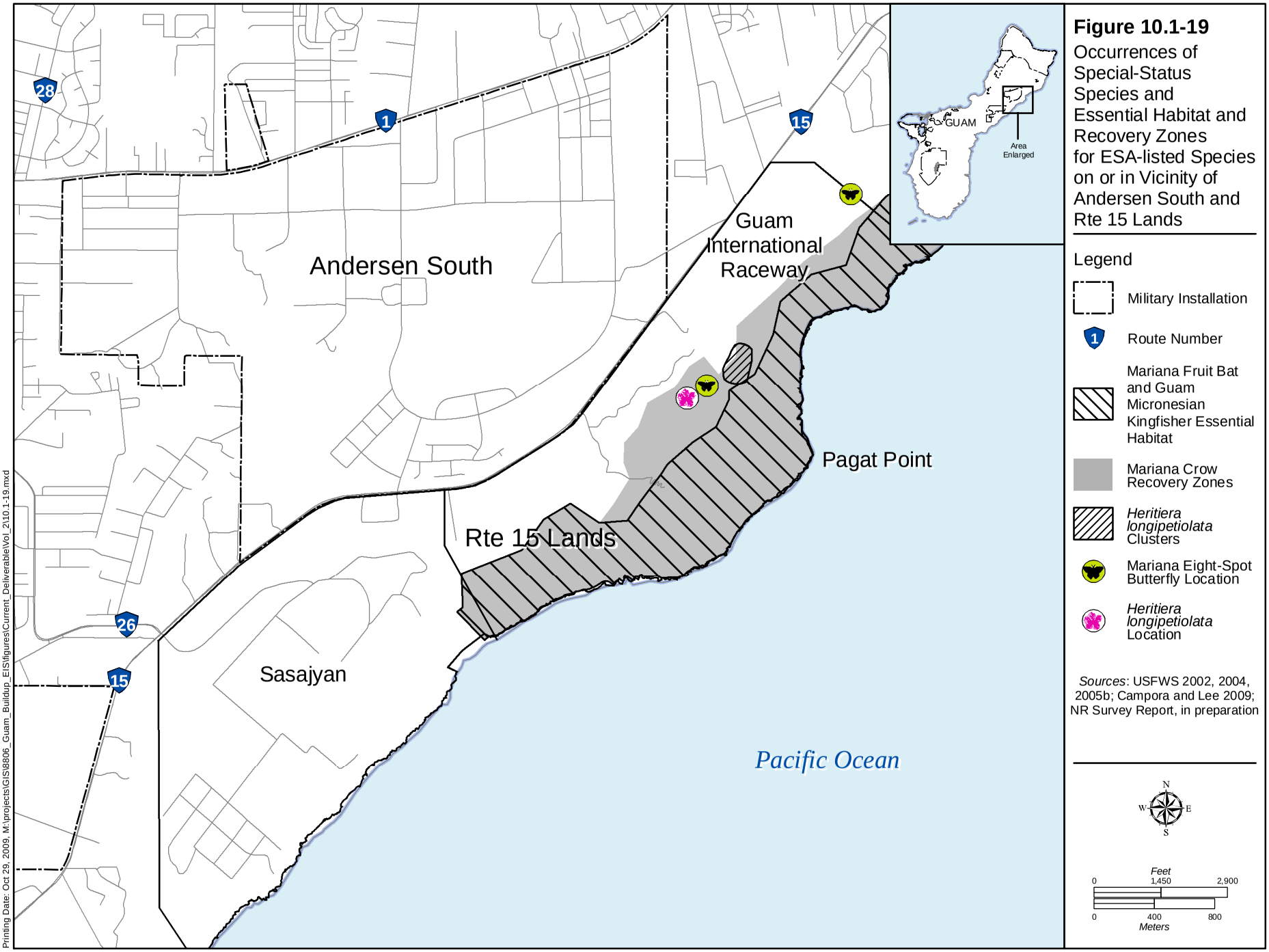
ESA-Listed Species

Nine ESA-listed or candidate species have been observed or habitat is present within the Route 15 lands (Table 10.1-14, Figure 10.1-19). Limestone forests are an important habitat for these species.

Table 10.1-14. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species at the Route 15 Lands

Common Name	*Status**		*Habitat*	*Occurrence at Route 15 Lands*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone forest, coastal forest, and coconut plantations	Present historically but not observed within the last several years; essential habitat is present
BIRDS				
Mariana crow	E	E	All forests with a preference for native limestone forest	Not currently present, but recovery zones designated
Guam Micronesian kingfisher	E	E	Forest and scrub with preference for native limestone forest	Extirpated but essential habitat present
Mariana swiftlet	E	E	Nests in caves; feeds in savannah and ravine forest	One possible colony in the area historically; not reported since 1998
REPTILES				
Pacific slender-toed gecko	-	E	Forests	Not observed in recent surveys
Moth skink	-	E	Forest areas with large tree trunks	Not observed in recent surveys
INVERTEBRATES				
Marianas eight-spot butterfly	C	-	Intact limestone forest with host species	Reported occurrence at Pagat Point and observed during recent surveys
Guam tree snail	C	T	Intact limestone forest	Not observed in recent surveys
Humped tree snail	C	E	Intact limestone forest	Not observed in recent surveys
Fragile tree snail	C	E	Intact limestone forest	Not observed in recent surveys
PLANTS				
Fire Tree	E	E	Limestone and ravine forests.	Habitat present
Heritiera longipetiolata	-	E	Limestone forest	Present

Legend: *T = threatened, E = endangered, C = candidate.
Sources: Wiles et al. 1995; GDAWR 2006.


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
28
1
15
26
15
GUAM
Area Enlarged
Figure 10.1-19
Occurrences of Special-Status Species and Essential Habitat and Recovery Zones for ESA-listed Species on or in Vicinity of Andersen South and Rte 15 Lands
Legend
Military Installation
Route Number
Mariana Fruit Bat and Guam Micronesian Kingfisher Essential Habitat
Mariana Crow Recovery Zones
Heritiera longipetiolata Clusters
Mariana Eight-Spot Butterfly Location
Heritiera longipetiolata Location
Sources: USFWS 2002, 2004, 2005b; Campora and Lee 2009; NR Survey Report, in preparation
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
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Mariana Fruit Bat

An estimated 40-60 fruit bats were believed to live in solitary or in small groups in northern Guam, primarily along the cliffline extending from Bijia Point to Iates Point east of Route 15 (GDAWR 2009). A single incidental fruit bat sighting was reported in 1999 during biological surveys in the Route 15 north parcel (Duenas & Associates 2000). There are no other recent records of Mariana fruit bats from Andersen South or the Route 15 lands. Based on the proposed critical habitat areas (USFWS 2002), essential habitat for the species occurs on Route 15 lands (refer to Figure 10.1-19).

Mariana Swiftlet

One swiftlet colony is known from the Lumuna district of Yigo in the area of the parcel. In November 1992 there were infrequent sightings of 1-6 birds, suggesting a possible colony size of 15-30 individuals (Wiles et al. 1995). Although the cave harboring these birds was not found, it was thought to be between Pagat Point and Lujuna Point. A search for swiftlets in this area in January 1998 recorded three birds at one site, but attempts to find the colony's cave were not successful (GDAWR 1998).

Mariana Crow

The crow does not currently occur on the Route 15 lands; however, a recovery zone has been designated along the coastal portion of the parcels (USFWS 2005b).

Guam Micronesian Kingfisher

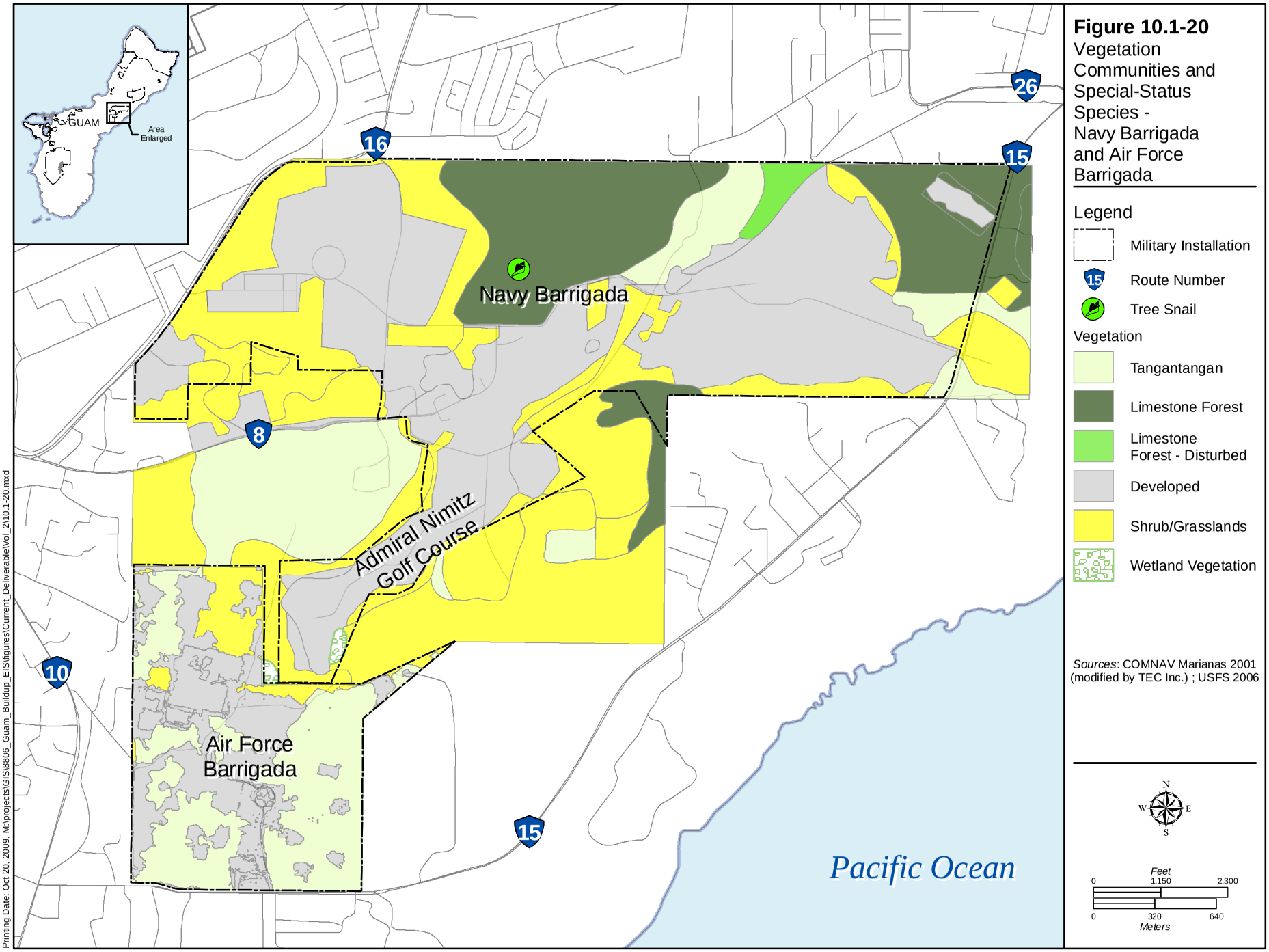
Kingfishers once utilized a wide variety of habitats on Guam, including limestone forest, strand forest, agricultural forest, secondary forest, edge habitats, and forest openings; however, mature forests with suitable cavity trees to provide nest sites may be the single most important requirement for kingfisher reproduction (USFWS 2008a). These habitat requirements are all present within the Route 15 lands. Furthermore, based on the proposed critical habitat areas (USFWS 2002), the coastal portion of the parcel within the limestone forest is considered essential habitat for the kingfisher.

Mariana Eight-Spot Butterfly

Two populations have been reported in the Pagat area of the Route 15 lands; however, the specific location was not given (Scheiner and Nafus 1996 as cited in USFWS 2007b). During December 2008 surveys at the site, one individual was observed at the southern location shown in Figure 10.1-20 (NR Survey Report in preparation). In July 2009, surveys were conducted for all life stages of the Mariana eight-spot butterfly and its two documented host plant species (Elatostema calcareum and Procris pedunculata) along three transects within the Route 15 Lands (Campora and Lee 2009). Host plants were generally sparsely distributed except for two areas which contain large groups of both plant species. One adult eight-spot butterfly was seen within one of the large host plant areas at the northern location shown in Figure 10.1-20. The previous adult eight-spot sighting in December 2008 at the southern location was within the other large host plant area. Other life stages (e.g. egg, larvae, pupae) were found on host plants in all three transects; however, without rearing these stages to the adult form they cannot be identified with complete certainty as Mariana eight-spot butterflies (Campora and Lee 2009).

Guam-Listed Species

Eleven Guam-listed species have been observed or potential habitat is present on the Route 15 lands (Table 10.1-14). Those species that are also listed under the ESA are discussed above.


GUAM
Area Enlarged
Navy Barrigada
Admiral Nimitz Golf Course
Air Force Barrigada
Pacific Ocean
16
26
15
8
10
15
Figure 10.1-20
Vegetation Communities and Special-Status Species - Navy Barrigada and Air Force Barrigada
Legend
Military Installation
Route Number
Tree Snail
Vegetation
Tangantangan
Limestone Forest
Limestone Forest - Disturbed
Developed
Shrub/Grasslands
Wetland Vegetation
Sources: COMNAV Marianas 2001 (modified by TEC Inc.) ; USFS 2006
N
W
E
S
Feet
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1,150
2,300
0
320
640
Meters
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Heritiera Longipetiolata

The Guam-listed endangered tree Heritiera longipetiolata has been identified on the Route 15 lands in previous surveys for the Guam International Raceway (Duenas & Associates 2000). A total of 22 mature trees and 184 seedlings of this species were found in the southeastern sector of the property (see Figure 10.1-19). One individual tree of this species was also recently observed along a transect on Route 15 lands.

10.1.3.3 Navy Barrigada and Air Force Barrigada

Vegetation Communities

Vegetation communities at Navy Barrigada have been mapped in the 2001 INRMP (COMNAV Marianas 2001). The vegetation of Air Force Barrigada was not mapped in any INRMP; however, the vegetation mapping for the entire island of Guam by the USFS (2006a) was used and categorized to match the vegetation community types in the Navy INRMP. Figure 10.1-20 depicts the cover types within the boundaries of Navy and Air Force Barrigada and acreages are listed in Table 10.1-15.

Table 10.1-15. Vegetation Communities at Navy Barrigada and Air Force Barrigada (ac [ha])

Vegetation Type	*Navy Barrigada*	*Air Force Barrigada*
Limestone forest	296 (120)	0
Limestone forest, disturbed	16 (6.5)	0
Tangantangan	68 (28)	198 (80)
Wetlands	2.8 (1.1)	0.9 (0.4)
Shrub/Grasslands	295 (119)	42 (17)
Developed	739 (299)	192 (78)

Limestone forest is present on Navy Barrigada in the northern portion of the site. A total of 290 ac (117 ha) of this forest was classified as limestone forest, and 16 ac (6 ha) was classified as degraded limestone forest in 2001 (COMNAV Marianas 2001). Based on transect data collected in 2008, the limestone forest has been degraded to some extent, particularly along its edges (NR Survey Report in preparation).

Wildlife – Native Species

The open grasslands and constructed wetlands within Navy and Air Force Barrigada are occasionally used as resting and foraging areas for migrating species (COMNAV Marianas 2001). Recent bird surveys documented the Pacific golden plover and yellow bittern. Other species likely use ponds on the adjacent golf course. Reptiles observed in recent studies were the blue-tailed skink and mourning gecko.

Wildlife – Non-Native Species

Signs of ungulate use, both feral pig and Philippine deer, were observed at Navy Barrigada during recent surveys (NR Survey Report in preparation). Soil and vegetation damage ranged from light to moderate. Eurasian tree sparrow, island collared dove, black francolin, curious skink, and house gecko were also observed in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

ESA-Listed Species and Critical Habitat

Three ESA-listed or candidate species have been observed, or habitat is present, at Navy Barrigada (Table 10.1-16 and Figure 10.1-20). No listed species occur at Air Force Barrigada.

Table 10.1-16. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-Listed Species at Navy Barrigada

Common Name	*Status**		*Habitat*	*Occurrence at Navy Barrigada*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone and coastal forests, coconut plantations	Historical reports of flyovers and a colony on Mt. Barrigada
BIRDS				
Mariana common moorhen	E	E	Freshwater wetlands	Observed in golf course ponds
INVERTEBRATES				
Guam tree snail	C	T	Intact limestone forest	Observed in recent surveys

Legend: *T = threatened; E = endangered; C = candidate.
Sources: Wiles 1987; Wiles et al. 1995; COMNAV Marianas 2001; GDAWR 2006; NR Survey Report in preparation.

There are small areas of habitat marginally suitable for the Marianas fruit bat at Navy Barrigada and it has been observed flying there in the recent past. Daytime sightings of bats (in solitary and in small groups) were made during 1980-1999 in the Barrigada Area at Mt. Barrigada and near the Navy Golf Course (GDAWR 2009). From observations in 1983 and 1984, the population of fruit bats in the Mt Barrigada area was estimated as less than 5 individuals (Wiles 1987). The few constructed wetlands within Navy Barrigada are also suitable for the Marianas common moorhen (COMNAV Marianas 2001). The ESA candidate Guam tree snail was found in recent vegetation surveys on Navy Barrigada in the north-central portion of the installation (NR Survey Report in preparation).

Guam-Listed Species

Three Guam-listed species have been observed, or habitat is present, at Navy Barrigada and their occurrence is discussed above.

10.1.3.4 Off Base Roadways

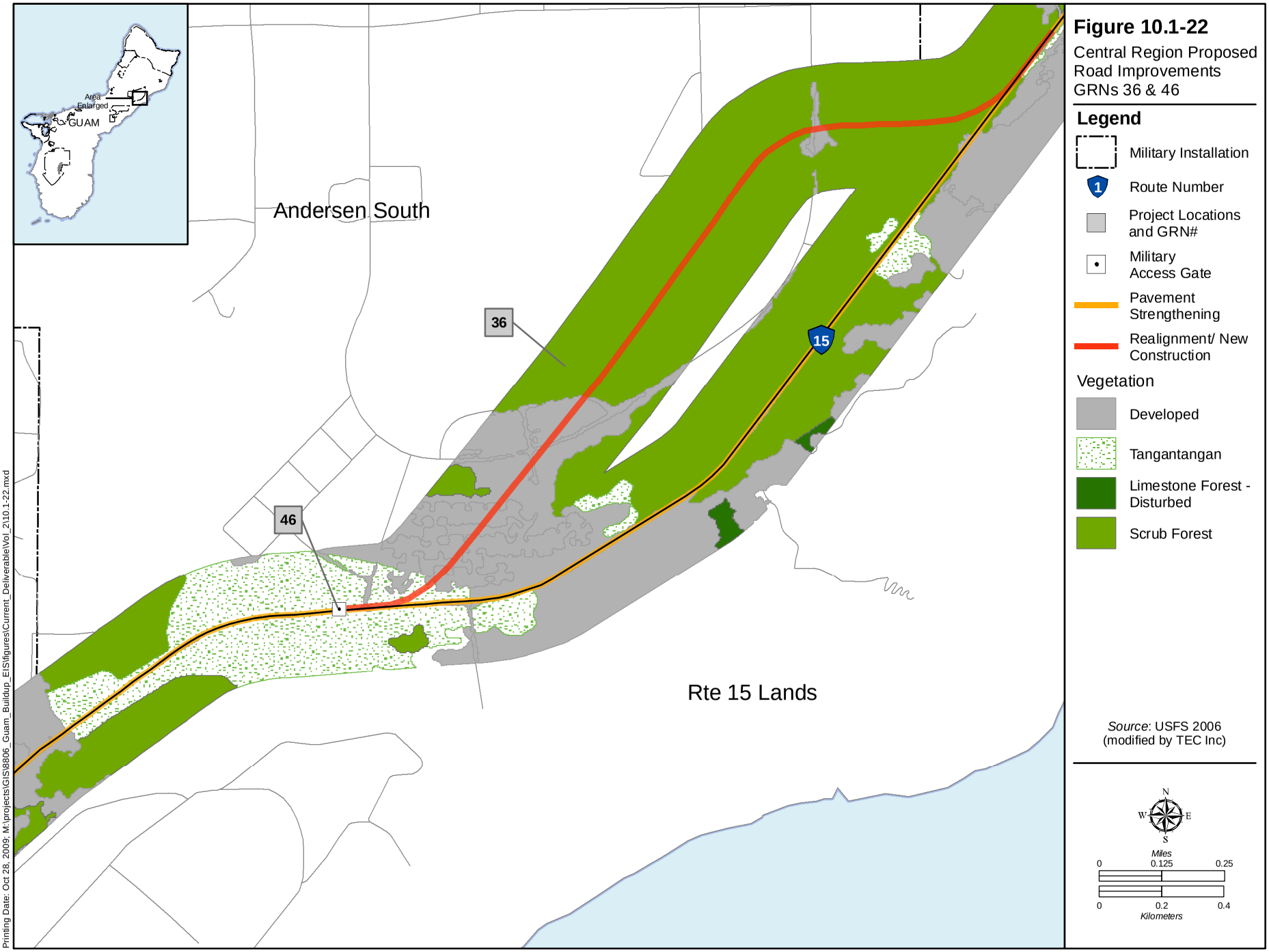
The proposed action include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Figures 10.1-21 and 10.1-22 show the location of Central Region proposed GRN projects and vegetation communities within the BRSA.

Vegetation Communities

For Central Region road projects, the BRSA includes maintained vegetated road shoulders (i.e., areas periodically mowed), herbaceous scrub community type along the fringe of the road shoulder, and developed areas. In some areas the BRSA extends into scrub forests and disturbed limestone forests (Table 10.1-17) that contain important foraging trees for some special-status species, but that have been heavily impacted by feral pigs. In relatively more intact areas in the BRSA of the Route 15 relocation, this community type is dominated by native breadfruit, screw pine, or in some instances native fig trees. The canopy is mostly closed in the disturbed limestone forest areas, allowing mesic conditions to persist on the forest floor and lower canopy layers.


Harmon Annex
Philippine Sea
Tumon Bay
Agana Bay
Navy Barrigada
Air Force Barrigada
Pago Bay
Pacific Ocean
Area Enlarged
GUAM
Figure 10.1-21
Central Region Proposed Road Improvements
Legend
Military Installation
Route Number
Project Locations and GRN#
Bridge Replacement
Intersection Improvement
Military Access Gate
Pavement Strengthening
Widening/ Pavement Strengthening
Realignment/ New Construction
Vegetation
Agricultural Field
Developed
Tangantangan
Limestone Forest - Disturbed
Scrub Forest
Shrub/Grassland
Sources: COMNAV Marianas 2001 (modified by TEC Inc); USFS 2006
N
W
E
S
Miles
0.8 0 0.8
1 0 1
Kilometers
Printing Date: Oct 28, 2009; M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\10.1-21.mxd


Area Enlarged
GUAM
Andersen South
36
46
15
Rte 15 Lands
Figure 10.1-22
Central Region Proposed Road Improvements
GRNs 36 & 46
Legend
Military Installation
Route Number
Project Locations and GRN#
Military Access Gate
Pavement Strengthening
Realignment/ New Construction
Vegetation
Developed
Tangantangan
Limestone Forest - Disturbed
Scrub Forest
Source: USFS 2006 (modified by TEC Inc)
N
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E
S
Miles
0
0.125
0.25
0
0.2
0.4
Kilometers
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Table 10.1-17. Vegetation Communities within the Central Region for the Proposed GRN Projects (ac [ha])

GRN #	*Route*	*Limestone Forest Disturbed*	*Scrub Forest*	*Tangantangan*	*Savanna*	*Mixed Herbaceous Scrub*	*Agricultural Field*	*Developed*
6	1	108 (43)	113 (45)	34 (13)	0	77 (31)	0	702 (284)
7	1	2.8 (1.1)	52 (21)	28 (11)	0	-	0	237 (95)
11	Chalan Lujan	1.9 (0.8)	77 (31)	7.5 (3)	0	5.0 (2)	0	75 (30)
12	15	6.5 (2.6)	97 (39)	15 (6)	0	7 (2.8)	0	56 (22)
13	1	0	71 (28)	17 (6.9)	0	0	0	134 (54)
14	1	0	47 (19)	0	0.4 (1.6)	0	0	94 (38)
15	1	0	7 (2.8)	7.6 (3.1)	0	0	0	221 (89)
16	8	0	15 (6)	16 (6)	0	0	0	253 (102)
17	8	0	19 (7)	24 (9)	0	0.4 (0.2)	0	224 (90)
18	16	0	10 (4)	8.8 (3.6)	0	-	0	123 (49)
19	16	0	23(9)	10 (4)	0	2.6 (1.1)	0	167 (67)
20	16	0	8.4 (3.4)	23 (9)	0	55 (22)	0	211 (85)
21	27	0	18 (7.3)	3.5 (1.4)	0	0	0.7 (0.3)	186 (75)
28	27	5.2 (2.1)	90 (36)	10 (4)	0	4.2 (1.7)	0	317 (128)
29	25	0	72 (29)	15 (6)	0	0	0	177 (71)
30	10	0	53 (21)	1.1 (0.4)	0	0.4 (0.2)	0	212 (85)
31	8a	0	0.3 (0.1)	55 (22)	0	56 (23)	0	133 (53)
32	15	232 (93)	182 (73)	278 (112)	0	79 (32)	0	527 (213)
33	1	2.8 (1.1)	112 (45)	38 (15)	0	0	0	748 (302)
36	15	111 (44)	84 (34)	41 (16)	0	10 (4)	0	90 (36)
63	16	0	23 (9)	10 (4)	0	2.6 (1.1)	0	167 (67)
74	8a	0	0.3 (0.1)	55 (22)	0	56 (23)	0	133 (53)
	Total	**470 (190)**	**1,386 (475)**	**697 (282)**	**0.4 (1.6)**	**397 (143)**	**2.3 (0.3)**	**5,187 (2,099)**

Wildlife – Native Species

Because of the presence of non-native species (e.g., predators, ungulates, and plants), the disturbed limestone forested areas within the BRSA do not currently support resident native bird species. These areas, however, do contain potential forage for future recovery of native forest birds.

Based on project-specific surveys in areas of the Route 15 realignment BRSA, and the generally degraded habitat throughout the entire BRSA, reptiles present would include the blue-tailed skink and the mourning gecko. Predation by BTS is a limiting factor for native reptiles. These species are described earlier in this chapter for discussions of wildlife within the Central Region of this EIS/OEIS.

Although numerous native butterflies potentially occur within the BRSA, the blue-banded king crow has been observed most frequently. Other butterflies may be limited by herbivory on nurse plants by Philippine deer and other habitat degradation associated with feral pigs.

Wildlife – Non-Native Species

Non-native bird species within the BRSA of the proposed road projects for the Central Region may include the black francolin, island collared dove, black drongo, Eurasian tree sparrow, and feral chickens associated with residences to the west of the Andersen South parcel.

Feral and domesticated cats and dogs, rats, Philippine deer, and feral pigs are known to inhabit the Central Region for the proposed GRN projects. Ungulate impacts are well evidenced within the area for the proposed relocation of Route 15. Extensive pig wallows and rooting of vegetation directly impact native vegetation and cause secondary impacts such as facilitating invasive weed encroachment, reducing or

eliminating recruitment of emergent tree species, and erosion of top soil. Non-native ungulates also facilitate the spread of invasive species through ingestion and subsequent defecation of seed material.

Curious skink, house gecko, greenhouse frog, and cane toads were observed within the Andersen South parcel during recent surveys in support of this EIS/OEIS. These species are likely to occur within the BRSA for the proposed Route 15 relocation site, as well as BTS.

The most common and easily observed invertebrates include a snail and the blue-banded king crow butterfly. Traps for the coconut rhinoceros beetle are seen occasionally along the existing road corridors. A recent outbreak of this non-native beetle that destroys coconut trees has occurred on Guam.

ESA- and Guam-Listed Species

The only Special-status Species associated with the Central Region BRSA for the proposed road improvements include the Mariana fruit bat, Mariana crow, and Pacific slender-toed gecko (Table 10.1-18). These species are not expected to occur within the BRSA; however, some elements of the vegetation communities (i.e., foraging, nesting, roosting tree species) may be important to ongoing and future recovery efforts for this species. There are no designated habitat areas such as essential habitats (i.e., formerly proposed critical habitat designations), recovery zones, or Overlay Refuge identified within the BRSA for proposed roads within the Central Region.

Table 10.1-18. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species within the Central Region for the Proposed GRN Projects

Common Name	*Status**		*Occurrence in the BRSA*
	ESA	*Guam*	
MAMMALS			
Mariana fruit bat	T	E	Not known to occur although may occasionally fly through the area or forage in individual trees; no essential habitat designated
BIRDS			
Mariana crow	E	E	Does not occur; no essential habitat
Guam Micronesian kingfisher	E	E	Does not occur; no essential habitat
REPTILES			
Moth skink	-	E	Not found in central Guam in recent surveys; last reported occurrence is at Haputo Beach area.
Pacific slender-toed gecko	-	E	Not documented and not likely to be present due to degraded habitat.
INVERTEBRATES			
Mariana eight-spot butterfly	C	-	Not known to be present; forested habitat with host plants that typically occur on karst are absent.
Guam tree snail	C	T	Not known to be present and unlikely because of degraded habitat and limited current distribution of these species.
PLANTS			
Heritiera longipetiolata	-	E	Unlikely to be present because of disturbance and degraded condition of the vegetation; small populations of *H. longipetiolata* are found in karst areas of Pati Point and in the non-DoD lands south of Route 15 area near Andersen South.

Legend: *C = candidate, E = endangered, T = threatened.
Sources: COMNAV Marianas 2001, GDAWR 2006, Andersen AFB 2008a.

10.1.4 Apra Harbor

10.1.4.1 Naval Base Guam

Vegetation Communities

Acreages are listed in Table 10.1-19 while Figure 10.1-23 depicts the cover types within the boundaries of Naval Base Guam as mapped in the 2001 Navy INRMP (COMNAV Marianas 2001).

Table 10.1-19. Vegetation Communities at Naval Base Guam

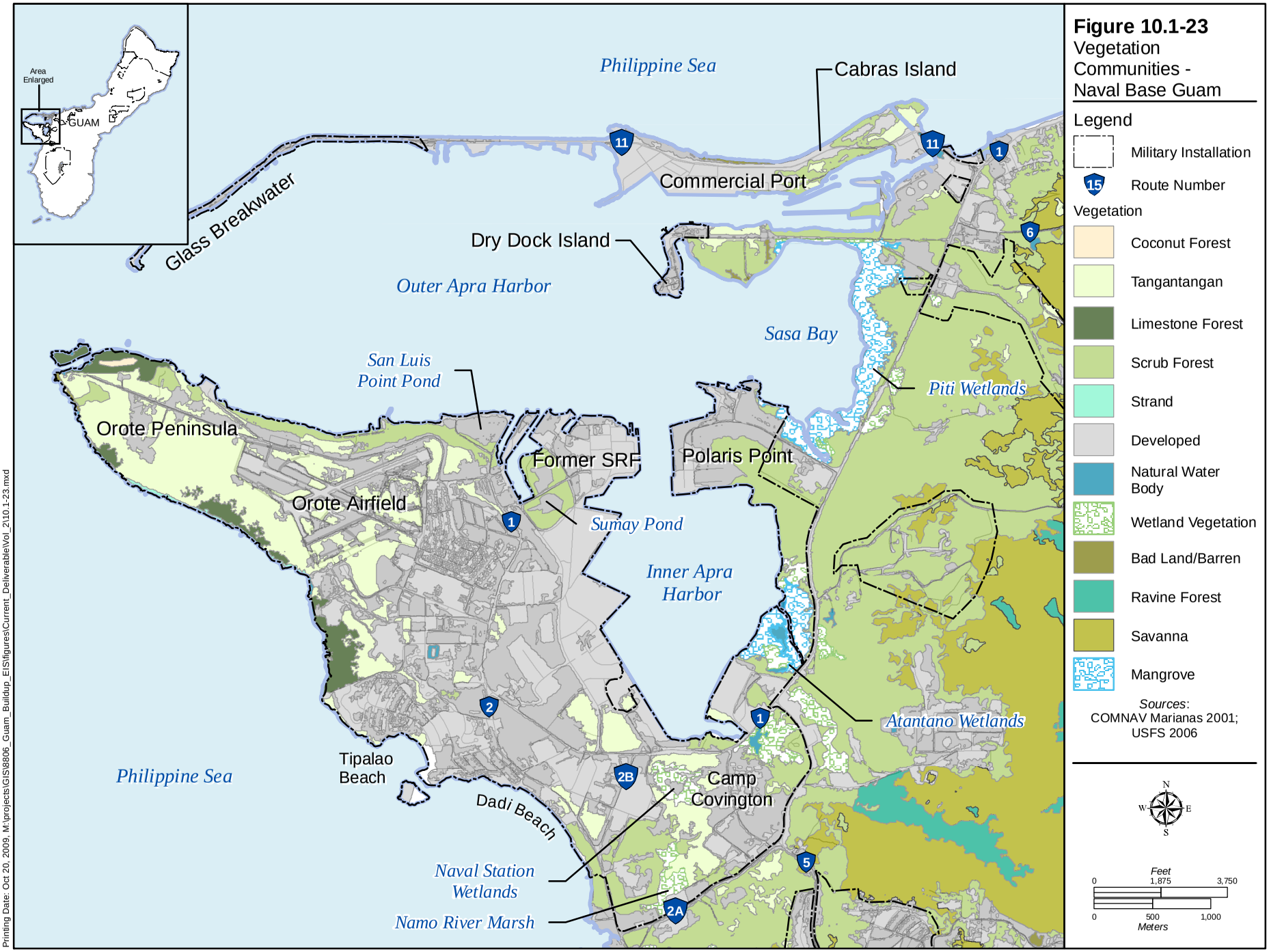
Vegetation Type	*ac (ha)*
Developed	2,106 (852)
Tangantangan	620 (251)
Scrub forest	353 (143)
Limestone forest	86 (35)
Mangrove	53 (21)
Strand	12 (4.9)
Coconut forest	3.8 (1.5)
Wetlands	3.8 (1.5)
Badland/barren	2.1 (0.8)

The Navy established the Orote Peninsula ERA in 1984 as a mitigation measure for the construction of Kilo Wharf. The Orote ERA includes submerged lands from the shoreline to a depth of 120 ft (36.6 m), and it extends inland from the mean lower low water line to the upper edge of the cliff along the southwestern edge of Orote Peninsula. The terrestrial unit of this ERA totals about 30 ac (12 ha), and the submerged lands total about 133 ac (54 ha) (COMNAV Marianas 2001).

There are numerous non-native species commonly found in the forests of the Orote Peninsula. They are common because the forest is short and open, and therefore more susceptible to invasion by non-natives. An alternative explanation could be that Orote, being highly disturbed, has a high store of non-natives to invade the cliff forests. Other factors may also influence the number of non-native species on Orote peninsula. Notable among the non-native species are *Carica papaya*, *Chromolaena odorata*, *Leucaena leucocephala*, *Passiflora foetida*, and *Antigonon leptopus* (USFWS 1986b).

Much of the terrestrial area of Naval Base Guam is vegetated with communities that have undergone previous disturbance (e.g., disturbed limestone forest, disturbed ravine forest, and urban/maintained). Limestone communities are limited to the cliff area on Orote Peninsula. A narrow band of halophytic/xerophytic scrub communities exists on cliff faces on Orote Peninsula (COMNAV Marianas 2001).

Mangroves are present along the east side of Apra Harbor. These mangroves and associated wetlands include the following plant species: *Rhizophora mucronata*, *Bruguiera gymnorhiza*, *Avicennia* spp., *Lumnitzera coccinea*, *Heritera littoralis*, *hibiscus*, and *giant swamp fern* (COMNAV Marianas 2001).



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Wildlife – Native Species

Birds

Common migratory seabird species seen on or in the vicinity of Naval Base Guam include brown noddy, white tern, and brown booby. Brown noddies nest and roost on steep cliffs and on rocky offshore islets. There is a nesting colony of brown noddies located on Orote Island just off the end of Orote Peninsula. This species also nests on Adotgan Rock north of Orote Peninsula (COMNAV Marianas 2008a). Numerous other migratory birds also use the wetland and mangrove areas of Apra Harbor for resting and feeding including Pacific reef heron, little egret, intermediate egret, and great egret. The indigenous yellow bittern and Pacific reef heron utilize food resources within the Apra Harbor shoreline areas. Historically, a breeding population of the Pacific reef heron occurred on Orote Peninsula (GDAWR 2006). The Pacific reef heron, along with the brown booby and white-tailed tropicbird are listed as SOGCN (GDAWR 2006). Exposed tidal mudflats and estuarine banks provide seasonal foraging and loafing habitat to any number of migratory avian species. Annual migrants to Guam that occur at Naval Base Guam are Pacific golden plover, common greenshank, Mongolian plover, gray-tailed tattler, whimbrel, ruddy turnstone, and cattle egret (COMNAV Marianas 2008, Eggleston 2009, NR Survey Report in preparation).

Reptiles

During recent surveys conducted in support of this EIS/OEIS, three native reptile species were found within the forested areas of the Orote Peninsula, in the vicinity of Dadi and Tipalao beaches, and at Polaris Point: Pacific blue-tailed skink, mourning gecko, and mutilating gecko (NR Survey Report in preparation).

Invertebrates

Native land hermit crabs and coconut crabs are present on Orote Peninsula and in coastal and estuarine areas (COMNAV Marianas 2008).

Wildlife – Non-Native Species

Birds

Eurasian tree sparrow, island collared dove, and black francolin were observed at Naval Base Guam in forested areas during recent surveys in support of this EIS/OEIS (NR Survey Report in preparation).

Reptiles and Amphibians

During recent surveys conducted in support of this EIS/OEIS, four non-native reptile and one amphibian species were found within the forested areas of the Orote Peninsula, in the vicinity of Dadi and Tipalao beaches, and at Polaris Point: curious skink, house gecko, monitor lizard, BTS, and marine toad (NR Survey Report in preparation).

USDA Wildlife Services conducts trapping and removal of the BTS on Navy property. These efforts include the placement of BTS traps within the interior of the main base and around ports of exit and cargo facilities on Navy proper to reduce the local population of BTS that might be available as possible stowaways within outbound cargo.

ESA-Listed Species and Critical Habitat

There are seven ESA-listed or candidate species, that have either been observed, or suitable habitat is present on Naval Base Guam (Table 10.1-20 and Figure 10.1-24).

Table 10.1-20. Known or Potential Occurrence of ESA- and Guam-Listed and Candidate Species at Naval Base Guam

Common Name	*Status**		*Habitat*	*Occurrence on Naval Base Guam*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone and coastal forests, coconut plantations	Possible observation at Orote Peninsula in 2007.
BIRDS				
Mariana common moorhen	E	E	Freshwater wetlands	Wetlands in various locations.
Guam rail	E	E	Secondary habitats, also savanna and limestone forests	Extirpated but habitat present throughout.
REPTILES				
Green sea turtle	T	T	Suitable beaches and strand for basking or nesting	Successful nesting has been recorded from 2007 - 2009 at Orote Point.
Hawksbill sea turtle	E	E	Historical reference of suitable nesting beach	Possible historic nesting at Sumay Cove.
INVERTEBRATES				
Marianas eight-spot butterfly	C	-	Limestone forest with host plants	Documented on Orote Peninsula
Guam tree snail	C	T	Intact limestone forest	Not documented on Naval Base Guam. Forested areas are not suitable for this species because of habitat degradation
PLANTS				
Heritiera longipetiolata	-	E	Limestone forest	Present along north and south coast of Orote Peninsula

Legend: T = threatened; E = endangered; C = candidate.
Sources: COMNAV Marianas 2001, 2008; GDAWR 2006; Brooke 2008.

Mariana Fruit Bat

The Mariana fruit bat is not typically observed at Naval Base Guam. However, a possible observation of a fruit bat was made in 2007 (Brooke 2008).

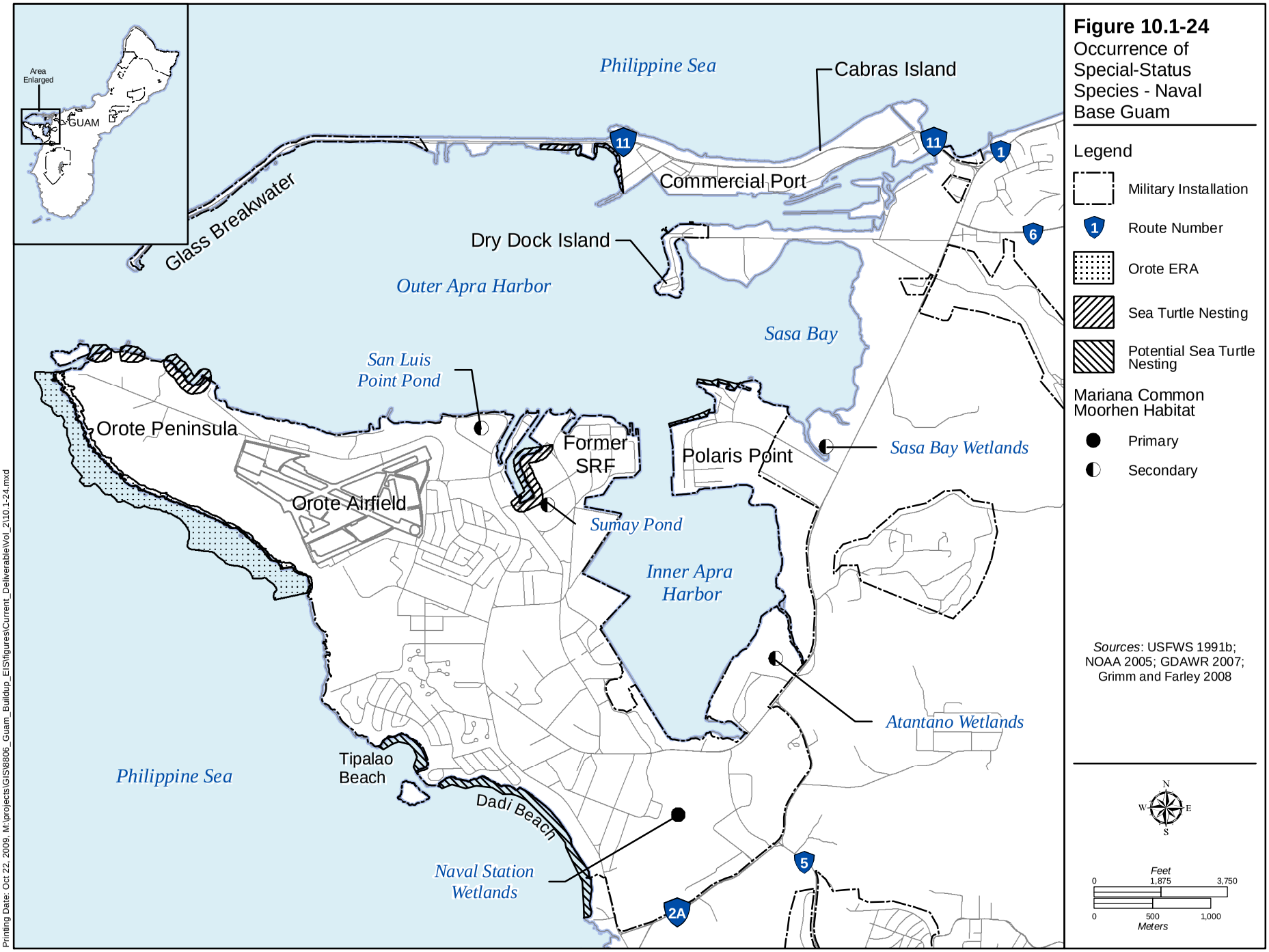
Mariana Common Moorhen

The moorhen utilizes a number of wetland habitats on Naval Base Guam, including wetlands associated with Camp Covington, Sumay Pond, and San Luis Point Pond. The Camp Covington wetlands are one of the main habitat areas for the moorhen, in addition to Agana Marsh and Fena Valley Reservoir.

Primary moorhen habitat is also present at the Camp Covington (Navy) wetlands located south of Apra Harbor, and secondary moorhen habitat is located at wetlands northwest and southeast of the Sumay inlet and in the Atantano wetland (non-Navy) east of the inner harbor (refer to Figure 10.1-24) (USFWS 1991b).

Guam Rail

This species is extirpated but habitat exists in some areas of the Overlay Refuge into which the species could be reintroduced.



Green and Hawksbill Sea Turtles

The Navy, in cooperation with the USFWS and GDAWR, monitors sea turtle nesting on Navy lands throughout the sea turtle nesting season. In June 2007, GDAWR and Navy Natural Resources staff confirmed five sea turtle nests on Orote Peninsula. Four nests were excavated for nest contents (counting unhatched eggs and shells). There was an estimated range of 73-97 eggs hatched with an estimated hatch success of 95%. Nesting activity continued at this beach in 2008 (Grimm and Farley 2008) and 2009 (A. Brooke, pers comm.). A reported nesting occurrence by a hawksbill sea turtle was documented on a small cobble and sand beach near the mangroves within the Sumay inlet; nesting has not been confirmed since 1995 (COMNAV Marianas 2001).

Mariana Eight-Spot Butterfly

One population of the Mariana eight-spot butterfly has been reported on Orote; the specific location was not given (Scheiner and Nafus 1996, as cited in USFWS 2007b).

Guam-Listed Species

Six Guam-listed threatened or endangered species have been observed, or habitat is present for them, on Naval Base Guam (see Table 10.1-20 and Figure 10.1-24). Those species that are also dually listed under the ESA are discussed above. *Heritiera longipetiolata* is widespread on Orote Peninsula along the north and south coasts, and a total of 142 trees were counted in 2000 (Wiles 2005 as cited in COMNAV Marianas 2007).

10.1.4.2 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Roadway projects in the Apra Harbor Region of Guam include pavement strengthening, intersection improvements, and bridge replacements (on Route 1). The BRSA for the proposed roadway projects at Apra Harbor Region is shown in Figure 10.1-25.

Vegetation Communities

Vegetation communities identified within the Apra Harbor Region BRSA for proposed GRN projects are listed in Table 10.1-21. These communities are characterized by prior disturbance and monoculture or near monocultures of tangantangan, with some hibiscus. Wetland vegetation on consists of freshwater wetlands and mangrove areas.

Table 10.1-21. Vegetation Communities within the Proposed GRN Projects Boundaries in the Apra Harbor Region (ac [ha])

GRN #	*Route*	*Barren*	*Savanna*	*Tangantangan*	*Scrub Forest*	*Wetlands*	*Mangrove*	*Open Water*	*Developed*
4	11	5.0 (2.0)	0	14 (5.7)	43 (17)	0	0	1.7 (0.7)	183 (74)
24	1	0	0	0.7 (0.3)	269 (108)	40 (16)	62 (25)	3.2 (1.3)	141 (57)
26	2A	0	1.8 (0.7)	4.0 (1.6)	65 (26)	27 (11)	0	0	69 (27)
Totals		**5.0 (2.0)**	**1.8 (0.7)**	**19 (7.6)**	**377 (153)**	**67 (27)**	**62 (25)**	**4.9 (2.0)**	**393 (159)**

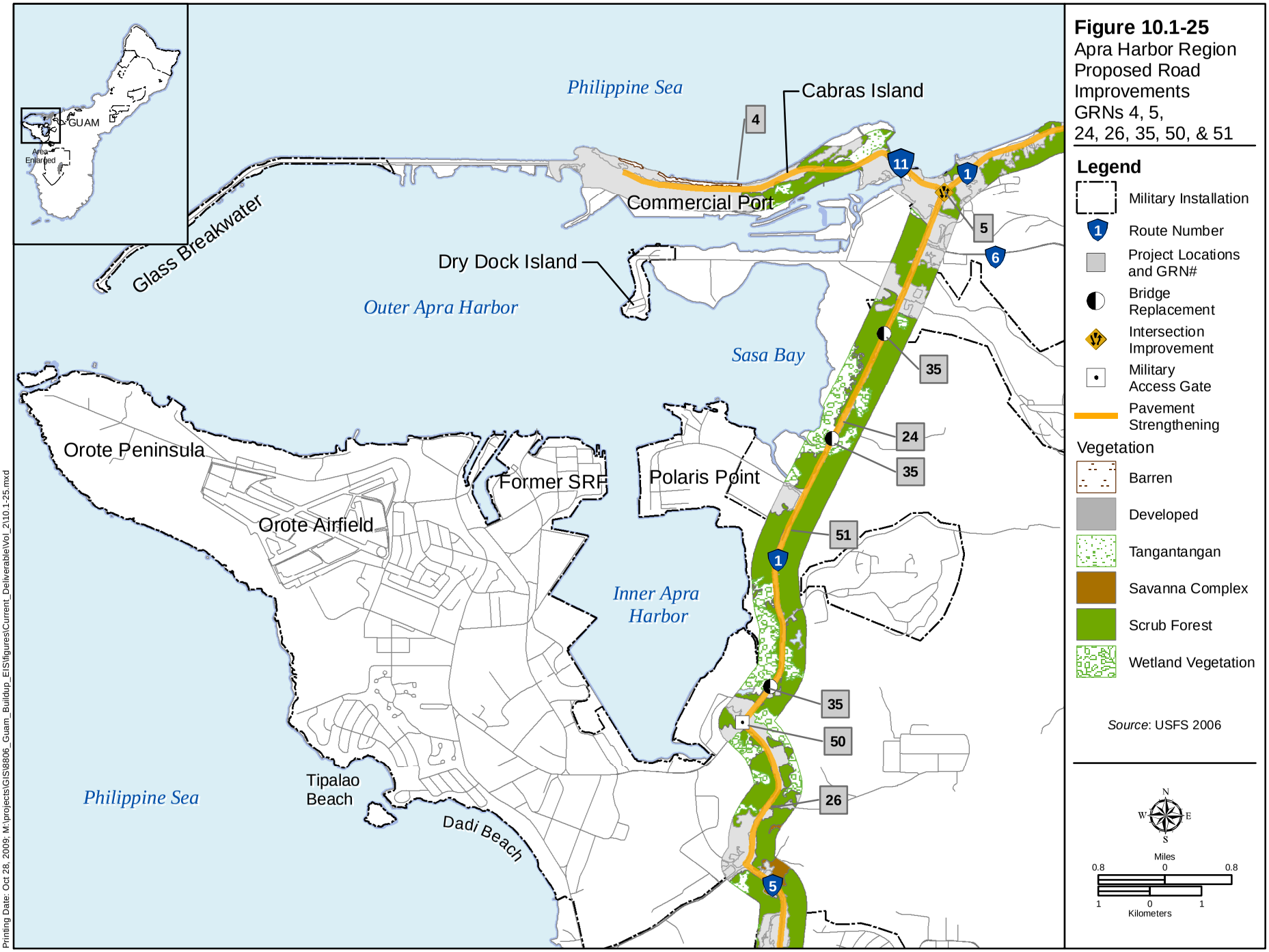


Figure 10.1-25
Apra Harbor Region
Proposed Road Improvements
GRNs 4, 5,
24, 26, 35, 50, & 51

Legend

- Military Installation
- Route Number
- Project Locations and GRN#
- Bridge Replacement
- Intersection Improvement
- Military Access Gate
- Pavement Strengthening

Vegetation

- Barren
- Developed
- Tangantangan
- Savanna Complex
- Scrub Forest
- Wetland Vegetation

Source: USFS 2006

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Wildlife

Wildlife present within the BRSA would be expected to be similar to that described previously for Navy Base Guam in Section 10.1.4.1.

ESA-Listed, Candidate and Guam-Listed Species

The only listed species (ESA and Guam) with habitat present in the Apra Harbor Region BRSA is the Mariana common moorhen, as indicated in Table 10.1-22. This bird species can be found in a variety of wetland habitats on Guam. No critical habitat has been proposed or designated for the Mariana common moorhen.

Table 10.1-22. Known or Potential Occurrence of ESA-listed, Candidate, and Guam-listed Species within the Apra Harbor Region BRSA for the Proposed GRN Projects

Common Name	*Status**		*Occurrence in the BRSA*
	ESA	*Guam*	
MAMMALS			
Mariana fruit bat	T	E	Not known to occur although may occasionally fly through the area or forage in individual trees; no essential habitat designated
BIRDS			
Mariana common moorhen	E	E	Wetland habitats present that may be utilized by this species
REPTILES			
Green sea turtle	T	T	Suitable nesting beaches not present
Hawksbill sea turtle	E	E	Suitable nesting beaches not present
INVERTEBRATES			
Guam Snail	C	T	Not known to be present and unlikely because of degraded habitat and limited current distribution of these species

Legend: *E = endangered, T = threatened, C = candidate.
Sources: GDAWR 2006, COMNAV Marianas 2001.

10.1.5 South

10.1.5.1 Naval Munitions Site

Vegetation Communities

The NMS contains some of Guam's most remote, inaccessible terrestrial habitat. Figure 10.1-26 depicts the vegetation communities within the boundaries of the NMS as mapped by the USFS (2006a) and acreages are listed in Table 10.1-23. Based on mapping in the 2001 INRMP (COMNAV Marianas 2001) and from recent field surveys (NR Survey Report in preparation), *Merrilliodendron*-dominated limestone forest communities were overlaid on USFS mapping.

Table 10.1-23. Vegetation Communities at NMS

Vegetation Type	*ac (ha)*
Ravine forest	3,673 (1486)
Savanna	2,677 (1083)
Limestone forest	1,390 (563)
Developed	648 (262)
Badland/barren lands	24 (9.7)
Scrub forest	19 (7.7)
Merrilliodendron forest	6.4 (2.6)

The NMS has diverse vegetative communities that include ravine forest, disturbed ravine forest, limestone forest, *Merrilliodendron* forest, savanna, wetland, coconut grove, and urban/developed. Fosberg (1960) classified the forest vegetation in valleys and ravines in southern Guam as ravine forests.

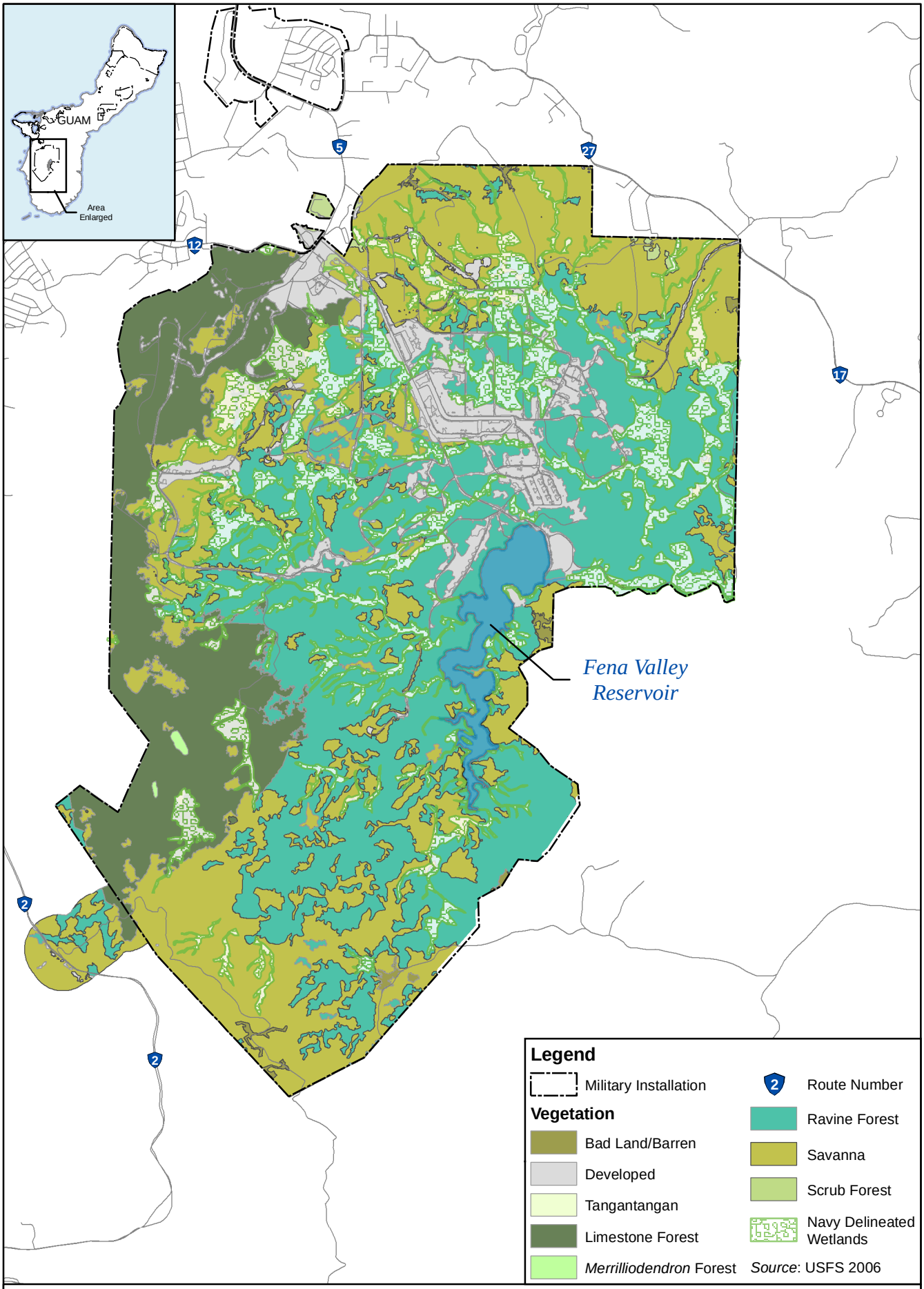

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Figure 10.1-26
Vegetation Communities - Naval Munitions Site

Although the floristic composition of the ravine communities can be similar to limestone communities, these forests are generally quite variable in floristic composition. They are located on volcanic soils or on argillaceous limestone soils. The ravine forest communities are abundant, occupying much of the south central portion of the NMS. Savannas, which are defined as grasslands with scattered trees or clumps of trees, cover extensive areas in southern Guam. Savannas are predominately found on volcanic soils (COMNAV Marianas 2001).

The Sadog Gago River valley was previously reported to be relatively pristine and may comprise the least disturbed ravine forest ecosystem left on Guam, to be valued as a botanical refuge and water resource (M&E Pacific 1998). However, a recent transect survey within the Sadog Gago River valley found a highly degraded ravine forest community dominated by the invasive *Vitex* in the canopy (NR Survey Report in preparation). Many other ravine forests are dominated by non-native woody species with a more open canopy. The floristic composition represents subclimax seral stages following human-induced disturbance, such as agriculture or clearing. *Vitex*, *Calophyllum inophyllum*, ilangilang, and allspice are common components of disturbed ravine forest on Navy lands (COMNAV Marianas 2001).

The fern *Ophioglossum pendulum* was found in the area of the Almagosa River mouth at Fena Reservoir and the uncommon fern *Asplenium unilateral* was reported as abundant on wet cliff faces here (M&E Pacific 1998).

NMS also has the largest extent of interior limestone communities on Navy lands. These limestone communities persist on the ridge tops and upper slopes from Mount Lamlam northward to Mount Alifan. The moist forests in limestone areas such as Mt. Almagosa contain wetter *Merrilliodendron*-dominated sites, rare trees such as *Psychotria hombroniana*, *Pisonia umbellifera*, *Fagraea berteriana* and the shrub, *Maesa walker*, as well as an undescribed species of *Rhaphidophora* in the Araceae family (M&E Pacific 1998).

According to surveys conducted in 1987 (NAVFAC Pacific 1989) and 1997 (M&E Pacific 1998), many rare, but unlisted species occur on NMS. The fern *Thelypteris warburgii* occurred along the Bonya, Maemong, Tolaeyuus and Maagas rivers and is found in few other locations. *Histiopters incisa* is a very rare fern found only where the Imong River joins the Sadog Gago River. Orchids such as *Eria rostriflora*, *Coelogyne guamensis*, and *Nervilia platychila* have been found on Guam only on NMS. Species such as *Fagraea berteriana* and *Pisonia umbellifera* occur only on the high limestone slopes of the NMS (NAVFAC Pacific 1989).

Wildlife – Native Species

Birds

Migratory birds observed in project-specific studies include the yellow bittern, white tern, grey-tailed tattler, and Pacific golden plover (NR Survey Report in preparation). A total of 34 species were noted in a summary of incidental observations of migratory shorebirds and waterbirds at Fena Lake and the rest of the NMS by GDAWR biologists from March 1987 to March 1996 (USFWS 1996). These included yellow bittern, Pacific golden plover, and a number of sandpiper, duck, egret, and heron species. Other information on migratory birds for the NMS area is found in the National Audubon Society's Christmas Bird Counts for southern Guam (National Audubon Society 2008). From1999 through 2005, a total of 54 species of birds have been reported, of which 35 species are protected under the MBTA. Ospreys have also been observed at Fena Reservoir (GDAWR 2000a).

Reptiles

During surveys conducted in support of this EIS/OEIS, four native reptile species were found within the forested areas of the NMS: Pacific blue-tailed skink, mourning gecko, mutilating gecko, and moth skink (a Guam-listed species discussed below) (NR Survey Report in preparation).

Freshwater Invertebrates and Fish

The NMS contains large areas of freshwater habitats. Nine streams traverse portions of the site: Talisay, Maemong, Bonya, Mahlac, Maagas, Maulap, Almagosa, Sadog gago, and Imong rivers. Guam's freshwater ecosystems have not been studied in detail. Indigenous freshwater fish found on Guam are amphidromous, moving between saltwater and freshwater during their life cycles. Guam stream fauna recorded during surveys on NMS include the species listed in Table 10.1-24. All the fish are amphidromous (i.e., fish which move between fresh and salt water during some part of life cycle, but not for breeding). The Tahitian prawn, marbled eel, flagtail and one goby species are designated as SOGCN (GDAWR 2006). Native eels have also been observed in Fena Reservoir (COMNAV Marianas 2001).

Table 10.1-24. Native and Non-native Aquatic Species Distribution in NMS Streams Based on Visual Surveys

Species or Group	*River*			
	Alamagosa	*Maulup*	*Sadog*	*Lost/Maagas (outside Fena watershed)*
Native Fish				
Marbled eel*	✓			
Guam goby	✓		✓	✓
Flagtail*				✓
Yellow tail rock-climbing goby				✓
Stiphodon spp. (goby)*	✓			✓
Non-native Fish				
Peacock bass				✓
Walking catfish				✓
Bighead catfish				✓
Mosquito fish				✓
Snappers				✓
Tilapia	✓		✓	✓
Native Invertebrates				
Freshwater prawn*	✓	✓	✓	✓
Neritina pulligera (nerite snail)*				✓
Stenomelania plicaria (thiarid snail)*				✓
Atyoida sp. and *Caridina* sp. (shrimp)*				✓
Varunid *crabs**				✓

Notes: *SOGCN.
Sources: GDAWR 2000b; NR Survey Report in preparation.

Wildlife – Non-Native Species

Birds

Non-native bird species observed at NMS during recent surveys in support of this EIS/OEIS include, island collared dove, black francolin, and black drongo (NR Survey Report in preparation).

Mammals

Asiatic water buffalo, locally called carabao, are large ungulates introduced to Guam in the 1600s by European settlers. The population of feral carabao on the NMS was estimated at approximately 300

animals as of 2001 (COMNAV Marianas 2001). The feeding and wallowing habits of the carabao have resulted in extensive accelerated soil erosion. These animals also produce large amounts of fecal material in and around the shores of Fena Reservoir, which raises water quality concerns. Between 1999 and 2003 the Navy, in cooperation with USFWS and GDAWR, administered an immunocontraception drug (PZP) to female carabao with the intent of reducing their fertility on the NMS (COMNAV Marianas 2003). The immunocontraception program was supplemented with a calf adoption program, and the number of calves declined 58% between 2001 and 2003; however, the population continued to increase.

Philippine deer inhabit limestone, ravine, and savanna plant communities. Spotlight surveys on the NMS in 1998 and 1999 counted 41 deer/mile surveyed (COMNAV Marianas 2001). Feral pigs inhabit similar habitat as Philippine deer. No abundance estimates have been made for pigs on the NMS. Severe damage due to pig rooting was observed in one area, and lesser damage in other areas was observed during recent surveys on the NMS (NR Survey Report in preparation).

Reptiles and Amphibians

During recent surveys conducted in support of this EIS/OEIS, two non-native reptile and four amphibian species were found within the forested areas of the NMS: curious skink, house gecko, marine toad, eastern dwarf tree frog, crab-eating frog, and Gunther's Amoy frog (NR Survey Report in preparation).

USDA Wildlife Services conducts trapping and removal of the BTS on Navy property. These efforts include trapping for protection for the federally endangered Mariana swiftlet (*Aerodramus bartschi*) within NMS.

Freshwater Invertebrates and Fish

Non-native crustaceans in Fena Reservoir include the shrimp *Atyoida pilipes* and *Caridina* sp. Several fish species were introduced into Fena Reservoir between 1956 and 1968 by GDAWR (NAVFAC Pacific 1989). The introduction of various cichlid fishes, including the tilapia (see Table 10.1-24), the sport fish Peacock bass, and small mouth bass, into Fena Reservoir and indirectly into the connected rivers potentially poses a threat to indigenous and endemic species. Introduced turtles and frogs have also been observed in Fena Reservoir (COMNAV Marianas 2001). Documented non-native species in the Lost/Maagas River system are listed in Table 10.1-24.

ESA-listed and Candidate Species

Eleven ESA-listed or candidate species have either been observed at NMS, or suitable habitat is present (Table 10.1-25). The majority of the NMS is also included as Overlay Refuge lands (refer to Figure 10.1-3).

Table 10.1-25. Known or Potential Occurrence of ESA-listed, Guam-listed, and Candidate Species at NMS

Common Name	*Status**		*Habitat*	*Occurrence at NMS*
	ESA	*Guam*		
MAMMALS				
Mariana fruit bat	T	E	Limestone forest, coastal forest, and coconut plantations	Known to be present; essential habitat present

Common Name	*Status**		*Habitat*	*Occurrence at NMS*
	ESA	*Guam*		
BIRDS				
Mariana common moorhen	E	E	Freshwater wetlands	Fena Reservoir
Mariana swiftlet	E	E	Nests in caves; feeds in savannah and ravine forest	Three occupied caves with hundreds of birds
Mariana crow	E	E	All forests with a preference for native limestone forest	Recovery zones and essential habitat present
Guam Micronesian kingfisher	E	E	Forest and scrub, preference for native limestone forest	Essential habitat present
Guam rail	E	E	Secondary habitats, also savanna and limestone forests	Extirpated but habitat present
REPTILES				
Pacific slender-toed gecko	-	E	Forests	Observed during recent surveys
Moth skink	-	E	Forest areas with large tree trunks	Observed during recent surveys
INVERTEBRATES				
Marianas eight-spot butterfly	C	-	Limestone forest with host plants	Alamagosa sink
Guam tree snail	C	T	Intact limestone forest	One population known
Humped tree snail	C	E	Intact limestone forest	Not known from the area but habitat present
Fragile tree snail	C	E	Intact limestone forest	Not known from the area but habitat present
PLANTS				
Fire Tree	E	E	Limestone and ravine forests.	Not known from the area but habitat present
Heritiera longipetiolata	-	E	Limestone forest.	Not known from the area but habitat present
Cyathea lunulata	-	E	Wet ravines and drainage slopes of southern Guam	Present in ravine forest in 1989 and 1997 surveys

Legend: *T = threatened, E = endangered, C = candidate.
Sources: COMNAV Marianas 2001; GDAWR 2006; Brooke 2008; Smith et al. 2008; NR Survey Report in preparation.

Based on the 2002 proposed critical habitat, essential habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher occurs throughout the NMS (Figure 10.1-28) (USFWS 2002). In addition, most of the NMS outside of the operations area is designated as a Mariana Crow Recovery Zone (Figure 10.1-27) (USFWS 2005b).

Mariana Fruit Bat

The USFWS recovery plan for the Mariana fruit bat identified the Fena watershed as the largest single parcel of suitable habitat in southern Guam (USFWS 1990a). There were 26 confirmed sightings of fruit bats between 1984 and 1996 with many distributed from Mount Almagosa to East Tower. More recently, an estimated 5 to 20 individual Mariana fruit bats were thought to occur within the NMS/Upper Talofofo Watershed, and were assumed to be full time residents of the area, rather than migrants from the main Pati Point Colony at Andersen AFB in northern Guam (Morton and Wiles 2002). The USFWS (1996a) speculated that disturbance associated with illegal hunting may be inhibiting the establishment of a communal roost. Currently, fruit bats are only occasionally observed at NMS. During dawn and dusk

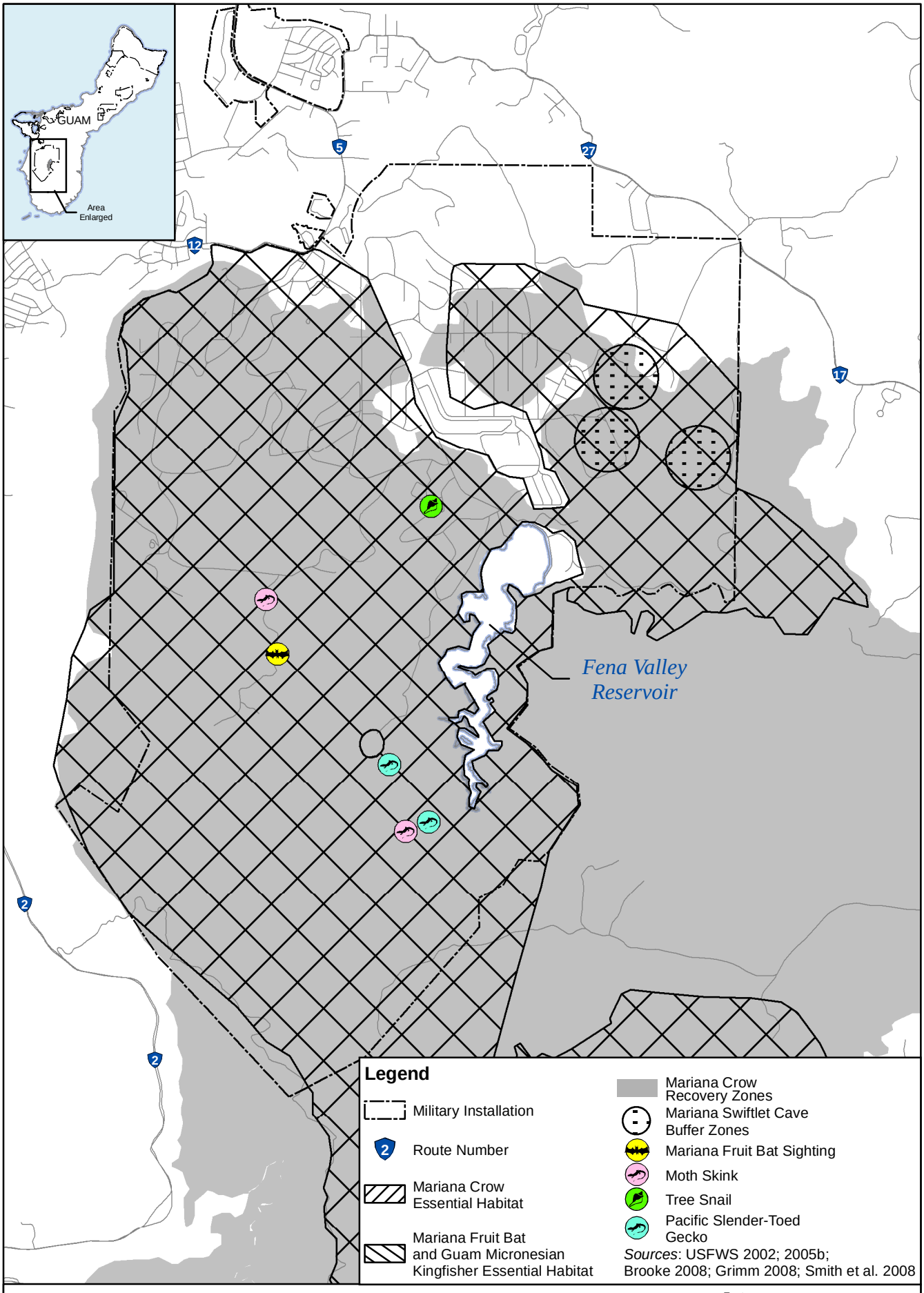

Figure 10.1-27
Occurrences of Special-Status Species and Essential Habitat and Recovery Zones of ESA-listed Species on or in the Vicinity of Naval Munitions Site

observations at 21 sites (NMS, Naval Base Guam, NCTS Finegayan, and Navy Barrigada) on 42 different days between February and July 2008, only one bat was sighted along Alamagosa Road (Brooke 2008).

Mariana Swiftlet

The NMS has a large population of the swiftlet within three occupied caves: Mahlac, Fachi, and Maemong (refer to Figure 10.1-27). Between 1984 and 1999, the estimated number of birds in Mahlac cave fluctuated between 150 and 500. Since 2002, the number of birds at Mahlac cave has increased to about 950 during the most recent count in 2008. Fachi cave has had no more than 100 birds present since the initial surveys in 1992. Birds using Maemong cave have increased from 4 individuals in 2004 to a breeding group of up to 100 (Grimm 2008). BTS predation is a frequent occurrence at the largest colony; only birds that nest and roost high on smooth walls and ceilings are difficult for the BTS to reach (Wiles et al. 2003).

Mariana Common Moorhen

The moorhen is a freshwater obligate species and inhabits emergent vegetation in freshwater marshes and ponds. On Guam, 90 birds are estimated to persist at three wetland sites (GDAWR 2006): Agana Marsh, Fena Valley Reservoir, and Camp Covington Wetlands. The largest concentration of this species was located on Fena Reservoir on the NMS (COMNAV Marianas 2001). During the dry season, most moorhens reside on Fena Reservoir because other wetland habitats are hydrologically intermittent (Takano and Haig 2004). Recently, conditions in the reservoir have changed causing the moorhen to find more suitable habitat elsewhere. Only a few birds have been recently sighted or heard, possibly because the submergent *Hydrilla* spp. is no longer found in the reservoir, and this provided forage and a base on which this species could walk. (Grimm 2008).

Guam Rail

This species is extirpated but habitat exists in some areas of the NMS into which the species could be reintroduced.

Tree Snails

Recent surveys of 15 sites on the NMS located two colonies of Guam tree snail at the Kitts Road Bonya River site (Smith et al. 2008); however, the previously reported fragile tree snail (USFWS 1996) was not found here again. Previous reports of Guam and humped tree snail colonies at Mt. Alifan in the late 1980s were not confirmed in the recent study, and are likely gone from Mt. Alifan (Smith et al. 2008). Shells of tree snails were found in abundance on the ground at all locations (USFWS 2007c).

Marianas Eight-Spot Butterfly

Marianas eight-spot butterflies were documented at the *Merrilliodendron* forest in Almagosa Basin, which was one of two sites identified in southern Guam (USFWS 1996).

Guam-Listed Species

Fourteen Guam-listed species have been observed or potential habitat is present on the NMS (refer to Table 10.1-25). Those species that are also listed under the ESA are discussed above.

Plants

The 1987 surveys (NAVFAC Pacific 1989) and the 1997 plant studies (M&E Pacific 1998) at the NMS noted the presence of the Guam endangered tree fern, or tsatsa (*Cyathea lunulata*), on the edge of or in ravine forests. Wildland fires were cited as potential threat because the species inhabits edges between

savanna and forest (M&E Pacific 1998). *Heritiera longipetiolata* was found on limestone near Mt. Lamlam and near the Almagosa Springs ridge (M&E Pacific 1998). Neither of these species was observed during recent plant surveys conducted in support of this EIS/OEIS (NR Survey Report in preparation).

Skinks and Geckos

Two Guam-listed species, the moth skink and the Pacific slender-toed gecko, were present in 1996 and both were reported in substantial numbers (202-810/ac [500-2,000/ha]). The gecko, detected in 1996 on Guam for the first time since WWII, was found only in the southern part of the NMS, whereas the skink was found throughout (USFWS 1996). Recently, both the moth skink and Pacific slender-toed gecko were observed on transects within the limestone and ravine forests of the NMS during recent surveys conducted in support of this EIS/OEIS (NR Survey Report in preparation).

10.1.5.2 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The South Region proposed GRN projects are shown in Figure 10.1-28.

Vegetation Communities

Vegetation communities identified within the BRSA for the South Region proposed GRN projects are listed in Table 10.1-26. Mapped wetlands within the BRSA consist of palustrine and estuarine marshes and mangroves (USFS 2006).

Table 10.1-26. Vegetation Communities within the Proposed South Region GRN Projects (ac [ha])

GRN #	*Route*	*Savanna*	*Scrub Forest*	*Tangantangan*	*Wetlands*	*Developed*
25	5	28 (11)	93 (38)	3.4 (1.4)	0	106 (42)
27	5	59 (24)	33 (13)	0	0	8.4 (3.4)
110	2	0	22 (9)	0	10 (4)	77 (31)

Wildlife

The BRSA for the proposed GRN projects within the South Region contain heavily disturbed scrub areas and areas of developed land and savanna. Based on comparison with other similar habitat on Guam, these habitats are not likely to support native wildlife vertebrate species other than common species such as the yellow bittern. The wetland area may also contain additional native migratory species. Surveys have not been conducted in this area but it is likely to be typical of other small wetlands in the area and any bird species present are likely to be common species. Other wildlife present would be typical of disturbed areas and may contain several species of native reptiles including the Pacific blue-tailed skink, mourning gecko, and mutilating gecko.

ESA- and Guam-Listed Species

The only listed species potentially found within the South Region BRSA is the Mariana common moorhen, as indicated in Table 10.1-27. This species is a wetland bird that can be found in a variety of wetland habitats on Guam. No critical habitat has been proposed or designated for the Mariana common moorhen.

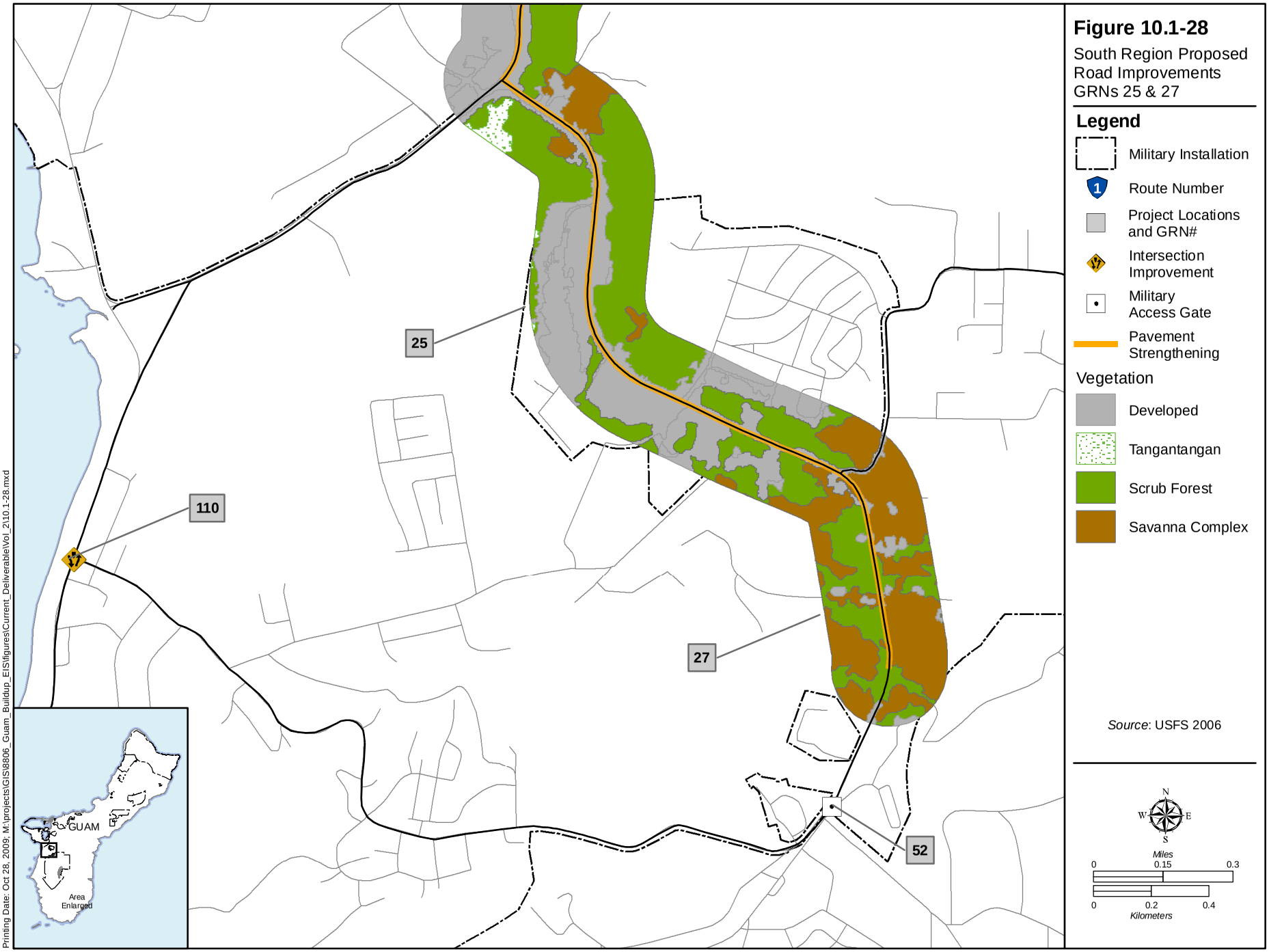
25
110
27
52
GUAM
Area Enlarged
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Figure 10.1-28
South Region Proposed Road Improvements GRNs 25 & 27
Legend
Military Installation
Route Number
Project Locations and GRN#
Intersection Improvement
Military Access Gate
Pavement Strengthening
Vegetation
Developed
Tangantangan
Scrub Forest
Savanna Complex
Source: USFS 2006
N
W
E
S
Miles
0
0.15
0.3
0
0.2
0.4
Kilometers

Table 10.1-27. Known or Potential Occurrence of ESA-listed, Guam-listed, and Candidate Species within the Proposed South Region GRN Projects

Common Name	*Status*		*Occurrence in the BRSA*
	ESA	*Guam*	
Birds			
Mariana common moorhen	E	E	Presence of wetlands present that may be used by this species.
Invertebrates			
Guam tree snail	C	T	Not known to be present and unlikely because of degraded habitat and limited current distribution of these species.

Legend: E = endangered, T = threatened, C = candidate.
Sources: COMNAV Marianas 2001; GDAWR 2006.

10.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

10.2.1 Approach to Analysis

10.2.1.1 Methodology

Biological resource issues and concerns include the potential direct, indirect, and cumulative impacts of the proposed action and alternatives during the construction and operation phases. Impacts may be either temporary (reversible) or permanent (irreversible). Direct and indirect impacts are distinguished as follows.

Direct impacts are associated with proposed construction activities (e.g., ground-disturbing activities) and operations (e.g., aircraft overflights and range use). Potential types of direct impacts include, but are not limited to:

- Loss of habitat due to vegetation removal during construction and potential wildfires from training activities.
- Temporary loss of habitat during construction from noise, lighting, and human activity.
- Potential loss of habitat due to increased noise from operations, including proposed aircraft activities, or training range usage.Injury or mortality to wildlife or special-status species caused by the action that occur at the same time and place as the action.

Indirect impacts are caused by or result from project-related activities, are usually later in time, and are reasonably foreseeable (e.g., increased likelihood of invasive species moving into the area after disturbance). Potential indirect impacts include, but are not limited to:

- All disturbances from human activity, noise, and lighting that would potentially impact unoccupied suitable habitat for special-status species.
- Introduction of new non-native species or increased dispersal of existing non-native species on Guam.

- Dispersal of existing non-native species from Guam to the CNMI, Hawaii, or other destinations.
- Increased threats from feral animals.
- Adverse effects from pollutants that are released from construction, military operations, or training.
- Adverse effects from wildfires.

Potential direct impacts of noise from aircraft operations and small arms ranges and munitions detonations were determined based on sound levels estimated from noise models. Potential direct and indirect impacts to species present and indirect impacts to unoccupied habitat (e.g., aircraft takeoff and landings, aircraft operations at maintenance or operations facilities, daily operations at facilities, and lighting disturbance) were determined based on the distances used by the USFWS in previous ESA formal consultations (e.g., ISR Strike BO) that were expected to cause disturbance to ESA-listed species (USFWS 2006). Within these distances or buffers, only undeveloped land was considered as suitable habitat. These buffers are as follows:

- Mariana fruit bat: roosting habitat within 492 ft (150 m) of aircraft ground operations; foraging habitat within 328 ft (100 m) from the activity. As the potential disturbance of roosting habitat is the greater of the two, the area within 492 ft (150 m) was used to determine the potential indirect impacts of the proposed construction and operation activities.
- Guam Micronesian kingfisher: foraging and nesting habitat within 328 ft (100 m) of proposed construction and ground and aircraft operations.
- Mariana crow: foraging and nesting habitat 984 ft (300 m) of aircraft ground operations and within 197 ft (60 m) of construction and general ground operations.
- Guam rail – unknown (no distances determined) (USFWS 2006).

General principles used to evaluate impacts are:

- The extent, if any, that the action would permanently lessen ecological habitat qualities that ESA-listed species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would diminish population sizes, distribution, or habitat of regionally important native plant or animal species.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any ESA-listed species.
- The extent, if any, that the action would be inconsistent with the goals of USFWS recovery plans, Navy and Air Force INRMPs, or the Guam CWCS.

10.2.1.2 Determination of Significance

Significance of impacts to vegetation, wildlife, and special-status species were determined using guidelines in the previous section. Special-status species are defined as ESA- and Guam-listed species and species that are designated candidates for ESA listing. Specific significance criteria are discussed below. If significant impacts are determined, then mitigation may be proposed to offset the impacts. For this EIS/OEIS, a major consideration for BMPs is biosecurity. This issue is discussed in detail with the evaluation of impacts (see Section 10.2.2.6).

Vegetation

Impacts would be determined significant if any primary limestone forest (mature forest dominated by

native species) would be cleared, unless determined to be very minor in the context of the surrounding forest areas. Any loss of this forest vegetation community would be considered significant because of the large historical and continuing losses of this forest type on Guam. Loss of wetland or mangrove vegetation would also be considered potentially significant.

Wildlife

Impacts would be determined significant if native wildlife species are present and the proposed project results in diminished population sizes or distributions of regionally important native animal species. These wildlife species include those designated as SOGCN in the Guam CWCS. Invasive species impacts that exceed the criteria specified above are evaluated. Historical impacts from non-native species have been severe, particularly from the BTS (see discussion in Section 10.1.1.2). Although the proposed action would not result in additional impacts from BTS on Guam, the concern is that the BTS would be inadvertently introduced to other islands throughout the Pacific. This concern is addressed comprehensively for all actions proposed in this EIS/OEIS with mitigation measures described in Section 10.2.2.6.

Migratory Birds

For migratory birds, the MBTA prohibits the taking, killing, or possession of migratory birds, with an exemption for military readiness activities (as defined in federal regulations) provided they do not result in a significant adverse effect on a population of a migratory bird species. Congress defined military readiness activities as all training and operations of the Armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (A) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (B) the operation of industrial activities; and (C) the construction or demolition of facilities used for a purpose described in A or B (50 CFR Part 21).

The DoD must consult with the USFWS if it is determined that a military readiness activity would have a significant adverse effect on a population of a migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem.

Migratory bird conservation relative to non-military readiness activities is addressed separately in a Memorandum of Understanding developed in accordance with EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. The Memorandum of Understanding between the DoD and USFWS was signed in July 2006 and DoD responsibilities included, but are not limited to: (1) incorporating conservation measures addressed in regional or state bird conservation plans and INRMPs; (2) managing military lands and activities other than military readiness in a manner that supports migratory bird conservation; and (3) avoiding or minimizing impacts to migratory birds, including incidental take and the pollution or detrimental alteration of the environments used by migratory birds.

The following species that occur on Guam are considered non-migratory birds and are not covered under the MBTA: black francolin, black drongo, Eurasian tree sparrow, island-collard dove (previously known as Philippine turtle dove), common pigeon, and king quail.

Special-Status Species

The presence of Special-Status species in the project areas was described in Section 10.1. Background information is presented in the species profiles in Appendix G. Impacts would be determined significant if special-status species are present in the project area and any project action is likely to result in harassment or harm of an individual, population or species. Impacts to ESA-listed species would include vegetation clearing of designated undeveloped Overlay Refuge habitat, or recognized essential habitat or recovery zones, unless it is determined that the removal of habitat or other affect is minor when considering all the remaining habitat and quality of habitat available to that species and considering USFWS recovery plan goals. Significant impacts would also include disturbing ESA- and Guam-listed species due to noise, lighting, or human activity. If species are currently present in a proposed project area, noise, lighting, and general human activity are considered direct impacts for the purposes of this analysis, even though it is recognized that some of the impacts from the proposed action may be indirect, rather than direct. If unoccupied but recognized habitat is affected by noise, lighting, or human activity, impacts would be considered indirect and would be determined significant unless the area affected is considered minor when considering all the remaining habitat and quality of habitat available to that species.

The baseline area for Overlay Refuge on Guam is 21,690 ac (8,778 ha) according to USFWS (2008d) with slight modifications made to correspond to the present NCTS-former FAA boundary (see Figure 10.1-2). The area of essential habitat, as directed by USFWS (USFWS 2009) is identical to the area proposed for critical habitat on Guam by the USFWS (2002), which is 24,802 ac (10,040 ha) for the Mariana fruit bat and Guam Micronesian kingfisher and 23,004 ac (9,309 ha) for the Mariana crow. The baseline Mariana crow recovery zone habitat on Guam based on the recovery plan is 35,360 ac (14,310 ha) (USFWS 2005b).

For ESA-listed species, federal agencies are required to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or its critical habitat. Analyses of potential impacts are based on review of plans for the proposed action and the available current and historical distributional data for each species. In accordance with section 7 of the ESA, a BA is being prepared by the Navy to analyze the potential impacts on ESA-listed and candidate species and critical habitat under the jurisdiction of the USFWS.

The BA and the subsequent BO issued by the USFWS after their review of the BA, would be the final determination of impacts to ESA-listed species that are being evaluated in this EIS/OEIS. Candidate species must also be evaluated in the BA, however if they are not formally listed by the time the BO is issued and the proposed action would not result in their listing, no determination for these species would be made in the BO. The BO would provide an Incidental Take Statement that would list the amount or extent of take anticipated. Based on that take it would specify Terms and Conditions that the action proponent must comply with to be exempt from the prohibitions of Section 9 of the ESA. These are non-discretionary requirements. The BO would also specify Conservation Recommendations that are discretionary proponent activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The USFWS effects determinations from the BO would be incorporated into the Final EIS/OEIS.

10.2.1.3 Issues Identified during Public Scoping Process

The terrestrial biological resource issues that were identified during the public scoping process include:

- Activities associated with the military expansion (i.e., construction, expansion, renovation projects, and military training activities) may result in habitat loss and physical disturbance of federally listed endangered species and other federally protected species.
- Potential for harm to fragile ecosystems on Guam and in the Marianas from the introduction of invasive species due to increased traffic among the islands from the movement of personnel and materials. Such species include the BTS, flatworms, various insects, and some plants. The EIS/OEIS should outline inspection and sanitary procedures to prevent this movement.
- Existing control and containment activities at air and sea ports for BTS are insufficient to deal with the risk associated with the increased cargo and personnel movement from Guam to other vulnerable destinations. The issue "of utmost concern" is BTS interdiction and an effective, enforceable, and fail-proof procedure for inspecting all military cargo, personnel, and equipment entering the CNMI must be instituted. The Navy must assure funding to sustain a 100% inspection rate of all cargo, vehicles, munitions, and household goods. Guam regulation protocols 505 and 506 should be incorporated into a BTS control plan to be included as part of the EIS/OEIS.
- Potential impact of placement of facilities on flora and fauna at Navy Barrigada.

10.2.2 Alternative 1

10.2.2.1 North

Andersen AFB

Construction

Vegetation. A total of 7.5 ac (3 ha) of primary limestone forest and 78 ac (32 ha) of disturbed limestone forest would be removed during proposed construction activities (Table 10.2-1 and Figures 10.2-1 and 10.2-2). The limestone forest that would be removed is classified by Andersen AFB as plateau/primary. The disturbed limestone forest that would be removed is classified as mixed limestone forest-plateau/secondary, including: *Ochrosia* edge (*Ochrosia mariannensis*; langiti), *Vitex*-closed canopy (*Vitex parviflora*), or *Vitex*-sparse canopy (see Figure 10.2-1). Because of historical and continued loss of primary limestone forest on Guam and the continued degradation of forest from invasive plant encroachment, the removal of this forest would be a significant impact. The vegetation to be removed serves as potential habitat for Special-status Species and is addressed below.

Table 10.2-1. Potential Impacts to Vegetation Communities at Andersen AFB with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Limestone Forest, Disturbed*	*Scrub*	*Developed*
Construction Areas (vegetation removed)				
North Ramp – ACE	7.1 (2.8)	16 (6.3)	15 (6.0)	177 (72)
South Ramp – Embarkation	0.4 (0.2)	4 (1.6)	4.5 (1.8)	24 (9.7)
Access Gate and Road	0	47 (19)	5.1 (2.1)	16 (6.4)
NWF – LZs	0	0	0	6.7 (2.7)
MSA – New Magazines	0	11 (4.5)	0	6.3 (2.5)
Total Area Removed	**7.5 (3.0)**	**78 (32)**	**25 (10)**	**230 (93)**

The limestone forest in the North Ramp ACE area contains individuals of *Tabernaemontana rotensis*, a species not listed as threatened or endangered, but considered a SOGCN (GDAWR 2006). Surveys in the ACE area identified two locations of *T. rotensis* with a total of several hundred saplings and one larger tree (UoG 2007; Figures 10.2-3 and 10.2-4). Surveys in the proposed new magazine area also identified *T.*

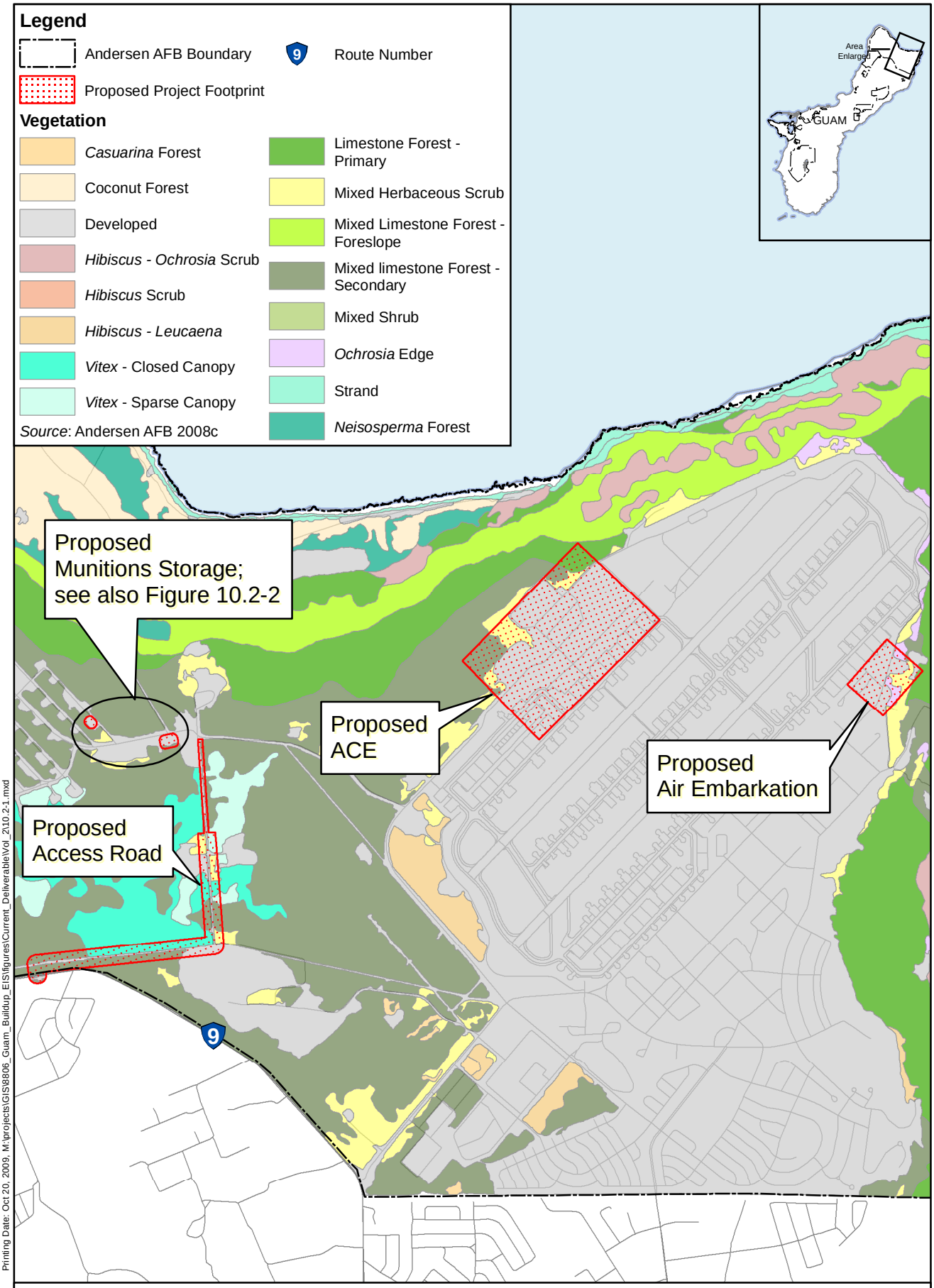

Figure 10.2-1
Potential Vegetation Impacts - Andersen AFB East

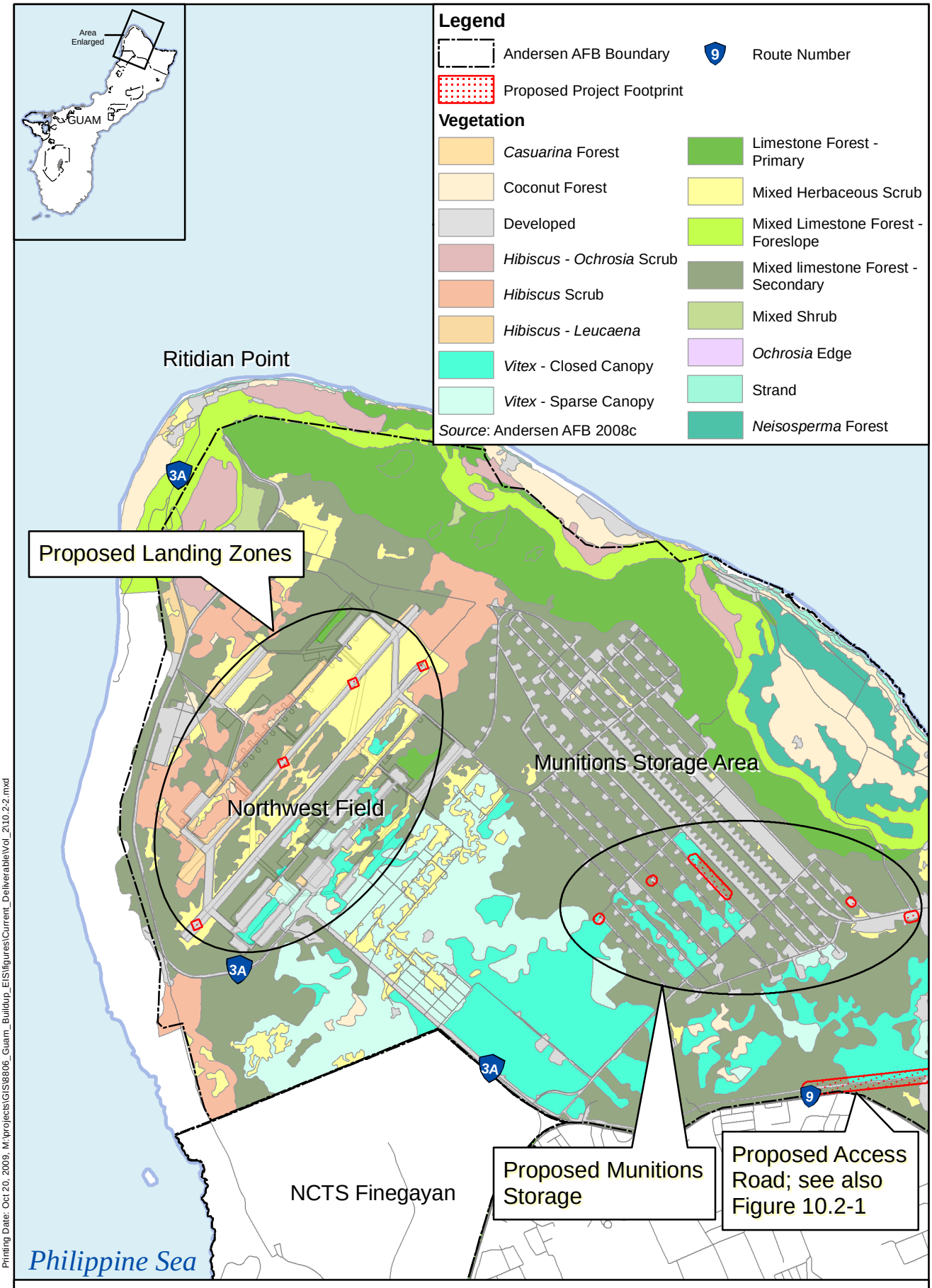

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Figure 10.2-2
Potential Vegetation Impacts - Andersen AFB West

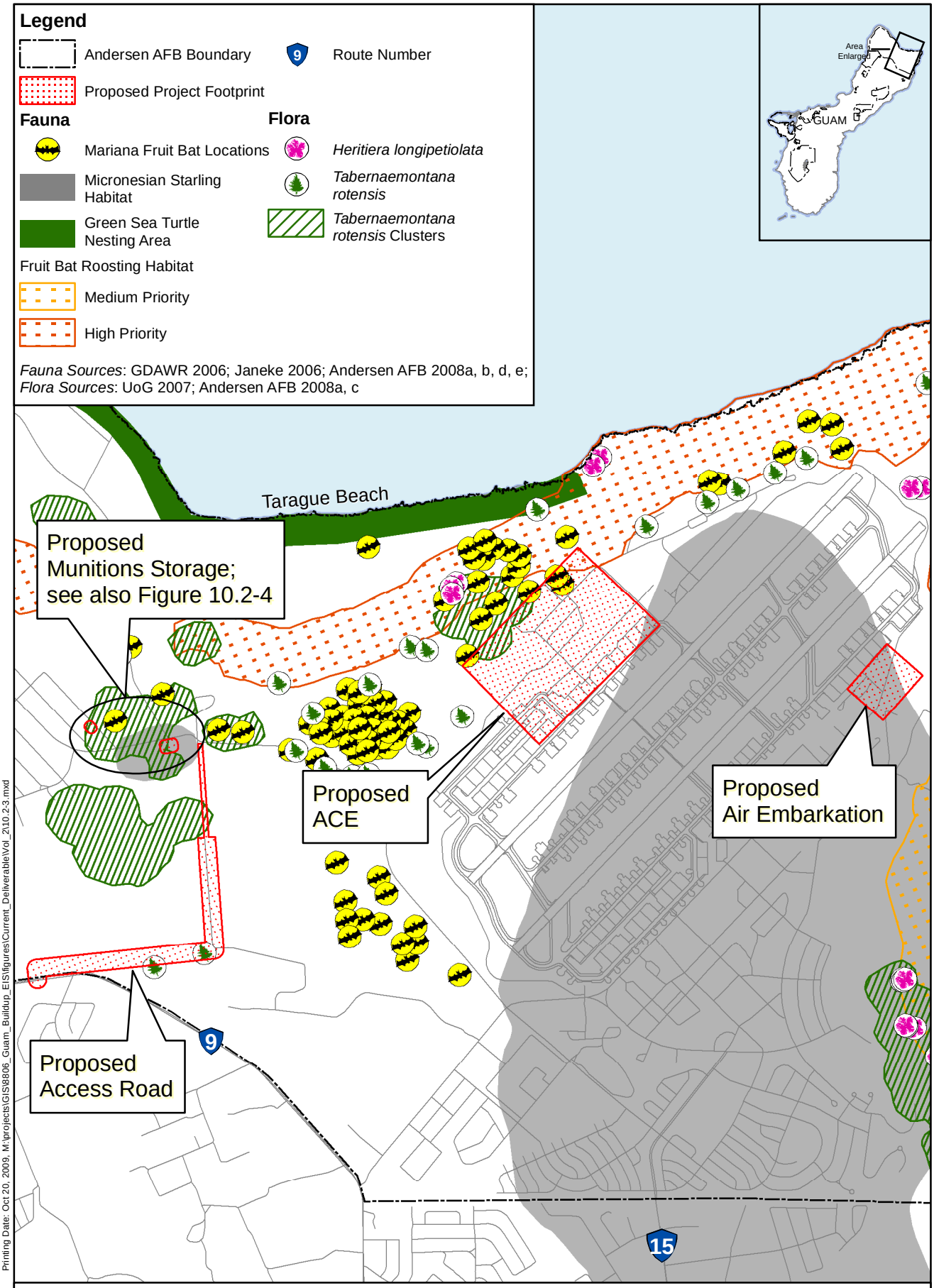

Figure 10.2-3
Potential Special-Status Species Impacts - Andersen AFB East

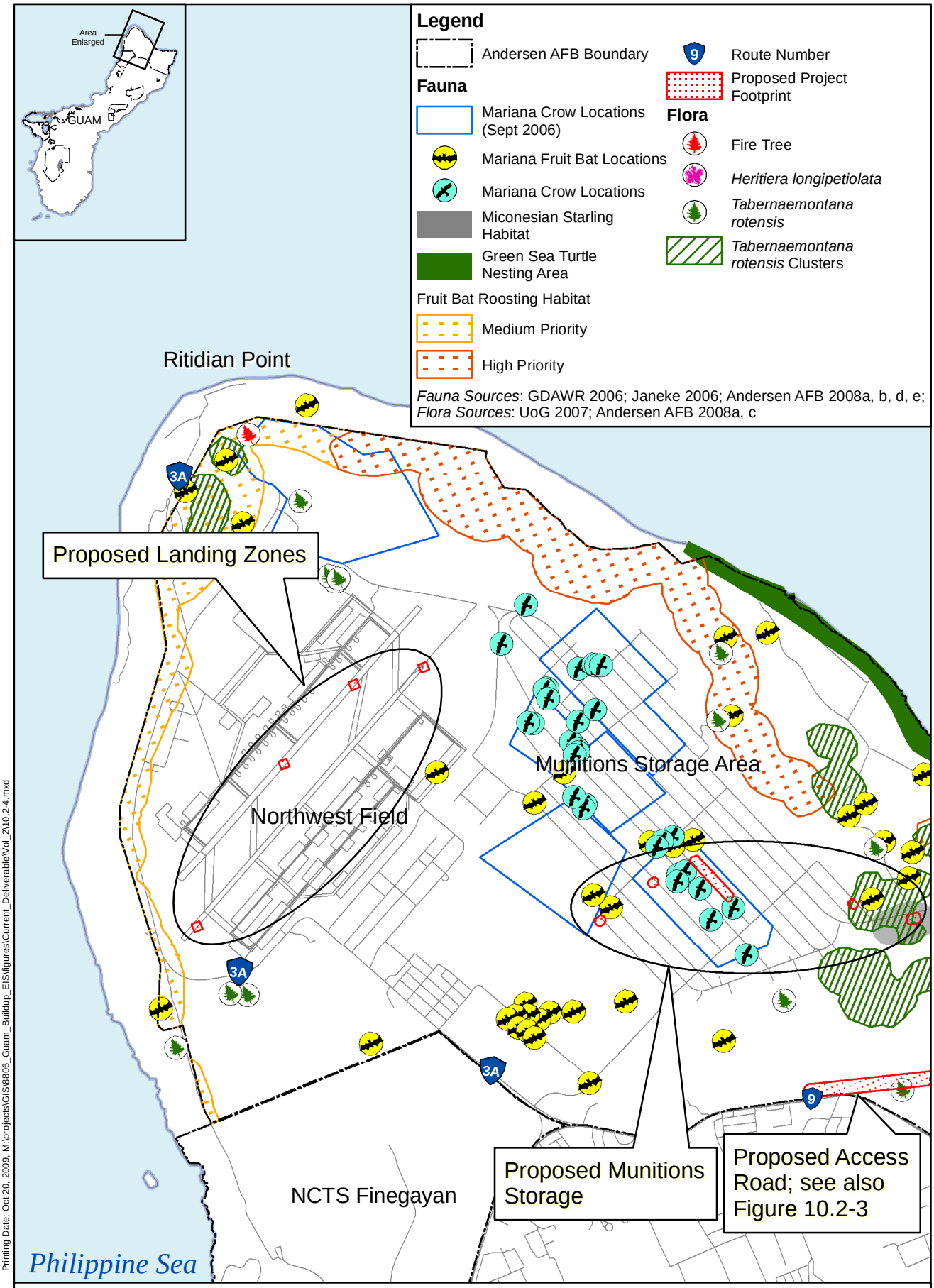

Figure 10.2-4
Potential Special-Status Species Impacts - Andersen AFB West

rotensis. Because over 21,000 *T. rotensis* individuals were found throughout Andersen AFB at 265 separate locations in a recent survey (UoG 2007; see Figure 10.2-1), the potential loss from the proposed construction of the ACE and magazine would be small compared to the total population on Andersen AFB. Therefore, impacts would be a less than significant.

Wildlife. Few migratory birds are present in the project areas. The only native migratory bird species likely to be present in the project construction area, based on surveys conducted in support of this EIS/OEIS and other studies, are the yellow bittern and possibly the Pacific golden plover in open areas; both species are located throughout Guam. The loss of woody vegetation would result in the loss of nesting areas for the bittern, but this loss would not result in significant adverse effects on its population because it is very common throughout the island.

Proposed construction activities would displace the species and other wildlife from suitable habitat in the proposed project areas. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities. However, long-term, permanent impacts to populations of such species would not result because the species known to be present are abundant in surrounding areas, and would rapidly repopulate suitable portions of the affected area. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts to wildlife due to proposed construction activities at Andersen AFB would be less than significant under Alternative 1.

Construction activities for the various facilities, the new gate, and access road construction or improvements would generate noise. Construction would take place during daylight hours. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of suitable habitat nearby and they could return during evenings and to some of the area when construction is complete. Effects would be short-term. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. Proposed construction activities could directly impact habitat for several ESA-listed species that currently occur on Guam. Construction activities would impact essential habitat that could serve as potential reintroduction areas for ESA-listed species that are currently extirpated from Guam.MARIANA FRUIT BAT. In 2005, the USFWS determined that movement of fruit bats between all islands in the Mariana archipelago occur that results in an exchange of genetic material between individuals in the region. Therefore, the Mariana fruit bat was considered one subspecies and was down-listed to threatened status throughout the region (USFWS 2005). Proposed construction activities would include the loss of limestone forest that is potential foraging and roosting habitat for the Mariana fruit bats on the base (refer to Figures 10.2-3 and 10.2-4). It is well documented from scientific studies and observations that fruit bats are found in the proposed project areas (see Section 10.1). However, the number of bats using the area at any time cannot be estimated because they are active at night. Bats that roost in Northwest Field during the day are solitary and difficult to locate in the forest. A total of 116 ac (47 ha) of essential habitat would be removed for construction of the various project components on the base. . This essential habitat is also designated Overlay Refuge (Figure 10.2-5). Removal of these areas due to construction would have a significant impact on fruit bat individuals because of the removal of habitat areas designated as essential habitat for the conservation of the species. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6. The proposed actions would have a minimal affect on the population or the subspecies with up to several thousand individuals present throughout the Mariana Archipelago.

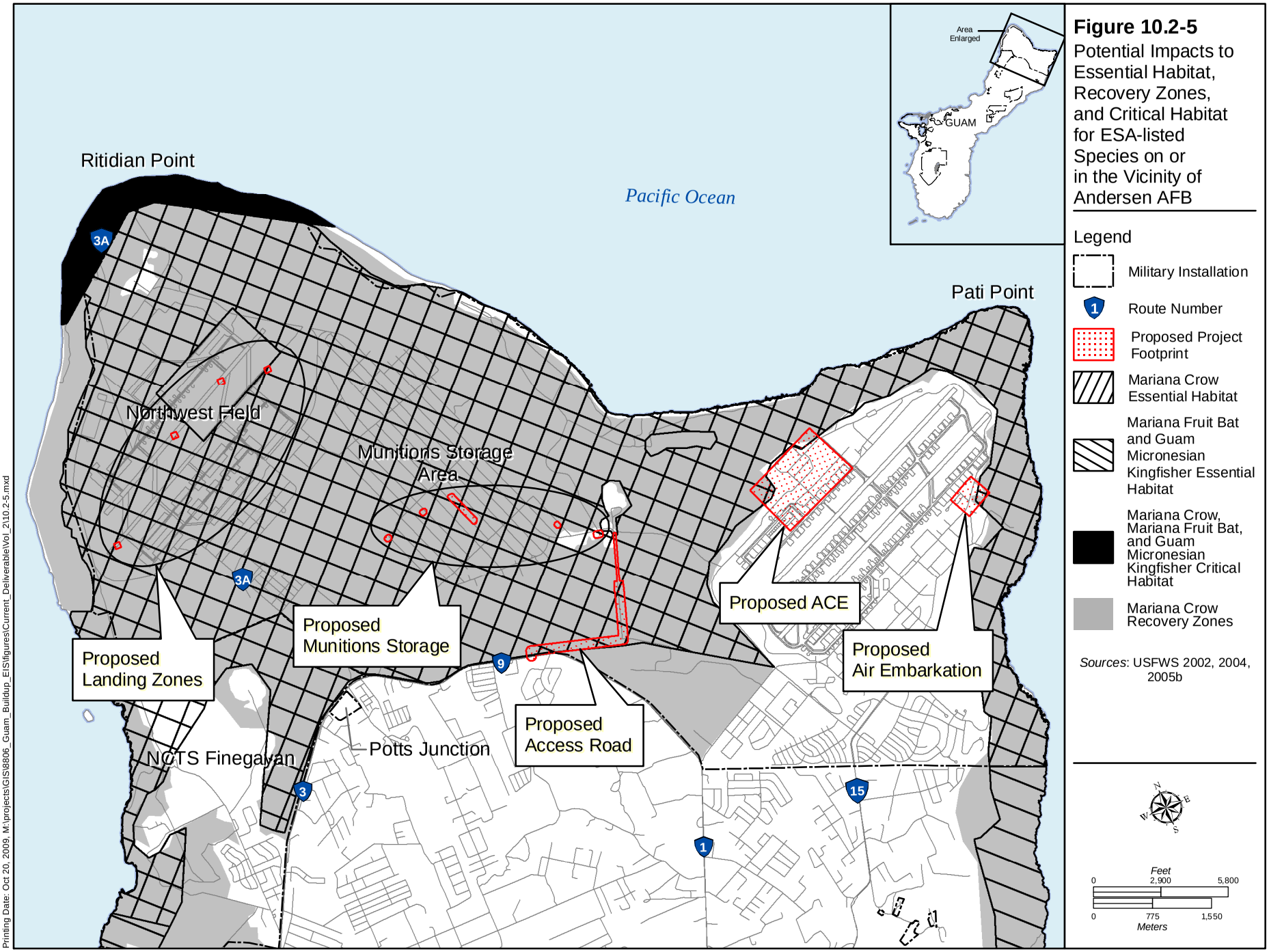

Figure 10.2-5
Potential Impacts to Essential Habitat, Recovery Zones, and Critical Habitat for ESA-listed Species on or in the Vicinity of Andersen AFB

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Construction activities for the various facilities, LZs, the new gate, and access road construction or improvements would temporarily generate noise and human activity. Fruit bats are rarely observed during the day in the proposed construction areas. Construction would occur during daylight hours, avoiding the nighttime activity of individual Mariana fruit bats. Therefore, direct impacts from noise and activity associated with construction would result in less than significant impacts to fruit bats.

GUAM MICRONESIAN KINGFISHER. Proposed construction activities would include the loss of limestone forest that is potential foraging and nesting habitat for a potential future introduction of the kingfisher. A total of 116 ac (47 ha) of essential habitat would be removed for construction of the various project components on the base (Special-Status Species). Proposed construction activities could directly impact habitat for several ESA-listed species that currently occur on Guam. Construction activities would significantly impact the species due to loss of essential habitat that could serve as potential reintroduction areas for ESA-listed species that are currently extirpated from Guam. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

MARIANA CROW. Proposed construction activities would include the loss of limestone forest that is potential foraging and nesting habitat for the crow. A total of 116 ac (47 ha) of essential habitat would be removed for construction of the various project components on the base (see Table 10.2-2). This essential habitat is also designated Overlay Refuge (refer to Figure 10.2-5). Removal of these areas due to construction would have a significant impact on the species. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Construction activities for the magazines at the MSA would temporarily generate noise and human activity at or near the location where the remaining crows are known to occur. Crows have been rarely observed in recent times in the other proposed construction areas. Potential indirect impacts to the crow are shown in Table 10.2-2. Using a surrounding zone of 197 ft (60 m) for project areas at the MSA, a total of 25 ac (10 ha) would be indirectly affected. Indirect impacts from noise and activity associated with construction would result in significant impacts to individual crows, however only two crows are known to be currently present on Guam. The entire remaining population of this species is on Rota, with the most recent species count being in 2004 at 170 breeding pairs (USFWS 2005b). Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

GUAM RAIL. Except for an experimental non-essential population that has been introduced to Rota, the rail survives only in captivity at this time and does not occur in the wild on Guam. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. No specific areas of essential habitat have been designated for this species, but 25 ac (10 ha) of favorable shrub/grasslands habitat contained within Overlay Refuge lands would be removed (see Figure 10.2-5). However, because the Guam rail is currently extirpated in the wild and most of Guam has habitat that is potentially suitable for the recovery of the species, removal of these areas due to construction would result in a less than significant impact.

MARIANA EIGHT-SPOT BUTTERFLY. This species was observed in the Pati Point area (PACAF 2006a). The larval stage of this species has 2 specific host plants not reported in the vicinity of Alternative 1 project areas; these host plants are generally associated with primary limestone forest in areas of pinnacle karst (karren) which is not present in the project areas. Therefore, removal of these areas due to construction would have no impact on the eight-spot butterfly.

Table 10.2-2. Potential Impacts to Special-Status Species Habitat at Andersen AFB with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Overlay Refuge**	*Essential Habitat – Bat and Kingfisher**	*Essential Habitat – Crow**	*Crow Recovery Zone**
Direct Impacts from Construction - Habitat Removed				
North Ramp – ACE	0	27 (11)	27 (11)	22 (8.9)
South Ramp – Embarkation	0	6.4 (2.6)	6.4 (2.6)	6.3 (2.5)
Access Gate and Road	53 (21)	65 (26)	65 (26)	66 (26.6)
MSA – New Magazines	18 (7.3)	18 (7.3)	18 (7.3)	15 (6.2)
Total Habitat Removed	**71 (29)**	**116 (47)**	**116 (47)**	**109 (44)**
Percentage of Habitat Type on Guam that is Removed	0.3 %	0.5 %	0.5 %	0.3 %
Direct Impacts – Noise, Lighting, Human Activity				
150 m buffer for FB (R*): Ground Ops				
North Ramp – ACE	21 (8.6)	63 (26)	NA	NA
South Ramp – Embarkation	0	18 (7.3)	NA	NA
Access Gate and Road	137 (55)	138 (56)	NA	NA
LZs	96 (39)	59 (24)	NA	NA
Totals	254 (103)	278 (113)	NA	NA
150 m buffer for FB (R/N*): Air Takeoff and Landings				
North Ramp – ACE	21 (8.6)	63 (26)	NA	NA
South Ramp – Embarkation	0	18 (7.3)	NA	NA
LZs	96 (39)	59 (24)	NA	NA
Totals	117 (47)	140 (57)	NA	NA
Direct Temporary Impacts from Construction– Noise, Lighting, Human Activity				
60 m buffer for MC (F,N)				
MSA – New Magazines	25 (10)	NA	25 (10)	25 (10)
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity				
60 m buffer for MC (F,N): Ground Ops				
North Ramp – ACE	8.1 (3.3)	NA	21 (8.5)	16 (6.5)
South Ramp – Embarkation	0	NA	5.1 (2.0)	6.1 (2.5)
Access Gate and Road	57 (23)	NA	56 (23)	64 (26)
LZs	21 (8.5)	NA	13 (5.3)	21 (8.5)
Totals	86 (35)	NA	95 (38)	107 (43)
100 m buffer for KF (F,N): Air Takeoff and Landings and Ground Ops				
North Ramp – ACE	14 (5.7)	39 (16)	NA	NA
South Ramp – Embarkation	0	10 (4.1)	NA	NA
Access Gate and Road**	92 (37)	91 (37)	NA	NA
LZs	48 (19)	30 (12)	NA	NA
Totals	154(62)	170 (69)	NA	NA
300 m buffer for MC (F,N): Air Takeoff and Landings				
North Ramp – ACE	43 (17)	NA	146 (59)	144 (58)
South Ramp – Embarkation	1.1 (0.4)	NA	50 (19)	54 (30)
LZs	315 (127)	NA	191 (77)	315 (12)
Totals	359 (143)	NA	387 (156	513 (207)

Notes: Each habitat category is considered independently of others and are not additive; Only species with specific, recognized habitat areas are included in the table; NA – Not applicable. *For the fruit bat the smaller foraging buffer of 100 m is not included; **Aircraft takeoff and landings are not applicable for this component. FB – Fruit Bat, MC - Mariana Crow, KF – kingfisher, F – Foraging, R – Roosting/Colony, N - Nesting.

MICRONESIAN STARLING. A small area of habitat that is identified for this species' future recovery in the proposed new munitions storage magazine area would be removed (see Figure 10.2-3). Because the amount of habitat lost is so small, compared to that which is otherwise available for the species, impacts would be less than significant.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. Awareness training and inspection of gear, clothing, and equipment as part of existing control measures would occur. The impacts are discussed in detail under operations below. Special status species impacts would be significant but numerous mitigation and other BMP measures, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. Invasive plant species are likely to expand ranges and new species are likely in some areas due to the increase in number of increased activities such as more training, more personnel, and more vehicles. However, this is unlikely to substantially impact primary limestone forest because most activities are well away from these primary forest areas. Therefore, impacts would be less than significant.

Wildlife. Aircraft operations would result in some migratory bird airstrikes however these would be few because of the lack of native bird species. A Bird/Wildlife Aircraft Strike Hazard (BASH) Plan is currently in place at Andersen AFB and has measures to decrease the likelihood of these strikes. With this plan in place, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species and impacts would be less than significant.

Operations at the facilities and LZs would generate noise. The few migratory birds present would be affected and would move away from these areas, but there are other large areas of habitat nearby where they could move to when disturbed. The magazine areas would be used infrequently and there would be no nighttime lighting or minimal lighting using hooded lights. Operations at the aviation and embarkation facilities would be continuous and could occur day or night. Lighting in these areas would be hooded or shielded to prevent unnecessary light beyond operational areas. LZs in the training area at Northwest Field would not be used at night. Indirect impacts from noise and activity associated with operations would result in less than significant impacts to wildlife.

Special-Status Species. Direct and indirect impacts from ground and aircraft operations are described for each species below.

MARIANA FRUIT BAT. Fruit bats are potentially present at all the proposed project areas at Andersen AFB and could be disturbed during foraging or roosting, primarily during nighttime acitivities. Activities at the facilities and LZs from ground and aircraft operations would generate noise and facilities would require night lighting. The magazine areas would be used infrequently and there would be no night lighting or minimal hooded lighting. Operations at the aviation and embarkation facilities would be continuous and could occur day or night. To reduce impacts, lighting at facilities would be hooded or shielded to prevent unnecessary light beyond operations areas. Under the proposed action, there would be an increase in Andersen AFB aircraft operations primarily associated with the basing of additional helicopters to support Marine Corps training on Guam and Tinian. Overall, annual and average daily aircraft operations would each increase by approximately 37% over baseline levels. This equates to an increase from an average of approximately ten daytime aircraft operations per hour to approximately 14/hour, and an increase in nighttime operations from approximately 1/hour to 1.5/hour.

To account for the new facilities and the increased aircraft takeoff and landings and ground operations, surrounding perimeter zones around the proposed facilities and LZs are assumed to be affected by human activity, noise, and lighting. Observations of roosting Mariana fruit bats near human activities reported by USFWS (2006) indicate that individuals were not disturbed by most activities greater than 492 ft (150 m) away from the roost site. Observations reported by USFWS (2006) indicate that foraging fruit bats would not be disturbed by most activities at distances greater than 328 ft (100 m). So conservatively, using 492 ft (150 m), the amount of fruit bat essential habitat that may be directly impacted by the operation of the proposed facilities on Andersen AFB is approximately 278 ac (113 ha) for ground operations and 140 ac (57 ha) for aircraft takeoff and landings (see Table 10.2-2). Impacts would be significant. The impacts would affect individual fruit bats, but impacts to the population or the subspecies would be minimal with up to several thousand individuals present throughout the Mariana Archipelago.

Aircraft operations could result in some airstrikes of the Mariana fruit bat. A BASH Plan is currently in place at Andersen AFB and has measures to reduce BASH potential. With this plan in place, the likelihood of strikes is minimal and direct impacts to special-status species would be less than significant (may affect but is unlikely to adversely affect).

Noise associated with baseline aircraft operations at Andersen AFB currently extends over areas that contain roosting and foraging habitat for the Mariana fruit bat (fruit bat). Specifically, areas that are considered essential habitat for the fruit bat on Andersen AFB currently experience noise levels ranging from 60 decibels (dB) to greater than 85 dB (Table 10.2-3 and Figure 10.2-6). Under the proposed action, the total acreage of essential habitat that would be subjected to an increase in noise levels would increase from 4,148 ac (1,679 ha) to 5,898 ac (2,387 ha), or an increase of 42%. However, the majority of this increase (89%) would occur within the 60-65 dB noise contour.

Table 10.2-3. Baseline and Projected Noise Contour Acreages over Essential Habitat for Mariana Fruit Bat and Guam Micronesian Kingfisher from Andersen AFB Aircraft Operations (ac [ha])

Average Noise Level (DNL)	*Baseline*	*Proposed*	*Change from Baseline*	*% Change from Baseline*
60-65 dBA	1,573 (637)	3,123 (1,264)	1,550 (627)	98.5%
65-70 dBA	797 (323)	579 (234)	-218 (-89)	-27.3%
70-75 dBA	933 (378)	1,251 (506)	318 (128)	34.1%
75-80 dBA	460 (186)	520 (210)	60 (24)	13.0%
80-85 dBA	307 (124)	329 (133)	22 (9)	7.2%
>85 dBA	78 (32)	96 (39)	18 (7)	23.1%
Total	**4,148 (1,679)**	**5,898 (2,387)**	**1,750 (708)**	**42.2%**

Legend: DNL= Day-Night Sound Level; dBA= A-weighted decibel.
Note: Acreages, including totals, may not correspond exactly due to rounding.

This increase in area is mainly associated with the proposed increased use of NWF by helicopters departing from Andersen AFB, as depicted in the finger-like contour extending north from south of Potts Junction over NCTS Finegayan to NWF. Based on past data and recent monitoring efforts (Morton 1996, GDAWR 2006, Janeke 2006, Andersen AFB 2008d), fruit bats have not been observed foraging or roosting in this area; this is possibly due to the lack of habitat (i.e., tree species with sufficient canopy structure and fruits). The increase in the acreages of the higher noise levels (>70 dB) in the vicinity of Andersen AFB is associated predominantly with the proposed transient basing of Marine Corps F/A-18D jet aircraft at Andersen AFB. As these jet aircraft arrive and depart Andersen AFB runways in a straight line and at a greater speed than the proposed helicopters, which stay within the Andersen AFB environment longer, the increase in noise associated with these jet aircraft is short term.

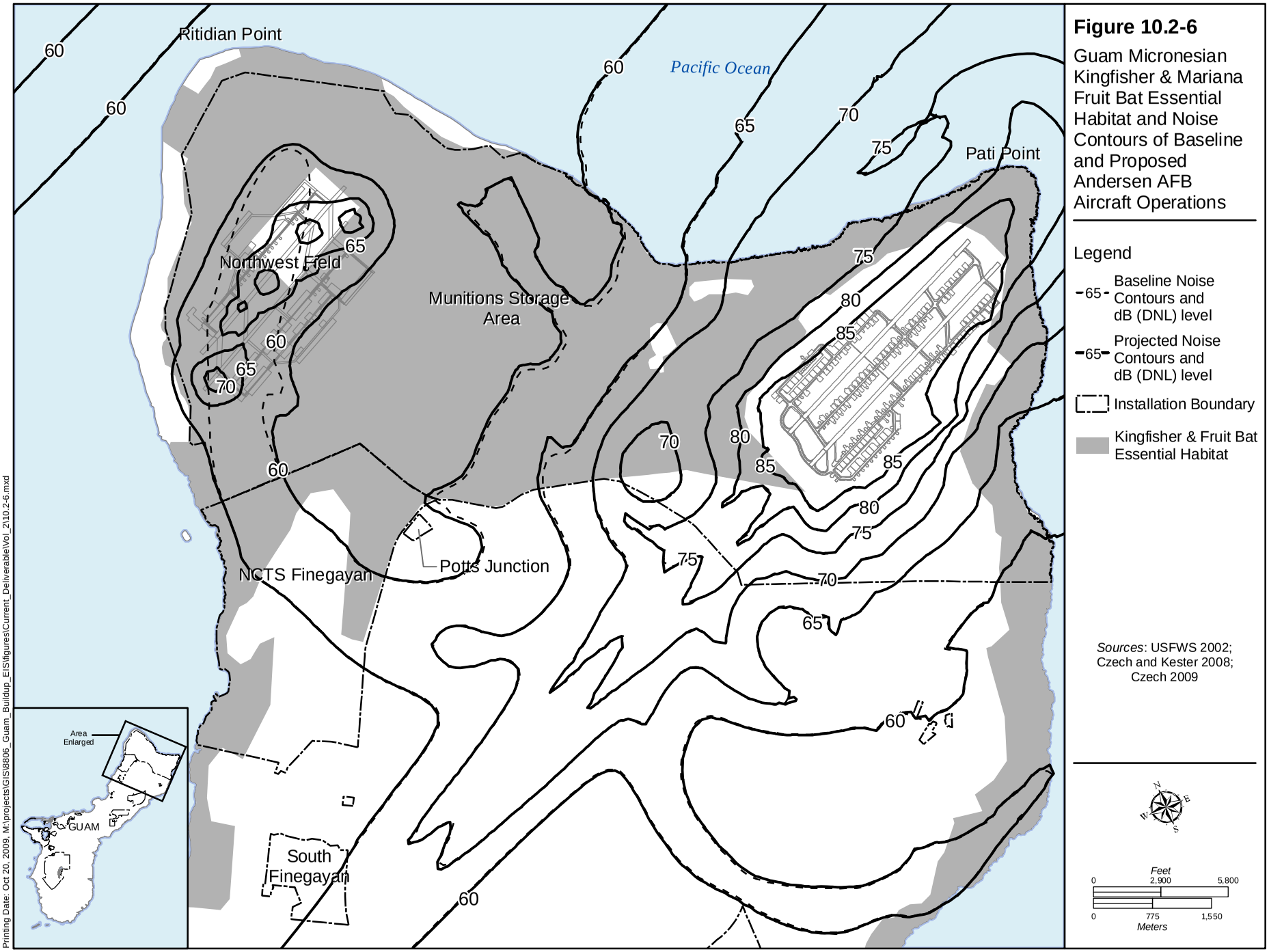

Figure 10.2-6

Guam Micronesian Kingfisher & Mariana Fruit Bat Essential Habitat and Noise Contours of Baseline and Proposed Andersen AFB Aircraft Operations

Legend

- 65 Baseline Noise Contours and dB (DNL) level
- 65 Projected Noise Contours and dB (DNL) level
- Installation Boundary
- Kingfisher & Fruit Bat Essential Habitat

Sources: USFWS 2002; Czech and Kester 2008; Czech 2009

Feet
0 2,900 5,800
0 775 1,550
Meters

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The proposed action for the previous 2006 ISR Strike EIS represents the current baseline conditions for this EIS/OEIS (PACAF 2006a). As part of the ESA Section 7 consultation process, the USFWS issued a Biological Opinion for the ISR Strike activities potentially impacting ESA-listed species on Guam, including the potential impacts of aircraft overflights and associated noise (USFWS 2006). Although it was recognized that noise from aircraft overflights would affect current populations of Mariana fruit bat, the USFWS concluded that implementation of the proposed aircraft operations of the ISR Strike action would not likely jeopardize the continued existence of the Mariana fruit bat. This conclusion was based on the implementation of conservation measures proposed by the Air Force as part of their proposed action, including conducting a multi-year monitoring program for the Mariana fruit bat and Mariana crow. This monitoring program would assess the current status of the Mariana fruit bat and evaluate any potential or known impacts of the ISR Strike project. Any adverse effects that become apparent due to aircraft operations would initiate modifications to aircraft ground tracks and profiles over sensitive areas through an adaptive management strategy. Although the results of the first year of monitoring (May 2007-May 2008) lacked overt evidence for panic, or colony flushing from aircraft noise the impact of increased aircraft noise was not measured. In addition, the full extent of increased aircraft noise was not evaluated because not all aircraft types were present for the study period. Therefore it was recommended that extensive monitoring of the effects of aircraft operations on fruit bat populations continue. To address the additional aircraft proposed under this study, the existing Andersen AFB monitoring data would be used and it would be augmented.

Aircraft disturbances have been found to impact native and non-native species at an individual and community level (e.g., Gladwin et al. 1987, National Park Service 1994). In terms of aircraft overrflights, wild animals generally respond to low altitude aircraft, although the ways in which they respond varies depending on life-history, habitat, aircraft and flight activities, as well as previous exposure to aircraft (Burger 1981). Physiological and/or behavioral responses that can reduce an animal's fitness, ability to survive or increase its propensity to relocate. It is thought that low-altitude overflights can cause excessive stimulation, alterness, or stress (Fletcher, 1980, 1990; Manci et al. 1988). In addition, chronic stress can compromise the general health of animals and behavioral responses by adults may interfere with offspring rearing, habitat use, and physiological energy budget (Owens 1977, Kushlan 1979, Burger 1981, Andersen et al., 1989, Belanger and Bedard 1989, Cook and Anderson 1990). According to the SWCA (2008) study, flushing episodes were infrequent at less than 5% for overflights louder than 75 dBC and 6% for overflights louder than 100 dBC. However, in a previous study, up to 42% of the Mariana fruit bat colony flushed in response to aircraft overflights (Morton 1996).

In addition, an increase in maintenance behaviors as a result of some overflights was recorded during the study (SWCA 2008). This behavior change during the day (when should be asleep) may result in increased stress on the animals.

Based on the above discussion, the primary increase in noise due to the proposed aircraft operations would be due to helicopter flights to NWF over areas potentially utilized by roosting or foraging fruit bats. The overall increase in noise experienced by Mariana fruit bats would not increase significantly on a daily or annual basis over baseline conditions, and there would be no significant impacts to the current fruit bat population or future recovery efforts due to proposed aircraft operations. As stated in the mitigation measures below, the Navy would provide additional support for the current monitoring effort of the effects of aircraft operations on Mariana fruit bats and adopt the Air Force's adaptive management strategy, which allows for modification of overflight patterns if adverse effects to fruit bats are documented. In addition, in support of recovery actions outlined in the recovery plan for the Mariana fruit bat (USFWS 1990a), the Navy would implement habitat restoration and control of BTS as provided

below in the mitigation measures. Therefore, noise resulting from aircraft operations of the proposed action would have a less than significant affect on the Mariana fruit bat.

Other noise increases would occur from the proposed action. Noise would be generated beyond current levels from increased use of the Northwest Field demolition facility. Its use is expected for one event per day up to 25 days per year. Noise studies have been conducted for this facility and a summary of the study and noise contours are shown in Chapter 6. Noise contours are based on the "busy day" C-weighted average sound day-night level (CDNL). The 70 dB CDNL contour within essential habitat for the fruit bat would be increased over a total of 1,385 acres under the proposed action. Given the limited amount of information available on the noise susceptibility of the fruit bat, noise from the demolition area may have a significant impact. To evaluate this potential, monitoring of the species in areas surrounding the demolition area would be conducted to determine potential noise impacts. If this monitoring determined that the fruit bat was being affected, techniques to reduce noise generation, such as noise barriers, would be employed. With this mitigation, impacts would be less than significant.

Impacts from noise and other activity may be exacerbated by effects from typhoons. Following typhoons, Mariana fruit bats are known to travel between Guam and Rota. Fruit bats would be under stress and food resources may be limited such that bats might forage during the day (USFWS 2006). In these situations, noise and other activity from operations would have a significant impact on the Mariana fruit bat and crow. Various conservation measures and mitigation actions would aid in the recovery of special-status species on Guam (see Section 10.2.2.5) and would reduce or compensate for these impacts.

GUAM MICRONESIAN KINGFISHER. The Guam Micronesian kingfisher has been extirpated from the wild and currently occurs only in captive breeding populations. When reintroduced in the future, it is expected that kingfishers are likely to avoid areas within 328 ft (100 m) of the proposed facilities and LZs due to operations and maintenance, perimeter and facility lighting at night, and aircraft takeoff and landing operations. Based on the essential habitat available within that distance, approximately 170 ac (69 ha) would be indirectly impacted by the operation of the proposed facilities on Andersen AFB (Table 10.2-2). Impacts would be significant.

Noise associated with baseline aircraft operations at Andersen AFB extends over areas that contain roosting and foraging habitat for kingfishers. Specifically, areas that are considered essential habitat for the Guam Micronesian kingfisher on Andersen AFB, NCTS Finegayan, and to the north of the Route 15 lands, currently experience noise levels ranging from 60 dB to greater than 85 dB (Table 10.2-3 and Figure 10.2-6). Under the proposed action, the total acreage of essential habitat that would be subjected to an increase in noise levels would increase from 4,148 ac (1,679 ha) to 5,898 ac (2,387 ha) or an increase of 42%. However, the majority of this increase (89%) would occur within the 60-65 dB noise contour. The immediate habitat areas that would potentially be affected by noise and impacts from ground and air operations are shown in Table 10.2-2.

Although the kingfisher does not presently occur in the wild, and no studies on the effects of aircraft overflights on this species or other kingfisher species have been conducted, the proposed aircraft operations over identified essential habitat for kingfishers are not expected to compromise the conservation and recovery process described in the revised recovery plan for the kingfisher (USFWS 2008a). With implementation of the mitigation measures described below including support for ungulate eradication and restoration of potential kingfisher foraging and nesting habitat and reintroducing kingfishers to Andersen AFB or other suitable areas on Guam, the proposed action aircraft operations would have a less than significant affect on kingfishers.

As described above for the fruit bat, noise would be generated beyond current levels from increased use of the Northwest Field demolition facility. The 70 dB CDNL contour within essential habitat for the kingfisher would be increased over a total of 1,385 acres under the proposed action. Given the limited amount of information available on the noise susceptibility of the kingfisher, noise from use of the demolition area may have a significant impact if it were to be reintroduced to the area. To evaluate this potential, if reintroduced to the area, monitoring of the species in areas surrounding the demolition area would be conducted to determine potential noise impacts. If this monitoring determined that the kingfisher was being affected, techniques to reduce noise generation, such as noise barriers, would be employed. With this mitigation, impacts would be less than significant.

MARIANA CROW. Crows are not currently present in proposed project areas other than at the magazines, where minimal operations occur. Therefore, impacts are assessed as indirect. Based on observations of foraging Mariana crows, it is expected that they are likely to avoid areas within 197 ft (60 m) of the proposed facilities due to operations and maintenance, and perimeter and facility lighting at night.. Based on the essential habitat available within 197 ft (60 m), approximately 95 ac (38 ha) would be indirectly impacted by the operation of the proposed facilities on Andersen AFB (Table 10.2-2). Air takeoff and landing operations at the north and south ramp and LZs would affect unoccupied crow habitat. Based on the essential habitat available within 984 ft (300 m), approximately 387 ac (156 ha) would be indirectly impacted by aircraft takeoff and landings. Impacts from noise, lighting, and human activity would be significant.

Noise associated with baseline aircraft operations at Andersen AFB currently extends over areas that contain roosting and foraging habitat and identified recovery zones for Mariana crows. Specifically, areas that are considered essential habitat and recovery zones for the crow on Andersen AFB, NCTS Finegayan, and to the north of the Route 15 lands currently experience noise levels ranging from 60 dB to greater than 85 dB (Table 10.2-4 and Figure 10.2-7). Under the proposed action, the total acreage of essential habitat that would be subjected to an increase in noise levels from aircraft operations would increase from 3,937 ac (1,593 ha) to 5,667 ac (2,293 ha) or an increase of 44%. However, the majority of this increase (88%) would occur within the 60-65 dB noise contour. As the recovery zones are predominantly coincident with essential habitat, the total acreage of recovery zones subjected to an increase in noise levels would be similar to that for essential habitat.

Table 10.2-4. Baseline and Projected Noise Contour Acreages over Mariana Crow Essential Habitat and Recovery Zones from Andersen AFB Aircraft Operations (ac [ha])

Average Noise Level (DNL)	*Baseline*	*Proposed*	*Change from Baseline*	*% Change from Baseline*
Essential Habitat				
60-65 dBA	1,362 (551)	2,892 (1,170)	1,530 (619)	112.3%
65-70 dBA	797 (323)	579 (234)	-218 (-89)	-27.3%
70-75 dBA	933 (378)	1,251 (506)	318 (128)	34.1%
75-80 dBA	460 (186)	520 (210)	60 (24)	13.0%
80-85 dBA	307 (124)	329 (133)	22 (9)	7.2%
>85 dBA	78 (32)	96 (39)	18 (7)	23.1%
Total	**3,937 (1,593)**	**5,667 (2,293)**	**1,730 (700)**	**43.9%**
Recovery Zone				
60-65 dBA	1,526 (618)	3,164 (1,280)	1,638 (663)	107.3%
65-70 dBA	924 (374)	599 (242)	-325 (-131)	-35.2%
70-75 dBA	1,062 (430)	1,408 (570)	346 (140)	32.6%
75-80 dBA	671 (272)	742 (300)	71 (29)	10.6%
80-85 dBA	356 (144)	436 (176)	80 (32)	22.5%
>85 dBA	85 (34)	103 (42)	18 (7)	21.2%
Total	**4,624 (1,871)**	**6,452 (2,611)**	**1,828 (740)**	**39.5%**

Note: Acreages and hectares, including totals, may not correspond exactly due to rounding.

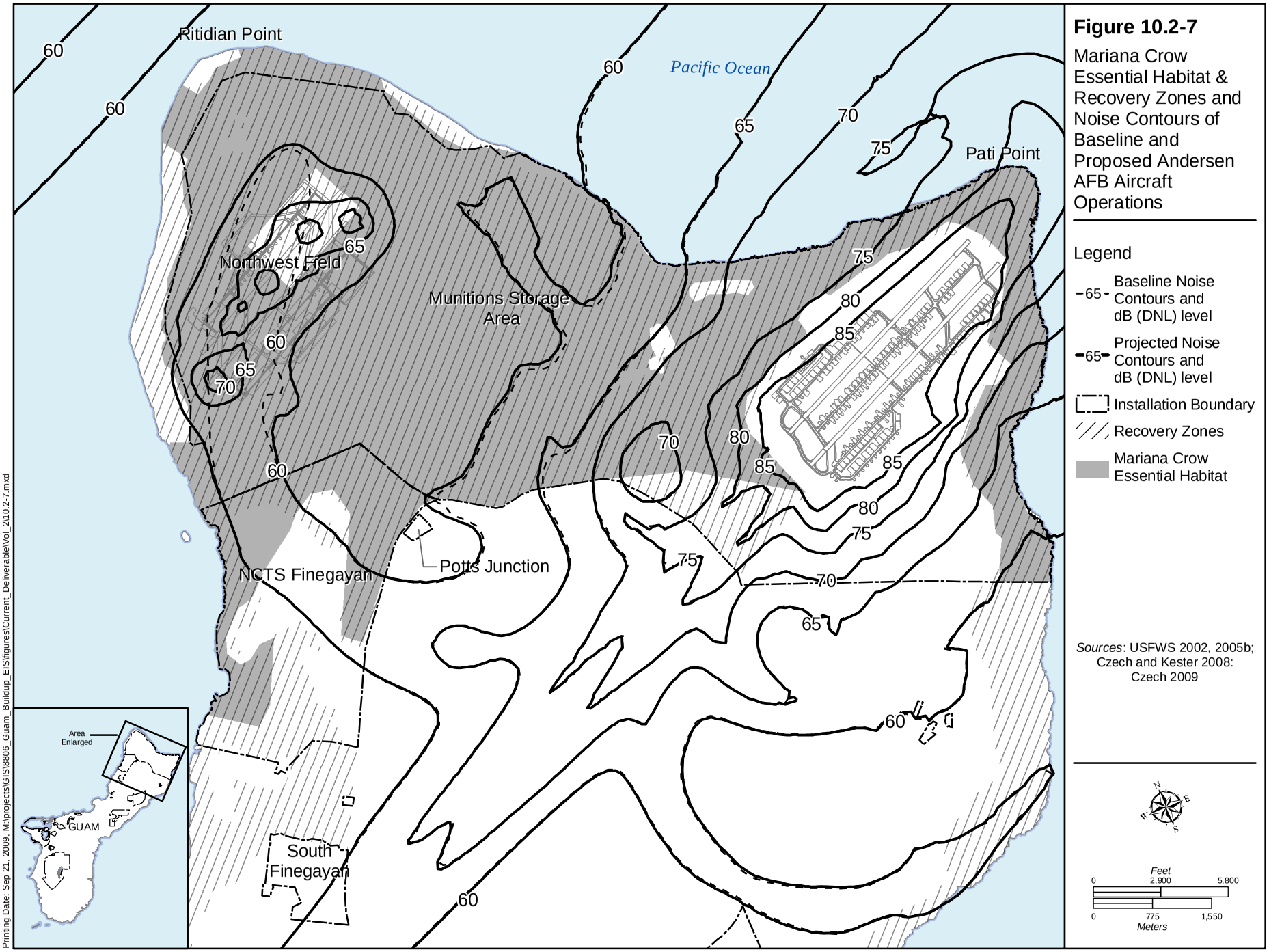

Figure 10.2-7

Mariana Crow Essential Habitat & Recovery Zones and Noise Contours of Baseline and Proposed Andersen AFB Aircraft Operations

Legend

- 65 Baseline Noise Contours and dB (DNL) level
- 65 Projected Noise Contours and dB (DNL) level
- Installation Boundary
- Recovery Zones
- Mariana Crow Essential Habitat

Sources: USFWS 2002, 2005b; Czech and Kester 2008: Czech 2009

Feet
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Since the areas of crow and fruit bat essential habitat that would experience increased noise from proposed aircraft operations are virtually the same (with fruit bat essential habitat encompassing a slightly larger area within the area to the south of Andersen AFB along the eastern coast of Guam), the impacts to crows would be similar to those previously described for fruit bats. The primary increase in noise, due to the proposed aircraft operations, would be the result of helicopter flights to NWF over areas not known to be utilized by nesting or foraging crows (Morton 1996, GDAWR 2006, Andersen AFB 2008d). The overall increase in noise experienced by crows would not increase significantly on a daily or annual basis over baseline conditions, and there would be no significant impacts to the current crow population or future recovery efforts due to proposed aircraft operations. As stated in the mitigation measures below, the Navy would provide additional support for the current monitoring effort of the effects of aircraft operations on crows and adopt the Air Force's adaptive management strategy. In addition, in support of recovery actions outlined in the draft revised recovery plan for the Mariana crow (USFWS 2005b), the Navy would implement habitat restoration as a mitigation measure and control of BTS as a BMP. Therefore, the proposed action aircraft operations would have a less than significant effect on the Mariana crow.

As described above for the fruit bat, noise would be generated beyond current levels from increased use of the Northwest Field demolition facility. The 70 dB CDNL contour within essential habitat for the crow would be increased over a total of 1,385 acres under the proposed action. Given the limited amount of information available on the noise susceptibility of the crow, noise from use of the demolition area may have a significant impact. To evaluate this potential, monitoring of the species in areas surrounding the demolition area would be conducted to determine potential noise impacts. If this monitoring determined that the kingfisher was being affected, techniques to reduce noise generation, such as noise barriers, would be employed. With this mitigation, impacts would be less than significant.

Guam Rail. The Guam rail has been extirpated from the wild and currently occurs only as captive breeding populations. Ground and air operations are not expected to compromise the conservation and recovery process described in the rail recovery plan (USFWS 1990b). With implementation of the mitigation measures described in Section 10.2.2.6, including support for ungulate eradication and restoration of potential rail foraging and nesting habitat, the proposed action operations would have a less than significant impact.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed action. The movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species might be accidentally introduced to Guam, spread on Guam, or transported to other islands through aircraft operations, shipment of supplies and equipment to the new facilities, movement of troops and supplies during training activities, or movement of household goods. Species that might be introduced or spread include plants such as *Vitex* that degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat, invertebrates such as coconut rhinoceros beetles or the flatworm predator of native snails, BTS and various frog and reptile species, rodents and cats. The introduction and spread of invasive species could result in predation, disease, and habitat alteration. These influences could have significant impacts on all special-status species potentially occurring in the project area (the same as those discussed under construction direct impacts). To prevent potentially invasive species from being moved or spreading, and in particular the BTS from being introduced in other areas from Guam, the project would fund and facilitate a 100% inspection effort for all cargo, vehicles, munitions, household goods, and other items leaving Guam. A Micronesian Biosecurity Plan would be developed as a

comprehensive plan to evaluate the risk of introducing species through various pathways (for example, air freight) and put in place measures to avoid, minimize and prevent further introductions of invasive species and to control invasive species already present. In addition, various other species specific plans and procedures would be developed or updated and implemented to address existing invasive species concerns such as ungulate damage that is affecting habitat quality of special-status species. These are described in Section 10.2.2.6, Potential Mitigation Measures. Once prepared and implemented, the objectives of the Micronesian Biosecurity Plan, along with other measures, would minimize the spread of invasive species to and from Guam and within Guam, and impacts would be less than significant.

The potential for wildfire to impact the fruit bat and crow currently present, or all special-status species if they returned or were reintroduced, would be low because proposed training exercises are non-firing, except for the demolition area which would be closely monitored. A wildfire plan would put into place policies and procedures that would prevent wildfires from occurring. A Marine Corps fire station with alert force facilities (manned by 51 staff) would be located at the Aircraft Fire and Rescue Station at Andersen AFB. That unit would help to ensure fire safety procedures and, along with the Andersen AFB fire department, would be responsible for controlling any fires that could be started during training exercises. There would be an Aircraft Fire and Rescue Station at the main cantonment at NCTS Finegayan which would respond to air-ground training incidents, and would be present during some training exercises as a precautionary measure. Based on a low fire potential and fire response capabilities, impacts to special-status species would be less than significant.

NCTS and South Finegayan

Under Alternative 1, approximately 1,181 ac (478 ha) of NCTS Finegayan and 283 ac (114 ha) of South Finegayan would be developed as part of the Main Cantonment.

Construction

Vegetation. A total of 1.5 ac (0.6 ha) of primary limestone forest and 562 ac (227 ha) of disturbed limestone forest would be removed during proposed construction activities at NCTS and South Finegayan (Table 10.2-5 and Figure 10.2-8). The limestone forest is not known to harbor any sensitive plant species identified by government or conservation groups. Areas of remaining limestone forest habitat are shown in Figure 10.2.8. Approximately 49 ac (20 ha) of shrub/grassland and 1.0 ac (0.4 ha) of tangantangan would be removed from these same areas.

Table 10.2-5. Potential Impacts to Vegetation Communities at Finegayan, Former FAA Parcel, and Harmon Annex with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Limestone Forest, Disturbed*	*Shrub/ Grassland*	*Tangan tangan*	*Developed*
NCTS and South Finegayan Vegetation Removed					
Main Cantonment	1.5 (0.6)	562 (227)	49 (20)	1.0 (0.4)	476 (193)
Former FAA and Harmon Annex Vegetation Removed					
Main Cantonment	1.0 (0.4)	480 (194)	387 (157)	32 (13)	31 (13)
Total Vegetation Removed	**2.5 (1.0)**	**1,042 (422)**	**436 (176)**	**33 (13)**	**507 (205)**

The most pristine vegetation and habitats are in the Haputo ERA, which would remain unchanged. Direct impacts to vegetation would be less than significant because only a very small amount of primary limestone forest would be removed in the upper plateau area. Removal of disturbed limestone forest, while not considered a significant impact for vegetation, is further evaluated for impacts wildlife and special-status species below.

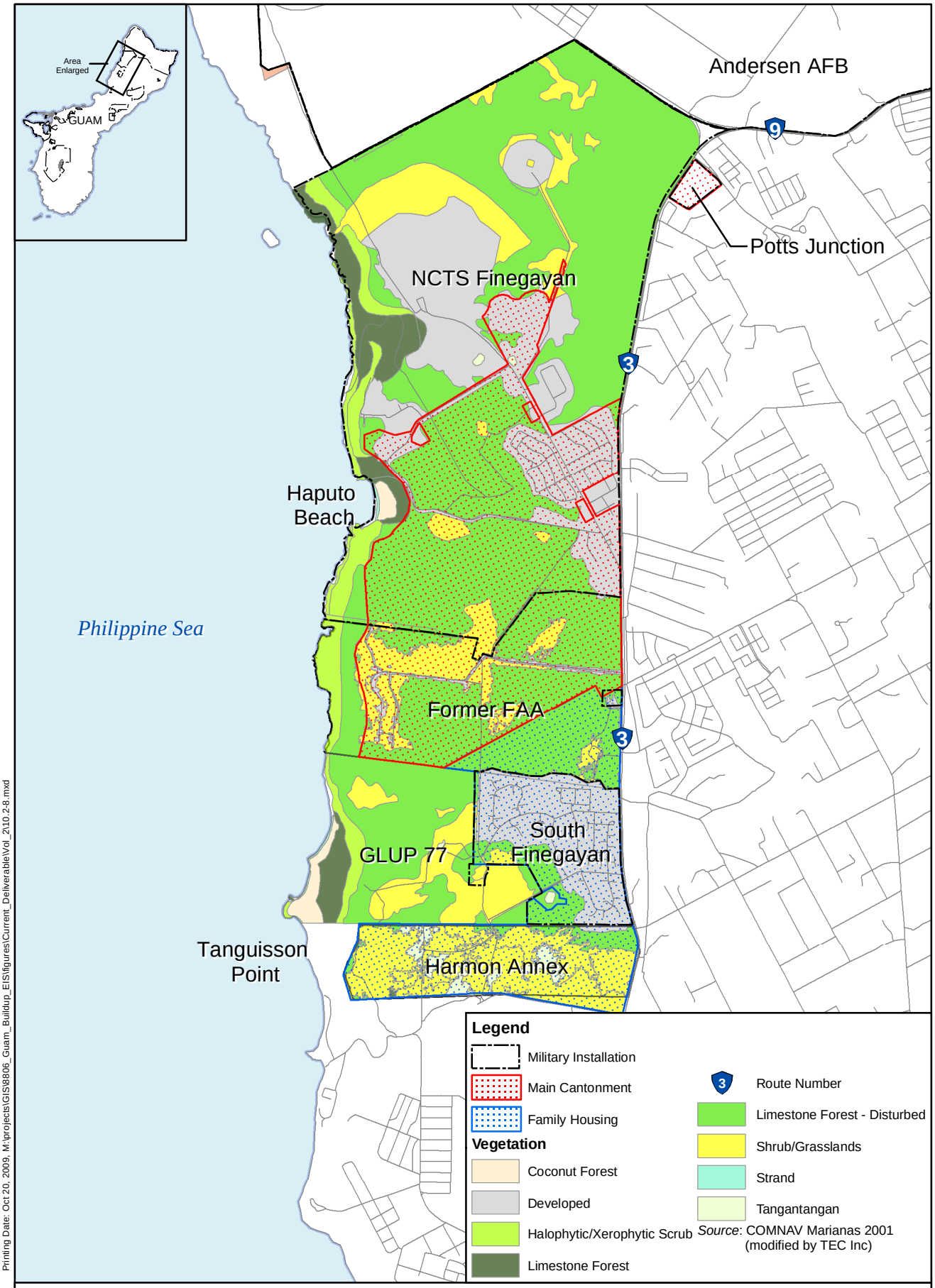


Figure 10.2-8
Potential Vegetation Impacts - Alternative 1
(NCTS Finegayan, Former FAA Parcel, South Finegayan, and Harmon Annex)

An indirect impact would occur from clearing large forested areas because of changes in evapotranspiration. Evapotranspiration would likely decrease from removal of the forest which would result in additional infiltration of rainwater and groundwater recharge and decreased moisture levels in the air. With respect to groundwater recharge, the construction of buildings and parking lots would have the opposite effect of reducing recharge. The overall effect on recharge is unclear but terrestrial biological resources in the remaining uncleared areas would be unlikely to be affected. With respect to moisture levels in the air, the impact is likely to be localized to the forested area removed and would not have a significant effect on the Haputo ERA, particularly since the area where vegetation would be removed is on the plateau and Haputo ERA primarily occupies the cliffs and lower bench along the coastline. Overall, the impacts from changed evapotranspiration would be less than significant.

Wildlife. Wildlife species that currently occur at Finegayan are native and non-native species that are common elsewhere on Guam, such as Pacific golden plover, yellow bittern, black francolin, Eurasian tree sparrow, blue-tailed skink, mutilating gecko, and mourning gecko. Feral pigs and deer are also present. No SOGCN species are known to occur in the area that would be developed. Construction activities would displace wildlife from habitat in the proposed project areas. The loss of woody vegetation would result in the reduction of nesting areas for the bittern, but this would not result in significant adverse effects on its population. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities; however, long-term, permanent impacts to populations of such species would not result because these species are abundant in surrounding areas and would rapidly repopulate portions of the affected area. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts to wildlife would be less than significant with implementation of Alternative 1 at Finegayan.

Noise from proposed construction activities would have an indirect effect on wildlife. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. All main cantonment components would be constructed on the upper plateau area. The Haputo ERA would remain as is and would be available to serve as a migration corridor for species moving or dispersing from Andersen AFB to potential habitat further south or from these areas to the north. Proposed construction activities could directly impact habitat for a number of ESA-listed species that currently occur on Guam and impact essential habitat and recovery zones that could serve as potential reintroduction areas for ESA-listed species that are currently extirpated or nearly extirpated from Guam.

MARIANA FRUIT BAT. Sightings of the fruit bat are uncommon at NCTS Finegayan (two sightings reported in 10 observation days) and occur in the Haputo ERA area or the very northern portion of the facility and there are no known colonial roost areas. Proposed construction activities would include the loss of disturbed limestone forest that is potential foraging and roosting habitat for the Mariana fruit bat. A total of 174 ac (70 ha) of essential habitat would be removed for construction of the various project components on the base (Table 10.2-6). This essential habitat is also designated Overlay Refuge (see Figure 10.2-9). Removal of these areas due to construction would have a significant direct impact due to the loss of habitat areas that would support the fruit bat in the future. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Because the fruit bat is currently rarely observed south of Andersen AFB, indirect impacts from noise generated during construction would be less than significant.

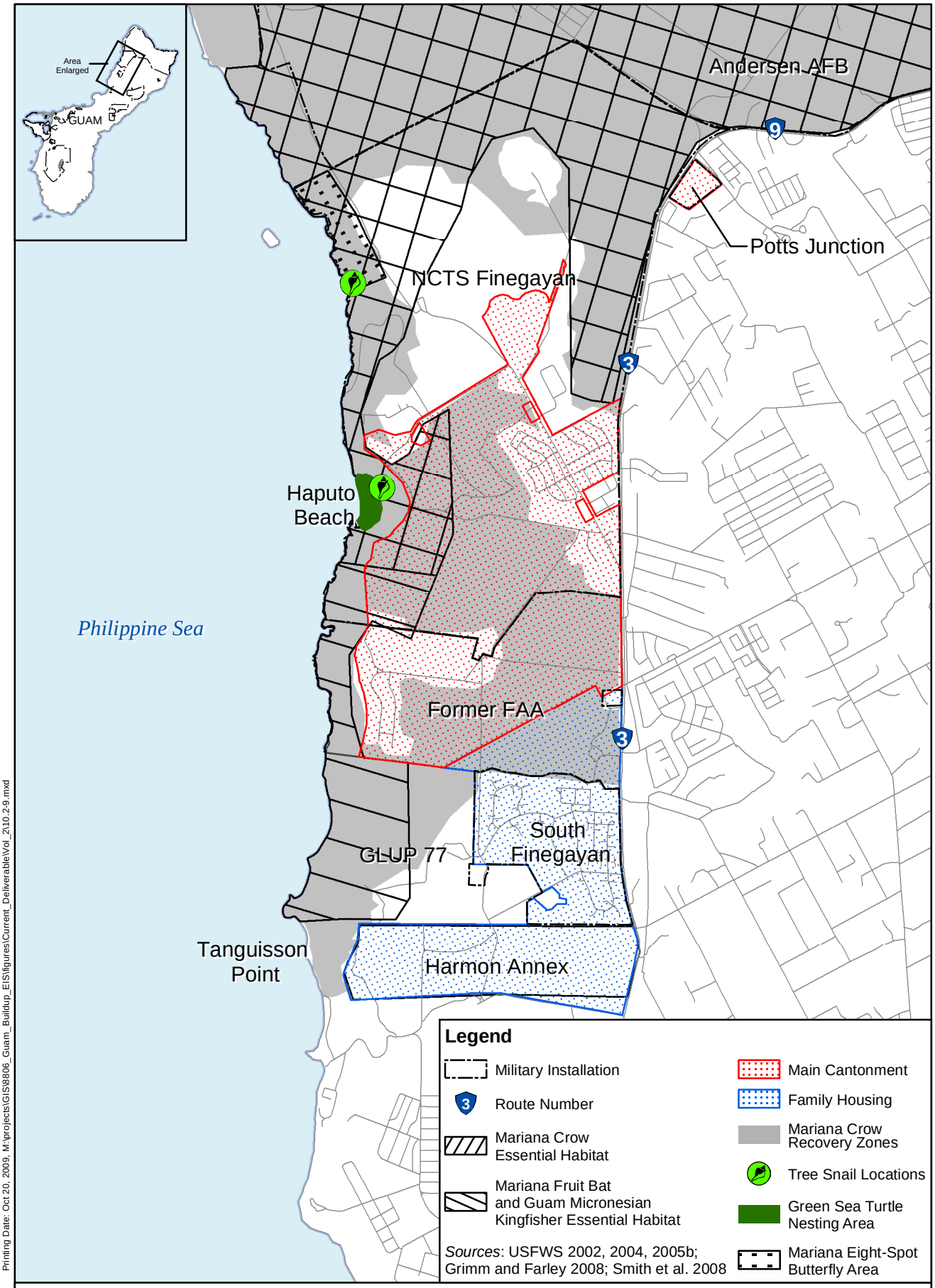


Figure 10.2-9
Potential Special-Status Species Impacts - Alternative 1
(NCTS Finegayan, South Finegayan, Former FAA Parcel, and Harmon Annex)

GUAM MICRONESIAN KINGFISHER. The kingfisher is not currently present in the wild. Proposed construction activities would include the loss of limestone forest that represents potential habitat that could be used by the species after future reintroduction. A total of 174 ac (70 ha) of essential habitat would be removed for construction of the various project components on the base (see Table 10.2-6). This essential habitat is also designated Overlay Refuge (see Figure 10.2-6). Removal of these areas, due to construction, would have a significant impact because they represent Overlay Refuge and essential habitat for the conservation and reintroduction of the species. Impacts would be significant. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

MARIANA CROW. Proposed construction activities would include the loss of 119 ac (48 ha) of limestone forest that is potential foraging and nesting habitat for the Mariana crow, and essential to the species' recovery. This essential habitat is also designated Overlay Refuge (see Figure 10.2-9). Removal of these areas, due to construction, would have a significant impact. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. No specific areas of essential habitat have been described for this species, but 49 ac (20 ha) of favorable shrub/grasslands habitat and contained within the Refuge Overlay would be removed. However, because the Guam rail is currently extirpated in the wild and most of Guam has habitat that is potentially suitable for the recovery of the species, removal of these areas due to construction would result in a less than significant impact.

Table 10.2-6. Potential Impacts to Special-Status Species Habitat at NCTS Finegayan, Former FAA Parcel, South Finegayan, and Harmon Annex with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Overlay Refuge*[1]	*Essential Habitat – Bat and Kingfisher*[1]	*Essential Habitat – Crow*[1]	*Crow Recovery Zone*[1]
Direct Impacts from Construction – Habitat Removed				
NCTS Finegayan	599 (242)	174 (70)	119 (48)	519 (210)
Former FAA Parcel and Harmon Annex	0	0	0	450 (182)
Total Habitat Removed	**599 (242)**	**174 (70)**	**119 (48)**	**969 (392)**
% of Habitat Type on Guam that is Affected	2.6 %	0.7 %	0.5 %	2.7 %
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity				
60-m buffer for MC (F, N) – Ground Ops				
NCTS and South Finegayan	60 (24)	NA	23 (9.3)	38 (15)
Former FAA Parcel and Harmon Annex	0.6 (0.2)	NA	0	28 (11)
Totals	61 (25)	NA	23 (9.3)	66 (27)
100-m buffer for KF (F, N) – Ground Ops				
NCTS Finegayan	100 (40)	54(22)	NA	NA
Former FAA Parcel and Harmon Annex	1.7 (0.7)	32 (13)	NA	NA
Totals	102 (41)	86 (35)	NA	NA
150-m buffer for FB (R) – Ground Ops				
NCTS and South Finegayan	147 (59)	89 (36)	NA	NA
Former FAA Parcel and Harmon Annex	3.9 (1.6)	60 (24)	NA	NA
Totals	151 (61)	149 (60)	NA	NA

Notes: Each habitat category is considered independently of others and are not additive. NA – Not applicable, FB – Fruit Bat, MC - Mariana Crow, KF – kingfisher, F – Foraging, R – Roosting/Colony, N - Nesting.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed action. Damage from ungulate disturbance of forested areas is a serious concern in Guam. Damage from ungulates on NCTS Finegayan ranges is moderate to severe throughout the area proposed for the main cantonment. Removal of the large amounts of habitat under Alternative 1 would displace and concentrate feral pigs and Philippine deer into adjacent areas, resulting in even higher densities. Assuming a potential density of 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) (Knutson and Vogt 2002) and the total of 612 ac (248 ha) of forest or shrubland to be removed, the number displaced would be approximately 43 deer and 92 pigs. This additional ungulate activity would result in significant impacts to all special-status species because of degradation of essential habitat and Overlay Refuge. As mitigation, an existing ungulate management plan that is currently being finalized would be updated to include specific management and control for the increase in ungulates resulting from this action and the plan would be implemented at NCTS Finegayan. Mitigation measures are further described in Section 10.2.2.6. With mitigation, impacts to habitat from ungulates would be less than significant.

Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. The impacts are discussed in detail under operations below. Impacts would be significant but numerous mitigation measures, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. Operations would not remove any limestone forest. Invasive plant species are likely to expand their ranges and new species are likely in some areas due to the increase in number of increased activities such as more training, more personnel, and more vehicles. However, this is unlikely to substantially impact primary limestone forest because most activities are away from primary forest areas that are located at Haputo ERA. Access to Haputo ERA would be limited. Therefore, impacts would be less than significant.

Wildlife. Indirect impacts include increased noise and human activity, increase and possible spread of feral and semi-feral animals, and increased recreational use of areas (especially those areas adjacent to the new housing and base). Operational activities would generate noise throughout the area. However, migratory bird species or other native wildlife that would otherwise use the area are common throughout Guam, and can utilize numerous habitats that are found throughout Guam. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, direct and indirect impact from noise and activity from operations associated with the proposed action would be less than significant.

Indirect impacts would occur from feral or unleashed animals. Housing is proposed for up to 3,520 families. The military typically allows two pets per family. Assuming that half of all families would have pets, the number of pets could be as high as 3,520. Cats and dogs that are not controlled, or that become feral due to escape or abandonment, are of concern due to their potential predation on native and non-native wildlife, particularly migratory birds. Shorebirds at Haputo beach and other beaches north and south along the shoreline would also be vulnerable. Skinks and geckos would also be preyed upon by cats. Impacts would be significant. Mitigation would be implemented through pet ownership policies and Base instructions or orders to ensure that pets are controlled and are not allowed in the Haputo ERA. With

mitigation there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species and impacts would be less than significant.

Special-Status Species. There would be no direct impacts from operations. Indirect impacts are described below.

MARIANA FRUIT BAT. Based on observations of roosting Mariana fruit bats, it is expected that fruit bats are likely to avoid areas within 492 ft (150 m) of the proposed facilities due to human activity from housing and during operations and maintenance, and perimeter and facility lighting at night. Based on the essential habitat available within that distance, approximately 89 ac (36 ha) would be indirectly impacted by the operation of the proposed cantonment facilities at NCTS Finegayan (see Table 10.2-6). This significant impact would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

GUAM MICRONESIAN KINGFISHER. The Guam Micronesian kingfisher has been extirpated from the wild and currently occurs only in captive breeding populations. When reintroduced in the future, it is expected that kingfishers are likely to avoid areas within 328 ft (100 m) of the proposed facilities due to human activity from housing and during operations and maintenance, and perimeter and facility lighting at night. Based on the essential habitat available within that distance, approximately 54 ac (22 ha) would be indirectly impacted by the operation of the proposed facilities proposed cantonment facilities at NCTS Finegayan (see Table 10.2-2). This significant impact would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

MARIANA CROW. Based on observations of foraging Mariana crow, it is expected that crows are likely to avoid areas within 197 ft (60 m) of the proposed facilities due to human activity from housing and during operations and maintenance, and perimeter and facility lighting at night. Based on the essential habitat available within that distance, approximately 23 ac (9.3 ha) would be indirectly impacted by the operation of the proposed facilities proposed cantonment facilities at NCTS Finegayan (see Table 10.2-2). This significant impact would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

GUAM RAIL. The Guam rail has been extirpated from the wild and currently occurs only as captive breeding populations. Cats and dogs that are not controlled, or that become feral, are of concern due to their potential predation on the Guam rail should it be reintroduced. Controls to prevent stray or feral animals would be implemented, as described in Section 10.2.2.6. Other effects from housing and ground operations are not expected to compromise the conservation and recovery process described in the rail recovery plan (USFWS 1990b). With implementation of the mitigation measures described in Section 10.2.2.6, including support for ungulate eradication and restoration of potential rail foraging and nesting habitat, the proposed operation of the operations areas at Finegayan would have a less than significant impact.

SEA TURTLES. Cats and dogs that are not controlled, or that become feral, are of concern due to their potential predation on sea turtles. Mitigation measures would be implemented to control pets and feral animals and to prohibit them from being taken into Haputo ERA. With these mitigation measures, impacts would be less than significant. Increased potential recreational use of the beach by marines and their families, particularly at Haputo Beach, could adversely impact the green sea turtle through harassment. Mitigation measures would be implemented to restrict use of the area and minimize disturbance. Pets would not be allowed in the Haputo ERA to prevent potential turtle disturbance. With these controls, impacts to sea turtles would be less than significant. The Marine Corps presence would also provide a benefit because poachers would be less likely to frequent the area.

TREE SNAILS. Three species of tree snails, all candidates for federal listing are present along the coast at Haputo Beach and further north in Haputo ERA. Increased potential recreational use of these areas by Marines and their families, particularly at Haputo Beach, could adversely impact these species from disturbance of vegetation, collection of the shells, or handling of the individuals. Mitigation measures would be implemented to reduce the potential impact and to stop or minimize disturbance. Increased use of the beach would have a significant impact on these species. Mitigation would be implemented that would include restrictions on the use of this area. With implementation of this mitigation, impacts to the species would be less than significant.

MARIANA EIGHT-SPOT BUTTERFLY. Two colonies of this federal candidate species were reported from the Tweed's Cove area at Haputo ERA. Increased use of this area would result in significant impacts to the species. Because of their relatively remote locations and with mitigation measures to prevent excessive use of this area, impacts to the species would be less than significant.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed action. The movement and spread of invasive plant and animal species from operations was described above under Andersen AFB and these same concerns and mitigation measures to address them would also apply at Finegayan. Detailed descriptions of the mitigation measures are provided in Section 10.2.2.6, Potential Mitigation Measures. Once all mitigation measures and BMPs are applied, impacts from invasive species would be less than significant.

Non-DoD Land

Construction

Vegetation. A total of 1.0 ac (0.4 ha) of limestone forest and 480 ac (194 ha) of disturbed limestone forest would be removed during proposed construction activities on the former FAA parcel and Harmon Annex (see Table 10.2-5 and Figure 10.2-9). Approximately 387 ac (157 ha) of shrub/grassland and 32 ac (13 ha) of tangantangan would be removed from these same areas. The limestone forest is not known to harbor any sensitive plant species identified by government or conservation groups. Direct impacts to vegetation would be less than significant because only a very small amount of primary limestone forest would be removed in the upper plateau area. Removal of disturbed limestone forest, while not considered a significant impact for vegetation, is further evaluated for impacts wildlife and special-status species below.

Wildlife. Wildlife species that currently occur at the former FAA parcel are similar to those that occur at NCTS Finegayan. No SOGCN species are known to occur in the area that would be developed. Based on having similar vegetation, it is assumed that the Harmon parcel would support similar wildlife species. Based on the similar types of actions occurring here as at NCTS Finegayan, there would be no significant impacts to wildlife with implementation of Alternative 1.

Construction activities for the cantonment would generate noise. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas and occupy other areas of suitable habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. All main cantonment components would be constructed on the upper plateau area. Proposed construction activities could directly impact habitat for two ESA-listed species that currently occur on Guam.

MARIANA CROW. Proposed construction activities would include the loss of wooded areas that are designated as recovery zone for the crow in the recovery plan. A total of 450 ac (182 ha) of this recovery zone would be removed for construction of the various project components on the base (see Table 10.2-6 and Figure 10.2.9). Large areas of recovery zone would remain on Andersen AFB as well as smaller areas remaining at NCTS Finegayan as shown in Figure 10.2-9. No Overlay Refuge is designated in this area. Removal of these areas due to construction would have a significant impact. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. No Overlay Refuge is designated in this area. No specific areas of essential habitat or other habitat have been identified for this species but 387 ac (157 ha) of favorable shrub/grasslands habitat would be removed (see Figure 10.2-9). Because the rail is not currently present at this location and no specific habitat areas have been identified as essential habitat, construction would have a less than significant impact on the species.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on both the Mariana crow and Guam rail from degradation of habitat would occur as a result of the proposed action. Existing ungulate damage on the former FAA parcel is generally moderate in the area proposed for the main cantonment based on field observations and this is also assumed to apply for Harmon Annex. Removal of the large amounts of habitat required for construction under Alternative 1 would displace feral pigs and Philippine deer into adjacent areas resulting in even greater density than currently exists. Assuming a potential density of 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) (Knutson and Vogt 2002) and the total of 899 ac (364 ha) of forest or shrubland to be removed, the number displaced would be about 63 deer and 135 pigs. This additional ungulate activity would result in significant impacts to the Mariana crow because of degradation of recovery zones and to the Guam rail due to degradation of potential habitat. As mitigation, an existing ungulate management plan that is currently being finalized would be updated to include specific management and control for the increase in ungulates resulting from this action. With this mitigation, impacts would be less than significant.

Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. The impacts are discussed in detail under operations below. Impacts would be significant but numerous mitigation measures, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. Operations would not remove any limestone forest. Invasive plant species are likely to expand their ranges and new species are likely in some areas due to the increase in number of increased activities such as more training, more personnel, and more vehicles. However, this is unlikely to substantially impact primary limestone forest because most activities are well away from these forested areas. Therefore, impacts would be less than significant.

Wildlife. Indirect impacts would include noise, human activity, and feral animals. Operational activities would generate noise throughout the area. However, migratory bird species or other native wildlife that would otherwise use the area are common throughout Guam and are generalists that can utilize numerous habitats that are abundant throughout Guam. There would be no diminished population sizes or

distributions of migratory birds or regionally important native animal species. Therefore, direct and indirect impacts from noise and activity from operations associated with the proposed action would be less than significant.

As discussed for Finegayan, the number of pets could be as high as 3,520. Cats and dogs that are not controlled, or that become feral due to escape or abandonment, are of concern due to their potential predation on native and non-native wildlife, particularly migratory birds. Cliff-line habitat that may be roosting areas for seabirds would be in close proximity to the family housing. Shorebirds at beaches in the Tanguisson and Hilaan areas would also be vulnerable. Skinks and geckos would also be preyed upon by cats. Impacts would be significant. Mitigation would be implemented through pet ownership policies and Base instructions or orders to ensure that pets are controlled and not allowed at Haputo Beach. Feral cats and dogs and rodents would be controlled by trapping or other techniques. With this mitigation, impacts would be less than significant.

Special-Status Species. There would be no direct impacts from housing and other operations. Indirect effects include impacts related to recreation, feral animals, and invasive species. The impacts from these proposed operations at the combined cantonment area (extending from NCTS Finegayan to Harmon) from these indirect effects have already been addressed above under NCTS and South Finegayan. Indirect impacts to special-status species would result from avoidance of essential habitat near human activity from housing and during operations and maintenance, and perimeter and facility lighting at night. The areas avoided, as specified in Table 10.2-6 are: fruit bat roosting activity - 60 ac (24 ha) and kingfisher activity – 32 ac (13 ha). Indirect impacts from these human activities and lighting would be significant. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

10.2.2.2 Central

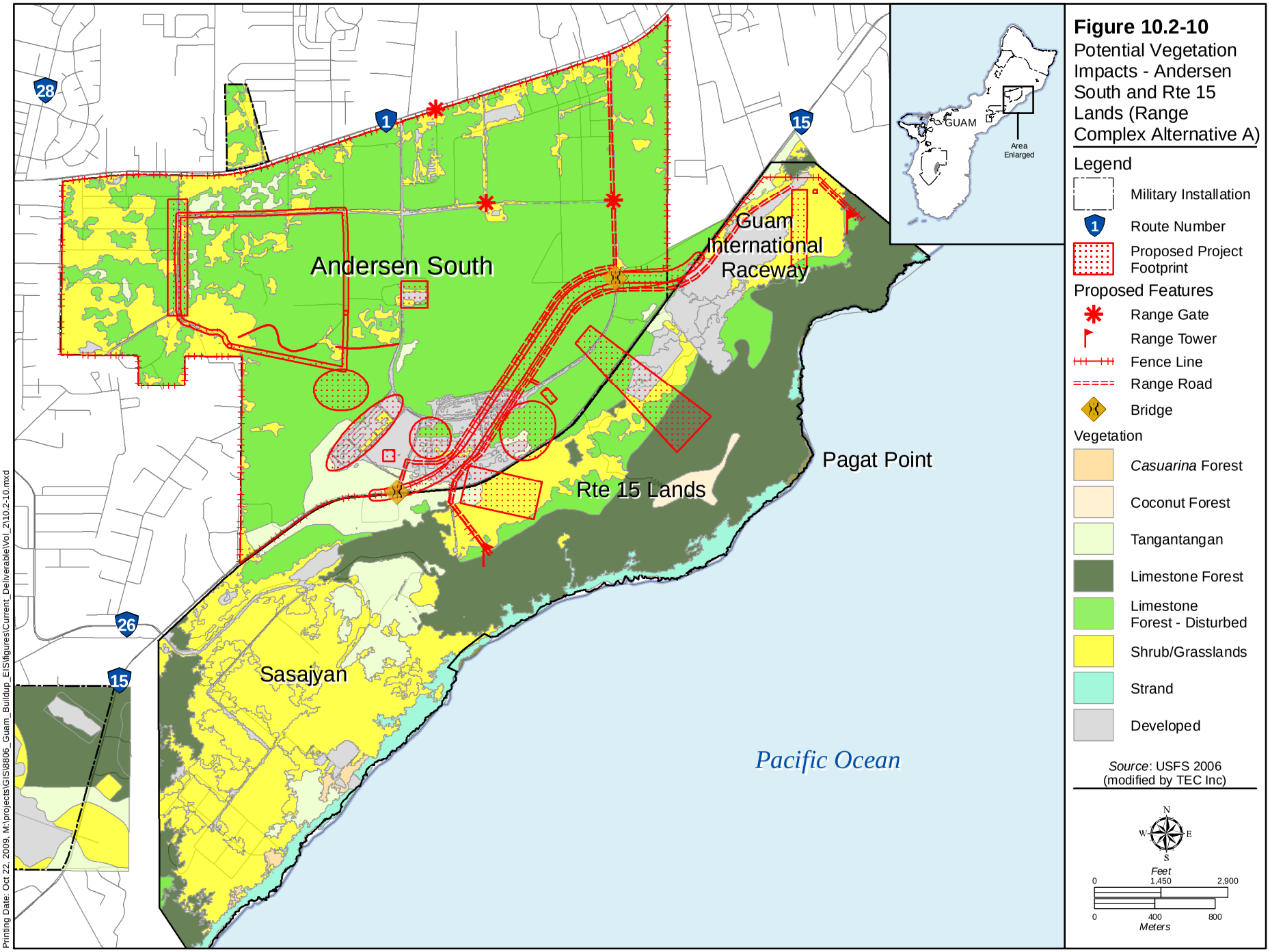
Andersen South and Non-DoD – Alternative A

Construction

Vegetation. Vegetation would be removed to construct various facilities at Andersen South and non-DoD lands. A total of 19 ac (7.7 ha) of primary (mature forest dominated by native species) limestone forest would be removed and 150 ac (61 ha) of disturbed limestone forest would be removed during proposed construction activities at Andersen South and the non-DoD lands (refer to Table 10.2-7 and Figure 10.2-10). The primary limestone forest that would be removed is mixed plateau forest, and it harbors a special-status plant species (see discussion below).

Table 10.2-7. Potential Impacts to Vegetation Communities at Andersen South and Route 15 Lands with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Limestone Forest, Disturbed*	*Shrub/ Grasslands*	*Tangantangan*	*Developed*
Andersen South and Non-DoD Alternative A Construction Areas (vegetation removed)					
Firing Range Training Areas	18 (7.3)	28 (11)	40 (16)	4.0 (1.6)	14 (5.7)
Hand Grenade Training	0	18 (7.3)	0	0	6.0 (2.4)
AMVOC Training Areas	0	16 (6.5)	6.7 (2.7)	0.2 (0.1)	1.5 (0.6)
Pioneer Road	0	3.6 (1.5)	0.8 (0.3)	0	0
MOUT Areas	0	24 (9.7)	3.5 (1.4)	1.5 (0.6)	31 (13)
Convoy Course	0	17 (6.9)	9.4 (3.8)	0	4.0 (1.6)
Landing Zones	0	3.1 (1.3)	1.7 (0.7)	0	4.3 (1.7)
Firing Range Access Areas	0	1.8 (0.7)	1.9 (0.8)	0.1 (0.04)	3.1 (1.3)
Range Roads and Control Areas	0.6 (0.2)	15 (6.1)	5.0 (2.0)	0.5 (0.2)	9.0 (3.6)
Fencing	0.3 (0.1)	9.3 (3.8)	8.1 (3.3)	1.6 (0.6)	4.2 (1.7)
Totals	**19 (7.7)**	**136 (55)**	**77 (31)**	**8.0 (3.2)**	**77 (31)**
Andersen South and Non-DoD Alternative B Construction Areas (vegetation removed)					
Firing Range Training Areas	13 (5.3)	12 (4.9)	61 (25)	0	15 (6.1)
Hand Grenade Training	0	27 (11)	0	0	0
AMVOC Training Areas	0	16 (6.5)	6.7 (2.7)	0.2 (0.1)	1.5 (0.6)
Pioneer Road	0	3.6 (1.5)	0.8 (0.3)	0	0
MOUT Areas	0	8.3 (3.4)	4.1 (1.7)	2.0 (0.8)	46 (19)
Convoy Course	0	17 (6.9)	9.4 (3.8)	0	4.0 (1.6)
Landing Zones	0	3.1 (1.3)	1.7 (0.7)	0	4.3 (1.7)
Firing Range Access Areas	0.4 (0.2)	0.8 (0.3)	1.8 (0.7)	0	3.9 (1.6)
Range Roads and Control Areas	0.7 (0.3)	3.4 (1.4)	4.9 (2.0)	0.4 (0.2)	2.6 (1.1)
Fencing	1.5 (0.6)	6.4 (2.6)	9.5 (3.8)	3.9 (1.6)	4.8 (1.9)
Totals	**16 (6.5)**	**98 (40)**	**100 (40)**	**6.5 (2.6)**	**82 (33)**


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
28
1
15
26
15
Figure 10.2-10
Potential Vegetation Impacts - Andersen South and Rte 15 Lands (Range Complex Alternative A)
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Vegetation
Casuarina Forest
Coconut Forest
Tangantangan
Limestone Forest
Limestone Forest - Disturbed
Shrub/Grasslands
Strand
Developed
Source: USFS 2006 (modified by TEC Inc)
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
Printing Date: Oct 22, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\10.2-10.mxd

Wildlife. Wildlife species that currently occur at Andersen South and the non-DoD parcels are non-native species that are common elsewhere on Guam, such as Eurasian tree sparrow, island collared dove, black francolin, curious skink, Pacific blue-tailed skink, house gecko, greenhouse frog, and cane toads. All these species are common on Guam and most are not native. Indicators of ungulate use, both feral pig and Philippine deer, were observed in all areas, but at a much greater density at Andersen South than the non-DoD parcels. Soil and vegetation damage ranged from light to severe. In one area on the eastern side of Andersen South, feral pigs were very abundant and were readily heard and observed. Based on the species and existing conditions and no diminished population sizes or distributions of migratory birds or regionally important native animal species, impacts to wildlife would be less than significant.

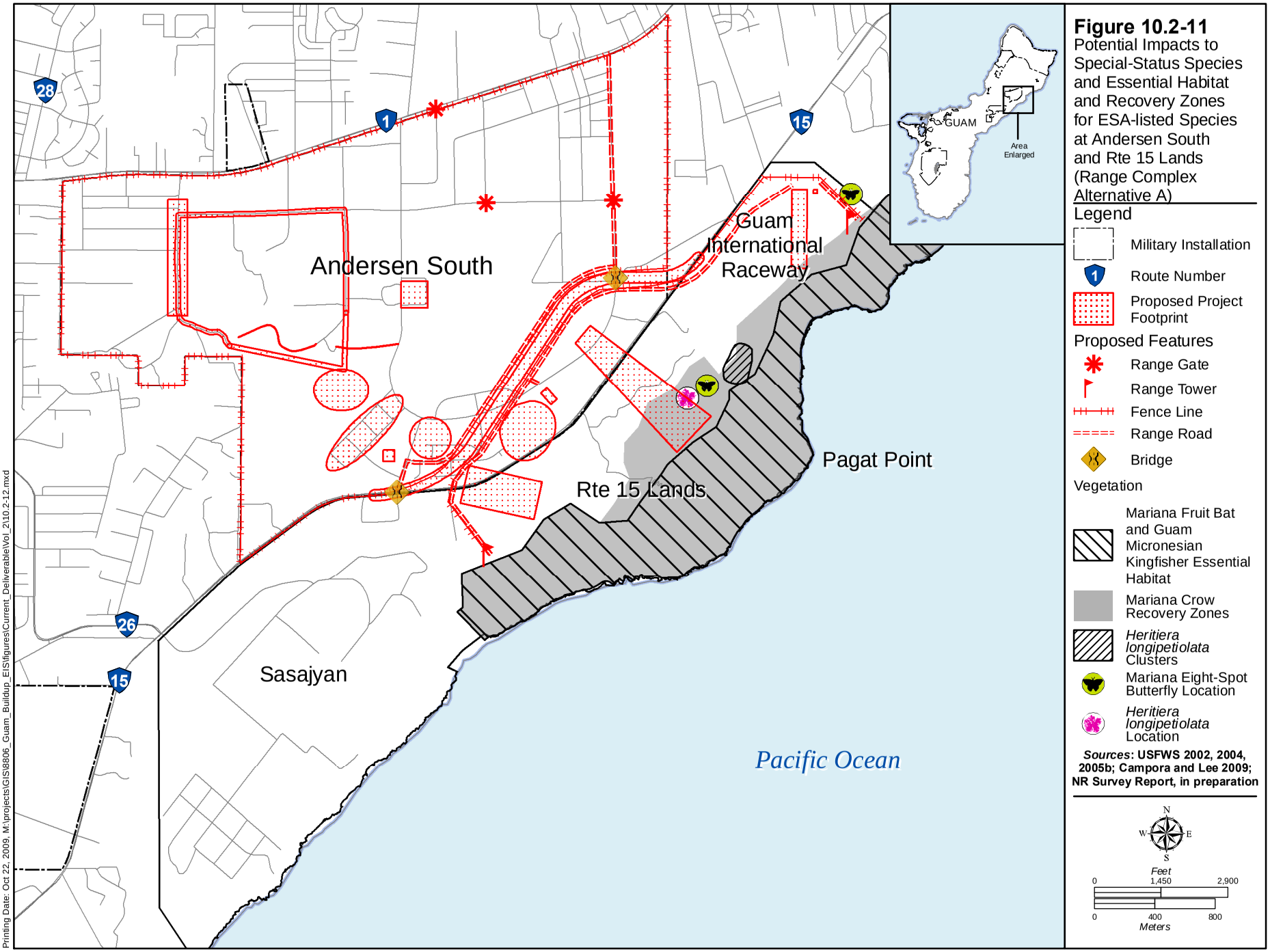
Construction activities for ranges and training areas would generate noise. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. At Andersen South, no special-status species have been reported as occurring onsite, and none were observed in recent project-specific surveys. At the non-DoD parcels, proposed construction activities could directly impact habitat for a number of ESA-listed species that currently occur on Guam. Construction activities would generate noise throughout the area. However, no special-status species are known to currently use the area. Therefore, noise and activity from construction associated with the proposed action would be less than significant.

MARIANA FRUIT BAT. The fruit bat has not been documented in project-specific surveys conducted at Andersen South and Route 15 lands and there have been no reported observations since 1999. They may move through the area, or use the area occasionally. Essential habitat has been designated for the species in the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast, but project areas do not extend into the essential habitat or any other designated critical habitat area. However, some primary limestone forest that is potential habitat would be removed. Because no designated habitat areas are removed there would be a less than significant impact on the fruit bat from construction activities.

MICRONESIAN KINGFISHER. The kingfisher currently survives only in captivity. Essential habitat has been designated for the species in the northern parcel, beginning along the cliff and down into the lower bench area along the coast (Figure 10.2-11); however, no construction is proposed for this portion of the project area. However, some primary limestone forest that is potential habitat would be removed. Because no designated habitat areas are removed there would be a less than significant impact on the fruit bat from construction activities.

MARIANA CROW. The crow does not currently occur in the project area. Construction would not occur in essential habitat (see Figure 10.2-11). However, construction would remove 22 ac (8.9 ha) of recovery zone habitat specified in the recovery plan within limestone forest in the plateau area of the parcel (see Table 10.2-8). Removal of this currently unoccupied habitat would have a less than significant impact on the species because the amount removed would be minor in relation to the overall recovery zone about on Guam (0.06%), including large areas adjacent to the proposed construction (see Figure 10.2-11), and would not significantly affect the recovery of the species (the amount of habitat required to meet recovery plan goals for the species is estimated at 8,100 ac [3,278 ha] compared to the total currently available of 23,004 ac [9,309] in Section 10.1.1.3).


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
28
1
15
26
15
Figure 10.2-11
Potential Impacts to Special-Status Species and Essential Habitat and Recovery Zones for ESA-listed Species at Andersen South and Rte 15 Lands (Range Complex Alternative A)
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Vegetation
Mariana Fruit Bat and Guam Micronesian Kingfisher Essential Habitat
Mariana Crow Recovery Zones
Heritiera longipetiolata Clusters
Mariana Eight-Spot Butterfly Location
Heritiera longipetiolata Location
Sources: USFWS 2002, 2004, 2005b; Campora and Lee 2009; NR Survey Report, in preparation
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
Printing Date: Oct 22, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\10.2-12.mxd

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail, should it be reintroduced. No specific areas of essential habitat have been designated for this species (refer to Figure 10.2-11). Based on the current absence of the species in the area and lack of designated habitat, there would be no impact on the species.

MARIANAS EIGHT-SPOT BUTTERFLY. This candidate species was observed in a mixed host plant area approximately 300 ft (91 m) from the Alternative A proposed machine gun range footprint during 2008 site-specific surveys (see Figure 10.2-11). Scattered individuals of its two host plants were also observed within the machine gun range footprint. An individual butterfly was also observed in a mixed host plant area approximately 50 ft (15 m) northeast of the proposed northern-most fenceline (see Figure 10.2-11). Scattered individuals of its two host plants were also observed within the proposed fenceline and access road footprints. Because only scattered host plants would be removed and the large mixed host plant areas would remain, impacts would be less than significant.

HERITIERA LONGIPETIOLATA. One specimen of this State-listed tree has been identified near or within the boundary of the Alternative A machine gun range near the southeastern corner. A complete survey of the range footprints and surrounding area has not been completed but would be completed prior to clearing. If any individuals are in areas to be cleared, they would be transplanted if possible, or attempts would be made to propagate the species for transplanting elsewhere. Additional information is provided under the mitigation discussion (Section 10.2.2.6). With implementation of this mitigation, impacts to the species would be less than significant.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. Awareness training and inspection of gear, clothing, and equipment as part of existing control measures would occur. The impacts are discussed in detail under operations below. Impacts would be significant but numerous mitigation measures and BMPs, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. Trees and shrubs in the surface danger zones (SDZs) of firing ranges would be damaged from stray munitions. However, stray bullets would be minimal, and are unlikely to damage the vegetation enough to kill individual specimens. Invasive plant species are likely to expand ranges and new species are likely in some areas due to the increase in activities such as more training, more personnel, and more vehicles. However, this is unlikely to substantially impact primary limestone forest as long as the substrate of the primary forest remains intact. Therefore, impacts would be less than significant.

Wildlife. Wildlife in the SDZs of firing ranges may be killed from stray munitions. However, stray munitions would be minimal. Assuming that 0.01% of munitions fall outside the range and in the SDZ, an estimated 1,013 bullets would fall on land within the SDZ for Alternative A over the course of a year. All wildlife present is widespread on Guam, so populations would not be diminished. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Direct and indirect impacts would be less than significant.

Operations at the ranges and training areas would generate noise. The few migratory birds likely to be present (such as the yellow bittern and Pacific golden plover) are widespread on Guam. They would be affected and would move away from these areas, but there are large areas of habitat nearby where they could move to, when disturbed. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Direct and indirect impacts from noise and activity associated with operations would result in less than significant impacts to wildlife.

Special-Status Species. Stray munitions may fall within the SDZs; however, the possibility of an individual animal or plant being struck is remote. As mentioned above, an estimated 1,013 bullets would fall on land within the SDZ for Alternative A over the course of a year.

MARIANA FRUIT BAT. Although not documented historically in the area, essential habitat has been designated in the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast (refer to Figure 10.2-11). Significant indirect impacts from general noise and activity would occur in surrounding areas. These areas are estimated in Table 10.2-8. Other noise increases would occur from the proposed training actions. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Noise would be generated at the proposed breacher facility at Andersen South and at small arms ranges on the Route. 15 lands. Noise studies have been conducted for these facilities. The breacher facility was evaluated using the CDNL noise levels and the small arms ranges were evaluated using a metric termed the PK15 (met) which is the peak noise exceeded by 15% of firing events and is a linear peak sound pressure level of individual shots rather than a cumulative or average level (using this measure means the size of the contours would not change if the number of rounds fired increased). The 70 dB CDNL contour within essential habitat for the fruit bat would cover a total of 49 ac (20 ha) of essential habitat for the breacher facility and the 104 dB PK15 (met) would cover 241 ac (98 ha) for the small arms ranges under the proposed action. The Mariana fruit bat is not known to currently occur at Andersen South or the Route. 15 lands. However, given the limited amount of information available on the noise susceptibility of the fruit bat, noise from the breacher facility and small arms ranges may have a significant impact to individuals that may potentially forage or roost at Andersen South or the Route. 15 lands. To assess the potential for proposed range activities to impact fruit bats, regular surveys of the Route. 15 lands would be conducted to determine the occurrence of fruit bats. If fruit bats are observed, monitoring of the species in areas surrounding the range facilities would be conducted to determine potential noise impacts. If this monitoring determined that the fruit bat was being affected, techniques to reduce noise generation, such as noise barriers, would be employed. With this mitigation, impacts would be less than significant.

MICRONESIAN KINGFISHER. The kingfisher currently survives only in captivity, but essential habitat has been designated in the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast (refer to Figure 10.2-11). As with the fruit bat, noise impacts to this species from weapons firing, should it be reintroduced, would be determined after monitoring of the species. Indirect impacts from general noise and activity to kingfishers may occur if they are reintroduced into the area. These areas are estimated in Table 10.2-8.

MARIANA CROW. The crow does not currently occur in the project area. No essential habitat has been determined for the area. A recovery zone is designated in the recovery plan for the coastal area and including the limestone forest in the plateau area of the parcel (see Figure 10.2-11). Significant indirect impacts from general noise and activity would occur in surrounding areas. These areas are estimated in Table 10.2-8.

Table 10.2-8.Potential Impacts to Special-Status Species Habitat at Andersen South and Route 15 Range Complex with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Essential Habitat – Bat and Kingfisher*	*Crow Recovery Zone*
Direct Impacts from Construction – Habitat Removed		
Ranges (Alternative A)	0	22
Ranges (Alternative B)	0	20
Habitat Removed Totals (using Alternative A)	0	22
Percentage of Habitat Type on Guam that is Removed (using Alternative A)	0 %	0.06 %
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity (Alternative A)		
60 m buffer for MC (F,N): Ground Ops; 100 m for KF (F,N): Ground Ops		
Perimeter Fencing	3.6 (1.4)	2.5 (0.9)
Range Roads	3.3 (1.3)	1.7 (0.7)
Range Control Towers	4.2 (1.7)	2.3 (1.0)
MG Range	6.7 (2.7)	16 (6.3)
UD Range	1.4 (0.6)	0.1 (0.03)
KD Range	1.2 (0.5)	3.3 (1.3)
Totals	20 (8.1)	26 (10)
150 m buffer for FB (R): Ground Ops		
Perimeter Fencing	7 (2.8)	NA
Range Roads	10 (4.1)	NA
Range Control Towers	12 (4.7)	NA
MG Range	15 (6.1)	NA
UD Range	4.8 (1.9)	NA
KD Range	4.3 (1.7)	NA
Totals	53 (21)	NA
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity (Alternative B)		
60 m buffer for MC (F,N): Ground Ops; 100 m for KF (F,N): Ground Ops		
Perimeter Fencing	1.6 (0.6)	4.0 (1.6)
Range Control Towers	1.1 (0.4)	2.8 (1.1)
UD Range	0 (0)	13 (5.4)
KD Range	0	5.0 (2.0)
Totals	2.7 (1.0)	25 (10)
150 m buffer for FB (R): Ground Ops		
Perimeter Fencing	4.3 (1.7)	NA
Range Control Towers	6.9 (2.8)	NA
UD Range	6.2 (2.5)	NA
KD Range	0.9 (0.3)	NA
Totals	18 (7.3)	NA

Notes: Each habitat category is considered independently of others and is not additive. NA – Not applicable.
FB – Fruit Bat, MC - Mariana Crow, KF – kingfisher, F – Foraging, R – Roosting/Colony, N – Nesting.

MARIANAS EIGHT-SPOT BUTTERFLY. This candidate species was observed near the Alternative A machine gun range area during 2008 site-specific surveys (NR Survey Report in preparation). Its two host plants were also observed in that area, and in areas within the machine gun range footprint. The eight-spot butterfly is unlikely to be affected by noise and activity in nearby ranges. Impacts would be less than significant.

HERITIERA LONGIPETIOLATA. As mentioned above, one specimen of this species is located within or near the machine gun range and additional surveys would be conducted. Any individuals within the SDZ would have a small chance of being struck by projectiles but these would not likely harm trees. Impacts to this species from operations would be less than significant.

ALL SPECIAL-STATUS SPECIES. The movement and spread of invasive plant and animal species within Guam and to other locations from Guam would degrade habitat for special-status species and are potential indirect impacts resulting from actions proposed in Alternative 1, Alternative A. Invasive species might be accidentally introduced to Guam, spread on Guam, or transported to other islands through aircraft operations, shipment of supplies and equipment to the new facilities, movement of troops and supplies during training activities, or movement of household goods. Species that might be introduced or spread include various plants such as *Vitex* that can degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat, invertebrates such as coconut beetles or the flatworm predator of native snails, BTS, various frog species, rodents, dogs, or cats. These influences could have significant impacts on all special-status species potentially occurring in the project area (the same as those discussed under construction direct impacts). To prevent potentially invasive species from being moved or spreading, and in particular the BTS from being introduced in other areas from Guam, the project would fund and facilitate a 100% inspection effort for all cargo, vehicles, munitions, household goods, and other items leaving Guam. In addition, various plans and procedures would be developed and implemented to address existing invasive species concerns such as invasive plants and ungulate damage that is affecting habitat quality of special-status species. These are described in Section 10.2.2.6, Potential Mitigation Measures. The successful implementation of a Biosecurity Plan (presently under preparation) and specific invasive species control procedures would help control the movement of invasive species so that impacts would be less than significant.

There is potential for ordnance-ignited wildfires that might impact designated habitat areas for the fruit bat, kingfisher, and crow. As mitigation, a Wildland Fire Management Plan would be developed for use in this area which would include prevention, planning, and suppression methods (see mitigation section 10.2.2.6). It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., firing may be disallowed under certain fire conditions) and location and management of fire breaks, fire fighting roads, and a fire fighting water system. Protocols for units undergoing training at the ranges would be briefed by range control on requirements suitable to the conditions of the day and protocols should a fire occur (e.g., specifying how the range would shut down and how fire suppression action would be taken). With implementation of the Wildland Fire Management Plan and procedures, impacts from training-related wildfires would be less than significant.

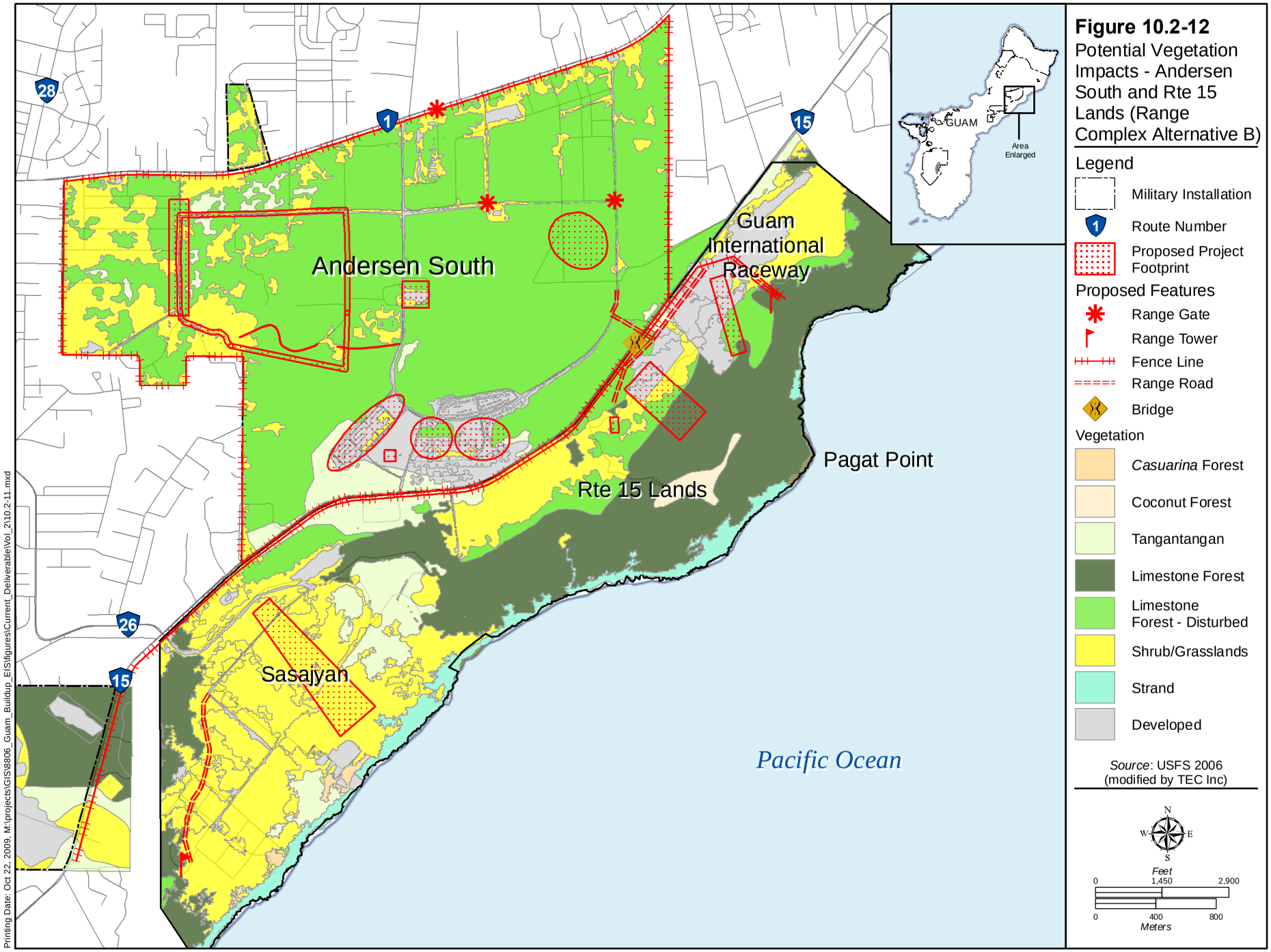
Andersen South and Non-DoD – Alternative B

Construction

Vegetation. Vegetation would be removed to construct various facilities at Andersen South and non-DoD Lands. A total of 16 ac (6.5 ha) of primary (mature forest dominated by native species) limestone forest and 112 ac (45 ha) of disturbed limestone forest would be removed during proposed construction activities at Andersen South and the non-DoD Lands (refer to Table 10.2-7 and Figure 10.2-12). The primary limestone forest that would be removed is mixed plateau forest. The limestone forest in the area does harbor a special-status plant species (see discussion below).

Wildlife. Impacts to wildlife would be the same as for Alternative A.

Special-Status Species. At Andersen South, no special-status species have been reported from the site, and none were observed in recent project-specific surveys. At the non-DoD parcels, proposed construction activities could directly impact habitat for a number of ESA-listed species that currently occur on Guam. Construction activities would generate noise throughout the area. In the area proposed for construction, no species are currently known to regularly use the area. Therefore, noise and activity from construction associated with the proposed action would be less than significant.


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
28
1
15
26
15
Figure 10.2-12
Potential Vegetation Impacts - Andersen South and Rte 15 Lands (Range Complex Alternative B)
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Vegetation
Casuarina Forest
Coconut Forest
Tangantangan
Limestone Forest
Limestone Forest - Disturbed
Shrub/Grasslands
Strand
Developed
Source: USFS 2006 (modified by TEC Inc)
N
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Feet
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1,450
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Meters
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MARIANA FRUIT BAT. The fruit bat has not been documented in historical or project-specific surveys from project areas and surrounding areas. Essential habitat has been designated for the species in the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast, but project areas do not extend into the essential habitat or any other designated habitat area. (Figure 10.2-13). However, some primary limestone forest that is potential habitat would be removed. Because no designated habitat areas are removed there would be a less than significant impact on the fruit bat from construction activities.

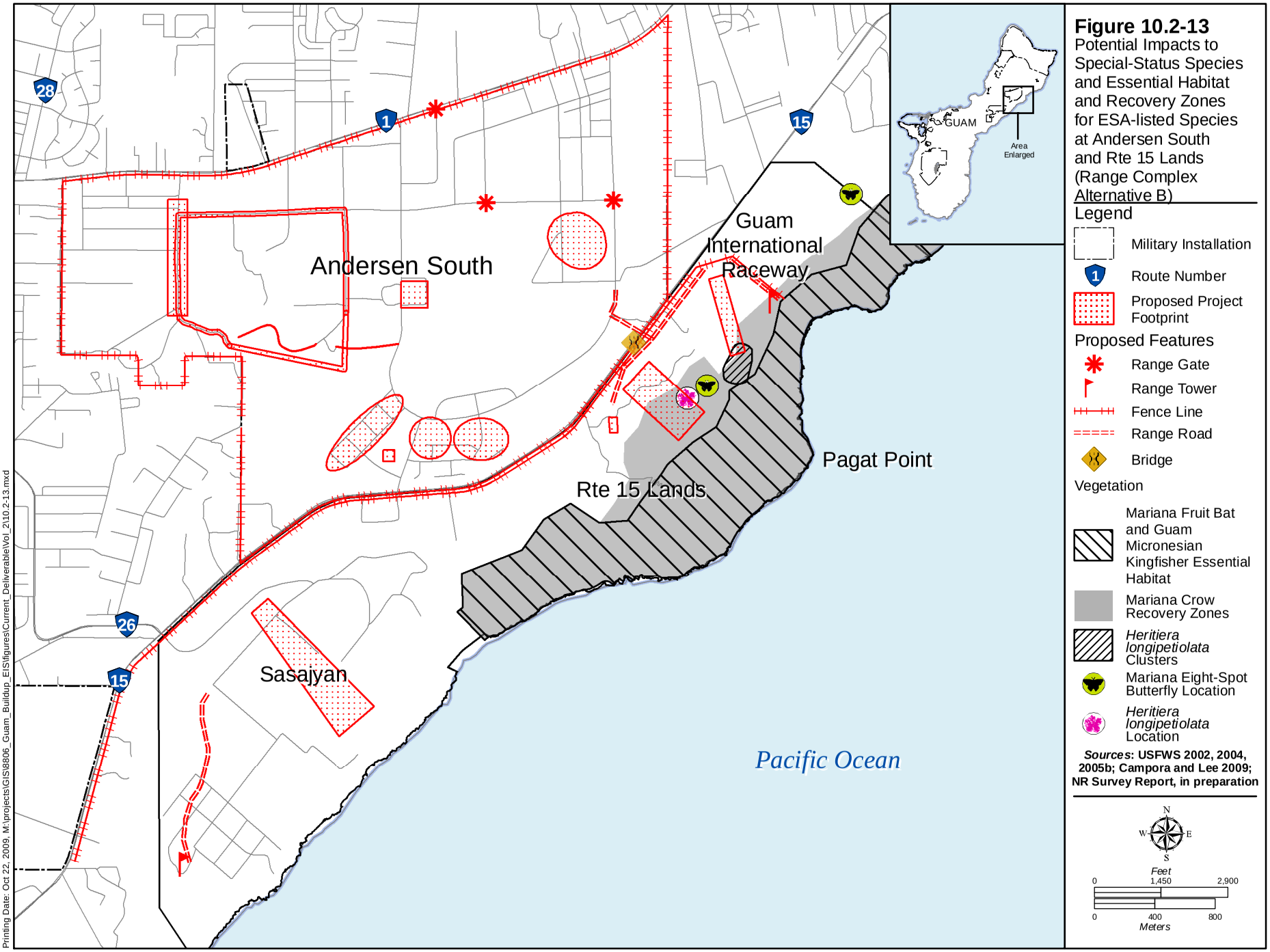
MICRONESIAN KINGFISHER. The kingfisher currently survives only in captivity. Essential habitat has been designated for the species in the northern parcel beginning along the cliff and down into the lower bench area along the coast (see Figure 10.2-13), but project areas do not extend into the essential habitat or any other designated habitat area. However, some primary limestone forest that is potential habitat would be removed. Because no designated habitat areas are removed there would be a less than significant impact on the fruit bat from construction activities.

MARIANA CROW. Removal of this currently unoccupied habitat would have a less than significant impact on the species because the amount removed would be minor in relation to the overall recovery zone about on Guam (0.06%), including large areas adjacent to the proposed construction (see Figure 10.2-13), and would not significantly affect the recovery of the species (the amount of habitat required to meet recovery plan goals for the species is estimated at 8,100 ac [3,278 ha] compared to the total currently available of 23,004 ac [9,309] in Section 10.1.1.3).

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail, should it be reintroduced. No specific areas of essential habitat have been designated for this species (see Figure 10.2-13). Based on the current absence of the species in the area and lack of designated habitat, there would be no impact on the species.

MARIANAS EIGHT-SPOT BUTTERFLY. This candidate species was observed in a mixed host plant area approximately 500 ft (152 m) from the Alternative B UD range area during 2008 site-specific surveys (see Figure 10.2-13). No host plants or butterflies have been documented within or near the range footprints. Impacts would be less than significant.

HERITIERA LONGIPETIOLATA. The cluster of 22 mature trees of this Guam-listed tree that were identified in 2000 (Duenas and Associates 2000) are located immediately to the south of the Alternative B KD range boundary. A complete survey of other range footprints and surrounding area has not been completed but would be completed prior to clearing. If any individuals are in areas to be cleared, they would be transplanted if possible, or attempts would be made to propagate the species for transplanting elsewhere. Additional information is provided under the mitigation discussion (Section 10.2.2.6). With implementation of this mitigation, impacts to the species would be less than significant.


Andersen South
Guam International Raceway
Pagat Point
Rte 15 Lands
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
28
1
15
26
15
Figure 10.2-13
Potential Impacts to Special-Status Species and Essential Habitat and Recovery Zones for ESA-listed Species at Andersen South and Rte 15 Lands (Range Complex Alternative B)
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Vegetation
Mariana Fruit Bat and Guam Micronesian Kingfisher Essential Habitat
Mariana Crow Recovery Zones
Heritiera longipetiolata Clusters
Mariana Eight-Spot Butterfly Location
Heritiera longipetiolata Location
Sources: USFWS 2002, 2004, 2005b; Campora and Lee 2009; NR Survey Report, in preparation
N
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ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. Awareness training and inspection of gear, clothing, and equipment as part of existing control measures would occur. The impacts are discussed in detail under operations below. Impacts would be significant but numerous mitigation measures and BMPs, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. Trees and shrubs in the SDZs of firing ranges would be damaged from stray munitions. However, stray bullets would be minimal and are unlikely to damage the vegetation enough to kill individual specimens. Invasive plant species are likely to expand ranges and new species are likely in some areas due to the increase in activities such as more training, more personnel, and more vehicles. However, this is unlikely to substantially impact primary limestone forest as long as the substrate of the primary forest remains intact. Therefore, impacts would be less than significant.

Wildlife. Impacts to wildlife would be the same as for Alternative A.

Special-Status Species. Stray munitions may fall within the SDZs; however, the likelihood of any single animal or plant being struck is negligible. As mentioned above, the estimated number of bullets that would fall on land within the SDZ is approximately 1,013 for Alternative B over the course of a year.

MARIANA FRUIT BAT. Although not documented historically in the area, essential habitat has been identified within the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast (see Figure 10.2-11). As described above under Alternative A, noise would be generated beyond current levels from small arms ranges. The 104 dB PK15 (met) contour for the small arms ranges would cover 41 ac (17 ha) of essential habitat for the fruit bat (Table 10.2-8). Given the limited amount of information available on the noise susceptibility of the fruit bat, noise from the small arms ranges may have a significant impact to individuals that may potentially forage or roost within the non-DoD lands. To assess the potential for proposed range activities to impact fruit bats, regular surveys of the range areas would be conducted to determine the occurrence of fruit bats. If fruit bats are observed, monitoring of the species in areas surrounding the range facilities would be conducted to determine potential noise impacts.

MICRONESIAN KINGFISHER. The kingfisher currently survives only in captivity but essential habitat has been designated in the non-DoD northern parcel below the cliff edge and in the lower bench area along the coast (see Figure 10.2-11). As with the fruit bat, noise impacts to this species from weapons firing, should it be reintroduced, would be determined after monitoring of the species. Indirect impacts from general noise and activity to kingfishers may occur if they are reintroduced into the area. These areas are estimated in Table 10.2-8.

MARIANA CROW. The crow does not currently occur in the project area. Essential habitat has been designated for the species in the northern parcel beginning along the cliff and down into the lower bench area along the coast (see Figure 10.2-11). In addition, a recovery zone is designated in the recovery plan for this same essential habitat area and extends beyond it to include limestone forest in the plateau area of the parcel. As with the fruit bat, noise impacts to this species from weapons firing, should it be reintroduced, would be determined after monitoring of the species. Indirect impacts from general noise

and activity to kingfishers may occur if they are reintroduced into the area. These areas are estimated in Table 10.2-8.

As described above for Alternative A for the crow, noise would be generated beyond current levels from the small arms ranges. The 104 dB PK15 (met) contour from the small arms ranges would cover 148 ac (60 ha) of crow essential habitat. However, given the limited amount of information available on the noise susceptibility of the crow, noise from the small arms ranges may have a significant impact on the ability of the area to support the reintroduction of crows. To evaluate this potential, if the species were reintroduced to the area, monitoring in areas surrounding the facilities would be conducted to determine potential noise impacts. If this monitoring determined that the crow was being affected, techniques to reduce noise generation, such as noise barriers, would be employed. With this mitigation, impacts would be less than significant.

MARIANAS EIGHT-SPOT BUTTERFLY. This candidate species was observed near the Alternative B UD range area during 2008 site-specific surveys (NR Survey Report in preparation). Its two host plants were also observed in that area, and in areas within the UD range footprint. The eight-spot butterfly is unlikely to be affected by noise and activity in nearby ranges. Impacts would be less than significant.

HERITIERA LONGIPETIOLATA. Previous studies identified 22 mature individuals of this Guam-listed tree near or within the boundary of the Alternative B UD range. With standard range design there would be a minimal number of projectiles falling immediately behind the range footprint, therefore impacts to this species from operations would be less than significant.

ALL SPECIAL-STATUS SPECIES. Impacts from the movement and spread of invasive plant and animal species within Guam and to other locations from Guam and from wildfires from range-related activities would be the same as for Alternative A.

10.2.2.3 Apra Harbor

Harbor

Impacts to off-shore areas are discussed in Chapter 11, Marine Biological Resources.

Naval Base Guam

Construction

Vegetation. All project areas are in locations that have been previously disturbed and do not include limestone forest (Figure 10.2-14 and Table 10.2-9). The Orote airfield LZ would not require construction. Impacts to vegetation would be less than significant.

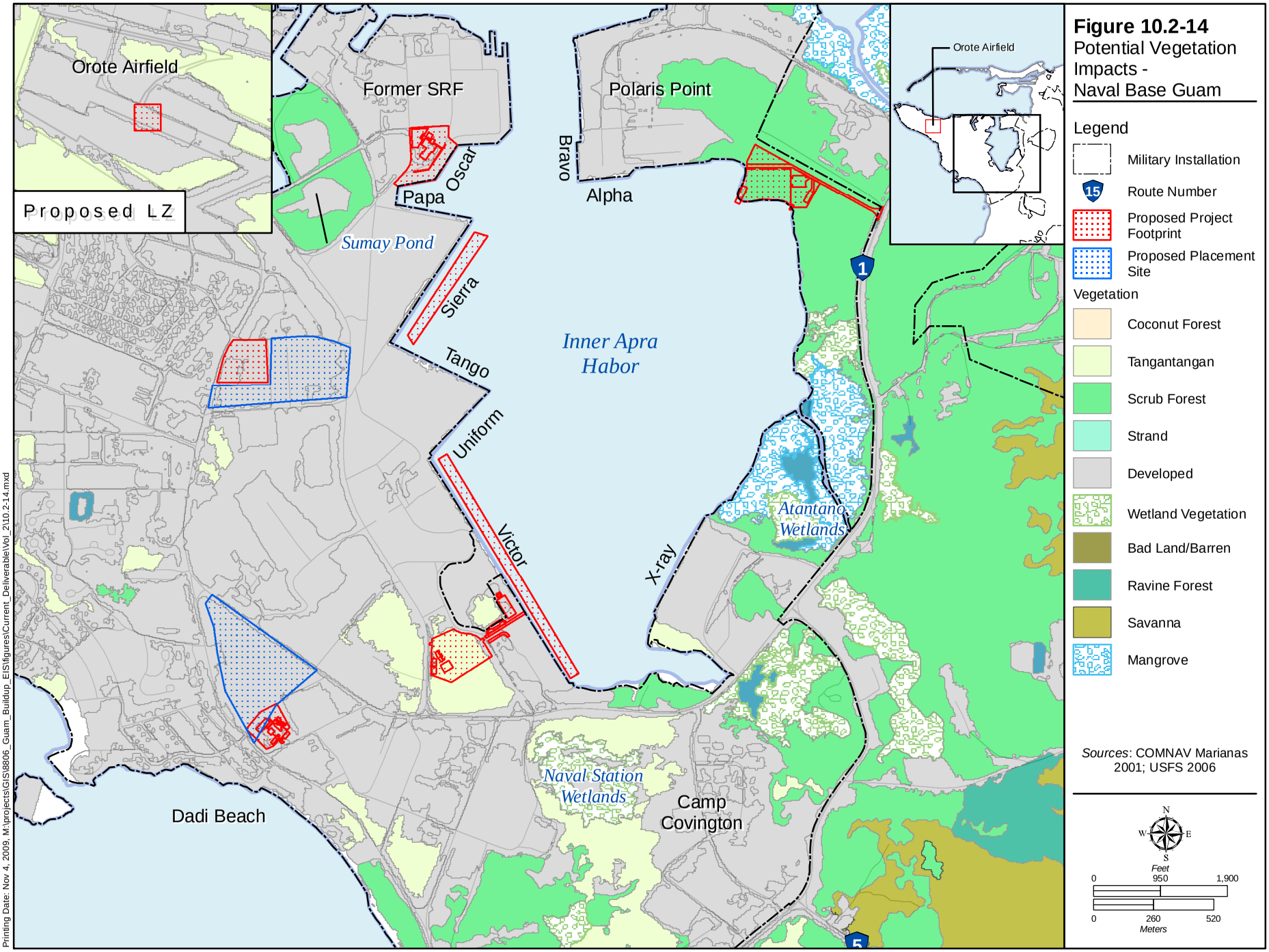

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Table 10.2-9. Potential Impacts to Vegetation Communities at Apra Harbor with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Shrub/ Grassland*	*Tangantangan*	*Developed*
Construction Areas (vegetation removed)			
Waterfront Projects	0	0	0
LCAC & AAV	12 (4.9)	0	9.9 (4)
Medical/Dental Clinic	0	0	7.8 (3.2)
CVN Berthing Area	0	0	11 (4.5)
USCG Relocation	0	0	11 (4.5)
Embarkation East	0	0	1.0 (.4)
Upland Placement Areas (vegetation removed)			
Dredge Upland Placement Sites	51 (21)	34 (14)	150 (61)
Total Vegetation Removed	**62 (25)**	**34 (14)**	**191 (77)**

Wildlife. Project areas include developed areas of the base where there is minimal habitat for avian species. The indigenous gray-tailed tattler and Pacific reef heron utilize food resources within the Apra Harbor shoreline areas. A small amount of shoreline habitat that is not currently developed would be removed at the landing craft air cushion (LCAC) and amphibious assault vehicle (AAV) ramp project site, and at a sediment dewatering project site in that same area. Similar areas of habitat are common in the area and any individuals affected would move to these other areas. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Impacts to wildlife would be less than significant.

Potential impacts include noise and activity, pollutants, and dredging sedimentation. Only common migratory bird species widespread on Guam are known from the area. Proposed construction activities and associated noise would force them to temporarily move from the project area into adjacent areas. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Impacts would be less than significant.

Fueling of project-related construction or operations vehicles, watercraft, and equipment could result in accidental releases of petroleum products that would migrate within Apra Harbor. The Atantano River mangrove area is approximately 4,000 ft (1,220 m) distant from the wharf area project locations (Figure 10.2-14). Required Best Management Practices (BMPs) during construction would make it unlikely for a major spill to occur. A mandatory spill plan exists for Navy Main Base for response to spills. There would be time for small spills to be cleaned up before reaching the mangrove area. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Potential impacts would be less than significant.

Proposed dredging and shoreline activities would result in sediment disturbance and suspension that could migrate to mangrove areas. However, modeling results from outer Apra Harbor dredge modeling show that sediments would largely be contained within silt curtains employed for the dredging; any sediment plume would migrate only a very short distance under all scenarios modeled (Ericksen 2009). Because the dredging being considered here is in the more-protected inner harbor, sediment migration should not be greater than that modeled for the outer harbor, and is likely to be less. It would be very unlikely that suspended sediments would reach the nearest mangroves at Atantano, approximately 4,000 ft (1,220 m) away. Use of silt curtains is part of the mitigation measures to minimize suspended sediment migration. With mitigation, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species and impacts would be less than significant.

Special-Status Species. No special-status species are known to be present in the project areas or in the vicinity of Apra Harbor. However, two species may be potentially impacted by proposed activities.

MARIANA MOORHEN. The only special-status species currently present in the Apra Harbor area is the Mariana moorhen. This species uses the freshwater wetland area of the Atantano wetlands east of the highway (Figure 10.2-15). The LCAC and AAV ramp construction area is within approximately one-half mile of the Atantano River, designated as secondary habitat for the Mariana common moorhen (USFWS 1991b). The site is also designated Overlay Refuge land and 12 ac (4.9 ha) would be removed during construction of the facility. Noise and activity from construction would be very unlikely to affect these areas. Any potential impact from project construction sedimentation or pollutants would be to the mangroves that are adjacent to the harbor waters, and not the freshwater wetlands that are further inland where the moorhen is known to occur. Impacts would be less than significant.

GUAM RAIL. The Guam rail is not currently present and exists only in captivity but 12 ac (4.9 ha) of shrub/grassland habitat potentially suitable for the reintroduction of the species is present and is designated Overlay Refuge (see Figure 10.2-15). However, because the Guam rail is currently extirpated in the wild and most of Guam has habitat that is potentially suitable for the recovery of the species, removal of these areas due to construction would result in a less than significant impact.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. The impacts are discussed in detail under operations below. Awareness training and inspection of gear, clothing, and equipment as part of existing control measures would occur. Impacts would be significant but numerous mitigation measures and BMPs, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. There is no primary limestone forest in the project areas. No wetland or mangrove habitat would be removed. Therefore, there would be less than significant impacts to vegetation.

Wildlife. Operations would generate noise. Only a few, widespread migratory bird species would be affected. They would move away from the operational areas but there are other areas of habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, direct and indirect impacts to wildlife from operations would be less than significant.

The LCAC and AAV ramp construction area is within approximately one-half mile of the Atantano River, a major mangrove and wetland complex. However, noise and activity from operations would be unlikely to affect these areas. Impacts would be less than significant.

Fueling and movement of petroleum in wharf areas could result in accidental releases of petroleum products that would migrate within Apra Harbor. A mandatory spill prevention plan that would be in place would minimize the likelihood of this happening. If there were a release, the Atantano River mangrove area is approximately 4,000 ft (1,220 m) distance from the wharf area project locations (refer to Figure 10.2-13). The Atantano mangroves provide important habitat for sponges, mollusks, bivalves, crustaceans, and fish, and is particularly well-suited for mollusks due to its location in Inner Apra Harbor

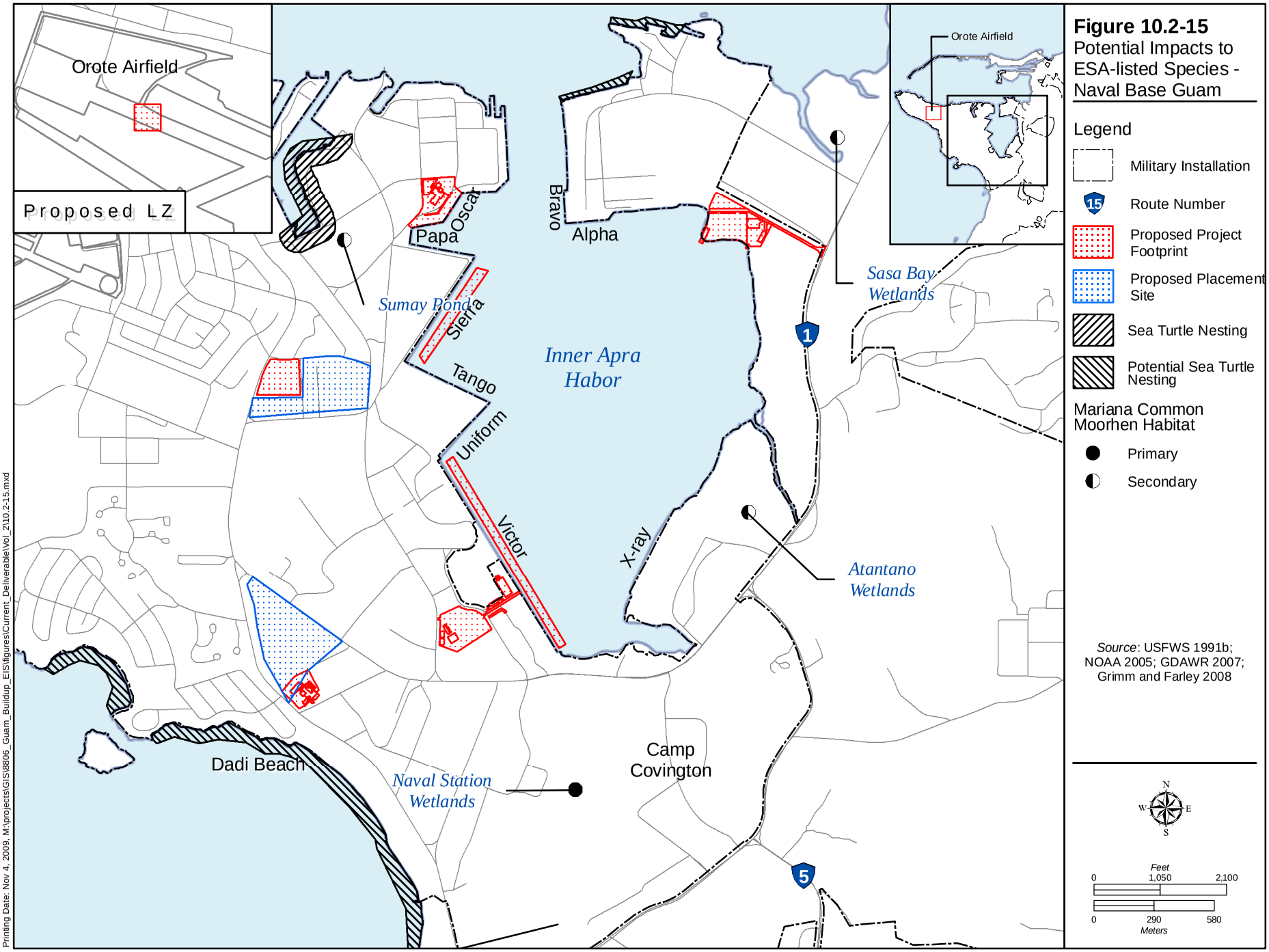

Figure 10.2-15
Potential Impacts to ESA-listed Species - Naval Base Guam

Legend

- Military Installation
- Route Number
- Proposed Project Footprint
- Proposed Placement Site
- Sea Turtle Nesting
- Potential Sea Turtle Nesting

Mariana Common Moorhen Habitat

- Primary
- Secondary

Source: USFWS 1991b; NOAA 2005; GDAWR 2007; Grimm and Farley 2008

N W E S

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where water turbidity is higher and water circulation is lower than in other mangroves on the island. The mangroves are also important nursery grounds for various marine fishes (Wiles and Ritter 1993).

Potential oil spills in Apra Harbor from proposed action under Alternative 1 are unlikely given the history of Navy operations. If a severe oil spill were to occur and reach the mangroves, substantial damage to that community would likely occur. Mangrove responses to oil spills have been summarized by Hoff et al. (2002). Mangrove tree species themselves are highly susceptible to oil exposure, and the lighter oils are more acutely toxic than heavier oils. Acute effects of oil (mortality) occur within six months of exposure and usually within a much shorter time frame (a few weeks). Common responses of mangrove tree species to oil include yellowing of leaves, defoliation, and tree death. Mangrove communities are complex, but the available information suggests that the mangrove faunal community recovers faster than the mangroves themselves, so the long term effects in this community from an oil spill is from loss of primary vegetative cover.

The potential that oil spills at the Inner Apra Harbor berthing area would reach the mangroves is partly controlled by currents in Apra Harbor. Currents in outer Apra Harbor are predominantly wind-driven, and occur as a two-layer system and currents tend to be weak with surface currents at 7.9 to 15.7 ft/second (4 to 8 centimeters/second) (Eriksen 2009). Currents within the inner harbor where the projects would occur are likely to be even weaker.

The capability to respond to any spill resulting from the proposed action is substantial. NOAA has developed a modeling tool for spills called the General NOAA Operational Modeling Environment, and has developed specific information for Apra Harbor (NOAA 2009). Various booms, skimmers and sorbents are available to response agencies and the Navy has a waste oil barge (ITOPF 2000).

The potential for sediment migration and petroleum spills in Inner Apra Harbor reaching mangrove areas would be minimized through implementation of avoidance and minimization measures and specific mitigation measures. With implementation of these measures, potential impacts to the mangrove areas and the associated migratory birds and migratory birds or regionally important native animal species would be less than significant.

The Orote LZ area is an open paved area. Migratory birds such as whimbrels are other shorebirds may use the area for resting but would disperse to other suitable areas during temporary training exercises. Impacts would be less than significant.

Special-Status Species. Any direct impacts such as incidental bird-vehicle or bird-boat strikes would be uncommon. Impacts would be less than significant. As mentioned previously, the only special-status species known to occur in the Apra Harbor area is the Mariana moorhen, but habitat is also present for the Guam rail.

Noise and activity from operations would affect special-status species that might use Overlay Refuge land in the future. Using a 60 m zone surrounding the perimeter, there would be indirect effects on 12 ac (4.9 ha) of Overlay Refuge. Using a 328 ft (100 m) zone surrounding the perimeter there would be indirect effects on 18 ac (7.3 ha). Using a 492 ft (150 m) buffer here would be indirect effects on 27 ac (11 ha). No essential habitat has been specifically determined for this area.

At the Orote LZ no special-status species are known to use the area. The boundary of the Overlay Refuge is approximately 1,000 ft (305 m) from the LZ. Because of the distance the Overlay Refuge and the present lack of special-status species, impacts from operations at this LZ would be less than significant.

The movement and spread of invasive plant and animal species within Guam and to other locations from Guam would degrade habitat for special-status species and are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species might be accidentally introduced to Guam, spread on Guam, or transported to other islands through aircraft operations, shipment of supplies and equipment to the new facilities, movement of troops and supplies during training activities, or movement of household goods. Species that might be introduced or spread include various plants such as *Vitex* that can degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat, invertebrates such as coconut rhinocerous beetles or the flatworm predator of native snails, BTS, various frog species, rodents, dogs, or cats. These influences could have significant impacts on all special-status species potentially occurring in the project area (the same as those discussed under construction direct impacts). To prevent potentially invasive species from being moved or spreading, and in particular the BTS from being introduced in other areas from Guam, the project would fund and facilitate a 100% inspection effort for all cargo, vehicles, munitions, household goods, and other items leaving Guam. In addition, various plans and procedures would be developed and implemented to address existing invasive species concerns such as invasive plants and ungulate damage that is affecting habitat quality of special-status species.. The successful implementation of a Biosecurity Plan (presently under preparation) and specific invasive species control procedures would restrict the movement of invasive species so that impacts would be less than significant.

10.2.2.4 South

Naval Munitions Site

Construction

Vegetation. Proposed action at NMS would potentially remove a small area of limestone forest and a maximum of 4.3 ac (1.7 ha) of ravine forest during construction activities for the munitions magazines, clearing vegetation from the LZs, and constructing the access road under Alternative A (Table 10.2-10 and Figure 10.2-16). Access road Alternative A would traverse an area mapped as limestone forest by the USFS (see Figure 10.2-16) a portion of which is merrilliodendron forest adjacent to the existing road (NR Survey Report in preparation). This merrilliodendron forest area would not be removed or at most only a few trees would need to be removed to make the road passable for military vehicles. The remainder of the mapped limestone forest that would be affected under Alternative A is degraded limestone dominated by non-native species based on a recent inspection (NR Survey Report in preparation). Based on this information, impacts to vegetation would be less than significant for Alternative A.

Table 10.2-10. Potential Impacts to Vegetation Communities at NMS with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Ravine Forest*	*Savanna*	*Developed Land*
Direct Impacts from Construction – Vegetation Removed				
New Magazines (Alt. A)	0	2.9 (1.2)	4.7 (1.9)	1.2 (0.5)
New Magazines (Alt. B)	0	5.8 (2.3)	1.6 (0.6)	1.4
Access Road (Alt. A)	0.4 (0.2)	0.8 (0.3)	2.5 (0.4)	0
Access Road (Alt. B)	0	0	0	0
Helicopter LZs	0	0.6 (0.2)	13 (5.3)	0
Totals for Construction Areas (with A Alternatives)	**0.4 (0.2)**	**4.3 (1.7)**	**20 (8.1)**	**1.2 (0.5)**
Indirect Impacts from Use of Non-Firing Training Area and Access Road- Vegetation not Removed				
Southern Training Maneuver Area	745 (301)	1,344 (544)	1,147(464)	3.5 (1.4)

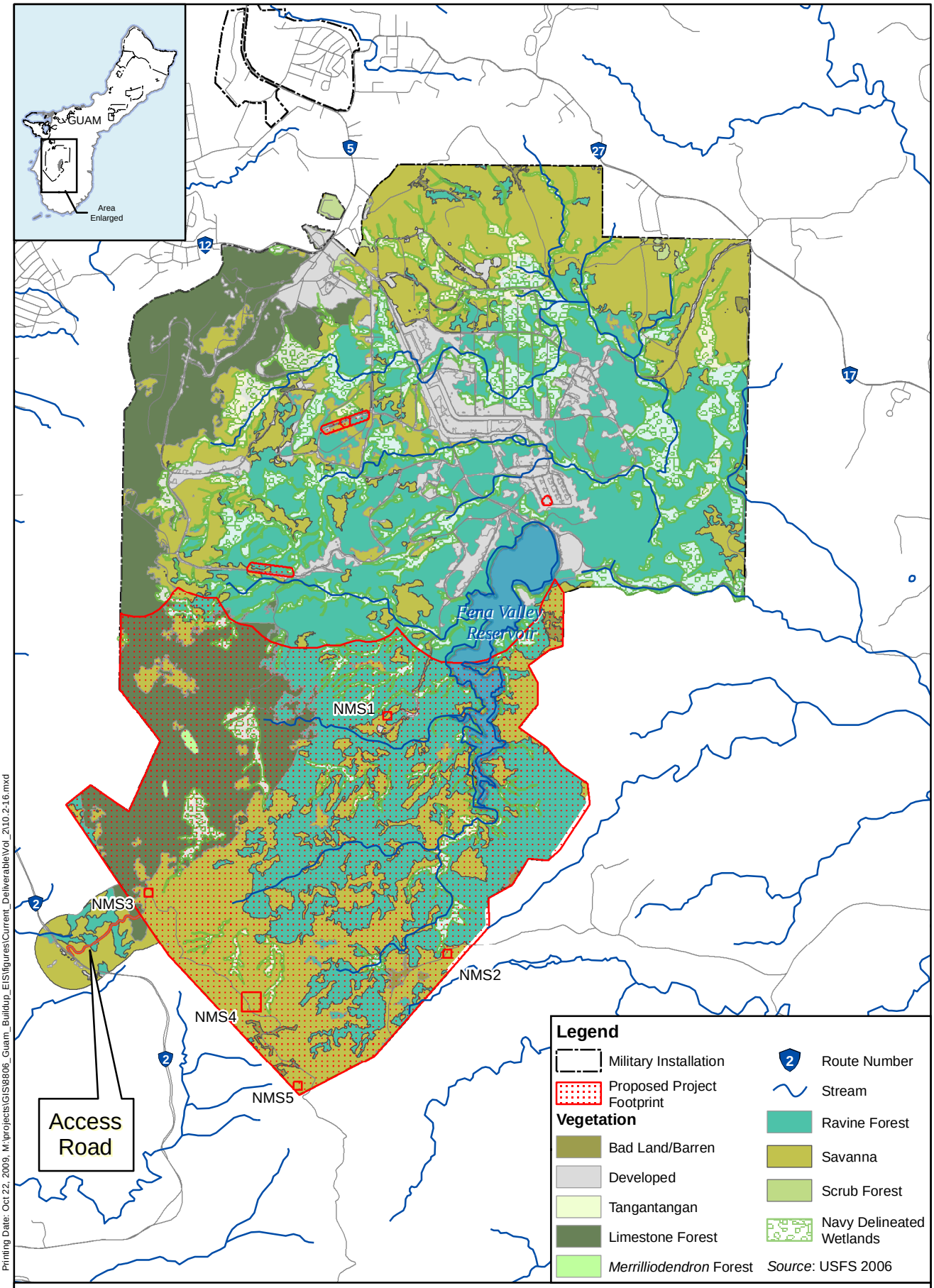

Figure 10.2-16
Potential Vegetation Impacts - Naval Munitions Site

Based on limited project-specific field evaluation of some areas within the southern training area, the ravine forest community is significantly degraded in many areas by invasion of non-native woody plant species including *Vitex* and betelnut palm, and heavy infestation by herbaceous invasive plants. Training impacts on this vegetation would be less than significant.

The ravine forest and other areas that would be removed or used for training are not known to harbor any sensitive plant species identified by government or conservation groups. However, the vegetation removed serves as potential habitat for sensitive animal species that are addressed under the Special-Status Species section below.

Wildlife. Proposed construction activities at the magazine areas and access road would displace wildlife or destroy slow-moving species. However, species potentially affected such as the yellow bittern and Pacific golden plover are regionally abundant, as is this habitat type, so impacts would not be significant. No construction is proposed in the southern training area; LZs would be cleared of vegetation but the soil would not be disturbed. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Impacts would be less than significant.

Construction activities for the magazines, LZs and the new access roads would generate noise. Only a few, widespread migratory bird species are present that would be affected. They would move away from the construction areas but there are other areas of habitat nearby and they could return during evenings and to some of the area when construction is complete. Effects would be short-term. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. Proposed construction activities for the magazines and the access road could directly impact essential habitat for a number of ESA-listed species that currently occur on Guam or that might be reintroduced. The ground would not be disturbed at LZs so direct impact for these features would be minimal. Indirect impacts from noise and activity would not occur during construction because species that might be affected by noise and activity are not currently present. These species could be affected by air and ground operations if they were present in the area in the future.

MARIANA FRUIT BAT. Currently fruit bats are rarely observed at NMS. Proposed construction activities would include the loss of ravine forest that is potential foraging and roosting habitat for the Mariana fruit bat on the base. A total of 20 ac (8.1 ha) of essential habitat would be removed for construction of the various project components on NMS (Table 10.2-11). This essential habitat is also designated National Wildlife Overlay Refuge land. Because the removal of habitat is minimal compared to what is available in the area, the quality of habitat removed is not high due to the mostly savanna vegetation in the project areas, and the proximity to existing roads for the magazines, impacts would be less than significant.

GUAM MICRONESIAN KINGFISHER. Proposed construction activities would include the loss of ravine forest that is potential habitat for the future reintroduction of the kingfisher. A total 20 ac (8.1 ha) of essential habitat would be removed for construction of the various project components on or adjacent to NMS (see Table 10.2-11). This essential habitat is also designated Overlay Refuge (see Figure 10.2-16). For the same reasons given for the fruit bat, impacts would be less than significant.

MARIANA CROW. The crow does not presently occur at NMS. Proposed construction activities would include the loss of ravine forest that is potential foraging and nesting habitat for the crow. A total of 36 20 ac (8.1 ha) of essential habitat would be removed for construction of the various project components on

Table 10.2-11. Potential Impacts to Special-Status Species Habitat at NMS with Implementation of Alternative 1 (ac [ha])

Parcel and Activity	*Overlay Refuge**	*Essential Habitat – Bat, Crow, and Kingfisher**	*Crow Recovery Zone**
Direct Impacts from Construction – Habitat Removed			
New Magazines (Alternative A)	10 (4.0)	10 (4.0)	10 (4.0)
New Magazines (Alternative B)	10 (4.0)	10 (4.0)	10 (4.0)
New Access Road (Alternatives A and B)	0	0	0
Helicopter LZ	13 (5.3)	9.6 (3.9)	13 (5.3)
Habitat Removed Totals (using road Alternative A)	23 (9.3)	20 (8.1)	23 (9.3)
Percentage of Habitat Type on Guam that is Removed (using A Alternatives)	0.1 %	0.1 %	0.1 %
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity			
60 m buffer for MC (F,N): Ground Ops			
LZs	40 (16)	31 (13)	40 (16)
100 m buffer for KF (F,N): Ground Ops			
LZs	80 (32)	62 (25)	80 (32)
150 m buffer for FB (R): Ground Ops			
LZs	136 (55)	111 (45)	142 (58)
300 m buffer for MC (F,N): Air Ops			
LZs	366 (148)	342 (138)	395 (160)
Indirect Effects from use of Non-Firing Training Area - Habitat not Removed)			
Southern Training Maneuver Area	3331 (1348)	3149 (1274)	3272 (1324)

Notes: Each habitat category is considered independently of others and are not additive.
FB – Fruit Bat, MC - Mariana Crow, KF – kingfisher.
F – Foraging, R – Roosting/Colony, N - Nesting.

NMS (see Table 10.2-11). This essential habitat is also designated Overlay Refuge (Figure 10.2-17). For the same reasons given for the fruit bat, impacts would be less than significant.

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of ravine forest and savanna but these areas are unlikely to support significant foraging and nesting habitat for the Guam rail. Based on habitat present, the fact that the Guam rail is currently extirpated in the wild, and that most of Guam has habitat that is potentially suitable for the recovery of the species, removal of these areas due to construction would result in a less than significant impact.

SKINKS and GECKOS. Two Guam-listed species, the moth skink and the Pacific slender-toed gecko, were present historically within NMS. The moth skink was present throughout NMS and the gecko in the southern portion only. The moth skink has been documented in project-specific surveys in or near the southern training area and the Alternative B magazine group. Proposed construction activities at the magazine areas and access roads may result in mortality of these less mobile species. However, long-term, permanent impacts to populations of such species would be unlikely to result because these species would be present in surrounding areas of extensive habitat similar to that being removed. Impacts to these species would be less than significant.

ALL SPECIAL-STATUS SPECIES. Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species impacts for construction would be similar to those for operations but shorter-term. The impacts are discussed in detail

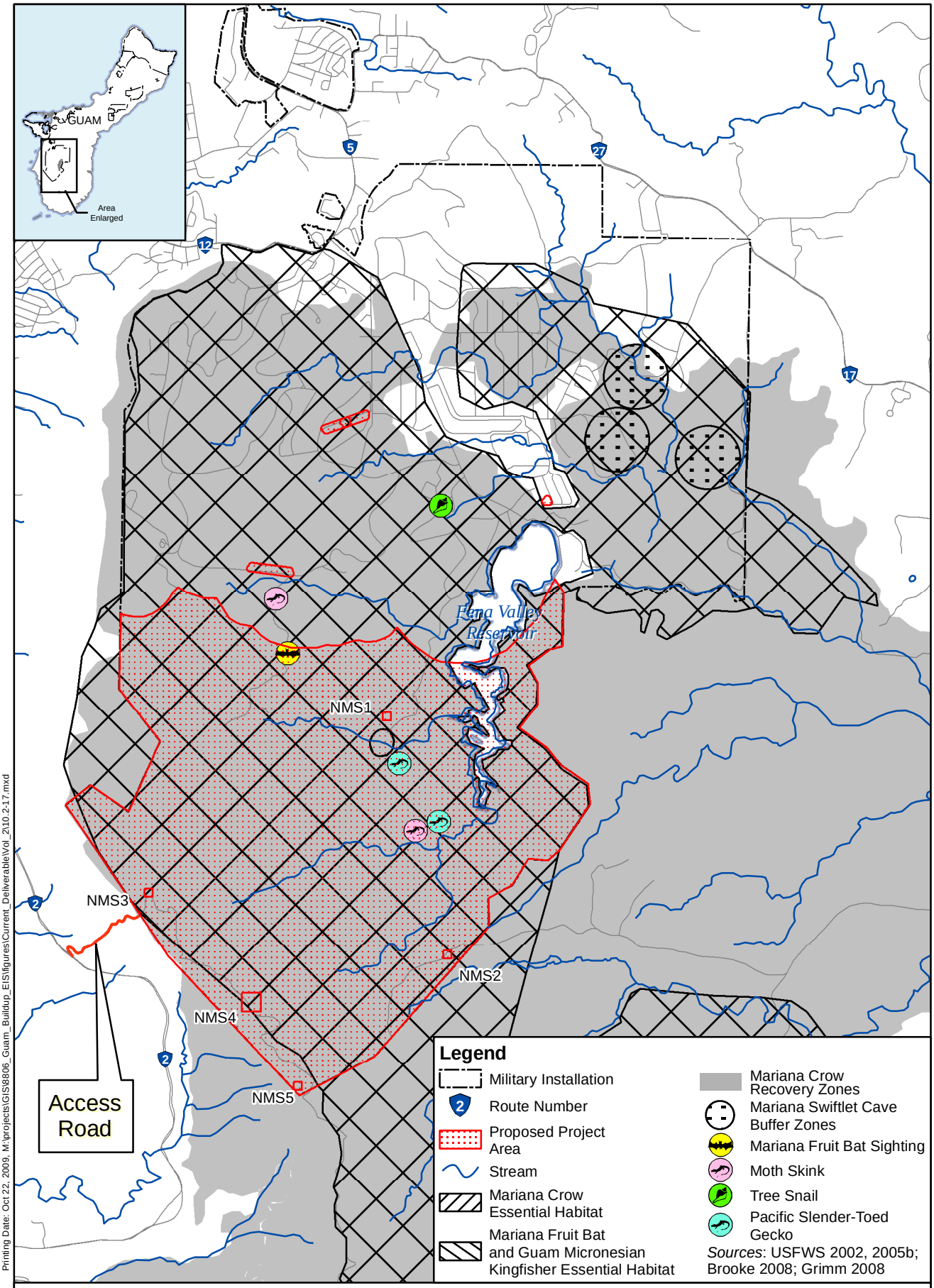

Figure 10.2-17
Potential Special-Status Species Impacts - Naval Munitions Site

under operations below. Impacts would be significant but numerous mitigation measures, as specified under mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

Operation

Vegetation. The southern training area contains 745 ac (301 ha) of limestone forest and 1,147 ac (464 ha) of ravine forest, as well as a large amount of savanna and smaller areas of barren and developed land (see Table 10.2-10 and Figure 10.2-16). Clearing of vegetation is currently not allowed during training in Marianas training areas in accordance with the Marianas Training Handbook and this practice would be maintained. Invasive plant species could expand ranges and new species could be introduced in some areas due to the increase in number of increased activities such as more training, more personnel, and more vehicles. However most activities and all vehicles would be located away from these primary limestone forest areas which are generally at the higher elevations in the west. Impacts would be less than significant.

Wildlife. Training impacts in the southern training area would involve company-level maneuvers. There is the potential for certain wildlife species to be crushed, but most wildlife would be able to move away from the maneuvers to avoid this. The level of mortality would be negligible and would not affect population levels. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Direct and indirect impacts would be less than significant.

Use of the access roads would involve short periods where vehicles move through and there would be minimal disturbance of wildlife. Magazine areas would be infrequently used. No motorized vehicles would be used during training within the facility, and the low frequency and intensity of training would result in only minimal wildlife disturbance. Aquatic habitats may be temporarily impacted during crossings but this would be infrequent and short in duration. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Direct and indirect impacts to wildlife would be less than significant.

Special-Status Species. Proposed ground training is company-level maneuver training supporting foot land navigation training with no weapons firing for 5-7 consecutive days, 12 weeks per year, day and night in the 3,300 ac (1,335 ha) southern training area. This area is all within the Overlay Refuge, most of which is essential habitat for the fruit bat, kingfisher, and crow (refer to Figure 10.2-11). These species are not currently present (or very rarely present in the case of the fruit bat) but may return or be reintroduced in the future.

The same also applies to special-status reptile species that are present in the training area. For all special-status species, direct impacts from training would be less than significant.

Noise disturbance would occur from company-level foot training for limited time periods and aircraft activity from proposed terrain flights and at the four proposed LZs in the southern training area and one south of the explosive ordnance disposal pit. Three of the LZs are in very open savanna areas with forested areas at least 350 ft (107 m) distance (see Figure 10.2-11). Two LZs are in open areas but within 100 ft (30 m) of forested areas.

MARIANA FRUIT BAT. Since fruit bats are only rarely present and in small numbers throughout a very large area, there would be no direct disturbance from ground training or aircraft. Under future conditions that assume the return of substantial numbers of the fruit bats, impacts from ground training would be less than significant because of the infrequent training and large size of the entire training area such that disturbance would be limited and the animals could easily avoid or move away from the training site.

For helicopter takeoff and landings at the LZs, using 492 ft (150 m) as a distance in which fruit bats would not be disturbed, the amount of fruit bat essential habitat that may be directly impacted by the air operations at NMS is approximately 222 ac (90 ha). However, for the following reasons the impacts are considered less than significant: LZs are near the edge of essential habitat areas; much of the area affected is savanna; and there large acreage of undisturbed habitat in surrounding areas.

Noise would be generated from helicopter training from approximately 1 sortie/day and 1 night sortie every 10 days at the NMS LZs. Estimated noise contours from LZ operations at NMS would not exceed 70 dBA within the immediate vicinity of the proposed LZs. In addition, terrain flights would occur within southern NMS. A total of 95 daytime and 5 nighttime terrain flight operations per year are proposed, or one daytime sortie every 3 days and one night-time sortie every 50 days. Terrain flights are conducted at 50-200 ft above ground level and would result in noise levels less than 53 dBA. Under future conditions that assume the return of substantial numbers of the fruit bats, impacts to roosting or foraging fruit bats or essential habitat from aircraft training would be less than significant given the low frequency of use of the NMS for aircraft operations, the localized area of potential noise impacts and the levels of noise generated.

For this species, increased Marine Corps presence from ground training would also have a positive benefit since this would reduce the number and frequency of poachers in the area.

MICRONESIAN KINGFISHER. The kingfisher currently survives only in captivity but essential habitat has been designated at NMS (Figure 10.2-17). Because Micronesian kingfishers are not currently present in the area, there would be no disturbance from ground or aircraft training. In the future, noise would be generated from helicopter training. For helicopter takeoff and landings at the LZs, using 328 ft (100 m) as a distance in which fruit bats would not be disturbed the amount of fruit bat essential habitat that may be directly impacted by the air operations at NMS is approximately 123 ac (50 ha). However, for the following reasons the impacts are considered less than significant: LZs are near the edge of essential habitat areas; much of the area affected is savanna; the essential habitat is currently unoccupied; and there large acreage of undisturbed habitat in surrounding areas. .

MARIANA CROW. The crow does not currently occur in the project area. Essential habitat has been designated for the species at NMS (see Figure 10.2-17). Since Mariana crows are not currently present in the area, there would be no disturbance from ground or aircraft training. In the future, noise would be generated from helicopter training. For helicopter takeoff and landings at the LZs, using 984 ft (300 m) as a distance in which fruit bats would not be disturbed the amount of fruit bat essential habitat that may be directly impacted by the air operations at NMS is approximately 645 ac (261 ha). However, for the following reasons the impacts are considered less than significant: LZs are near the edge of essential habitat areas; much of the area affected is savanna; the essential habitat is currently unoccupied; and there large acreage of undisturbed habitat in surrounding areas. .

GUAM RAIL. The rail does not currently occur in the project area. No Essential habitat has been designated for the species at NMS but some Overlay Refuge habitat is that could support the species is present. Since the rail is not currently present in the area, there would be no disturbance from ground or aircraft training. In the future, noise would be generated from helicopter training. Given the large size and low frequency of use of the NMS for aircraft operations, the localized area of potential noise impacts (described above for the fruit bat), and the fact that most of Guam has habitat that is potentially suitable for the recovery of the species, impacts would be less than significant.

SKINKS and GECKOS. Impacts from ground training in the southern training area would be minimal because of the large size of the training area and the relatively low frequency of training. Use of the

ccess road would involve only short periods of vehicle movement through primarily savanna habitat, so there would be minimal mortality, if any. Impacts would be less than significant.

ALL SPECIAL-STATUS SPECIES. The movement and spread of invasive plant and animal species within Guam and to other locations from Guam would degrade habitat for special-status species and are potential indirect impacts resulting from actions proposed in Alternative 1. Invasive species might be accidentally introduced to Guam, spread on Guam, or transported to other islands through aircraft operations, shipment of supplies and equipment to the new facilities, movement of troops and supplies during training activities, or movement of household goods. Species that might be introduced or spread include various plants such as *Vitex* that can degrade habitat by displacing native species and ultimately reducing food or important nesting or roosting habitat, invertebrates such as coconut rhinoceros beetles or the flatworm predator of native snails, BTS, various frog species, rodents, dogs, or cats. These influences could have significant impacts on all special-status species potentially occurring in the project area (the same as those discussed under construction direct impacts). To prevent potentially invasive species from being moved or spreading, and in particular the BTS from being introduced in other areas from Guam, the project would fund and facilitate a 100% inspection effort for all cargo, vehicles, munitions, household goods, and other items leaving Guam. In addition, various plans and procedures would be developed and implemented to address existing invasive species concerns such as invasive plants and ungulate damage that is affecting habitat quality of special-status species. The successful implementation of a Biosecurity Plan (presently under preparation) and specific invasive species control procedures would restrict the movement of invasive species so that impacts would be less than significant.

Fire potential would be increased due to the presence of marines during ground training exercises. Fire is a serious problem on Guam. Fire history records available from 1979 – 2002 indicate that over this 23-year period more than 16,000 fires have occurred in Guam (averaging more than 700 per year) that have burned in excess of 100,000 ac (40,469 ha). For the same period on Naval Base Guam, primarily at

Apra Harbor and NMS, the number of fires was 477 (just over 21 per year) burning more than 9,800 ac (3,966 ha) (COMNAV Marianas 2008). Potentially greater access to trespassers including hunters due to the development of the proposed NMS training access road would be prevented by installation of fencing and gates at the access road entrance. Impacts would be significant. As mitigation BMP, the recently completed Wildland Fire Management Plan would be implemented in this area. It would include protocols for monitoring fire conditions and adjusting training as needed (e.g., certain types of training may be disallowed under certain fire conditions); location and management of fire breaks, fire fighting roads, and a fire fighting water system. Units undergoing training would be briefed on requirements suitable to the conditions of the day and protocols should a fire occur (e.g., specifying how the range would shut down and how fire suppression action would be taken) (see Section 10.2.2.6). With implementation of the Wildland Fire Management Plan and procedures, impacts from training-related wildfires would be less than significant.

10.2.2.5 Summary of Impacts

Construction impacts would include direct significant impacts to vegetation from loss of 28 ac (11 ha) of primary limestone forest. There would be direct significant impacts to the endangered Mariana fruit bat and Micronesian kingfisher from clearing of 309 ac (125 ha) of essential habitat and to the endangered Mariana crow from clearing of 254 ac (103 ha) of essential habitat. There would be direct impacts to 704 ac (285 ha) of Overlay Refuge, which includes the essential habitat just listed and other additional lands. There would be additional direct significant impacts to the Mariana fruit bat and indirect significant effects to the Mariana crow and Micronesian kingfisher due to loss of habitat in areas surrounding new

facilities because of noise and lighting from facility operations and aircraft takeoff and landings. The specific habitat requirements of special-status species impacted are not understood well enough to conclude that the type of habitat that would remain upon implementation of the proposed action is adequate to meet the goals of the recovery plans. There would be potential significant direct impacts to a Guam endangered tree species on non-DoD lands at Route 15, mitigated to less than significant.

Overall effects for all actions being proposed in this EIS are in Volume 7,Potential Mitigation Measures

10.2.2.6 Potential Mitigation and BMP Measures

Specific conservation BMPs are described in this section. Protection measures and conservation measures are described as well as existing conservation measures which are relevant to the terrestrial natural resources that may be affected. These BMPs are mentioned, although they are not generally considered mitigation because they are actions, plans or standard operating procedures that would be implemented as part of the proposed action. A detailed description of BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. A more detailed explanation of regulatory permitting requirements may also be available in Volume 8.

Existing Conservation Measures/Bat Andersen AFB

Existing conservation measures at Andersen AFB would be continued under the proposed action. The conservation measures developed by the Air Force were designed to compensate and minimize the potential impacts from implementation and operation of the ISR/Strike action to the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher, and the Guam rail. The conservation measures correspond to recovery actions outlined in various USFWS recovery plans for these species. Overall goals of the conservation measures contribute to important habitat and species management objectives on Guam, and may be grouped into the following categories: (1) habitat improvement measures including establishment of ungulate exclosures, Mariana fruit bat foraging plots, and habitat management units (2) studies and research, (3) BTS interdiction and control, and (4) adaptive management and avoidance/minimization measures. The BTS interdiction and control measures are implemented by an Air Force Instruction (36 WG INSTRUCTION 32-7004, dated March 15, 2006).

Specific conservation measures in place include aircraft training restrictions and Post-typhoon Training Schedule restrictions to protect fruit bats and crows. At Northwest Field, helicopter overflights north of the South Runway below 1,000 ft (305 m) above ground level are prohibited. Overflights of the MSA are prohibited below 1,000 ft (305 m) above ground level. Overflights within 3,000 ft (914 m) of Pati Point are prohibited below 1,600 ft (488 m) above mean sea level, except for flights from the end of the Andersen AFB primary runways.

Existing Conservation Measures on Navy Lands

Existing conservation measures on Navy lands would be continued under the proposed action. Conservation measures currently in place include:

- The Navy would maintain the 328 ft (100 m) radius No-Training Areas around the three known Mariana swiftlet caves within the NMS. The largest cave, Mahlac, has been monitored since 1984 by GDAWR and NAVFACPAC biologists. Two smaller caves, Fachi and Maemong, have been monitored since 1992 and 2004, respectively. A recent survey of the three known swiftlet caves suggests an overall increase in swiftlet numbers in Mahlac Cave and Maemong Cave, and Fachi Cave may have reached a maximum capacity to support swiftlets (due to limited size of roosting sites) (NAVFACMAR 2008a). The Navy has

contracted USDA WS to trap brown treesnakes in areas surrounding the caves since 2005, which has resulted in the removal of 488 snakes (NAVFACMAR 2008a). The Navy believes that 100-meter buffers to exclude training activities are sufficient to meet conservation goals for the swiftlet because (1) populations have increased under similar training restrictions and (2) the Navy would continue trapping efforts in swiftlet cave areas, which is likely to have factored into the population increases within the NMS. Some normal day-to-day operations of the NMS may occur within the buffers (such as driving on roads), but no training would occur within the buffers.

- No maneuver and navigation training occurs in areas with known Mariana common moorhen nesting activity. In addition there would be no clearing of vegetation during training events.
- Environmental restrictions and requirements for training operations are included in the COMNAV Marianas Training Handbook (COMNAV Marianas Instruction 3500.4, June 2000). The instruction contains the following components: guidance for developing an Environmental Protection Annex in support of a major military exercise plan; training requirements; BTS control and interdiction; monitoring and monitoring reports; emergency procedures; environmental monitor checklists; and an environmental awareness pocket card.
- BTS interdiction and control measures are implemented by a *Brown Treesnake Control and Interdiction or Management Plan* (COMNAV Instruction 5090.10A, dated February 2005). The BTS plan was used as a basis to develop the BTS-related project-specific protection measures discussed below.

Project-Specific Protection Measures and Best Management Practices

The Navy is considering some or all of the potential protection measures described below to minimize potential impacts to special-status species.

Avoidance and Minimization of Effects to Special Status Species

- Construction at any areas with Mariana crow nesting activity in the year prior to construction would be limited to outside the Mariana Crow breeding/nesting season of October through April if the potential exists for new nesting activity in the area. Crow nesting activity is currently being monitored (Andersen AFB 2008d).
- All construction in areas with Mariana fruit bats and Mariana crows would be limited to daytime hours to avoid nighttime impacts.
- One week prior to clearing vegetation, a qualified biologist would conduct surveys to determine if federally protected species are present in the project site. For example, if crows are nesting within 984 ft (300 m) of the project site the work would be postponed. O if fruit bats are present within 492 ft (150 m) of the project site, the work must be halted and not started again until the bat has left the area.
- Standard SOPs/Operating Instructions would be developed and included within the Joint Region INRMP and in an updated COMNAV Marianas Training Handbook (COMNAV Marianas Instruction 3500.4, June 2000) to describe restricted activities and areas and procedures if special-status species are observed during construction or training or for other special requirements identified for special-status species including limitations to training if fruit bat or nesting Mariana crows were present, and reporting procedures for injured or dead birds, mammals, or reptiles observed during construction or training.

- For the protection of fruit bats, hooded lights would be used on roads associated with the proposed North Gate and truck inspection area, aircraft staging areas, and magazines on Andersen AFB.
- A qualified biologist would conduct weekly monitoring of Mariana fruit bats at all roost sites in the project area until 1 year after the proposed project is fully constructed. After a typhoon event occurs on Rota, monitoring would be increased to three times per week for 8 weeks to more accurately monitor potential migration of bats between Rota and Guam.
- The Navy would adopt the Andersen AFB aircraft operations monitoring program for Mariana fruit bats and crows by providing additional support for the current monitoring effort of the effects of aircraft operations on Mariana fruit bats and crows and following the Air Force's adaptive management strategy, which allows for modification of overflight patterns if adverse effects to fruit bats or crows are documented.
- To evaluate potential noise impacts from expanded use of the demolition area at Andersen AFB and use of the breacher facility and small arms ranges at Andersen South and the Route 15 ranges, monitoring of the Mariana fruit bat and Mariana crow, if present, would be conducted in areas surrounding these facilities to determine potential noise impacts. If this monitoring determined that these species were being affected, techniques to reduce noise generation, such as noise barriers, would be employed.
- To prevent disturbance of sensitive species in recreational areas, restrictions on the use of Haputo Beach and ERA would be included within the Joint Region INRMP.
- Vehicle traffic would be carefully controlled on the access road to the NMS southern training area; only military training units and other authorized military personnel on military business would be allowed to use the road.
- Excessive lighting would be prohibited at beaches that have the potential to be used by sea turtles.
- Mature specimens of *Heritiera longipetiolata*, a Guam-listed tree identified near the KD range in the Duenas and Associates (2000) study would not be removed. Any seedlings identified in the area to be cleared would be transplanted. A survey would be conducted by a qualified biologist in all of the Route 15 range footprint areas prior to clearing for Heritiera longipetiolata. If the species is found in areas to be cleared, individuals would be transplanted if possible, or if not possible efforts would be made to propagate the species and replace the number of trees lost with an equal number on adjacent lands.
- Before the start of construction, all personnel involved would receive a briefing on special-status species potentially present and avoidance measures.
- The COMNAV Marianas Training Handbook (COMNAV Marianas Instruction 3500.4, June 2000) would be updated and include all avoidance, minimization, and monitoring requirements applicable to the actions described in this EIS.

Invasive Species Avoidance, Minimization, and Control

- The 5-Step Hazard Analysis and Critical Control Point (HACCP) planning method (an international standard, ASTM E2590-08) for reducing or eliminating the spread of unwanted species would be used for high-risk activities (to be identified in the Biosecurity Plan (see below under Potential Conservation Measures) and would be required for all construction project sites.
- All personnel involved in training activities would adhere to the COMNAV Marianas Training Handbook, which calls for individual troops to be responsible for conducting self inspections to avoid potential introductions of invasive species to Guam (both on to Guam and intra-Guam) and

the CNMI. Troops would inspect all gear and clothing (e.g. boots, bags, weapons, pants) for soil accumulations, seeds, invertebrates, and possible inconspicuous stow away brown treesnakes). The intent of this measure is to minimize the potential effects associated with transport of troops and personnel to and in and around Guam and the CNMI from areas that contain species not native to terrestrial habitats within the area. In addition, compliance with the COMNAV Marianas Training Handbook, COMNAV Marianas Instruction 5090.10A and per requirements in DoD 4500.9-R (Chapters 505 and 506) would be required for travel to and from training sites within the Mariana Islands Range Complex. The intent of these measures is to minimize the transport of potentially invasive plant and animal species (other than BTS which is addressed separately below) associated with transport of troops and personnel within and between Guam and the CNMI. The Navy is in ESA section 7 consultation with USFWS Pacific Islands Field Office to develop SOP and/or Operating Instruction templates and exercise planning to better meet invasive species management needs associated with proposed operations and training on Guam.

- To prevent predation on native wildlife, the escape, abandonment, or intentional release of pets (such as cats and dogs, but including all pets) would be prevented through pet ownership policies and Base instructions or orders to ensure that pets are controlled and not allowed at Haputo ERA, Overlay Refuge, or other conservation lands.
- Invasive Species Avoidance, Minimization, and Control – BTS Specific. The Navy would supplement and update the existing environmental education program for new arrivals. The updates may include (1) mandatory viewing of a new BTS educational video, (2) pocket guides with BTS information and personal inspection guidelines, and (3) assurance that BTS awareness extends from the chain of command to the individual marine and sailor.
- The DoD, working in collaboration with the USFWS, and USDA –Wildlife Services (USDA-WS) and Animal and Plant Health Inspection Service (APHIS) would decide how best to implement the Joint Region BTS Control Plan relevant to the proposed activities. The Navy strategy would involve three components: (1) avoidance, (2) minimization, and (3) offsetting measures. Specific aspects of these strategies are still in development and would be included in the USFWS Biological Opinion; however, the overall strategies are outlined in the following bullets.
- The Navy, in compliance with the DoD Defense Transportation Regulations, Chapter 505 protocols, is committed to implementing 100 percent inspection of all outgoing vessels and aircraft with dog detection teams. This could be supplemented by other pest control expertise (with appropriate USDA-WS BTS detection training and oversight) to meet 100 percent inspection goals for large scale training activities. The Navy understands that inspection capacity limitations exist within the present USDA-WS interdiction capabilities. In the event of DoD-related, vehicles, and equipment leaving Guam without inspection, the Navy would notify the point of destination port or airport authorities.
- The Navy could support rapid response actions to BTS sightings within the CNMI and locations outside of the CNMI and Guam, specifically Hawaii, by working with USGS Biological Resources Discipline (BRD) in developing procedures and protocols that would support rapid action for a BTS sighting. The Navy could also establish temporary snake-free quarantine areas for cargo traveling from Guam to CNMI and locations outside of the CNMI and Guam. These BTS sterile areas would be subject to multiple night searches with appropriately trained interdiction (dog) teams. Temporary barriers are preferable to permanent exclosures because of the variable sizes needed for various training activities.

- The Navy would fund additional research to protect ESA-listed and recently delisted species from BTS. From the research and development list provided by the BTS Technical Working Group, the Navy proposes to fund the USGS-led project for integrating canine and human search teams, which would improve snake sightings in low density areas (e.g., to ensure a snake can be found if a sighting occurs on Tinian). Other promising research would also be funded such as chemical irritants to assist dog teams with capture of detected snakes. If successful, this method enhancement would fully integrate three tools: human searching, dog-aided searches, and snake repellents/irritants.
- Additional trapping of BTS and rodent control near new housing areas would be conducted.

Potential Conservation Measures and Best Management Practices

Ungulate Management Plan

This plan is currently being developed by the Navy to control and monitor ungulates including deer, pigs, and carabao on all military lands in Guam; this plan would greatly reduce the habitat degradation currently occurring because of excessive ground disturbance and herbivory; the plan would be extended to include the Joint Region (includes AAFB) and new non-DoD lands proposed for use and would be used to compensate for displacement of ungulates (and resulting greater potential damage in neighboring areas) due to construction at NCTS Finegayan, former FAA parcel, and Harmon Annex.

Wildland Fire Management Plan

A Wildland Fire Management Plan exists that has been developed by the USFS for Navy lands (USFS 2008). The plan currently includes a series of recommended actions to develop and implement an effective wildland fire management program, covering such topics as staffing, equipment, training, and development and implementation of fire management strategies, prevention, suppression methods, preparedness, impacts, and management techniques. Reasons for not implementing any of the recommendations would be specifically addressed. The plan does not currently address the proposed new ranges at Route 15 and other proposed new training areas so would be updated to address these areas. The plan would also include BMPs such as for cleaning gear and equipment to prevent the spread of invasive species resulting from wildfire suppression. Any impacts related to fire breaks, fire fighting roads, or other land disturbance related to fire management would be addressed in subsequent NEPA documentation.

Micronesian BioSecurity Plan (MBP)

BTS management plans (Base instructions) for Navy and Air Force lands are currently in place for ongoing operations (see above under existing conservation measures). The military buildup in Guam and CNMI would result in a substantial increase in the amount of cargo and personnel arriving and departing in Guam and the CNMI. This increase would significantly increase the risk of marine and terrestrial invasive species arriving in Guam and the CNMI as well as being transported throughout the region. Invasive species such as the BTS, coconut rhinoceros beetle, cycad scale, fruit fly and numerous other vines, weeds, and pathogens already significantly impact the Pacific region.

Biosecurity is mission critical and actions that prevent or control invasive species support the Executive Order 13112; Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended (ESA); National Invasive Species Act of 1996; Brown Treesnake Control and Eradication Act of 2004; Sikes Act (16 U.S.C. 670a et seq.); Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855); and the Animal Damage Control Act of 1931, as amended (46 Stat. 1486; 7 U.S.C. 426-426c).

The MBP, including a risk analysis, is currently being developed by the National Invasive Species Council in conjunction with USFWS, USDA, GDAWR, Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife, and other interested parties to facilitate a comprehensive approach to control invasive species export, import, and spread. This comprehensive approach looks at the potential pathways for inadvertent introduction of species and allows for the control or spread of multiple species. This plan intended to be the basis for a large-scale strategic biosecurity plan for Micronesia. Of particular concern is the export of the BTS to other islands in the Pacific. The plan would be comprehensive for all Marine Corps and Navy actions on Guam and CNMI, including those being proposed in this EIS/OEIS. It would include the BTS interdiction and control measures described above as well as additional measures for both BTS and other invasive species.

The risk analysis component would include the following: 1) identification of and ranking of priority species and vectors and potential pathways, particularly those requiring pre-departure mitigation measures for the Micronesian region and Hawaii; these could include could include, but are not limited to, nuisance and noxious species, construction equipment, personal protective equipment, foot traffic, vehicles and vessels, and shipping material; 2) risk ranking for ports of origin for the Micronesian region; and 3) development of a regional monitoring strategy.

The biosecurity plan component would include the following: 1) certification of goods and transport, standard operating procedures for regional ports, warehouses, shipping and consolidation facilities to include training, inspections and monitoring, early detection of newly establishing species; 2) mitigation measures such as rapid response; 3) a public outreach program; 4) projection of required resources, facilities and manpower to match the planned military build-up with the goal of 100 % prevention, control and treatment for the identified highest risk pathways; and 5) a strategy, produced collaboratively with local and regional officials, on the policy and regulatory changes needed to achieve 100 percent prevention, control and treatment for the identified highest risk pathways, ports of origin, and species for the region.

Once the MBP is developed, the Navy would dedicate resources to address high-priority action items specified in the plan. Regarding cargo inspections and procedures, although the Navy cannot require the inspection of non-DoD cargo, the plan would be available for others to use. The Navy would be working with non-DoD partners to evaluate prioritization and implementation of management actions identified in the MBP

A detailed outline of the MBP would be in the BA that supports Section 7 consultation with USFWS for the preferred actions described in this EIS/OEIS. The MBP elements in the BA would be part of the conservation measures for this EIS/OEIS.

Invasive Species Management

In addition to ungulate and BTS control and management, management options would be assessed for other invasive species that are threatening special-status or SOGCN species. Insects that are threatening the native cycads and the few remaining fire trees and preventing the recovery of that species would be evaluated and management options would be developed to evaluate and address the problems.

Potential Mitigation Measures

Ecological Reserve and Conservation Area

The Navy would expand the existing Orote ERA and would consider the creation of new ERAs or conservation areas. Ecological Reserve Areas (ERA) have previously been established on Guam (the Orote and Haputo ERAs) as mitigation for a previous project.

The general objectives of ERAs, as established by guidelines are to identify and protect examples of ecosystems and of physical or biological phenomena;

- Provide research and education opportunities for scientists in the observation and study of the environment;
- Preserve the full range of biological diversity; and
- Provide a basis for organized research and exchange of information on these areas.

According to guidelines in establishing ERAs, those areas should show no evidence of human disturbance over the past fifty-years; however, exceptions may be made for unique or particularly valuable ecological communities. The areas should contain typical or unusual flora or fauna or other biotic phenomena or characteristics or outstanding geologic, pedologic, or aquatic features or processes. ERAs should be large enough to provide essentially unmodified conditions in their interior portions.

Orote ERA would be expanded to protect the Spanish Steps area that has turtle nesting and Orote Island which supports nesting seabirds. The current Orote ERA has a marine unit consisting of 133 ac (54 ha) and a terrestrial unit of 30 ac (12 ha). Orote ERA would be expanded to include Orote Island and Adotgan Point which would add a total of 113 ac (46 ha), of which there would be 81 ac (33 ha) of marine area and 32 ac (13 ha) of terrestrial area.

ESA-Protected Sea Turtle Natural History

Green turtles (*Chelonia mydas*) nest on Navy and Air Force lands along with foraging in the nearshore waters off the installations. As a measure to benefit long-term military mission planning, collection of key information on sea turtles is being considered. Population abundance estimates, demographic information and near shore habitat use of marine turtles in the waters of Guam, Saipan, Tinian and Rota of the Mariana Archipelago is necessary to develop a better understanding of population baseline and long-term ecological processes. Long-term foraging habitat capture-mark-recapture programs combined with laparoscope examinations can acquire necessary abundance estimates as well as growth, reproductive status, and sex ratio information essential for adequate population demographic modeling. A long-term in-water study would provide valuable information regarding near shore foraging habitat use, and combined with applied research techniques including sonic (or acoustic) tags, satellite telemetry, and genetic analysis would provide greater insight into foraging ecology, migratory movements and connectivity within the greater Western Pacific Region.

This would be a joint Navy and NMFS project. It is a 3-5 year capture-mark-recapture laparoscopy program for green sea turtles occurring in near shore waters surrounding Guam, Saipan, Tinian and Rota.

Fencing Enclosures and Foraging Plots

A potential conservation measure would be constructing enclosures similar to those on or proposed at Andersen AFB to exclude one or more of the following: BTS, ungulates, rats, dogs, monitor lizards, and cats. These would be constructed in areas of high quality habitat at NCTS Finegayan and/or at NMS.

Within these areas all feral animals and BTS would be removed to protect special-status species. Foraging plots could be established to ensure quality food sources are present. Invasive plants would be removed.

AAFB is erecting an ungulate-proof fence and eradicating ungulates as a part of their ISR Strike and Redhorse Beddown BOs. After this occurs, an additional step would be to install additional measures to prevent entry by brown treesnake and other feral mammals. This would provide a more complete restoration of the native ecosystem and would set the stage for reintroduction of threatened and endangered species. This multi-phased project could include:

- Forest enhancement by planting of native species that have been removed by typhoons, ungulate browsing, logging, poaching, (such as native breadfruit, joga, ifit, Pisonia)
- Protection and establishment of endangered Serianthes trees
- Development of seedling protectors appropriate for tropical tree species
- Reintroduction of native skink species
- Translocation of native birds non-endangered (Micronesian starlings from AFB, other bird species from Rota, fan-tails, white-eyes)
- Initial release of endangered Guam rail

Greenbelt Development

An example of greenbelt development on Southern Guam (or NMS) would be reclamation of forest habitat on savanna lands for watershed protection, to limit the spread of wildland fires, and to restore threatened and endangered species habitat. This could include:

- Establish greenbelts of *Acacia* to fix soil nitrogen, build soil quality and limit the spread of wildland fires, extend greenbelts to become continuous forest areas
- Underplanting of *Acacia* with native species, and then
- Reduction of *Acacia* after native species is established

Fencing, Patrols, or Cameras to Exclude Poachers and Prevent Deliberately Set Fires

A potential conservation measure would be to fence, patrol, or place cameras in certain areas to help prevent intrusion by poachers who may try to illegally take endangered Mariana fruit bats from areas where they currently occur or have the potential to occur in the future, or those who set fires.

10.2.3 Alternative 2

10.2.3.1 North

Andersen AFB

For Andersen AFB, Alternative 2 is identical to Alternative 1.

Finegayan

Construction

Vegetation. A total of 0.7 ac (0.3 ha) of primary limestone forest and 890 ac (360 ha) of disturbed limestone forest would be removed during proposed construction activities at NCTS Finegayan and South Finegayan (Table 10.2-12 and Figure 10.2-18). Approximately 140 ac (57 ha) of shrub/grassland and 1.0 ac (0.4 ha) of tangantangan would be removed from these same areas.

The limestone forest in these areas is not known to harbor any sensitive plant species identified by a government or conservation groups. It serves as potential habitat for sensitive animal species that are

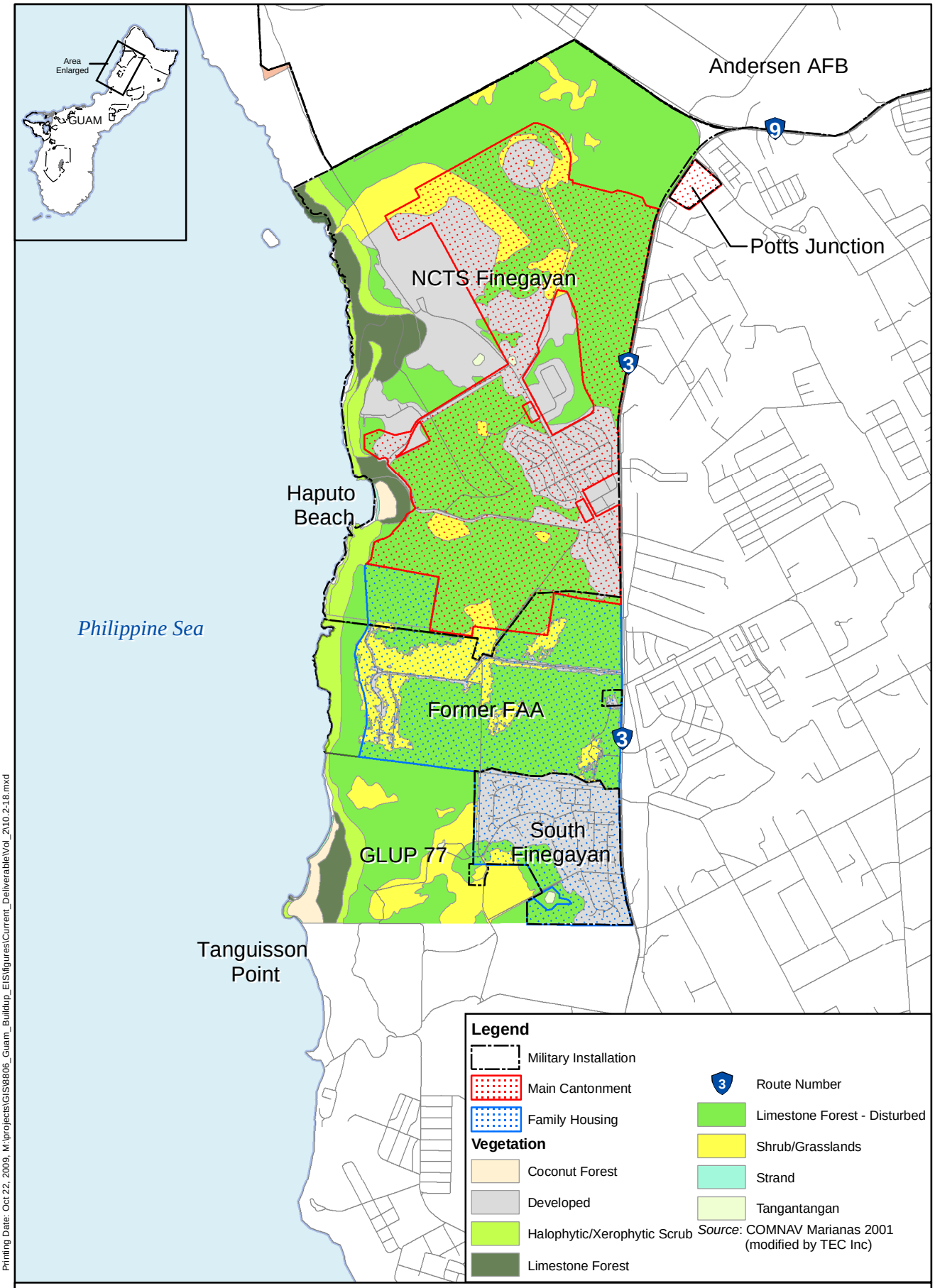

Figure 10.2-18
Potential Vegetation Impacts - Alternative 2
(NCTS Finegayan, Former FAA Parcel, and South Finegayan)

Table 10.2-12. Potential Impacts to Vegetation Communities at NCTS Finegayan, South Finegayan, and Former FAA Parcel with Implementation of Alternative 2 (ac [ha])

Parcel and Activity	*Limestone Forest, Primary*	*Limestone Forest, Disturbed*	*Shrub/ Grassland*	*Tangantangan*	*Developed*
NCTS and South Finegayan Vegetation Removed					
Main Cantonment	0.7 (0.3)	890 (360)	140 (57)	1.0 (0.4)	578 (234)
Former FAA Parcel Vegetation Removed					
Main Cantonment	0	445 (180)	134 (54)	0	26 (11)
Total Vegetation Removed	**0.7 (0.3)**	**1,335 (540)**	**274 (111)**	**1.0 (0.4)**	**604 (244)**

addressed under the Special-Status Species section below. The most pristine vegetation and habitats are on Haputo ERA which would remain unchanged. Impacts to vegetation would be less than significant.

Wildlife. Wildlife species that currently occur at NCTS Finegayan are species that are common elsewhere on Guam including Pacific golden plover, yellow bittern, black francolin, Eurasian tree sparrow, blue-tailed skink, mutilating gecko, and mourning gecko. Construction activities would displace wildlife from habitat in the proposed project areas. The loss of woody vegetation would result in the loss of nesting areas for the bittern, but this loss would not result in significant adverse effects on its population. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities. However, long-term, permanent impacts to populations of such species would not result because these species are abundant in surrounding areas and would rapidly repopulate portions of the affected area. Therefore, impacts to wildlife would be less than significant with implementation of Alternative 2 at Finegayan.

Construction activities for the cantonment would generate noise. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of habitat nearby. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. All main cantonment components would be constructed on the upper plateau area. Haputo ERA would remain as is and would be available to serve as a migration corridor for species moving or dispersing from Andersen AFB to potential habitat further south or from these areas to the north. Proposed construction activities would directly impact habitat for a number of ESA-listed species that currently occur on Guam and impact essential habitat and recovery zones that could serve as potential reintroduction areas for ESA-listed species (Table 10.2-13).

MARIANA FRUIT BAT. Sightings of the fruit bat are uncommon at NCTS Finegayan (2 sightings reported in 10 observation days) and occur in the Haputo ERA area or the very northern portion of the facility and there are no known roost areas. Proposed construction activities would include the loss of disturbed limestone forest that is potential, but currently mostly unused foraging and roosting habitat for the Mariana fruit bat. A total of 433 ac (175 ha) of essential habitat would be removed for construction of the various project components on the base (Figure 10.2-19). This essential habitat is also designated Overlay Refuge. Removal of these areas due to construction would have a significant impact. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Since the fruit bat is rarely observed south of Andersen AFB, noise impacts from construction would be less than significant.

Damage from ungulate disturbance of forested areas is a serious concern in Guam. Ungulate damage on Finegayan ranges from moderate to severe throughout all of Finegayan in the area proposed for the main

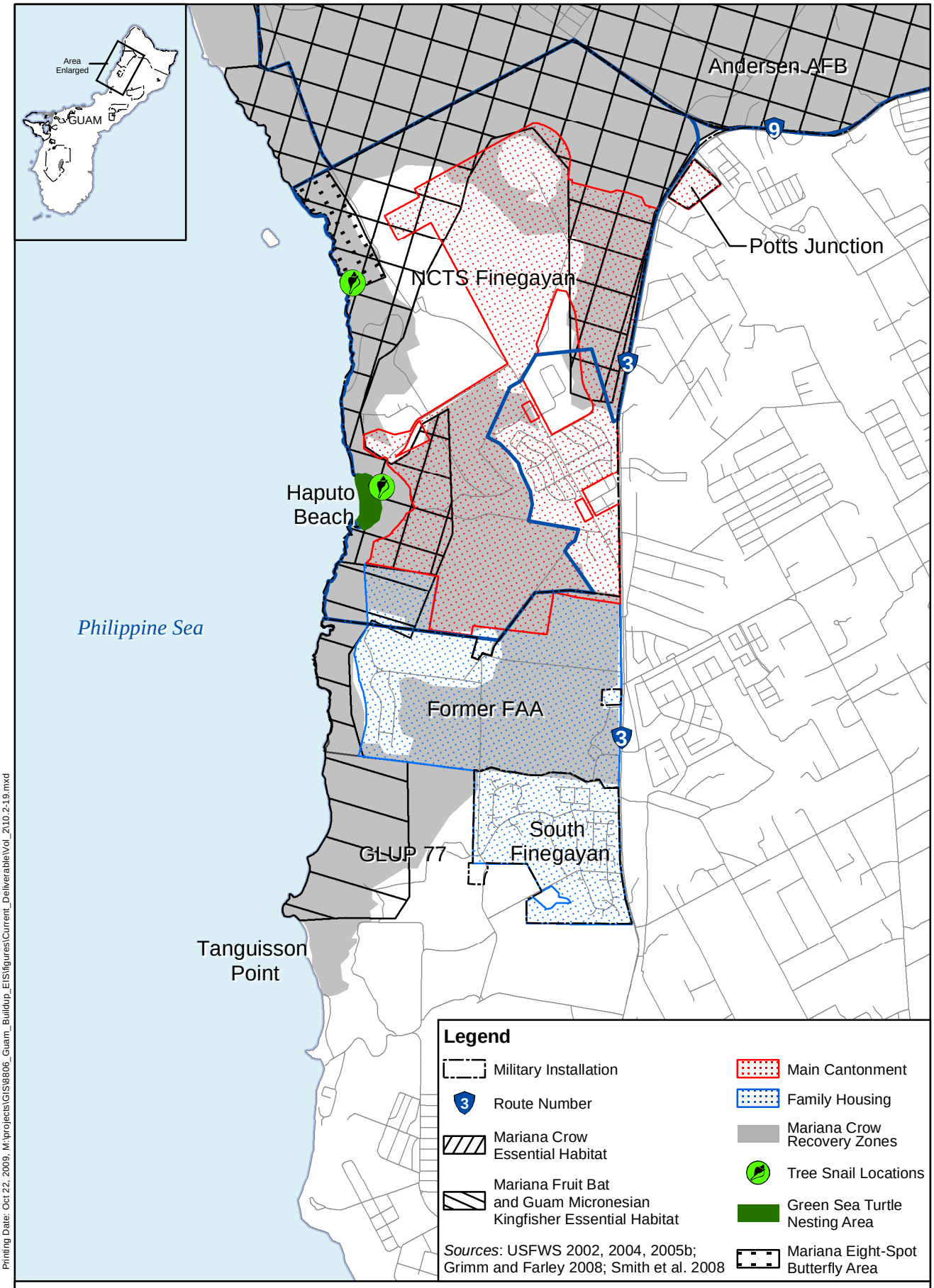

Figure 10.2-19
Potential Special-Status Species Impacts - Alternative 2
(NCTS Finegayan, Former FAA Parcel, and South Finegayan)

Table 10.2-13. Potential Impacts to Special-Status Species Habitat at NCTS Finegayan, South Finegayan, and Former FAA Parcel with Implementation of Alternative 2 (ac [ha])

Parcel and Activity	*Overlay Refuge*	*Essential Habitat – Bat and Kingfisher*	*Essential Habitat – Crow*	*Crow Recovery Zone*
Direct Impacts from Construction – Habitat Removed				
NCTS Finegayan Habitat Removed	1106 (448)	433 (175)	379 (153)	800 (324)
Former FAA Parcel Habitat Removed	0	0	0	450 (182)
Total Habitat Removed	1106 (448)	433 (175)	379 (153)	1,250 (506)
Percentage of Habitat Type on Guam that is Removed	5.1 %	1.7 %	1.6 %	3.5 %
Indirect Impacts (unoccupied habitat) – Noise, Lighting, Human Activity				
60 m buffer for MC (F, N) – Ground Ops				
NCTS and South Finegayan	104 (42)	NA	38 (29)	87 (35)
Former FAA Parcel	2.6 (1.1)	NA	0	24 (10)
Totals	107 (43)	NA	38 (29)	111 (45)
100 m buffer for KF (F, N) – Ground Ops				
NCTS and South Finegayan	166 (67)	135 (55)	NA	NA
Former FAA Parcel	5.7 (2.3)	25 (10)	NA	NA
Totals	172 (70)	160 (65)	NA	NA
150 m buffer for FB (R) – Ground Ops				
NCTS and South Finegayan	242 (98)	202 (82)	NA	NA
Former FAA Parcel	12 (4.9)	51 (21)	NA	NA
Totals	254 (103)	253 (102)	NA	NA

Notes: Each habitat category is considered independently of others and is not additive. NA – Not applicable; FB – Fruit Bat, MC - Mariana Crow, KF – kingfisher; F – Foraging, R – Roosting/Colony, N - Nesting.

cantonment. Removal of the large amounts of habitat required for construction under Alternative 2 would displace feral pigs and deer into adjacent areas resulting in even greater density than currently exists. Assuming a potential density of 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) (Knutson and Vogt 2002) and the total of 1,032 ac (418 ha) forest or shrubland to be removed, the number displaced would be 72 deer and 155 pigs. This additional ungulate activity would result in significant impacts to the Mariana fruit bat because of degradation of essential habitat. As mitigation, an ungulate management plan would be developed and implemented to control ungulates and to compensate for displacement of ungulates into adjacent areas due to construction at NCTS Finegayan. With this mitigation, impacts to fruit bat habitat from ungulate habitat damage would be less than significant.

GUAM MICRONESIAN KINGFISHER. The kingfisher is not currently present in the wild. Proposed construction activities would include the loss of limestone forest that is potential habitat for the possible future introduction of the kingfisher. A total of 433 ac (175 ha) of essential habitat would be removed for construction of the various project components on the base (see Table 10.2-13). This essential habitat is also designated Overlay Refuge. Removal of these areas due to construction would have a significant impact because of the removal of habitat areas designated as Overlay Refuge and essential habitat for the conservation and reintroduction of the species. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Concerns regarding damage to kingfisher essential habitat from ungulates as an indirect result of construction would be similar to that already described for the fruit bat. With mitigation, impacts from ungulate habitat damage would be less than significant.

MARIANA CROW. Proposed construction activities would include the loss of limestone forest that is potential foraging and nesting habitat for the Mariana crow, although the crow does not currently occur on Finegayan. A total of 379 ac (153 ha) of essential habitat would be removed for construction of the various project components on the base (Table 10.2-13). This essential habitat is also designated Overlay Refuge. Removal of these areas due to construction would have a significant impact. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Concerns regarding damage to Mariana crow designated essential habitat from ungulates as an indirect result of construction would be similar to that already described for the fruit bat. With mitigation, impacts from ungulate habitat damage would be less than significant.

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. No specific areas of essential habitat have been designated for this species but 140 ac (57 ha) of favorable shrub/grasslands habitat contained within the Overlay Refuge would be removed. However, because the Guam rail is currently extirpated in the wild and most of Guam has habitat that is potentially suitable for the recovery of the species, removal of these areas due to construction would result in a less than significant impact.

PACIFIC SLENDER-TOED GECKO. This Guam-listed species was detected in recent natural resource surveys in northeastern NCTS Finegayan in the northeast portion of the footprint of the proposed construction area. The abundance is unknown in the area surveyed or in others areas. This species is known to be present in other areas on Guam (for example, on NMS where it was detected in project-specific surveys). Based on its habitat preference of forest edge habitat on rocky substrates, the species is likely to be present in other locations. Because the species was uncommonly observed in project-specific surveys, the only area-wide surveys conducted on Guam within the past several decades, the numbers remaining of this species is unknown. As mitigation additional surveys would be conducted for this species on NCTS Finegayan to determine its distribution there and potential impacts to the population on Guam. If the Guam population was found to be affected, a habitat improvement project would be included for the species at NMS, where the species was also found during project-specific surveys. With this mitigation, impacts would be less than significant.

ALL SPECIAL-STATUS SPECIES. Removal of land under Alternative 2 would displace and concentrate feral pigs and Philippine deer into adjacent areas. Greater amounts of habitat would be removed under Alternative 2 versus under Alternative 1. Assuming a potential density of 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) (Knutson and Vogt 2002) and the total of 1,031 ac (417 ha) of forest or shrubland to be removed, the number displaced would be approximately 72 deer and 155 pigs. This additional ungulate activity would result in significant impacts to all special-status species because of degradation of essential habitat and Overlay Refuge. As mitigation, an existing ungulate management plan that is currently being finalized would be updated to include specific management and control for the increase in ungulates resulting from this action and the plan would be implemented at NCTS Finegayan. Mitigation measures are further described in Section 10.2.2.6. With mitigation, impacts to habitat from ungulates would be less than significant.

Operation

Vegetation. There would be no impacts to vegetation.

Wildlife. Impacts to wildlife would be the same as for Alternative 1.

Special-Status Species. Impacts to special-status species would be the same as for Alternative 1 except that the indirect impacts to special-status species from avoidance of essential habitat near human activity resulting from housing and during operations and maintenance, and perimeter and facility lighting at night would affect essential habitat as follows (see Table 10.2-13): Mariana fruit bat - 202 ac (82 ha); Micronesian kingfisher – 135 ac (55 ha); and Mariana crow – 38 ac (29 ha). Indirect impacts from these human activities and lighting would be significant. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Non-DoD Land

Construction

Vegetation. A total of 445 ac (180 ha) of disturbed limestone forest would be removed during proposed construction activities on the former FAA parcel (see Table 10.2-13). Approximately 134 ac (54 ha) of shrub/grassland would also be removed. The limestone forest is not known to harbor any sensitive plant species identified by government or conservation groups. It serves as potential habitat for sensitive animal species that are addressed under the Special-Status Species section below. Impacts to vegetation would be less than significant.

Wildlife. Wildlife species that currently occur at the former FAA parcel are similar to those that occur at NCTS Finegayan. Based on the similar types of actions occurring here as at Finegayan, there would be no significant impacts to wildlife with implementation of Alternative 2.

Construction activities for the cantonment would generate noise. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of habitat nearby. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. All main cantonment components would be constructed on the upper plateau area. Proposed construction activities could directly impact habitat for a number of ESA-listed species that currently occur on Guam and impact essential habitat and recovery zones that could serve as potential reintroduction areas for ESA-listed species that are currently extirpated or nearly extirpated from Guam.

MARIANA CROW. Proposed construction activities would include the loss of forested areas that are within a suggested recovery zone for the crow. A total of 450 ac (182 ha) of this recovery zone would be removed for construction of the various project components on the base (see Table 10.2-13). No Overlay Refuge is designated in this area. Removal of these areas due to construction would have a significant impact. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

Ungulate damage on the former FAA parcel is generally moderate in the area proposed for the main cantonment. Removal of the large amounts of habitat required for construction under Alternative 2 would displace feral pigs and deer into adjacent areas resulting in even greater density that currently exist. Assuming a potential density of 0.07 deer/ac (0.17 deer/ha) (NAVFAC Marianas 2009) and 0.15 pigs/ac (0.38 pigs/ha) (Knutson and Vogt 2002) and the total of 579 ac (234 ha) forest or shrubland to be removed, the number displaced would be 41 deer and 87 pigs. This additional ungulate activity would result in significant impacts to the Mariana crow because of degradation of recovery zone habitat. As mitigation, a plan would be developed and implemented to control ungulates to compensate for displacement due to construction at the former FAA parcel. With this mitigation, impacts would be less than significant.

GUAM RAIL. The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. No Overlay Refuge is designated in this area. No specific areas of essential habitat or other habitat have been designated for this species but 134 ac (54 ha) of favorable shrub/grasslands habitat would be removed. Because the rail is not currently present at this location and no specific habitat areas have been designated, construction would have a less than significant impact.

Operation

Vegetation. There would be no impacts to vegetation.

Wildlife. Impacts to wildlife would be the same as for Alternative 1.

Special-Status Species. There would be no direct impacts from operations. Impacts to special-status species would be the same as for Alternative 1 except that the indirect impacts to special-status species from avoidance of habitat near human activity resulting from housing and during operations and maintenance, and perimeter and facility lighting at night would affect essential habitat as follows (Table 10.2-13): Mariana fruit bat - 51 ac (21 ha); and Micronesian kingfisher – 25 ac (10 ha). Indirect impacts from these human activities and lighting would be significant. Impacts would be mitigated to less than significant with a suite of actions described in Section 10.2.2.6.

10.2.3.2 Central

Andersen South

For Andersen South, Alternative 2 is identical to Alternative 1.

Non-DoD Land

For non-DoD land, Alternative 2 is identical to Alternative 1.

10.2.3.3 Apra Harbor

For Apra Harbor, Alternative 2 is identical to Alternative 1.

10.2.3.4 South

For NMS, Alternative 2 is identical to Alternative 1.

10.2.3.5 Summary of Impacts

Construction impacts would include direct significant impacts to vegetation from loss of 28 ac (11 ha) of primary limestone forest; direct significant impacts to the endangered Mariana fruit bat and Micronesian kingfisher from clearing of 568 ac (230 ha) of essential habitat and to the endangered Mariana crow from clearing of 514 ac (208 ha) of essential habitat. There would be direct impact to 1,211 ac (490 ha) of Overlay Refuge, which includes the essential habitat just listed and other additional lands. There would be additional direct significant impacts to the Mariana fruit bat and indirect significant effects to the Mariana crow and Micronesian kingfisher due to loss of habitat in areas surrounding new facilities because of noise and lighting from facility operations and aircraft takeoff and landings. The specific habitat requirements of special-status species impacted are not understood well enough to conclude that the type of habitat that would remain upon implementation of the proposed action is adequate to meet the goals of the recovery plans. There would be significant impacts to the Guam-listed Pacific slender-toed gecko that is present in the construction footprint. There would be potential significant direct impacts to a Guam endangered tree species at non-DoD Route 15 lands, mitigated to less than significant. Other indirect effects are described in Table 10.2-15.

Overall effects for all actions being proposed in this EIS/OEIS are in Volume 7.

10.2.3.6 Potential Mitigation Measures

Conservation measures, BMPs, and mitigation measures would be the same as those identified for Alternative 1 with adjustments based on amount of designated habitat areas impacted. An additional mitigation measure would be implemented for the Pacific slender-toed gecko since the species is known to occur in the area that would be removed in northeast Finegayan, Mitigation would include additional surveys conducted for this species on NCTS Finegayan to determine its distribution there and potential impacts to the population on Guam. If the Guam population was found to be affected, a habitat improvement project would be included for the species at NMS, where the species was also found during project-specific surveys.

10.2.4 Alternative 3

10.2.4.1 North

Andersen AFB

For Andersen AFB, Alternative 3 is identical to Alternative 1.

Finegayan

For NCTS and South Finegayan, Alternative 3 is identical to Alternative 2. Figures are provided showing vegetation (Figure 10.2-20) and special-status species (Figure 10.2-21) for the layout of the cantonment area.

Non-DoD Land

Alternative 3 does not include acquisition or use of the non-DoD lands identified as the former FAA parcel and the Harmon Annex.

10.2.4.2 Central

Andersen South

For Andersen South, Alternative 3 is identical to Alternative 1.

Navy and Air Force Barrigada

Construction

Vegetation. A total of 153 ac (62 ha) of primary (mature forest dominated by native species) limestone forest would be removed during proposed construction activities at Barrigada (Table 10.2-14 and Figure 10.2-20). Approximately 122 ac (49 ha) of shrub/grassland and 197 ac (80 ha) of tangantangan would be removed from these same areas. The limestone forest in these areas is not known to harbor any sensitive plant species identified by a government or conservation groups. It serves as potential habitat for sensitive animal species that are addressed under the Special-Status Species section below. Impacts would be significant.

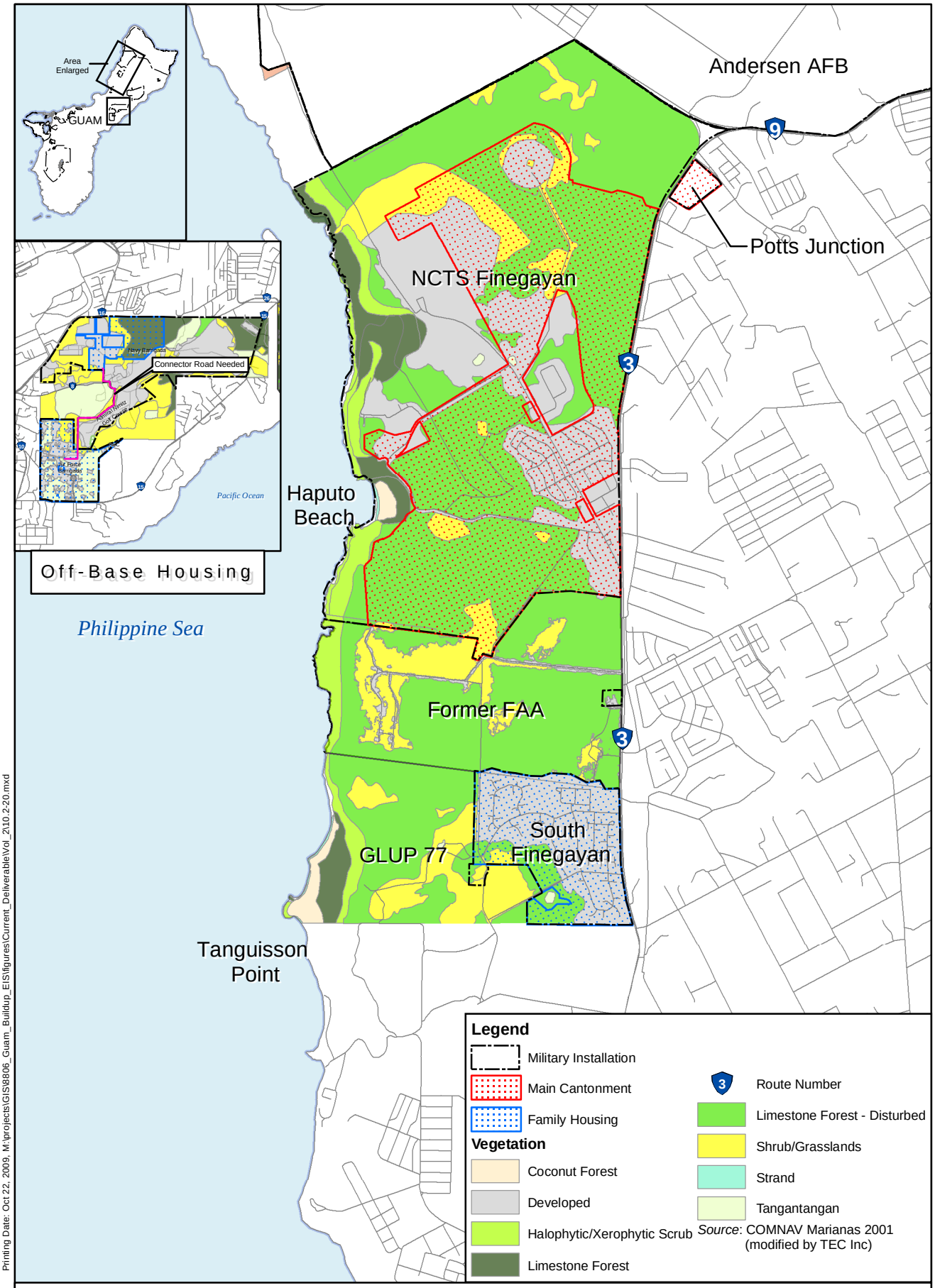

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Figure 10.2-20
Potential Vegetation Impacts - Alternative 3
(NCTS Finegayan, South Finegayan, Navy Barrigada, and Air Force Barrigada)

Table 10.2-14. Potential Impacts to Vegetation Communities at Navy and Air Force Barrigada with Implementation of Alternative 3 (ac [ha])

Parcel and Activity	*Limestone Forest*	*Shrub/ Grassland*	*Tangantangan*	*Developed*
Air Force Barrigada (Vegetation Removed)				
Air Force Barrigada	0	42 (17)	197 (80)	190 (77)
Navy Barrigada (Vegetation Removed)				
Navy Barrigada	153 (62)	80 (32)	0	143 (58)
Total Vegetation Removed	**153 (62)**	**122 (49)**	**197 (80)**	**330 (134)**

Wildlife. Wildlife species that currently occur at Navy Barrigada are native and non-native species that are common elsewhere on Guam such as Pacific golden plover, yellow bittern, island collared dove, western cattle egret, black francolin, Eurasian tree sparrow, blue-tailed skink, mutilating gecko, and mourning gecko. It is assumed that similar species would be present at Air Force Barrigada. Proposed construction activities would displace wildlife from habitat in the proposed project areas. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities; however, long-term, permanent impacts to populations of such species would not result because these species are abundant in surrounding areas and would rapidly repopulate portions of the affected area. Therefore, there impacts to wildlife would be less than significant.

Construction activities for the operation buildings and housing would generate noise. Only a few widespread migratory bird species are present that would be affected. They would move away from the construction areas, but there are other areas of habitat nearby. Therefore, indirect impacts to wildlife from construction would be less than significant.

Special-Status Species. Proposed construction activities would not impact any designated habitat areas.

GUAM TREE SNAIL. The Guam tree snail, an ESA candidate species, was documented in the limestone forest at Navy Barrigada (Figure 10.2-21) on one transect during site-specific surveys in 2008 in support of this EIS/OEIS. The distribution and numbers of tree snails at the site is unknown. Proposed construction activities would remove primary limestone forest, the habitat of the Guam tree snail, and would result in direct mortality of individuals. Mitigation would include the relocation of snails to another location with habitat that could support the species. With this mitigation, impact on the Guam tree snail would be less than significant.

Operation

Vegetation. There would be no impacts to vegetation.

Wildlife. There would be no direct impacts to wildlife because operations would occur in previously cleared areas.

Operational activities would generate noise throughout the area. However, migratory bird species or other native wildlife that would otherwise use the area are common throughout Guam and are generalists that can utilize numerous habitats that are abundant throughout Guam. Therefore, noise and activity from operations associated with the proposed action would be less than significant.

Special-Status Species. There would be no direct impacts from operations on special-status species. The only special-status species that might occasionally use the area and be affected indirectly is the Mariana fruit bat but based on historical observations this would be infrequent. Impacts to special-status species would be less than significant.

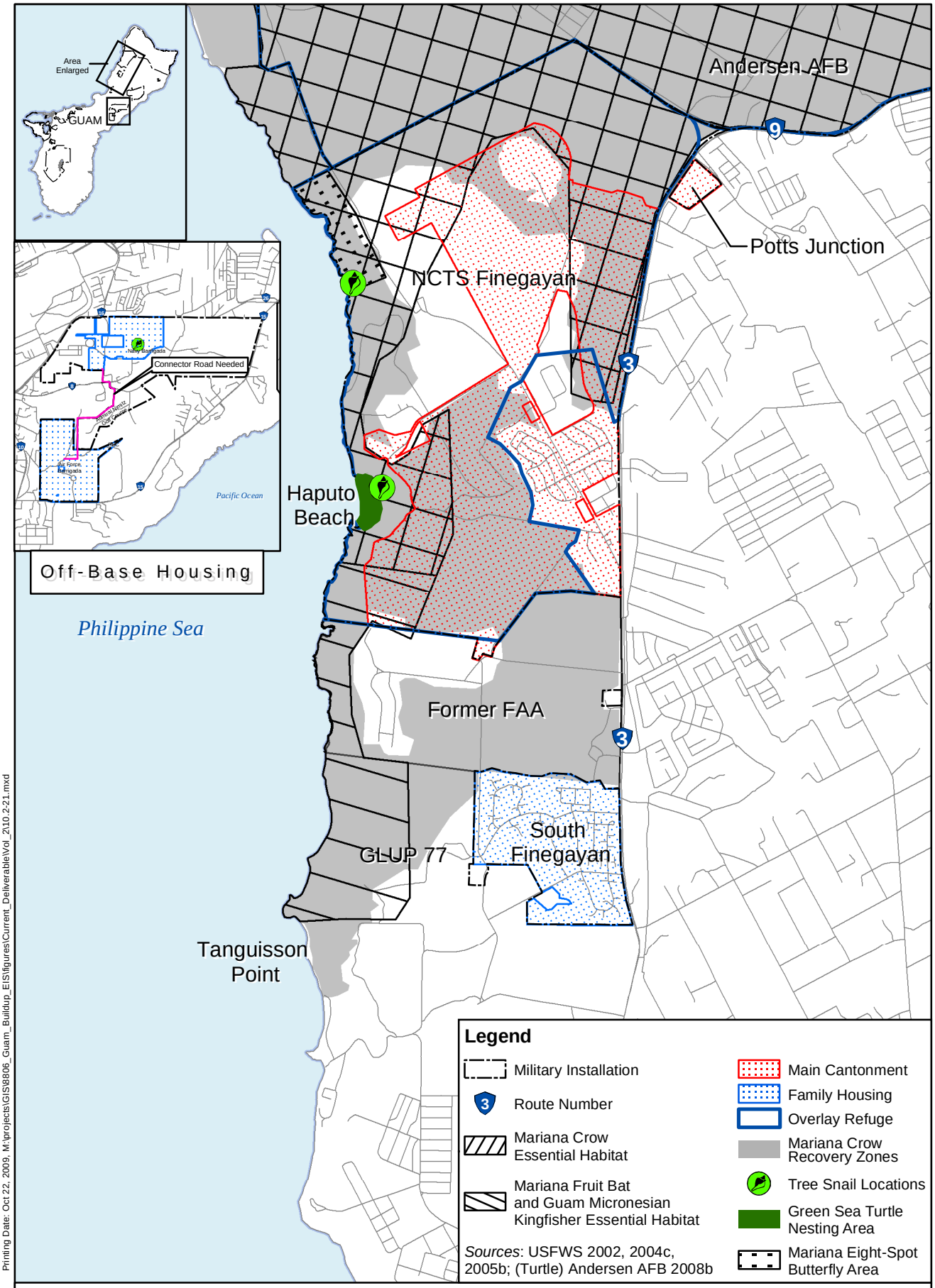

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Figure 10.2-21
Potential Special-Status Species Impacts - Alternative 3
(NCTS Finegayan, South Finegayan, Navy Barrigada, and Air Force Barrigada)

Non-DoD Land

Alternative 3 is identical to Alternative 1.

10.2.4.3 Apra Harbor

For Apra Harbor, Alternative 3 is identical to Alternative 1.

10.2.4.4 South

For NMS, Alternative 3 is identical to Alternative 1.

10.2.4.5 Summary of Impacts

Construction impacts would include direct significant impacts to vegetation from loss of 28 ac (11 ha) of primary limestone forest; direct significant impacts to the endangered Mariana fruit bat and Micronesian kingfisher from clearing of 568 ac (230 ha) of essential habitat and to the endangered Mariana crow from clearing of 514 ac (208 ha) of essential habitat. There would be direct impact to 1,211 ac (490 ha) of Overlay Refuge which includes the essential habitat just listed and other additional lands. There would be additional direct significant impacts to the Mariana fruit bat and indirect significant effects to the Mariana crow and Micronesian kingfisher due to loss of habitat in areas surrounding new facilities because of noise and lighting from facility operations and aircraft takeoff and landings. The specific habitat requirements of special-status species impacted are not understood well enough to conclude that the type of habitat that would remain upon implementation of the proposed action is adequate to meet the goals of the recovery plans. There would be significant impacts to the Guam-listed Pacific slender-toed gecko that is present in the construction footprint. There would be potential significant direct impacts to a Guam endangered tree species at non-DoD lands at Route 15, mitigated to less than significant.

Overall effects for all actions being proposed in this EIS/OEIS are in Volume 7.

10.2.4.6 Potential Mitigation Measures

Mitigation measures would be the same as those identified for Alternative 2. In addition, a plan to translocate Guam tree snails at Navy Barrigada to another site on DoD lands would be developed and implemented after approval by USFWS. Additional mitigation would be completed for the destruction of primary limestone forest at Navy Barrigada which is habitat for the Guam tree snail. The mitigation would be improvement of existing primary limestone habitat by removal of invasive plants or additional fencing. Habitat improvement is described further under Alternative 1 mitigation.

10.2.5 Alternative 8

10.2.5.1 North

Andersen AFB

For Andersen AFB, impacts from Alternative 8 would be identical to Alternative 1.

Finegayan

For Finegayan, impacts from Alternative 8 would be the same as Alternative 1. Figures are provided showing vegetation (Figure 10.2-22) and special-status species (Figure 10.2-23) for the layout of the cantonment area.

Non-DoD Land

For non-DoD land, impacts from Alternative 8 would be identical to Alternative 2. Figures are provided showing vegetation (Figure 10.1-22) and special-status species (Figure 10.2-23) for the layout of the cantonment area.

10.2.5.2 Central

Andersen South

For Andersen South, impacts from Alternative 8 would be identical to Alternative 1.

Barrigada

For Air Force Barrigada, impacts would be the same as for Alternative 3. Figures are area provided showing vegetation (Figure 10.2-22) and special-status species (Figure 10.2-23) for the layout of the cantonment area.

Non-DoD Land

For non-DoD lands, impacts from Alternative 8 would be identical to Alternative 1.

10.2.5.3 Apra Harbor

For Apra Harbor, impacts from Alternative 8 would be identical to Alternative 1.

10.2.5.4 South

For NMS, impacts from Alternative 8 would be identical to Alternative 1.

10.2.5.5 Summary of Impacts

Construction would cause direct significant impacts to vegetation from loss of 28 ac (11 ha) of primary limestone forest; direct significant impacts to the endangered Mariana fruit bat and Micronesian kingfisher from clearing of 309 ac (125 ha) of essential habitat and to the endangered Mariana crow from clearing of 254 ac (103 ha) of essential habitat. There would be direct impacts to 704 ac (285 ha) of Overlay Refuge, which includes the essential habitat just listed and other additional lands. There would be additional direct significant impacts to the Mariana fruit bat and indirect significant effects to the Mariana crow and Micronesian kingfisher due to loss of habitat in areas surrounding new facilities because of noise and lighting from facility operations and aircraft takeoff and landings. The specific habitat requirements of special-status species impacted are not understood well enough to conclude that the type of habitat that would remain upon implementation of the proposed action is adequate to meet the goals of the recovery plans. There would be potential significant direct impacts to a Guam endangered tree species on non-DoD lands at Route 15, mitigated to less than significant.

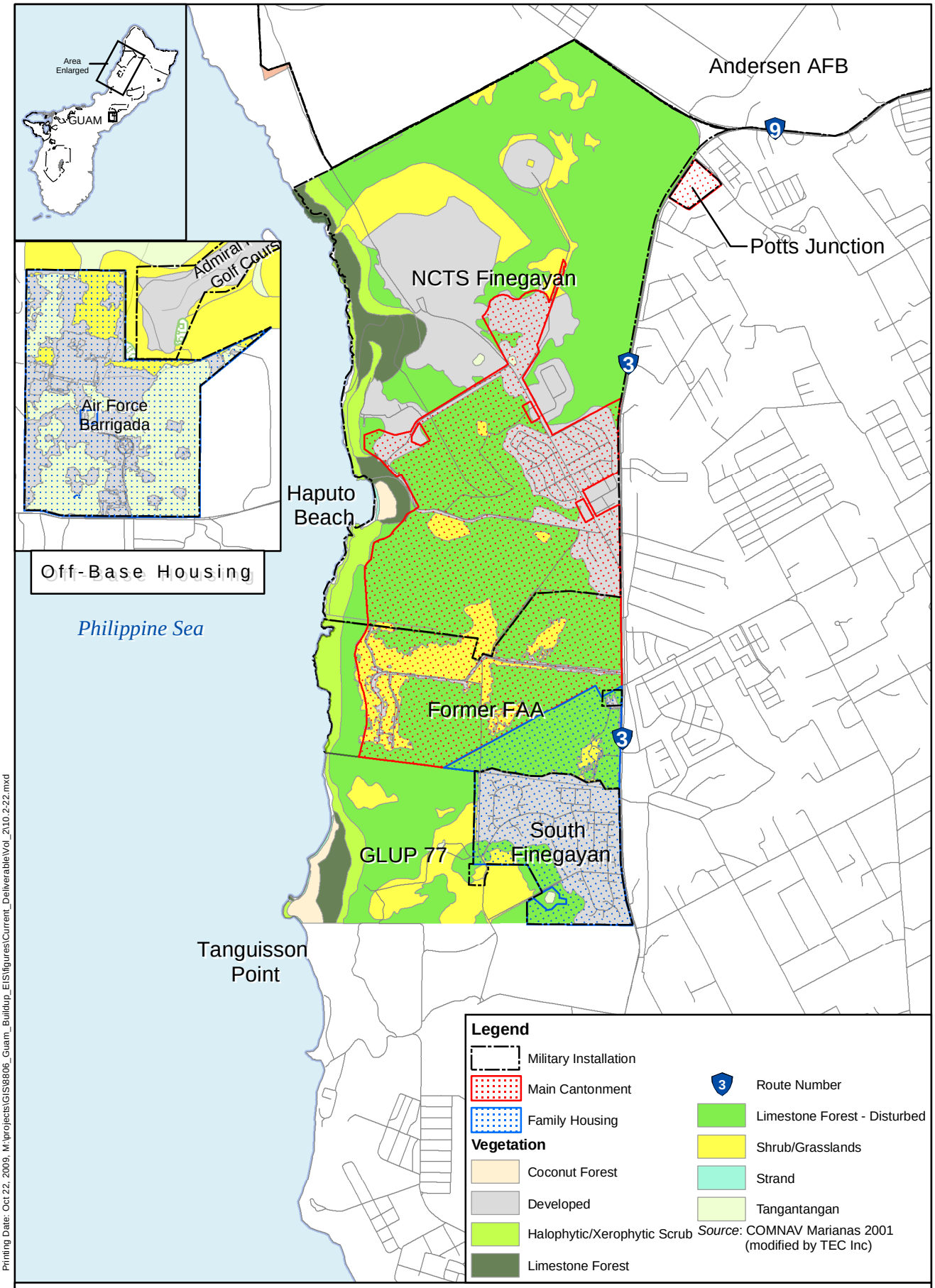

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Figure 10.2-22
Potential Vegetation Impacts - Alternative 8
(NCTS Finegayan, Former FAA Parcel, South Finegayan, and Air Force Barrigada)

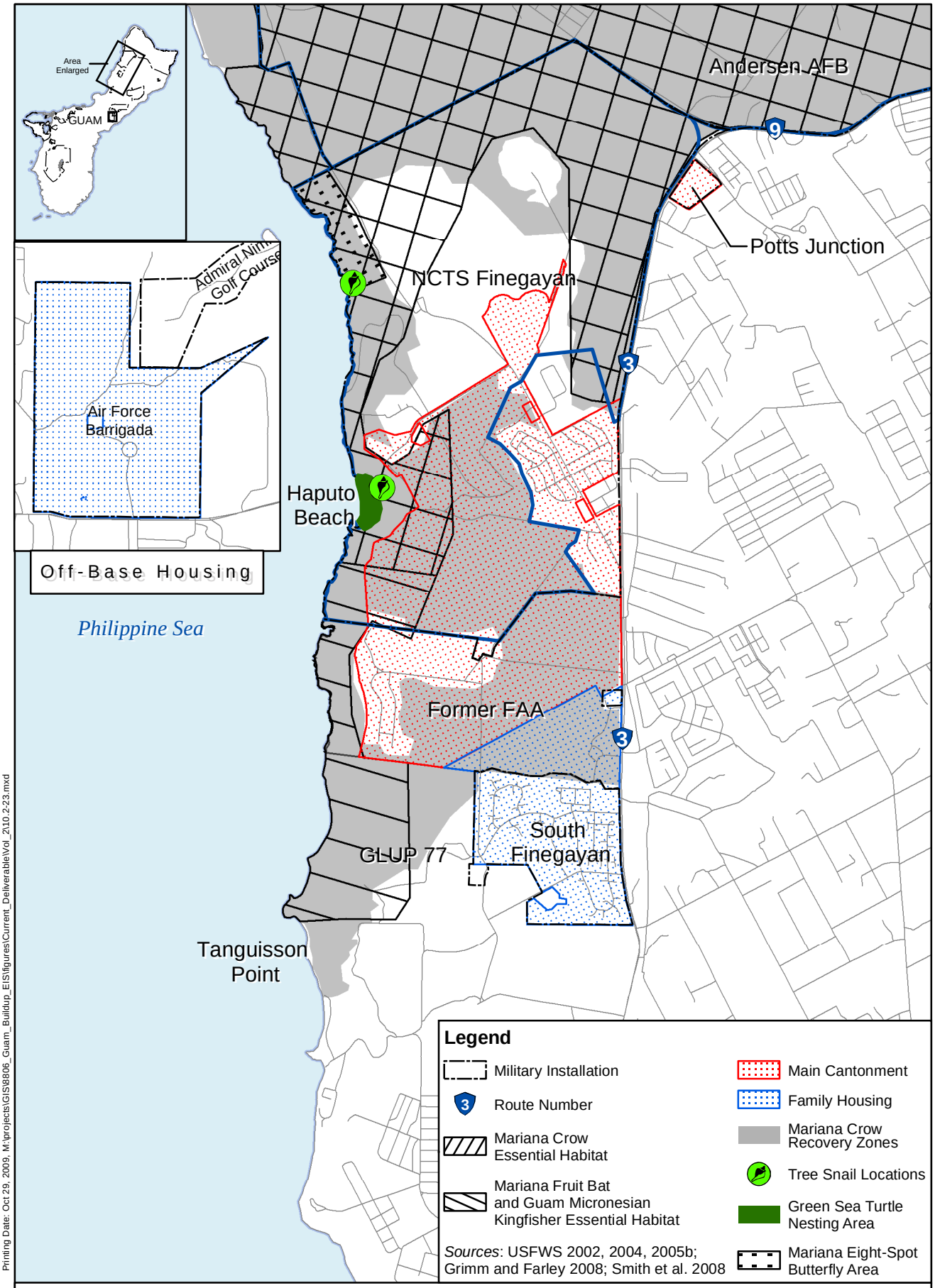

Figure 10.2-23
Potential Special-Status Species Impacts - Alternative 8
(NCTS Finegayan, Former FAA Parcel, South Finegayan, and Air Force Barrigada)

10.2.5.6 Potential Mitigation Measures

Mitigation measures would be the same as those identified for Alternative 1 with adjustments based on amount of designated habitat areas impacted.

10.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing conditions on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

10.2.7 Summary of Impacts

Tables 10.2-15 through 10.2-18 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 10.2-23 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 10.2-15. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
• WL: SI-M. Significant potential indirect impacts due to increases in feral animals surrounding the main cantonment, mitigated to less than significant. • SS: SI-M. Significant potential direct impacts due to removal of essential habitat or Overlay Refuge for several endangered species at NCTS Finegayan, former FAA parcel. • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.	• WL: SI-M. Significant potential indirect impacts due to increases in feral animals surrounding the main cantonment.. • SS: SI-M. Significant potential direct impacts due to removal of essential habitat or Overlay Refuge for several endangered species at Finegayan, former FAA parcel, • SS: SI-M. Significant impacts to the Guam-listed Pacific slender-toed gecko. • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.	• VG: SI. Significant potential direct impacts due to construction at Navy Barrigada that would remove primary limestone forest. • WL: SI-M. Significant potential indirect impacts due to increases in feral animals surrounding the main cantonment. • SS: SI-M. Significant potential direct impacts due to removal of essential habitat or Overlay Refuge for several endangered species at NCTS Finegayan SS: SI-M. Significant impacts to the Guam-listed Pacific slender-toed gecko. • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.	• WL: SI-M. Significant potential indirect impacts due to increases in feral animals surrounding the main cantonment • SS: SI-M. Significant potential direct impacts due to removal of essential habitat or Overlay Refuge for several endangered NCTS Finegayan, former FAA parcel • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Operation			
• VG: LSI • WL: LSI • SS: SI-M. Significant potential indirect impacts due to increased recreation at Haputo ERA • SS: SI-M. Significant potential indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Significant potential indirect impacts due to increased recreation at Haputo ERA • SS: SI-M. Significant potential indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Significant potential indirect impacts due to increased recreation at Haputo ERA • SS: SI-M. Significant potential indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Significant potential indirect impacts due to increased recreation at Haputo ERA • SS: SI-M. Significant potential indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Significant potential indirect impacts from invasive species at all locations

Legend: VG = Vegetation, WL = Wildlife, SS = Special-Status species, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 10.2-16. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
• VG: SI. Significant potential direct impacts due to construction at Route 15 Lands that would remove primary limestone forest • WL: LSI. Less than significant impacts • SS: SI-M. Significant potential direct impacts due to removal of essential habitat or for several endangered species at Route 15 Lands • SS: SI-M. Potential removal of a Guam-listed tree species • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: SI. Significant potential direct impacts due to construction at Route 15 Lands that would remove primary limestone forest • WL: LSI. Less than significant impacts • SS: SI-M. Potential indirect impacts from invasive species at all locations
Operation	
• VG: LSI • WL: LSI • SS: SI-M. Potential direct and indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Potential indirect impacts from wildfire effects • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Potential direct and indirect impacts from noise and other disturbance to ESA-listed species • SS: SI-M. Potential indirect impacts from wildfire effects • SS: SI-M. Potential indirect impacts from invasive species at all locations

Legend: VG = Vegetation, WL = Wildlife, SS = Special-Status species, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact.

Table 10.2-17. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
• VG: LSI • WL: LSI • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: LSI
Operation	
• VG: LSI • WL: LSI • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: LSI

Legend: VG = Vegetation, WL = Wildlife, SS = Special-Status species, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact.

Table 10.2-18. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
• VG: LSI • WL: LSI • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: LSI
Operation	
• VG: LSI • WL: LSI • SS: SI-M. Potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: LSI

Legend: VG = Vegetation, WL = Wildlife, SS = Special-Status species, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 10.2-19. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
• VG: LSI • WL: LSI • SS: SI-M. Significant direct impacts due to removal of essential habitat or Overlay Refuge for several endangered species at Andersen AFB • SS: SI-M. Significant potential impacts to the Mariana crow from noise and disturbance during construction of magazines at the MSA • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: SI. Significant potential direct impacts due to construction at Andersen AFB that would remove primary limestone forest. • WL: LSI • SS: SI-M. Significant direct impacts due to removal of essential habitat or Overlay Refuge for several endangered species at Andersen AFB. • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.	• VG: LSI • WL: LSI • SS: SI-M. Significant direct impacts due to removal of Overlay Refuge at the LCAC/AAV area that could support special-status species. • SS: SI-M. Significant potential indirect impacts from invasive species at all locations.

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Operation		
• VG: LSI • WL: LSI • SS: SI-M. Significant potential direct and indirect impacts from noise and other disturbance to ESA-listed species at the Andersen AFB LZs • SS: SI-M. Significant potential indirect impacts from wildfire effects at NMS LZs and NMS ground training • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Significant potential direct and indirect impacts from noise and other disturbance to ESA-listed species at the Andersen AFB airfield areas • SS: SI-M. Significant potential indirect impacts from invasive species at all locations	• VG: LSI • WL: LSI • SS: SI-M. Significant potential direct and indirect impacts from noise and other disturbance to Overlay Refuge that could support special-status species • SS: SI-M. Significant potential indirect impacts from invasive species at all locations

Legend: VG = Vegetation, WL = Wildlife, SS = Special-Status species, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

10.2.8 Summary of Potential Mitigation Measures

Table 10.2-20. Summary of Potential Mitigation Measures

Alternatives 1, 2, 3, and 8	*Additional for Alternatives 2 and 3*	*No-Action Alternative*
Vegetation - None	None	None
Wildlife and Special-Status Species		
At Andersen AFB the construction period would be limited if Mariana crows were present and there would be no work at night to avoid impacts to the Mariana fruit bat	Additional surveys would be conducted for the Pacific slender-toed gecko at NCTS Finegayan and, habitat enhancement at NMS if necessary	None
Biological surveys would be conducted for crows and bats before clearing		
The COMNAV Marianas Training Handbook would be updated with procedures to protect special-status species during project-specific training		
Hooded lights would be used on roads associated with the proposed new Andersen AFB access gate, truck inspection station, and aircraft staging areas		
Fruit bat monitoring would occur weekly at all roost sites in the project area until 1 year after the construction was completed, with increased frequency after typhoon events		
The Andersen AFB aircraft operations monitoring program and adaptive management strategy for Mariana fruit bats and crows would be adopted and modified as necessary for project-specific actions.		
Monitoring of the Mariana fruit bat, Micronesian kingfisher, and Mariana crow, if present, would be conducted in areas surrounding demolition, breacher, and small arms training areas to determine potential noise impacts and if this monitoring determined that these species were being affected, techniques to reduce noise generation, such as noise barriers, would be employed.		
Restrictions would be placed on the use of Haputo beach and ERA		
Controls would be placed on the use of the access road established for NMS training		

Alternatives 1, 2, 3, and 8	*Additional for Alternatives 2 and 3*	*No-Action Alternative*
Conduct sea turtle natural history studies to better understand the species and benefit the long-term military mission planning		
A survey would be conducted in the Route 15 range footprint areas prior to clearing for *Heritiera longipetiolata* with subsequent translocation or propagation if found; mature trees identified in previous studies would not be removed		
Natural resource awareness briefings would be conducted for construction personnel		
HACCP planning would be used for high-risk activities and construction projects		
Base policies, instructions, or orders would be put in place to ensure that cats and dogs are documented and all pets are controlled and not allowed at Haputo ERA		
Translocate Guam tree snails at Navy Barrigada to another site on DoD lands after approval by USFWS (not required for preferred alternative).		
The existing Navy Ungulate Management Plans would be updated to include the new lands to be used for training and cantonment areas and additional project-specific actions that would be necessary to ensure sensitive ecological resources are protected		
The existing Navy Fire Management Plan would be updated to include new lands to be used for training and additional project-specific actions that would be necessary to ensure sensitive ecological resources are protected		
Invasive insect management options would be investigated for the ESA-listed fire tree and SOGCN cycad		
Establishment of new or expansion of existing ERAs and conservation areas would be considered		
Fencing, patrols, or cameras would be used to prevent poaching		
Greenbelt development would be considered for watershed protection, wildfire control, and restoration of habitat		
Exclusion fencing and foraging plots would be set up for protection of wildlife and special-status species		

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CHAPTER 11. MARINE BIOLOGICAL RESOURCES

11.1 AFFECTED ENVIRONMENT

11.1.1 Definition of Resource

For the purpose of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), marine biological resources are defined as those marine-related organisms (marine flora and fauna), their behaviors, and their interactions with the environment that may be directly or indirectly affected by the proposed action within the established marine region of influence (ROI). The ROI is defined as the nearshore waters of Guam out to the 164 feet (ft) [50-meter {m}} isobath (depth line on a map of the ocean/sea). This includes waters offshore of Finegayan on the west coast, offshore of the Route 15 Lands on the east coast, and all waters of Apra Harbor (Figure 11.1-1 and Figure 11.1-2). The ROI does not include the Marianas Trench Marine National Monument, which was established in January 2009 by Presidential Proclamation, as the proposed action and alternatives would not impact this area.

The environmental analysis focuses on species or areas that are important to the function of the ecosystem, of special societal importance, or are protected under federal, state, commonwealth or territory law or statutes. For the purpose of this EIS/OEIS, marine biological resources have been divided into four major categories: marine flora, invertebrates and associated Essential Fish Habitat (EFH), fish and EFH, special-status species, and non-native species.

11.1.1.1 Marine Flora, Invertebrates and Associated EFH

This chapter provides a description of marine flora and macroinvertebrates (including a brief description of corals, which are addressed further under the EFH section) found within the ROI. Examples include macroalgae (or seaweeds), seagrasses, emergent vegetation (plants that are rooted in the substrate beneath water, but grow tall enough to protrude above water or have leaves that float on the water), gastropods (snails), cephalopods (squid and octopus), crustaceans (lobsters and crabs), and sponges. All these examples are also included within the managed fisheries in the Western Pacific under five fisheries management plans (FMPs): (1) coral reef ecosystems, (2) bottomfish and seamount Groundfish, (3) crustaceans, (4) precious corals, and (5) pelagic species. Each of these FMPs identifies specific management unit species (MUS) for different life stages of the species managed under the respective plan (Western Pacific Regional Fisheries Management Council [WPFMC] 2005). Essential Fish Habitat is described further below.

11.1.1.2 Essential Fish Habitat

The primary federal laws that make up the regulatory framework for fish and EFH include the Magnuson-Stevens Fishery Conservation and Management Act or Magnuson-Stevens Act (M-SA), Executive Order (EO) 12962, and the Endangered Species Act (ESA). EFH is defined as those waters and substrate necessary to fish (finfish, mollusks, crustaceans and all other forms of marine animal and plant life other than marine reptiles, marine mammals and birds) for spawning, breeding, feeding, or growth to maturity (WPRFMC 2005). EFH for managed fishery resources is designated in the FMPs prepared by the local regional fisheries management council - WPRFMC - and in conjunction with the Guam Division of Aquatic and Wildlife Resources (GDAWR), which manages the fisheries resources in Guam. The

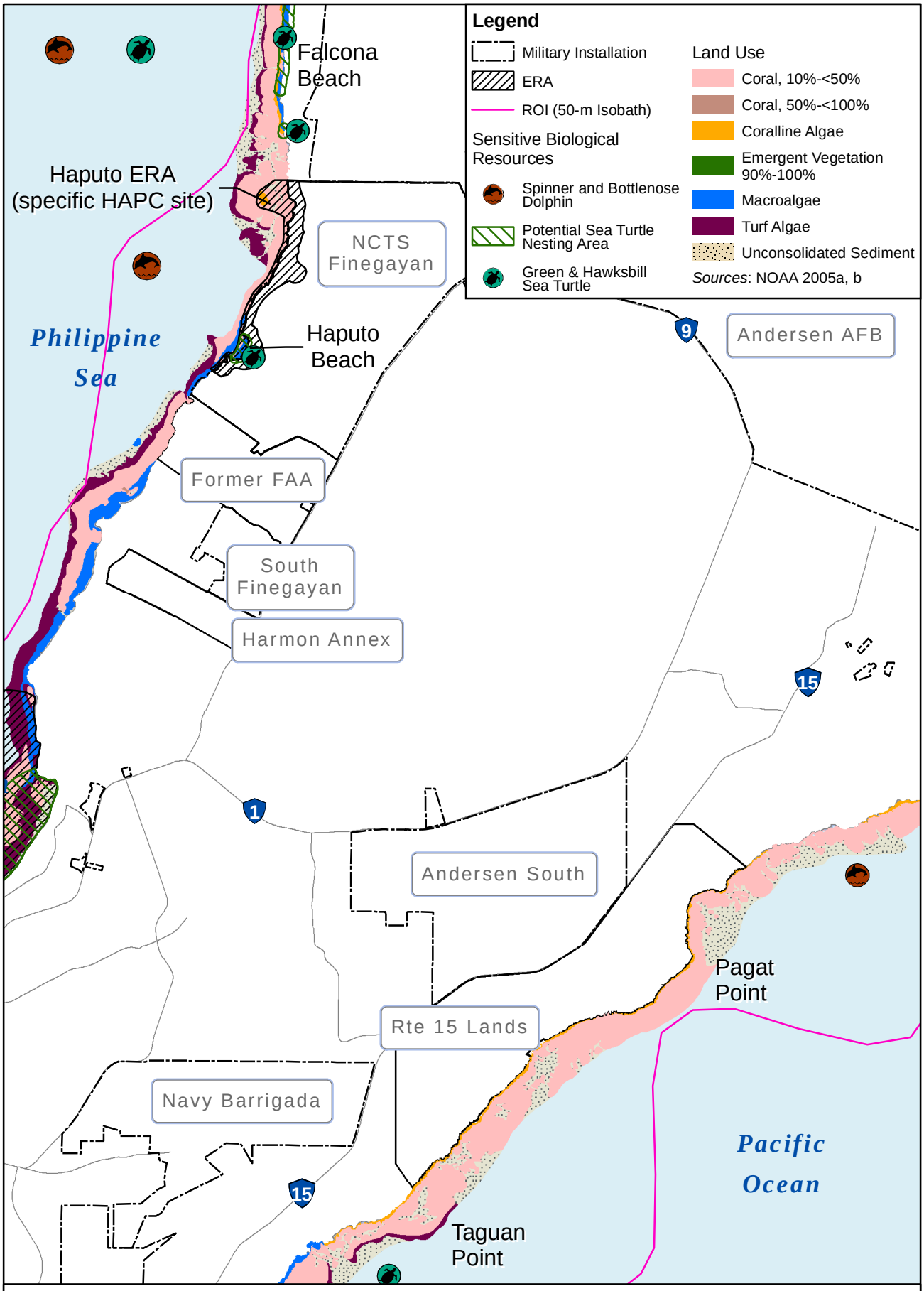

Figure 11.1-1
Overview of Sensitive Marine Biological Resources and Habitats Associated with the Study Areas - NCTS Finegayan and Rte 15 Lands

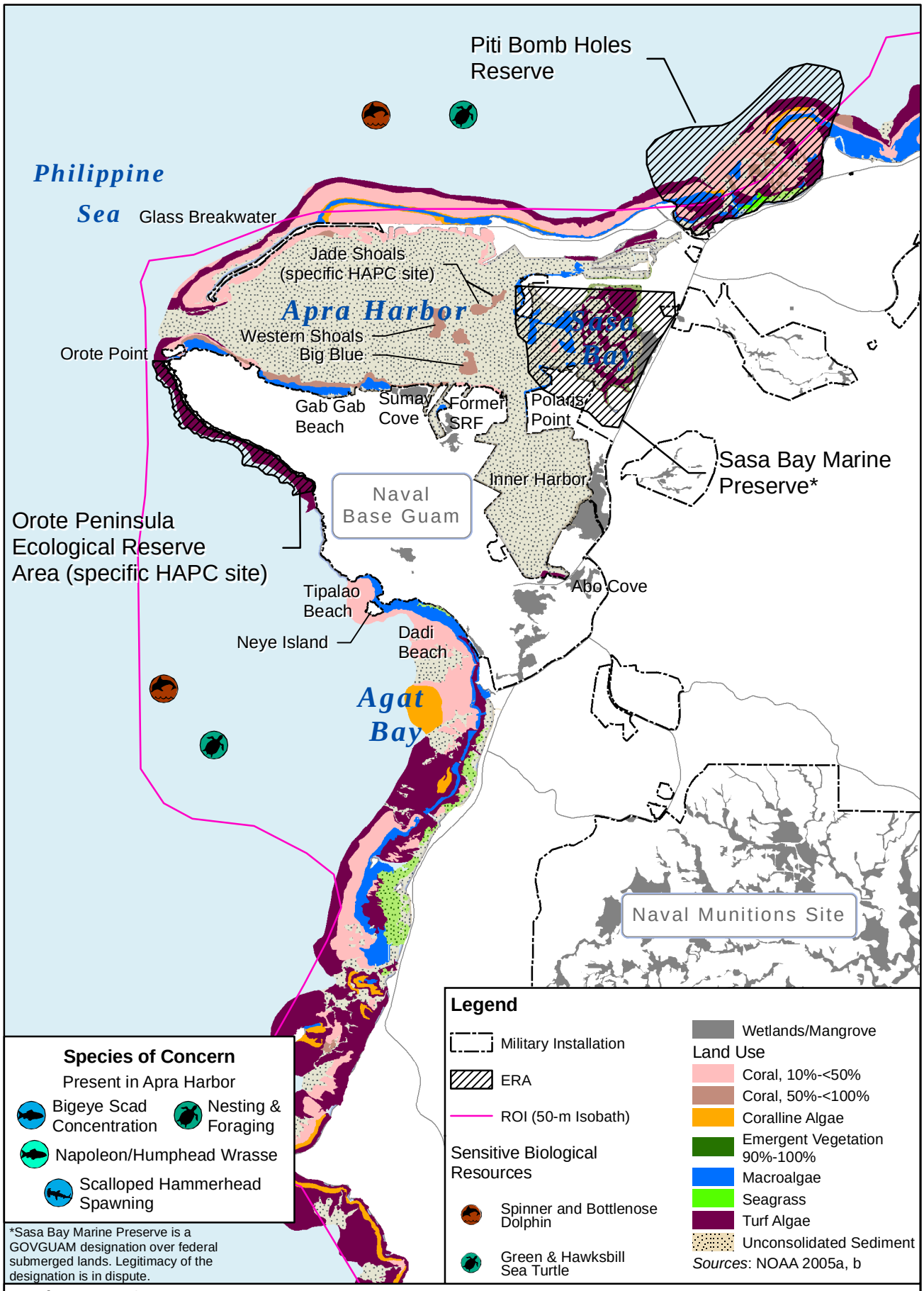

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Figure 11.1-2
Overview of Sensitive Marine Biological Resources and Habitats Associated with the Study Areas - Apra Harbor and Naval Base Guam

WPRFMC is currently converting its FMPs to fishery ecosystem plans (FEPs). In other words, changing from species-based management to place-based management for the Pacific Region. The draft FEPs and Preliminary EIS are being reviewed and the Record of Decision for the associated Programmatic EIS is being prepared.

The Navy is consulting with the National Marine Fisheries Service (NMFS) on proposed activities that may adversely affect EFH. There are four steps in the EFH consultation process (NMFS 1999):

1. The federal agency provides a project notification to NMFS of a proposed activity that may adversely affect EFH.
2. The federal agency provides an assessment of the effects on EFH with the project notification. The EFH Assessment (EFHA) prepared as part of this EIS/OEIS includes: (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species by life history stage; (3) the federal agency's views regarding the effects of the proposed action of EFH; and (4) proposed mitigation, if applicable.
3. NMFS provides EFH conservation recommendations to the federal agency. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH and are to be provided to the action agency in a timely manner.
4. The federal agency provides to NMFS a detailed written response, within 30 days of receiving the NMFS EFH conservation recommendations (at least 10 days before final approval of the action for decisions that are rendered in fewer than 30 days).

11.1.1.3 Special-Status Species

For the purpose of this document, special-status species include ESA-listed and candidate species, marine mammals not listed under ESA, species of concern, and Guam-listed species, found in the nearshore marine ROI (Table 11.1-1). Brief species descriptions are located in Section 11.1.4, Guam Regional Environment, and within specific study area sections below. Detailed descriptions of all potentially affected special-status species, including life history information is included in Volume 9, Appendix G.

Table 11.1-1. Special-Status Marine Species Present in the ROI Around Guam

Group	*Common Name/Chamorro Name*	*Status**	
		Federal	*Guam*
MAMMALS	Common bottlenose dolphin/Toninos/	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E
FISH**	Napoleon wrasse/Tanguisson	SOC	SOGCN
	humphead parrotfish/Atuhong	SOC	SOGCN

Legend: *****E = endangered; T = threatened; MMPA = Marine Mammal Protection Act; SOC = NOAA species of concern, SOGCN = Species of Greatest Conservation Need (GDAWR 2006).
****** Addressed further under EFH Section.
Sources: NOAA 2005a, NMFS 2009a, USFWS 2009.

ESA-Listed Species, Critical Habitat, and Candidate Species

ESA-listed species are defined as those plant and animal species currently listed by the United States (U.S.) Fish and Wildlife Service (USFWS) under the ESA as threatened, endangered, or proposed as such. Candidate species are plant or animal species for which USFWS or NMFS has on file sufficient

information on biological vulnerability and threats to support a proposal to list them as endangered or threatened under the ESA based on the most recent candidate review (USFWS 2009). The Navy has initiated consultation under Section 7 of the ESA regarding the potential effects of the proposed action on endangered and threatened species within the ROI. All special-status marine species, including threatened and endangered marine species, occurring in the ROI are listed in Table 11.1-1 and discussed in more detail below. There is no critical habitat designation for any marine species on Guam.

Sea Turtles

All sea turtles that occur in the U.S. are listed under the ESA as either threatened or endangered. The threatened green sea turtle and the endangered hawksbill sea turtle are the only ESA-listed species that regularly occur in the nearshore marine ROI. Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources, since they are terrestrial at the nesting stage and are under the jurisdiction of USFWS for consultation purposes.

Species of Concern

Species of Concern are those species about which NMFS has concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA. The goal is to draw proactive attention and conservation action to these species. Two species of fish, the Napoleon wrasse and the humphead parrotfish, are listed as species of concern by NMFS (NMFS 2009a) and are expected to occur in the nearshore marine ROI (refer to Table 11.1-1). These species are discussed in the EFH section of this EIS/OEIS, as they are protected under the Coral Reef Ecosystems MUS (CREMUS) (WPRFMC 2005).

Guam-Listed Species

Guam-listed species are defined as those plant and animal species found in the nearshore marine ROI that are not ESA-listed or Candidate species, but are currently designated by legislative authority in the Territory of Guam as endangered or threatened species. There are no Guam-listed marine species other than those that are also ESA-listed (sea turtles) so these Guam-listed marine species are discussed in the ESA-listed species section of this EIS/OEIS.

Marine Mammals

Marine mammals are discussed in this EIS/OEIS because several species are known to occur or potentially occur in the waters around Guam. The Marine Mammal Protection Act (MMPA) of 1972 makes it illegal to "take" any species of marine mammal. The definition of take refers to the harassing, injuring or killing of any marine mammal, or the possessing of any marine mammal or part of a marine mammal, without authorization. Some marine mammals are listed under the MMPA as strategic. Strategic refers to a stock of marine mammals that is being negatively impacted by human activities and may not be sustainable. When a population or stock has fallen below optimum sustainable levels, it is considered depleted. A stock may be considered depleted when the mortality in multiple units exceeds the Potential Biological Removal identified for the species. All marine mammal species listed under the ESA of 1973 are considered depleted. No ESA-listed marine mammals are anticipated in the ROI (Navy 2005, NOAA 2005a).

The National Defense Authorization Act of Fiscal Year 2004 (Public Law 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 U.S. Code (USC) 1374 (c)(3)]. The National Defense Authorization Act (2004) adopted the definition of "military

activity" as set forth in the Fiscal Year 2003 National Defense Authorization Act (Public Law 107-314). Military training activities on and around Guam (and Commonwealth of the Northern Mariana Islands [CNMI]) constitute military readiness activities as defined in Public Law 107-314 because training activities constitute "training and operations of the armed forces that relate to combat" and constitute "adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use". For military readiness activities, the relevant definition of harassment is any act that: (1) Injures, or has the significant potential to injure, a marine mammal or marine mammal stock in the wild ("Level A harassment"); or (2) Disturbs, or is likely to disturb, a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered ("Level B harassment") [16 USC 1362 (18)(B)(i)(ii)].

Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing), if certain findings are made and permits are issued. Permission would be granted by the Secretary for the incidental taking of marine mammals if the taking would have a negligible impact on the species or stock and would not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Marine mammals addressed in this document include all species listed under the MMPA found in the marine ROI. Marine mammals are not well-documented in Micronesia. The first compilation of available information for 19 species of marine mammals from Micronesia was provided by Eldredge (1991) with additional records compiled in 2003 (Eldredge 2003b), which took into account marine mammal distribution and habitat preferences, expanding the list to 32 marine mammal species (29 cetaceans [i.e., whales, dolphins, and porpoises], 2 pinnipeds [i.e., seals and sea lions], and the dugong) with confirmed or possible occurrence in oceanic waters around Guam (Navy 2005).

Based on Appendix B's figures and supporting text from the Marine Resource Assessment for the Marianas Operating Area (Navy 2005), spinner dolphins and common bottlenose dolphins are the only marine mammals expected to regularly occur within the nearshore marine ROI (164-ft [50-m] isobath) of Guam (see Table 11.1-1).

In general, the main intentions of the three federal acts (ESA, MMPA, and M-SA) listed above are as follows:

- The ESA established protection over and conservation of special-status species and the ecosystems upon which they depend and requires any federal action (authorized, funded, or carried out) to ensure its implementation would not jeopardize the continued existence of the listed species or adversely modify their critical habitat.
- The MMPA established a moratorium on the "taking" (16 USC 1312[13]) of marine mammals in waters or on lands under U.S. jurisdiction.
- The M-SA was designed to protect and conserve important fish/fisheries habitats, including coral reef associated fisheries.

11.1.1.4 Non-Native Species

Non-native species include all marine organisms that have the potential to be introduced from one location or ecosystem to another where it is not native and could potentially cause harm to the receiving ecosystem. This topic is discussed further in Section 11.1.4, and in the subsequent specific study areas.

Most of the relevant site-specific research to date has been within Apra Harbor, so this topic is discussed thoroughly in that section.

11.1.2 Region of Influence

As previously discussed, the marine ROI encompasses all of Apra Harbor, including Sasa Bay and the submerged lands offshore out to the 164-ft (50-m) isobath that may be directly or indirectly impacted by any component of the proposed action. Construction or training activities may impact biological resources due to ground-disturbing activities, in-water construction and/or benthic (bottom) substrate-disturbing activities (dredging), but they may also be impacted through noise, decreased water quality, excess lighting, and other factors.

11.1.3 Study Areas and Survey Methods

For the purposes of this EIS/OEIS, the project area for marine biological resources has been subdivided into three study areas and is assessed for potential impacts from implementation of the proposed action within the nearshore marine ROI. Because of either the location or the nature of the action, some components of the proposed action would have very minimal impact on the marine environment, and therefore no impact assessment is provided. In these cases, a brief explanation of why no assessment is required is provided in those site-specific sections.

Existing conditions and environmental consequences associated with marine biological resources are discussed for the following study areas: Naval Computer and Telecommunications Station (NCTS) Finegayan, Route 15 Range Lands, and Apra Harbor. The other study areas potentially affected by the proposed action do not have marine-related construction and/or land-based construction or training activities that would impact nearshore coastal marine waters.

In addition to existing marine biological resources data for the study areas, project-specific benthic studies and mapping efforts have either been performed for this EIS/OEIS, are ongoing, or are being planned for areas potentially impacted by the proposed action and alternatives (e.g., a 2009 marine benthic survey in the vicinity of the aircraft carrier fairway and turning basin, Outer Apra Harbor). Locations and methods for the survey efforts associated with this EIS/OEIS are provided in detail in the Natural Resources (NR) Survey Report (in progress). Table 11.1-2 lists the specific biological surveys references for this EIS/OEIS.

Table 11.1-2. Summary of Previous and Current Marine Biological Surveys within the Study Areas

Reference	*Type of Work*	*Location*
Paulay 1995-1996	Preliminary Non-indigenous Survey - Focusing on Bivalves	Guam
Paulay 1996	Biodiversity and Monitoring Survey of Marine Faunas	Apra Harbor
MRC 1996	Marianas Environmental Impact Statement Marine Environmental Assessment	Guam and Tinian
MRC 1997	Marine Environmental Impact Assessment for Military Training Exercises	Off Tipalao and Dadi Beaches, Guam
Paulay 1998-2000	Introduced Species Survey - Focusing On Hard-bottom Fauna	Guam
Paulay et al. 2000	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Southern Orote Peninsula and North Agat Bay Area
Paulay et al. 2001	Marine Invertebrate Biodiversity: Significant Areas and Introduced Species	Apra Harbor
Amesbury et al. 2001	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Haputo ERA – Offshore NCTS Finegayan
MRC 2002	Maintenance Dredging Rapid Ecological Marine	Inner Apra Harbor

Reference	*Type of Work*	*Location*
	Assessment	
Smith 2004a	Reconnaissance Level Observation – Staff Working Paper. in COMNAV Marianas 2006b.	Inner Apra Harbor Entrance Channel
Smith 2004b	Field Report of Supplemental Reconnaissance Level Observations in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
Smith 2004b	Ecological Assessment of the Marine Community in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
MRC 2005a	Marine Resource Assessment in COMNAV Marianas 2006b	Entrance Channel of Inner Apra Harbor
MRC 2005b	Reconnaissance Survey of the Marine Environment, Characterization of the Benthic Habitat in COMNAV Marianas	Outer Apra harbor
Smith 2006	Assessment of Stony Corals	Orote Point to Sumay Cove, Apra Harbor
NOAA 2005c	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report - Oscar Elton Sette	Marianas Archipelago: Island of Guam, Santa Rosa Reef, and Galvez Bank
NOAA 2007	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report – *Hi'ialakai*	Guam and CNMI (Rota, Aguijan, Tinian, and Saipan
Smith 2007	Ecological Assessment of Stony Corals and Associated Organisms	Eastern Portion of Apra Harbor
NAVFAC Pacific 2007	Unpublished Cruise Report - Sea Turtle and Cetacean Survey	Mariana Islands
Smith et al. 2008	Marine Biological Survey	Inner Apra Harbor – areas off Sierra, Tango, X-ray, Uniform, Victor Wharves, and Abo Cove.
Smith et al. 2009b [TBP]	Marine Biological Survey	Apra Harbor Cabras Outfall and Polaris Point
Navy 2009b	HEA Remote Sensing Mapping of Coral Communities	Eastern end of Outer Apra Harbor in the vicinity of the CVN channel and turning basin.
Smith et al. 2009a [TBP]	Marine Biological Survey	Navy Main Base - Dadi and Tipalao Beaches
Resource Agency [TBP]	Marine Biological Survey - Spring 2009	Apra Harbor – CVN Fairway

Legend: COMNAV= Commander Navy Region; CVN= Aircraft Carrier-Nuclear; ERA - Ecological Reserve Area.

11.1.4 Guam Regional Environment

Though the focus of this chapter is on marine biological resources within the nearshore ROI, marine ecosystems are also greatly affected by terrestrial inputs (i.e., stormwater runoff, sediments, etc.) and open ocean currents. A brief introduction of the marine geology, environmental habitats, and biological oceanography from the shore to the open ocean is presented for this region, which comprises the Mariana Islands chain.

Marine Geology

The Mariana Islands are volcanic in nature and thus the overall geology reflects this. Coastlines in the study area are generally lined with rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat. Water erosion of rocky coastlines has produced wave-cut cliffs and sea-level benches (volcanic and limestone) and wave-cut notches at the base of the cliffs. Large blocks and boulders often buttress the foot of these steep cliffs in the Marianas. Wave-cut terraces also occur seaward of the cliffs (Navy 2005).

Physical and Biological Oceanography

The North Equatorial Current, which provides the bulk of water passing the Mariana archipelago, is composed primarily of plankton-poor water; however, detailed information on the North Equatorial Current is lacking. Overall, the upper portions of the water column in the western Pacific is nutrient depleted, which greatly limits the presence of organisms associated with primary productivity, such as phytoplankton. Phytoplankton are single-celled organisms that are similar to plants because they photosynthesize using sunlight and chlorophyll. Phytoplankton are at the base of the marine food chain, and are essential to the overall productivity of the ocean. In regions in which the overall nutrient concentrations are low, the phytoplankton communities are dominated by small nanoplankton and picoplankton. This is true for Guam, as phytoplankton communities in the western Pacific are dominated by cyanobacteria (*Synechococcus spp*.), prochlorophytes, haptophytes, and chlorophytes (Higgins and Mackey 2000).

The available studies on plankton (tiny plants [phytoplankton] and animals [zooplankton]) in the neritic zone (also called the sublittoral zone - part of the ocean extending from the low tide mark to the edge of the photic zone) have centered around Apra Harbor and Piti Reef on Guam. In general, abundance of zooplankton is highly variable with respect to location and time (both throughout the day and month to month) (Navy 2005).

Guam tides are semidiurnal with a mean range of 1.6 ft (0.5 m) and diurnal range of 2.3 ft (0.7 m). Extreme predicted tide range is about 3.5 ft (1.1 m). Surface sea temperatures average close to 80 degrees Fahrenheit (°F) year-round (GEPA 2006).

Intertidal Zone

The intertidal zone is the area between low and high tide marks. Approximate tidal ranges on Guam are from -0.6 ft (-0.2 m) at low, low tide to 2.6 ft (0.8 m) at high, high tide (UoG 2009). The intertidal zone of the shoreline can be divided into three subzones: the high-tide zone, the mid-tide zone, and the low-tide zone. In the high-tide zone, benthic organisms are covered by water only during the highest high tides. Organisms in this zone spend the majority of the day exposed to the atmosphere. In the mid-tide zone, benthic organisms spend approximately half of the time submerged. Organisms residing in this zone are exposed during periods of low tides, but are covered with water during all high tides. Organisms in the low-tide zone are submerged most of the time but may be exposed to the air during the lowest of low tides (Navy 2005).

Coral Communities and Reefs of the Mariana Islands

Coral communities and reefs are dynamic and changing ecosystems subject to natural and human induced disturbances. Natural disturbances that affect coral communities and reefs in the Mariana Islands include storm-related damage caused by frequent typhoons; El Niño-Southern Oscillation (ENSO) events (a coupled ocean-atmosphere phenomenon that has global effects); outbreaks of the crown-of-thorns starfish, a predator of corals; freshwater runoff; recurrent earthquakes; and volcanic activity. Human-induced disturbances on reefs in the Mariana Islands result from upland erosion and offshore sedimentation, polluted runoff (input of nutrients), exposure to warm water (global warming and thermal effluents) leading to bleaching, overfishing, anchor damage, tourism-related impacts, ship groundings, and certain military activities (Abraham et al. 2004, Birkeland 1997, Paulay 2003b).

The Mariana nearshore environment is characterized by extensive coral bottom and coral reef areas. There are fewer hard coral reef-building species and genera in the northern compared to the southern Mariana Islands: 159 species and 43 genera hard coral species in the northern islands versus 256 species

and 56 genera in the southern islands (Randall 2003, Abraham et al. 2004). There is also a greater species diversity of fishes and mollusks (invertebrates) on the southern islands than on the northern islands (Birkeland 1997).

In general, the coral reefs of the Marianas have a lower coral diversity compared to other reefs in the northwestern Pacific (e.g., Palau, Philippines, Australian Great Barrier Reef, southern Japan, Marshall Islands) but a higher diversity than the reefs of Hawaii. Corals reported in Guam are typically found on shallow reefs and upper forereefs (< 245 ft [<75 m] water depth), and deeper forereef habitats (> 245 ft [>75 m] water depth) (Randall 2003).

With respect to Guam, most of the northern part of the island's shorelines are karstic and bordered by limestone cliffs. In a few areas, the shorelines consist of volcanic substrates. On windward shores, reefs are narrow and have steep forereefs. Narrow reef flats or shallow fringing reefs (approximately 325 to 3,250 ft [100 to 1,000 m wide]) are characteristic of leeward and more protected coastlines. Reefs also occur in lagoonal habitats in Apra Harbor. Reef organisms also occur on eroded limestone substrates including submerged caves and crevices, and large limestone blocks fallen from shoreline cliffs (Paulay 2003b).

Natural Disturbances

Coral communities and reefs on the eastern, windward side of the islands are exposed to dominant winds, strong wave action, and storms (including typhoons). Corals found above the 100-ft (30-m) isobath on windward coasts are conditioned to withstand heavy wave action and would recover if damaged. Typhoons can cause substantial damage to corals on windward coasts. Corals in this exposed area of the reef typically include encrusting or massive growth forms as well as columnar, platy and branching growth forms. Exposed windward reef fronts are dominated by three growth forms of Acropora: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short, nonanastomosing branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

The disruption of the tradewind pattern during ENSO events has caused sea level to drop in the Mariana Islands and exposed shallow corals and other reef organisms over prolonged periods, which has caused mass mortality (Birkeland 1997). Further, ENSO events have produced unusually high seawater temperatures that may have caused coral bleaching. The bleaching of corals has been recorded in the Marianas since 1994, and some bleaching events have caused coral mortality. In 1994, corals were bleached on all reefs of Guam. While the coral families Pocilloporidae and Acroporidea incurred severe bleaching on Guam during the 1994 event, no stony coral mortality was observed.

The chronic outbreaks and predation of crown-of-thorns starfish on corals reefs have also caused coral mortality. In the forereef zone in sheltered areas, massive corals (*Porites* and *Favia*) that are more resistant but not immune to crown-of-thorns starfish have replaced the corals decimated by crown-of-thorns starfish (Navy 2005).

Other sources of coral mortality and degradation are freshwater runoff and seismic and volcanic activity. Freshwater runoff naturally affects reefs during the rainy season (Navy 2005). No areas are reported within the ROI that are particularly affected by natural sedimentation following heavy rainfall, although two rivers discharge into Inner Apra Harbor, which is a highly turbid area. Areas impacted by heavy sediment laden stormwater outside the ROI include the Ugum River watershed (southeast Guam) and the south coast of Guam (Abraham et al. 2004). Coral reefs within the ROI have been impacted by recurrent seismic activity as recent as 1993 in Guam (Birkeland 1997).

Human-Induced Disturbances

The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution (GEPA 2006). The main source and most serious nonpoint, human-induced impacts on marine communities in and around Guam is erosion and high sediment containing runoff (particularly during storm events in the southern areas) due to increased land clearing and construction of coastal roads, housing, and tourism-related facilities (Paulay 2003b, Abraham et al. 2004). Grading or clearing of land by burning results in significant topsoil loss during heavy rain storms leaving more compact soil behind that makes re-vegetation difficult. Runoff of feedlot waste has also been identified as a nonpoint source of pollution needing mitigation. Urban runoff is one of Guam's most critical nonpoint source problems which impacts both groundwater and coastal waters (GEPA 2006). Sedimentation affects both coral cover and diversity. Sedimentation-impacted sites can further be degraded by the compounding effects of overfishing of herbivorous fishes and crown-of-thorns starfish (Abraham et al. 2004). Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam and has a significant anthropogenic (human-induced) impact on corals. See Volume 6, Section 13.2.4 for detailed discussion on nutrient impacts to coral and Volume 2, Section 4.1.1.4 for nearshore water quality discussion.

Estuarine Habitat

Estuarine habitats on Guam, include lagoons, embayments, and river mouths. They occur in areas of tidal intrusion or brackish water, and consist primarily of mangroves and the lower channels of rivers that are inundated by tides ranging from 30 to 35 inches (in) (75 to 90 centimeters [cm]) in amplitude. Nine of Guam's 46 rivers that empty into the ocean have true estuarine habitats with elevated salinity levels extending upstream (Scott 1993). Guam contains numerous relatively shallow lagoons (depths ranging from 3 to 50 ft [1 to 15 m]). The bottoms of the lagoons are mostly sandy and flat or undulatory (wavy in appearance). Coral rubble, coral mounds (patch reefs), seagrass, and algae are found within the lagoons. Coral mounds tend to be more abundant in the outer lagoons and are widely scattered or absent in the inner lagoons (NOAA 2005a, Navy 2005).

Seagrass Beds

Tropical seagrass meadows typically occur in most shallow, sheltered soft-bottomed marine coastlines and estuaries. Barrier reefs protect coastlines, and the lagoon formed between the reef and the mainland is protected from waves, allowing mangrove and seagrass communities to develop. Tropical seagrasses are also important in their interactions with mangroves and coral reefs. Seagrasses trap sediment and slow water movement, causing suspended sediment to fall out. This trapping of sediment benefits coral by reducing sediment loads in the water. All these systems exert a stabilizing effect on the environment, resulting in important physical and biological support for the other communities. Seagrasses are unique amongst flowering plants in that all but one genus can live entirely immersed in seawater. Ten species are reported from Micronesia. Seagrasses provide a sheltered, nutrient-rich habitat for a diverse range of flora and fauna, including higher vertebrates such as dugongs and green sea turtles. A concise summary of the seagrass species found in the western tropical South Pacific is given by Coles and Kuo (1995).

From the fisheries perspective, the fishes and other organisms harvested from the coral reef and associated habitats, such as mangroves, seagrass beds, shallow lagoons, bays, inlets and harbors, and the reef slope beyond the limit of coral reef growth, contribute to the total yield from coral reef-associated fisheries (Navy 2005).

Mangrove Forests

Mangrove forests are a type of wetland located on the border of estuaries and shores protecting them from the open ocean (Scott 1993). They are composed of salt-tolerant trees and other plant species and they provide essential habitat for both marine and terrestrial life. Mangroves possess large roots that spread laterally and consolidate sediments, eventually transforming local mudflats into dry land. Species diversity is usually high in mangroves, and like seagrasses, they can act as a filter to remove sediments before they can be transported onto an adjacent coral reef. The extensive root system and nutrient rich waters found in mangroves make them among the richest of nursery grounds for marine life, including peneaeid shrimps, inshore fish species, and some commercially important crustaceans (Scott 1993, Myers 1999, Navy 2005, WPRFMC 2005).

Mangrove forests are native to the Marianas, though they are only present on the islands of Guam and Saipan, with the mangroves of Guam being the most extensive and diverse, totaling approximately 173 acres (ac) (70 hectares [ha]) (Navy 2005). There are 125.3 ac (51 ha) of mangrove forests on 10 sites within Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of Apra Inner Harbor (Navy 2005). Mangroves/wetlands are discussed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

11.1.4.1 Marine Flora, Invertebrates and Associated EFH

Algae (seaweeds) occupy a wide range of habitats including but not limited to: sandy bottoms of lagoons; shallow, calm fringing reefs; barrier reef coral bottoms; outer reef flats; and the outer reef slope. Coralline algae are of primary importance in constructing algal ridges that are characteristic of exposed Indo-Pacific reefs preventing oceanic waves from eroding coastal areas (WPFMC 2001). Over 237 species of algae or seaweed (blue-green, green, brown, and red) occur on Guam (Lobban and Tsuda 2003). Green, brown, and red algae are commonly harvested for sale at local markets or used as bait for rod and reel fishing on Guam (Navy 2005). Since algae are direct contributors to the well-being and protection of fish species, both as a source of food and protection to larvae and small fish species, algae has a EFH designation and is managed as part of the potentially harvested coral reef taxa (PHCRT) by WPFMC (WPFMC 2005).

Seagrass beds cover approximately 917 ac (371 ha) of reef flats in several coastal bays around Guam (WPFMC 2005). Three species found there include *Halodule uninervis*, *Enhalus acoroides*, and *Halophila minor* (Lobban and Tsuda 2003). These beds are used as foraging grounds by sea turtles and are an important nursery area for a number of economically important reef fish species including but not limited to emperors, scads, wrasses and goatfish (GDAWR 2006).

Sponges in the Marianas have a considerable variation in the distribution and composition among neighboring reefs and islands. Their diversity is greatest, regardless of depth, on coral reefs, in caves and vertical areas not colonized by hard corals. They are also abundant in seagrass beds, mangroves, and other environments, providing residence for a huge variety of animal including crustaceans, annelids and echinoderms among others. Over 120 sponge species have been reported from Guam (and CNMI), have EFH designations, and are managed as part of the PHCRT (WPFMC 2005).

Guam supports biogenic (produced by a living organism) or hermatypic (reef-building) coral reefs. The degree of reef development depends on a number of environmental controls, including the age of the islands, volcanic activity, the availability of favorable substrates and habitats, weathering caused by groundwater discharge, sedimentation and runoff accentuated by the overgrazing of feral animals, and varying levels of exposure to wave action, trade winds, and storms (Navy 2005). Guam is almost entirely surrounded by fringing reefs, is entirely surrounded by forereefs, and has barrier reefs at Apra Harbor

(Luminao Barrier Reef at the western end of Guam) and Cocos Lagoon (southern end of Guam) (Eldredge 2003a, Navy 2005). The fringing reef is interrupted at several locations along the coastline by bays, channels, and areas where the insular shelf is colonized by seagrass. Along the northern coast of the island between Achae Point and the Ritidian Channel, the fringing reef and forereef area transitions from a relatively wide swath of coral (less than 820 ft [250 m] wide) to an area populated by turf algae (approximately 650 to 1,650 ft [200 to 500 m] wide) (NOAA 2005a).

Figures 11.1-1 and 11.1-2 show an overview of sensitive marine biological resources, including benthic habitats associated with the study areas. These habitats are based on National Oceanic and Atmospheric Administration (NOAA) (2005a) Environmental Sensitivity Index (ESI) Mapping, supplemented by the Guam Coastal Atlas (NOAA 2005b) and may include if present:

- Coral Reef and colonized hardbottom, which are broken into two density categories.
  - Lower Density Live Coral Cover (Sparse cover: 10% - <50%).
  - Higher Density Live Coral Cover (Patchy: 50% - <90% and Continuous: 90%-100%).
- Coralline Algae (one category).
  - Sparse (10% - <50%), patchy (50% - 90%), and continuous (90% - 100%) combined.
- Macroalgae, Turf Algae, and Seagrass (one separate category each).
  - All coverage percentages combined (sparse, patchy, and continuous) combined.
- Turf Algae (one category).
  - All coverage percentages (sparse, patchy, and continuous) combined.
- Seagrass (one category).
  - All coverage percentages (sparse, patchy, and continuous) combined.
- Unconsolidated Sediment, usually sand or mud, uncolonized 90-100%

Reefs in the southern half of Guam have always been subject to more naturally-occurring sedimentation than in the northern half of the island because of the lack of surface water associated with the porous limestone substrate and soil type in the north versus the volcanic substrate in the south. Coral cover and diversity are currently higher on reefs located along the northeastern coast of Guam. Historical surveys suggest that diversity was actually higher in the south before anthropogenic impacts severely impacted those reefs (Navy 2005). The NOAA ESI Map (2005a) and Guam Coastal Atlas (NOAA 2005b), produced from surveys of shallow water benthic habitats of Guam show that the overall coral cover around Guam ranges from 10 to 90%. Most of the reefs surrounding Guam have a coral cover ranging from 10 to 50%.

Natural and anthropogenic disturbances affecting the reefs of Guam have caused a significant decline of coral cover and recruitment since the 1960s. Coral cover on many forereef slopes on Guam has decreased from over 50% to less than 25% (Birkeland 1997). There are, however, several reefs of Guam where coral cover remains high, including reefs in Apra Harbor, Agat Bay, Orote Point Ecological Reserve Area (ERA), and Haputo ERA (Navy 2005).

11.1.4.2 Essential Fish Habitat

The 1996 amendments to the M-SA set forth a mandate for NMFS, Regional Fisheries Management Councils, and other federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. To protect EFH in accordance with the law, suitable fishery habitats must be maintained. Guam is within the jurisdiction of the WPRFMC, which has designated the marine waters around Guam as EFH, and adopted a precautionary approach to EFH designation due to the lack of scientific data (COMNAV Marianas 2007a).

EFH for CREMUS covers all the waters and habitats at depths from the sea surface to 328 ft (100 m) extending from the shoreline (including state and territorial lands and waters) to the outer boundary of the exclusive economic zone (EEZ). This broad EFH designation ensures that enough habitat is protected to sustain managed species. In addition to EFH, the WPRFMC also identified Habitat Areas of Particular Concern (HAPC) for CREMUS. Within the EFH, HAPC are specific areas that are essential to the life cycle of important coral reef species. At least one or more of the following criteria established by NMFS must be met for HAPC designation: (1) the ecological function provided by the habitat is important; (2) the habitat is sensitive to human-induced environmental degradation; (3) development activities are, or would be, stressing the habitat type; or (4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth criterion, not established by NMFS, in HAPC designation of areas that are already protected, such as wildlife refuges (WPRFMC 2005).

As described earlier, the WPRFMC currently manages fisheries in the Western Pacific under five FMPs: (1) coral reef ecosystems (2) bottomfish and seamount groundfish, (3) crustaceans, (4) precious corals, and (5) pelagic species. Each of these FMPs identifies areas of EFH and HAPC for different life stages of species managed under the respective plan. There is no designated EFH or HAPC for precious corals or seamount groundfish around Guam, but other designations do apply (COMNAV Marianas 2007a). The preferred alternative in the next FEP amendment would add *Heterocarpus spp.* as a deepwater shrimp MUS.

EFH habitats include mangrove, estuarine, seagrass beds, soft substrate, coral reef/hard substrate, patch reefs, surge zone, deep-slope terraces, and pelagic/open ocean and can be viewed in relation to the species specific life stages in the FEP for Mariana Archipelago (WPFMC 2005). Specific EFH habitats occurring in waters within the study areas that are described within the text or depicted on figures include the following:

- *Intertidal Zones.* This habitat includes a small margin of seabed existing between the highest and lowest extent of the tides extending around Guam and is present in all ROI.
- *Seagrass Beds.* Seagrass beds occur in patches within Outer and Inner Apra Harbor and other isolated areas around Guam (e.g., Agat Bay).
- *Macroalgae.* Located within most habitats associated with the ROI and around Guam.
- *Mangrove Forests/Wetlands.* These forests are located in the intertidal zone along the coast of Outer and Inner Apra Harbor.
- *Coral Reefs and Colonized Hardbottom.* Coral reefs are located along the coast of the ROI, on shoals (Big Blue Reef, Western Shoals, Middle Shoals, and Jade Shoals) and the coasts of Outer and Inner Apra Harbor.
- *Estuarine Water Column.* Includes the open water areas within Sasa Bay and river mouth areas.
- *Marine Water Column.* Many managed species occur in this habitat and rely on this for development, dispersal, or feeding.
- *Unconsolidated Bottom.* This includes benthic substrates along the coast or within Apra Harbor such as clay and silt, sand, gravel, rubble and boulders.

EFH or HAPC occur in throughout the ROI. The geographic extent of the habitat types varies, but are generally a key portion of each Alternative if discussed.

Table 11.1-3 and Figure 11.1-3 summarize and portray the EFH and HAPC designations for Guam. Each of the FMPs in Table 11.1-3 has an associated figure listed in the right column that illustrate them.

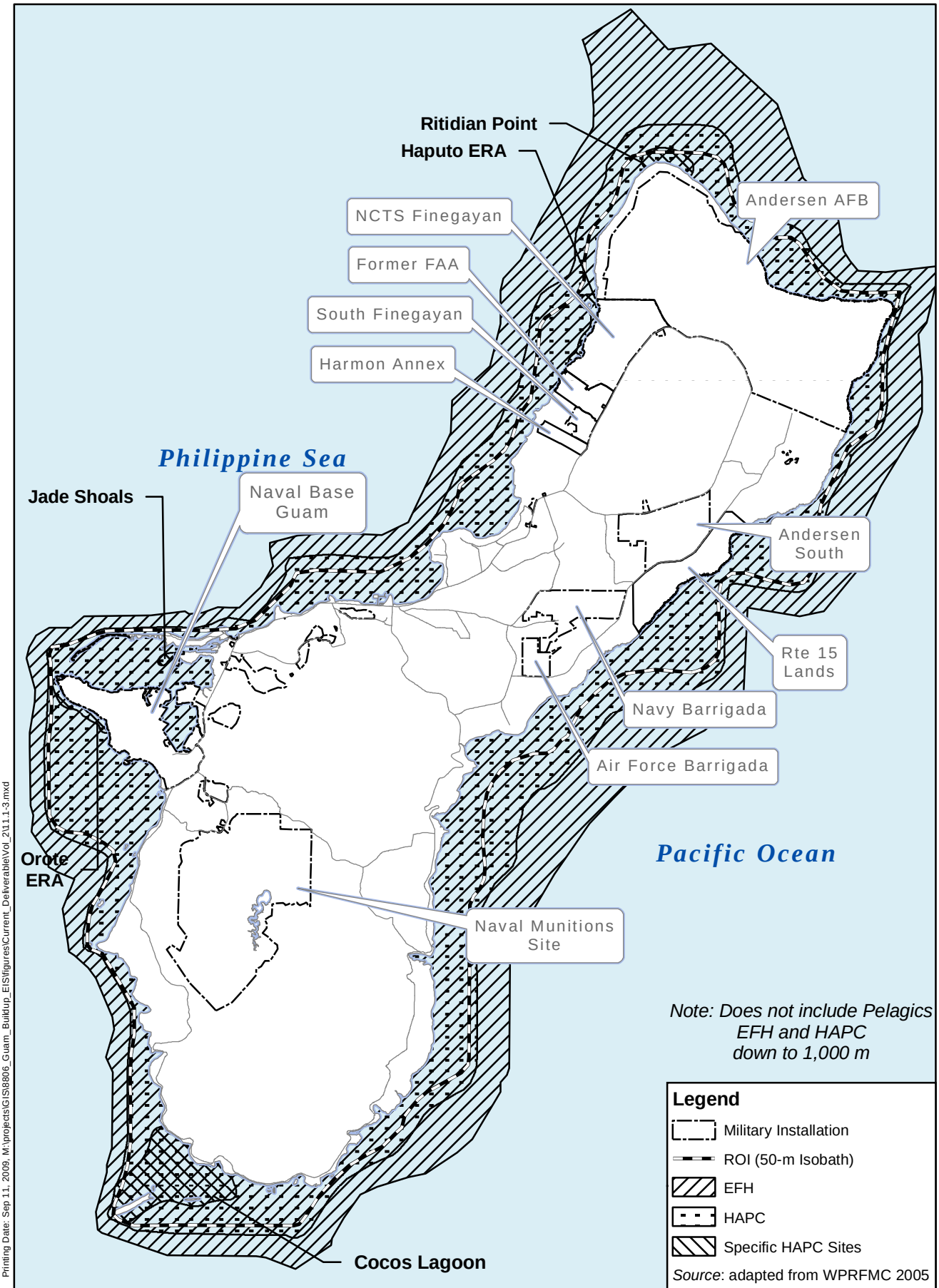


Figure 11.1-3
EFH, HAPC, and Specific HAPC Sites Designated within Guam Waters

Table 11.1-3. Guam EFH and HAPC

FMP	*EFH (Juveniles and Adults)*	*EFH (Eggs and Larvae)*	*HAPC*	*Figure*
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 328 ft (100 m)	Water column and benthic substrate to a depth of 328 ft (100 m)	All marine protected areas identified in an FMP, all PRIAs, many specific areas of coral reef habitat (see FMP)	11.1-4
Bottomfish	Bottomfish: Water column and bottom habitat down to 400 m	Bottomfish: Water column down to 1,312 ft (400 m)	Bottomfish: All escarpments and slopes between 130 – 920 ft (40-280 m)	11.1-5
Crustaceans	Bottom habitat from shoreline to a depth of 328 ft (100 m)	Water column down to 490 ft (150 m)	None	11.1-6
Pelagics	Water column down to 3,280 ft (1,000 m)	Water column down to 655 ft (200 m)	Water column above seamounts and banks down to 3,280 ft (1,000 m)	11.1-7

Note: All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.
Source: WPRFMC 2005.

EFH for at least one life stage of a managed species group extends from the shoreline to the outer extent of the EEZ from the surface to a water depth of 3,280 ft (1,000 m) and includes bottom habitat to a depth of 1,312 ft. (400 m).

HAPC within submerged lands around Guam includes seamounts and banks to depths of 3,280 ft (1,000 m), escarpments and slopes between 130 and 920 ft (40 and 280 m), bottom habitat down to depths of 328 ft (100 m) and specific areas around Ritidian Point, Haputo ERA, Jade Shoals in Apra Harbor, and Orote ERA.

EFH life stage, status, and life history for each of these management units are summarized below. See the FEP for Mariana Archipelago [WPFMC 2005] for a detailed listing of all FMP MUS.

Coral Reef Ecosystem Management Unit Species (CREMUS)

In designating EFH for CREMUS, the WPFMC-linked MUS to specific habitat "composites" (e.g., sand, live coral, seagrass beds, mangrove, open ocean) for each life history stage, consistent with the depth of the ecosystem.

For several of the major coral reef associated species, very little is known about the life histories, habitat utilization patterns, food habits, or spawning behavior of most coral reef associated species. For this reason, the WPFMC, through the CRE-FMP, designated EFH using a two-tiered approached based on the divisions of MUS into the currently harvested coral reef taxa (CHCRT) (this also includes likely targeted species in the near future) and PHCRT categories (WPFMC 2005).

In the first tier, EFH has been identified for various life stages and juvenile and adult life stages of CHCRT and includes the water column and all benthic substrate to a depth of 328 ft (100 m) from the shoreline to the outer limit of the EEZ (Figure 11.1-4). HAPC for important coral reef species includes all no-take marine protected areas identified in the CRE-FMP, all Pacific remote islands, and numerous other existing marine protected areas, research sites, and coral reef habitats throughout the western Pacific (WPRFMC 2005).

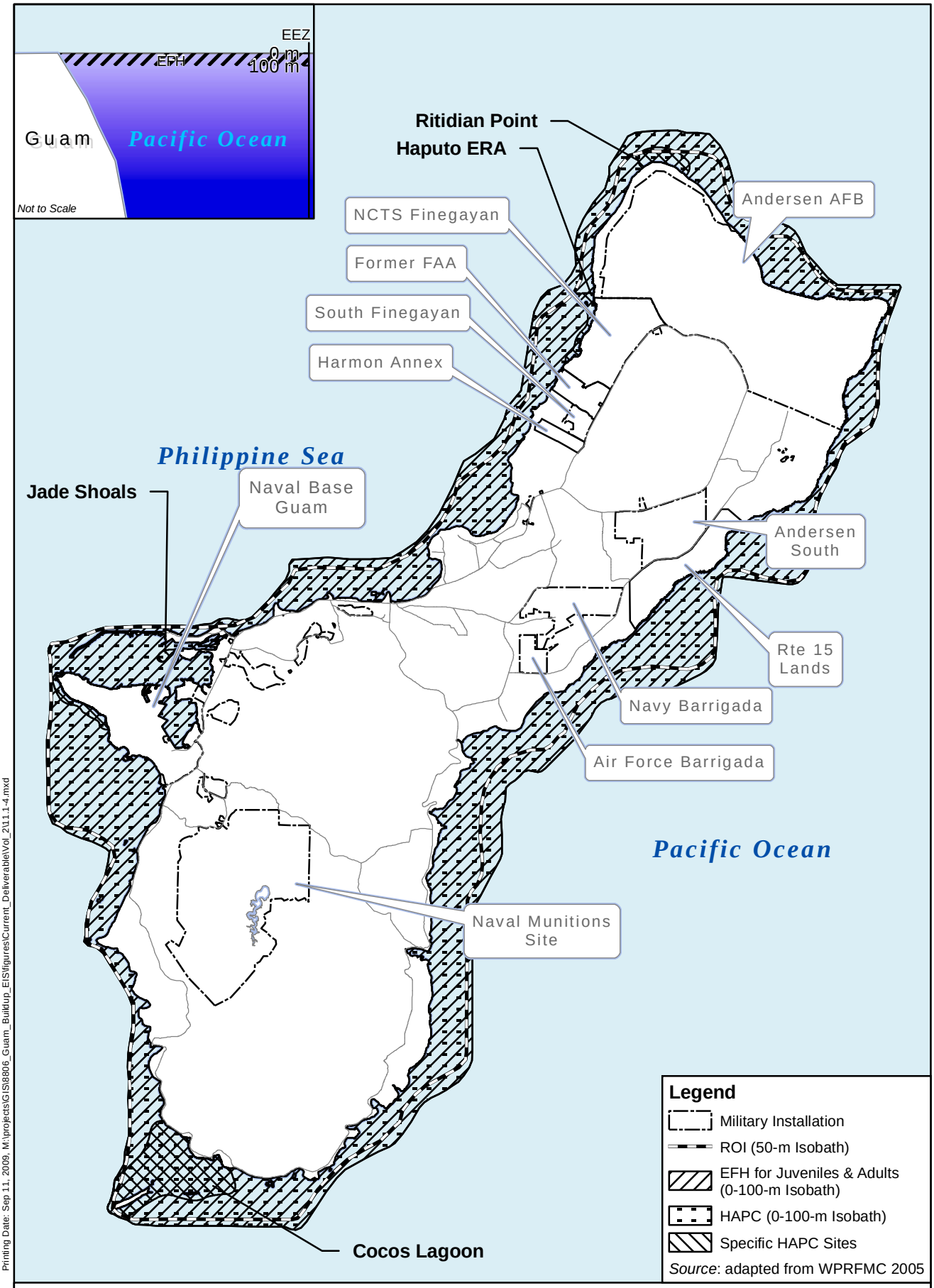


Figure 11.1-4
EFH and HAPC Designated within Guam Waters for Various Life Stages of CHCRT and PHCRT

HAPC for all life stages of the CREMUS includes all hardbottom substrate between 0 and 328 ft (100 m) depth in the study area. Five individual HAPC sites (see Figure 11.1-4) have been identified for the island of Guam:

- Jade Shoals, which occurs within Apra Harbor
- Orote Point ERA, which lies immediately outside of Apra Harbor
- Ritidian Point, located in northern Guam, along the shoreline of Andersen AFB
- Haputo ERA, in northwestern Guam along the shoreline of NCTS Finegayan
- Cocos Lagoon, southern Guam

CHCRT include surgeonfishes and unicornfishes, triggerfishes, jacks/scads, sharks soldierfishes and squirrelfishes, flagtails, rudderfishes, wrasses, goatfishes, octopuses, mullets, moray eels, threadfins, bigeyes, parrotfishes, rabbitfishes, tuna/mackerel, barracudas, turban shells, and aquarium species/taxa.

EFH has also been designated for the second tier, PHCRT, and includes literally thousands of species encompassing almost all coral reef flora and fauna. An example of some of these PHCRT MUS/taxa are additional fish MUS/taxa, hard and soft corals, anemones, zooanthids, sponges, hydrozonans, bryozoans, tunicates, feather duster worms, sea cucumbers/urchins, mollusks, sea snails/slugs, other bivalves, other lobsters and crabs, shrimp/mantis, annelids, algae, and live rock (WPFMC 2005).

The two NOAA-designated fish SOC (also MUS under the CHCRT), and two potentially sensitive MUS are briefly described below and in Figure 11.1-4. Factors contributing to their decline and additional information on these species are included in Volume 9, Appendix G.

Napoleon Wrasse

The Napoleon wrasse is the largest species of the Labridae family, with the males exceeding 6 ft (2 m) in length and 420 pounds (lbs) [190 kilograms {kg}] (Sadovy et al. 2003). Females rarely exceed 3 ft (1 m) in length (Choat et al. 2006). This species is slow-growing and long-lived, with delayed reproduction, and consequently, low stock replenishment rates. Individuals become sexually mature at 5 to 7 years old and can live at least 30 years (Choat et al. 2006). Its generation time is expected to be in excess of 10 years. They primarily eat mollusks, fish, sea urchins, crustaceans, and other invertebrates and are one of the few predators of toxic animals such as sea hares, boxfishes and crown-of-thorns starfish (NMFS 2009b).

This species is believed to be uncommon to rare wherever it occurs, and natural densities are never high even in preferred habitats. Once an economically important species in Guam, it is now rarely seen on reefs there, and is infrequently reported on inshore survey catch results.

Humphead Parrotfish

The humphead parrotfish is the largest of all parrotfishes, growing to 4 ft (1.2 m) in length and 100 lbs (46 kg) in weight. This species is slow growing, with delayed reproduction and low replenishment rates, and may live to 40 years of age (NMFS 2009b). Humphead parrotfish primarily eat coral, but also eat benthic algae. The humphead parrotfish has a very wide range, but population sizes have been declining due to overfishing. Additionally, their slow growth and delayed reproduction make them susceptible to stressors (Donaldson and Dulvy 2004). The species has nearly disappeared from Guam's reefs (NMFS 2009b).

Potentially-Sensitive CREMUS in the EFH of Guam

Two other EFH fish species are addressed in this EIS/OEIS: the adult bigeye scad, a CHCRT MUS, is identified in seasonally high concentrations (June – December) at two locations within Apra Harbor; and the scalloped hammerhead shark, a PHCRT MUS, is found during seasonal spawning at one location (NOAA 2005a). Both of these species' locations are in proximity to the proposed action and alternatives within Apra Harbor and are addressed further in that section. Additionally, a "sessile benthic" PHCRT MUS, mainly addressing hard corals (although it includes algae, sponges, hard and soft corals, etc.) within the study area is discussed throughout this EIS/OEIS and in further detail in Volume 4, Chapter 11 (Table 11.1-4).

Table 11.1-4. Sensitive MUS present in the EFH of Guam

Group	*Common Name / Chamorro Name*	*Status**	
		Federal	*Guam*
Coral Reef Ecosystem - Fishery Management Plan (CRE-FMP)			
Fish MUS	Napoleon wrasse / Tanguisson	CHCRT and SOC	SOGCN
	humphead parrotfish / Atuhong	CHCRT and SOC	SOGCN
	Bigeye scad / Atulai	CHCRT	SOGCN
	Scalloped hammerhead / halu'u (general term)	PHCRT	SOGCN
Sessile Benthic MUS**	Hard coral / cho' cho'	PHCRT	SOGCN

Legend: SOC = NOAA Species of Concern; EFH; SOGCN = Species of Greatest Conservation Need.
Notes: ** includes algae, sponges, hard and soft corals, etc. Only a hard coral example is given for the table and is the main focus of this EIS/OEIS (WPFMC 2005).
Sources: NOAA 2005a, WPRFMC 2005, GDAWR 2006, USFWS 2009.

Bigeye Scad

The bigeye scad or atulai can be found off the coast of Guam year-round, but is scarce in July and August, which may be due to spawning activities. This species tends to spawn in the pelagic environment in large aggregations. Larvae and juveniles remain offshore for the first several months, then migrate to the nearshore habitat (refer to Figure 11.1-2). Small schools are typically found inshore or in shallow water and occasionally over shallow reefs in turbid water. Large schools of atulai appear seasonally in Guam from August to November in shallow sandy lagoons, bays, and channels (Navy 2005).

This species is an economically important food fish and a small seasonal fishery is present in Guam (WPRFMC 2005). Atulai reach a size of 15 in (38 cm), but are rarely more than 10 in (25 cm) at Guam. On moonless nights, atulai beyond the reef, can be attracted to lights set in the water beneath fishing boats and caught with hook and line. When inshore, atulai are harvested by nets and hook and line during the daytime. Sometimes a large net is set across an entire bay to trap the atulai. A large group of people help close the net and harvest the atulai. Several thousand pounds can be harvested this way. Atulai may also move between islands or island groups since they are not always present near Guam. Little is known of these offshore movements (GDAWR 2009).

Scalloped Hammerhead

Scalloped hammerheads are found in a wide variety of coral reef habitats. They are very active swimmers, occurring in pairs, schools, or solitary, ranging from the surface, surfline, and intertidal region down to at least 900 ft (275 m) (Compagno 1984). Juveniles often occur in schools inhabiting inshore areas such as bays, seagrass beds, and lagoon flats, foraging near the bottom before moving into deeper waters as adults (WPRFMC 2005). As adults they can be found in shallow inshore areas during mating or birthing events (Compagno 1984). The scalloped hammerhead produces an offspring of 15 to 31 pups per litter and utilizes shallow, turbid coastal waters (e.g., Guam's Inner Apra Harbor) as nursery areas (refer to

Figure 11.1-2). The pups may remain in these shallow areas for several months, then venture to coastal waters (Compagno 1984, Myers 1999). The scalloped hammerhead is reported to spawn in January through March outside the Inner Apra Harbor Entrance Channel (NOAA 2005a), although their occurrence is reported as extremely rare (personal communication with Steve Smith, [Navy 2009c]).

Sessile Benthic MUS

In general, the Haputo ERA and Outer Apra Harbor (two of the three study areas addressed in this chapter) are vibrant thriving coral reef communities with a diverse biota of algae, invertebrates and fish. Both locations have well-developed coral reefs containing some of the highest coral cover on Guam (Paulay et al. 1997, Amesbury et al. 2001) (refer to Figures 11.1-1 and 11.1-2). In addition, the Haputo ERA and Jade Shoals of Apra Harbor are identified as Specific HAPC sites, which are defined as "areas that are essential to the life cycle of important coral reef species" (WPFMC 2005). More detailed information regarding the sessile benthic community at these two locations and the sensitivity of the coral reef community is described within the site-specific sections.

Bottomfish Management Unit Species (BMUS)

EFH for egg and larval life stages includes the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 1,310 ft (400 m) and encompasses both the shallow-water (0 to 328 ft [100 m]) and deep-water complexes (328 to 1310 ft [100 to 400 m]) (COMNAV Marianas 2007a). EFH for juvenile and adult life stages encompasses the water column and all bottom habitat extending from the shoreline to a depth of 1,310 ft (400 m) and includes the shallow-water and deep-water complexes (WPFMC 2005). All life stages of the BMUS have HAPC designated in the ROI that includes all slopes and escarpments between 131 and 920 ft (40 and 280 m) (Figure 11.1-5) (Navy 2005, WPFMC 2005).

There are currently 16 BMUS in the Mariana Archipelago FEP managed by the WPRFMC. In Guam, the BMUS is divided into a shallow-water complex and a deep-water complex based on depth and species composition. The juvenile and adult deep-water complex is outside the ROI, therefore would not be addressed in this document. All species have viable recreational, subsistence, and commercial fisheries with none of the BMUS approaching an overfished condition (WPRFMC 2005).

The shallow-water complex is distributed throughout the tropical and subtropical waters of the insular and coral reef-bordered coastal areas of the Pacific Islands (Myers and Donaldson 2003). The proxy used to calculate how much bottomfish habitat is available (comprising the shallow-water and deep-water complexes) is the length of the 100-fathom contour (183-m contour) (index of bottomfish habitat) that surrounds Guam and the CNMI (WPRFMC 2005). Juvenile and adult bottomfish are typically found in habitats characterized by a mixture of sandy bottoms and rocky areas of high structural complexity (WPRFMC 2005). Habitats encompassing the shallow-water complex includes various habitats such as: mangrove swamps; seagrass beds; shallow lagoons; hard, flat coarse sandy bottoms; coral and rocky substrate; sandy inshore reef flats; and deep channels (WPFMC 2005).

Within the shallow-water complex, snappers form large aggregations and groupers/jacks occur in pairs within large aggregations near areas of prominent relief. Spawning coincides with lunar periodicity corresponding with new/full moon events (Amesbury and Myers 2001). Groupers have been shown to undergo small, localized migrations of several kilometers to spawn. Large jacks are highly mobile, wide-ranging predators that inhabit the open waters above the reef or swim in upper levels of the open sea (Navy 2005).

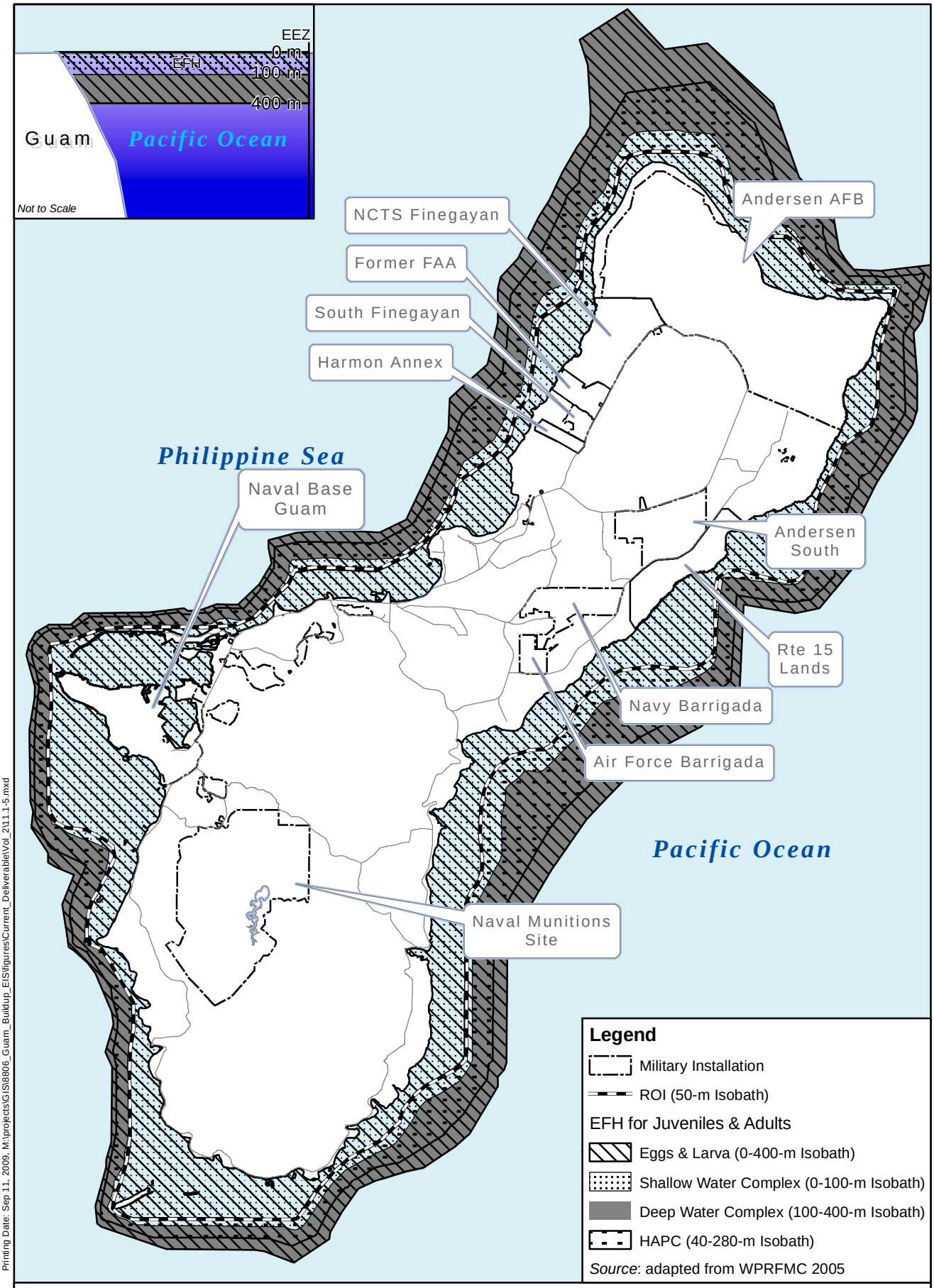


Figure 11.1-5
EFH Designated within Guam Waters for Egg, Larval, Juvenile, and Adult Life Stages of Bottomfish

Crustacean Management Unit Species (CMUS)

EFH for the larvae life stages is the water column from the shoreline to the outer limit of the EEZ down to a depth of 492 ft (150 m). All bottom habitat from the shoreline to a depth of 328 ft (100 m) is designated as EFH for juveniles and adults (Figure 11.1-6). No HAPC is designated for Guam waters.

Four CMUS, three lobster and one crab are currently in the Mariana Archipelago FEP, specifically, spiny and slipper lobsters, and Kona crab (WPFMC 2005). There are 839 species of crustaceans in the Marianas and 13 species of spiny lobster that occur in the tropical and subtropical Pacific between 35 degrees North and 35 degrees South (WPRFMC 2005). Of the five species of spiny lobsters that occur within the Marianas, *Panulirus penicillatus* is the most common (Paulay 2003b, WPRFMC 2005).

In general, adults of the CMUS prefer sheltered areas with rocky substrates and/or sandy bottoms. There is a lack of published data pertaining to the preferred depth distribution of decapod (invertebrate animal with 10 legs [e.g., lobsters, crabs and shrimp]) larvae and juveniles in this region (WPRFMC 2005). Spiny lobsters are mainly found in windward surf zones of oceanic reefs but some are also found on sheltered reefs (Pitcher 1993). Adult spiny lobsters are typically found on rocky substrate in well-protected areas, such as crevices and under rocks (Holthuis 1991, Pitcher 1993). Some species of spiny lobsters prefer depths less than 33 ft (10 m) while others are found to depths of around 360 ft (110 m) (Holthuis 1991, Pitcher 1993, WPRFMC 2005). Small juvenile spiny lobsters are found only in the same habitat as larger individuals (Pitcher 1993). The depth distribution of the Chinese slipper lobster is 0 to 33 ft (10 m) and some are taken as incidental catch in the spiny lobster fishery (Polovina 1993). Slipper lobsters prefer to live in coral or stone reefs with a sandy bottom (Holthuis 1991).

Decapods exhibit a wide range of feeding behaviors, but most combine nocturnal predation with scavenging; large invertebrates are the typical prey items. Both lobsters and crabs are ovigerous—the females carry fertilized eggs on the outside of their body. The relationships between egg production, larval settlement, and stock recruitment are poorly understood. Spiny lobsters produce eggs in summer and fall. The larvae have a pelagic phase lasting about one year and can be transported up to 2,300 miles (mi) (3,700 kilometers [km]) by prevailing ocean currents (WPRFMC 2005). Spiny lobsters are nocturnal, hiding during the daytime in crevices in rocks and coral reefs. At night, this lobster moves up through the surge channels to forage on the reef crest and reef flat (Pitcher 1993).

Pelagic Management Unit Species (PMUS)

EFH for the egg and larval stages includes the water column down to a depth of 655 ft (200 m) from the shoreline to the outer limit of the EEZ. EFH for juveniles and adults includes the water column down to a depth of 3,280 (1,000 m) from the shoreline to the outer limit of the EEZ. All life stages of the PMUS have HAPC designated and that includes the entire water column to a depth of 3,280 ft (1,000 m) above all seamounts and banks with summits shallower than 6,560 ft (2,000 m) within the EEZ (Figure 11.1-7) (Navy 2005).

Although certain pelagic MUS are known to occur within the boundary of the Mariana Archipelago FEP, they are currently managed under a separate Pacific Pelagic FEP. Thirty-three species are currently managed as PMUS by the WPRFMC through the FMP for the Pelagic Fisheries of the Western Pacific Region (Navy 2005, WPRFMC 2005). PMUS are divided into the following species complex designations: marketable species, non-marketable species, and sharks. The designation of these complexes is based on the ecological relationships among the species and their preferred habitats (Navy 2005). The marketable species complex has been further divided into temperate and tropical assemblages.

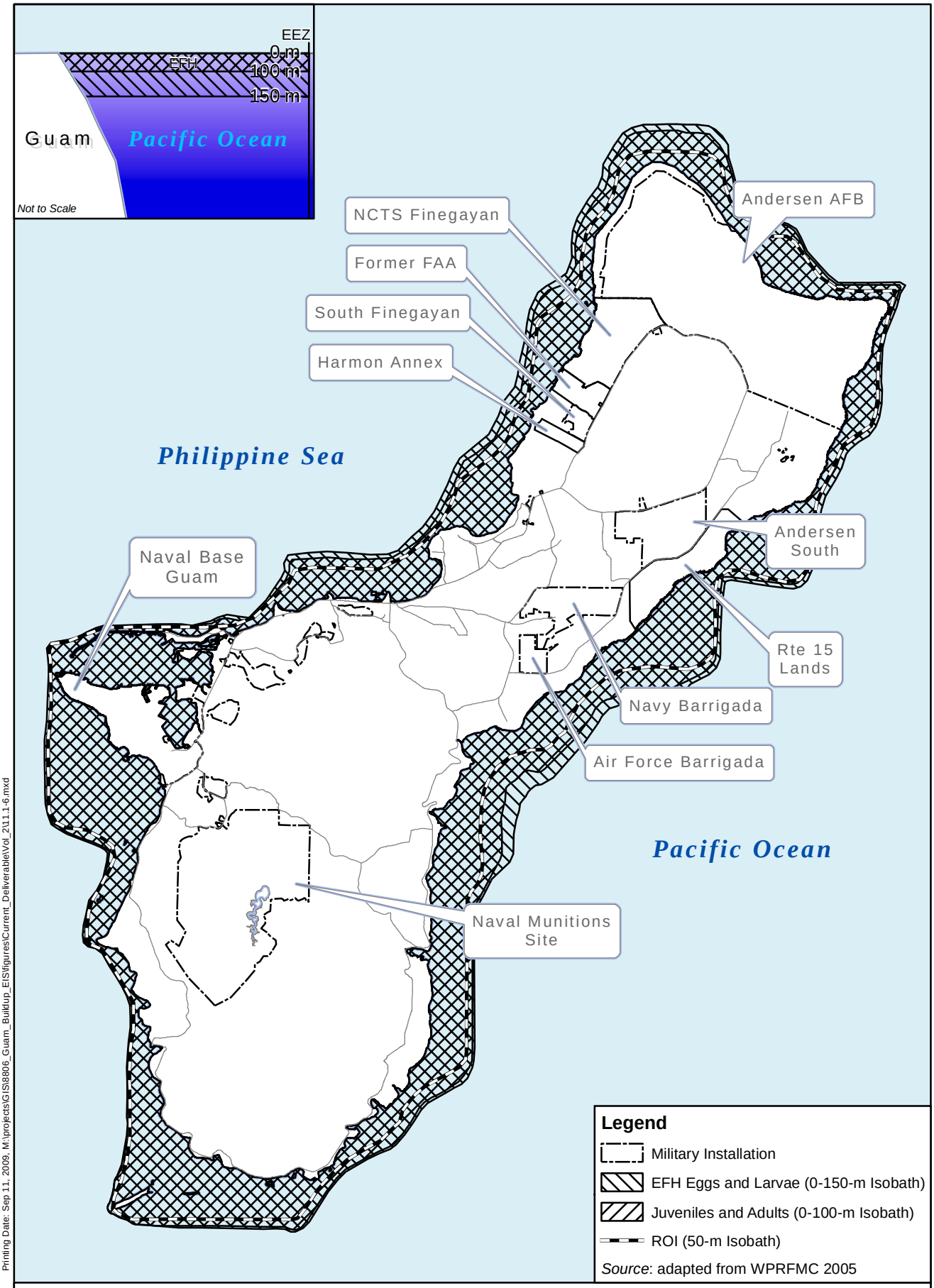


Figure 11.1-6
EFH Designation within Guam Waters for Egg, Larval, Juvenile, and Adult Life Stages of Crustaceans

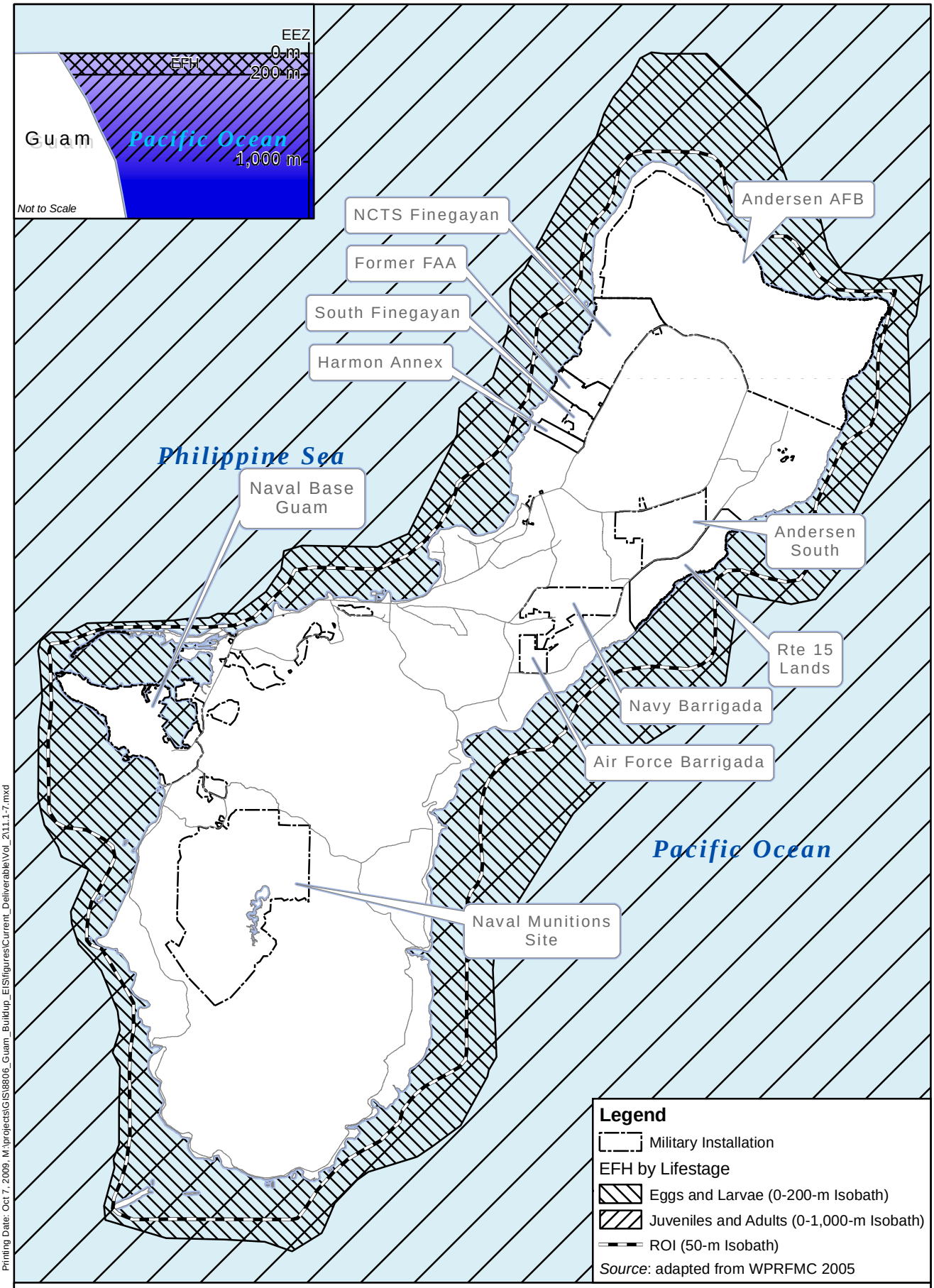


Figure 11.1-7
EFH and HAPC Designated within Guam Waters for all Life Stages of Pelagic Fish

The temperate species complex includes those PMUS that are found in greater abundance outside tropical waters at higher latitudes (e.g., broadbill swordfish, bigeye tuna, northern bluefin tuna, and albacore tuna) (Navy 2005, WPRFMC 2005).

PMUS are typically found in epipelagic (upper ocean zone or the surface to 720 ft [220 m]) to pelagic (open-ocean zone) waters; however, shark species can be found in inshore benthic, neritic (shallow coastal) to epipelagic, and mesopelagic (intermediate ocean depths) waters. Factors such as gradients in temperature, oxygen, or salinity can affect the suitability of a habitat for pelagic fishes. Skipjack tuna, yellowfin tuna, and Indo-Pacific blue marlin prefer warm surface layers, where the water is well mixed and relatively uniform in temperature. Species such as albacore tuna, bigeye tuna, striped marlin, and broadbill swordfish, prefer cooler temperate waters associated with higher latitudes and greater depths. Certain species, such as broadbill swordfish and bigeye tuna are known to aggregate near the surface at night. However, during the day broadbill swordfish can be found at depths of 2,620 ft (800 m) and bigeye tuna around 900 to 1,800 ft (275 to 550 m). Juvenile albacore tuna generally concentrate above 295 ft (90 m) with adults found in deeper waters (295 to 900 ft [90 to 275 m]) (Navy 2005, WPFMC 2005).

Migration and life history patterns of most PMUS in the Pacific Ocean are poorly understood. Additionally, very little is known about the distribution and habitat requirements of the juvenile lifestages of tuna and billfish prior to recruitment into fisheries. Seasonal movements of cooler-water tunas such as the northern bluefin and albacore are more predictable and better defined than billfish migrations. Tuna and related species tend to move toward the poles during the warmer months and return to the equator during cooler months. Most pelagic species make daily vertical migrations, inhabiting surface waters at night and deeper waters during the day. Spawning of pelagic species generally occurs in tropical waters, but may occur in temperate waters during warmer months (Navy 2005, WPFMC 2005).

Guam Fishery Distribution and Abundance and Composition

Distribution and abundance of fishery species depends greatly on the physical and biological factors associated with the ecosystem, as well as the individual species. Physical parameters include habitat quality variables such as salinity, temperature, dissolved oxygen, and large-scale environmental perturbations (e.g., ENSO). Biological factors affecting distribution are complex and include variables such as population dynamics, predator/prey oscillations, seasonal movements, reproductive/life cycles, and recruitment success. Rarely is one factor responsible for the distribution of a species; usually it is a combination of factors. For example, pelagic species optimize their growth, reproduction and survival by tracking gradients of temperature, oxygen, or salinity (Helfman et al. 1999). Additionally, the spatial distribution of food resources is variable and changes with prevailing physical habitat parameters. Another major component in understanding species distribution is the location of highly productive regions such as frontal zones. These areas concentrate higher trophic-level predators such as tuna and provide visual clues for the location of target species for commercial fisheries (NMFS PIR 2001).

Coral reef communities surrounding Guam are typically uniform and stable year-round. However, there are exceptions, as seasonal variations in pelagic species distributions in the area are understood. Several of the reef fish species (juvenile rabbitfish, juvenile jacks, juvenile goatfish, and bigeye scad) targeted in Guam show strong seasonal fluctuations, usually related to juvenile recruitment (Amesbury et al. 1986).

Fish species composition in Guam is typical of most Indo-Pacific insular, coral reef-bordered coastal areas: 73% of the total number of species belong to 20 families (Myers and Donaldson 2003). The geographic location of the study area suggests a more diverse ichthyofauna than areas such as the Hawaiian Islands. However, the recorded species diversity in the Guam/Marianas Islands chain is lower than that of the Hawaiian archipelago. Actual diversity may be higher and the recorded diversity may be

an artifact of insufficient sampling (Paulay 2003b). However, many other factors, such as larval recruitment and frequent natural disturbances, have dramatic impacts on species diversity. Myers and Donaldson (2003) noted the occurrence of 1,019 fish species (epipelagic and demersal species found to 655 ft [200 m]) in the Mariana Islands. Inshore species are composed primarily of widespread Indo-Pacific species (58%) with the remainder consisting of circumtropical species (3.6%) and nearly equal numbers of species with widespread distributions primarily to the west, south, and east of the islands. Ten species of inshore and epipelagic fishes are currently considered endemic to the Marianas. However, this number is probably too high due to the observations of transient species in the area.

11.1.4.3 Special-Status Species

As noted in Section 11.1.1.3, this section includes USFWS ESA-listed and candidate species and marine mammals not listed under ESA. NMFS species of concern are addressed under EFH CHCRT.

The threatened green sea turtle and the endangered hawksbill sea turtle are the only two ESA-listed species that are anticipated to be in the nearshore marine environment and adjacent beaches. The Navy, in cooperation with USFWS and GDAWR, monitors for sea turtle nesting on Navy land throughout the sea turtle nesting season (April – July for the green sea turtle and January – March for the hawksbill sea turtle) (Navy 2005, COMNAV Marianas 2008). There is no critical habitat designation for any marine species on Guam.

The spinner dolphin and common bottlenose dolphin are the only two marine mammals anticipated in the nearshore (<164-ft [50-m] isobaths) ROI for the study areas (Navy 2005). Table 11.1-5 identifies the special-status species that are addressed in this EIS/OEIS.

Table 11.1-5. Special-Status Species for Guam

Group	*Common Name/Chamorro Name*	*Status**	
		Federal	*Guam*
MAMMALS	Common bottlenose dolphin/Toninos	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E

Legend: *E = endangered; SOGCN = Species of Greatest Conservation Need; T = threatened.
Sources: Navy 2005, GDAWR 2006, USFWS 2009, NMFS 2009a.

The special status species are briefly described below. Information about these species, including status, habitat preferences, distribution, behavior and life history, can be found in Volume 9, Appendix G.

Green Sea Turtle

The green sea turtle is by far the most abundant sea turtle found around Guam; aerial surveys by GDAWR indicate a year-round resident population. The green sea turtle occurrences are listed as "concentrated" and the hawksbill as "expected" in nearshore waters of Guam. The green sea turtle is ESA-listed as threatened and is the largest of the hard-shelled turtles, with adults commonly exceeding 39 in (100 cm) in carapace length and 220 lbs (100 kg) in weight. As hatchlings, they are only about 2 in (50 cm) long and weigh less than 1 ounce (25 grams [g]). Adult carapaces range in color from solid black to gray, yellow, green and brown in muted to conspicuous patterns (Navy 2005, WPFMC 2005).

Late juveniles and adults feed primarily on seagrass and macroalgae of the genera *Codium, Amansia, Pterocladia, Ulva, Gelidium, Acanthophora,* and *Hypnea*, and other reef-associated organisms in nearshore waters and within harbors and lagoons. Early juveniles are omnivorous and feed on a variety of algae, invertebrates, and small fishes (COMNAV Marianas 2007a).

Hawksbill Sea Turtle

The hawksbill turtle is a small to medium-sized sea turtle. Adults range between 25 and 35 in (65 and 90 cm) in carapace length and typically weigh around 176 lbs (80 kg.). Hawksbill sea turtles are distinguished from other sea turtles by their hawk-like beaks, posteriorly (near the back) overlapping carapace scutes (bony plates), and two pairs of claws on their flippers. The carapace of this species is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown (Navy 2005, WPFMC 2005).

The hawksbill sea turtle is far less abundant than the green sea turtle, and as a result, debate exists on its occurrence (rare versus regular) within the ROI. There are however, historic reports of hawksbill nesting activity on beaches in northern and central (Apra Harbor) Guam (Navy 2005).

Upon recruitment to benthic feeding habitats, hawksbills are known to become omnivores and feed on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items such as crustaceans and jellyfish. Older juveniles and adults are more specialized and feed primarily on sponges. Sponges comprise as much as 95% of their diet in some locations (Navy 2005, WPFMC 2005).

Common Bottlenose Dolphin

There are no occurrence records for this species in the Marianas, but this is within the known distribution range for the species. Bottlenose dolphins are expected to occur from the coastline to the 6,550-ft (2,000-m) isobaths (Navy 2005).

Bottlenose dolphins are medium-sized, relatively robust dolphins that vary in color from light gray to charcoal. The common bottlenose species *Tursiops* is named for its short, stocky snout. There is striking regional variation in body size; adult body length ranges from 6.2 to 12.4 ft. (1.9 to 3.8 m). They can be found in groups of two to 15 individuals, although groups (pods) of up to 100 or more have been reported (Navy 2005).

Common bottlenose dolphins are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp using a wide variety of feeding strategies. Near the shore, these species prey predominantly on coastal fish and cephalopods (Navy 2005).

Spinner Dolphin

The spinner dolphin is expected to regularly occur all around Guam, except Apra Harbor, where there are few occurrences of this species. Spinner dolphins are behaviorally sensitive and avoid areas with much anthropogenic usage (Navy 2005).

Spinner dolphins are a slender species that have a very long, slender beak. Adults can reach 7.8 ft. (2.4 m) in length and generally have a dark eye-to-flipper stripe and dark lips and beak tip. They typically have a three-part color pattern (dark gray cape, light gray sides, and white belly) (Navy 2005).

Spinner dolphins residing around islands and atolls rest during the daytime hours in shallow, wind-sheltered nearshore waters and forage over deep waters at night. They feed primarily on small mesopelagic (intermediate ocean depths of 328 to 3,280 ft. [100 to 1000 m]) fishes, squids, and shrimps, diving to at least 655 to 984 ft. (200 to 300 m). Group sizes around Guam range from one to 120 individuals, with most groups consisting of less than 30 individuals (Navy 2005).

11.1.4.4 Non-Native Species

Marine organisms, pathogens, or pollutants may be taken up with ship ballast water (or attached to vessel hulls) and be transferred to a different location or ecosystem and cause harm to the receiving ecosystem.

These organisms and pollutants are in greater concentration within 3 nm of the coast (COMNAV Marianas 2007a).

Guam is the administrative and economic hub of Micronesia, hosts one of the largest and expanding U.S. military bases in the Pacific, and lies at the crossroads among Pacific islands, the U.S., and Asia. Although terrestrial introductions, exemplified by the brown treesnake, have received much attention, marine introductions have been little studied until five major marine biodiversity surveys were performed on Guam in the mid-1990s to 2001 (Paulay et al. 2002).. Approximately 5,500 non-native species were recorded in these surveys, of which most remain restricted to Apra Harbor (Paulay et al. 2002). According to the Global Invasive Species Database (GISD), nine marine and 12 estuarine marine invasive alien species (IAS) have been identified associated with Guam habitats (GISD 2009). The database print out can be viewed in Appendix G. Paulay et al. (2002) describes 85 nonindigenous species (mainly sessile organisms [75%]) with Apra Harbor (see Outer Apra Harbor non-native species section).

In general, these marine studies have documented a diverse assemblage of marine species, dominated by sessile organisms, which have been transported to Guam by humans. The main potential sources of nonindigenous species to Guam are purposeful introductions for fisheries and agriculture together with species that inadvertently arrived with such seed stock and hull and ballast transport with shipping traffic. The nature and extent of purposeful introductions of marine species is relatively well-documented because they have been carried out largely by government agencies (Eldredge 1994), although accidental introductions of species hitchhiking on purposeful introductions (such as the parasitic gastropod *Tathrella iredalei* on tridacnines [giant clams]) have occurred. Most of the marine invasive species survey work, although limited, has been conducted in Apra Harbor and is discussed in that section.

Marine IAS are poorly addressed in most national frameworks, although they are now considered as great a problem as terrestrial IAS. Information on marine IAS is needed as scientists are only just beginning to look at the issue in depth. Management of invasive marine species (IMS) is non-existent in the Austral-Pacific Region. Level of awareness is very low and there are no legal and institutional structures in place to effectively address the issue (IAS 2002).

In the South Pacific Regional Environment Programme's (SPREP) draft Regional Strategy on Invasive Species, prepared in 1999, it was decided to address IMS separately. This was due to two main reasons: IAS participants were not fully aware of the issues (most coming from the traditional quarantine and terrestrial invasive species backgrounds) and IMS issues were seen as sufficiently different to invasive terrestrial species issues to warrant separate treatment.

The ballast water situation in Pacific Island countries and territories (PICTS) needs further analysis. Most PICTS do not know if they are acting as exporters and/or importers of marine IAS in ballast water. PICTs need to assess the risks they face and the risks they may pose to other countries. Australia's experience of tackling the incursion and eradication of Black Striped mussel (Mytilopsis sp.) in the Northern Territory was discussed in the IAS Workshop (2002). The competent authorities used pre-existing powers to implement mandatory inspection of all yachts arriving in specific ports in the Northern Territory. As the mussel had not reoccurred in Darwin, the inspection regime does demonstrate that it is possible to prevent marine IAS incursions, provided that there is political willingness to bear the cost of the prevention mechanisms. In this case, the prevention was cost-effective: the Northern Territory pearl industry is worth Aus $50 million per year and could have been severely affected by the IAS.

As reported by *Managing Marine Protected Areas: A TOOLKIT for the Western Indian Ocean, Alien invasive species, sheet K5*, many Marine Protected Areas (MPAs) are located adjacent to ports and

shipping lanes, or to sites that would eventually become ports. These MPA's are at risk from non-native species carried on the hull of yachts and fishing boats, as has been discovered in Guam.

Managing Natural Resource Pathways

In natural resource management work, equipment and organisms are often moved from one location to another. The specific equipment or organism being moved is called the target. Targets could include animals for relocation or stocking for recreation, equipment such as dredging equipment, ships, bulldozers and backhoes, sampling gear such as nets or traps, and even people. Transporting targets provide potential vectors for the spread of non-target species that could potentially invade new habitats. Non-target species are the plants, animals, diseases, pathogens and parasites that are not intended to be moved (HACCP-NRM 2009).

As described, natural resource management work often creates open pathways that could spread non-native species to unique and critical habitats for already endangered species. Next to habitat loss, non-native species are natural resource management's biggest challenge. On February 3, 1999, EO 13112 was signed establishing the National Invasive Species Council. The EO requires that a Council of Departments dealing with non-native species be created and directs agencies to prevent the spread of non-native species in their work, but few management tools exist to implement this directive. Hazard Analysis and Critical Control Points (HACCP) planning has been modified from the food industry for natural resource work. Around the world, industry uses the HACCP planning tools to avoid product contamination. In natural resource pathways, "hitchhiking" species are considered contaminants. HACCP's comprehensive planning identifies these species and the risk of contamination while documenting the best management practices (BMPs) used to prevent and remove hitchhikers. HACCP planning is an international standard (ASTM E2590-08) for reducing or eliminating the spread of unwanted species during specific processes or practices or in materials or products. HACCP planning focuses attention on critical control points where non-target species can be removed. Documenting risks and methods used to remove non-target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits. A standard guide for conducting a HACCP evaluation is provided at the website included with the reference (HACCP-NRM 2009).

Navy Policy and Ballast Water Management

If it is necessary for a surface ship to load ballast water in an area that is either potentially polluted or within 3 nm from the shore, it is Navy policy for the ship to pump the ballast water out when outside an area 12 nm from shore and twice rinse the ballast tank(s) with clean sea water prior to the next entry within 12 nm of shore. Surface ships perform a ballast exchange twice in clean water, even if the ballast water was pumped out before exiting the polluted waters or 3 nm limit, as residual water remaining in a tank after emptying it may still contain unwanted organisms that could be transferred during the next ballasting evolution (Navy 2003).

This policy is based on the U.S. Coast Guard's (USCG) "Ballast Water Management for Control for Nonindigenous Species in Waters of the U.S." (33 Code of Federal Regulations [CFR] §151 Subpart D), which is applicable to all foreign and U.S. vessels, equipped with ballast tanks that enter a U.S. port. The USGC's published guidelines are based on guidelines developed by the Marine Environmental Protection Committee of the International Maritime Organization for the control of ship ballast water to prevent the introduction of unwanted aquatic organisms and pathogens. In addition, the Navy, in cooperation with U.S. Environmental Protection Agency (USEPA), fully complies with the Uniform National Discharge Standards. These Standards regulate discharges incidental to normal operations and apply to the ocean

water out to 12 nm. All vessels are required to maintain a ballast water management plan that is vessel-specific. The Vessel Master is responsible for understanding and executing the management plan (COMNAV Marianas 2007a).

11.1.5 North

11.1.5.1 Andersen Air Force Base (AFB)

Baseline marine biology information for the Andersen AFB study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.5.2 Finegayan

The following specific study area information is provided in addition to that presented in Section 11.1.4, Guam Regional Environment.

The northwest coast of Guam is steep and karstic, with limited marginal reef development. The coast faces west/northwest and thus it is relatively sheltered, with usually low to moderate wave impact and weak currents. Relatively narrow reef flats are developed along the northern portion of this coast, south to Falcona Beach, and again south of Ague Point. The central section of the northwest coast is largely devoid of reef flats, bounded mostly by narrow, supratidal (pertaining to the shore area immediately above the high-tide level) benches, or by rock faces lacking any reef protection.

Marine Flora, Invertebrates and Associated EFH

Off-shore habitat includes fringing, patch, submerged and barrier reefs, and offshore banks (COMNAV Marianas 2007a). Macroalgae lines the southern portion of the coast from Harmon Annex north to Haputo Beach; turf algae fringes the outer portions of the coral reef in the same area. The majority of the coral reef ecosystems offshore of Finegayan are included in the Haputo ERA, which extends offshore on Navy land to a depth of 121 ft (37 m) (Navy 2005). There are two small, localized reef flats (flat reef, usually exposed at low tide) located outside the ERA off Haputo Beach and inshore of Pugua Patch Reef or Double Reef, which is considered a coral area of special significance (COMNAV Marianas 2007a, NOAA 2005a). Double Reef is the most striking offshore feature along the entire northwest coast of Guam. It is an incipient (just beginning) barrier reef that breaks the surface (Amesbury et al. 2001). Double Reef, is one of Guam's few remaining examples of a healthy leeward fringing reef community and enhances this area as a nursery for species of subsistence and commercial fishery value (Navy 2005) (Figure 11.1-8).

Essential Fish Habitat

EFH-designated habitat areas for Finegayan would be the same as those described in Section 11.1.4. EFH in the Mariana Archipelago is defined for bottomfish, pelagic, crustaceans, and coral reef ecosystems (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off Finegayan are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 Federal Register (FR) 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished.

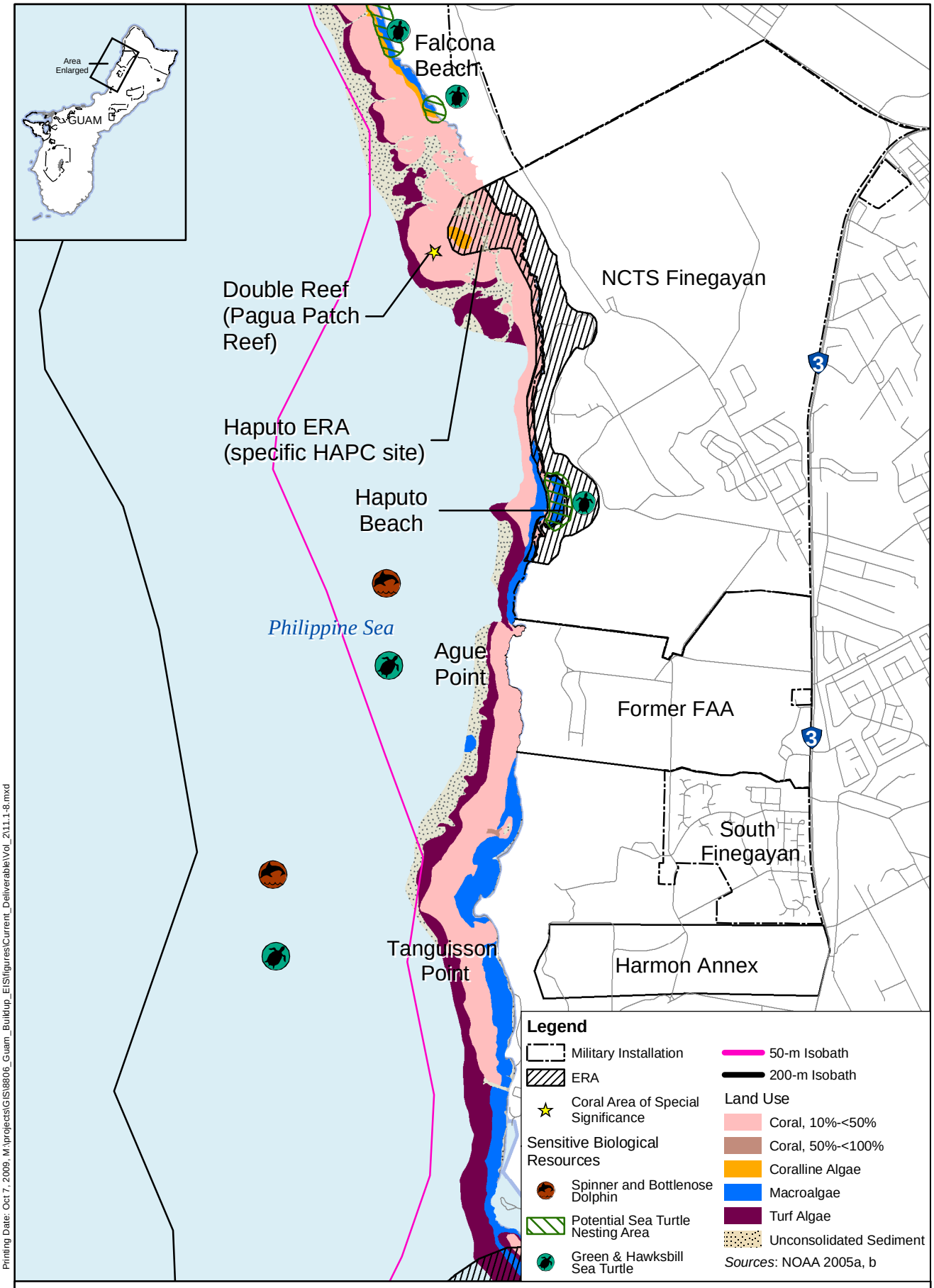


Figure 11.1-8
Sensitive Marine Habitats associated with NCTS Finegayan

Double Reef, an area noteworthy for its unusually high coral cover and coral diversity, lies on a shelf that extends considerably further from the coast than adjacent areas of forereef of Finegayan. The area around Double Reef is highly heterogeneous (varied), both because of topographic variation created by reef growth and the erosive action of the large freshwater aquifer discharge in the area, and because the bulk of Double Reef creates sufficient shelter in its lee to host a distinct backreef community. Otherwise, the fore reef of northwest Guam shows relatively little variation in macrohabitat, although fine-scale variation in benthic communities is widespread (Amesbury et al. 2001).

Coral cover around most of Guam is <20%, but in the Double Reef area it averages 46%. High coral cover on Guam is largely associated with reefs dominated by the weedy coral *Porites rus*. Such high cover *P. rus* reefs dominate Apra Harbor, and occur locally at a number of other locations around the island. Although *P. rus* dominated the reef tract immediately to the south of Double Reef, it was rare elsewhere. The high coral cover of the area is typical throughout, and not only of this locally *P. rus* dominated section (Amesbury et al. 2001).

Another noteworthy area is the reef front off Haputo Beach, where unusually large colonies of faviid and mussid corals dominate very high coral cover. No other site on Guam has been reported where such large coral heads, other than *Porites*, dominate cover. The lee of Double Reef supports highly heterogeneous coral communities, with patches of unusual corals (Amesbury et al. 2001).

Coral diversity of the area is very high, with approximately 60% of the known coral fauna of Guam encountered during a limited survey on this short reef section (Amesbury et al. 2001). In contrast to the great abundance and diversity of corals, the local fish fauna was depauperate (lacking species variety and not fully grown), of low population density, and had especially few fishes belonging to taxa targeted by fisheries. All these factors indicate that overfishing is a serious problem in the area. The Haputo ERA had considerably lower fish diversity and lesser abundance of large fish than the Orote-Agat reef section surveyed earlier (Paulay et al. 2000). Some of the differences between these areas are clearly the result of very different habitats. The southern Orote coast is washed by relatively strong currents that bring abundant food for fishes and also provides greater structural complexity with its dropoffs and giant boulder fields. Nevertheless, the low abundance of large fish in the Haputo ERA is striking (Amesbury et al. 2001).

There are six main macrohabitats supporting corals in the Haputo ERA within the 3 to 60 ft (1 to 18 m) water depth range: exposed benches, protected reef flats, Double Reef Top, the back reef, the shallow fore reef, and the deep fore reef. Macrohabitats on the fore reef 3 to 60 ft (1 to 18 m) in depth support more diverse assemblages of corals, macroinvertebrates, and fish than the three shallow macrohabitats. Corals, however, have the greatest diversity in shallow water on Double Reef. Coral cover ranged from 37 to 64% in the Haputo ERA. Coral cover is higher along transects taken at an 26 ft (8 m) depth compared to those taken at 50 ft (15 m), and coral species with the highest coverage in the Haputo ERA include *Porites* (deep area), *Montipora* (shallow area), and *Leptastrea* (Amesbury et al. 2001).

Specific macro- and micro-habitats are noteworthy for the diversity of unusual species they harbor. The reef front of Haputo Bay and the lee of Double Reef have already been mentioned for their striking coral communities. The back reef at Double Reef also holds a diverse cryptofauna (hidden or not easily detected). The caverns, fissures and frequently associated freshwater seeps along the steep portion of the coast from the north end of Haputo to Pugua Point are also noteworthy, they hold numerous species not previously seen on Guam, some of which may be endemic. These include crabs associated with freshwater seeps, sponges associated with the caverns, and likely numerous other species of cryptofauna (Amesbury et al. 2001).

Haputo ERA

The Haputo ERA, a specific EFH HAPC site, was established by the Chief of Naval Operations on March 15, 1984, as one of several mitigation measures implemented by the Navy to obtain approval from federal and Government of Guam (GovGuam) agencies for the construction of a munitions wharf (Kilo Wharf) at Adotgan Point in outer Apra Harbor, Guam. The ERA is 252 ac (102 ha) in area and consists of a terrestrial and marine unit. The 72-ac (29-ha) marine unit originates at the mean lower low water (MLLW) line and extends to the edge of the outer coral reef line to a depth of 120 ft (37 m) (refer to Figure 11.1-8).

Amesbury et al. (2001) documented 21% of the known marine fauna of Guam, approximately 4,500 species, within the Haputo ERA. These organisms consisted of 154 species of corals, 583 species of other macroinvertebrates (>0.4 in [1 cm]), and 204 species of fish. The 154 coral species found in the Haputo ERA correspond to approximately 60% of the coral species known on Guam, and the 204 fish species, 22% of the fish known on Guam. The marine unit of the Haputo ERA is therefore an area of relatively high biodiversity, yet because of overfishing, the fish in the ERA are not very diverse or abundant.

Shallow splash pools found on the exposed benches support low diversities of corals, fishes, and cryptic organisms. Shoreward of the benches and at the base of the cliffs are erosional notches created by wave action on the rock face where habitat-specific species of limpets, chitons, slugs, and shore crabs can be found. The seaward edge of the benches is a steep subtidal face typically burrowed by echinoids that supports corals, macroinvertebrates and fishes. A freshwater seep microhabitat associated with this area had three species not encountered elsewhere within the study area: the barnacle *Balanus eburneus* and two grapsid crabs. The crabs are likely undescribed and endemic to the Marianas (Amesbury et al. 2001).

Two narrow, protected reef flats off Haputo Beach and shoreward of Double Reef are intertidal habitats supporting numerous species that are found only in sheltered reef flat or shallow lagoon habitats, such as the coral *Pavona divaricata*, several species of hermit crabs and crabs, sea slugs, and sea cucumbers that can withstand the rigors of an exposed habitat. Corals and fishes are more common and diverse at the seaward margin of these reef flats (Amesbury et al. 2001).

The shallow forereef substrate within the Haputo ERA includes a steep reef front and gently sloping forereef starting at a water depth of 13 to 26 ft (4 to 8 m). Numerous cuts and channels normal to the shoreline run through the fore reef and create abundant structural complexity and increased biodiversity. Coral and macroinvertebrate diversity peaked at this macrohabitat, with 54 and 116 species, respectively. Three new sponge species that had not been seen elsewhere on Guam were also identified in this macrohabitat (*Neofibularia hartmani*, "yellow tough sponge," and "puff sponge") (Amesbury et al. 2001). Branching corals (*Acropora*, *Pocillopora*) dominate the 3 to 10-ft (1 to 3-m) depth range on the fore reef. Coral composition within the 13 to 30-ft (4 to 9-m) depth range varies within the Haputo ERA, including several areas dominated by encrusting species of *Montipora* while other areas are dominated by the massive *Porites*. The cryptofauna of the rubble fields is highly diverse and includes several species (*xanthid* crab *Atergatis granulates*, the flatworm *Pseudoceros bimarginatus* and the hermit crab *Pylopaguropsis kiejii*). The ahermatypic coral, *Dendrophyllia gracilis*, a rare coral species on Guam, was observed in one of the small caverns (Amesbury et al. 2001).

The two fish species of concern (and CHCRT MUS), the napoleon wrasse and humphead parrotfish, may be found offshore of Finegayan associated with the Haputo ERA; however, these two species were not identified in biodiversity checklist surveys (Amesbury et al. 2001).

The ESA-listed green sea turtle utilizes the Haputo Beach as nesting habitat (NOAA 2005a, Navy 2005). The Haputo ERA is popular with the public for hiking, wildlife viewing, crabbing, fishing, and beach-combing.

Special-Status Species

The threatened green sea turtle nests on beaches in the area and can be anticipated in nearshore waters. The endangered hawksbill sea turtle has been recorded nesting near Achae point (north of this area) and as far south as Falcona Beach, and could be expected in the coastal waters. No other marine ESA-listed species are known to frequent the area (Navy 2005, COMNAV Marianas 2008).

Spinner dolphins occur in relatively high concentrations (pod sizes of ~100) and bottlenose dolphins are identified as present in the coastal waters (Navy 2005, NOAA 2005a) (refer to Figure 11.1-8).

Non-Native Species

Only 23% of the nonindigenous species recognized by Guam have been found in natural habitats outside Apra Harbor: six introduced and 14 cryptogenic species. These include three purposeful introductions: two brackish-water fish species and the gastropod *Trochus niloticus*. This gastropod species is now abundant around Guam and is the basis of a local fishery. Fifty percent of the nonindigenous species that have been encountered outside Apra Harbor are ascidians (sea squirts), none of which are abundant. Cryptic hydroids (related to jellyfish, sea anemones and corals) common outside Apra Harbor include *Pennaria disticha* and *Thyroscyphus fruticosus* (Paulay et al. 2002).

Non-invasive species information is lacking for this specific study area.

11.1.5.3 Non-DoD Land

Baseline marine biology information for the Non-DoD Land study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.5.4 Off Base Roadways

The proposed actions include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

Marine biological resources considered in the analysis of the proposed roadway improvement projects include (1) Marine Flora, Invertebrates and Associated EFH, (2) Essential Fish Habitat, (3) special-status species, and (4) invasive species. These resource definitions are analyzed within areas where the construction and use of proposed road projects could directly or indirectly affect marine resources. Figure 4.1-6 in Volume 4, Chapter 4.1.2.4 presents a map of the surface waters and affected watersheds in each region of the proposed roadway projects that discharge to coastal areas.

The proposed roadway projects in the North Region include pavement strengthening and road widening, as well as access point construction for facilitating access to Finegayan and Andersen AFB. None of the proposed roadway improvement projects within the North Region are located near or are anticipated to affect marine biological resources; therefore, no affected environment component pertains to marine biological resources within this region associated with the proposed roadway improvements projects.

Because of the high permeability of the limestone substrate, no perennial streams exist on the northern end of the island. Runoff from roadways usually sheet flows off the pavement to grassy swales or flat strips of grass, and the runoff from the roadway is generally filtered prior to its conveyance to offsite drainages. Volume 4, Chapter 4, Water Resources provides a detailed description of the surface water resource environment that would be impacted by the proposed roadway improvement projects.

11.1.6 Central

11.1.6.1 Andersen South

Baseline marine biology information for the Andersen South study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.2 Barrigada

Baseline marine biology information for the Barrigada study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.3 Non-DoD Land

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. The proposed training activities associated with Route 15 Range Lands does not contain any surface water resources (refer to Volume 4, Figure 4.1-2). Impervious areas on the Route 15 parcel amount to 71 ac (28.73 ha), or 3.5% of the total Route 15 project area of 2,031 ac (822 ha). The Route 15 Range Lands may include increased access to the shoreline areas by foot and boat, and the presence of range surface danger zones (SDZs) that extend over the coastal waters. Therefore, this study area has been analyzed for potential threat to the resources below, especially special-status species that may occur in waters off-shore.

Marine Flora, Invertebrates and Associated EFH

The coastline off the Route 15 Range Lands consists of exposed rocky shores and an intertidal bench providing habitat for many intertidal invertebrate species including octopus, sea cucumbers, swimming crabs, slipper and spiny lobsters. Little evidence of marine flora (seagrasses, macro algae, or turf algae) is seen in the area (NOAA 2005a).

Coral communities and reefs are exposed to dominant trade winds, strong wave action, and storms (including typhoons). From Pagat Point south to Taguan Point coral reef and colonized hard bottom (live coral 10 to 50%) are present seaward of the exposed wave-cut platforms. Corals found above the 100-ft (30-m) isobath in this area typically include encrusting or massive growth forms of corals as well as columnar, platy and branching growth forms conditioned to withstand heavy wave action and would recover if damaged (Navy 2005).

Exposed windward reef fronts are dominated by three growth forms of *Acropora*: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

Essential Fish Habitat

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off Route 15 are used for commercial, recreational or subsistence fishing has not been determined.

Site-specific information is limited for this study area (Pagat Point); however, general fish and abundance would be similar to those described in Section 11.1.4, and include a host of juvenile and adult fish and invertebrate MUS with year round residence.

Special-Status Species

There are no reported sea turtle nesting beaches or foraging areas in this vicinity based on NOAA (2005a) mapping; however, green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters. The nearest reported nesting beach from Pagat Point is located south of Pago Bay, approximately 5 mi (8 km) away. The nearest potential foraging area appears to begin at Tanguan Point approximately 2 mi (3 km) south.

There are no regularly reported marine mammals offshore of this study area, however spinner dolphins (pod sizes ~80) are reported in association with the Pati Point reserve and south past Anao Point, approximately 2 mi (3 km) north of Pagat Point (NOAA 2005a). Their range could be expected to extend south to the offshore waters of the study area. As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam. The bathymetry off this coast transitions rapidly through the island-arc margin toward the trench system (Navy 2005). The 655-ft (200-m) isobath is within 1 mi (1.6 km) of the shoreline just southeast of Pagat Point. Consequently, the marine mammals that normally inhabit oceanic waters may be present closer to the shoreline off Pagat Point. These additional species are identified on Figure 11.1-9.

Non-Native Species

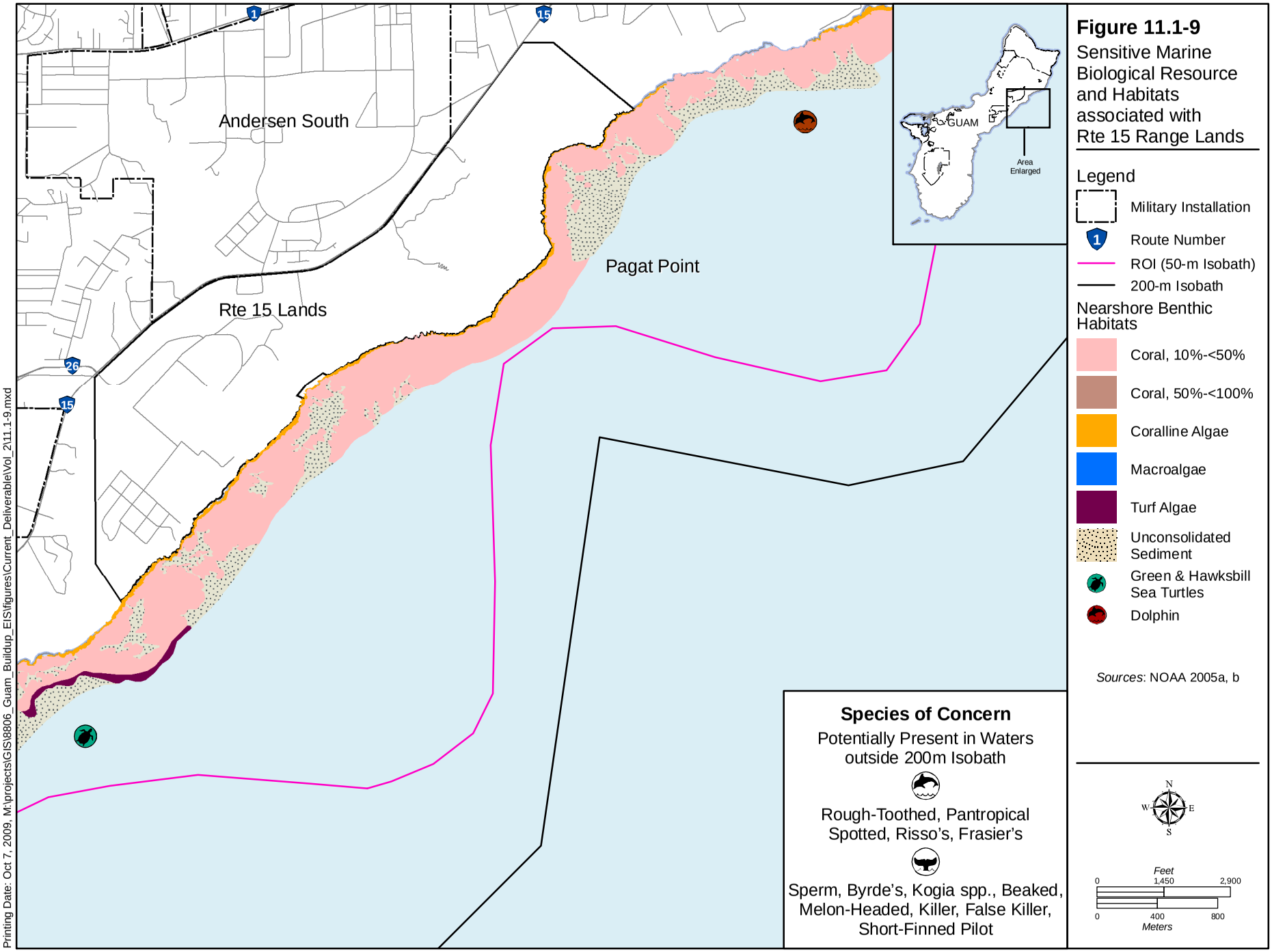
Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that this coastline has seen minimal impact from non-native species due to the distance from Apra Harbor; however, data are limited.

Piti/Nimitz Hill

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. Baseline marine biology information for the Piti/Nimitz Hill study area was analyzed commensurate with the land-based road construction projects (e.g., bridge replacement) along Route 1, which may affect the nearshore marine environment (see Section 11.1.6.4 for details). There is no in-water or land-based training activities proposed that would affect the marine environment.

Marine Flora, Invertebrates and Associated EFH

The three embayments (Piti, Asan and Agana Bay) along this coastline have similar benthic habitats consisting of a nearshore unconsolidated sediment (sandy, uncolonized 90-100%) intermixed with rubble, seagrass, macroalgae and coral as you continue offshore. The coral communities are approximately 1,650 ft (500 m) from the Fonte and Agana Rivers where bridge replacement projects would be occurring (NOAA 2005b). These areas, including the Piti Bay MPA provide habitat for intertidal invertebrate species including octopus, sea cucumbers, swimming crabs, giant clams, and spiny lobsters (NOAA 2005a).


Andersen South
Rte 15 Lands
Pagat Point
GUAM
Area Enlarged
Figure 11.1-9
Sensitive Marine Biological Resource and Habitats associated with Rte 15 Range Lands
Legend
Military Installation
Route Number
ROI (50-m Isobath)
200-m Isobath
Nearshore Benthic Habitats
Coral, 10%-<50%
Coral, 50%-<100%
Coralline Algae
Macroalgae
Turf Algae
Unconsolidated Sediment
Green & Hawksbill Sea Turtles
Dolphin
Sources: NOAA 2005a, b
Species of Concern
Potentially Present in Waters outside 200m Isobath
Rough-Toothed, Pantropical Spotted, Risso's, Frasier's
Sperm, Byrde's, Kogia spp., Beaked, Melon-Headed, Killer, False Killer, Short-Finned Pilot
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
Printing Date: Oct 7, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-9.mxd

Essential Fish Habitat

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off this area are used for commercial, recreational or subsistence fishing has not been determined.

General fish and abundance would be similar to those described in Section 11.1.4, and include a host of juvenile and adult fish and invertebrate MUS with year round residence. High concentrations of fish species noted include juvenile rabbitfish (April and May), adult bigeye scad (June – December), giant manta rays (January - December). The humphead parrotfish is reported within Piti Bay MPA (NOAA 2005a, and Figure 11.1-10).

Special-Status Species

There are no reported sea turtle nesting beaches. Green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters and the seagrass beds provide potential foraging habitat (NOAA 2005a and Figure 11.1-10).

Spinner dolphins (pod sizes ~80-100) may be present in coastal waters (NOAA 2005a). As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam.

Non-Native Species

Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that Piti Bay has seen additional influence from non-native species due to the canal connecting the power plant near the commercial port at Apra Harbor to Piti Bay; however, data are limited.

11.1.6.4 Off Base Roadways

The proposed actions include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

The central region covers a relatively large area of the island that encompasses two different hydrologic regimes – the northern broad sloping limestone plateau in the north area and the southern mountainous region composed of eroded volcanic formations in the south area. Descriptions of potentially affected coastal water resources have therefore been split into the northern and southern parts of the central region. Roadway projects located in the north central area include improvements along Routes 1, 8, 8A, 10, 15, 16, 26, and 27. Roadway projects in the south central area include improvements to several bridges along Route 1 along the west side of the island.

Specifically, roadway projects in the Central Region include pavement strengthening, road widening, intersection improvements, and bridge replacements (on Route 1), as well the rerouting of Route 15. The proposed new location of Route 15 would redirect the road onto Department of Defense (DoD) property (Andersen South) so that the public road would not be within any firing range danger zones. These projects include: (1) pavement strengthening between Asan River and Route 11 along Route 1; (2) pavement strengthening between Asan River and Route 6 along Route 1; (3) pavement strengthening between Route 6 and Route 4 along Route 1; (4) pavement strengthening between Route 6 and Route 4 along Route 1; and (5) the replacement of bridges over the Atantano, Laguas, Agana, Sasa, and Fonte rivers.

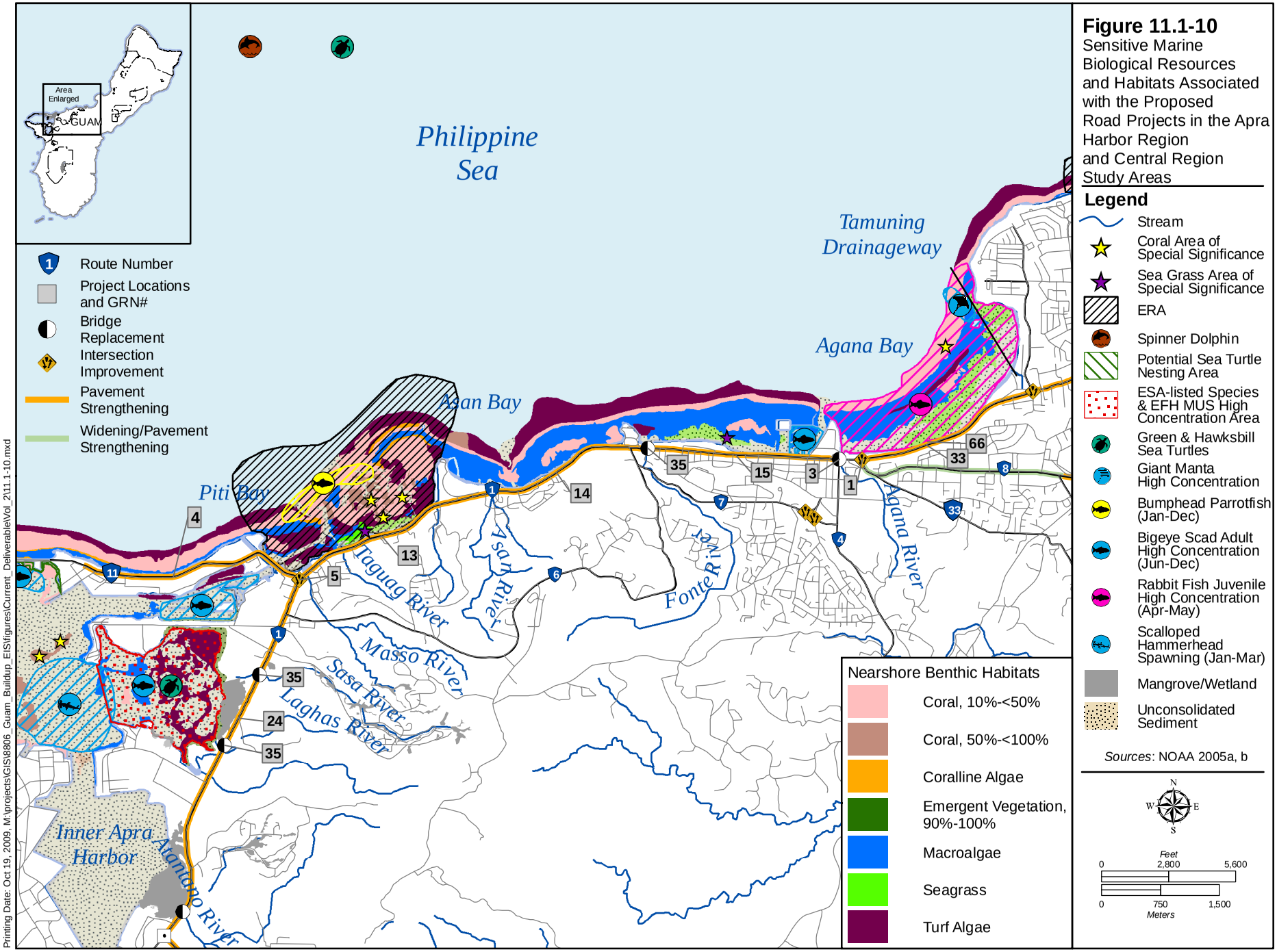


Figure 11.1-10
Sensitive Marine Biological Resources and Habitats Associated with the Proposed Road Projects in the Apra Harbor Region and Central Region Study Areas

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The north central region has similar characteristics to those of the North Region, with few streams and several sinks. In general, new development in this area is required to treat surface water generated from impervious surfaces by utilizing BMP treatment schemes, such as oil water separators and detention basins that allow pollutants and settleable solids to separated and settle out prior to entering a storm drainage system, to protect surface, ground and coastal waters. Other roadways in this area are curbed and convey concentrated flow to low points in the roads that connect directly to some of the sinks located in the vicinity. There are no coastal resources or coastal barriers near the roadway projects in the north central area.

Proposed Guam Road Network (GRN) projects within the southern part of the central region are generally on the west side of the island characterized by eroded volcanic formations with streams that are short with steep gradients and drainage areas of less than 3 mi^2 (777 ha) each. These streams are generally deeply channeled within the volcanic slopes that outlet into shallow fringing coral reefs at the mouths of the streams. Route 1 is located very close to the mouths of several of these streams that outlet into several bays connected to the Philippine Sea or Apra Harbor in the Piti/Nimitz and Apra Harbor areas.

Figure 11.1-10 identifies road projects locations and GRN# (see Volume 6, Section 13.2.6 for GRN# details), including bridge replacements over streams, with respect to sensitive marine biological resources in the nearshore environment. The streams and outlets include: (1) the Agana River that outlets into Agana Bay; (2) the Fonte River that outlets into Hagatna Bay; (3) the Asan River with two tributaries that outlet into Asan Bay; (4) the Matgue, Taguag, and Masso Rivers that outlet into Piti Bay; (5) the Sasa, Laguas, and Aguada Rivers that outlet into the Sasa Bay Marine Preserve; and (6) the Atantano and Apalacha Rivers that outlets into the Apra Inner Harbor. See Volume 4, Chapter 4.1.3.4 for the field investigation descriptions of issues with the nine bridges and figures/photos associated with these structures. Erosion along the upstream side of these bridges is common and contributes to downstream sedimentation that is a continual issue along the shoreline. Sediments have been found to contain heavy metals, such as copper and zinc, in Agana (Hagatna) Bay.

There are no areas subject to the Coastal Barrier Act near the roadway projects in this area. Coastal resources within this area include (1) Agana Bay, located at the outlet of the Agana River and Tamuning Drainageway; (2) Asan Bay, located at the outlet of the Asan River; and (3) Piti Bay, located at the outlet of the Masso and Taguag Rivers. These areas are within the Coastal Zone Management Program (GEPA 2000) and fall under Section 309 of the CZMA, which evaluates and regulates dredging activities within the harbors and bays of Guam.

As shown in Figure 11.1-10, Route 1 parallels the coastline from Apra Harbor northward to Agana Bay. Along this section of roadway, several locations are designated within Federal Emergency Management Agency (FEMA) Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or riprap slope protection (See Volume 4, Figure 4.1-23 and 4.1-24).

11.1.7 Apra Harbor

11.1.7.1 Harbor

Apra Harbor, located along Guam's southwestern coast, is the largest and busiest U.S. deepwater port (>100 ft [33 m] deep) in the Western Pacific and Micronesia. Orote Peninsula borders most of the southern boundary of the outer harbor while the Glass Breakwater and Cabras Island form the northern borders.

The Glass Breakwater was constructed in 1944 of 2 million cubic yards (1.5 million cubic meters [m^3]) of soil and coral extracted from adjacent Cabras Island. This totally altered the barrier reef system by restricting the exchange of water between Apra Harbor and the open ocean. With an average height of approximately 15 ft (4.6 m) above mean sea level, it is the largest artificial substrate in the Marianas (COMNAV Marianas 2007a). In addition, fill operations that developed Dry Dock Island, Polaris Point and artificial shorelines of the northeastern and southeastern boundaries also altered the lagoon (Paulay et al. 1997).

For the purposes of this EIS/OEIS Apra Harbor was divided into two study areas: Outer Apra Harbor (including Sasa Bay), and Inner Apra Harbor. The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment.

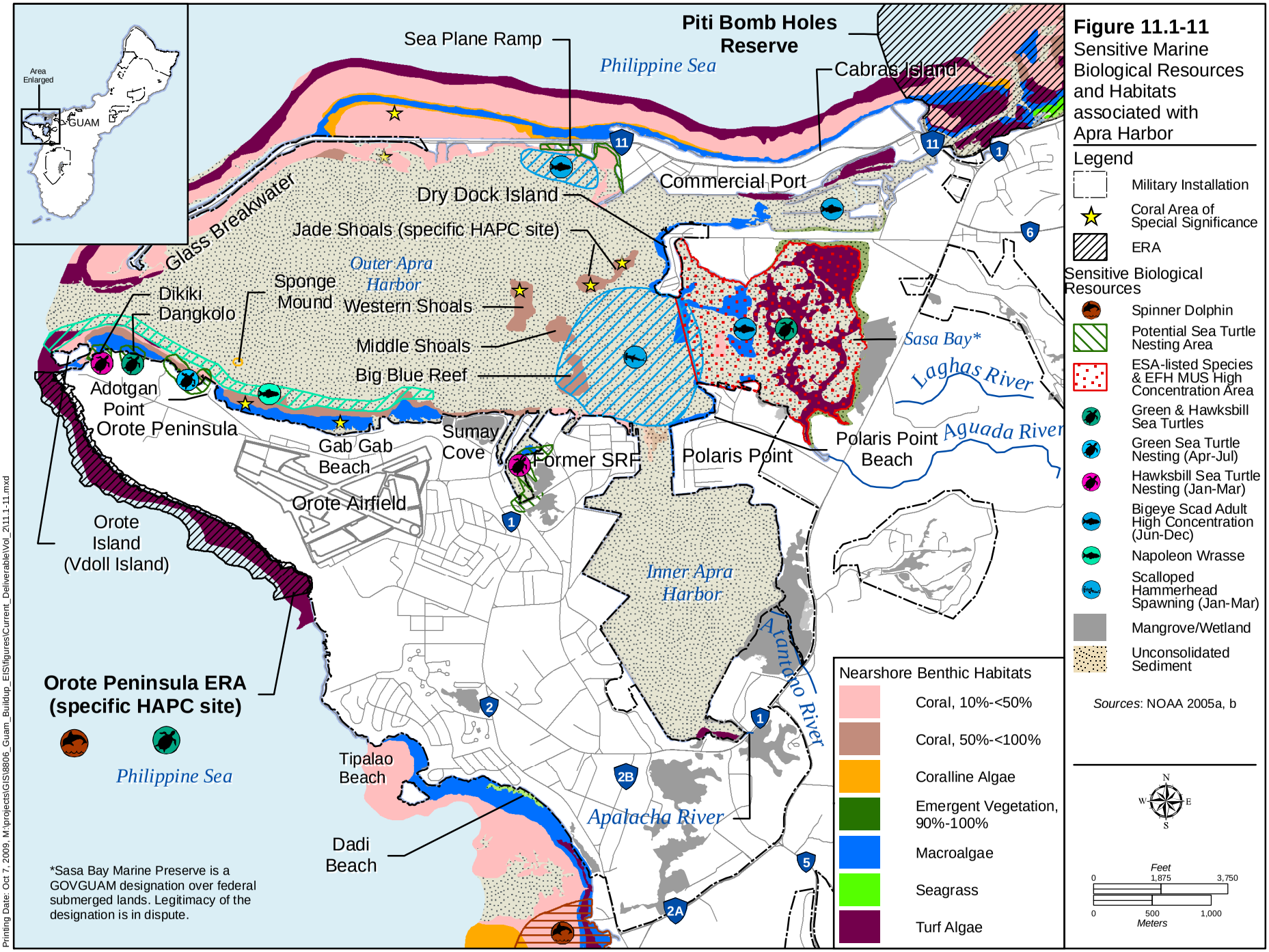
Outer Apra Harbor and Sasa Bay

In spite of the alterations to the harbor since the liberation of Guam during World War II, the outer harbor "…holds a vibrant and thriving marine community, including well-developed reefs with some of the highest coral cover on Guam, and a diverse biota of algae, invertebrates and fish. In this regard the harbor is unlike most other major ports, which tend to become greatly degraded for marine life" (Paulay et al. 1997). In addition, the outer harbor supports diverse populations of macro-invertebrates, finfish and moderate numbers of the threatened green sea turtle (COMNAV Marianas 2006b).

Outer Apra Harbor contains the port operations for both the Navy and civilian commercial port, which is currently operated by the GovGuam. In addition, the outer harbor has fringing and patch reefs with some of the highest percentages of coral cover on the island, and these reefs are important recreational sites for residents and tourists alike. The Port Authority of Guam maintains the Commercial Port of Guam facilities on Cabras Island. Much of the remainder of the outer harbor contains both port and recreational facilities owned by the Navy. The outer harbor supports well developed reefs, with diverse populations of algae, macro-invertebrates, fish and moderate to high numbers of the threatened green sea turtle (Paulay et al. 1997) (Figure 11.1-11).

Sasa Bay, located in the eastern portion of the outer harbor, is a shallow estuarine lagoon containing patchy corals and an extensive mangrove habitat. Sasa Bay's waters are generally extremely turbid because of rivers emptying fine sediments into the bay. The bottom substrate is mostly fine muds to rocky and sandy habitats (Scott 1993). GovGuam has set aside over 10% of Guam's coastline in five marine preserves, one of which is Sasa Bay. The Sasa Bay Marine Preserve Area (1.2 mi^2 [311 ha]) extends from Dry Dock Island to Polaris Point and ends at the public right of way bordering Marine Corps Drive (Route 1). Route 18 runs along its northern end while the road to Polaris Point borders its southern end. Although the southern portion of Sasa Bay is within the Navy's submerged lands, the Navy does not recognize its preserve status (COMNAV Marianas 2007a) (see Figure 11.1-11).

Sasa Bay contains a large, diverse mangrove habitat, one of few such habitats on Guam. Mangroves are typically found in estuaries or shores protected from the open ocean throughout the tropical and subtropical regions of the world (Scott 1993). They are composed of salt-tolerant woody trees and shrubs and other plant species and provide habitat for both marine and terrestrial life. Species diversity tends to be high in functioning mangroves. Mangrove habitats, like seagrass beds, can also act as water filters by removing sediments and nutrients from waters that flow through them. When mangroves are not functioning properly, sediments and nutrients flow into and can damage fragile coral reef ecosystems (Scott 1993). This may account for the limited coral habitat (4.5 ac [2 ha]) in Sasa Bay. Two rivers, the Sasa and Aguada Rivers, dump large quantities of sediment-laden water into the bay, which lowers visibility and overwhelms most corals (GDAWR 2006).



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There are 125.3 ac (50.7 ha) of mangrove forests on 10 sites on Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of the Inner Apra Harbor. There are four mangrove areas near Abo Cove at the southern tip of the Inner Apra Harbor, two mangrove sites near Dry Dock Island, two more sites near Polaris Point and one mangrove area along the southern shore of Apra Harbor (Navy 2005 (see Figure 11.1-11).

Sasa Bay is also a loafing and feeding habitat for migratory shore birds and is visited by foraging green sea turtles and hawksbill sea turtles, both of which are ESA-listed species and reported in high concentrations (NOAA 2005a). Estuarine areas like Sasa Bay are particularly important to both the native land hermit crabs and coconut crabs, both of which begin life in the sea. Adult females return to the sea to lay eggs. After a planktonic larval stage, small crabs emerge from the ocean to live on land (COMNAV Marianas 2001).

Estuarine communities (e.g., mangroves/wetlands) are described further under the Essential Fish Habitat section below, and Volume 2, Chapter 10, Terrestrial Biological Resources.

A detailed descriptive tour of Outer Apra Harbor benthic habitats can be found in Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary. The descriptive tour begins with the Glass Breakwater on the north, continuing to the south in the area from Orote Point to the Entrance Channel of Inner Apra Harbor, and finally to the mounds and shoals (e.g., Big Blue Reef, Middle Shoals, and Western and Jade Shoals) located throughout the lagoon (Navy 2005).

Marine Flora, Invertebrates and Associated EFH

Outer Apra Harbor provides habitats for unique and diverse coral reef ecosystems and floral communities. For example, most of the sponges and ascidians found in Apra Harbor, 48 species of sponges and 52 species of ascidians, are unique to Apra Harbor, and many are indigenous native to Guam. Indigenous (native) species generally occupy natural substrates while introduced and cryptogenic species generally occupy artificial substrata (e.g., wharf walls, concrete revetments, moorings, and navigational buoys). Some of the species (one sponge and 16 ascidians) were introduced via ship traffic (Paulay et al. 1997). Macroalgae species are dominant around the perimeter of Outer Apra Harbor, but are present on the shoal areas. These species are discussed further under special-status species as potential foraging habitat.

Essential Fish Habitat

EFH-designated habitat areas for Outer Apra Harbor are the same as those described in Section 11.1.4, Guam Regional Environment (refer to Figure 11.1-3 through Figure 11.1-7). Accordingly, all of Apra Harbor has been designated an EFH, including Sasa Bay on its eastern edge. Jade Shoals, approximately 4,692 ft (1,430 m) north of the entrance channel, is a Specific HAPC Site. The extent to which Apra Harbor and coastal waters outside the harbor are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 FR 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished (COMNAV Marianas 2007b) (see Figure 11.1-11).

In Apra Harbor, the commercial port area contains the highest levels of zooplankton with copepods dominating. Other organisms in the harbor include finfish larvae, decapod zoeae (free-swimming larvae), and pteropods (ocean gastropod mollusk) (Navy 2005).

Along the southern boundary of Apra Harbor between Orote Point and Gab Gab Beach, including areas east and west of Kilo Wharf, coral cover on fringing reefs is high (Smith 2004b, NOAA 2005a) as described in detail in the Apra Harbor Benthic Habitat Summary in Volume 9, Appendix G. The areas

adjacent to Kilo Wharf are close to 100% coral cover, consisting mainly of *P. rus* (>90% of the cover) and other stony corals including *P. lichen*, *P. lobata*, *Platygyra pini*, *Leptoseris* spp., *Lobophyllia corymbosa*, and *Acanthastrea echinata*. Reefs located further in the harbor (excluding the Inner Apra Harbor) have been severely impacted by freshwater runoff, siltation, and polluted discharges (Smith 2004b, Navy 2005).

Sasa Bay and the mangroves provide refuge for high concentrations of many species, and serve as nursery grounds for jacks, barracudas, snappers, and groupers, as well as numerous burrowing invertebrates including bivalves, small crabs and worms.

NOAA (2005a) identifies two sensitive fin fish MUS: the adult bigeye scad, in seasonally high (June – December) at two locations within Apra Harbor; and the scalloped hammerhead, which occurs during seasonal spawning (January – March) at one location extending from the entrance channel to the western edge of Big Blue reef, north to Jade Shoals (a HAPC), and easterly into Sasa Bay (refer to Figure 11.1-11). The hammerhead spawning is reported to be extremely rare (personal communications with Steve Smith, [Navy 2009c]). In addition, the shoal areas, which contain numerous CREMUS including high live coral coverage (50% to <100%) and coral areas of special significance, fringe the navigational channel bend and fairway for the approach into Inner Apra Harbor. The six coral areas of special significance within Outer Apra Harbor, were designated by NOAA resource experts as those areas that should be highly prioritized for protection following spills due to various reasons (e.g., species diversity, abundance of soft coral species, high percent cover, sensitive habitat for fish/invertebrates, having structure-building potential that may lead to high diversity/high coral cover in the future, etc.) (NOAA 2005a).

Special-Status Species

In general, the threatened green sea turtle is frequently sighted in Apra Harbor, while the endangered hawksbill sea turtle has been recorded occasionally. The green and hawksbill sea turtles are the only special-status species reported in Apra Harbor.

Sea turtles have been observed to nest during all months of the year on Guam, however the peak of nesting activity occurs from April to July. Sea turtles nesting activity has been reported from three Apra Harbor locations: Adotgan Dangkolo (Dangkolo) (green sea turtles), Adotgan Dikiki (Dikiki) (hawksbill sea turtle), and Kilo Wharf (green sea turtle) (COMNAV Marianas 2008). Historic records of sea turtle nesting include a hawksbill reported at a beach near Sumay Cove in 1997 and a general report of nesting at a beach near the Sea Plane Ramp (COMNAV Marianas 2007b) (refer to Figure 11.1-11Figure 11.1-11). No activity has occurred at these areas since this reported event (COMNAV Marianas 2008, Navy 2009b). In general, turtles nest and hatch at night. They cue in on natural light to orient toward the ocean; however the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings into orienting away from the open ocean (COMNAV Marianas 2007b).

During Smith (2007) survey dives in the eastern Apra Harbor area, no hawksbill turtles were observed. Nine green sea turtles were observed, five of which were on Big Blue Reef. All turtles sighted were between 15 to 23 in (40 to 60 cm) in length, with no visible fibropapilloma tumors or other signs of injury. Balazs et al. (1987) identified ten genera of algae that he considered preferred forage for green sea turtles in Hawaii. Although algal surveys were not conducted, Smith (2007) suggests that more potential sea turtle resting habitat and preferred algal forage species were present on Big Blue Reef and the Fairway areas, where most turtle sightings occurred. Preferred forage genera observed included: Chlorophyta (green algae), *Dictyospheria* and *Ulva;* Phaeophyta (brown algae) *Sargassum;* Rhodophyta (red algae) *Gracillaria, Jania, Hypnea, Acanthophora* and *Laurencia.* Green sea turtles are probably

opportunistic feeders; however, within preferred food items listed above, three specific species (*dictyospheria versluysii, Sargassum obtusifolium and Acanthophora specifera)* have been reported from Guam (Lobban and Tsuda 2003) and were tentatively field identified on Big Blue Reef west and the Fairway Shoals. During the observation periods, none of the algae listed above were abundant at any of the study sites.

Spinner and common bottlenose dolphins are not expected to regularly occur within Apra Harbor (Navy 2005, NOAA 2005a). However, according to Roy Brown (personal communication, September 2007), spinner dolphins are noted on a rare, but somewhat regular basis within Apra Harbor. Brown runs dolphin tours throughout Guam's waters and estimates that spinner dolphins are seen up to four times a year within the outer harbor, as they enter the harbor in a small group for a few hours and then exit (COMNAV Marianas 2007a).

Critical Habitat

There is no critical habitat designation for any marine species on Guam.

Non-Native Species

Guam, particularly Apra Harbor, has been invaded by numerous nonindigenous species. However the spread and impact of the nonindigenous species to outside areas on Guam have been relatively limited. These species are relatively rare on natural reef bottoms, but abundant on artificial substrata (Paulay et al. 2002).

Opportunities for ballast transport of nonindigenous species has been fairly limited, and hull transport appears to have been the predominant avenue of invasion identified in Apra Harbor. A study of the fauna associated with two dry docks hauled from Hawaii and the preponderance of sessile organisms supports this conclusion (Paulay et al. 2002).

Paulay et al. (2002) recognized 85 nonindigenous species on Guam (see Volume 9, Appendix G). Forty-one species can be categorized as introduced and 44 as cryptogenic (unknown origin). Fourteen percent represent purposeful introductions, the rest accidental. Sessile organisms comprise 76% of the total and 86% among accidental introductions. Sessile nonindigenous species include numerous sponges, hydroids, anemones, bivalves, barnacles, bryozoans, and ascidians. Over half of these nonindigenous species (46) were restricted to artificial substrata (e.g., moorings, wharf structural supports, etc.).

Paulay et al. (2002) noted the lack of spreading to areas outside the harbor of well-established species in Apra Harbor, such as the Caribbean barnacle and the sponge *Ianthella basta*. The differences between invasion and impact on Guam and those in other locations (e.g., Pearl Harbor) is associated with several factors: shipping traffic is lower; Apra Harbor's reefs are still relatively intact with a diverse community, and therefore resistance to invasion by nonindigenous communities is higher. This was also observed by Lambert (2002), who found nonindigenous ascidians were extremely abundant on artificial surfaces in harbors and marinas around the world, however they rarely colonized adjacent natural benthic ecosystems. She also noted, along with Paulay et al. (2002), the specific confinement of nonindigenous ascidians to Apra Harbor without significant colonization on the outside reefs. This is quite different from other harbors and marinas around the world (e.g., Pearl Harbor, San Francisco Bay), where coastal areas have been invaded by nonindigenous species (Paulay et al. 2002, Lambert 2002).

Inner Apra Harbor

Inner Apra Harbor is a natural embayment formed by tectonic activity along the Cabras Fault, separating the volcanic Tenjo Block in central Guam from the limestone Orote Block immediately to the west. Two

rivers, the Apalacha and Atantano, drain the volcanic mountain land to the east of Apra Harbor and discharge into the inner harbor waters (Randall and Holloman 1974).

Although naturally formed, Inner Apra Harbor was dredged in the 1940s and used exclusively by the Navy. The only portion of the inner harbor remaining unchanged is the mangrove area at the mouth of the Atantano River (Smith et al. 2008). Inner Apra Harbor is approached through the Inner Apra Harbor entrance channel between Polaris Point and the former Ship Repair Facility (SRF), which allows entrance by vessels with a maximum draft of 33 ft (10 m). The eastern side of the entrance channel extends for approximately 1,804 ft (550 m) while the western side extends approximately 1,312 ft (400 m). The width of the entrance channel is 984 ft (300 m). The bottom of the inner or southern portion of the entrance channel is comparable to the floor of the inner harbor and is composed of fine calcareous sand. Moving seaward in a northerly direction the channel sediments become increasingly coarse, rock outcrops appear and hard corals become more common (COMNAV Marianas 2007b).

Inner Apra Harbor was dredged to a maximum depth of approximately 36 ft (11 m) in the 1940s. More recent maintenance dredging in 1978 and 2004 has maintained the original dredged depths that allow for safe navigation by seagoing vessels. Primarily because of the original and continued dredging, Inner Apra Harbor is dramatically different from Outer Apra Harbor. While Outer Apra Harbor supports a diverse community of corals, algae, fish and other organisms, Inner Apra Harbor is relatively devoid of marine life (COMNAV Marianas 2006b).

Marine Flora, Invertebrates and Associated EFH

The floor of Inner Apra Harbor is composed predominantly of sticky, fine sand and silty/muddy-type sediment that is easily resuspended (Smith et al. 2008). Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel. The closest area to the Inner Apra Harbor where corals occur on the seafloor is in the outer reaches of the entrance channel of the Inner Apra Harbor as described above. In this area corals present include P. rus and P. cylindrica (Navy 2005). Corals, both soft and hard, algae and most other sessile organisms require hard substrata on which to attach. The lack of hard substrata on the floor of the inner harbor may explain the lack of these groups (COMNAV Marianas 2006b). For further detail on the Inner Apra Harbor Entrance Channel habitat, please see Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary.

Although the fine silty sediment bottom of the inner harbor contains little life other than burrowing organisms, corals and other sessile fouling organisms are found growing on the upper half of vertical hard surfaces such as metallic sheet piles and concrete walls. Randall and Holloman (1974) reported living Pocillopora and Porites corals on the wharf and dock structures in the inner harbor. Paulay et al. (1996) found that artificial surfaces in the inner harbor supported diverse fouling communities, including both indigenous and introduced species. They noted the presence of Porites convexa, known in Guam from only a few locations. They also remarked on the abundance of the hammer oyster on wharf faces in Inner Apra Harbor. Three species of hard corals are dominant on these vertical surfaces: Porites rus, P. lutea and Pocillopora damicornis, all of which are common on Guam's reefs. These vertical surfaces act like artificial reefs and provide the hard substrata needed for attachment (COMNAV Marianas 2006b). These coral species were also found encrusting rocks and concrete debris, in addition to sheet pilings (Navy 2005).

A 2008 marine benthic survey of Inner Apra Harbor recorded 70 benthic taxa. Twenty eight of these species were corals and related organisms. Species richness was highest at X-ray Wharf, where eight

species occurred on the transect; only four species occurred at the other wharves and Abo Cove. Few corals were present on the inner harbor floor transects, and only small colonies of Porites lutea were observed on scattered pieces of debris and old pilings that provided the only hard substrata available for larval attachment. Thirty species of solitary macroinvertebrates were encountered; all were suspension feeders but three, those being detritus feeders. The greatest diversity was found at Victor Wharf, where bivalve mollusks and ascidians dominated in terms of diversity and density. These numbers, along with average species richness were low compared to results of similar surveys in other areas (Smith et al. 2008).

The most 'natural' site (Abo Cove) is significantly less taxon-rich than the wharf sites due to its mostly flat sediment-covered bottom and highly turbid conditions. Large specimens of Caulerpa verticillata, a green alga that copes well with increased sedimentation levels and low salinity, were found in Abo Cove, probably a result of relatively low herbivore pressure. The distribution of the seagrass species Halophila japonica also seems to be restricted to Abo Cove (Smith et al. 2008).

The benthic assemblages of the wharves contain interesting but very different taxa from Abo Cove. For example, the very abundant Celleporaria sibogae and the rather uncommon Lichenopora sp. are most likely new bryozoan records for Guam, although this group has been virtually unstudied in the region (Paulay 2003a).

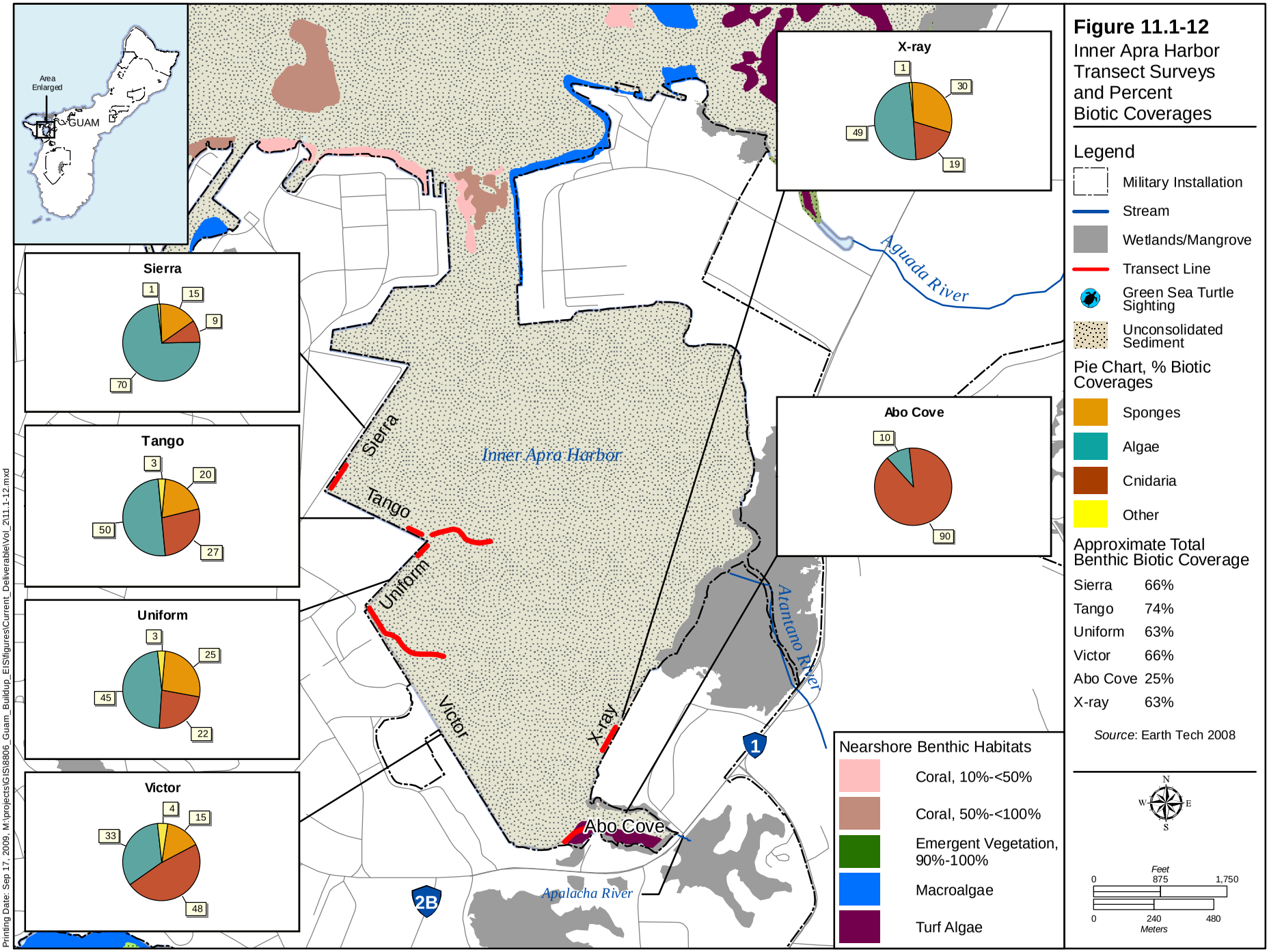
Corals represent the majority of biotic assemblages at Abo Cove, while the wharves predominantly include encrusting macroalgae and sponges (Smith et al. 2008) (Figure 11.1-12).

Essential Fish Habitat

EFH-designated habitat areas in Inner Apra Harbor are described in Section 11.1.7.1, Outer Apra Harbor. All of Apra Harbor is considered EFH; however, neither Inner Apra Harbor nor the entrance channel are cited as being significant from an EFH perspective (COMNAV Marianas 2006b).

Finfishes, although present, are not abundant and are represented by only three families: Pomacentridae (damselfishes), Chaetodontidae (butterflyfishes), and Carangidae (jacks). The waters of the inner harbor are highly turbid with some areas having a visibility of less than a few feet. High turbidity in the inner harbor makes surveying fish difficult, and also decreases the amount of sunlight available to algae and corals (COMNAV Marianas 2006b). Smith et al. (2008) made limited qualitative assessments of habitat utilization by fish in the turbid waters. Overall, man-made structures (i.e., wharves provided relatively considerable habitat for a diverse array of fishes compared to the reef at Abo Cove or the harbor floor offshore from the wharves. Benthic species, such as cardinalfishes, damselfishes, and gobies favored corals, debris, sand, and soft corals, and the wharf wall and pilings. Species that were active swimmers, such as butterflyfishes, emperors, snappers, surgeonfishes, sweetlips, trevallys and jacks, etc., were found in the water column directly adjacent to the wharves.

On the reef at Abo Cove, cardinalfishes were observed with corals or rock, gobies with sand, mullet with rubble or sand, and a snapper was observed in the sand community. Visibility was very poor during this survey and it is expected that other species present along the wharf transects would be present as well, particularly at high tide. The harbor floor transects also were surveyed under conditions of poor visibility, but burrowing gobies associated with the fine sand were observed.



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Special-Status Species

No marine mammals are expected in Inner Apra Harbor and sea turtles are not expected on a regular basis, and considerably less frequent and in smaller numbers than in Outer Apra Harbor. A green turtle was observed on a recent marine benthic survey of Inner Apra Harbor (Smith et al. 2008) in waters between Abo Cove and the southern end of Victor Wharf, most likely foraging at the seagrass bed in Abo Cove. The individual observed was small (18 to 36 in [50 to 100 cm] carapace length). Considering the sponge community and other soft body invertebrates present on the wharves, the hawksbill sea turtle could also forage at this site, however are not of preferred species. No sea turtle nesting habitats have been identified and because of the fine-grained, muddy composition of the shoreline of Inner Apra Harbor, the beaches at this study area are not considered potential nesting sites for threatened and endangered sea turtles known to occur in Apra Harbor. The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex, and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. Aside from the recent green sea turtle observation (identified above) no other observations have been reported and no density information is available for Apra Harbor. However, if sea turtles are present within Inner Apra Harbor during construction activity, the proposed and associated underwater noise has the potential to affect the ESA-listed species by temporarily altering their behavior (i.e. changing their swimming, resting or feeding patterns).

There have been limited studies on green sea turtle hearing capabilities, but the available data suggests a hearing in the moderately low frequency range, and have relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999, Ketten and Bartol 1995). NOAA (2005 [pp 3-88 and 3-89]) identifies sea turtle hearing sensitivity, and includes the following information. The range of maximum sensitivity for sea turtles is 100 to 800 Hz, with an upper limit of about 2,000 Hz. Hearing below 80 Hz is less sensitive but still potentially usable to the animal (Lenhardt 1994). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz. They possess an overall hearing range of approximately 100 to 1,000 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 µPa-m (Lenhardt 1994).

TEI (2006) gathered unpublished data on hearing thresholds for green sea turtles from an Office of Naval Research hearing threshold study at the New England Aquarium and combined this data with other information (Ruggero and Temchin 2002) to present the hearing thresholds in Table 11.1-6. These data show similar results as above and provides the best available estimates for green sea turtle. The hearing bandwidth was relatively narrow, 50 to 1,000 Hz with maximum sensitivity around 200 Hz. And these animals have very high hearing thresholds at over 100 dB re 1 µPa in low frequencies where construction sound is concentrated.

Table 11.1-6. Hearing Thresholds and Bandwidth for Sea Turtles

Hearing Bandwidth 1/3 Octave Band (Hz)	*Hearing Threshold Sea Turtle (dB re 1 µPa*
50	149
63	142
80	131
100	119
125	118
160	117
200	115
250	119
315	123
400	130
500	136
630	144
800	154
1,000	166

Source: TEI 2006, NEA 2005, and Ruggero and Temchin 2002.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Due to the distances of Adotgan Point, Kilo Wharf and the historic Seaplane Ramp nesting areas from the proposed action under Alternative 1, it is unlikely that any nesting-related activities would be affected by the action alternatives, including night work and the associated lights and noise. The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during nighttime construction operations. However, as mentioned previously, this site has not been active since a reported hawksbill nesting event in 1997.

Non-Native Species

Non-native species information for Inner Apra Harbor would be similar as described in Section 11.1.6.1. In general, nonindigenous species are abundant on artificial substrata (e.g., moorings, steel pile wharf supports).

11.1.7.2 Naval Base Guam

The LCAC/AAV laydown area, which includes amphibious operations facility and marine ramp, is proposed for construction on Polaris Point. The benthic community associated with the AAV's marine ramp would be the same as described under the Inner Apra Harbor section above (i.e. the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily resuspended. Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

11.1.7.3 Off Base Roadways

The proposed actions include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Roadway projects in the Apra Harbor region include pavement strengthening and intersection improvements and bridge replacements (on Route 1). Figure 11.1-13 shows representative photographs along Route 11 to the commercial port that are areas of proposed road improvement projects adjacent to marine environments within the Apra Harbor region study area. These projects include (1) rehabilitation of Route 11 from the commercial port to the Route 1 intersection, and (2) pavement strengthening along Route 1 from the intersection with Route 11 and Route 2A. Figure 11.1-10 shows the roadway projects, including bridge replacement locations, that may affect sensitive marine biological resources and habitats associated with the downstream or adjacent nearshore environment.

Left: View from Route 11 to northeast. **Right:** Cooling water canal (Approximately 5 ac (2 ha) with rip rap lining the sides. This canal connects the power plant near the Commercial Port along Route 11 to Piti Bay and the Philippine Sea.

Figure 11.1-13. Photographs of Marine Environmental Features along Route 11 (Commercial Port)

11.1.8 South

11.1.8.1 Naval Munitions Site

Baseline information for the areas in and adjacent to Naval Munitions Site (NMS) was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.2 Non-DoD Land

Baseline information for the areas in and adjacent to potential access road options A, B, and C was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.3 Off Base Roadways

The proposed actions include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Roadway projects in the southern portion of Guam include pavement strengthening and roadway modifications. None of the proposed roadway improvement projects within the South Region includes in-water construction, dredging, or land-based construction projects that would affect streams and/or marine biological resources; therefore, marine biological resources were not evaluated.

11.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. Since some of these project components would not affect the marine environment, their potential impacts on marine biology would be negligible and are not addressed in detail. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, an analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

11.2.1 Approach to Analysis

11.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to marine biological resources was based on federal laws and regulations including the ESA, MMPA, M-SA, Section 404(b)(1) of the CWA, and EO 13089, *Coral Reef Protection*. Significant marine biological resources include all special-status species including species that are ESA-listed as threatened and endangered or candidates for listing under ESA, species protected under the MMPA, or species with designated EFH or HAPC established under the M-SA. The M-SA defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. 'Substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities. 'Necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem, and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (16 USC 1801 et seq.). Additionally, at least one or more of the following criteria established by the NMFS must be met for HAPC designation: 1) the ecological function provided by the habitat is important; 2) the habitat is sensitive to human-induced environmental degradation; 3) development activities are, or will be, stressing the habitat type; or 4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth HAPC criterion, not established by NMFS, that includes areas that are already protected, such as Overlay Refuges (WPRFMC 2005). Section 404(b)(1) Guidelines (Guidelines) of the CWA is in essence a Memorandum of Agreement (MOA) between the USEPA and U.S. Department of the Army (Army), to articulate policies and procedures to be used in the determination of the type and level of mitigation necessary to demonstrate CWA compliance. The MOA is specifically limited to the Section 404 regulatory program and does not change substantive Section 404 guidance. The MOA expresses the intent of the Army and USEPA to implement the objective of the CWA to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, including special aquatic sites (SAS). SAS are those sites identified in 40 CFR 230, Subpart E (i.e., sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes). They are geographic areas, large or small, possessing special ecological characteristics of

productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region.

In general, the main intentions of the three federal acts listed above are as follows:

- The ESA establishes protection over and conservation of threatened and endangered species and the ecosystems upon which they depend, and requires any action that is authorized, funded, or carried out by a federal entity to ensure its implementation would not jeopardize the continued existence of listed species or adversely modify critical habitat.
- The MMPA was established to protect marine mammals by prohibiting take of marine mammals without authorization in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.
- The M-SA requires NMFS and regional fishery management councils to minimize, to the extent practicable, adverse effects to EFH caused by fishing activities. The M-SA also requires federal agencies to consult with NMFS about actions that could damage EFH.
- The CWA Guidelines set forth a goal of restoring and maintaining existing aquatic resources, including SAS (i.e. coral reefs, wetlands etc.).

The ESA, MMPA, and M-SA require that NMFS and/or USFWS be consulted when a proposed federal action may adversely affect an ESA-listed species, a marine mammal, EFH or HAPC. In addition, while all habitats are important to consider, 'coral reef ecosystems' are perhaps the most important habitats and the analysis of this SAS is included under EFH. As a note, EO 13089 also mandates preservation and protection of U.S. coral reef ecosystems that are defined as "… those species, habitats and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction and control of the U.S.".

The CWA guidelines and the subsequent MOA requires the EPA and Army to implement the objectives of the CWA. For dredging activities, the U.S. Army Corps of Engineers (USACE) first makes a determination that potential impacts have been avoided to the maximum extent practicable (striving to avoid adverse impacts); remaining impacts would be mitigated the extent appropriate and practicable by requiring steps to reduce impacts; and finally, compensate for aquatic resource values. This sequence is considered satisfied where the proposed mitigation is in accordance with specific provisions of a USACE and USEPA approved comprehensive plan that ensures compliance with the compensation requirements of the Guidelines Determination of Significance.

Best Management Practices and Protective Measures

The implementation of appropriate resource agency (USFWS/NOAA/NMFS) BMPs, construction and industrial permit BMPs, Navy Low Impact Development (LID) concept plans and Industrial Management Practices (IMPs), USACE permit conditions, and general maritime measures in place by the military and USCG is assumed for each resource and anticipated to reduce any construction- and operation-related impacts to marine biological resources. With respect to possible construction impacts on the nearshore marine environment, the implementation and management of such plans would reduce/eliminate any construction-related stormwater runoff into the nearshore environment. The LID concept plan would support master planning activities, and through these joint efforts, a sustainable development strategy would be implemented where pre-construction site hydrology would be equal or nearly equal to post-construction hydrology. Stormwater would be treated for pollutants prior to discharge to the porous ground surface. Other avoidance and minimization measures employed during operations, including the

use of "green bullets" composed of non-toxic alloys and periodic benthic cleanup, would be used to decrease potential impacts.

General maritime protective measures in place by the military (which may apply to ranges with SDZs overwater) include lookouts trained to sight marine mammals or sea turtles. Specific duties include the following (U.S. Fleet Forces 2007):

- All commanding officers, executive officers, lookouts, and officers of the deck (or range) complete the NMFS-approved Navy Marine Species Awareness Training, which is a DVD-based instructional course. All bridge (or range) watchstanders/lookouts would complete both parts one and two of the Marine Species Awareness Training; part two is optional for other personnel. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.
- Navy lookouts undertake extensive training in order to qualify as a watchstander in accordance with the *Lookout Training Handbook* (NAVEDTRA 12968-B).
- Lookout training includes on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).
- Lookouts are trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

The *Environmental Handbook for Trainers* further states the following:

- Survey the area after each exercise for any harmful objects, abandoned wire, netting and other debris that poses a danger to people and wildlife.

A detailed listing of BMPs is provided in Volume 2, Chapter 4, Water Resources, and in Volume 7 of this EIS/OEIS.

11.2.1.2 Determination of Significance

This section analyzes the potential for impacts to marine biological resources from implementation of the action alternatives and the no-action alternative. Factors considered in the analysis of potential impacts to marine biological resources include: (1) importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; (2) proportion of the resource that would be affected relative to its occurrence in the region; (3) sensitivity of the resource to proposed activities; and (4) duration of ecological ramifications. The factors used to assess significance of the effects to marine biological resources include the extent or degree that implementation of an alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community. The following significance criteria were used to assess the impacts of implementing the alternatives:

- The extent, if any, that the action would diminish suitable habitat for a special-status species or permanently lessen designated EFH or HAPC for the sustainment of managed fisheries.
- The extent, if any, that the action would disrupt the normal behavior patterns or habitat of a federally listed species, and substantially impede the Navy's ability to either avoid jeopardy or conserve and recover the species.

- The extent, if any, that the action would diminish population sizes or distribution of special-status species or designated EFH or HAPC.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any special-status species or result in the destruction or adverse modification of habitat of such species or designated EFH or HAPC.
- The extent, if any, that the action would permanently lessen physical and ecological habitat qualities that special-status species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would result in a substantial loss or degradation of habitat or ecosystem functions (natural features and processes) essential to the persistence of native flora or fauna populations.
- The extent, if any, that the action would be inconsistent with the goals of the Navy's Integrated Natural Resources Management Plan (INRMP).

The MMPA generally defines harassment as Level A or Level B, and these levels are defined uniquely for acts of military readiness such as the proposed action. Public Law 108-136 (2004) amended the MMPA definition of Level A and Level B harassment for military readiness events, which applies to this action.

- Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild.
- Level B harassment is now defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behaviors are abandoned or significantly altered." Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may cause Level B harassment.

ESA specifically requires agencies not to "jeopardize" the continued existence of any ESA-listed species, or destroy or adversely modify habitat critical to any ESA-listed species. Under Section 7, "jeopardize" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution. Section 9 of the ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.

Effects determination for EFH are either "no adverse effect on essential fish habitat" or "may adversely affect essential fish habitat" (WPRFMC 2005). Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity EFH. Adverse effects to EFH require further consultation if they are determined to be permanent versus temporary (NMFS 1999). To help identify Navy activities falling within the adverse effect definition, the Navy has determined that temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 FR 2354) were used as guidance for this determination, as they highlight activities with impacts that are more than minimal and not temporary in nature, opposed to those activities resulting in inconsequential changes to habitat. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (67 FR 2354). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (67 FR 2354). Whether an impact is minimal would depend on a number of factors (Navy 2009a):

- The intensity of the impact at the specific site being affected

- The spatial extent of the impact relative to the availability of the habitat type affected
- The sensitivity/vulnerability of the habitat to the impact
- The habitat functions that may be altered by the impact (e.g., shelter from predators)
- The timing of the impact relative to when the species or life stage needs the habitat

The analysis of potential impacts to marine biological resources considers direct, indirect, and cumulative impacts (refer to Volume 7 of this EIS/OEIS for the cumulative impacts analysis). The *Council on Environmental Quality (CEQ), Section 1508.08 Effects,* defines direct impacts as those caused by the action and occur at the same time and place, while indirect impacts occur later in time or farther removed in distance, but are still reasonably foreseeable. Direct impacts may include: the removal of coral and coral reef habitat, the "taking" of special-status species, increased noise, decreased water quality, lighting impacts resulting from construction or operation activities. Indirect impacts, for the purposes of this evaluation, may include any sedimentation/siltation of coral reef ecosystems resulting from construction or operational activities (i.e., dredging, resuspension of sediment via propeller wash), recreational activities in the vicinity of the resource that may lead to impacts to special-status species and EFH.

If marine biological or aquatic resources could be significantly impacted by proposed project activities, potential impacts may be reduced or offset through implementation of appropriate BMPs and/or mitigation measures. "Significantly" as used in NEPA Per (per 43 FR 56003, November 29, 1978; 44 FR 874, January 3, 1979) requires considerations of both context and intensity:

- Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
- Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the Habitat Equivalency Analysis (HEA) Volume 9. These communities are not considered to be coral reef (per USACE definition of what constitutes a coral reef), and therefore are not subject to compensatory mitigation.

11.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to marine biological resources that could be impacted by the proposed action. As part of the analysis, concerns relating to marine biological resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. A general account of these comments includes the following:

- Potential impacts on the Apra Harbor marine environment from CVN berthing, fully documenting impacts from dredging (acreage and ecosystem characteristics of affected area, depth of dredging operations, duration of affects)
- Potential impacts to endangered species (including nesting habitats), species of concern, and federal trust species such as corals and marine mammals
- Potential impacts from military expansion from all project sites on the marine resources, including removal or disturbance of the marine habitat
- Impacts to culturally significant marine-related areas for subsistence fishing and beliefs

- Increased "high impact" recreational use that would damage the ecosystem and impact fish habitat (e.g., Sasa Bay Marine Reserve)
- Increased land runoff impacting beaches and marine life (erosion and sediment stress)
- Increased anthropogenic factors impacting the coral reef ecosystem and concerns about the education and training that would be provided for newly arriving military personnel and their dependants regarding reef protection
- Mitigation measures and non-structural alternatives to avoid and minimize impacts to coral reefs

11.2.2 Alternative 1

11.2.2.1 North

Andersen AFB

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would occur from construction or operations.

Finegayan

Construction

Construction of the main cantonment, family housing, and community support facilities would take place at Finegayan under Alternative 1. The main cantonment land use functions include bachelor housing, supply warehouses, maintenance facilities, various headquarters and administrative support facilities, community support functions (e.g., retail, education, recreation, medical, day care, etc.), some training areas, and open space.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permit BMPs and IMPs discussed in Section 11.2.1.1. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Potential impacts to species with FMP would be addressed accordingly under Essential Fish Habitat.

Essential Fish Habitat. No direct impact on these resources are expected with the implementation and management of appropriate construction permit BMPs and IMPs. These resources would not be appreciably modified from existing conditions by indirect impacts. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. However, an increase in recreational use of Haputo ERA may be seen through such activities as dive boat tours. Indirect impacts would not be significant, and there would be no adverse effect to EFH. Alternative 1 would result in less than significant impacts to fish and EFH.

Special-Status Species. No direct impact on this resource is expected with the implementation and management of appropriate construction permits BMPs and IMPs.

This resource would not be appreciably modified from existing conditions by indirect impacts. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of

Alternative 1. Green sea turtles may be minimally, but not adversely affected; therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-native species. There would be no direct impact to this resource. No in-water construction, dredging, or training activities are proposed in the marine environment; therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased boating-related recreational activities (e.g., personnel boats and dive tours) associated with construction personnel which has the potential for transport of non-native species to and from other locations within the Mariana Islands chain. This increase above existing conditions is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and IMPs and existing Navy and USCG policies as discussed in the existing conditions section. Therefore, Alternative 1 would result in a less than significant impact regarding non-native species introduction.

Operation

Potential operations effects of implementing the proposed action in the Finegayan area would occur in the Haputo ERA. Because the Haputo shore area is relatively accessible, many of the marine biological resources discussed in this chapter may be adversely affected by indirect, long-term recreational activities due to the substantial increase of people potentially using Haputo ERA and coastal waters as a result of the proposed action (Figure 11.2-1). Recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing) may result in indirect loss of Haputo ERA habitat. This is a significant impact that can be mitigated through the implementation of mitigation measures such as natural resource educational training and public outreach, controlled access (a short video and access pass required before entry), informational documents (i.e., preparation of a *Military Environmental Handbook*, distribution of natural resource educational materials to dive boat operators); multiple designated mooring areas offshore; and increased efforts toward ERA enforcement (starting with Haputo) of "no take" and other ESA, MMPA, and EFH policies.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial stormwater pollution prevention plans and BMPs as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. No direct impact on these resources is expected with the implementation and management of appropriate industrial permits and BMPs for the reasons provided above.

Considering the dramatic increase of operations-related (military) personnel and their dependents working and living at Finegayan (see Volume 2, Section 2.1), an increased usage of Haputo ERA and adjacent coastal waters for recreational activities is expected. This increased usage has the potential for long-term reduction of the quality and/or quantity of CREMUS (specifically coral) (Table 11.2-1). The WPRFMC FEP for the Mariana Archipelago (2005) identifies "fishing related and non-fishing related impacts that may adversely affect EFH," in Sections 6.4 and 6.5, respectively, of this FEP. One or more of these impacts described may apply to this study area. Alternative 1 may adversely affect EFH. Though implementation and enforcement of appropriate BMPs and mitigation measures would reduce effects, Alternative 1 would result in significant impacts to fish and EFH. These impacts are mitigable to less

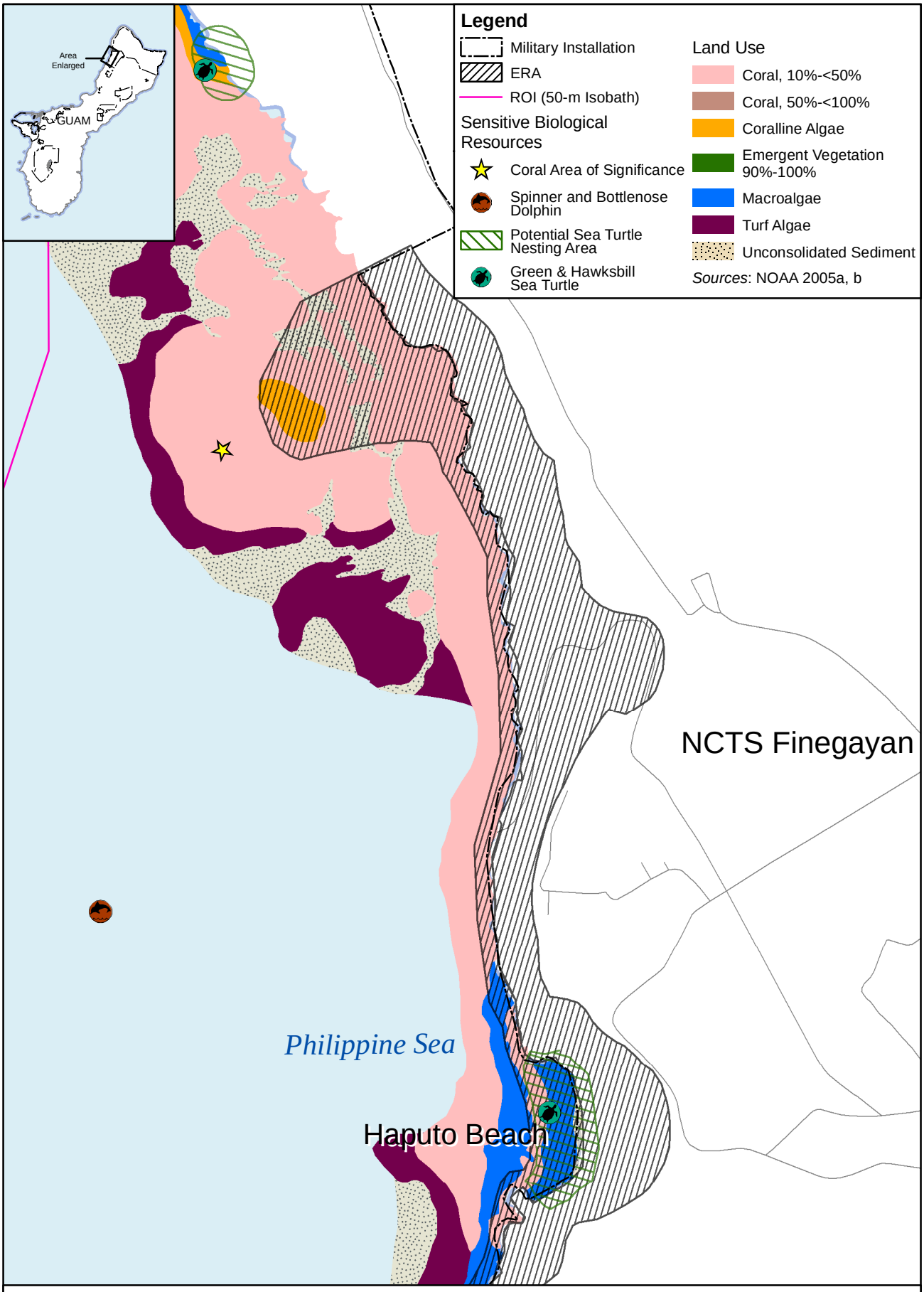

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Figure 11.2-1
Sensitive Marine Biological Resource and Habitat impacts associated with NCTS Finegayan

than significant through implementation and management of mitigation measures described in Volume 7.

Table 11.2-1 identifies the potential effects associated with fish and EFH.

Table 11.2-1. EFH Areas Associated with Finegayan and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Effect*
Coral and Coral Reef Ecosystems	Haputo ERA, including Double Reef, coral reef ecosystem outside ERA, including off-shore of Haputo Beach	Increased recreational activity	Potential long-term reduction in the quality and/or quantity of EFH through long-term, periodic and localized degradation.
Marine Water Column	Haputo ERA and coral reef ecosystem outside ERA	Increased recreational activity	Direct, long-term, periodic and localized.
Intertidal Zones	NCTS Finegayan Coastline	Increased recreational activity	Direct, long-term, periodic and localized.

Special-Status Species. No direct impact on this resource is expected with the implementation and management of appropriate industrial permits and BMPs described above and in Volume 7.

There may be long-term, indirect adverse impacts on this resource due to the considerable increase of operational personnel and their dependents using the Haputo ERA and adjacent coastal waters for recreational activities. Increased dive boat operations have the potential for increased turtle and marine mammal harassment and strikes, impacting special-status species. Considering the mobility of sea turtles and dolphins in the water, and the protective measures anticipated to be in place (i.e., by dive boat operators and Navy), these increased recreational activities would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Thus, sea turtles may be affected, but are not likely to be adversely affected with the implementation Alternative 1 actions. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Therefore, Alternative 1 would result in less than significant impacts to special-status species.

Sea turtle nesting areas may be affected by one or more jeopardizing actions as described under Sections 7 and 9 of the ESA. Implementation and enforcement of appropriate mitigation measures would reduce impacts, possibly from significant to less than significant with the possibility of a beneficial effects outcome compared with existing conditions. These potential impacts to nesting sea turtles are addressed further under Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-Native Species

There would be no direct impact to this resource. No in-water operation or training activities are proposed in the marine environment, therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased boating-related recreational activities (e.g., personnel boats and dive tours) associated with operation-based personnel which have the potential for transport of non-native species to and from other locations within the Mariana Islands chain. This increase above existing conditions is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and existing Navy and USCG policies as discussed in the existing conditions section. Therefore, Alternative 1 would result in a less than significant impacts regarding non-native species introductions.

Non-DoD Land

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would result from the proposed action.

11.2.2.2 Central

Andersen South

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would result from either construction or operations associated with the proposed action.

Non-DoD Land

Construction

As described in Section 2.3.1 Alternatives Development, Volume 2, to minimize the non-DoD land required, planning density assumptions were re-evaluated. There are two alternatives for the Route 15 Range Lands firing range complex:

- Alternative A. All ranges would be on the plateau area of the Route 15 lands. This training option would require realignment of Route 15 to accommodate the machine gun range. Land available for other land uses at Andersen South would be reduced (refer to Figure 2.3-6).
- Alternative B. The machine gun range would be sited in the valley and all other ranges would be sited on the plateau area of the Route 15 Range Lands. There would be no realignment of Route 15, no impact to available land at Andersen South, and would not require more land acquisition or long term leasing than training Alternative A (refer to Figure 2.3-7).

The impacts described below would be similar for either Alternative A or B.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, and the minimal runoff from the limestone landscape. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be short-term and localized, negligible indirect impacts to fish and EFH due to the increase of construction personnel and their dependents using the adjacent coastal waters for recreational activities. The potential for long-term reduction of the quality and/or quantity of CREMUS (specifically corals) of the EFH does not exist for the following reasons: the shoreline is exposed to dominant winds, wave action and storms and is not readily accessible by land or boat; and the construction project is not as large as other areas (e.g., NCTS Finegayan), As a result, no adverse indirect effects are expected to EFH, therefore impacts would be less than significant from Alternative 1 proposed actions.

Special-Status Species. A less than significant indirect impact to this resource is expected from construction-related recreational activities for similar reasons as described above in EFH. Additionally, special-status species are not as common on this coast compared to others around Guam and there are no sea turtle nesting areas (see operation description below for elaboration). No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of

Alternative 1. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA, thus sea turtles would not be adversely affected. Therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-native species. There would be no direct impact to this resource. No in-water construction, dredging, or training activities are proposed in the marine environment. Increased boating-related activities associated with construction personnel have the potential for transport of non-native species to and from other locations within the Mariana Islands chain; however, the access to this rough water coast is difficult. Therefore no major direct or indirect conduit exists for introduction of non-native species into the marine environment.

Any potential introduction/transport of non-native species would be lessened or even prevented through appropriate BMPs and existing Navy and USCG ballast water policies and the DoD-funded Biosecurity Risk Assessment and Management Plan, as discussed in the existing conditions section. Consequently, Alternative 1 would result in a less than significant impact regarding introduction of non-native species.

Operations

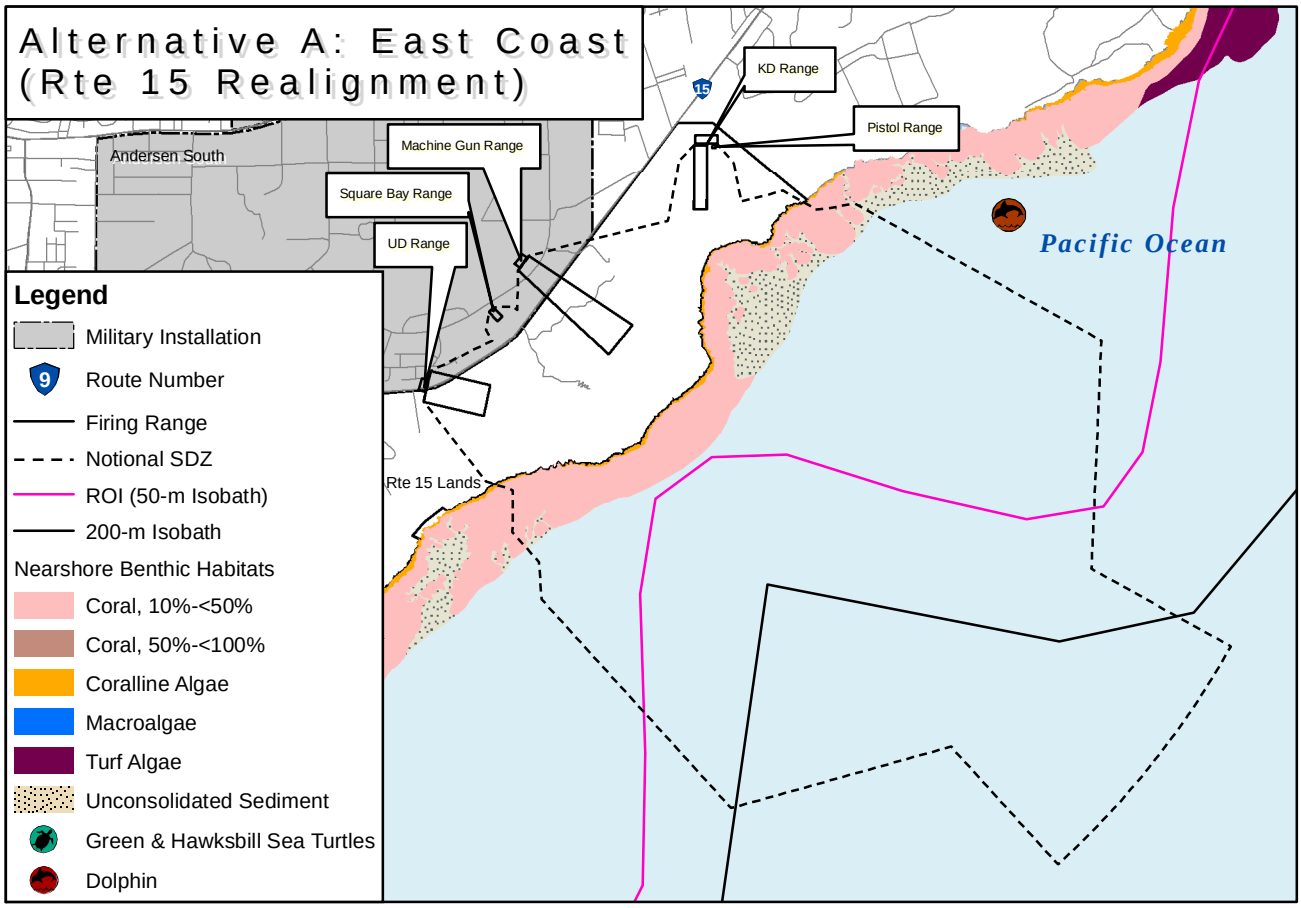
Because the Route 15 Range Lands shore area is not readily accessible (compared to the Haputo ERA), marine biological resources would be minimally impacted by indirect, long-term recreational activities from increased personnel using the coastal waters (Figure 11.2-2). Increased recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing), may occur and result in indirect loss of habitat offshore if not properly mitigated. Range activities, specifically the SDZs, are analyzed for potential impacts on marine mammals in the offshore waters in the following *Special-Status Species* subsection below.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial permits and BMPs as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be no direct impact on these resources as described above.

There would be minimal indirect impacts to EFH from recreational activities of operations personnel and their dependents. Impact assessment reasoning is similar as that as described above under *Construction*. Additionally, there would be a beneficial impact to nearshore communities due to limited and controlled access at the coastline during training operations.

There would be long-term, localized accumulation of small arms (.50 cal and MK19 TP) expended materials in the benthic habitat from the firing range operations. There would be limited potential for ingestion (Navy 2009a). Avoidance and minimization measures (see Section 11.2.1.1), including the use of "green bullets" and periodic benthic cleanup, would be employed to decrease potential impacts. The "green bullets" are composed of non-toxic alloys and would not contaminate the surrounding areas or marine benthic habitat if munitions land in the water or were ingested. Therefore, no adverse affects to EFH would occur, and Alternative 1 would result in less than significant impacts to fish and EFH.



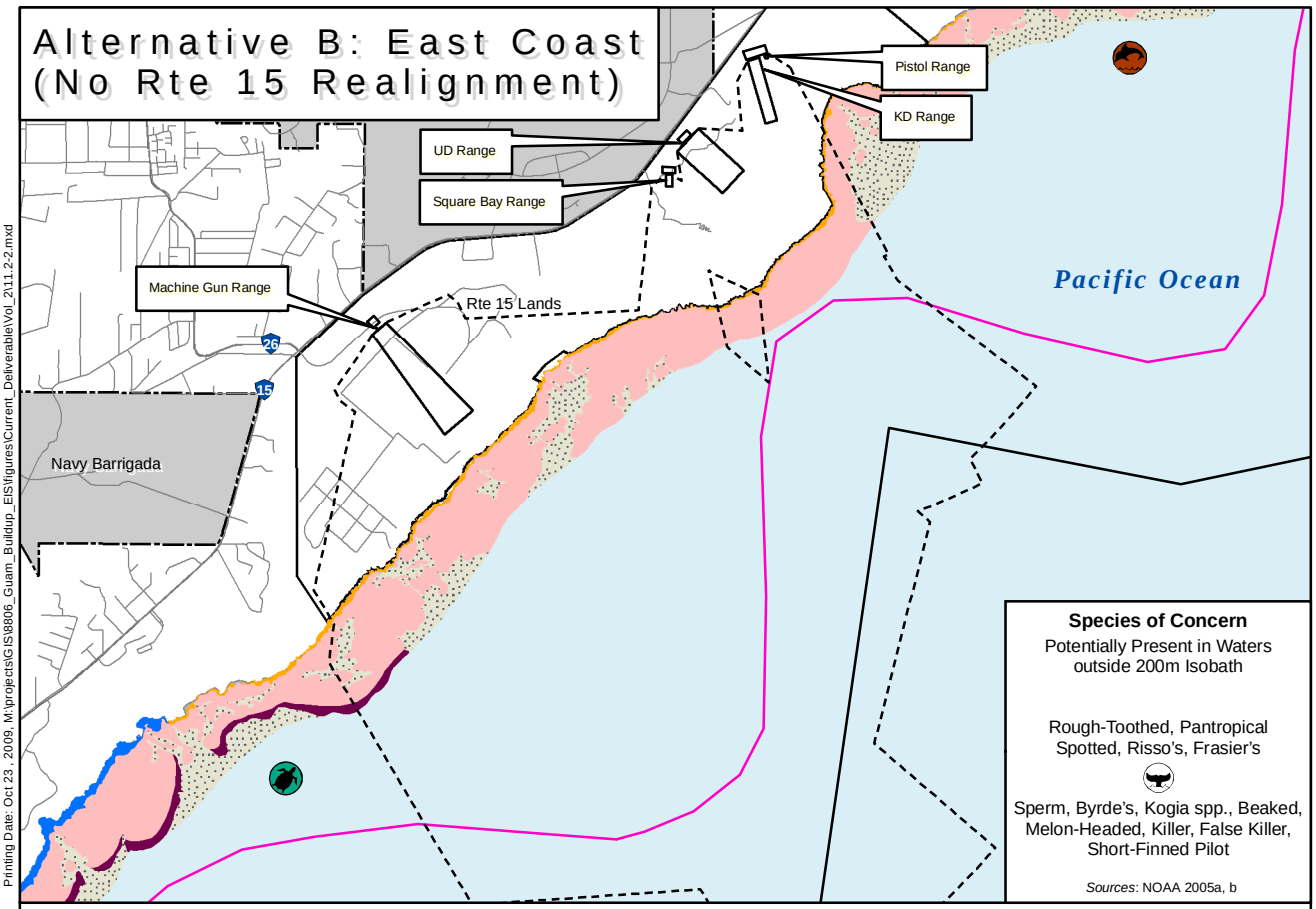


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Figure 11.2-2
Sensitive Marine Biological Resource and Habitat impacts associated with Rte 15 Range Lands, Guam

Table 11.2-2 includes information on the EFH types present in the study area and potential effects.

Table 11.2-2. EFH Areas Associated with Route 15 Range Lands and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Potential Effect*
Coral and Coral Reefs	Pagat Point, live coral coverage area (10% -<50%).	Increased indirect recreational activities	Potential for less than significant reduction in the quality and/or quantity through long-term, periodic and localized degradation offset by limited access during training activities and mitigation.
Intertidal Zone	Route 15 Lands Coastline	Increased recreational activity and range fire w/in SDZ	No Effect
Benthic Habitat	Pagat Point	Range Activities	Minimal effect from inert expended munitions build up on the bottom.

Special-Status Species. There would be a less than significant direct impact to special-status species from range operations based on the assessment below.

Figure 11.2-2 identifies the special-status species potentially present in coastal waters (Navy 2005), and depicts the surface danger zones SDZs for the training area. The potential for range training activities to lead to Level B harassment as defined by the MMPA (Section 11.2.1.2), or impact the ESA-listed sea turtle would be negligible for the following reasons.

Special-status species, although potentially present within the ROI and offshore, are not common (NOAA 2005a). NOAA (2005a) does not list either of these special-status species (dolphins or sea turtles) as notably present within these coastal waters.

General maritime measures and range operations in place by the military include lookouts to keep vessels out of the SDZs and trained personnel to sight marine mammals or sea turtles. It is also anticipated that preventative measures would be developed by the military for activities at Route 15 Range Lands (among other areas) and would be described in Range and Training Regulations, Standing Operating Procedures for Range Control and revised Navy INRMPs. Actions described in these documents are standard operating procedures that would be used in the future for all activities being analyzed in this EIS/OEIS. Activities at the Route 15 Range Lands on Guam would use up to .50 caliber and MK19 TP, which are essentially inert, so there would be no explosive projectiles involved. All projectiles would be contained within the range footprint by bullet traps or backstops, with the exception of ricochets, which by statistical analysis could escape the range but would be contained within the SDZs.

Although the SDZs extend off the cliff and over the water (refer to Figure 11.2-2), all anticipated rounds would impact and be contained within the range. However, as these waters support visits by the special-status species and potential impacts may include direct strike or debris ingestion, estimates of the annual level of munitions and those that statistically may land in the water from the Route 15 Range Land are provided in Table 11.2-3. As only smaller munitions (in effect, .50 caliber) would be used, this would pose an even lower magnitude of risk to special-status species.

Table 11.2-3. Annual Use of Proposed Outdoor Ranges on Guam under All Alternatives

Range	*Weapon*	*Ammunition Type*	*Typical Daily Use*				*Monthly Use*	*Annual Number Rounds*
			Hours of Use	*Days/Yr*[(a)]	*Rounds Day*	*Rounds Night*		
Rifle KD	Rifle	5.56 mm		225	15,000	0	Jan - Dec	3,375,000
Pistol	M9	9 mm		225	7,000	3,000	Jan - Dec	2,250,000
Square Bay	Rifle	5.56 mm		225	4,523	2,227	Jan - Dec	1,518,750
	Pistol	9 mm		225	3,769	1,856	Jan - Dec	1,265,625
UD	Rifle	5.56 mm		225	12,750	2,250	Jan - Dec	3,375,000
Machine Gun	Machine Gun	.50 cal		225	640,000	0	Jan - Dec	144,000,000
	Machine Gun	7.62 mm		225	512,000	0	Jan - Dec	115,200,000
	MK 19 Grenade Machine Gun	40 mm		225	112,000	0	Jan - Dec	25,200,000
Hand Grenade	M67 Fragmentation	N/A		48 or 225	96	0	Jan - Dec	4,608 or 21,600
Demolition	N/A	TNT (≤20 lb)		36 or 48	360	0	Jan - Dec	N/A
							Total	**296,184,375** [(b)]

Legend: cal = caliber; mm = millimeters; N/A = not applicable; KD= Known Distance; UD= Unknown Distance.
Notes: [(a)]Hand grenade and demolition ranges would be used approximately 4 days/ month; all other ranges would be used 5 days/week, 45 weeks/year.
[(b)]Total is for small arms only and does not include use of demolition or hand grenade ranges.

Conservative munitions strike probability, as described below for the spinner dolphin, would be significantly less than ($< 2.3 \times 10^{-8}$), hence negligible. Other larger marine mammal species present outside the 655-ft (200-m) isobath are less common and include only a small representative portion of the SDZ and ocean surface area.

MUNITIONS STRIKE PROBABILITY. An analysis was conducted using Army (1995) methodology to examine the probability of direct strikes to special-status species and the resultant total number of potential strikes based on the annual number of munitions that may land in the water and the density of dolphins within SDZ areas identified off the Route 15 Range Lands. The probability of a direct strike was determined by first calculating the area of the potential strike surface (approximately 13,107,199 m^2) and multiplying it by the total number of rounds that may enter the water (~75%). The area of the potential strike surface is a dolphins dorsal surface area multiplied by the species density in that location and at the surface based on year-round average estimates. The estimate of bottlenose dolphin surface area was calculated (a more conservative estimate than the smaller and more common spinner dolphin and considerable greater than a sea turtle) as 15,339 square ft [ft^2] (1.425 square meters {(m^2}) (or the average length of 9.35 ft times 2.85 m) times the average body width of 1.6 ft [0.5 m]). The total annual number of small arms rounds at the Route 15 Range Lands is 296,184,375. The total number of rounds that may land in the SDZ and Pacific Ocean, based on a .001% (conservative) non-containment of munitions, is approximately 3,000 annually. Probabilities of a direct strike were calculated for the spinner dolphins for the area off Route 15 Range Lands.

The likelihood of a direct strike would be negligible and an analysis was not conducted for other special-status species as the probability of a direct strike would be less. Due to the low probability of projectiles strike and the implementation of preventative measures (observers, etc.), there would be a very low probability that projectiles would come in contact with a marine mammal or sea turtle. An even less likely scenario would be an injury to an animal given that the velocity of the projectile would have significantly

decreased due to the distance from the range. Additionally, due to the inert quality of the munitions, there would be negligible ingestion effects to special-status species.

Table 11.2-4 lists the probabilities of direct impact to spinner dolphins from munitions that may land in the water.

Table 11.2-4. Potential for Direct Strike of Munitions on Marine Mammals from the Route 15 Land Range – Alternative 1

Species	*Species Density*	*Probability of Direct Strike*	*Annual Estimate of Dolphin Potentially Impacted by Direct Strike*
Spinner Dolphin	1.43 m^2	2.3 X 10^{-8}	Significantly less than 2.3 X 10^{-8}

This conservative analysis assumes that a dolphin would be present on the surface within the SDZ 100% of the time and confirms that the risk of the probability of direct strike is very low. The annual estimates would be substantially lower due to the low to moderate occurrence of marine mammals (and sea turtles) within the ROI (NOAA 2005a) and that they would be below the surface for a percentage of the time.

Indirect impacts to special-status species would be similar to those described in the *Construction* section. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native species. Impacts to this resource would be similar as described in the *Construction* section. Alternative 1 would result in no impacts regarding the introduction of non-native species.

Barrigada

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would occur as a result of construction and operations associated with the proposed action.

Piti/Nimitz Hill

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would occur as a result of construction and operations associated with the proposed action.

Apra Harbor

Project activities occurring in Apra Harbor may negatively impact marine or estuarine organisms or habitats. The embarkation operations would support amphibious transportation of Guam-based Marines to and transiting amphibious forces for potential contingency, humanitarian efforts, and exercise operations in the Pacific Theater. The Navy's Amphibious Ready Groups and the Marine Expeditionary Units (MEU) are transient forces that have traditionally come to Guam for port visits and training. These and other amphibious task force visits would occur more frequently with the relocation. The MEU embarkation ships currently come into port four times per year. This frequency would increase under Alternative 1. The escort ships for the MEU are the same types of ships that would support the CVN (refer to Volume 4 of this EIS/OEIS for an assessment of CVN impacts). Typically, there would be three

ships carrying amphibious vessels and four combatant ships that escort the amphibious ships. Transport of Marines and supplies between Guam and the CNMI would likely occur via High Speed Vessels (HSVs). The HSVs would be homeported in Guam and are a new type of vessel for Apra Harbor.

There are general purpose Navy wharves in Inner Apra Harbor that the amphibious task force currently uses. The proposed increase in the number of amphibious task force visits, the class of ships that would be homeported, and the utilities that would be needed would require a new embarkation area for loading and unloading of ships and a new amphibious vehicle laydown area. There would be four waterfront facility projects to support the proposed action.

Vessel operations within Apra Harbor would be expected to increase proportionally to support increased embarkation training activities under the proposed action.

Construction dredging, including tug and scow transport of dredged materials, and pier rehabilitation associated with Alternative 1 would be limited to areas of Inner Apra Harbor that have been previously dredged. These operations and construction-related projects were addressed to assess potential disturbances to marine biological resources including flora and invertebrates, fish and EFH, special-status species and non-native species. The activities addressed include: embarkation and support ship berthing (embarkation operations, HSV berthing, escort ship berthing); Amphibious Vehicle Laydown Area and ramps construction, new USCG ship berthing, construction-related projects; and the increased small boat, HSV, and escort ship traffic within Apra Harbor. Documents from a variety of sources including Navy, NOAA NMFS, and individual scientific investigators are referenced for analysis of potential impacts to marine biological resources.

Outer Apra Harbor

Construction

Marine Flora, Invertebrates and Associated EFH. This resource would not be appreciably modified from existing conditions. Impacts to this resource would be short-term and minor from Alternative 1 actions. Impact assessment reasoning is similar to that described below in Fish and EFH. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact on these resources. Table 11.2-5 includes information on the EFH types present in the study area and potential effects.

Table 11.2-5. EFH Areas Associated with Outer Apra Harbor and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Potential Effect*
Coral and Coral Reef Ecosystems	Shoal, Sasa Bay, and Entrance Channel Areas	Increased sediment resuspension and vessel traffic	Temporary and episodic minor behavioral responses to fish MUS and impact to coral polyp spawning survival.
Marine Water Column	Apra Harbor and Turning Basin	Increased vessel traffic	Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Water Column	Sasa Bay	Increased vessel traffic	Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Benthic Habitat	Sasa Bay	Increased vessel traffic and sediment resuspension	Temp. and episodic disturbances
Submerged Aquatic Vegetation	Sasa Bay	Increased vessel traffic	No effect

There may be minor impacts to this study area from Inner Apra Harbor dredging-related sedimentation during receding tidal actions carrying the sediment plume toward the Entrance Channel and Outer Apra Harbor. The turbidity levels are not expected to increase above existing conditions in Outer Apra Harbor with the implementation USACE permit BMP conditions (i.e., silt curtains). Short-term behavioral responses to noise are expected from finfish during dredging operations, which may temporarily inhibit entrance to Inner Apra Harbor. This temporary impact is less than significant.

It is estimated that a tug and scow would make one round trip/day for 6 to 8 months for dredged material disposal. See Volume 2, Chapter 14, Marine Transportation for detailed description. The vessels would adhere to the channel centerline, use the existing Outer Apra Harbor navigational channel to the ocean dredged disposal site, and return to Inner Apra Harbor. This increase of vessel movements would result in short-term and localized disturbances to the water column and organisms living in or on the shallow portions of the benthic substrate due to propeller wash and resuspension of sediments. Short-term behavioral and/or physiological responses to finfish (e.g., swimming away and increased heart rate) would result; however, such responses would not be expected to compromise the general health or condition of individual fish. The seasonal spawning of scalloped hammerhead sharks, although reported to be extremely rare (personal communication with Steve Smith, [Navy 2009c]), may also be temporarily disturbed by increased vessel traffic if in the area. EFH for this PHCRT species would not likely be adversely affected with appropriate NMFS BMPs being implemented (Volume 7). The probability of collisions between vessels and adult fish, which could result in injury, would be extremely low due this highly mobile life stage and slow moving vessels within the navigational channel and shipping lanes in the ROI (Navy 2009a).

There is no evidence that underwater noise negatively affects marine invertebrates (COMNAV Marianas 2007b).

The EFH of planktonic eggs and larvae of all species as identified in the Coral Reef, Bottomfish, Pelagic Fish, and Crustacean FMPs could be directly impacted by increased vessel movement. These life stages typically are weak swimming forms and are carried about by local currents. Based on wind and current measurements (SEI 2008) planktonic larvae of many species most likely never leave the confines of the harbor. Some recruitment to Apra Harbor may occur from eggs and larvae being carried into the harbor by local currents as well as by active recruitment (swimming into) by juveniles. The relative contributions from each of these sources of larvae are unknown, although recruits from outside Apra Harbor must pass through the relatively narrow entrance channel (relative to the volume of Apra Harbor), which would reduce the opportunity for eggs and larvae to passively enter the harbor. Thus the probability of their presence in the vicinity of the Alternative 1 action area is small (COMNAV Marianas 2007b). Although the eggs and larvae of these FMP species in the upper portions of the water column associated with the Alternative 1 actions (including previously identified turbidity plume limits) could be displaced, injured, or killed by vessel and propeller movements, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to vessel movements would be low relative to total biomass within the ROI (Navy 2009a). Based on the small coverage areas, these impacts would be negligible, therefore no adverse impacts to EFH are anticipated.

Figure 11.2-3 (used together with Table 11.2-6) identifies sensitive months (and areas) for certain species in Apra Harbor.

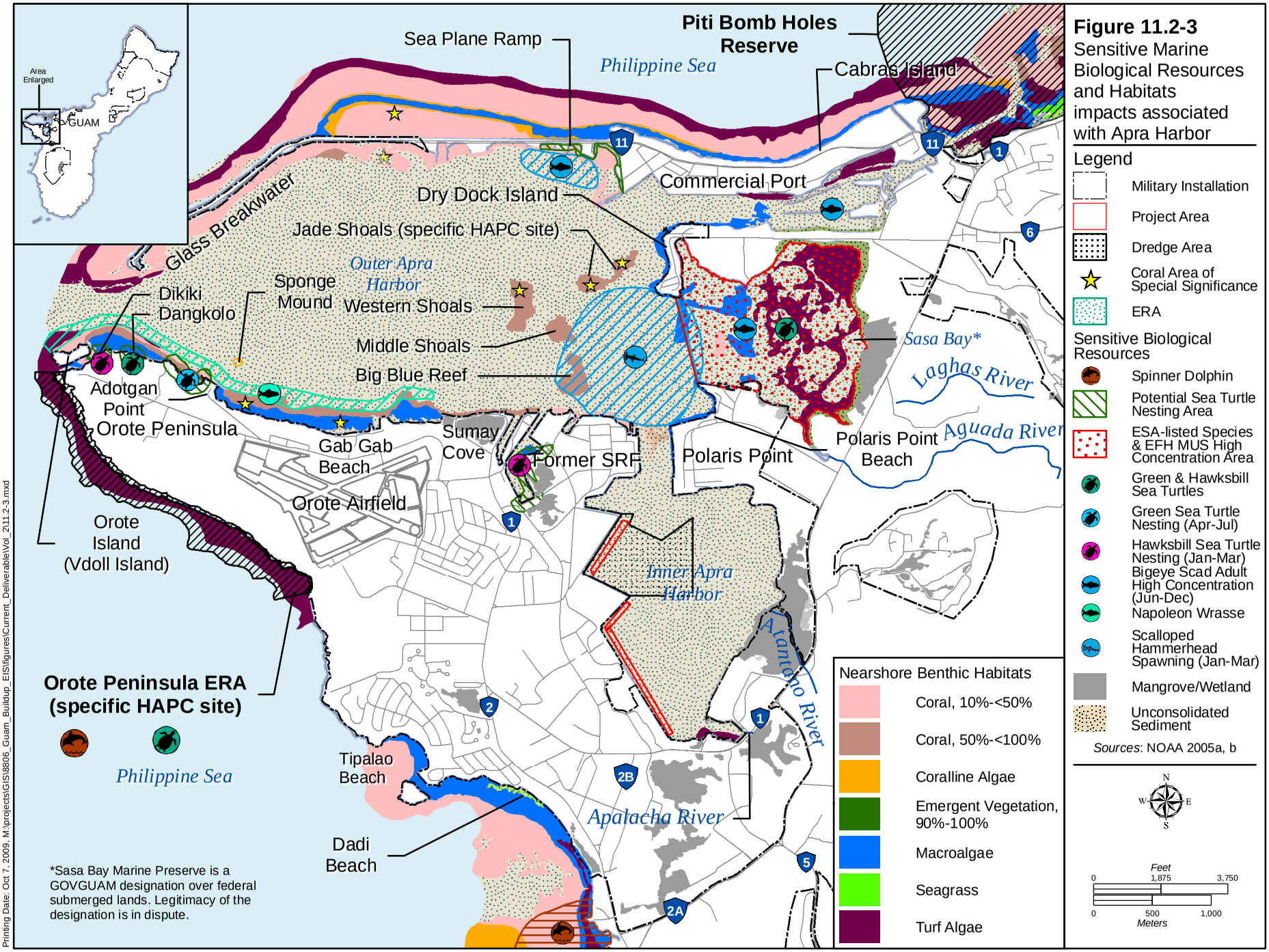

Table 11.2-6. Sensitive Months for Certain Species within Apra Harbor

Species	*Status*	*Location*	*Months*
Green Sea Turtle	ESA-listed, Threatened	see Figure 11.2-3	Nesting: Jan – Mar
Hawksbill Sea Turtle	ESA-listed, Endangered	see Figure 11.2-3	Nesting: Apr – Jul
Green and Hawksbill Sea Turtles	ESA-listed	see Figure 11.2-3	Foraging: Jan – Dec
Adult Bigeye Scad	EFH species	see Figure 11.2-3	Jun – Dec
Scalloped Hammerhead	EFH species	CVN turning basin - see Figure 11.2-3	Spawning: Jan – Mar
Juvenile Fish[1]	EFH	Sasa Bay and other nearshore environments	Nursery: Jan – Dec
Hard Corals	EFH-PHCRT	All of Outer Apra Harbor	Full Moon Spawning: (July-Aug)

Note: [1]includes barracudas, emperors, goatfishes, groupers, mullets, parrotfishes, puffers, snappers, surgeonfishes, wrasses, and small-toothed whiptails.

The EFHA for Outer Apra Harbor found that the increase of construction-related vessel movements could result in:

- Short-term, periodic, and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from propeller wash
- Short-term, periodic, and localized increase in benthic sedimentation
- Short-term, periodic, and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
- Seasonal disturbances to spawning coral reef and scalloped hammerhead sharks respectively

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of the EFH does not exist; therefore, there would be no adverse effects on EFH with the implementation of Alternative l, and less than significant impacts to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. Indirect effects from sedimentation plumes would be similar as described under fish and EFH above. Turbidity levels are not anticipated to exceed existing conditions in Outer Apra Harbor.

Many of the ongoing and proposed actions within the ROI involve marine navigation of various types of surface ships and boats (vessels). The increased vessel movements through the Outer Apra Harbor navigational channel associated with the ocean disposal of dredged materials has the potential to affect sea turtles by disturbing or directly striking individual animals.

The implementation of NOAA-NMFS recommended BMPs and existing Navy maritime policies (see Volume 7 and Section 11.2.2.5 in association with Table 11.2-6 and Figure 11.2-3) is anticipated to continue to reduce potential vessel interactions and impacts to sea turtles.

Construction-related vessel movements would be short-term, localized and slow-moving (see Volume 2, Chapter 14, Marine Transportation). The ability of sea turtles to detect slow approaching vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology. If their response to oncoming vessels does not induce a sea turtle to flee the area of vessel movement, the behavioral response may induce confusion, thereby increasing the possibility of a collision. Boat strikes in general are from small fast moving boats (Navy 2009a). There have been no vessel strikes on sea turtles since the Navy has been operating within Apra Harbor (Navy 2009d).

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1.

The short-term and periodic impacts associated with Alternative 1 actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native Species. Potential impacts to the marine habitat from non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) are a genuine threat as described in the Affected Environment, Section 11.1. Any potential introduction/transport of non-native species from one area to another may be lessened or even prevented through appropriate implementation and management of BMPs and existing USCG and Navy policies (see Volume 7).

The Navy would prepare a Regional Biosecurity Plan with Risk Analysis with the overall goal to identify terrestrial and marine biosecurity risks associated with DoD build-up and training activities on Guam and the CNMI posed by transportation and commerce to and within the Micronesia and Hawaii, and to document prevention, control and treatment measures that can be incorporated by civilian and military operations. Volume 7 includes a more detailed description of the BioSecurity Risk Assessment and Management Plan. Therefore, Alternative 1 would result in less than significant impacts regarding the introduction of non-native species.

Operations

Marine Flora, Invertebrates and Associated EFH. Effects on this resource would not appreciably modify existing conditions, although an increase in ship traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column, in or on the sediments due to propeller wash and resuspension of sediments. There is no evidence that underwater noise negatively affects marine invertebrates.

The impact reasoning would be similar to that described under construction activities for increased vessel movement, although less in frequency (approximately four times/year over existing conditions), but longer in duration and increased vessel traffic during those events. Impacts to this resource would be long-term, but episodic and minor compared to existing conditions. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact on these resources. Impacts resulting from the increased MEU embarkation ship movement would be similar to those described in the Construction sections above. Fish in the Apra Harbor channel and associated nearby shoals and nurseries (Sasa Bay) may be disturbed by increased levels of vessel movements by underwater noise or physical disturbance (resuspension of sediment from propeller wash). While fish may exit the immediate area during vessel movement, it is not likely that there would be a permanent effect to the present populations. Impacts on reef fish populations would be short-term, periodic, localized, and would not appreciably change existing conditions. Alternative 1 would result in no adverse effects on EFH. Therefore, Alternative 1 would result in less than significant impacts to fish and EFH.

Implementation of BMPs would reduce any potential impacts of vessel interactions with sensitive EFH MUS. Measures would be implemented by vessels while underway within Apra Harbor and especially while in the vicinity of Sasa Bay, and during sensitive months. Table 11.2-6 above (used in concert with

Figure 11.2-3) identifies these sensitive months (and areas) for respective EFH (and ESA-listed) species in Apra Harbor.

The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements could result in:

- Long-term, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Long-term, periodic and localized minimal increase of turbidity (decreased water quality) in the water column from propeller wash
- Long-term, periodic and localized minimal increase in benthic sedimentation
- Long-term, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from a negligible increased vessel traffic
- Seasonal disturbances to spawning coral reef and scalloped hammerhead sharks

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of the EFH does not exist. Therefore, Alternative 1 would result in no adverse effects on EFH, and less than significant impacts to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. Increased vessel movements associated with MEU embarkation operations have the potential for increased sea turtle strikes enroute to and from Sasa Bay (a high turtle concentration area). Implementation of NOAA/NMFS-recommended BMPs (Volume 7) is anticipated to reduce any potential impacts of vessel interactions with sea turtles to less than significant impacts. These BMPs would be implemented while vessels are underway within Apra Harbor and especially while in the vicinity of Sasa Bay and during nesting season.

General maritime measures in place by the military, including lookouts trained to sight marine mammals or sea turtles, are in use and designed to avoid collisions with protected species. These protective measures are described in detail in Volume 7.

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1.

The long-term, periodic impacts associated with Alternative 1 actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) as described in the Construction section.

Inner Apra Harbor

As described in Volume 4, Chapter 2 Section 2.3.5, four dredged material disposal options are considered in this EIS/OEIS: 100% ocean disposal, 100% upland placement, 100% beneficial reuse, and 15-20% beneficial reuse/75-80% ocean disposal. Beneficial reuse of dredged material is preferred by the Navy and would be evaluated on a case-by-case basis. Potential uses include landfill cover, road base, backfill,

and beach renourishment if suitable. Several local beneficial reuse projects could include fill for shoreline stabilization below the proposed aircraft carrier wharf, fill of berms and backstops at proposed military firing ranges on Guam, and fill for the Port Authority of Guam expansion program.

If upland dredged material disposal is required for any volume of material that does not meet Marine Protection, Research, and Sanctuaries Act Section 103 rules for ocean disposal, the dredged material would be placed at existing permitted sites. Use of these sites is subject to ongoing operational permit conditions that address potential impacts to biological resources, including threatened and endangered species. The Navy would comply with all applicable requirements; therefore, associated biological resource impacts would not be significant.

Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the HEA Volume 9. These communities are not considered to be coral reef (per USACE definition of what constitutes a coral reef), and therefore are not subject to compensatory mitigation.

Construction

Marine Flora, Invertebrates and Associated EFH. There would be a less than significant impact to these resources. Dredging activities planned for Sierra and Tango Wharves would include all areas from -35 to -38 ft (-10 to -11 m) MLLW. The effects on communities that have established themselves on Navy-installed artificial structures are of less concern than establishment on natural surfaces and will not be evaluated for compensatory mitigation. Marine flora communities are limited and occur mainly near Abo Cove. Benthic invertebrates, such as sponges, sea urchins, starfish, and mollusks are poorly represented within Inner Apra Harbor, except for on wharf vertical structures. Representatives of few families were sighted, and none of those groups observed were abundant (COMNAV Marianas 2006b.). Floral and invertebrate communities present on the wharves' vertical support columns or infaunal communities in the soft bottom may be directly impacted in the short-term through removal during wharf structural refurbishing and dredging operations, but are expected to reestablish themselves quickly on the new vertical structures from laterally soft bottom (TEI 2009). Taylor Engineering, Inc. (2009) performed a literature review of effects of beach nourishment, dredging and disposal projects on benthic habitat. The following paragraphs cite the reviewed articles and list the key findings related to benthos effects:

- NOAA Benthic Habitat Mapping. 2007. Applying Benthic Data: *Dredging and Disposal of Marine Sediment*.
  - "Benthic organisms living in shallow water estuarine and nearshore environments are well adapted to frequent physical disturbance"
  - "Tides, currents, waves, and storms cause sediments to be lifted, deposited, or shifted"
  - "The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging"
- Dredging Operations and Environmental Research (DOER). 2005. *Sedimentation: Potential Biological Effects of Dredging Operations in Estuarine and Marine Environments.*
  - "most shallow benthic habitats in estuarine and costal systems are subject to deposition and resuspension events on daily or even tidal time scales"
  - "Many organisms have physiological or behavioral methods of dealing with sediments that settle on or around them, ranging from avoidance to tolerance of attenuated light and/or anaerobic conditions caused by partial or complete burial"
- Section 404(b) Evaluation, *Pinellas county Florida Beach Erosion Control Project Alternative Sand Source Utilization."*

  - "Fill material will bury some benthic organisms."
  - Most organisms in this turbid environment are adapted for existence in area of considerable substrate movement"
  - Re-colonization will occur in most cases within one year following construction"
- Atlantic States Marine Fisheries Commission. 2002. *Review of the Biological and Physical Impacts.*
  - *"Studies from 1985-1996 report short-term declines in infaunal abundance, biomass, and taxa richness following beach nourishment, with recovery occurring between 2 and 7 months"*
  - *"Studies from 1994-2001 reported recolonization of infauna occurred within two weeks"*
- U.S. Army Corps of Engineers coastal Engineering Research Center. 1982. *Biological Effects of Beach Restoration with Dredged material on Mid-Atlantic Coasts.*
  - "animals that spend their entire life cycle in the substrate were not seriously impacted by burying from beach nourishment"
  - "nourishment destroyed or drove away the inertial macrofauna; but, based in other regional studies, recovery should occur within one or two seasons (i.e. 3-6 months)

Conclusions of the literature review identified short-term impacts to benthic habitat. Most references listed considered those impacts short-term because the majority of benthic infaunal organisms have the ability to adapt for existence in areas of considerable substrate movement (TEI 2009).

A beneficial long-term impact for the recruitment of marine flora, invertebrates and associated EFH and the ecology of the immediate area is expected with the increased settlement potential of the cleared hard surfaces after dredging and the added aircraft carrier wharf armor rip rap and vertical pilings provide. The development of the pier would provide suitable habitat for species such as benthic invertebrates including sponges, sea urchins, starfish, and mollusks, which are poorly represented within Inner Apra Harbor and the entrance channel areas (COMNAV Marianas 2006).

Those organisms that are not directly subjected to removal or fill, or are motile, could sustain short-term and minimal impacts as a result of transport, suspension and or deposition of dredging-generated sediments. These organisms are accustomed to resuspension of sediment and would adapt to these short-term effects. No coral reef communities have been identified on the harbor bottom in the areas fronting Sierra and Tango Wharves or within Inner Apra Harbor (MRC 2002). The impacts associated with marine flora, invertebrates and associated EFH (either on man-made structures or infaunal communities present in soft bottom habitat) would be short-term and localized based on rapid reestablishment rates (TEI 2009), and are less than significant.

Increased vessels movements during in-water construction and dredging activities would be similar to those described under Outer Apra Harbor Fish and EFH. There would be a short-term and periodic increase in frequency of vessel movement. The impacts associated with marine flora, invertebrates and associated EFH would be short-term, periodic and localized, hence negligible.

Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact to these resources. As described earlier, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the Inner Harbor as described above in the marine flora, invertebrates and

associated EFH discussion. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as a significant spawning or nursery area for either invertebrates or fishes and/or any other FMP species. The effects on communities that have established themselves on Navy-installed artificial structures are of less concern than establishment on natural surfaces and will not be evaluated for compensatory mitigation.

The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that larvae might be present would survive. Therefore, spawning and reproductive activities that may occur within the Inner Harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2006b).

The Navy would comply with USACE permit conditions; therefore re-suspension of sediment would be localized. Long-term water quality would not be significantly changed from these activities; however, removal of some of the very fine sediment in the Inner Harbor would likely have a beneficial effect on the marine community and EFH. The beneficial effects would result from: improved water quality; the removal of fine particulates which are routinely re-suspended and swept into Outer Apra harbor; and the increase in the amount of hard substrate, which would enhance the successful recruitment of stony corals (COMNAV Marianas 2006b).

Table 11.2-7 includes information on the EFH types present in the study area and potential effects.

Table 11.2-7. EFH Areas Associated with Inner Apra Harbor and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Effect*
Coral Reefs Ecosystem	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	Short-term and periodic behavioral responses from fish
Marine Water Column	Inner Apra Harbor	Dredging and wharf structural refurbishing, increased vessel movement	Short-term and minimal w/ temporary beneficial
Wharf Vertical Substrate	All Wharves	Wharf structural refurbishing	Direct, however short-term and minimal based on quick (2-6 months) reestablishment
Soft Bottom Benthic Habitat	Inner Apra Harbor Wharves and off Polaris Point	Dredging and wharf structural refurbishing, increased vessel movement	Direct, however short-term and minimal based on quick (2-6 months) reestablishment
Submerged Aquatic Vegetation	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	No effect

Species with FMPs may experience minimal, short-term and localized, impacts; fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing-activities cease. Invertebrate communities that have established themselves on Navy-installed wharves or man-made structures would be directly impacted during refurbishing; however, they are anticipated to recolonize quickly after the new wharf is constructed. Though infaunal soft bottom communities would be impacted through dredging removal, these communities are expected to reestablish themselves laterally from other areas in Inner Apra Harbor. Based on this assessment and information provided in other sections, there are no adverse impacts to EFH. Therefore, Alternative 1 would result in a less than significant impact to fish and EFH.

Special-Status Species. The green sea turtle has been observed in Inner Apra Harbor, though with considerably less frequency and in smaller numbers than in Outer Apra Harbor. Thus, the proposed construction action and associated noise has the potential to affect the ESA-listed green sea turtle if present by temporarily changing their swimming or feeding patterns. The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex,

and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. Aside from a recent observation during a survey in Inner Apra Harbor (Smith B.D. et al. 2008) no other observations have been reported. No density information is available for Inner Apra Harbor.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Due to the distances of Adotgan Point, Kilo Wharf and the historic Seaplane Ramp nesting areas from the proposed action under Alternative 1, it is unlikely that any nesting-related activities would be affected by the action alternatives, including night work and the associated lights and noise. The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during nighttime construction operations. However, as mentioned previously, this site has not been active since a reported hawksbill nesting event in 1997.

As identified in the affected environment section, the available data on sea turtle hearing suggest a hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 1995). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 µPa-m (Lenhardt 1994).

As described earlier, the ability of sea turtles to detect noise and slow moving vessels via auditory and /or visual cues would be expected based on knowledge of their sensory biology (Navy 2009a). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m]) is well below the 180 dB re 1 µPa NMFS guideline to protect all marine species from high sound levels at any point on the frequency spectrum. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.8 m) from in-water construction activities (NMFS 2008c). It is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area.

Tech Environmental (2009) predicted underwater sound levels of pile driving perceived by sea turtles-all species (hearing threshold sound levels – dBht re 1 µPa) is 56 (at 500 m), 60 (at 320 m), and 80 (at 30 m). Research shows marine animals avoidance reactions occur for 50% of individuals at 90 dBht re 1 µPa, occur for 80% of the individuals at 98 dBht re 1 µPa, and occur for the single most sensitive individual at 70 dBht re 1 µPa. This threshold for significant behavioral response is consistent with NOAA/NMFS guidelines defining a zone of influence (i.e., annoyance, disturbance). For estimating the zone of injury for marine mammals, a sound pressure level of 130 dBht re 1 µPa (i.e. 130 dB above an animal's hearing threshold) is recommended (Nedwell and Howell 2004). Therefore the calculated zone of behavior response for significant avoidance reaction (i.e. distance where dBht = 90 dB re 1 µPa and avoidance reaction may occur) to pile driving for sea turtles-all species is <98 ft (<30 m) (Tech Environmental, Inc. 2006). In other words, no injury to any marine animals, including sea turtles, are predicted even if an individual were to approach as close as 30 m to pile driving because all dBht values at this minimum distance are well below.

Sea turtles are highly mobile and capable of leaving or avoiding an area during proposed dredging and in-water construction activities Dredging and pile driving activities would probably deter green sea turtles from closely approaching the work area, and as a result, the likelihood that a green sea turtle would get

close enough to experience and effects is remote, especially with the silt curtain barriers and mitigation measures in place.

The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this Draft EIS/OEIS. The Navy will continue to research these studies and where appropriate, incorporate and apply methodologies, analysis, and results to the ongoing impact analysis to sea turtles from the proposed action. Applicability of these studies will also be coordinated through consultations with NMFS. The Final EIS/OEIS will contain revised sea turtle impact analysis as developed through the process described above.

The Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and impact minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures are expected to considerably lessen any potential impacts to sea turtles in the area.

In summary, it is anticipated that implementation of Alternative 1 may affect, but is not likely to adversely affect the ESA-listed green sea turtles in Apra Harbor. Table 11.2-6 and Figure 11.2-3 above identify sensitive months (and areas) for respective ESA-listed and FMP MUS in the EFH due to nesting, spawning and/or high concentration. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Section 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies as described in the Affected Environment, Section 11.1.

Operations

Marine Flora, Invertebrates and Associated EFH. There would be a less than significant impact to this resource. Effects on this resource would not differ much from existing conditions, although an increase in ship traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column, in or on the sediments due to propeller wash and resuspension of sediments. There is no evidence that underwater noise negatively affects marine invertebrates.

The impact reasoning would be similar to that described under Outer Apra Harbor operations activities and Inner Apra Harbor construction activities for vessel movements. Although this resource is poorly represented at this study area, impacts would be long-term but episodic and minor compared to existing conditions. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact to these resources. As describe earlier in the construction section above, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the Inner Harbor.

Table 11.2-7 includes information on the EFH types present in the study area and potential effects.

Species with FMPs may experience short-term and temporary impacts during vessel movements; however fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing activities cease. Based on this assessment and information provided in other sections, there are no adverse impacts to EFH. Therefore, Alternative 1 would result in a less than significant impact to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. The green sea turtle may be expected in Inner Apra Harbor; however, it would occur less frequently and in considerably smaller numbers than in Outer Apra Harbor. As described earlier, sea turtles are expected to be able to detect noise and slow moving vessels via auditory and /or visual cues. Additionally, the Navy would comply with their general maritime measures reducing potential interactions with sea turtles and special-status species in general. Table 11.2-6 (used in concert with Figure 11.2-3) identifies sensitive months (and areas) for respective ESA-listed and EFH species in Apra Harbor.

The long-term but episodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not "jeopardize" or "take" ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-Native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies as described in the Affected Environment, Section 11.1.

Naval Base Guam

Naval Base Guam (Tipalao/Dadi Beaches) study area would now be addressed under a programmatic National Environmental Policy Act (NEPA) document, therefore baseline marine biology information and analysis has been removed from this document.

Construction

Land-based activities associated with the LCAC Laydown Area may impact coastal water quality in the vicinity of Polaris Point within Inner Apra Harbor via storm runoff. Appropriate construction BMPs would be in place to minimize this short-term localized impact to marine biological resources that are well adapted to turbid waters.

The AAV Marine Ramp would disturb soft bottom communities. The benthic community associated with the AAV's Marine Ramp would be the same as described under the Inner Apra Harbor section above (i.e., the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily re-suspended. Marine biota are not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

There would short-term, localized direct impacts to soft bottom infaunal communities at the area of impact; however it is anticipated that disturbed areas would quickly recover with new infaunal recruitments. Those organisms that are not directly subjected to removal or fill, or are motile, could sustain impacts as a result of transport, suspension and deposition of dredging-generated sediments. See Inner Apra Harbor section above for more a similar and more detailed impact analysis. Impacts would be less than significant.

Operation

The less than significant impacts to marine biological resources associated with the LCAC and AAV operation under Alternative 1 are expected to be similar to those described under Inner Apra Harbor above.

11.2.2.3 South

Baseline marine biology information for this South Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment. There would be no construction or operations impacts reaulting from implementation of Alternative 1 in this area.

11.2.2.4 Summary of Alternative 1 Impacts

Significant indirect impacts, mitigated to less than significant indirect impacts, are anticipated on EFH at Haputo ERA, specifically coral and coral reef ecosystem, with an increase of recreational use. All other impacts on marine biological resources are anticipated to be less than significant. Section 11.2.8, Table 11.2-1 describes associated impacts from all alternatives.

11.2.2.5 Summary of Alternative 1 EFH Assessment

The EFHA found that Alternative 1 actions may adversely affect EFH, specifically CRE MUS at Haputo ERA, without the implementation of appropriate mitigation measures. All other Alternative 1 actions would have no adverse effect on EFH and are summarized in Section 11.2.8, Table 11.2-6.

11.2.2.6 Alternative 1 Potential Mitigation Measures

In additional to Volume 2, Recreational Resources, Section 9.2.2.5 and the Terrestrial Biological Resources, Section 10.2.2.5, the following mitigation measure would help reduce impacts to marine biological resources. Potential Mitigation Measures for all Volumes are summarized in Volume 7.

Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Base Orders, educational training (i.e., require watching a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook* and natural resource educational handouts [i.e., to dive boat tours)), or a combination of all.

11.2.3 Alternative 2

11.2.3.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.3.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.3.3 Apra Harbor

Harbor

Alternative 1 is the only proposed wharf improvement alternative.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.3.4 South

Until further notice, impacts from this Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents**.**

11.2.3.5 Summary of Alternative 2 Impacts

The Alternative 2 impact assessment would be the same as prepared for Alternative 1.

11.2.3.6 Summary of Alternative 2 EFH Assessment

The Alternative 2 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6.

11.2.3.7 Potential Mitigation Measures

Mitigation measures for Alternative 2 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.4 Alternative 3

11.2.4.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.4.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.4.3 Apra Harbor

Harbor

Alternative 1 is the only alternative where the proposed wharf improvement and LCAC/AAV Laydown and Ramp projects are planned.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.4.4 South

Until further notice, impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.4.5 Summary of Alternative 3 Impacts

The Alternative 3 impact assessment would be the same as prepared for Alternative 1.

11.2.4.6 Summary of Alternative 3 EFH Assessment

The Alternative 3 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6

11.2.4.7 Potential Mitigation Measures

Mitigation measures for Alternative 3 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.5 Alternative 8

11.2.5.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.5.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for Alternative A or B.

11.2.5.3 Apra Harbor

Harbor

Alternative 1 is the only proposed wharf improvement and LCAC/AAV Laydown and Ramp.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.5.4 South

Until further notice, impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.5.5 Summary of Alternative 8 Impacts

The Alternative 8 impact assessment would be the same as prepared for Alternative 1.

11.2.5.6 Summary of Alternative 8 EFH Assessment

The Alternative 8 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6

11.2.5.7 Potential Mitigation Measures

Mitigation measures for Alternative 8 would be similar to those described under Alternative 1.

11.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

The embarkation areas and the LCAC/AAV laydown area, discussed in Section 2.7.5.2, would not be constructed. The USCG would not relocate facilities from Victor Wharf to Oscar and Papa Wharves, and the Military Working Dog Kennel would not be relocated. There eventually would be structural improvements at Victor, Sierra, and Uniform Wharves, including dredging at Sierra and Tango Wharves to maintain existing operations at these wharves.

The no-action alternative does not meet the purpose and need of the proposed action. It serves as a baseline, representative of the "status quo" condition, against which to compare the action alternatives when assessing potential environmental impacts. See Section 2.7.5.2 for the Description of Proposed Action and Alternatives (DOPAA) for this project for more details

11.2.7 Summary of Impacts

Table 11.2-8 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 11.2-9 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 11.2-10 and

11.2-11 summarize the impacts at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives respectively. A summary of potential noise impacts due to Other Training, Airfield, and Waterfront is provided in Table11.2-12. A text summary follows the summary tables.

Table 11.2-8. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1(North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions.
Operation			
SI-M • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary.	SI-M • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary.	SI-M • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary.	SI-M • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 11.2-9. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
LSI • Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs.	LSI • Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs.
Operation	
LSI • Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to Special-Status Species. Beneficial impacts to marine biological resources may be seen from restricted access to the coastal areas during training activities.	LSI • Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to Special-Status Species. Beneficial impacts to marine biological resources may be seen from restricted access to the coastal areas during training activities.

Legend: LSI = Less than significant impact.

Table 11.2-10. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-11. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-12. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. • Environmental effects from roadway construction activites are addressed in Volume 6.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	LSI • Less than significant direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during vessel movements (Outer and Inner Apra Harbor), dredging and in-water construction activities of wharves (pile driving) and LCAC and AAV operations area within Inner Apra Harbor. See Table 11.2-9 for EFHA summary. A beneficial mid-term impact to water quality may be seen from the removal of the fine benthic sediment within Inner Apra Harbor. • Less than significant direct and indirect impacts (no adverse effects) from increased vessel movements in Apra Harbor. • Less than significant impacts from runoff or spills associated with construction- related activities in Apra Harbor • Environmental effects from roadway construction activities are addressed in Volume 6.
Operation		
NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment. • Environmental effects from roadway construction activities are addressed in Volume 6.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	LSI • Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality, and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-9 for EFHA summary). • Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-9 for EFHA summary). • Less than significant direct and indirect impacts from increased vessel movements in Apra Harbor. • Less than significant impacts from runoff or spills associated with operation-related activities in Apra Harbor

Legend: LSI = Less than significant impact, NI = No impact.

11.2.8 Summary of Essential Fish Habitat Assessment

The Alternative 1 EFHA would be essentially the same for all alternatives. Table 11.2-13 below summarizes this Assessment.

Table 11.2-13. EFHA Summary

Area	*Project Activities*	*Project Specific Impacts*
NORTH		
Finegayan	Construction	Increased construction-related personnel and associated recreational activities may adversely affect EFH, specifically CRE MUS at the Haputo ERA. EFHA identified the following indirect and cumulative effects: • Minor, short-term and localized disturbance and displacement of motile species. • Adverse, short-term and localized potential effects to EFH. Specifically, potential damage to coral structures and the coral reef ecosystem within Haputo ERA. However, this effect would be mitigable to no adverse effect. There would be no adverse direct effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs measures as described in Volume 7.
	Operation	Increased operation-related personnel and associated recreational activities may adversely affect EFH at the Haputo ERA. EFHA identified the following indirect and cumulative effects: • Temporary and minor localized disturbance and displacement of motile species. • Long-term, localized, potential impacts to EFH. Specifically, potential damage to coral structures and coral reef ecosystems within Haputo ERA may adversely affect EFH. However, this effect is mitigable to no adverse effect. • Potential long-term reduction in the quality and/or quantity of the and EFH through long-term, periodic and localized degradation There would be no adverse direct effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
CENTRAL		
Non-DoD Land	Construction	There would be no adverse effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. Increased construction-related personnel and associated recreational activities would not affect EFH as access to this shoreline is limited and there are no dive boat tour spots identified. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
	Operation	There would be minimal indirect impacts to EFH from recreational activities of operation-based personnel and their dependants. Effects determination would be similar as that described above under construction. Additionally, beneficial impact to

Area	*Project Activities*	*Project Specific Impacts*
		nearshore communities due to limited and controlled access at the coastline during training operations. There would be long-term, localized accumulation of small arms (.50 cal and MK19 TP) expended materials in the benthic habitat from the range operations, however minimal potential for ingestion. Avoidance and minimization measures, including the use of "green bullets" (non-toxic alloys) and periodic benthic clean up would be employed to decrease potential impacts. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
APRA HARBOR		
Harbor	Construction	The proposed action would have direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances on EFH FMP species. These impacts would occur during dredging and in-water construction activities of the wharves (i.e. pile driving) and LCAC and AAV operations area associated with Inner Apra Harbor, including dredged spoils tug and scow movements through Outer Apra Harbor to the ocean disposal site. The EFHA for Apra Harbor found that the in-water construction and increase of construction-related vessel movements could result in: • Direct, short-term and localized removal of soft bottom habitat and infaunal community during dredging activities, which is anticipated to recovery quickly (2-6 months) due to horizontal reestablishment • Direct, short-term and localized impacts to invertebrates colonized on wharf vertical structures. Invertebrates are anticipated to quickly recolonize post construction. • Short-term, and localized disturbance and displacement of motile species of fish during in-water transit, dredging and pile driving activities. Ramping up methods of pile driving will allow marine species to exit the immediate area • Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from dredging, pile driving, and vessel propeller wash • Short-term, periodic, and localized increase in benthic sedimentation • Seasonal disturbances to potential scalloped hammerhead sharks As describe earlier, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the inner harbor. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as an important spawning or nursery area for either invertebrates or fishes. Based on this assessment, the Navy has determined that these minimal, short-term and localized impacts associated with Alternative 1would result in no adverse effects on EFH with the implementation of BMPs along with USACE permit conditions as described in Volume 7.
	Operation	The proposed action would have direct, indirect and cumulative impacts from noise, resuspension of sediment, decreased water quality, and other disturbances on EFH FMP species from increased vessel movements in Outer and Inner Apra Harbor. The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements would be a negligible increase, however would result in: • Long-term, however, periodic and localized disturbance and displacement of

Area	Project Activities	Project Specific Impacts
		motile species (fish) during in-water transit activities • Long-term, however, periodic and localized increase of turbidity (decreased water quality) in the water column from propeller wash • Long-term, however periodic and localized increase in benthic sedimentation • Long-term, however periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic • Seasonal disturbances to potential spawning scalloped hammerhead sharks. Based on this assessment, the Navy has determined that these temporary and/or minimal impacts associated with Alternative 1would result in no adverse effects on EFH with the implementation of BMPs as described in Section 11.2.2.1 and associated Figures (11.1-3 – 11.1-7, 11.1-11 and 11.1-12) and Tables 11.2-5, 11.2-6, and 11.2-7).
Naval Base Guam	Construction	The proposed action would have minimal direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances on EFH FMP species present during land-based and in-water construction activities of the LCAC and AAV operations area associated with Inner Apra Harbor. The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that larvae present would survive. Therefore, spawning and reproductive activities that may occur within the inner harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2006b). Based on this assessment, the Navy has determined that these minimal impacts associated with Alternative 1would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
	Operation	There would be minimal, short-term and localized impacts to EFH. Effects determination would be similar as that described above under construction.

11.2.9 Summary of Potential Mitigation Measures

In addition to Volume 2, Recreational Resources, Section 9.2.2.5 and the Terrestrial Biological Resources, Section 10.2.2.5, the following mitigation measures (Table 11.2-14) would further reduce impacts to marine biological resources. Potential mitigation measures for all Volumes are summarized in Volume 7.

Table 11.2-14. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Construction Activities			
• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all.

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
• Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.
Operation Activities			
• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all. • Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all. • Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all. • Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.	• Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook*), or a combination of all. • Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.

CHAPTER 12. CULTURAL RESOURCES

12.1 AFFECTED ENVIRONMENT

12.1.1 Definition of Resource

Cultural resources are defined as any district, site, building, structure, or object considered to be important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. Cultural resources include pre-Contact (before European contact) and post-Contact archaeological resources, architectural resources, and traditional cultural properties. The cultural resources discussed in this chapter only include those that meet the specific criteria of the National Historic Preservation Act (NHPA) and its associated regulations.

Pre-Contact and post-Contact archaeological resources are areas or locations (sites) where human activity measurably altered the earth or left deposits of physical remains. Archaeological resources can be identified and evaluated for significance according to each site's cultural importance, integrity, and ability to yield important information. Architectural resources are standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. Traditional cultural properties are resources associated with cultural practices and beliefs of a living community that are rooted in its history and are important in maintaining the continuing cultural identity of the community; such properties may not always be represented by archaeological or architectural resources. In general, specific locations of archaeological sites and traditional cultural properties are not revealed to the public because of the concern of vandalism or cultural sensitivity. Therefore, figures with specific locations of archaeological sites would not be presented in this chapter. However, figures with commonly known sites are presented in Volume 2, Chapter 9, Recreational Resources of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

12.1.1.1 Regulatory Review

Archaeological and architectural resources determined to be significant under cultural resource legislation such as the NHPA and the Archaeological Resources Protection Act (ARPA) are subject to protection or consideration by a federal agency. Significant cultural resources are those that are eligible for or listed on the National Register of Historic Places (NRHP). The criteria for significance are contained in Federal Regulation 36 Code of Federal Regulations (CFR) 60.4 and include criterion A) association with significant historic events, criterion B) association with significant people, criterion C) embodiment of distinctive characteristics, and criterion D) ability to yield information important in prehistory or history. Sites and structures that are eligible for or are listed on the NRHP on Guam include Latte Stone Park, Asan Invasion Beach, Agat Bridge, and Orote Field. Other sites or structures are important because they may yield important information about prehistory or history through the study of artifacts, such as pottery sherds, stone tools or their remains termed lithics, bottles, and food remains. The determination of significance is made in consultation with the Guam Historic Preservation Officer (HPO). Section 106 of the NHPA requires federal agencies to consider the effects of their actions on NRHP-eligible or listed cultural properties. The implementing regulations for Section 106 (36 CFR 800) specify a consultation process to assist in satisfying this requirement. This approach is in accordance with the Secretary of the Navy's Instruction 4000.35A, Department of Navy Cultural Resources Program.

National Historic Landmarks (NHL) are cultural resources of national historic importance and are automatically listed on the NRHP. Under the implementing regulations for Section 106 (36 CFR 800.10), special consideration to minimize harm to an NHL is required, and both the Advisory Council for Historic Preservation (ACHP) and the Secretary of the Interior are consulted if any adverse effects are likely to occur to such resources.

NRHP-eligible or listed post-Contact resources usually must be at least 50 years old; however, certain structures at technical or scientific facilities associated with important periods such as the Cold War, the Space Age, or the Nuclear Age, may be considered to be eligible for listing on the NRHP. Guidelines for determining the significance of traditional cultural properties are contained in *Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties* (National Park Service [NPS] 1998); however, in order to be considered a historic property under the NHPA, they must meet the criteria in 36 CFR 60.4.

Section 4(f) of the Department of Transportation Act of 1966 (49 United States (U.S.) Code [USC] 303) also offers protection to historic properties, which are resources that are eligible for or listed on the NRHP. The Transportation Administration (Federal Highway Administration or Federal Transit Administration) may not permit the use of historic properties unless it has been determined through evaluation that no prudent and feasible alternative to the use exists or unless it has been determined that the impact is considered *de minimis*, meaning trivial. The Transportation Administration may consider use of a historic Section 4(f) property *de minimis* if Section 106 consultation with the HPO results in a finding of No Adverse Effect or No Historic Properties Affected.

The laws and regulations related to the management and preservation of cultural resources on Guam consist of Title 21 Guam Code Annotated (GCA), Chapter 76, Historical Objects and Sites, codified as Public Law 12-126, which establishes public policy to implement a comprehensive program of historic preservation; Public Law 20-151, which establishes authority for preservation review of all government permits or licenses and provides authority to stop projects in violation of preservation requirements; Executive Order 89-9, which requires consideration of historic preservation for any action needing an approval of the Territorial Land Use Commission (now known as the Guam Land Use Commission); and Executive Order 89-24, which establishes policies for the disposition of archaeologically recovered human remains. The *Comprehensive Historic Preservation Plan for Guam* (Belt Collins 2007) and *Guidelines for Archaeological Burials* (Parks and Recreation n.d.) further define specific procedures and consultation requirements. Federal agencies are required to comply with federal laws, which supersede local laws; however, such compliance would meet local historic preservation goals.

12.1.1.2 Research Methodology

The region of influence (ROI) for cultural resources includes areas subject to construction, training maneuvers, firing and nonfiring ranges, road improvements, and landing zones (LZs), among other activities. The ROI for cultural resources is synonymous with the Area of Potential Effect (APE) under NHPA.

The methodology for determining the presence of NRHP-eligible or listed cultural resources within the ROI was based on a combination of existing data and special studies. The Navy assessed the adequacy of existing data (Tomonari-Tuggle et al. 2007) and conducted extensive archaeological and architectural surveys in Guam (Athens et al. 2008, Welch et al. 2008). These studies included:

- Complete surveys and assessment of resources in Naval Computer and Telecommunications Site (NCTS) Finegayan, South Finegayan, former Federal Aviation Administration (FAA)

parcel, Guam Land Use Plan (GLUP) 77 parcel, Naval Munitions Site (NMS), portions of Andersen Air Force Base (AFB), Andersen South, Navy Barrigada, Air Force Barrigada, and southeast of Route 15.

- Subsurface testing at Naval Base Guam and Dadi and Tipalao Beaches.
- Underwater surveys at Dadi and Tipalao Beaches.
- World War II (WWII) oral histories and archival studies.
- Traditional cultural property studies.

Three types of data on traditional cultural properties on Guam have been collected to identify traditional cultural properties in the study areas:

- Legendary association – myths, legends, or stories from the written record.
- Archaeological association – sites or other resources documented by archaeological investigations such as surveys, testing or excavations, or mitigation.
- Ethnographic association – information from the oral histories, as well as contemporary accounts from readily accessible sources, and current inventories of resources (marine or terrestrial) deemed important to traditional practices (Griffin et al. 2009a, b, c).

Additional information was provided by the Regional Integrated Cultural Resources Management Plan (ICRMP) for Commander Navy Region (COMNAV) Marianas Lands (Tomonari-Tuggle et al. 2005), the Andersen AFB ICRMP (Tomonari-Tuggle and Tuggle 2003), numerous survey reports, and traditional cultural property studies from Andersen AFB (Welch and Prasad 2006).

12.1.1.3 Historical Overview

Guam's oldest archaeological sites are from the Pre-Latte and Latte Periods of Chamorro occupation, prior to western contact in 1521. Other archaeological and architectural resources show evidence of Guam's status as a former possession of Spainand as an American territory, while numerous structures and relics attest to the island's occupation by Japan and subsequent reoccupation by the U.S. during WWII. Other areas on Guam are important to the Chamorro people because of their historical and traditional use. The following discussions first present a brief overview of regional prehistory and history, followed by a presentation of the type of investigations conducted in each area, the type and number of resources eligible or listed on the NRHP, and the potential for finding NRHP-eligible or listed cultural resources in the impact areas. Locations of archaeological sites on U.S. title fee land are protected under ARPA to prevent vandalism to sites not revealed to the general public; therefore, as previously noted, figures with site locations are not included in this section. However, sites commonly known to the public are presented in Volume 2, Chapter 9, Recreational Resources.

Pre-Contact in the Mariana Archipelago

At the time of Western contact, the Mariana Islands were inhabited by a group of people that came to be known to the rest of the world as the Chamorro. The first European contact in this archipelago is considered to have taken place in 1521, the year that Ferdinand Magellan and his crew landed on Guam after a 99-day voyage across the Pacific from South America. The inhabitants of all of the Mariana Islands were found to share similar customs, technology, and artifact styles. They spoke a non-Oceanic Austronesian language with dialect differences between islands (Levesque 1995).

Chamorro is one of only two non-Oceanic languages within the Austronesian family in remote Oceania, the other is Palauan. Examination of Chamorro syntax, phonology, and lexicon, when compared with other Austronesian languages and discounting post-European contact influences, indicates divergence from a distant Austronesian ancestry prior to the development of more than 450 related Oceanic

Austronesian languages in Melanesia, Micronesia, and Polynesia (Carson and Tuggle 2007). Linguistic evidence favors the central or northern Philippines as the most likely origin of populations initially settling the Mariana Islands.

Initial Settlement

The main Mariana Islands were settled by at least 1500 years Before Christ (B.C.) according to archaeological data. However, some paleoenvironmental evidence suggests initial settlement of Guam by as much as 300 to 900 years earlier, as yet uncorrobrated by archaeological data. Far from the Marianas being an accidental discovery, it appears much of island SE Asia was being populated at roughly the same time in what has been termed a "swarm" of maritime exploration (Peterson 2009), perhaps coinciding with a global high sea stand between 5,000 and 3,500 years Before Present (B.P.).

Early Settlement: Pre-Latte Period

This period dates from the time of initial settlement circa 1500 B.C. to Anno Domini (A.D.) 1000. Moore (2002 *in* Tomonari-Tuggle et al. 2007) subdivides the Pre-Latte Period into four phases based on pottery styles: Early Unai, Middle Unai, Late Unai, and Huyong. Archaeological sites dating to the early Pre-Latte Period are limited, but are usually found in coastal calcareous sand deposits and typically contain small numbers of redware pottery sherds (some with lime-filled stamping or incising) associated with marine midden or food remains, consisting mainly of bivalve shells. Site integrity is frequently compromised as a result of both natural shoreline processes reworking of the deposits and later human activities (Carson 2008).

Due to poor site integrity, evidence of residency and community composition is difficult to identify. However, the basic settlement pattern appears to have been one of small population groups living along the back of sandy embayments, especially near coastal lagoons with easy access to marine resources (Graves and Moore 1985). Caves and rock overhangs near shore were used for shelter, presumably during inclement weather. Considering the increasing quantity of shellfish and reef fish remains found in middle to late Pre-Latte coastal sites, it appears that subsistence practices still focused primarily on ocean resources, with an emphasis on exploitation of the shallow water, fringing reef, and lagoon areas (Reinman 1977, Kurashina and Clayshulte 1983, Hunter-Anderson 1989, Burtchard 1991). Activities that took place in the interior of the island are evident archaeologically, including burial of the dead and foraging for resources not available on the coast after typhoons or during prolonged doubts such as birds, fruit bats, and forest fruits and nuts.

Figure 12.1-1. *Latte* Site at NMS

Latte Period

The Latte Period is distinguished from earlier periods by the presence of *latte* sets or stone structures (Figure 12.1-1). The earliest and generally smallest *latte* structures date to between A.D. 1000 and 1300, while most of the largest

latte sets date to between A.D. 1450 and 1650 (Russell 1998). These sites are also accompanied by a change in pottery technology, from small bowls and griddles to larger jars, suggesting a change from baking to boiling techniques (Moore and Hunter-Anderson 1996). During this period populations increased and settlements expanded into areas outside of the optimal coastal environments (Dye and Cleghorn 1990; Hunter-Anderson and Moore 1994). Latte Period sites are more abundant than Pre-Latte sites on all of the Mariana Islands, and are present in virtually all environmental settings.

Lattes are large upright pillars of limestone, each topped by a semi-hemispherical capstone (Morgan 1988). These pillars were placed in two parallel rows of even numbered uprights forming a single set, supporting an A-framed superstructure of wood and thatch. *Latte*s served as foundations for house and storage structures of varying size and function, according to early Spanish records (Barratt 2003). Variation in the number and size of *latte* may reflect growing differentiation in the relative status of some occupants within late pre-Contact communities (Graves 1986). Burial areas are more commonly associated with larger *latte* sets, for instance. Individuals were buried beneath the structure and within the area formed by the pillars, although Spanish clergy noted the veneration of ancestral skulls within some structures above (Coomans 1997).

Latte Period sites generally consist of clusters of individual structures forming what the early Spanish called villages, although single *latte* sets are found in isolation too. They are most commonly found along the shorelines of the major Mariana Islands and in inland settings near permanent water or arable soils. Marine resources, such as fish and shellfish, continued to provide protein during this period, as did birds, fruit bats, lizards, and turtles. But the presence of *lusong* or boulder mortars near many *latte* sets (Dixon et al. 2006) suggests the increased consumption of rice (Butler 1990), while rock-filled ovens nearby are assumed to have been used to bake tubers such as taro or yams (Bulgrin 2006), or forest products such as breadfruit (Petersen 2006). Spanish clergy noted individual plots worked by Chamorro farmers well inland from coastal communities (Driver 1993), and the ubiquitous Latte Period pottery scatter in these settings may well be the archaeological signature of this agricultural landscape (Bulgrin 2009).

Post-Contact Period

European Contact

The Contact Period is the interval between Magellan's landing in 1521 and the first Spanish settlement on Guam in 1668. Latte stone structures continued to be built (Driver 1993), but Spanish-introduced materials are also found at a few sites dating to this period including iron, fragments of glass, and Asian or European ceramicstraded to the islanders by visiting sailors.

Breadfruit, coconuts, yams, and taro were traded to passing vessels during this time period (Coomans 1997), as were bananas, sugarcane, and rice, plus the results of inshore and offshore fishing. Chamorros were noted for their *proa* or unique sailing vessel and their superlative skills at handling these outrigger canoes (Barratt 2003), even in rough conditions.

Spanish Missions

Spanish missionaries of the Jesuit order arrived on Guam in 1668 with a small group of soldiers, intent on establishing a permanent colony for the glory of God and King. The Spanish changed native life in the Marianas drastically by 1700 as part of the *reduccion*, a deliberate effort to gather together all indigenous people of the archipelago into a few communities on Guam and Rota (Coomans 1997). They were initially assisted by a local leader on Guam named Quipuha who gave them land for a mission and garrison in what is now Agana (Garcia 1980), and helped them to convert some of the local population to Christianity. But when the Spanish clergy began systematic baptism of children, some of whom

succumbed to recently introduced diseases, several influential missionaries were killed and many Chamorro moved to the northern part of the island or fled to other islands.

New diseases and ensuing war with the Spanish decimated the local population of Guam, from an estimated pre-Contact level of between 20,000 and 40,000 in 1668, to a total of 1,800 in 1690 (Abella 1962 as cited in Tomonari-Tuggle et al. 2007) and only 1,600 by 1693 (Russell and Fleming 1990 as cited in Tomonari-Tuggle et al. 2007). Maize was introduced during this period after inland settlements were discouraged and it soon became a staple food crop, being processed into *tortillas* or *atol* using a *metate*. Rice also increased in importanceafter the introduction of the water buffalo as draft animal, and pigs, goats, and deer were added to the diet.

The Marianas in the 19th Century

The Philippines assumed administrative control over the Marianas in 1817, relinquishing direct control from Spain and New Spain (Mexico after 1821). Sometime between 1815 and 1820, after severe storms devastated the Caroline Islands, Carolinian refugees began arriving in the Marianas (Driver and Brunal-Perry 1996), as they may have done periodically in prehistory. During this period they established trading networks with the Spanish on Guam. By the 1880s, more Carolinians immigrated to the Marianas and were resettled to the northern islands of Saipan and Tinian where they assisted in rounding up and salting feral cattle for sale to Guam, and provided inter-island transportation for the government..

While the Carolinians were an asset to the Marianas economy, a serious drain on local self-sufficiency was incurred by the deportation of hundreds of Spanish and Philippino political prisoners to Guam from 1870 to 1877 (Madrid 2006), during which time often unsavory individuals were housed and fed by the residents of Agana and surrounding villages. In response to local privations, some prisoners were then sent to Saipan and Tinian where they often led a life of destitution. Such deportations eventually ceased and most of the remaining prisoners were repatriated, after which a period of relative political calm prevailed in Spain and its colonies.

Guam in the 20th Century

Guam was ceded by Spain to the U.S. government in 1898, but did not become a U.S. territory until 1950. Between 1898 and 1941 Guam served as a coaling and fueling station for Naval ships, as the site of the trans-Pacific cable station, the base of a strategic naval radio station, and a landing place for the Pan-American trans-Pacific air clippers flying between San Francisco and Hong Kong. Despite being surrounded by Japanese controlled islands, the U.S. did little in terms of military defense development (Peattie 1988) under terms of their agreement with other colonial powers in the Pacific after World War I.

A few hours after the attack on Pearl Harbor in December of 1941, Japanese planes from Saipan attacked Guam. Japanese planes first bombed the Pan American building and the Standard Oil fuel tank in Sumay. Then the Japanese turned to bombing military targets at the Piti navy yard, the Libugon radio towers, and the few vessels in and around Apra Harbor (Rogers 1995).

Two days later Japanese forces landed on Guam where the met with limited resistance. For the next 2 years the Japanese Navy controlled the island and its economy (Higuchi 2008). All of the Americans who were on the island were shipped to Japan as prisoners of war in January of 1942. In 1944 Japanese reinforcements came to Guam from Manchuria and began fortifying the beaches that the Americans might use for invasion landings and strategic overlooks (Denfield 1997). The local population was forced into labor to build these defenses and feed the soldiers, and eventually into internment camps when combat began (Sanchez 1979 *in* Tomonari-Tuggle et al. 2007).

In 1944 the U.S. began air raids over Japan-occupied Saipan, Tinian, Rota, and Guam. As a response, the Japanese ordered the Chamorro to construct air-raid shelters and to stock them with food. Most of these air-raid shelters were dugouts topped with coconut logs as well as tunnels dug into cliffs and hillsides (Rogers 1995).

The U.S. commenced an intensive bombardment of Guam that started on July 8, 1944 and lasted for 13 days. The 3rd Marine Division and the 1st Provisional Brigade landed on Asan Beach on July 21. The Army 77th Infantry Division followed on July 22. By July 27, American sovereignty over Guam was proclaimed andby August 10 all organized resistance ceased (Lodge 1954 as cited in Tomonari-Tuggle et al. 2007), although small groups of stragglers remained hidden for months and even years on Guam and other Mariana islands (Fukimi and Cross 1969, Jones 1986, Kahn 1962). Many Chamorro were killed during the American recapture of Guam, both by Japanese defenders in blatant acts of atrocity (Blas 2008, Palomo 1984), and inadvertently during U.S. bombing and urban combat.

Figure 12.1-2. Northwest Field 1945

After recapturing the island, there was a massive build-up of American forces and new facilities in support of air attacks on Japan and in preparation for an invasion of Japan. The new facilities included a major port and ship repair facility at Apra Harbor and five airfields, Northwest Field (Figure 12.1-2), North Field, Harmon, Agana, and Orote.

The Mariana Islands also became the platform for the strategic bombing campaign against Japan that was to employ the new VHB/VLR B-29 Superfortress. Five B-29 airfields were built in the Mariana Islands; Northwest Field and North Field were constructed on Guam, in the area that is now Andersen AFB. After WWII, Northwest Field was decommissioned, but North Field continued to be used and additional facilities were added in response to military needs arising from the Cold War, Korean War, and Vietnam War (Rogers 1995).

In 1946, a civilian government under U.S. Navy administration was established on Guam, and in 1950 the Guam Organic Act passed by the U.S. Congress made the island an unincorporated U.S. territory and gave Guamanians American citizenship, with significant amendments implemented in 1970. Since the late 1960s, tourism particularly from Japan and other Asian countries has become the mainstay of the Guam economy, alongside local government employment (see Volume 2, Chapter 16, Socioeconomics and General Services). Resorts have been developed in the Tumon and Agana Bay areas on the west coast, with a few inland golf courses. The American military presence on the island has also remained significant in the economy, through federal subsidies, civilian employment, and military personnel expenditures.

12.1.2 North

12.1.2.1 Andersen AFB

Andersen AFB is one of the largest airfields in Air Force jurisdiction. It covers 15,500 acres (ac) (6,273 hectares [ha]) and occupies a mostly flat, uplifted limestone plateau in the northern portion of the island. To the north, west, and east of the plateau, steep cliffs drop 500 to 600 feet (ft) (152 to 183 meters [m]) to a coastal terrace that extends 300 to 900 ft (91 to 274 m) to a rocky shoreline. The Tarague Embayment is a coastal flat along the north shore that offers the only direct access to the ocean from the base.

The eastern third of the base includes the main active airfield and an array of operations, maintenance, and community support facilities, most of which are located along the South Ramp. The North Ramp area includes operations of the Navy's HSC-25, munitions storage in the former Strategic Command storage area, and a parking apron space for contingency operations (U.S. Pacific Command [PACOM] 2006:2-6). The central third of the base is a Munitions Storage Area (MSA). The western third is Northwest Field (NWF), which is currently used for helicopter training, various field exercises, and bivouac.

This summary of surveys and resources on Andersen AFB is derived primarily from Tomonari-Tuggle and Tuggle (2003) and Tomonari-Tuggle et al. (2007). There have been 41 cultural resources surveys on Andersen AFB beginning in the 1920s. Two major cultural resource projects in the 1990s were the preparation of a Cultural Resources Management Plan (Schilz et al. 1996) and a study of the Tarague Embayment (Camacho et al. 1996 as cited in Tomonari-Tuggle et al. 2007, Liston 1996, Randall and Siegrist 1996 as cited in Tomonari-Tuggle et al. 2007, Tomonari-Tuggle and Olmo 1996 in Tomonari-Tuggle et al. 2007). The Cultural Resources Management Plan was updated in 2003 (Tomonari-Tuggle and Tuggle 2003). Other work included an overview survey of archaeological and architectural resources on Andersen AFB (Yoklavich et al. 1996 as cited in Tomonari-Tuggle et al. 2007), an assessment of proposed military training activities on Guam (McNeill and Welch 1998), identification of cultural resource improvement projects that could be implemented over the period Fiscal Year 2002 through 2007 (Tomonari-Tuggle and Welch 2001 in Tomonari-Tuggle et al. 2009), additional post-Contact sites documentation (Yoklavich 2003 in Tomonari-Tuggle and Welch 2007), and a surface survey along Route 9 (Yee et al. 2004).

Cultural resources on Andersen AFB include pre-Contact and post-Contact sites, post-Contact structures, and pictographs. The Pati Point Complex and the Tarague Beach Historic District are listed on the Guam Register (Guam Register of Historic Places 2008). NRHP-eligible or listed resources include the Tarague Beach Historic District, the Pati Point Complex, a Spanish oven and well, a stone pier, NWF, a farmhouse, water catchment features, a Japanese bunker, and reservoirs. There are a number of architectural resources on Andersen AFB that are eligible for or listed on the NRHP.

In 2004 a study was conducted to retrieve additional information about the lands on which Andersen AFB is located and identify the presence of any traditional cultural properties that may exist on Andersen AFB (Welch and Prasad 2006). No traditional cultural properties were identified on Andersen AFB during the course of the research. While the study succeeded in identifying and interviewing Chamorro and part-Chamorro informants with close ties to the lands within and around Andersen AFB, these informants were unable to identify places of traditional importance at the base; this inability to identify places of traditional importance is a likely result of alienation of the native peoples from the lands dating back to the arrival of Spanish missionaries and soldiers in the late 1600s. The Spanish forced all the occupants to leave their villages in the north of Guam and resettle in the south, and only gradually in the nineteenth century were the northern lands reoccupied. These new settlers frequently worked and lived on their "ranchos" while retaining permanent residence in a southern town; they were also Christianized and

gradually lost much of their spiritual knowledge connecting them to the land (Welch and Prasad 2006). However, later studies have identified two traditional cultural properties in the Andersen AFB region. The Tarague Historic District is a traditional property with archaeological, legendary and ethnographic associations. The Jinapsan Complex is a traditional cultural property with archaeological and ethnographic associations (Griffin et al. 2009). All of these resources are eligible for listing on the NRHP.

North Ramp

Previous surveys in the North Ramp area are listed in Table 12.1-1 (Tomonari-Tuggle et al. 2007). Portions of the North Ramp area had been previously surveyed for archaeological resources by Geo-Marine (2006). None of the sites recorded by Geo-Marine were eligible for listing in the NRHP.

Table 12.1-1. Previous Surveys in the North Ramp Area

Year of Work	*Reference*	*Type of Work*	*Location*
1992	Tuggle 1993	Surface survey of two areas near Andersen Airfield; no sites located	Adjacent of Beddown parcel
1992	Yoklavich et al. 1996*	Overview survey; field search for selected sites, based on documentary research	All of Andersen AFB
1996	McNeill and Welch 1998	Assessment of training areas	All of Andersen AFB
2002	Tomonari-Tuggle and Tuggle 2003	ICRMP, 2003 update	All of Andersen AFB
2003	Yoklavich 2003**	Documentation of three post-Contact sites	North Field
2004	Yee et al. 2004	Surface survey of Route 9 corridor between Main Gate and Potts Junction; relocation of previously identified sites	Northwest of APE
2005	Welch and Prasad 2006	Assessment of potential traditional cultural properties, including interviews with Chamorro with ties to the land in the Andersen AFB area	All of Andersen AFB
2006	Geo-Marine 2006	Survey of Air Force Guam FOL Ramp area	Guam FOL Ramp
2007	Welch et al. 2008	Survey of North Ramp Area north of North Field Complex	North of North Field Complex

Notes: * As cited in Tomonari-Tuggle et al. 2007
**As cited in Tomonari-Tuggle and Welch 2007

The remaining portions of the APE were surveyed in 2007; thirteen additional sites were recorded, and three previously recorded sites were reevaluated (Welch et al. 2008 as cited in Tomonari-Tuggle et al. 2007). Twelve sites in the ACE Beddown Area consist of five complexes of WWII-era and/or post-war concrete slabs/structures, the remains of a fuel tank farm, two WWII-era artifact concentrations, and four pre-Contact artifact scatters. Additionally, one pre-Contact artifact scatter was found in the Air Force Fighter Town Area. All of these sites are eligible for inclusion on the NRHP (Table 12.1-2). Given modern disturbance and the condition of resources found to date, the likelihood of finding previously undocumented sites in the North Ramp area is low.

Table 12.1-2. NRHP-eligible Sites in the North Ramp Area

Guam HPO Number	*Temporary Number*	*Site Description*	*NRHP/GR Status**
08-2124		Bottle Dump	Eligible
08-2127		Ceramic/artifact scatter	Eligible
	1038	Bottle/artifact dump	Eligible
	1039	Ceramic/artifact scatter	Eligible
	1040	Abandoned sewage disposal facility	Eligible
	1041	Concrete slab complex (49)	Eligible

Guam HPO Number	*Temporary Number*	*Site Description*	*NRHP/GR Status**
	1042	Concrete slab complex (13)	Eligible
	1043	Earthen berm rectangular structures (3), former tank farm	Eligible
	1044	Ceramic/artifact scatter	Eligible
	1045	Ceramic/artifact scatter	Eligible
	1046	Ceramic/artifact scatter	Eligible
	1049	Ceramic/artifact scatter	Eligible
	T-NW-1	Ceramic/artifact scatter	Eligible

Legend: *GR=Guam Register of Historic Places; Eligible= Eligible for the GR and NRHP.

Munitions Storage Area (MSA)

Portions of the MSA were surveyed by Davis (1984) and no sites were recorded. Other surveys and assessments are presented inTable 12.1-3. Approximately 30% of the MSA has been surveyed (Hokanson et al. 2008).

Table 12.1-3. Previous Surveys in the MSA

Year of Work	*Reference*	*Type of Work*	*Location*
1983	Davis 1983	Survey of Andersen Air Field	Main Operations Area
2003	Hunter-Anderson and Moore 2003	Survey of fenceline	MSA
2004	Mason Architects 2004	Historic Building Inventory	MSA 1 and 2
2006	DeFant and Leon Guerrero 2006	Survey within the MSA	MSA
2008	Hokanson et al. 2008	Survey within the MSA	MSA

Table 12.1-4 lists the previously recorded NRHP-eligible sites in the MSA (Tomonari-Tuggle and Tuggle 2003, Tomonari-Tuggle et al. 2007).

Table 12.1-4. NRHP-eligible Sites in the MSA

Guam HPO Number	*Temporary Number*	*Site Description*	*NRHP/GR Status**
08	PN-6	Spanish (?) Oven	Eligible
	Site 1	*Latte* site	Eligible
	Site 2	Limestone gravel mound	Eligible
	Site 2	Sherd scatter	Eligible
	Site 4	Sherd scatter with *lusong*	Eligible
	Site 6	Sherd scatter	Eligible
	Site 7	Sherd scatter	Eligible
66-08-2155		Artifact scatter	Eligible
66-08-2156		Artifact scatter	Eligible

Legend: GR=Guam Register of Historic Places; Eligible= Eligible for the GR and NRHP.

Although the MSA has been developed, archaeological resource potential is considered moderate. The survey by DeFant and Leon Guerrero in 2006 recorded eight sites in 70 ac (28 ha). Four of those sites are eligible for inclusion on the NRHP. Surveys by Hunter-Anderson and Moore and Hokanson et al. recorded sherd and artifact scatters along the fenceline and within the MSA. All buildings in the MSA built prior to 1950 have been surveyed and found ineligible for listing on the NRHP. Structures dating from 1950 to 1956 were inventoried in 2004. Three storage igloos (Buildings 8400, 8408, and 8617) within MSA1 are eligible for inclusion on the NRHP (Mason Architects 2004).

Surveys conducted for the current project within the MSA include one by Dixon and Walker (2009). They surveyed eight isolated parcels throughout the munitions storage area that would be impacted by the proposed action. Dixon and Walker located four sites within the MSA during their surveys that are eligible to the NRHP and were given the following temporary site numbers: T-9-1 (prehistoric artifact scatter), T-9-2 (prehistoric and WWII artifact scatter), T-15-1 (prehistoric artifact scatter with *lusong*), and T-3-1 (prehistoric artifact scatter).

Northwest Field (NWF)

Portions of NWF and areas surrounding NWF were surveyed by Kurashina et al. (1987), and Haun (1988, 1989). Table 12.1-5 lists the surveys associated with

NWF (Tomonari-Tuggle et al. 2007). Previously recorded sites, as listed in the Andersen AFB ICRMP (Tomonari-Tuggle and Tuggle 2003) are presented in Table 12.1-6.

Table 12.1-5. Previous Surveys in the NWF Area

Year of Work	*Reference*	*Type of Work*	*Location*
1987	Kurashina et al. 1987	Surface Survey	NWF
1988	Haun 1988	Reconnaissance Survey	NWF
1989	Haun 1989	Reconnaissance Survey	NWF
1992	Yoklavich et al. 1996*	Overview survey; field search for selected sites, based on documentary research	All of Andersen AFB
1996	McNeill and Welch 1998	Assessment of training areas	All of Andersen AFB
2002	Tomonari-Tuggle and Tuggle 2003	ICRMP, 2003 update	All of Andersen AFB
2005	Welch and Prasad 2006	Assessment of potential traditional cultural properties, including interviews with Chamorro with ties to land the Andersen AFB area	All of Andersen AFB

Notes: As cited in Tomonari-Tuggle et al. 2007

Table 12.1-6. NRHP-eligible Sites in the NWF Area

Guam HPO Number	*Temporary Number*	*Site Description*	*NR/GR Status**
08-100+		Sherd Scatters	Eligible
08-200+		Sherd Scatters	Eligible
08-01065		NWF Runways	Eligible
08	PN-5	Sherd Scatters	Eligible
08	PN-8+	Water Catchments	Eligible

Legend: GR=Guam Register of Historic Places; NR=National Register of Historic Places; Eligible= Eligible for the GR and NR.

All buildings in the NWF area built prior to 1950 have been surveyed and found ineligible for listing on the NRHP. NWF itself (site 08-01065), which is eligible for listing on the NRHP for its role in the strategic bombing of Japan in 1945, remains in use as an active training site for fixed-wing and helicopter units. The NWF site has been fully documented in the Historic American Engineering Record as part of the mitigation for the Memorandum of Agreement for the NWF Beddown Initiatives in 2006 (Aaron et al. 2007).

Current protective measures at Andersen AFB include a Programmatic Agreement (PA) regarding the implementation of military training on Guam that was signed and executed in 2009 as part of the Mariana Islands Range Complex (MIRC) EIS/OEIS (Navy 2009). The PA specifies that any area of NWF that has not been previously surveyed and in which training involves construction or ground-disturbing activities would be surveyed and inventoried for pre-Contact or post-Contact resources. Any archaeological sites

within the affected area would be evaluated for inclusion on the NRHP. Any site(s) determined eligible for the NRHP that cannot be avoided would be subjected to data recovery. The PA also specifies that certain areas of NWF are designated for certain training activities, such as LZs and drop zones, bivouac, and driver training areas (Navy 2009).

Surveys conducted for the current project within the NWF vicinity by Dixon and Walker (2009) include a 90-ac (36 ha) area in the southeast corner of the NWF and a 250-ac (101 ha) area in the northwest corner of the NWF. In the 90-ac (36 ha) area, Dixon and Walker located two sites eligible to the NRHP which were given the following temporary site numbers: T-90-2 (prehistoric agricultural zone and WWII artifact scatters), and T-90-3 (prehistoric agricultural zone and artifact scatters).

Within the 250-ac (101 ha) area, 41 sites were recorded by Dixon and Walker (2009), including 25 prehistoric pottery scatters considered to be eligible to the NRHP (T-SP-4, and T-NW-2, 4-7, 11-14, 18-24, 26-29, 34, 36, 39, and 40), two prehistoric pottery scatters with WWII artifacts considered to be eligible to the NRHP (T-NW-9 and 15), three WWII Japanese defensive sites eligible to the NRHP (T-SP-1 through 3), one WWII American fuel tank farm eligible to the NRHP (T-NW-8), one WWII concrete pad and artifact scatter eligible to the NRHP (T-NW-3), six WWII artifact scatters eligible to the NRHP (T-NW-16, 25, 31, 35, 37, and 38), one WWII firing range eligible to the NRHP (T-NW-32), and two post-WWII artifacts scatters not eligible to the NRHP (T-NW-1 and 10).

South Ramp

The South Ramp area was surveyed by Davis in 1983; however, information on sites from that survey is limited. Because of development in this area, resource potential in the South Ramp area is considered low. An additional survey of this area was completed in 2009 for the Air Embarkation project (Dixon and Walker 2009). No sites were located during this survey.

North Gate Construction Access Road

This 1.5-mile (mi) (2.4 kilometers [km]) long roadway was surveyed in 2008 for the Guam Joint Buildup EIS (Athens et al. 2008). No NRHP-eligible archaeological sites were located during the survey.

Secondary Access Road

The 37-ac (15-ha) Secondary Access Road project area was surveyed in 2008 for this EIS/OEIS (Athens et al. 2008). The area surveyed was located along existing roadways. No NRHP-eligible archaeological sites were located during the survey of this area.

Potts Junction

The 50-ac (20.2-ha) Potts Junction APE was surveyed in 2007 (Welch et al. 2008). The area had been substantially disturbed as a result of its development as a fuel storage tank farm. No archaeological sites were identified in the APE.

Water Wells

Dixon and Walker (2009) also surveyed 22 well locations located in the southern portion of Andersen AFB for the current project, only three of which were located within the MSA. Four previously unrecorded sites were located outside the MSA and were given temporary site numbers: T-W-4 (WWII era artifact scatter), T-W-5 (post-WWII artifact scatters and concrete pad), T-W-7 (prehistoric artifact scatter), and T-W-14 (post WWII artifact scatter and aircraft remains). Of these sites, only T-W-4 and T-W-7 were found eligible to the NRHP.

12.1.2.2 Finegayan

Comprising about 2,952 ac (1,195 ha), NCTS Finegayan and South Finegayan are located in northwestern Guam, west of Route 3 and south of NWF at Andersen AFB. The limestone plateau area of NCTS Finegayan supports headquarters activities, communications center activities, and provides communications receiving operations for the Navy. South Finegayan contains family housing. Table 12.1-7 provides a summary of the surveys that have taken place at NCTS Finegayan (Tomonari-Tuggle et al. 2007). Three traditional cultural properties have been recorded in Finegayan (two in NCTS Finegayan and one in South Finegayan). Haputo Beach and Pugua Point (NCTS Finegayan) are traditional properties with both archaeological and ethnographic associations (Griffin et al. 2009). Latte Stone Park (South Finegayan) has archaeological associations.

NCTS Finegayan

Four surveys in NCTS Finegayan on the limestone plateau were conducted in the late 1980s (Kurashina et al. 1987; Haun 1988, 1989; Highness and Haun 1990 as cited in Tomonari-Tuggle et al. 2007). Ceramic scatters were identified by Kurashina et al. (1987) and Haun (1988). These surveys overlapped Andersen AFB property. More recent surveys had difficulty re-identifying these scatters, primarily due to the nature of the sites and the dense ground cover in the area.

A Phase II archaeological survey including archival research, field survey, and subsurface testing was conducted by Olmo et al. (2000 *in* Tomonari-Tuggle et al. 2007) in portions of NCTS Finegayan and South Finegayan. This study included a complete survey of the coastal shelf and a partial survey of the limestone plateau. The study identified over 20 sites of significance.

Previous surveys at NCTS Finegayan have recorded 28 sites that are considered to be eligible or need further evaluation (Tomonari-Tuggle et al. 2005).

Table 12.1-7. Summary of the Surveys that have Taken Place at NCTS Finegayan

Year of Work	*Reference*	*Type of Work*	*Location*
1921-4	Hornbostel n.d*, Thompson 1932	Survey	Coast
1952	Reed 1952*	Survey	Coast
1965-6	Reinman 1967*	Survey	Coast
1986	Kurashina et al. 1987	Survey boundary with Andersen AFB; 17 sherd scatters recorded; Post-Contact sites not recorded	NCTS Finegayan
1988	Haun 1988	Survey boundary with Andersen AFB; sherd scatters found, only some recorded	NCTS Finegayan (northern area)
1988	Haun 1989	Reconnaissance survey near boundary with FAA parcel	NCTS Finegayan (southern area)
1990	Highness and Haun 1990*	Inventory survey of facility in northern area of NCTS Finegayan	NCTS Finegayan (northern area)
1992	Craib and Yoklavich 1996c*	Overview survey	All of NCTS Finegayan
1993	Lauter-Reiman 1997	Management plan for WWII resources	All of NCTS Finegayan
1996	McNeill and Welch 1998	Assessment of training area	All of NCTS Finegayan
1998	Tuggle and Welch 2000	Archival research, reconnaissance survey, assessment	FAA Parcel

Year of Work	*Reference*	*Type of Work*	*Location*
1998	Olmo et al. 2000*	Phase II survey and detailed recording; complete survey of coastal shelf, reconnaissance survey of limestone plateau	NCTS Finegayan
2000	Hunter-Anderson et al. 2001	Survey, limited archaeological testing	FAA parcel
2001-5	Welch et al. 2005*	Synthesis of Guam prehistory and history	All of Guam
2001-5	Tomonari-Tuggle et al. 2005	Regional ICRMP for Navy lands	All NCTS Finegayan
2007	Welch et al. 2008	Survey, limited testing	NCTS Finegayan, GLUP 77
2008	Athens et al. 2008	Survey	South Finegayan, Former FAA Parcel

Notes: *As cited in Tomonari-Tuggle et al. 2007

At total of 1,400 ac (565 ha) at NCTS Finegagan on the limestone plateau were surveyd in 2007 (Welch et al. 2008). The survey resulted in the identification of 19 previously unrecorded archeaolical sites: 13 pre-Contact and six post-Contact period sites. The pre-Contact sites consist of ten artifact scatters, five with possible middens, two isolated mortars found near bulldozed mounds filled with post-Contact or modern debris, and one large site that includes three *lusong* (grinding stone), several *latte* stone pillars and capstones, three possible quarry areas, and at least four possible midden areas with ceramics, other ceramic scatters, and numerous basalt artifacts (Tomonari-Tuggle et al. 2005, Welch et al. 2008). All of these sites are eligible for inclusion on the NRHP (Table 12.1-8).

Table 12.1-8. NRHP-Listed or Eligible Sites in the NCTS Finegayan Area

*Guam HPO Site #/Map #**	*Temporary Map #*	*Site Name/Description*	*NRHP/GR Status*
08-0007/370		Haputo Complex Large Pre-Contact/post-Contact village	NRHP/GR
08-0008/373		Paugua Point Complex: includes 20 sites, extends 450 m	Eligible
374		Tweed's Cave	Eligible
375		Ceramic scatter	Eligible
376		Ceramic scatter	Eligible
377		Ceramic scatter	Eligible
378		Ceramic scatter	Eligible
379		Ceramic scatter	Eligible
380		Artifact scatter	Eligible
381		Ceramic scatter	Eligible
687		Pugua Point 1	Eligible
688		Pugua Point 2	Eligible
689		Pugua Point 3	Eligible
690		Pugua Point 4	Eligible
691		Pugua Point 5	Eligible
693		Pugua Point 7	Eligible
694		Pugua Point 8	Eligible
695		Pugua Point 9	Eligible
696		Sinkhole and rockshelter complex	Eligible
697		Rockshelter	Eligible
698		Rockshelter	Eligible
699		Cave	Eligible
700		Rockshelter	Eligible

*Guam HPO Site #/Map #**	*Temporary Map #*	*Site Name/Description*	*NRHP/GR Status*
701		Rockshelter	Eligible
702		Rockshelter	Eligible
703		Artifact Scatter	Eligible
704		Artifact Scatter	Eligible
705		Rockshelter complex, pictographs	Eligible
	1031	Artifact scatter	Eligible
	1024	Mortar/*lusong*	Eligible
	1026	Habitation site/artifact scatter	Eligible
	1032	Mortar/*lusong*	Eligible
	1027	Encampment	Eligible
	1028	Encampment	Eligible
	1029	Water catchment structure	Eligible
	1030	Artifact scatter	Eligible
	1033	Artifact scatter	Eligible
	1034	Artifact scatter	Eligible
	1035	Artifact scatter	Eligible
	1012	Artifact scatter	Eligible
	1018	Concrete trough structure	Eligible
	1019	Artifact scatter	Eligible
	1020	Artifact scatter	Eligible
	1021	Artifact scatter/Concrete pad	Eligible
	1022	Artifact scatter	Eligible
	1023	4 defense structures	Eligible

Legend: **GR=Guam Register of Historic Places; Eligible= Eligible for the GR and NR.
Notes: *See Welch et al. 2005 (as cited in Tomonari-Tuggle et al. 2007): Appendix A (Guam Sites in the Navy Retained Lands Presented in Geographic Information System Assigned Map Number Order).

Three post-WWII encampments were also identified during the survey in 2007. Two camps were identified by the presence of curbed concrete foundations and the third by the presence of numerous artifacts. A crudely built, long narrow curbed concrete trough structure may date from the 1950s and be associated with nearby barrow pits. There are no NRHP-eligible or listed architectural resources in NCTS Finegayan APE (Welch et. al. 2008 as cited in Tomonari-Tuggle et al. 2007).

An additional 150 ac (61 ha) was surveyed at NCTS Finegayan in 2008 near the northern boundary of NCTS Finegayan (Athens et al. 2008). Two post-Contact and four pre-Contact sites were recorded; however, because of poor condition, none are eligible for inclusion on the NRHP. The pre-Contact sites were pottery scatters and the post-Contact sites were concrete pads.

South Finegayan

A Phase II archaeological survey including archival research, field survey, and subsurface testing was conducted by Olmo et al. (2000 as cited in Tomonari-Tuggle et al. 2007) in portions of NCTS Finegayan and South Finegayan. This study included a complete survey of the coastal shelf and a partial survey of the limestone plateau. One site was listed on the NRHP (Table 12.1-9) (Tomonari-Tuggle et al. 2007).

Table 12.1-9. NRHP-listed Sites in the South Finegayan Area

*Guam HPO Site #/Map #**	*Site Name/Description*	*NRHP/GR Status**
08-0141/811	Latte Stone Park; *latte* set, cultural deposit	NRHP, GR

Legend: *GR=Guam Register of Historic Places.

Archaeological surveys completed in 2008 of South Finegayan encountered no intact archaeological resources (Athens et al. 2008). This area has been highly disturbed by bulldozing and clearing activities.

In addition, there are no NRHP-eligible or listed architectural resources in South Finegayan project area (Welch et al. 2008).

12.1.2.3 Non-DoD Land

Former FAA Parcel

The former FAA parcel was subject to a reconnaissance survey by Tuggle and Welch in 1998. They conducted ground surveys along the coastal cliffs and in selected areas of the limestone plateau. At Ague Cove they documented three rock shelters, a cave with rock art, and a midden scatter. The previously recorded Hilan'an Rock Shelter was also relocated during this survey. The WWII-era Navy Communications Camp was recorded on the limestone plateau. As a follow-up to this survey Hunter-Anderson et al. (2001) conducted a survey and did limited archaeological excavations. They identified four pre-Contact sites and a post WWII site.

New resource potential in the Former FAA parcel is low (Tomonari-Tuggle et al. 2007). During the 2008 survey no new cultural resources were located (Athens et al. 2008). However, the previously recorded cultural resources were relocated and are eligible for inclusion on the NRHP (Table 12.1-10).

Harmon Annex Area

The Harmon Annex area has not been surveyed. A reconnaissance survey would be conducted in 2009; however the area was used for airfield operations during WWII and probably contains numerous historic sites.

12.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

Thirteen roadway improvement projects are located in the north region along existing Routes 1, 3, 9, 28, and 15, including new road construction between Route 1 and Finegayan South. No known historic properties are located within the APE of any project in the north region.

Table 12.1-10. NRHP-eligible Sites in the Former FAA Parcel

Guam HPO Site #	*Site Name/Description*	*NR/GR Status***
GL-12	Partially disturbed cultural deposits; ceramics, burned limestone	Eligible
08-0066	FAA rock shelter, deposit, Latte Period ceramics on surface	Eligible
08-1672	Rock shelter; ceramics on surface	Eligible
08-1673	Ceramics scatter	Eligible
08-1674	Rock shelter, ceramics on surface	Eligible
08-1675	Cave with pictographs	Eligible
08-1676	Rock shelter	Eligible
08-1677	Rock shelter	Eligible
08-1678	Ceramic scatter	Eligible
08-1680	Mortar	Eligible
08-1681	Ceramic scatter	Eligible

Legend: **GR=Guam Register of Historic Places; NR=National Register of Historic Places.

12.1.3 Central

12.1.3.1 Andersen South

Andersen South covers approximately 2,000 ac (809 ha) in east-central Guam (Kaschko and Welch 2002:1 as cited in Tomonari-Tuggle et al. 2007). The Andersen South Housing Area is no longer in use for housing; family housing and bachelor quarter buildings that remain on-site are in poor condition. However, power and water related infrastructure and roadways are maintained by Andersen AFB. The abandoned housing area is currently used for military training. The northern portion of Andersen South contains the remnants of the Army Air Corps Base Command. Andersen AFB considers all of Andersen South as a training area without cultural resources constraints (Navy 2009). Table 12.1-11 summarizes previous surveys that have taken place in the Andersen South parcel (Tomonari-Tuggle et al. 2007).

Table 12.1-11. Previous Surveys at Andersen South Parcel

Year of Work	*Reference*	*Type of Work*	*Location*
1947	Osborne 1947*	Survey	All of Guam
1952	Reed 1952*	Survey	All of Guam
1992	Yoklavich et al. 1996*	Overview survey, field search for selected sites, based on documentary research	All of Guam
2002	Kaschko and Welch 2002*	Assessment survey	All of Guam
2001-5	Welch et al. 2005*	Summary of Guam prehistory and history	All of Guam
2001-5	Tomonari-Tuggle et al. 2005	Regional ICRMP for Navy lands	All of Navy lands on Guam
2007	Welch et al. 2008	Survey and limited testing	All of Andersen South
2009	Dixon and Carson 2009	Survey	Eastern portion of Andersen South

Notes: *As cited in Tomonari-Tuggle et al. 2007

Kaschko and Welch (2002 as cited in Tomonari-Tuggle et al. 2007) conducted a study of Andersen South which included field inspections to evaluate the potential presence of cultural resources, and to predict the kind and density of cultural resources likely to be found and the geographic location where these resources may be situated.

A 2007 survey of Andersen South covered approximately 1,700 ac (688 ha) (Welch et al. 2008). The Andersen South archaeological sites consist of: 1) a complex of WWII and post-WWII military infrastructure, mostly associated with MARBO Command; 2) an isolated early 20th century building; 3) an area of scattered Latte Period subsurface deposits; and 4) a second area of scattered Latte Period subsurface deposits (Welch et al. 2008). All of these sites are eligible for inclusion on the NRHP (Table 12.1-12).

Table 12.1-12. NRHP-eligible Sites at Andersen South Parcel

Site Number (Temp.)	*Map Number*	*Site Description*	*NRHP/GR Status**
T-2 (2007)	1051	Former U.S. Army Medical Department complex (former T-8)	Eligible
T-7 (2007)	1063	Subsurface pre-Contact artifact scatter	Eligible
T-20 (2007)	1065	Subsurface pre-Contact artifact scatter (former T-13)	Eligible

Legend: *GR=Guam Register of Historic Places; Eligible=Eligible for the GR and NRHP.

There are two NRHP-eligible buildings at Andersen South, an incinerator potentially associated with the former 204th Army Hospital and a series of concrete pads (Welch et al. 2008). The small portion of the

Andersen South area that was not surveyed in 2007 was surveyed in 2008 (Dixon and Carson 2009). An additional eight prehistoric sites were recorded during this survey. They include artifact scatters and a bulldozed displaced *latte* set. All of the eight sites are eligible for inclusion on the NRHP.

12.1.3.2 Barrigada

Navy Barrigada

Navy Barrigada covers 1,850 ac (749 ha) in east-central Guam. The two main uses of Navy Barrigada are former and active communications facilities, which occupy the eastern half and western edge of Navy Barrigada, and the Barrigada Golf Course, which is in the middle of Navy Barrigada. Table 12.1-13 summarizes the previous surveys that have taken place at Navy Barrigada (Tomonari-Tuggle et al. 2007).

Table 12.1-13. Previous Surveys at Navy Barrigada

Year of Work	*Reference*	*Type of Work*	*Location*
1984	Kurashina and Sinoto 1984*	Inventory survey of Loran-C station site southeast of golf course	Adjacent area
1991	Craib and Yoklavich 1996a*	Overview survey of NCTAMS Westpac	All of Navy Barrigada
1993	Lauter-Reinman 1997	Cultural Resources Management Plan for WWII resources	All of Guam
1996	McNeill and Welch 1998	Assessment of training area	All of Navy Barrigada
1998	Olmo et al. 2000*	Phase II survey and detailed recording in undeveloped areas	East of Navy Barrigada
1999	Tuggle and Welch 2000	Archival research, reconnaissance survey, assessment for GLUP	All of Guam
2000	Hunter-Anderson et al. 2001	Survey, limited testing	Adjacent areas
2001-5	Welch et al. 2005*	Synthesis of Guam prehistory and history	All of Guam
2001-5	Tomonari-Tuggle et al. 2005	Regional ICRMP for Navy lands	All of Navy lands on Guam
2008	Athens et al. 2008	Survey, limited testing	100 ac (40 ha) within Navy Barrigada

Notes: *As cited in Tomonari-Tuggle et al. 2007

Four field surveys have been conducted in and near Navy Barrigada. The first was by Kurashina and Sinoto (1984 as cited in Tomonari-Tuggle et al. 2007). No evidence of pre-Contact sites was found during the survey, although an informant suggested that two *latte* stones had once been in the area. Tuggle and Welch (2000) conducted a survey of selected portions of Navy Barrigada and Hunter-Anderson et al. (2001) completed surface surveys and limited tests based on the Tuggle and Welch study. Olmo et al. (2000 *in* Tomonari-Tuggle et al. 2007) conducted an archaeological survey (Phase II) of portions of Navy Barrigada that included subsurface testing. Two sites are currently eligible for inclusion on the NRHP (Table 12.1-14) (Tomonari-Tuggle et al. 2007).

Table 12.1-14. NRHP-eligible Sites at Navy Barrigada

Site #	*Map #*	*Site Description*	*NRHP/GR Status**
04-1059	367	Barrigada Battlefield; site of battle August 2-3, 1944; includes Barrigada Well and reservoir, which were the objective of the battle	Eligible
04-1705	371	Officers Country Gates; includes entry pillars and other remains of U.S. officers' quarters; distinctive masonry of entry gates indicates possible construction by Japanese prisoners in 1945	Eligible

Legend: *GR=Guam Register of Historic Places; Eligible= Eligible for the GR and NRHP.

A 2008 survey of Navy Barrigada (Athens et al. 2008) encountered human bone fragments and a metate, which is a flat stone that has a shallow depression in the upper surface for holding maize or other grains so they can be more easily ground. One traditional cultural property has been identified on the Navy Barrigada (Mount Barrigada). Mount Barrigada is tied to the origin myth of the Chamorro people (Griffin et al. 2009).

Air Force Barrigada

An archaeological survey of the Air Force Barrigada APE took place in 2008. No archaeological sites were identified in the APE during the survey. The survey area had already been highly disturbed by bulldozing activity; however, road beds greater than 50 years in age are located in the APE and may be eligible for inclusion on the NRHP.

12.1.3.3 Non-DoD Land

Route 15 Valley and Escarpment

The proposed firing ranges for Alternatives A and B associated with the proposed action are located on the Route 15 valley and escarpment east of Andersen South. Approximately 60% of the Route 15 impact area has been surveyed. The unsurveyed areas are considered to be medium probability areas for archaeology because archaeological sites are known from the vicinity. Resource potential in the Route 15 survey area is high. Near the coast outside the project area, the Pagat Site Complex (Site 04-0022) is contemporary with the historically known Pagat Village, where a Spanish church was built in 1672 (Table 12.1-15). The Pagat Site Complex includes at least 20 *latte* sets, more than 50 mounds of artifacts and midden, remnants of trails, more than 30 mortars and grinding areas, an unknown number of caves and rock shelters, and other features (Carson and Tuggle 2007). Limited test excavations revealed a widespread and dense Latte Period deposit associated with the surface-visible remains, and remnants of an earlier occupation period were present in some locations (Carson and Tuggle 2007). Surveys of the Route 15 impact area indicate as least three other NRHP-eligible sites are located within this area (Dixon and Carson 2009). They include sites 04-0021, 04-0024, and 04-0642. Two of these sites are also traditional cultural properties, including the Pagat site and Marbo Cave, already identified in the Route 15 area (Griffin et al. 2009).

Cabras Point

Surveys of the Cabras Point project area were conducted in 2008 (Dixon and Carson 2009). No archaeological resources were recorded during the survey, although the area has been subject to considerable disturbance since at least 1898.

Table 12.1-15. NRHP-eligible and Listed Sites at Route 15 Parcel

*Guam HPO Site #/Map #**	*Temporary MAP #*	*Site Name/Description*	*NRHP/GR Status*
04-0024		Marbo Site	Eligible
04-0642		Rock shelter	Eligible
04-0021		Pagat Site	Eligible
04-0022		Pagat Site (main)	NRHP
MaG-Ma-5		*Latte* Period Site	Eligible
MaG-Ma-6		*Latte* Period Site	Eligible
AS-T-2007-07		*Latte* Period Site	Eligible
AS-T-2007-20		*Latte* Period Site	Eligible

Legend: *GR=Guam Register of Historic Places; Eligible=Eligible for the GR and NRHP.

12.1.3.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Thirty-three (33) roadway improvement projects are located in the central region along existing Routes 1, 8, 8A 10, 15, 16, 25, 26, and 27, Alageta-Lily, and Chalan Lujuna Road. Several known historic properties are within the APE for these projects. Historic properties are listed inTable 12.1-16 and Figure 12.1-3 illustrates the location of well known historic properties in the APE. Archaeological sites are not depicted on Figure 12.1-3.

Table 12.1-16. Historic Properties within the APE of Central Region Projects

Historic Property	*Description*	*GRN #*
Cormoran Monument	The Cormoran Monument is a monument to the sailors lost aboard the *Cormoran*. It is located within the U.S. Naval Cemetery. It was listed on the GRHP July 24, 1974.	1
U.S. Naval Cemetery	The U.S. Naval Cemetery in Agana is listed on the NRHP and GRHP.	1
Asan Invasion Beach	Asan Invasion Beach is listed as on the NRHP and GRHP. It is the site of the U.S. invasion, July 21, 1944. Part of this property is included within the War in the Pacific National Historic Park (NHP).	13
Memorial Beach Park	Memorial Beach Park is listed on the NRHP and GRHP. It is the site of the U.S. invasion, July 21, 1944. It is included within the War in the Pacific NHP.	13
War in the Pacific National Historic Park	This park was listed on the NRHP and GRHP in 1978. This unique National Park is the only site in the National Park System that honors the bravery and sacrifices of all those who participated in the Pacific Theater of World War II.	13
Aspaalas #675	Archaeological site.	13
Adelup RT Burial #300	Archaeological site.	14
Asan Patriots of World War II Memorial	Asan Patriots of World War II Memorial is listed on the GRHP, and it is eligible for listing on the NRHP.	14
Asan archaeological site	Archaeological site.	14
Guam Heroes Memorial / Skinner Plaza	Eligible for the NRHP/GRHP.	15
Taitano House	Eligible for the NRHP/GRHP.	15
Garrido House	Listed on the GRHP in 1984.	15
Toves House	Listed on the NRHP and GRHP.	15
Agana Spanish Bridge	Listed on the NRHP and GRHP. Stone arch bridge ca. 1800.	15
Agana-Hagatna Pillbox	Listed on the NRHP and GRHP. Japanese coastal defense fortifications.	15
Unnamed Archaeological Site	Archaeological site.	36

Legend: GRHP= Guam Register of Historic Places; GRN= Guam Road Network.

GRN #1 passes by the U.S. Naval Cemetery and Fortification along Route 1. Cormoran Monument is also located within the cemetery boundary. GRN #13 passes by the Asan Invasion Beach and Memorial Beach Park, which are adjacent to the north side to Route 1, along the Philippine Sea. Both of these properties are included within the War in the Pacific NHP. The NHP has a much larger boundary and straddles Route 1 at Asan Point. GRN #13 also passes by one archaeological site. GRN #14 is adjacent to the Asan Patriots of World War II Memorial and two archaeological sites. GRN #15 is adjacent to parcels holding the San Nicholas Bridge, the Guam Heroes Memorial, historic Skinner Plaza, Taitano House, Garrido

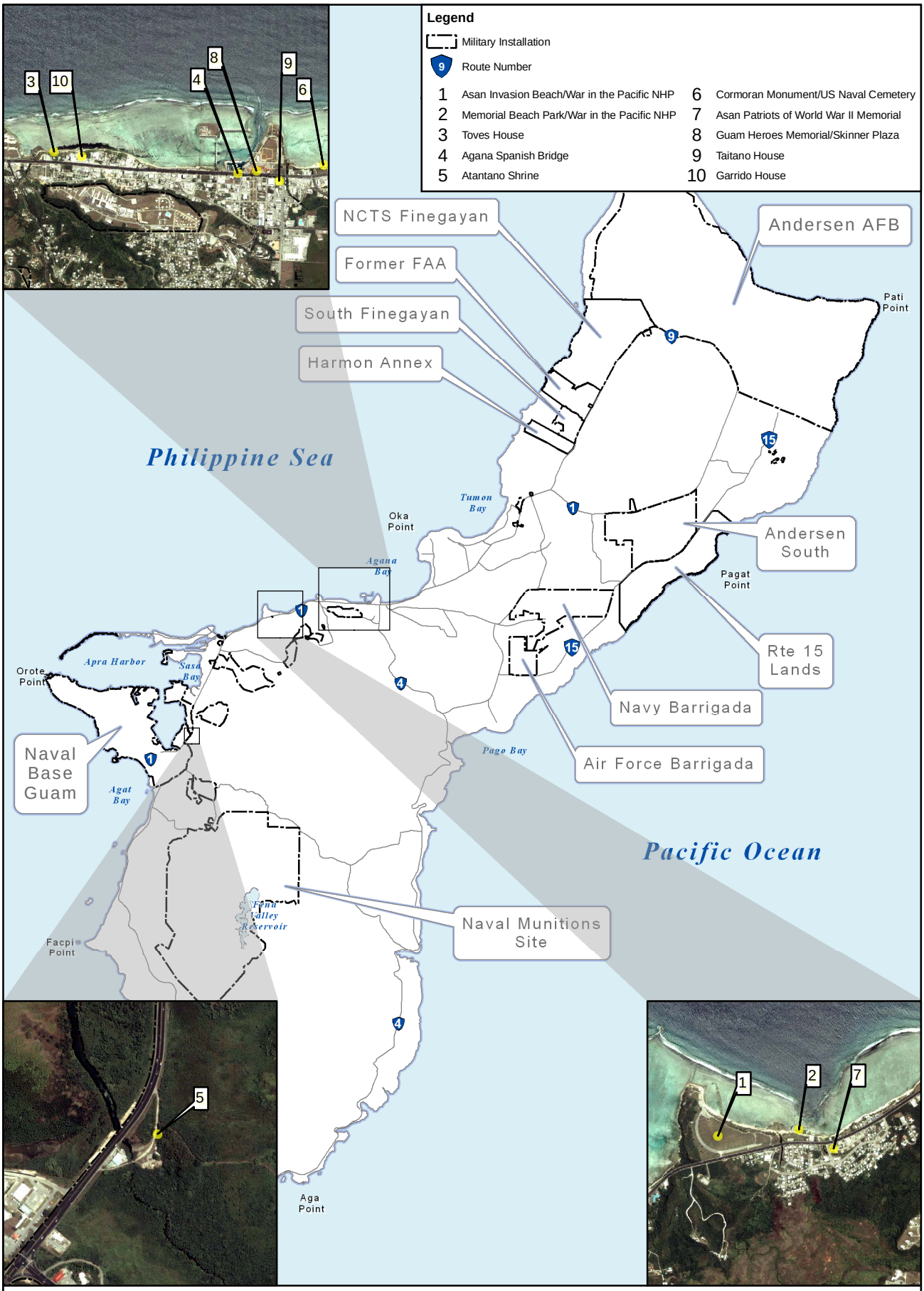

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Figure 12.1-3
Historic Properties in the Area of Potential Effect (APE)

House, Toves House, and the Agana Spanish Bridge. An unnamed archaeological site is located within the APE of GRN #36 (Route 15 relocation).

War in the Pacific National Park

War in the Pacific National Park includes, Asan Bay Overlook, the 20 cm short-barrel Japanese Coastal Defense Gun and the Japanese Twin Mount 25mm Anti Aircraft Gun that are located at Ga'an Point, Liberator's Memorial commemorates the 50th anniversary of the Liberation of Guam, over 3,500 marine species and 200 species of coral that are located within the scuba and snorkeling areas of park waters including the endangered hawksbill sea turtle and the threatened green sea turtle and over 100 historical sites, caves, bunkers, pill boxes, emplacements, latrine foundations, plaques, and structures that can be seen throughout War in the Pacific's landscape.

12.1.4 Apra Harbor

12.1.4.1 Harbor

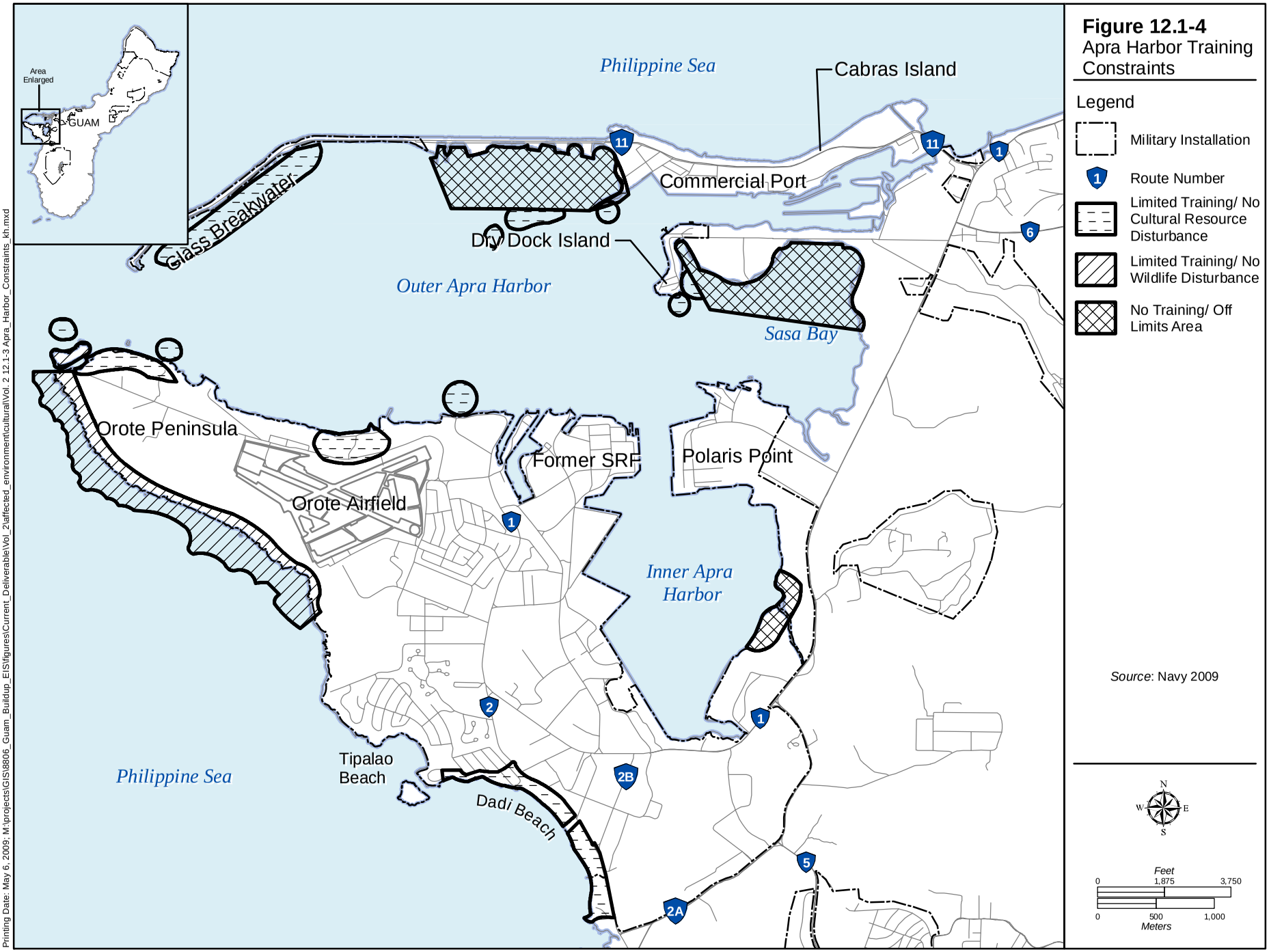
Thirty-one known locations of shipwreck sites and submerged objects are located in Outer Apra Harbor. These include 29 shipwrecks consisting of fishing boats, yachts, barges, tugs, landing craft utility vessels, British passenger ships, WWII Japanese freighters or transport ships, and two plane wrecks with a total of 3 planes (Navy 2009). The SMS Cormoran and the Tokai Maru are listed on both the Guam Register (Guam Register of Historic Places 2008) and the NRHP (NRIS 2008). The SMS Cormoran was a German ship anchored in Apra Harbor near the beginning of World War I. When the U.S. joined the war in 1917, the SMS Cormoran's crew was ordered to turn over the ship; they destroyed it instead with nine crewmen dying in the incident. The Tokai Maru, a Japanese passenger-cargo freighter built in 1930, was used to transport military supplies during WWII. The Tokai Maru was sunk in Apra Harbor in 1943 by a U.S. submarine.

Current protective measures at the Apra Harbor include a PA regarding the implementation of military training on Guam that was signed and executed in 2009 (Navy 2009). These restrictions on training exercises correspond to mapped constrained areas designated as no training or limited training /no cultural resource damage (Figure 12.1-4). No training areas identify areas that would be completely avoided with no training exercises allowed. Limited training areas are primarily designated as pedestrian traffic areas with vehicular access limited to designated roadways and/or with the use of rubber-tired vehicles. However, no pyrotechnics, demolition, or digging are allowed without prior consultation with the appropriate HPO. Two areas within Outer Apra Harbor are designated as no training areas; seven additional areas within the harbor are designated as limited training (Navy 2009).

12.1.4.2 Naval Base Guam

Naval Base Guam covers about 4,500 ac (1,821 ha) on the west-central coast of Guam. It surrounds Apra Harbor and includes all of Orote Peninsula, as well as a low, largely marshy area along the east side of the harbor. The APE consists largely of lands that were created by dredging during and immediately after WWII. Only the areas immediately west of Marine Drive on the west side of the inner harbor are part of the original landform. There are over two thousand buildings and structures/facilities at Naval Base Guam, built between 1944 and 2008.

A variety of facility types are present at Naval Base Guam, including housing quarters, administrative buildings, quality of life facilities, utility facilities, commercial buildings, sidewalks, bridges, and roadways. Buildings built prior to 1965 have been evaluated for NRHP-eligibility. Those facilities built



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after 1965 are currently being evaluated as part of a Cold War-era study. Table 12.1-17 summarizes the previous surveys that have taken place at the Naval Base Guam (Tomonari-Tuggle et al. 2007).

Table 12.1-17. Previous Surveys at Naval Base Guam

Year of Work	*Reference*	*Type of Work*	*Location*
1991	Craib and Yoklavich 1996a*	Overview survey of FISC	Littoral Warfare Training Center
1991	Craib and Yoklavich 1996b*	Overview survey of Main Base	All of Naval Base Guam
1991	Yoklavich and Craib 1996*	Overview survey of Public Works Center	Marine Corps embarkation area
1993	Lauter-Reinman 1997	Cultural Resources Management Plan for WWII resources	All of Naval Base Guam
1993	Lauter-Reinman 1998	CRMP for Apra Harbor Naval Complex	All of Naval Base Guam
1996	Henry et al. 1998b*	Phase I survey, testing of Sumay caves	Sumay Cove
1996	McNeill and Welch 1998	Assessment of training areas	All of the Naval Base Guam
1997	Fulmer et al. 1999*	Detailed recording and test excavations at Orote Point Site, Fort Santiago, Sumay Village	Sumay Cove
2000-1	Hunter-Andersen and Moore 2002	Survey and detailed mapping of Waterfront and NMS; 300 ac (121 ha)	Sumay Cove
2002	Dixon et al. 2004	Inventory survey, testing	Marine Corps embarkation area, Littoral Warfare Training Center
2001-5	Welch et al. 2005*	Synthesis of Guam pre-Contact and history	All of Naval Base Guam
2001-5	Tomonari-Tuggle et al. 2005	Regional ICRMP for Navy lands on Guam	All of Naval Base Guam
2007	Welch et al. 2008	Survey and backhoe trenching	Sumay Village Area
2008	Athens et al. 2008	Survey and limited testing	Tipalao/Dadi Beach
2008	Dixon and Carson 2009	Survey and limited testing	Military Working Dog Kennel Amphibious Landing Training Area Overland Options Training Routes

Notes: *As cited in Tomonari-Tuggle et al. 2007

Fulmer et al. (1999), as cited in Tomonari-Tuggle et al. 2007, conducted testing at Sumay Village. Sumay was a documented 17th century village on the north coast of the Orote Peninsula, at the western mouth of the inner lagoon. It was occupied much earlier, from at least the Late Unai Phase of pre-Contact occupation and continuing through the Latte Period (Welch et al. 2005:70 as cited in Tomonari-Tuggle et al. 2007). Dixon et al. (2004) conducted a survey of the Victor Wharf area, although much of the area could not be surveyed due to the presences of hazardous materials. See Volume 2, Chapter 17, Hazardous Materialns and Waste for more information on hazardous materials. Other surveys include cultural resource management plans by Lauter-Reinman (1997, 1998) and Tomonari-Tuggle et al. (2005).

Post-Contact properties in the Naval Base Guam represent all periods of Guam history, although most are related to WWII and post-war construction. One hundred twenty-two resources are listed, considered eligible for inclusion on the NRHP or need further evaluation (Tomonari- Tuggle et al. 2005). The Cable Station Remains, the Japanese Midget Submarine, Orote Airfield, Orote Historical Complex, and Sumay Cemetery are listed on the Guam Register (Guam Register of Historic Places 2008); the Cable Station Remains, Orote Airfield, and the Orote Historical Complex are also listed on the NRHP (NRIS 2008).

In the area on the west side of Sumay Cove are two sites: Sumay Village (Site 03-1038) and the Pan American Airways seaplane channel/ramp (International Archaeological Research Institute, Inc. map no. 270). Sumay Village was occupied through the First American Period (from 1898 to WWII). It also contains materials dating to the Pre-Latte and Latte Periods, albeit intermingled with historical and modern debris. During the pre-Contact occupation, the site was situated on a level sandy shore facing north and northeast "to a quiet lagoon with extensive reef flats. Inland of the site are limestone terraces which once were forested and likely contained a variety of useful species" (Hunter-Andersen and Moore 2002:6 as presented in Tomonari-Tuggle et al. 2007). Sumay Village is also considered a traditional property by the Chamorro people (Griffin et al. 2009). The Pan American Airways seaplane channel/ramp was originally built in the 1920s as part of the Marine Aviation base and later used by Pan American Airways in the 1930s; it was also used as an important landing area during the last months of WWII. Sites and structures located adjacent to Apra Harbor that are eligible for inclusion on the NRHP are presented in Table 12.1-18 (Tomonari-Tuggle et al. 2007).

Table 12.1-18. NRHP-Listed or Eligible Sites in the Naval Base Guam Area

*Guam HPO Site #/Map #**	*Site Name/Description*	*NRHP/GR Status***
194	Cable Station Remains	Eligible
03-1126/221	Fort San Luis	Eligible
03-1128; 03-1346; 03-1347/227	Gab Gab Beach Fortifications	Eligible
229	Gab Gab Beach Site	Eligible
231	Glass breakwater	Eligible
03-1088/251	Japanese midget submarine	Eligible
253	Japanese steps and wall	Eligible
254	Lathe from New York Shipyard – ship repair operations area	Eligible
261	NOB Hill Bowl Theatre	Eligible
03-1066/264	Orote Airfield	Listed
03-1009/265	Orote Historical Complex	Eligible
267	Orote Village	Eligible
270	Pan American Airways Seaplane Channel/Ramp – west of Sumay Cove	Eligible
01-1337/275	Leepers Look Pottery and Lithic Scatter	Eligible
03-1038/319	Sumay Village	Eligible
02-1853/706	Harbor facilities	Eligible
03-1854/707	Japanese defensive position	Eligible
710	Japanese WWII defensive position	Eligible
719	Guam Dredging Contractors	Eligible
726	Gab Gab Beach fortification	Eligible
727	Pottery scatter	Eligible
729	Gab Gab Beach far west fortification	Eligible
734	Post-Contact site	Eligible
737	Post-Contact site	Eligible
740	Pre-Contact site	Eligible
741	Site 7 (post-Contact site)	Eligible
742	Post-Contact site	Eligible
03-1863/743	Luis P. Garrido House	Eligible
744	Site 8 (post-Contact site)	Eligible
746	Post-Contact site	Eligible
753	Post-Contact site	Eligible
754	Post-Contact site	Eligible
756	Post-Contact site	Eligible

Legend: **GR=Guam Register of Historic Places; Eligible= Eligible for the GR and NRHP.

Marine Corps Embarkation Area

Archaeological work in 2007 involved surface survey and excavation of 22 backhoe test trenches in the proposed impact areas near the Marine Corps Embarkation Area (Welch et al. 2008). These revealed no NRHP-eligible or listed archaeological deposits. The Sierra, Tango Uniform, and Victor Wharves are located at the Marine Corps Embarkation Area. None of these wharves are eligible for listing on the NRHP (Tomonari-Tuggle et al. 2007). The wharves of Inner Apra Harbor are evaluated as not eligible for listing on the National Register due to "changes in design, materials and workmanship [that] have affected their integrity" (Lauter-Reinman 1998: E-13 as quoted in Tomonari-Tuggle et al. 2007). Although they retain their original alignments, they have been rebuilt in concrete. The original wharves were sheet-pile with wooden fenders.

At the southwest corner of Inner Apra Harbor is the possible location of the Chamorro village of Apra. Like Sumay Village, this village would have been situated on the edge of the embayment. This location is based on map analysis (Tuggle 1993), but the possibility of finding intact cultural remains is low due to the extent of war-era and modern construction.

Oscar and Papa Wharves (Former Ship Repair Facility)

A floating drydock is located at the Papa Wharf. It is not eligible for inclusion on the NRHP.

Medical-Dental Clinic Site

The central portion of Naval Base Guam on Marine Drive is considered a low probability area for cultural resources (Tomonari-Tuggle et al. 2005).

Military Working Dog Kennel (MWDK)

Several cultural resource sites have been documented in the vicinity of the MWDK (Table 12.1-19), but only one has been identified specifically within the two project areas. Several Japanese WWII defensive sites and remnants of concrete pads are in the vicinity, and limited subsurface testing has revealed Latte Period and earlier cultural materials in sandy deposits nearby at Dadi Beach. Subsurface testing of this area was completed in 2009 (Dixon and Carson 2009). No intact cultural features were recovered in the MWDK, although surface remains of WWII-era Camp Bright (Guam Site 2-1300) were present.

Table 12.1-19. Sites in the Vicinity of the MWDK

Site Designation	*Site Name/Description*	*NRHP/GR Status***
PS-14	Gun emplacement	Eligible
TN-8	Concrete pads	Eligible
TN-19	Concrete foundation	Eligible
TN-20	Water system	Eligible
TN-21	Stone wall and steps	Eligible
2-1300	Japanese bunker and cave	Eligible
2-1301	Japanese bunker and cave	Eligible
2-1302	Dadi Beach Rock Shelter	Eligible
2-1303	Atypical Japanese bunker	Eligible
2-1305	Japanese defensive cave	Eligible
2-1306	Japanese defensive cave	Eligible
2-1307	Japanese defensive cave	Eligible
2-1308	Japanese defensive cave	Eligible
2-1309	Japanese defensive cave	Eligible
2-1310	Japanese defensive cave	Eligible
3-1129	Japanese bunker and cave	Eligible
3-1305	Japanese defensive cave	Eligible

Legend: **GR=Guam Register of Historic Places; Eligible=Eligible for the GR and NRHP.

Surveys of the Tipalao and Dadi Beach areas for this EIS/OEIS were completed in 2008 (Athens et al. 2008). Six backhoe trenches were excavated at Tipalao and nine trenches at Dadi Beach. Cultural deposits were recovered in trenches at both beaches. Additional trenches were excavated on the terrace above Dadi Beach in 2009 (Dixon and Carson 2009). Excavation of the these trenches demonstrate the presence of WWII era or later cultural material related to WWII-era Camp Bright (Guam Site 2-1300) in all 11 trenches, but only secondary depositional evidence of earlier historic or prehistoric occupation nearby.

Overland Options Training Routes

Mechanical excavations along the proposed Overland Options Training Routes situated between Dadi Beach and Inner Apra Harbor encountered primary depositional evidence of prehistoric Chamorro occupation and probable human burial in one excavation, Trench 1. These deposits included three probable Late Pre-Latte or Transitional Period earth ovens likely dating between 500 B.C. and A.D. 500, overlain by a probable Latte Period midden likely dating between A.D. 1,000 and 1,500. The intact ovens and midden demonstrate that this back dune setting was once situated further inland than is Dadi Beach today, and was favorable to native Chamorro occupation given its proximity to coastal resources. In fact, it is possible that these remains represent the antecedents of the late 17th century traditional village of Orote.

Additional trenching to the north on the Overland Option area exposed the buried remains of destroyed concrete structures and associated refuse related to WWII-era Camp Bright (Guam Site 2-1300) in Trenches 2 and 3, two extant concrete foundations of the same era on the surface, modern refuse from a former landfill in Trenches 4 through 6, construction fill associated with the access road to the former Camp Bright laundry in Trench 7, and a metal sewer pipe entering this facility from the Camp Covington direction in Trench 8.

Polaris Point

The Alpha and Bravo Wharves are located on the southwest corner of Polaris Point. These wharves date to the WWII era. None of these wharves is eligible for listing on the NRHP (Tomonari-Tuggle et al. 2005). Because it is a man-made construction of fill, Polaris Point has no potential for archaeological resources (Tomonari-Tuggle et al. 2005).

12.1.4.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Five roadway improvement projects are located in the Apra Harbor Region along existing Routes 1, 2A, and 11. One known historic property, the Atantano Shrine, is within the APE for these projects. It is described in Table 12.1-20, and Figure 12.1-3 illustrates its location. The Shrine itself is east of Route 1, but the parcel is adjacent to the road, and an access road to the shrine intersects Route 1.

Table 12.1-20. Historic Properties within the APE of Apra Harbor Region Projects

Historic Property	*Description*	*GRN #*
Atantano Shrine	Listed on the NRHP and GRHP. This shrine marks the location where Piti villagers honored 18th century Spanish Governor Felipe Cerain for constructing a road that connected the southern half of the island with the capital of Hagåtña.	24

12.1.5 South

12.1.5.1 Naval Munitions Site

NMS comprises approximately 8,800 ac (3,561 ha) and is situated within the inland volcanic hills, valleys, and mountains of southern Guam. The terrain in the site is mountainous and rugged. See Volume 2, Chapter 3, Geological and Soil Resources, for discussion on geological resources. This area has been physically isolated and, therefore, more protected from construction and destruction than any of the other Navy areas. The modern landscape retains many elements of native forest and, in the more remote sections, has only been slightly modified by twentieth century introductions.

Cultural resources identified in NMS include pre-Contact, post-Contact, and multi-component archaeological sites and buildings and structures (Tomonari-Tuggle et al. 2005). Three hundred and eighty-seven resources are listed or eligible for the NRHP or need further evaluation. At least 146 *latte* sites, containing over 350 *latte* sets, have been identified in NMS, ranging from single, isolated *latte* structures to complexes of multiple *latte* sets combined with other features. Where identifiable, *latte* sets in complexes exhibit 6, 8, 10, and 12 pillars each in two paired rows. Also found in NMS are quarries, cliff overhangs, caves, artifact scatters, and isolated objects such as sling stones, stone tools, mortars, and a grooved boulder. Forty-six post-Contact resources considered NRHP-eligible are located on NMS and include an airplane crash location, a baseball field, depressions, concrete blocks, and artifact scatters. Three resources, the Bona Site, the Fena Massacre Site, and the West Bona Site are listed on the Guam Register (Guam Register of Historic Places 2008); the West Bona site is also listed on the NRHP (NRIS 2008). Table 12.1-21 summarizes the previous surveys that have taken place at NMS (Tomonari-Tuggle et al. 2007).

Table 12.1-21. Previous Surveys at NMS

Year of Work	*Reference*	*Type of Work*	*Location*
1921-4	Hornbostel (n.d.)*,Thomson 1932	Island-wide survey	Central NMS
1947	Osborne 1947*	Island-wide survey	Central NMS
1952	Reed 1952*	Island-wide survey	Central NMS
1965-6	Reinman 1967*	Island-wide survey	Central NMS
1988	Shun 1988*	Survey	Portion of magazine area
1991	Craib and Yoklavich 1997*	Overview survey	New magazine area
1992	Tuggle 1993	Survey and testing	All of NMS
1993	Lauter-Reinman 1997	Cultural Resources Management Plan for WWII resources	All of NMS
1993	Caruccci 1993	Survey	Magazine area
1994	Craib and Nees 1998	Survey and subsurface testing; revisited *latte* areas identified by Hornbostel and Osborne	Central and northeastern NMS
1996	McNeill and Welch 1998	Assessment of training areas	All of NMS
1996	Henry et al. 1998a*	Survey and subsurface testing; southern portion of Annex	Southern NMS
1997	Henry et al. 1999*	Survey and subsurface testing;	Central NMS
1997	Craib 1997	Survey	Surveys in northeast portion of NMS
1998	Allen et al. 2002	Survey and testing in four areas, total	North and Central NMS
2000	DeFant 2000*	Cultural Resources Management Plan	All of NMS

Year of Work	*Reference*	*Type of Work*	*Location*
2001-5	Welch et al. 2005*	Summary of Guam pre-Contact and history	All of NMS
2001-5	Tomonari-Tuggle et al. 2005	Regional ICRMP for Navy Lands	All of NMS
2002	Hunter-Anderson and Moore 2002*	Survey	Southwest portion of NMS
2007	Welch et al. 2008	Survey and limited testing	Southwest portion of NMS
2002	Dixon et al 2004	Survey and limited testing	Northeast NMS Lost River

Notes: *As cited in Tomonari-Tuggle et al. 2007

Survey and auger testing was conducted by Tuggle (1993) just north of Dealey Road. No pre-Contact sites were found in this parcel. The central portion of NMS was surveyed by Craib and Nees (1998). They note that use of this area began as early as Anno Domini 400, with Latte Period construction and habitation.

Approximately 2,850 ac (1,153 ha) in the southern portion of NMS was surveyed by Henry et al. (1998a as cited in Tomonari-Tuggle et al. 2007). Henry et al. (1999, as cited in Tomonari-Tugglet et al. 2007) suggest that specific activities that took place in NMS including resource procurement, cooking, storage, ceramic manufacturing, shelter, stone tool manufacturing, *latte* construction, plant processing, woodworking/fiber craft, hearth construction, oven construction, marine exploitation, hunting, warfare, food production, and mortuary activities. This variety indicates that inland sites were not just for occasional use or collection of resources, but were used for long-term habitation and activities.

Allen et al. (2002) conducted a survey of approximately 365 ac (148 ha) in four parcels in the northern and central portions of NMS. They located artifact scatters, *latte* sets, military sites, overhangs and cave shelters, and early 20th century habitations. Welch et al. (2007) surveyed the southwestern portion of NMS.

A traditional cultural properties study of Guam was completed in 2009 (Griffin et al. 2009). Two traditional cultural properties were identified in NMS. The Fena Massacre Site has archaeological and ethnographic associations. The Fena Watershed contains numerous archaeological sites and has legendary, archaeological, and ethnographic associations. Concerns over the possible disturbance and disposition of pre-Contact human remains are likely and the presence of petroglyphs and pictographs may indicate past or present ceremonial or religious activities. Pre-Contact human remains have been recovered from caves and rockshelters as well as near *latte* sites.

Specific areas known to have traditional importance to the Chamorro include Almagosa Springs area of Fena on NMS. The Fena Massacre Caves on NMS are the location of annual commemoration ceremonies by the Chamorro.

Munitions Storage

In the northeastern portion of NMS, a surface survey in 2007 identified several abandoned magazines, a recently renovated bridge, one *latte* site, an isolated stone artifact fragment, and the displaced remnants of a damaged Armco structure. One *latte* site is eligible for listing on the NRHP. Of the architectural sites present in the area, the abandoned Armco Magazines are eligible for listing on the NRHP (Welch et al. 2008). Bridge 705 was not eligible for listing on the NRHP (Welch et al. 2008).

Lost River

In 2002, Dixon et al (2004) surveyed approximately 205 hectares of the Naval Magazine, in the region called Lost River or Area 5. The southwest 1/3 of Area 5 consists of deep sinkholes with narrow ridges between them, leaving almost no flat terrain except in the marshy sink bottoms and along the Tolaeyuus River floodplain on its northern and eastern boundary. Sites here included shallow rock shelters (Sites T-4, 8-10, 12, 13, 15, 16, 20, 21, 23, 24, 51-53, 79, and 81) and caves (Sites T-2, 3, 5-7, 11, 17, 19, 22, 54, and 80) located along the sides of the sinks and Tolaeyuus River floodplain. Two components of a mid-20th century water management system were located along the west bank of the Tolaeyuus River floodplain (Site T-18 and 27), and historic remains likely deposited by WWII Japanese stragglers were encountered within some of the prehistorically utilized caves and rock shelters already mentioned above (Sites T-13, 22, 51, and 53).

The northeast 1/3 of Area 5 consists of steep N/S trending limestone ridges with some sinkholes, surrounded by the floodplains of the Maemong and Mahlac Rivers with interconnected marshes. Sites here included *latte* sets (Sites T-67, 68, 82), shallow rock shelters (Sites T-26, 27-29, 32, 69, 70, 72-76, 78, and 83-85), and caves (Sites T-30, 31, 71, 77, and PHRI-15) located along the ridge tops and sides immediately above the marshes and floodplains. Historic remains likely deposited by Japanese stragglers between 1944 and 1945 were encountered within some of the prehistorically utilized caves and rock shelters mentioned above (Sites T-30, 31, 78, and PHRI-15).

The southeast 1/3 of Area 5 consists of rolling hills and occasional sinks, bracketed by the Maagas River floodplain to the south, the Mahlac floodplain to the northeast, and marshes above the Maemong and Tolaeyuus River floodplains to the northwest. Sites here included *latte* sets (Sites T-1, 55, 56, 64, and 65), shallow rockshelters (Sites T-57 and 58), and caves (Sites T-63) located on the tops and flanks of wide ridges above the marshes and floodplains. Permanent habitation is assumed at the large village of Site T-55 and likely at the other *latte* sets in this zone, given their proximity to Site T-55. Site T-56, a low three-pair *latte* set, was located just above the Maagas River marsh.

South Area NMS

In 1996, Henry et al. (1998a as cited in Tomonari-Tuggle et al. 2007) conducted an inventory survey of about 2,850 ac (1,153 ha) in the southern portion of the NMS. Of the 122 documented sites, 114 are pre-Contact, seven are post-Contact, and one is modern. Testing provided subsurface evidence of early Pre-Latte to Spanish Period occupations. According to the Regional ICRMP for Guam, most of the southern portion of the NMS has a low to medium sensitivity for archaeological sites (Tomonari-Tuggle et al. 2005).

Current Protective Measures at NMS include a PA regarding the implementation of military training on Guam that was signed and executed in 2009 (Navy 2009) as part of the MIRC EIS/OEIS. The 2009 restrictions on training exercises correspond to mapped constrained areas designated as no training or limited training /no cultural resource damage. "No training" areas designate complete avoidance, with no training exercises allowed. "Limited training" areas are primarily designated as pedestrian traffic areas with vehicular access limited to designated roadways and/or with the use of rubber-tired vehicles. However, no pyrotechnics, demolition, or digging are allowed without prior consultation with the appropriate HPO. Five areas in NMS are designated as no training. Most of the southern and eastern portion of NMS are designated as limited training (Navy 2009) (Figure 12.1-5).

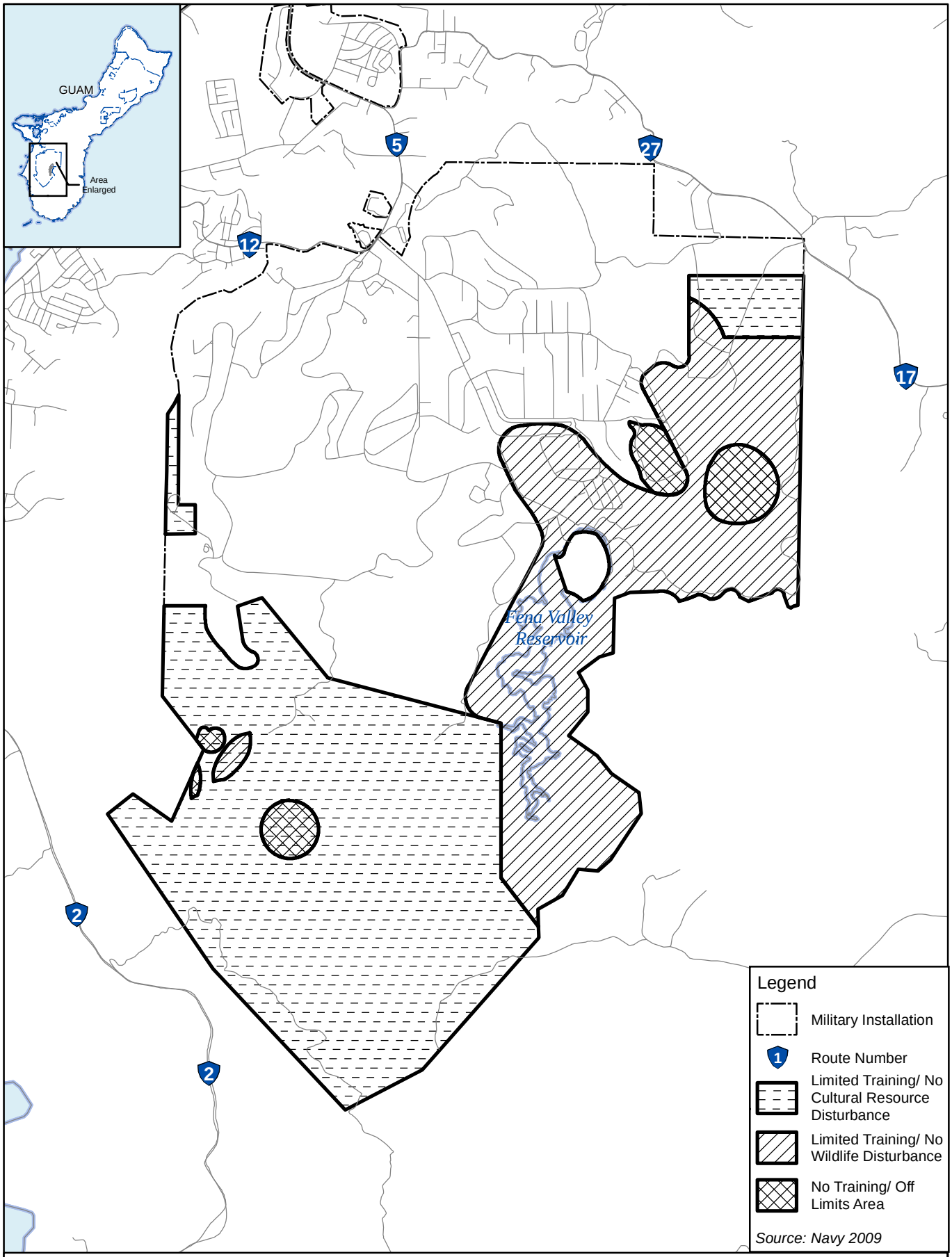

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Figure 12.1-5
Naval Munitions Site Training Constraints

12.1.5.2 Non-DoD Lands

Access Road

Access road Alternative A was surveyed in 2008 (Dixon and Carson 2009). No archaeological sites were recorded along this existing foot path.

12.1.5.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Four roadway improvement projects are proposed within the south region – two pavement strengthening projects, one intersection improvement project, and one military access point (MAP). No known historic properties are located within the APE of any project in the south region.

12.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

12.2.1 Approach to Analysis

12.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to cultural resources has been established through federal laws and regulations including the NHPA and the ARPA.

A significant resource is a cultural resource eligible or listed on the NRHP. A project affects a NRHP-eligible or listed resource when it alters the resource's characteristics, including relevant features of its environment or features that qualify it for inclusion on the NRHP. Adverse effects may include the following: physical destruction, damage, or alteration of all or part of the resources; alteration of the character of the surrounding environment that contributes to the resource's qualifications for the NRHP; introduction of visual, audible, or atmospheric elements that are out of character with the resource; neglect of the resource resulting in its deterioration or destruction; and transfer, lease, or sale of the property (36 CFR 800.5(a)(2)) without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts are those that may occur during either the construction or operations phase of the project. They may be the result of increased noise during operations or ground disturbing activities involving construction, modification, or the use and maintenance of facilities. Indirect impacts are those that may occur as a result of the completed project such as increased vehicular or pedestrian traffic in the vicinity of the resource that may lead to vandalism or increased erosion from ground disturbing activities.

Vandalism is considered to be a significant impact because it damages the integrity of the site, which is the major determinant of NRHP-eligibility. Physical evidence left in archaeological sites is finite and cannot renew itself once it has been disturbed. For this reason, federal activities that open areas up to the public or that involve personnel traveling through an area may have an adverse impact, especially if vandalism to NRHP-eligible or listed resources in the vicinity occurs. If a site is eligible to the NRHP primarily for its setting or location, changes to the visual setting are considered a significant impact. Cumulative impacts, the impact on cultural resources which result from the incremental impact of the action when added to other past, present, and future actions, must also be taken into account.

12.2.1.2 Determination of Significance

A historic property is a property that is eligible for or listed on the NRHP. For cultural resources found eligible to the NRHP, a significant adverse impact is one that disturbs the integrity of a historic property. If a project disturbs intrinsic characteristics that make the property eligible for or listed on the NRHP (other than its integrity), then it is also considered to have a significant adverse impact.

The Regional ICRMP for Navy property in Guam has established Standard Operating Procedures for protecting known NRHP-eligible or listed cultural resources; procedures for managing the inadvertent discovery of archaeological resources, inadvertent discovery of human remains, inadvertent disturbance to historic properties; and distributing permits for archaeological investigations (Tomonari-Tuggle et al. 2005). In addition, agreements on limitations in training have been made as part of the MIRC EIS PA (Navy 2009). Areas with limited or no training stipulations at Apra Harbor are presented in Figure 12.1-3 and at NMS in Figure 12.1-5.

As part of the Section 106 consultation process for the proposed action, a PA for all proposed military training activities, construction, and operations, which includes additional mitigation measures and procedures, is being prepared. Current signatories to this PA are: the Department of Defense (Joint Region Marianas); DoD Representative Guam, CNMI, Federated States of Micronesia, and Republic of Palau; Marines; Navy; Army; Air Force), other federal agencies (U.S. Environmental Protection Agency, ACHP, and the NPS), and local government agencies (Guam HPO, CNMI HPO). Tthe signed PA would be incorporated into the Final EIS. Stipulations in the PA include the following:

- DoD would ensure the identification and evaluation of historic properties within the APE before the project is completed or prior to the initiation of any part of the project with the potential to impact historic properties.
- For areas or properties that have not been previously inventoried for historic properties, DoD would record surface sites and, when possible, areas would also be archaeologically sampled for subsurface sites, when data is easily obtainable without having to demolish existing facilities or infrastructure.
- Archaeological probability maps have been generated for all DoD lands on Guam. For all other areas and islands impacted by the project, archaeological probability maps would be generated that predict the probability of encountering subsurface cultural resources in three categories (no/low, medium, and high). These maps would be compiled using previous archaeological investigations, maps, interviews, and ethnohistoric accounts and in consultation with the HPOs and the NPS.
    - **No to Low Probability Areas**: These areas contain no surface sites and include reclaimed fill lands or heavily disturbed areas. No to low probability areas are also areas that have been previously surveyed and tested and were found not to contain subsurface

resources, orareas not likely to contain subsurface materials based on known social practices or history of the area.

- **Medium Probability Areas**: These areas have not been surveyed but may have the potential to contain sites (surface and/or subsurface), or are areas that contain no known surface sites but have the potential to encounter subsurface archaeological resources based on known social practices or history of the area.
- **High Probability Areas**: These areas contain known surface and/or subsurface sites or are areas where historic maps, documents, or legends indicate former villages, habitations, shrines, cemeteries, or other types of cultural activity areas are present or have been in the past.

- Any properties not evaluated shall be assessed for NRHP eligibility. These historic properties would be incorporated into existing ICRMPs as they are revised or updated or if a new ICRMP is developed in consultation with the appropriate HPOs.

Any updates to the existing Geographical Information System cultural resource layers, such as shape files showing the locations of known archaeological sites and buildings and structures, would be shared with the appropriate HPO or NPS (if a property is associated with a NHL in accordance with 36 CFR 800.11(c)). The HPOs and the NPS recognize that these layers may contain sensitive information and would not disseminate or make them available to the public without obtaining permission of the appropriate responsible person whose jurisdiction that historic property is under. Maps of all areas with archaeological potential and sensitivity for the presence of NRHP-eligible or listed resources would be appended to the PA. No further review under Section 106 is required for areas designated as No to Low probability areas. Mitigation measures for Medium and High probability areas are stipulated as follows:

- High Probability Areas would be avoided if possible. If sites are impacted, a mitigation plan would be developed and reviewed by the appropriate HPO and then data recovery excavations would take place.
- Medium Probability Areas would be subject to monitoring or testing. Prior to any disturbance or excavation, work plans would be developed and reviewed by the appropriate HPO.

In recognition of the significance that traditional cultural properties within the APE of the proposed action have to various cultural groups, DoD would allow access to individuals and organizations that attach significance to these historic properties, where security requirements are not prohibitive. The PA also provides stipulations for treatment in case of emergency discoveries, the review process, and report requirements. The Standard Operating Procedures in the current Regional ICRMP would be updated, revised, and attached to the PA. Although probability maps would be generated based on the likelihood of archaeological resources, treatment of known architectural resources and traditional cultural properties as a result of the proposed action would also be stipulated in the PA.

12.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible impacts to cultural resources—archaeological, architectural, and traditional cultural properties—that could be impacted or affected by the proposal. As part of the analysis, concerns relating to cultural resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These include:

- Access to cultural sites
- Construction impacts to cultural resources
- Thorough and adequate data collection

- Public participation in the planning process relating to cultural resources

12.2.2 Alternative 1

Alternative 1 contains actions relating to construction of a main cantonment at Finegayan and adjacent non-DoD lands (the Former FAA parcel and the Harmon Annex); construction and operation of waterfront improvements at Apra Harbor; aviation training at Andersen AFB, Orote Field, and Andersen South; firing training south of Route. 15; and non-firing training at Andersen South and NMS.

12.2.2.1 North

Andersen AFB

Construction

The Air Combat Element Beddown project construction would take place in an area of low and high archaeological probability near North Field (Figure 12.2-1). Given the level of development in the area, it is assumed that 100% of the area would be disturbed. Ground excavation and soil removal associated with buildings and utilities construction would adversely impact NRHP-eligible archaeological resources known in the project area, including site 1044 (artifact scatter) and 1046 (artifact scatter).

The Air Embarkation project construction would take place primarily in a developed, paved area. However, approximately 20 ac (8 ha) of undeveloped land were surveyed in 2009 (Dixon and Walker 2009). No sites were discovered, therefore this area is considered to have a low probability for archaeological remains (see Figure 12.2-1) The project would require the demolition of one building, Building 19028, the Air Mobility Command Headquarters Building. This building is not eligible for listing on the NRHP.

The North Gate and Access Road construction would take place in an area of low archaeological probability. This area was surveyed in 2008 and no NRHP-eligible sites occur in this area. No construction impacts are anticipated.

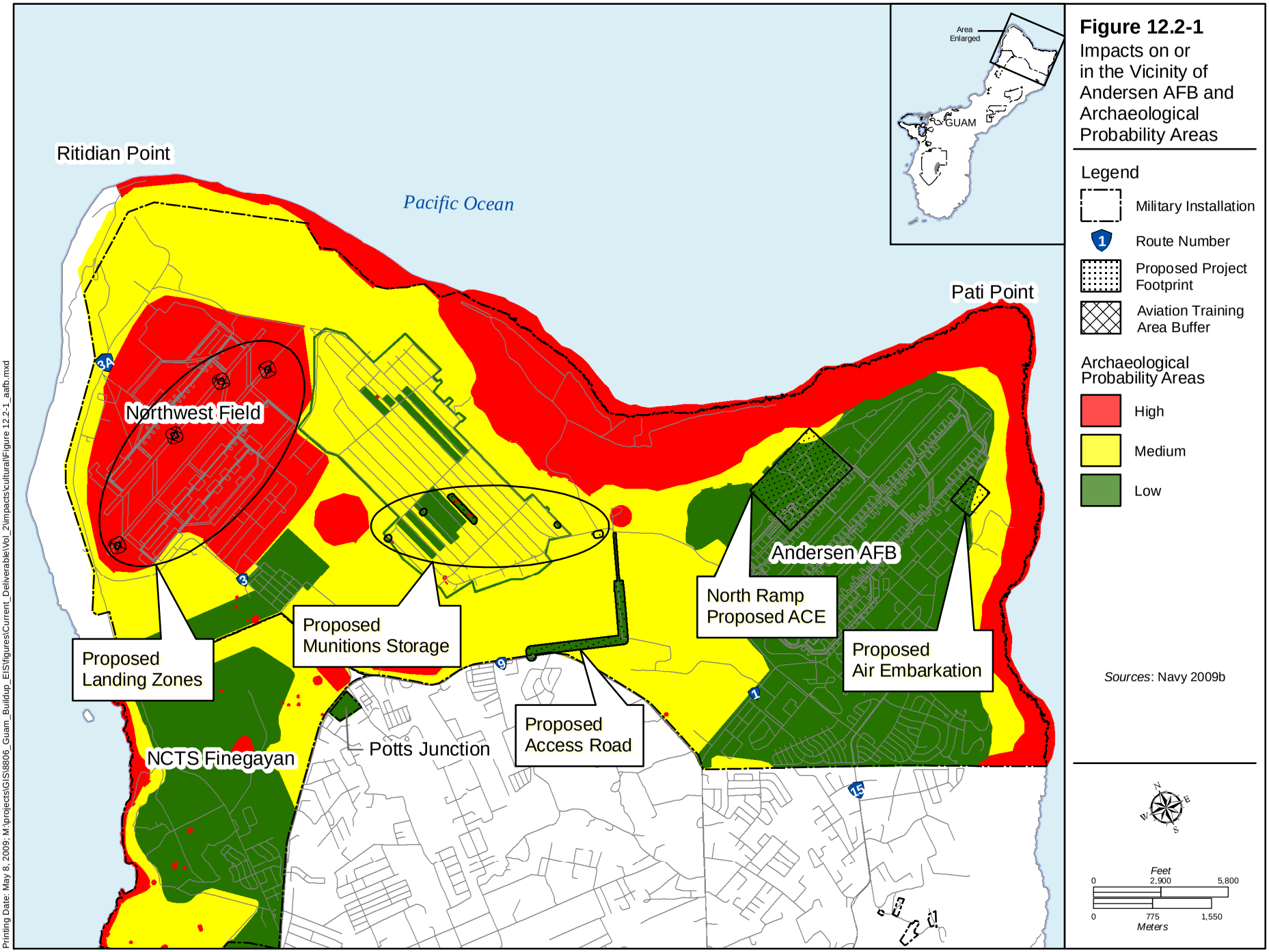
The Secondary Access Road construction would also take place in an area of low archaeological probability. NRHP eligible sites do not occur in this area and no construction impacts are anticipated.

LZs would be established at NWF under Alternative 1. These LZs would occur in an area currently used for training (and approved for training under the MIRC PA [Navy 2009]) and would not adversely affect the site (NWF).

Construction of 12 standard earth covered magazines (ECMs) and associated support facilities (two concrete pads and a concrete support building) at MSA 1 would occur in a low and high probability area. Ground excavation and soil removal associated with buildings and utilities construction would adversely impact NRHP-eligible archaeological resources recorded by Dixon and Walker (2009) at prehistoric sites T-9-1 and T-9-2,. NRHP eligible prehistoric site T-1-15 is located near the project APE, but would not be affected by the proposed action.

Operation

Operating activities (training and non-training related) include increased personnel in the area as a result of the proposed action. This increase in personnel in the area could increase site vandalism. Additional traffic on NWF due to increased aviation activities could adversely impact the runway surface. Disturbance to NRHP-eligible resources indirectly through increasing access to the sites is considered to be a significant adverse impact.


Ritidian Point
Pacific Ocean
Pati Point
Area Enlarged
GUAM
Northwest Field
Andersen AFB
North Ramp
Proposed ACE
Proposed
Air Embarkation
Proposed
Munitions Storage
Proposed
Landing Zones
Proposed
Access Road
Potts Junction
NCTS Finegayan
3A
3
9
1
15
Figure 12.2-1
Impacts on or
in the Vicinity of
Andersen AFB and
Archaeological
Probability Areas
Legend
Military Installation
Route Number
Proposed Project
Footprint
Aviation Training
Area Buffer
Archaeological
Probability Areas
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Finegayan

Construction

Construction of the main cantonment, family housing, and community support would take place at Finegayan under Alternative 1 (Figure 12.2-2). A variety of land uses/functions would be sited at NCTS Finegayan and South Finegayan including: housing, quality of life facilities, administration, training, and education. A total of 1,090 ac (441 ha) within NCTS Finegayan and 290 ac (117 ha) within South Finegayan could be affected by construction and development. The initial planning process considered the locations of NRHP-eligible resources and avoided impacting the majority of the historic properties in the area. Additional efforts would be made during the final planning stage to avoid all historic properties, if possible.

Construction of the Bachelor Enlisted Quarters (BEQ) would impact areas with low, medium, and high archaeological probability. This setting would require a substantial amount of vegetation/ground excavation and soil removal, and has the potential to adversely affect archaeological resources and disturb an area with high probability for archaeological resources, which includes site 1021 (artifact scatter).

Construction of Headquarters (HQ) facilities would impact areas with a medium archaeological probability. This setting would disturb an area with medium probability for archaeological resources. Construction of the BASE, DIVA and MEFA facilities would impact areas with low, medium, and high archaeological probability. This setting has the potential to adversely affect archaeological resources in an area with medium/high probability. Sites in this area include 1022 (artifact scatter) 1023 (four WWII defensive structures) and 1026 (habitation site and artifact scatter). Construction of the Marine Logistic Group (MLG) facilities would impact areas with low, medium, and high archaeological probability. This setting would adversely affect archaeological resources in areas with medium/high archaeological probability. These resources include sites 381 (ceramic scatter), 1012 (artifact scatter) and 1020 (artifact scatter). Construction of the LTC facilities would impact an area with low archaeological probability. NRHP-eligible or listed sites do not occur in this area and construction impacts are not expected. Construction of housing and education facilities would impact areas on South Finegayan. However, site 811 (Latte Stone Park) would be avoided.

Construction at Finegayan has the potential to require the removal of dukduk trees, a traditional resource used by canoe builders.

Operation

Operation of the main cantonment and family housing and community support would take place at Finegayan under Alternative 1 and would bring additional personnel into the area. This increase in personnel could increase site vandalism, especially to sites such as Haputo on the coast and Latte Stone Park. Disturbance to NRHP-eligible or listed resources, either directly through construction or indirectly through increasing access to the sites, is considered to be a significant adverse impact.

Non-DoD Land

Non-DoD land impacted by Alternative 1 includes the FAA parcel and the Harmon Annex. Under Alternative 1, a real estate interest would be obtained for these parcels.

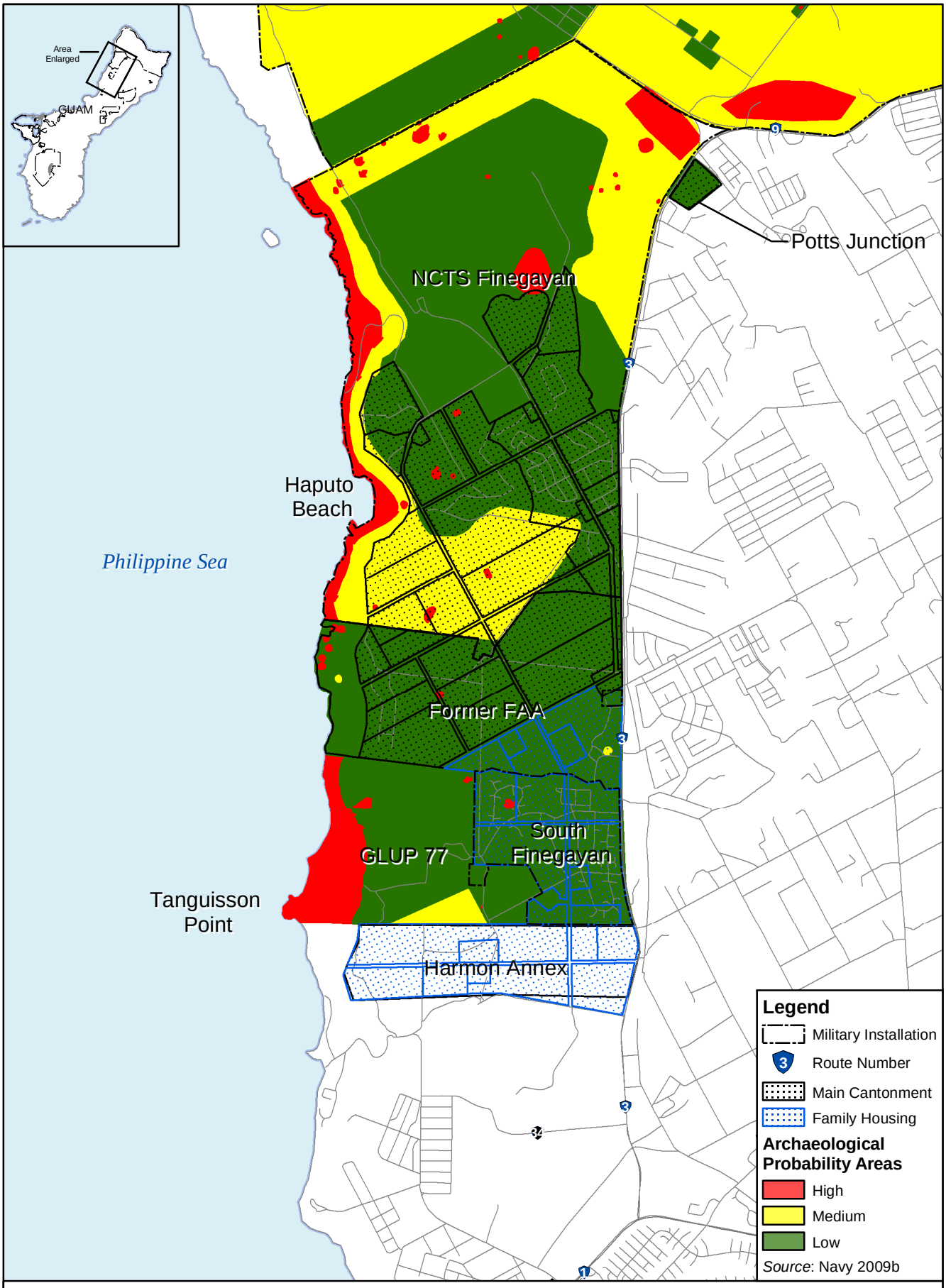

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Figure 12.2-2
Construction at Main Cantonment Alternative 1 and Archaeological Probability Zones

Construction

Construction of Quality of Life (QOL), HSG, Bachelor Officer Quarters (BOQ) and education facilities would impact 680 ac (275 ha) in areas with low and high archaeological probability at the FAA parcel. This setting would impact sites 1678 (ceramic scatter) and 1681 (ceramic scatter).

Construction of the Personnel Management Office (PMO) facilities would impact areas with medium and low archaeological probability at the FAA parcel. Construction of the TRN facilities would impact areas with low archaeological probability at the FAA Parcel. NRHP eligible or listed sites do not occur in this area and construction and operational impacts are not expected.

Construction of HSG and education facilities at the Harmon Annex would impact 326 ac (132 ha) in areas of medium archaeological probability.

Operation

Operation of these facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism. Disturbance to NRHP-eligible or listed resources indirectly through increasing access to the sites is considered to be a significant adverse impact. Sites that could be impacted indirectly include sites 1678 and 1681, if they are not directly disturbed by construction.

12.2.2.2 Central

Andersen South

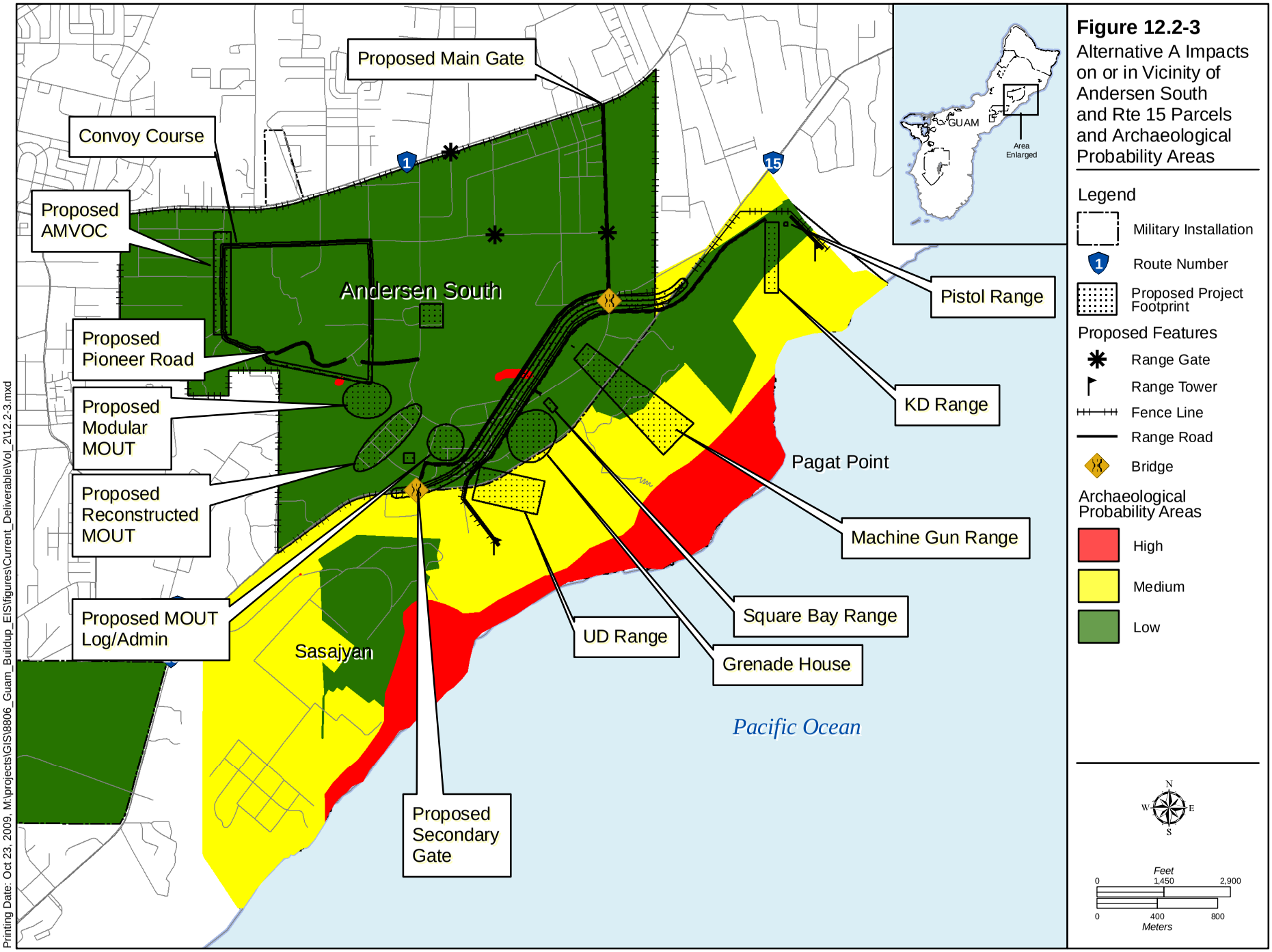
Construction

Training at Andersen South would involve reuse of the existing barracks and demolition of the family housing located in this area. None of the buildings to be reused or demolished are eligible or listed on the NRHP. It would also involve construction of a Driver's Course and a Convoy Course for a total of 35 ac (14 ha), clearing for two LZs, and other training facilities (Figure 12.2-3). Two NRHP-eligible archaeological sites are located in the vicinity of the planned training areas: 1063 (subsurface pre-Contact artifact scatter) and 1065 (subsurface pre-Contact artifact scatter). Clearing of the training areas and construction of the Driver's Course and convoy course would result in adverse impacts to these archaeological sites. Clearing for the LZs would involve an area of 100 ft (30 m) square. As the LZs would be used by MV-22 aircraft, the buffer area around the LZ for analysis purposes was 300 ft (100 m) in keeping with impact areas defined in the MV-22 Draft EIS (Navy 2009) . Both of the LZs in Andersen South are in low probability areas and would not impact any NRHP-eligible or listed archaeological sites, architectural resources, or traditional cultural properties.

A perimeter fence would be constructed around Andersen South. Most of the area in which the fence would be constructed is an area of low archaeological probability. Portions of Andersen South border areas with medium archaeological probability along Route 15, although surface recording and subsurface testing of prehistoric sites AS-T-2008-1 through -8 conducted during survey (Dixon and Carson 2009) is considered adequate mitigation of these adverse effects.

At Andersen South there are two proposed Hand Grenade Range and Grenade House options associated with the Training Range Complex Alternatives A and B. Option 1 would affect medium and low probability areas. Option 2 would affect low probability areas.

Construction at Andersen South has the potential to require the removal of dukduk trees, a traditional resource used by canoe builders.


Proposed Main Gate
Convoy Course
Proposed AMVOC
Andersen South
Proposed Pioneer Road
Proposed Modular MOUT
Proposed Reconstructed MOUT
Proposed MOUT Log/Admin
Sasajyan
Proposed Secondary Gate
Pistol Range
KD Range
Pagat Point
Machine Gun Range
Square Bay Range
UD Range
Grenade House
Pacific Ocean
GUAM
Area Enlarged
Figure 12.2-3
Alternative A Impacts on or in Vicinity of Andersen South and Rte 15 Parcels and Archaeological Probability Areas
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Archaeological Probability Areas
High
Medium
Low
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
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Operation

In addition, a 2,000 ac (809 ha) area would be used for maneuver training by 300 personnel for over 45 weeks per year. Operation of the training facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism Disturbance to NRHP-eligible or listed resources indirectly through increasing access to the sites, is considered to be a significant adverse impact.

Non-DoD Land

Non-DoD land in the central project sites includes the proposed firing ranges near Route 15. There are two possible locations for the training ranges, Alternative A and Alternative B.

Construction

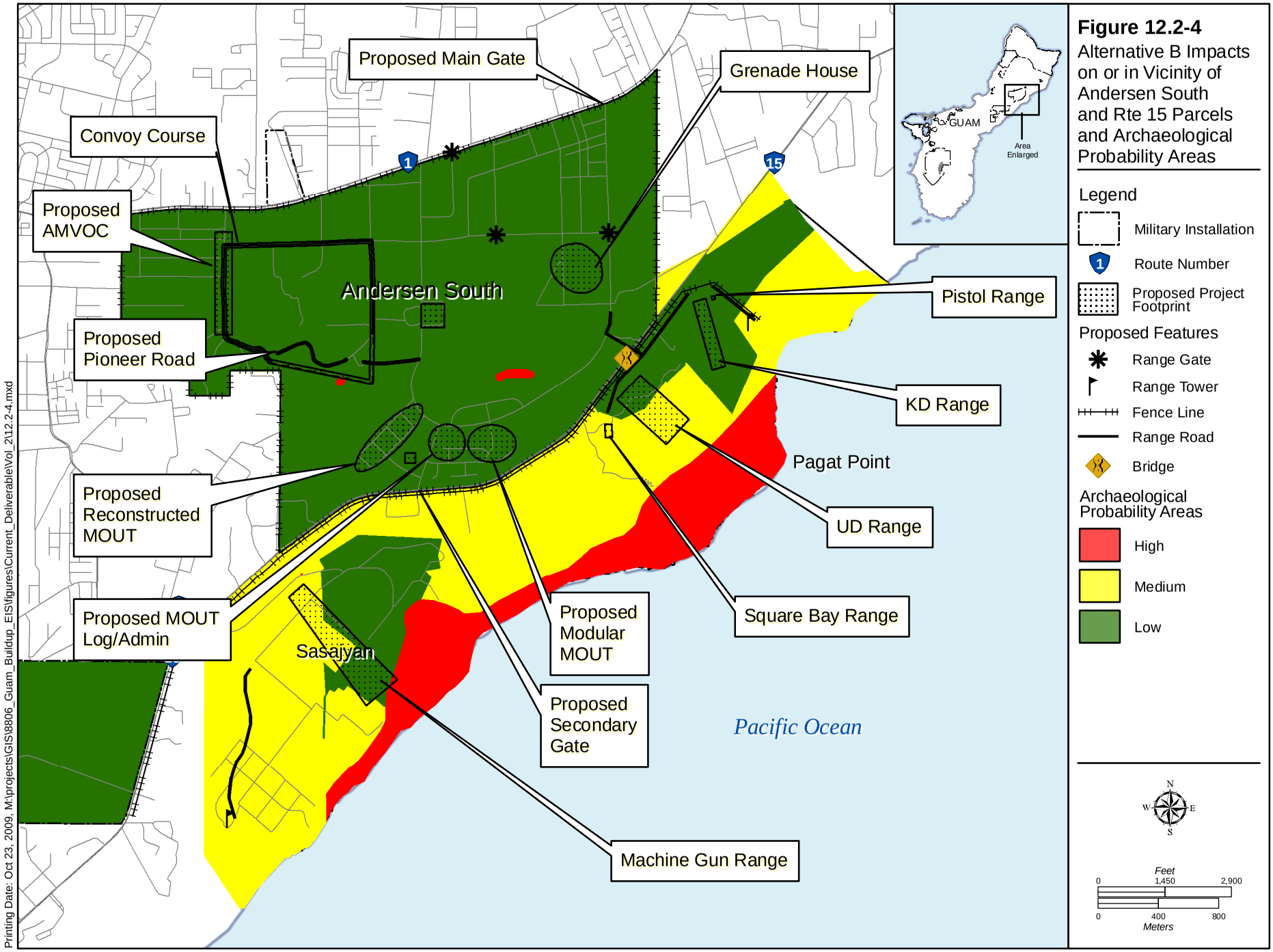
Alternative A includes a pistol range, a known distance (KD) range, a machine gun range, an unknown distance (UD) range, and a square bay range (see Figure 12.2-3). Alternative A would also include the realignment of a portion of Route 15 to go through Andersen South with a fence constructed on either side of the road. Construction of Alternative A has the potential to disturb previously unrecorded archaeological sites within medium probability areas. Construction of the pistol range and KD range would affect medium probability areas. Construction of the machine gun range and the UD range would affect both medium and low probability areas. The square bay range is located within a low probability area. The road realignment would be located in low and high probability areas. Construction of the realigned road would have adverse impacts to site 1063 (artifact scatter). Construction of the range roads and fencelines would impact medium and low probability areas. Construction of the range towers would impact medium probability areas. Construction of the range support areas would impact both medium and low probability areas. Total area of medium probability of Alternative A would be 61 ac (25 ha).

Alternative B contains similar firming ranges as Alternative A, but would not require the realignment of Route 15 (Figure 12.2-4). Construction of Alternative B has the potential to disturb previously unrecorded archaeological sites within medium probability areas. Construction of the pistol range, KD range, and square bay range would affect medium probability areas. Construction of the machine gun range and the UD range would affect both medium and low probability areas. The fenceline would impact both medium and low probability areas. The range towers would impact areas with medium probability. The range roads would impact medium and low probability areas. Construction of the range support areas would impact both medium and low probability areas. Total area of medium probability area under Alternative B is 50 ac (20 ha).

Construction of Alternatives A and B have the potential to require the removal of dukduk trees, a traditional resource used by canoe builders, and ifit trees, which are used for timber, fuel wood and craft wood.

Operation

Part of the construction would include fencing the firing range and restricting access to the public. As a result, operation of the training facilities at Alternative A would restrict public access to the Pagat site (04-0022, an NRHP-listed archaeological site and a traditional cultural property). Restricted access would have a beneficial impact to the site. Reduction in public access would reduce the incidence of vandalism. Also, these sites would not be affected by cleanup activities associated with the operations at the range because the sites are located outside of any potential impact areas. However, use of the firing range could create an audible change in the setting of the Pagat site. In addition, losing access to the site could be perceived by the public as an adverse impact.


Proposed Main Gate
Grenade House
Convoy Course
Proposed AMVOC
Andersen South
Pistol Range
Proposed Pioneer Road
KD Range
Pagat Point
Proposed Reconstructed MOUT
UD Range
Square Bay Range
Proposed MOUT Log/Admin
Sasajyan
Proposed Modular MOUT
Proposed Secondary Gate
Pacific Ocean
Machine Gun Range
GUAM
Area Enlarged
Figure 12.2-4
Alternative B Impacts on or in Vicinity of Andersen South and Rte 15 Parcels and Archaeological Probability Areas
Legend
Military Installation
Route Number
Proposed Project Footprint
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
Bridge
Archaeological Probability Areas
High
Medium
Low
N
W
E
S
Feet
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Operation of the training facilities at Alternative B would also limit public access to two traditional cultural properties--the Pagat site (04-0022 and 04-0020) and Marbo Cave (04-0642 and 04-0024). This would have a beneficial impact to the sites. These sites would not be affected by cleanup activities associated with the operations at the range because the sites are located outside of the any potential impact areas. As discussed under Alternative A, loss of access to these sites could be perceived as an adverse impact by the public due to their traditional importance.

Barrigada

No new Marine Corps-related construction or training activities are planned at Navy or Air Force Barrigada under Alternative 1. Therefore, Alternative 1 Marine Corps related-projects would have no impact on NRHP-eligible cultural resources on Navy or Air Force Barrigada.

12.2.2.3 Apra Harbor

Harbor

Activities in Apra Harbor under Alternative 1 include dredging near Sierra Wharf and increased ship traffic in inner Apra Harbor.

Construction

Dredging would take place in inner Apra Harbor in the vicinity of Sierra and Tango Wharves. No cultural resources are known in the dredging area and no cultural resources impacts would occur.

Operation

Operations within Apra Harbor would not adversely impact any NRHP-eligible or listed cultural resources, since none of these resources occur within the APE.

Naval Base Guam

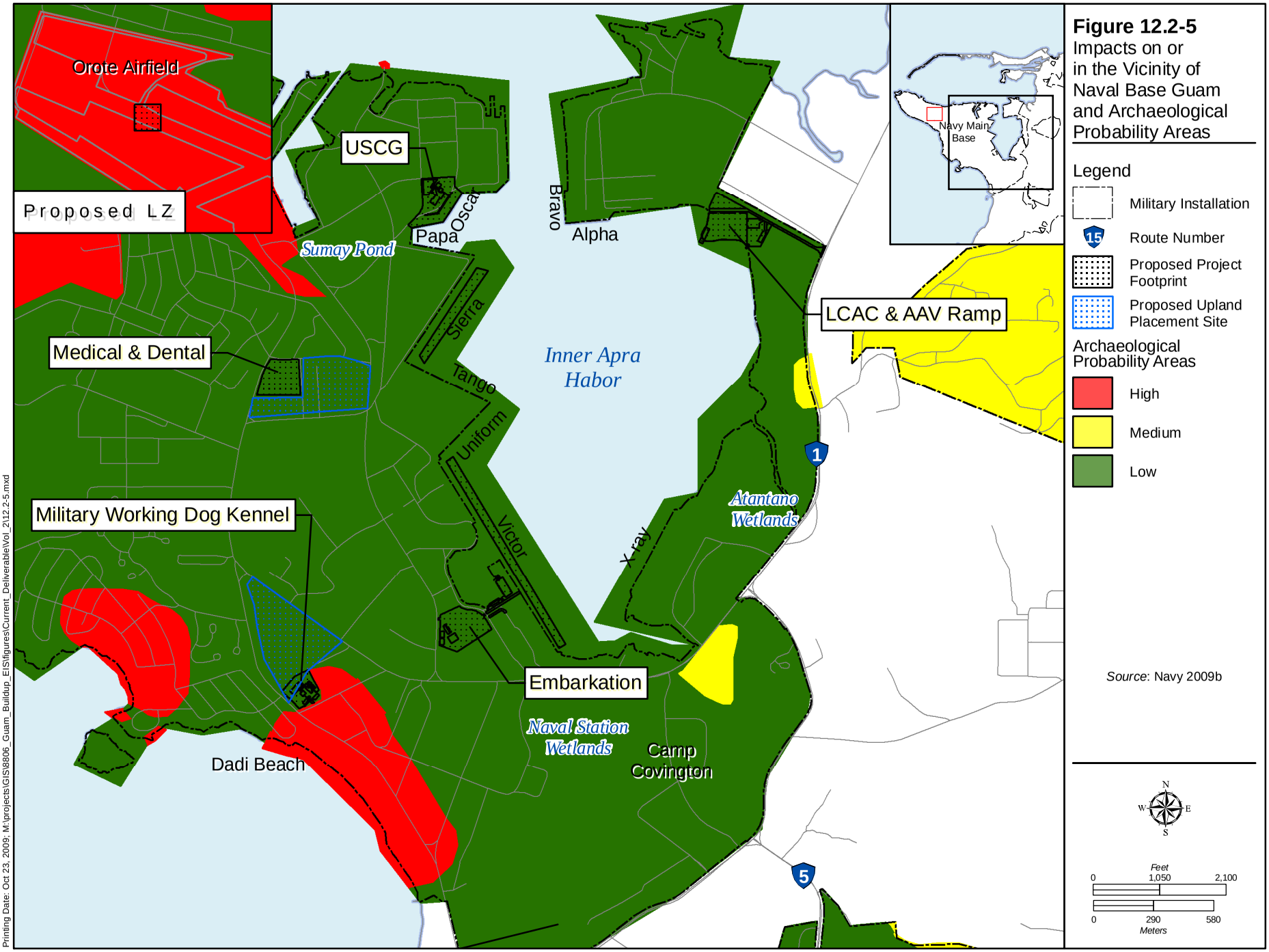
Construction

Several projects would be implemented at Naval Base Guam associated with Alternative 1: ship berthing and embarkation/staging area at Victor Wharf; amphibious craft laydown area at Victor Wharf; relocation of the USCG berthing and crew support buildings to Oscar/Papa Wharves; relocation of the MWDK; and construction of the Apra Medical/Dental clinic. In addition, several wharves would be repaired and improved—Victor, Uniform, Sierra, and Tango.

The ship berthing and embarkation staging area construction would take place in a low archaeological probability area at the wharves on the western portion of inner Apra Harbor (Figure 12.2-5). No demolition of existing buildings would be required. None of the wharves located at the ship berthing and embarkation area (Victor, Uniform, Sierra, and Tango) are eligible for inclusion on the NRHP.

The amphibious craft laydown area construction would take place in a low archaeological probability area near Alpha and Bravo wharves at Polaris Point. Since Polaris Point is constructed entirely of manmade fill, there is no potential for archaeological sites. Ground disturbance as a result of this construction would be 468,000 square ft (ft^2) (43,479 square m [m^2]). No demolition of existing buildings is required as this parcel is undeveloped.

The construction of the relocated U.S. Coast Guard (USCG) berthing and crew support buildings would take place in a low archaeological probability area at Oscar and Papa wharves. Several buildings would be demolished for the construction of the USCG berthing and crew support buildings (Buildings 24, 27,


Orote Airfield
Proposed LZ
USCG
Papa
Oscar
Bravo
Alpha
Sumay Pond
Sierra
Tango
Uniform
Victor
X-ray
Inner Apra Habor
LCAC & AAV Ramp
Medical & Dental
Military Working Dog Kennel
Embarkation
Atantano Wetlands
Naval Station Wetlands
Camp Covington
Dadi Beach
Navy Main Base
1
5
Figure 12.2-5
Impacts on or in the Vicinity of Naval Base Guam and Archaeological Probability Areas
Legend
Military Installation
15
Route Number
Proposed Project Footprint
Proposed Upland Placement Site
Archaeological Probability Areas
High
Medium
Low
Source: Navy 2009b
N
W
E
S
Feet
0
1,050
2,100
0
290
580
Meters
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29, 40, 42, 43, and 2078) and a floating drydock. None of these buildings is eligible for or listed on the NRHP.

The construction of the MWDK would take place near a high archaeological probability area associated with Dadi Beach and WWII-era Camp Bright (Guam site 02-1300). However, surveys of the relocated area for the MWDK site in 2009 included backhoe testing that did not find any NRHP-eligible archaeological resources (Dixon and Carson 2009). Therefore, no impacts would occur due to construction of the MWDK.

Construction of the Apra Medical/Dental clinic would take place in an area with low archaeological probability. Ground disturbance as a result of this construction would be 334,000 ft^2 (31,030 m^2). Sites are not located in this low probability area and no impacts would occur.

Operation

Use of the MWDK, the USCG berthing, the amphibious laydown area, and the Apra Medical/Dental clinic, would not impact NRHP-eligible or listed resources. Five potential upland placement sites would be located at Naval Base Guam. Dredged material would be temporarily stored in these areas. No construction is associated with creating the upland placement sites. Three of these sites, Fields 3, 5 and Polaris Point, have been analyzed in a previous NEPA document. The other two sites, Field 4 and PWC Compound, analyzed in this document are located in low probability areas.

War in the Pacific National Park

None of the projects associated with the proposed action would have an inpact on the War in the Pacific National Park. The closest projects associated with the proposed action to the War in the Pacific National Park would be at Apra Harbor approximately 0.75 miles away from the Piti Guns Unit portion of the park.

12.2.2.4 South

Naval Munitions Site

Activities at NMS would include munitions storage, aviation training, and non-firing maneuver training.

Construction

The NMS munitions area would be expanded by constructing 11 ECMs under Alternative 1. There are two alternatives for locating these storage areas. In Alternative A, 10 ECMs would be located on Parson's Road. Under Alternative B, 10 ECMs would be located at the High Road area. Under either alternative, one ECM would be placed within the High 12 Group. Alternative A would not impact any NRHP-eligible or listed archaeological, architectural, or traditional cultural property. Alternative B would adversely impact six WWII-era open munitions pads (Buildings 618, 619, 620, 623, 626, and 628. Five LZs would be placed within the southern portion of the NMS. Three LZs are within medium probability areas and two, NMS 4 and NMS 1, would adversely impact NRHP-eligible archaeological sites. Clearing associated with the preparation of the LZs could have an adverse impact on these NRHP-eligible sites.

Construction at NMS has the potential to require the removal of da'ok trees, a traditional resource used by canoe builders.

Operation

Non-firing maneuver training is planned for NMS in areas with low, medium, and high archaeological probability (Figure 12.2-6. Archaeological Probability Area Impacts on or in the vicinity of Naval Munitions Site). A 3,000 ac (1,214 ha) area would host 120 personnel 12 times a year. All of

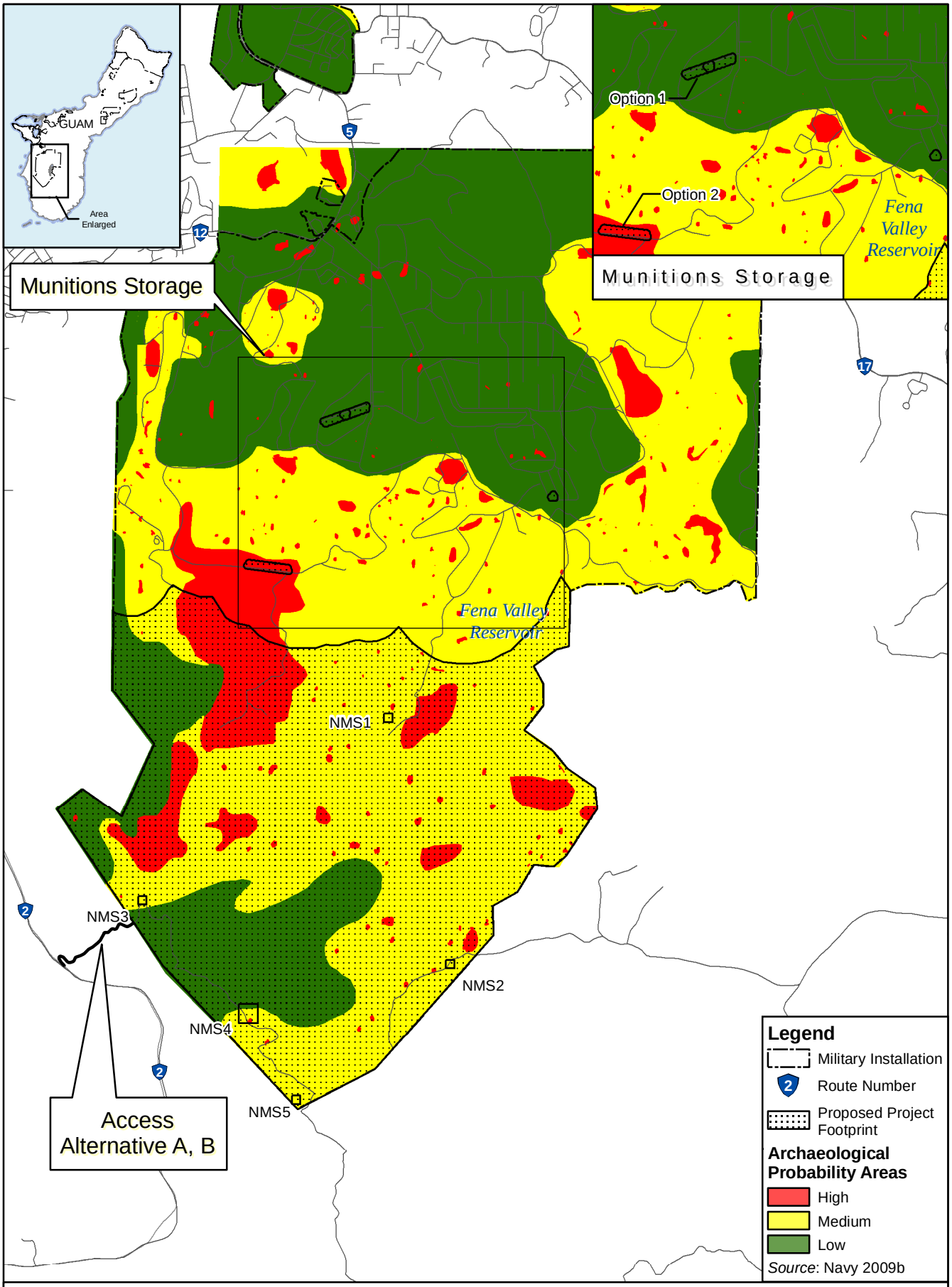

Figure 12.2-6
Archaeological Probability Area Impacts on or in the Vicinity of Naval Munitions Site

these training areas are protected by the PA associated with the MIRC EIS/OEIS signed in 2009 (Navy 2009g) as light training/ no cultural resource damage areas. The proposed maneuver training would be in accordance with the PA and would not adversely impact NRHP-eligible or listed archaeological sites.

Non-DoD Lands

Construction

An access road would be constructed to provide a transportation route to the southern portion of NMS. Access Alternative A and B (0.4 mi [0.6 km]) has been surveyed and no NRHP-eligible resources would be impacted from construction of this road.

Operation

Access roads into the southern portion of NMS could lead to increased vandalism in an area with a high density of archaeological sites and traditional cultural properties. This would be an adverse impact to these resources.

12.2.2.4 Summary of Impacts

Therefore, implementation of Alternative 1 would result in significant adverse impacts to 18 NRHP-eligible archaeological sites (9 in the Main Cantonment, 1 in Range Complex Alternative A, and 8 in airfield training areas), six NRHP-eligible architectural resources (at the Ammunition Storage Alternative B), and four traditional cultural properties (two associated with the Main Cantonment and two with Range Complex Alternative B). No adverse impacts would occur to NRHP-eligible or listed cultural resources at Apra Harbor or Barrigada.

12.2.2.5 Potential Mitigation Measures

Alternative 1 would have significant adverse impacts to cultural resources. However, with implementation of the proposed mitigation measures listed below and in accordance with the PA for this EIS/OEIS, these impacts would be resolved through consultation to less than significant levels.

Direct impacts to two archaeological sites in and around North Field at Anderson AFB (sites 1044 and 1046) would be avoided, or if avoidance is not possible then data recovery would take place at sites 1044 and 1046. Operational impacts would be mitigated through training of personnel working in the area to avoid impacts to archaeological sites.

Ground excavation and soil removal associated with MSA buildings and utilities construction would adversely impact 2 NRHP-eligible archaeological resources recorded by Dixon and Walker (2009) at prehistoric sites T-9-1 and T-9-2, but surface recording and subsurface testing conducted during survey is considered adequate mitigation of these adverse effects. NRHP eligible prehistoric site T-1-15 is located near the project APE, but would not be affected by the proposed action if avoided.

Direct impacts to 9 NRHP-eligible sites (381, 1012, 1020, 1021, 1022, 1023, 1026, 1678, and 1681) in the Main Cantonment and Housing areas would be avoided, or if avoidance is not possible, data recovery would take place. Indirect impacts to the Haputo site (08-007) and the Latte Stone Park (site 811) from possible vandalism would be mitigated through interpretive signs and documentation. The sign at the Latte Stone Park would be replaced. The Haputo site would be documented and brochures and signs created for public educational purposes.

The HQ area at the Main Cantonment and other medium probability areas in Finegayan and NMS would be subject to archaeological monitoring during construction.

Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible. For post review discoveries, an assessment would be made for NRHP eligibility in consultation with the Historic Preservation Office.

Direct impacts to 2 NRHP-eligible sites 1063 and 1065 at Andersen South, 1 site (1063) at Training Range Complex Alternative A, and 2 NRHP-eligible archaeological sites at NMS would be avoided or, if avoidance is not possible, then data recovery would take place. Potential indirect impacts to NRHP-eligible sites 04-0022 and 04-0021 (Pagat site) in the proposed firing area at Route 15 Alternatives A and B and to 04-0025 and 04-0642 (Marbo Cave and Marbo site) with Alternative B would be mitigated through implementation of a management plan. The Pagat Preservation Plan (sites 04-0021 and 04-0022) would be updated and executed. In recognition of the significance that Pagat cave has to various ethnic and historic groups, cultural access would be granted to the Pagat site when Navy procedures are followed. As stipulated in the PA, access to the Pagat site would be considered in light of military operational requirements and anti-terrorism/force protection security conditions and other pertinent circumstances as determined by the DoD at the time. Operational impacts would be mitigated through training of personnel working in the area to avoid impacts. Provisions for periodic access to Marbo Cave would be instituted if possible.

12.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 differs from Alternatives 1, 3, and 8 by the location of the main cantonment. Under Alternative 2, the main cantonment would be constructed at Finegayan and the Former FAA land. Elements of Alternative 2 that are the same as the other alternatives include the aviation training at Andersen AFB, Andersen South, NMS, and Naval Base Guam; the two alternatives for the firing range south of Route 15; and non-firing ranges at Andersen South and NMS.

12.2.3.1 North

Andersen AFB

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Finegayan

Construction

Construction of the main cantonment and family housing and community support would take place at Finegayan under Alternative 2. A variety of land uses/functions would be sited at NCTS Finegayan and South Finegayan including: housing, training, quality of life facilities, administrative, and educational facilities. A total of 1,610 ac (652 ha) at NCTS Finegayan and 290 ac (117 ha) at South Finegayan could be affected by construction. For the purposes of this analysis, all of this area would be considered disturbed, although some landscaping and open spaces may occur among the buildings. Initial planning considered the locations of NRHP-eligible resources and avoided impacting the majority of the historic properties in the area. Additional efforts would be made during the final planning stage to avoid all historic properties if possible.

Construction of the MLG facilities would impact areas with low and high archaeological probability (Figure 12.2-7). This setting would adversely impact sites 1024 (mortar and *lusong*) and 1026 (habitation site and artifact scatter). Construction of the QOL facilities would impact in areas with low and high archaeological probability. This setting would impact site 1012 (artifact scatter). Construction of the HQ, DIVA and MEFA facilities would impact areas with low, medium and high archaeological probability. This setting would impact sites 381 (ceramic scatter), 1020 (artifact scatter), 1022 (artifact scatter), 1032 (mortar/*lusong*), 1033 (artifact scatter), and 1034 (artifact scatter). Construction of the BEQ, BOQ, Military Aircraft Wing (MAW), and recreation facilities would impact in areas with low and high archaeological probability. This setting would impact sites 1021 (artifact scatter) and 1023 (four defensive structures).

Construction of education facilities would impact 290 ac (117 ha) in South Finegayan. However, site 811 (Latte Stone Park) would be avoided by construction and there would be no direct impacts to this site.

Construction at Finegayan has the potential to require the removal of dukduk trees, a traditional resource used by canoe builders.

Operation

Operation of these facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism, especially to sites such as Haputo on the coast and Latte Stone Park.

Non-DoD Land

Non-DoD land under Alternative 2 includes the lands in the Former FAA parcel.

Construction

Under Alternative 2, impacts to cultural resources within the FAA parcel would be similar to those discussed for Alternative 1. Most of the construction that would take place at the FAA Parcel under Alternative 2 would be housing, education, and QOL. Construction would take place in areas with primarily low archaeological probability, but small amounts of medium archaeological probability would be impacted. Direct impacts from construction would occur to sites 1678 (ceramic scatter) and 1681 (ceramic scatter). The total impact area subject to ground disturbance would be 680 ac (275 ha).

Operation

Operation of these facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism.

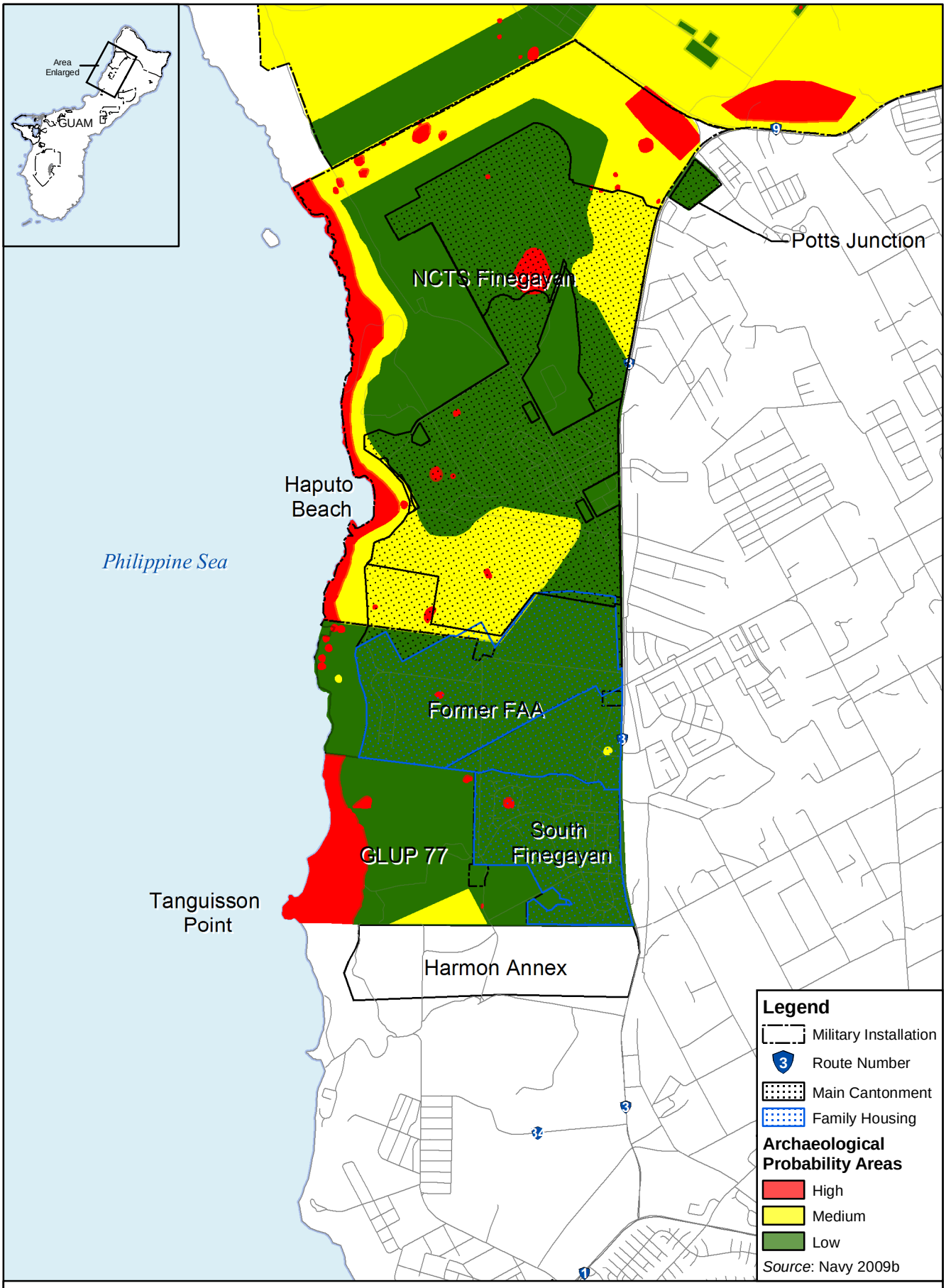

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Figure 12.2-7
Construction at Main Cantonment Alternative 2 and Archaeological Probability Zones

12.2.3.2 Central

Andersen South

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Barrigada

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.3.3 Apra Harbor

Harbor

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Naval Base Guam

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.3.2 South

Naval Munitions Site

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.3.3 Summary of Impacts

Therefore, implementation of Alternative 2 would result in significant impacts to 22 NRHP-eligible archaeological sites, including 13 sites associated with the Main Cantonment, six NRHP-eligible architectural resources, and four traditional cultural properties. No adverse impacts would occur to NRHP-eligible or listed cultural resources at Apra Harbor or Barrigada.

12.2.3.4 Potential Mitigation Measures

Alternative 2 would have significant adverse impacts to cultural resources. However, with implementation of the proposed mitigation measures listed below and in accordance with the PA for this EIS/OEIS, these impacts would be resolved through consultation to less than significant levels.

Impacts and mitigations to cultural resources at Andersen AFB, Andersen South, Route 15, NMS, and Apra Harbor would be the same as for Alternative 1.

Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.

Direct impacts to NRHP-eligible sites (381, 1012, 1020, 1021, 1022, 1023, 1026, 1033, 1034, 1678, and 1681) in the Main Cantonment and Housing areas would be avoided or if avoidance is not possible, then data recovery would take place at these sites. Operations impacts would be mitigated through training of personnel working and living in the area to avoid impacts to archaeological sites. The *lusong* at sites 1024 and 1032 would be curated or relocated. Indirect impacts to the Haputo site (08-007) and the Latte Stone Park (site 811) from possible vandalism would be mitigated through signage and documentation. The sign at the Latte Stone Park would be replaced. The Haputo site would be documented and brochures and signs created for public educational purposes.

The HQ, MEFA, and MAW area at the Main Cantonment would be subject to archaeological monitoring during construction because they are within medium archaeological probability areas.

12.2.4 Alternative 3

Alternative 3 differs from Alternatives 1, 2, and 8 by the location of the main cantonment. Under Alternative 3 the main cantonment would be constructed at Finegayan, Air Force Barrigada, and Navy Barrigada. Elements of Alternative 3 that are the same as the other alternatives include the aviation training at Andersen AFB, Andersen South, NMS, and Naval Base Guam; the two alternatives for the firing range south of Route 15; and non-firing ranges at Andersen South and NMS.

12.2.4.1 North

Andersen AFB

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Finegayan

Construction

Construction and operation for the main cantonment and family housing and community support would take place at Finegayan under Alternative 3. A variety of land uses/functions would be sited at NCTS Finegayan and South Finegayan including; housing, training, administration, quality of life facilities, and educational facilities. A total of 1,610 ac (652 ha) at NCTS Finegayan and 290 ac (117 ha) at South Finegayan could be affected by construction. For the purposes of this analysis, all of this area would be considered disturbed, although some landscaping and open spaces may occur among the buildings. Initial planning considered the locations of NRHP-eligible resources and avoided impacting the majority of the historic properties in the area. Additional efforts would be made during the final planning stage to avoid all historic properties if possible.

Construction of the MLG facilities would impact areas with low, medium, and high archaeological probability (Figure 12.2-8). This setting would impact sites 1024 (mortar and *lusong*) and 1026 (habitation site and artifact scatter).

Construction of the QOL facilities would impact areas with low and high archaeological probability. This setting would impact site 1012 (artifact scatter). Construction of the HQ , DIVA and MEFA facilities would impact areas with low, medium and high archaeological probability. This setting would impact sites 381 (ceramic scatter) and 1020 (artifact scatter),. Construction of the MLG facilities would impact areas with medium and high archaeological probability including sites 1032 (mortar/*lusong*), 1033(artifact scatter), and 1034 (artifact scatter). Construction of the BEQ and BOQ facilities would impact areas with low, medium and high archaeological probability. This setting would adversely affect sites 1021 (artifact scatter) and 1023 (four defensive structures).

Construction of HSG and education facilities would impact areas with low and high archaeological probability at South Finegayan. However, site 811 would be avoided by construction and there would be no direct impacts to this site.

Construction at Finegayan has the potential to require the removal of dukduk trees, a traditional resource used by canoe builders.

Operation

Operation of these facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism, especially to sites such as Haputo on the coast and Latte Stone Park.

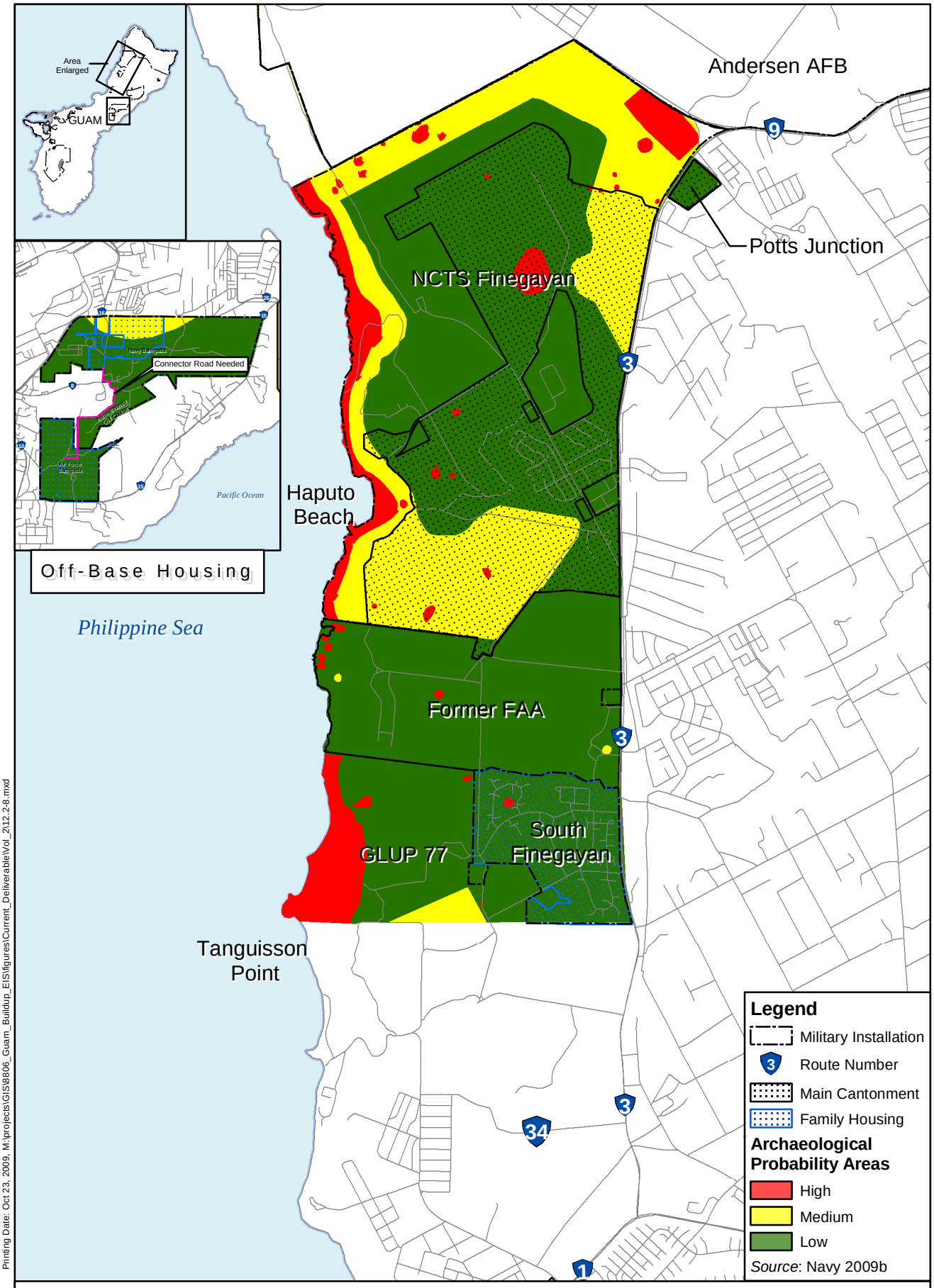

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Figure 12.2-8
Construction at Main Cantonment Alternative 3 and Archaeological Probability Zones

Central

Andersen South

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Barrigada

Construction

Under Alternative 3, HSG and education facilities would be constructed at Navy and Air Force Barrigada. Air Force Barrigada has a low potential for archaeological sites. NRHP-eligible sites do not occur in this area and construction and operational impacts are not expected.

The majority of the construction would occur in a low archaeological probability area. Construction at the northern boundary of Navy Barrigada would occur at an area considered to be a medium probability area for archaeology (see Figure 12.2-8). This area is also the southwestern corner of Mount Barrigada or Mount Tuyan, a traditional cultural property. The proposed construction would place the Base Gate, BEQ/BOQ, QOL and all housing facilities atop the steep slope on the southwestern side of Mount Barrigada. This setting would require a substantial amount of vegetation/ground excavation, and soil removal and has the potential to adversely affect a traditional cultural property by the removal of the foot of the mountain and disturb an area with medium probability for archaeological resources.

Operation

Operations at the Navy Barrigada would include the use of administrative, maintenance, and housing by Marine Corps personnel. The occupation of housing in the area would increase the population living in the area. This increase in personnel in the area could increase site vandalism and have a visual and audible impact on the surrounding area. However, most of the area is situated in a low archaeological probability area and NRHP-eligible resources do not occur in this area. Increased population in this area would not adversely impact Mount Barrigada since the operations would not restrict access to the property, or adversely impact its association with Chamorro legends.

12.2.4.2 Apra Harbor

Harbor

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.4.3 South

Naval Munitions Site

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.4.4 Summary of Impacts

Therefore, implementation of Alternative 3 would result in significant impacts to 19 NRHP-eligible archaeological sites (including 10 sites in the Main Cantonment alternative), six NRHP-eligible architectural resources, and five traditional cultural properties. No adverse impacts would occur to NRHP-eligible or listed cultural resources at Apra Harbor.

12.2.4.5 Potential Mitigation Measures

Alternative 3 would have significant adverse impacts to cultural resources. However, with implementation of the proposed mitigation measures listed below and in accordance with the PA for this EIS/OEIS, these impacts would be resolved through consultation to less than significant levels.

Impacts and mitigations to cultural resources at Andersen AFB, Andersen South, Route 15, NMS, and Apra Harbor would be the same as for Alternative 1.

Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.Direct impacts to NRHP-eligible sites (381, 1012, 1020, 1021, 1022, 1023, 1026, 1033, and 1034) in the Main Cantonment and Housing areas would be avoided or, if avoidance is not possible, then data recovery would occur. The *lusong* at sites 1024 and 1032 would be curated or relocated. Operational impacts would be mitigated through training of personnel working and living in the area to avoid impacts to archaeological sites. Indirect impacts to the Haputo site (08-007) and the Latte Stone Park (site 811) from possible vandalism would be mitigated through the signage and documentation. The sign at the Latte Stone Park would be replaced. The Haputo site would be documented and brochures and signs created for public educational purposes.

The HQ, MEFA, and MAW area at the Main Cantonment would be subject to archaeological monitoring during construction because it is within a medium archaeological probability area. Construction of facilities in the north of Navy Barrigada that would require leveling a portion of Mount Barrigada would be redesigned to avoid disturbing this area, if possible. Otherwise, appropriate documentation or interpretation would take place.

12.2.5 Alternative 8

Alternative 8 differs from Alternatives 1, 2, and 3 by the location of the main cantonment. Under Alternative 8, the main cantonment would be constructed at Finegayan and the Former FAA land and at Air Force Barrigada. Elements of Alternative 8 that are the same as the other alternatives include the aviation training at Andersen AFB, Andersen South, NMS, and Naval Base Guam; the two alternatives for the firing range south of Route 15; and non-firing ranges at Andersen South and NMS.

12.2.5.1 North

Andersen AFB

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Finegayan

Construction

Construction of the main cantonment and family housing and community support would take place at Finegayan, the Former FAA property, and Air Force Barrigada under Alternative 8. A variety of land uses/functions would be sited at Finegayan and South Finegayan including housing, training, quality of life facilities, administration, and educational facilities. A total of 1,090 ac (441 ha) at NCTS Finegayan and 290 ac (117 ha) at South Finegayan could be affected by construction. For the purposes of this analysis, all of this area would be considered disturbed, although some landscaping and open spaces may occur among the buildings. Initial planning considered the locations of NRHP-eligible resources and avoided impacting the majority of the historic properties in the area. Additional efforts would be made during the final planning stage to avoid all historic properties if possible.

Construction of the BEQ would impact areas with low, medium, and high archaeological probability (Figure 12.2-9). This setting would impact site 1021 (artifact scatter).

Construction of HQ facilities would impact areas with a medium archaeological probability. Construction of the BASE, DIVA and MEFA facilities would impact areas with low, medium, and high archaeological probability. This setting would impact sites 1022 (artifact scatter) 1023 (four defensive structures) and 1026 (habitation site and artifact scatter).

Construction of the MLG facilities would impact areas with low, medium, and high archaeological probability. This setting would impact sites 381 (ceramic scatter), 1012 (artifact scatter) and 1020 (artifact scatter). Construction of the LTC facilities would impact an area with low archaeological probability. NRHP-eligible sites do not occur in this area and no impacts are expected.

Construction of education facilities would impact areas with low archaeological probability at South Finegayan. Site 811 (Latte Stone Park) would be avoided.

Construction at Finegayan has the potential to require the removal of dukduk trees, a traditional resource used by canoe builders.

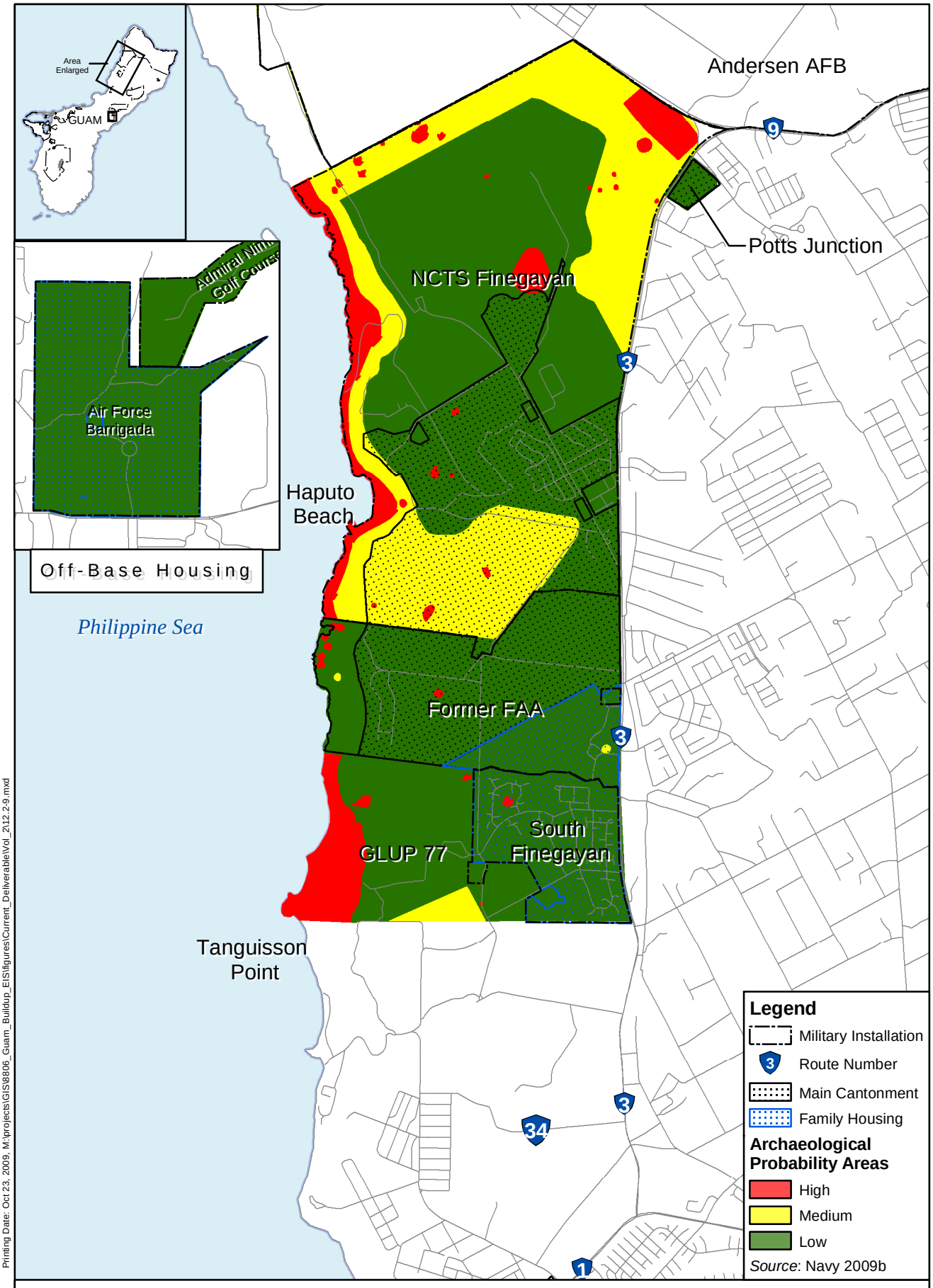

Figure 12.2-9
Construction at Main Cantonment Alternative 8 and Archaeological Probability Zones

Operation

Operation of the HQ facilities, education facilities, BASE facilities, and BEQ would bring additional personnel into the area. This increase in personnel could increase site vandalism, especially to sites such as Haputo on the coast and Latte Stone Park.

Non-DoD Land

Construction

Under Alternative 8, impacts to the FAA Parcel would be similar to those discussed for Alternative 1. Most of the construction that would take place at the FAA Parcel under Alternative 8 would be HSG, education, BOQ, PMO, TRN, and QOL . Construction would take place in areas with low, medium, and high archaeological probability including sites 1678 (ceramic scatter) and 1681 (ceramic scatter). Total impacted acres would be 680 (275 ha).

Operation

Operation of these facilities would bring additional personnel into the area. This increase in personnel could increase site vandalism.

12.2.5.2 Central

Andersen South

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Barrigada

Construction

Under Alternative 8, HSG, BASE, QOL and education facilities would be constructed at Air Force Barrigada. Air Force Barrigada has a low potential for archaeological sites. NRHP-eligible sites do not occur in this area and no impacts to NRHP-eligible cultural resources would occur.

Operation

Under Alternative 8, HSG, BASE, QOL and education facilities would be constructed at Air Force Barrigada. Air Force Barrigada has a low potential for archaeological sites. NRHP-eligible sites do not occur in this area and no impacts to NRHP-eligible cultural resources would occur.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.5.2 Apra Harbor

Harbor

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Naval Base Guam

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.5.3 South

Naval Munitions Site

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

Non-DoD Land

Construction

Impacts would be the same as those discussed under Alternative 1.

Operation

Impacts would be the same as those discussed under Alternative 1.

12.2.5.4 Summary of Impacts

Therefore, implementation of Alternative 8 would result in significant impacts to 18 NRHP-eligible archaeological sites (including 9 sites associated with the Main Cantonment alternative), six NRHP-eligible architectural resources, and five traditional cultural properties. No adverse impacts would occur to NRHP-eligible or listed cultural resources at Apra Harbor

12.2.5.5 Potential Mitigation Measures

Alternative 8 would have significant adverse impacts to cultural resources. However, with implementation of the proposed mitigation measures listed below and in accordance with the PA for this EIS/OEIS, these impacts would be resolved through consultation.

Impacts and mitigations to cultural resources at Andersen AFB, Andersen South, Route 15, NMS, and Apra Harbor would be the same as for Alternative 1.

Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible. Direct impacts to NRHP eligible sites (381, 1012, 1020, 1021, 1022, 1023, 1026,

1678, and 1681) in the Main Cantonment and Housing areas would be avoided or if avoidance is not possible, then data recovery would take place. Operational impacts would be mitigated through training of personnel working and living in the area to avoid impacts to archaeological sites. Indirect impacts to the Haputo site (08-007) and the Latte Stone Park (site 811) from possible vandalism would be mitigated through the signage and documentation. The sign at the Latte Stone Park would be replaced. The Haputo site would be documented and brochures and signs created for public educational purposes.

The HQ area at the Main Cantonment would be monitored during construction because it is within a medium archaeological probability area.

12.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. DoD management of cultural resources on non-DoD lands at the Harmon Annex or Route 15 would not occur and these sites could be vandalized or allowed to deteriorate. Implementation of the no-action alternative would maintain existing conditions, although there could be a significant adverse impact to NRHP-eligible or listed sites on non-DoD lands. In addition, implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

12.2.7 Summary of Impacts

Extensive data collection and surveys associated with this EIS/OEIS have examined more than 5,000 acres in Guam and recorded more than 100 NRHP-eligible archaeological sites and architectural resources. Recent studies have also identified traditional cultural properties, and conducted interviews with individuals knowledgeable about the history of WW II and of traditional practices.

The impact analysis has identified significant adverse impacts from the proposed action to between 20 and 35 NRHP-eligible archaeological and architectural resources and traditional cultural properties. Most of the impacts would occur on DoD lands. This EIS/OEIS has proposed potential mitigation measures to reduce those impacts to less than significant levels through data recovery, implementation of a preservation plan, public education, signs, brochures, and documentation.

Table 12.2-1. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
SI-M • Significant adverse direct impacts to 7 NRHP-eligible or listed archaeological resources on Finegayan, 2 on non-DoD land (FAA), all mitigated to less than significant through data recovery	SI-M • Significant adverse direct impacts to 11 NRHP-eligible or listed archaeological resources on Finegayan, 2 on non DoD land (FAA)	SI-M • Significant adverse direct impacts to 10 NRHP-eligible or listed archaeological resources on Finegayan,	SI-M • Significant adverse direct impacts to 7 NRHP-eligible or listed archaeological resources on Finegayan, 2 on non DoD land (FAA
Operation			
SI-M • Significant adverse impacts to two traditional cultural properties at Finegayan all mitigated to less than significant through public education	SI-M • Significant adverse impacts to two traditional cultural properties at Finegayan all mitigated to less than significant through public education	SI-M/LSI • Significant adverse impacts to two traditional cultural properties at Finegayan • Less than significant impacts to one traditional cultural property at Barrigada.	SI-M • Significant adverse impacts to two traditional cultural properties at Finegayan all mitigated to less than significant through public education

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 12.2-2. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
SI-M • Significant adverse indirect impacts to 1 NRHP eligible site	• NI No impact to archaeological sites
Operation	
SI-M • Significant adverse indirect impacts to Pagat site at Route 15 due to operations	SI-M • Significant adverse indirect impacts to Pagat site and Marbo site at Route 15 due to operations

Legend: SI-M = Significant impact mitigable to less than significant, NI = No impact.

Table 12.2-3. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS	SI-M • Significant adverse direct impacts to 6 NRHP-eligible or listed architectural resources on NMS
Operation	
NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS	NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS

Legend: SI-M = Significant impact mitigable to less than significant, NI = No impact.

Table 12.2-4. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS	NI • No construction
Operation	
NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS	NI • There would be no adverse impacts to NRHP-eligible or listed sites on NMS

Legend: NI = No impact.

Table 12.2-5. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
SI-M • Significant adverse direct impacts to 2 NRHP-eligible or listed archaeological resources on NMS; 2 on Andersen South, and 2 on Andersen AFB for construction of LZs for aviation and maneuver training	SI-M • Significant adverse direct impacts to 2 NRHP-eligible or listed archaeological resources on NMS	NI • No adverse impacts to NRHP-eligible or listed archaeological, architectural or traditional resources at Apra Harbor, • No adverse impacts to NRHP-eligible or listed submerged resources or objects
Operation		
NI • No adverse impacts to NRHP-eligible or listed archaeological resources	NI • No adverse impacts to NRHP-eligible or listed archaeological resources	NI • No adverse impacts to NRHP-eligible or listed archaeological resources at Apra Harbor, due to operations • No adverse impacts to NRHP-eligible or listed submerged resources or objects

Legend: SI-M = Significant impact mitigable to less than significant, NI = No impact.

12.2.8 Summary of Potential Mitigation Measures

Table 12.2-6. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Archaeological Resources			
• Data Recovery of sites 1044, 1046, 1021, 1022, 1023, 1012, 381, 1020, 1026,1678, 1681, 1063, 1065, T-9-1, NMS 1, NMS 2, and T-9-2. • Pagat Preservation Plan would be updated and executed for 04-0021 and 04-0022 • Preservation of 04-0642 and 04-0024 • Conduct cultural resources education training of Marines and soldiers to promote protections of sensitive sites. • For post review discoveries an assessment will be made for NRHP eligibility in consultation with the Historic Preservation Office.	• Data Recovery of sites 1044, 1046, 1021, 1022, 1023, 1012, 238, 1020, 1024, 1026, 1033, 1034,1678, 1681, 1063, 1065, NMS1, NMS2, T-9-1, and T-9-2. • Relocation or curation of 1024 and 1032 • Pagat Preservation Plan would be updated and executed for 04-0021 and 04-0022 • Preservation of 04-0642 and 04-0024 • For post review discoveries an assessment will be made for NRHP eligibility in consultation with the Historic Preservation Office.	• Data Recovery of sites 1044, 1046, 1021,, 1023, 1012, 381, 1020, 1026, 1033, 1034, 1063, 1065, NMS1, NMS2, T-9-1, and T-9-2. • Relocation or curation of 1024 and 1032 • Pagat Preservation Plan would be updated and executed for 04-0021 and 04-0022 • Preservation of 04-0642 and 04-0024 • Conduct cultural resources education training of Marines and soldiers to promote protections of sensitive sites. • For post review discoveries an assessment will be made for NRHP eligibility in consultation with the Historic Preservation Office.	• Data Recovery of sites 1044, 1046, 1021, 1022, 1023, 1012, 381, 1020, 1026, 1678, 1681, 1063 1065, NMS1, NMS2, T-9-1, and T-9-2. • Pagat Preservation Plan would be updated and executed for 04-0021 and 04-0022 • Preservation of 04-0642 and 04-0024 • For post review discoveries an assessment will be made for NRHP eligibility in consultation with the Historic Preservation Office.
Architectural Resources			
• Archival research and detailed mapping of 6 architectural resources	• Archival research and detailed mapping of 6 architectural resources	• Archival research and detailed mapping of 6 architectural resources	• Archival research and detailed mapping of 6 architectural resources
Submerged Resources			
• None	• None	• None	• None
Traditional Cultural Properties			
• Preserve site and upgrade sign for 811 • Documentation of site, brochure, signs for 08-007 • Cultural access would be granted to the Pagat site when Navy procedures are followed. • Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.	• Preserve site and upgrade sign for 811 • Documentation of site, brochure, signs for 08-007 • Cultural access would be granted to the Pagat site when Navy procedures are followed. • Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.	• Avoidance of Mount Barrigada; public education • Preserve site and upgrade sign for 811 • Documentation of site, brochure, signs for 08-007 • Cultural access would be granted to the Pagat site when Navy procedures are followed. • Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.	• Preserve site and upgrade sign for 811 • Documentation of site, brochure, signs for 08-007 • Cultural access would be granted to the Pagat site when Navy procedures are followed. • Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.

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CHAPTER 13. VISUAL RESOURCES

This section describes the applicable existing visual conditions and resources on Guam by geographical area. While the focus is on the visual resources on those lands being considered under the proposed action, it also includes areas within the general region of influence. Figure 13.1-1 shows where all of the various areas and scenic points of interest are throughout Guam and described in this section.

Visual resources include scenic areas, vistas or thoroughfares and locations that provide natural-appearing or aesthetically-pleasing places or views. This includes natural views such as shorelines, seascapes, cliffs and man-made views such as unique buildings, landscaping, parks, and other types of cultural features. Typically, visual resource descriptions focus on those that are recognized as highly valued. For instance, they may be specific places, vistas, and scenic overlooks identified by a visitor's association. However, visual resources are also recognized as views and vistas that people are accustomed to seeing and often take for granted as a general part of the landscape.

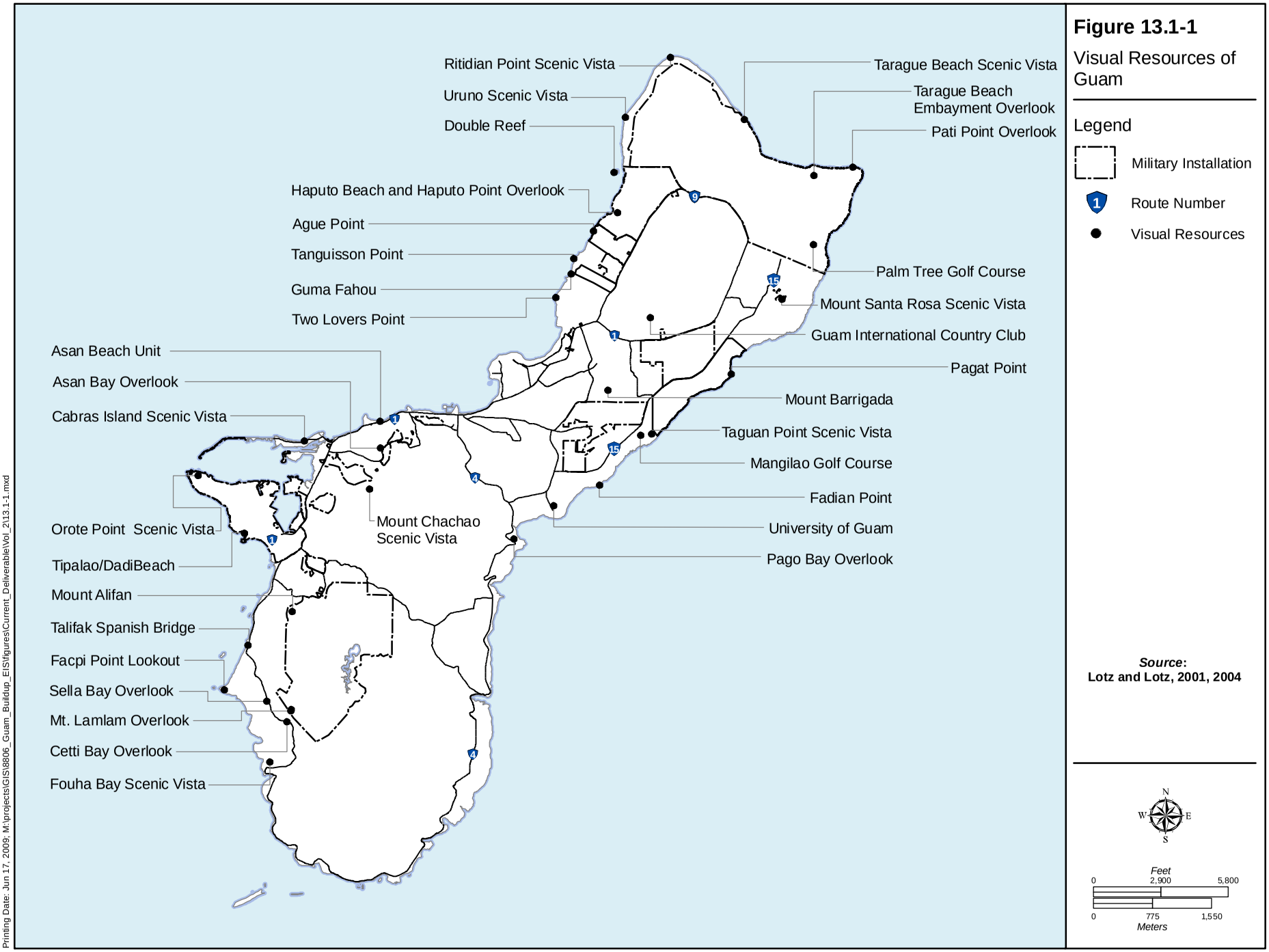
Visual resources are an important part of the quality and sensory experience of an area. Users often encounter an area first and foremost through a visual interaction or their 'view' of a place. Views are generally composed of, and often described in terms of foreground, middle-ground and background depending on the site. For analysis purposes, visual resources are composed of the following:

- Dominant landscape features (e.g., a tall water tower in a landscape otherwise composed of low vegetation and one or two story buildings)
- Diversity (e.g., rows of crops adjacent to an urban area with the mountains as a backdrop)
- Elements of line, color, form, and texture
- Distinctive visual edges (e.g., a housing tract adjacent to a forested area).

13.1 AFFECTED ENVIRONMENT

13.1.1 North

Northern Guam's topography is generally flat to gently rolling with abrupt cliff lines reaching downward to the shoreline. This is particularly the case on the north and west sides of this area. Much of northern Guam is thickly vegetated with green hues that accentuate the flora of the area. Dominant man-made features include the Finegayan water tower and the Naval Computer and Telecommunications Station (NCTS) communications facilities – i.e., 'golf ball' antennae. Dominant natural features include Mount Santa Rosa (the highest point on northern Guam) and the surrounding cliff lines. The northeastern area can generally be categorized as a rural to suburban landscape while the northwestern area is generally more rural in appearance. A view of northern Guam from offshore presents an almost continuous landscape of flora with limestone walls extruding along the shoreline covered under the abundant vegetation.



13.1.1.1 Andersen Air Force Base (AFB)

Andersen AFB is composed of runways, buildings, facilities, and housing areas all surrounded by moderately to heavily vegetated forest. Due to the relatively flat topography and moderate to heavy vegetation, the surrounding communities of Dededo and Yigo have limited views into Andersen AFB. One exception to this is the views afforded from Mount Santa Rosa. From this point, sweeping 360-degree views can be seen of the entire north area, including distant views of Andersen AFB facilities and surrounding landscape.

North Ramp Area

As illustrated in Figure 13.1-2, the existing North Ramp Area consists of flat runways and low-sloped aviation ramps, and adjacent base facilities. This area is surrounded by a landscape made up primarily of natural-appearing low-growth vegetation that extends outward to the cliffs and shoreline to the north and east, and the more developed base facilities mixed with natural-appearing vegetation to Highway 9 to the south. Most of the facilities in the North Ramp Area are either hangars, fuel tanks, or one-to-two story buildings that are situated well above the cliff line. Therefore, views of this area from offshore are primarily of the heavily vegetated limestone cliffs.

Figure 13.1-2. Aerial View of the North Ramp Area looking from the Northeast to the Southwest with Heavily Vegetated Cliff line in the Foreground

Source: EDAW 2008.

Tarague Embayment Overlook

Tarague Embayment Overlook faces east towards the Pacific Ocean. The overlook offers a view of the nearby cliffs and Tarague Beach. The Tarague Embayment Natural Trail traverses Tarague Embayment Overlook and is only accessible overland through military-controlled property. See Volume 2, Chapter 9, Recreation, for more information on trails on Guam.

Pati Point Overlook

Pati Point Overlook not only offers views of the shoreline and cliffs, but also of the Pati Point Marine Preserve area. The nearby limestone forests show prominently in this viewshed and are protected as part of the Pati Point Natural Area only accessible overland by trail through military-controlled property.

South Ramp Area

The South Ramp Area (Figure 13.1-3 and Figure 13.1-4) is located on the south side of the Andersen AFB runways. This area is composed of Air Force facilities (hangars, warehouses, and one-to-two story buildings) surrounded by family housing. The area adjacent to the runways and associated facilities can generally be described as a low density urban to suburban landscape with a unified streetscape and landscape features. Low vegetation (grass, shrubs and small street trees) is predominant, as larger canopy trees are often damaged during typhoon events.

Figure 13.1-3. Aerial View of the South Ramp Port of Debarkation (APOD) at South Ramp 7 Viewed from the North Looking South

Source: EDAW 2008.

Figure 13.1-4. Aerial View of South Ramp and the Andersen AFB Housing Area Viewed from the Southwest Looking Northeast

Source: EDAW 2008.

Palm Tree Golf Course

The Palm Tree Golf Course is located in the South Ramp Area between the Terminal and Heritage Room and the Anao Conservation Reserve. The golf course is part of Andersen AFB and provides a view of the northeastern shoreline and the Pacific horizon (Figure 13.1-5). A view of the Pati Point cliff ridge is also provided from the golf course. The Palm Tree Golf Course is located on military-controlled property.

Figure 13.1-5. A View at the Palm Tree Golf Course Looking North Toward the Pacific Ocean and Pati Point

Source: AFCEE 2005.

Air Force Munitions Storage Area (MSA)

The MSA is located between Andersen Main Base (which includes both the North Ramp and South Ramp areas) and Andersen Northwest Field (NWF) (Figure 13.1-6). The MSA site is located on relatively flat ground and consists of roadways and earth covered magazines arranged in a large grid pattern across the landscape. Land surrounding this area and in between the roads and earth covered magazines is dominated by dense and natural-appearing vegetation. Therefore, in most locations, long-range views are obscured due to the heavy vegetation growing on this site.

Figure 13.1-6. Aerial View of Andersen MSA in the Foreground Looking East Toward Tarague Beach, Adjoining Cliffs, and Andersen Main Base in the Distance

Source: EDAW 2008.

On the northeastern side of the MSA lies the Tarague Beach Scenic Vista. This scenic viewpoint offers views of Ritidian Point and its nearby shoreline (Figure 13.1-7 and Figure 13.1-8).

Figure 13.1-7. View of Tarague Beach and Ritidian Point from the Tarague Beach Scenic Vista
Source: EDAW 2007.

Figure 13.1-8. The Road to Tarague Beach Provides a Panoramic Ocean View
Source: Google Earth 2008.

Tarague Beach Scenic Vista

Tarague Beach (refer to Figure 9.1-1) is located about one mile northeast of the Andersen MSA. The beach area provides a wide range of coastal views, including the reefs and surrounding limestone cliffs (Figure 13.1-9). This area is only accessible overland through military-controlled property.

Figure 13.1-9. A View of Ritidian Point from Tarague Beach
Source: Google Earth 2008.

Northwest Field

NWF, located in the northwestern sector of Andersen AFB, contains several old runways within a setting of dense tropical vegetation (Figure 13.1-10). The landscape is similar to that of the MSA, featuring a thickly vegetated landscape dominated by wide canopy trees and shrubs that generally block long distance views (Figure 13.1-11). Along the adjacent coastline lie several scenic points of interest that provide recognized scenic and recreational value, such as Ritidian Point and Uruno Point. The views at Ritidian Point and Uruno Point are discussed in Section 13.1.1.3.

Figure 13.1-10. Aerial View of Northwest Field Looking North
Source: EDAW 2008.

Figure 13.1-11. A Typical View from Within the Northwest Field Area
Source: EDAW 2008.

13.1.1.2 Finegayan

The Finegayan area is composed of a relatively flat to gently rolling landform, much of which is covered by dense vegetation. Limestone outcrops and green vegetated cliffs dominate the coastline. While there are a few open vistas, the terrain and dense tropical vegetation blocks most long distance views of the surrounding landscape and Philippine Sea beyond.

NCTS Finegayan

The NCTS Finegayan area is composed of Navy communication facilities surrounded by low grasslands, shrubs and densely forested areas (Figure 13.1-12, Figure 13.1-13, Figure 13.1-14, and Figure 13.1-15). Wide open vistas from and into this area are limited due to the terrain and vegetative canopy. Nevertheless, there are locations along Highway 3 that afford views into and of the NCTS area and facilities. Figure 13.1-16 is a view looking north into the north part of NCTS as viewed from Route 3. This picture is a clear illustration of how thick and 'wall-like' the vegetation is in NCTS along this portion of Highway 3. Figure 13.1-17 is a view looking northwest into the central part of NCTS as viewed from Highway 3. The open landscape and low buildings surrounded by the perimeter fence are evident along this stretch of the roadway. Figure 13.1-18 is a view looking northward along Highway 3 adjacent to South Finegayan. From this vantage point the two exiting water tower/tanks can be seen in the foreground and background with the FAA parcel in between them.

Figure 13.1-12. A South-Looking Aerial View of NCTS Finegayan with the Philippine Sea in the Distance and Route 3 in the Left of the Picture
Source: EDAW 2008.

Figure 13.1-13. NCTS Finegayan Communications Facilities
Source: EDAW 2007a.

Figure 13.1-14. NCTS Finegayan Interior Roadways and Facilities
Source: EDAW 2007b.

Figure 13.1-15. The North Part of NCTS Finegayan Features Dense Vegetation
Source: EDAW 2007b.

Figure 13.1-16. View from Route 3 Looking Northward into the North Part of NCTS
Source: EDAW 2009.

Figure 13.1-17. Panoramic View from Route 3 Looking Northwestward Into the Central Part of NCTS
Source: EDAW 2009.

Figure 13.1-18. View from Route 3 Looking Northward with South Finegayan Water Tower in Foreground and NCTS Finegayan Water Tower in Background as Seen from Route 3 looking North. FAA Parcel lies in Between the two.
Source: EDAW 2007b.

Double Reef

Double Reef and North Double Reef (refer to Figure 9.1-1) are located offshore of NCTS Finegayan (Figure 13.1-19). This area is considered one of the most pristine coastal areas (and dive locations) on Guam and is only accessible overland by trail through military-controlled property.

Figure 13.1-19. Ocean from NCTS Finegayan toward Double Reef
Source: The Jim Anna Chronicles 2009.

Haputo Beach and Haputo Point Overlook

Haputo Beach (refer to Figure 9.1-1) is located on NCTS Finegayan where it too is only accessible to military-affiliated personnel. Haputo Beach has been designated as part of the Haputo Ecological Reserve Area. The trail to this Reserve Area provides views of the dense limestone forest. In addition, there is an archaeological site near Haputo Beach which was once the location of an ancient Chamorro village known as Hilaan. There are latte stones scattered along the trail that add cultural value to the natural landscape. The Haputo Point lookout provides a view overlooking the Haputo Beach below (Figure 13.1-20).

Figure 13.1-20. A View of Haputo Beach
Source: EDAW 2007.

South Finegayan

The South Finegayan site lies approximately one mile south of NCTS Finegayan. It consists of an existing Navy housing area on the eastern side of the parcel and natural appearing vegetation to the west along the coastal cliff line. With the exception of the communications facilities, South Finegayan has a similar landscape character to NCTS Finegayan but includes extensive grasslands previously developed for Department of Defense (DoD) use (Figure 13.1-21). There is a similar scenic effect between NCTS Finegayan and South Finegayan from the aerial view, but the ground-level view is slightly different due to the shorter vegetation that dominates the plant community at South Finegayan. Because of this views from Route 3 into South Finegayan are relatively open and are similar to those into central NCTS. Views from the ocean are similar to those of NCTS, i.e., they are primarily of heavily vegetated limestone cliffs which tend to obscure the existing man-made development.

Figure 13.1-21. A Typical View from Within the South Finegayan Housing Area
Source: Google Earth 2008.

13.1.1.3 Non-DoD Land

Ritidian Point Scenic Vista

Ritidian Point is located at the northwestern most part of Guam. It was once a restricted military area controlled by the Navy but is now open to the public. The vantage point of Figure 13.1-22 shows undisturbed scenic features including dense tropical green foliage on a flat limestone plateau and sheer cliff line with distant views of deep blue ocean waters. The Guam National Wildlife Refuge is situated within the Ritidian Point area and consists of 371 acres (ac) (150 hectares [ha]) of native forest and 401 ac (162 ha) of marine habitat, and a long stretch of white-sand beach (Figure 13.1-23).

Figure 13.1-22. View of Ritidian Point
Source: Google Earth 2008.

Figure 13.1-23. Ritidian Point Beach Area
Source: Google Earth 2008.

Uruno Scenic Vista

Uruno Scenic Vista is located approximately 2.5 miles (mi) (4.2 kilometers [km]) south of Ritidian Point. Uruno Point offers views of the northern Guam shoreline and cliffs. In addition, an extended view south towards central Guam is offered at this scenic point.

Several scenic points east of the South Finegayan area provide panoramic views of the Philippine Sea to the west and some partial views of Dededo Village to the east. Ague Point (refer to Figure 9.1-1) is located approximately one mile east South Finegayan. The point is situated between Hilaan Beach and Haputo Beach providing views of the Philippine Sea. Tanguisson Point (refer to Figure 9.1-1) is located about one mile to the north of Two Lovers Point (also known as Puntan dos Amantes). Tanguisson Point provides an expansive view looking down to Tanguisson Beach. Views from the beach toward Tanguisson Point are also considered by many to be striking, as a canopy of dense foliage covers the vertical cliffs. Guma Fahou is situated on the north side of Tanguisson Beach along the coastline. It is a scenic beach used for fishing, snorkeling and picnics. This is a popular site due to the crystal clear water and the unique limestone boulders in the water (Figure 13.1-24).

Figure 13.1-24. A View of the beach at Guma Fahou
Source: Google Earth 2008.

Mount Santa Rosa Scenic Vista

Mount Santa Rosa, which is located approximately 1.5 mi (2.4 km) to the south of the Andersen AFB main gate, is an extinct volcano surrounded by an elevated petrified coral formation. The highest point in northern Guam, it offers a panoramic view of Guam's northern plateau including dense limestone forests, portions of Andersen AFB, and Pati Point (Figure 13.1-25). On a clear day, visitors can see the island of Rota approximately 25 mi (40 km) to the north.

Figure 13.1-25. A View of Andersen AFB and Pati Point from Mount Santa Rosa Scenic Vista
Source: EDAW 2009.

13.1.1.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

This section describes existing visual quality of the proposed roadway improvement corridors based on methodologies established by the Federal Highway Administration's (FHWA) *Visual Impact Assessment for Highway Projects* (1981). This methodology divides the views into landscape or character units that have distinct but not necessarily homogenous visual character. Typical views, called key viewpoints, are selected for each unit to represent the views to/from the project. The view of the motorist is also considered as a separate character unit.

Existing visual quality from the viewpoints is judged by three criteria: vividness, intactness, and unity. Descriptions for the three criteria are:

- Vividness: The memorability of the landscape components as they combine to form striking or distinctive patterns.
- Intactness: The integrity of visual order in the view and its freedom from visual encroachment.

- Unity: The visual coherence and composition of the landscape viewed to form a harmonious visual pattern.

These criteria provide a method for describing the form, line, color, and texture of the components found within a view. As in all things aesthetic, "beauty is in the eye of the beholder;" therefore, there is a subjective component to this or any visual analysis evaluation. However, as outlined in the FHWA methods, the use of these descriptors allows for a basis for understanding the evaluator's rationale behind a visual quality determination. It is important to note that visual character terms are descriptive and non-evaluative, meaning that they are based on defined attributes that are neither good nor bad by themselves. Changes in visual character cannot be described as having good or bad attributes until compared with viewer responses to the change.

The proposed roadway improvement projects within the North Region are located along existing Routes 1, 3, 9, 28, and 15. The following subsections describe the nature of each roadway improvement type within the North Region.

Military Access Point Projects

Four military access point (MAP) projects are proposed within the North Region. Because these projects are located within Department of Defense (DoD) land, in which photographing is not permitted, typical views are not included in this report; however, descriptions are included here.

The visual character and quality of each of the MAP locations is similar to the adjacent roadway network. These point locations are generally off of main routes by a short distance, usually less than 1.0-mile (1.6-kilometer [km]). In most cases, the MAPs are existing gates already part of the visual environment and include low buildings, roadways, fencing, and security gates. Table 13.1-1 identifies the existing visual quality for each MAP.

Table 13.1-1. Existing Visual Quality for Military Access Point Projects – North Region

Guam Road Network (GRN) #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
38	3	MAP 2, Naval Computer and Telecommunications Station (NCTS) Finegayan (Commercial Gate); 0.5–mi (0.3-km) west of Route 9, across from Chalan Kareta	Moderate	Moderate	Moderate	Moderate
39	3	MAP 3, NCTS Finegayan (Main Gate); 0.9–mi (1.4 km) north of Bullard Avenue	Moderate	Moderate	Moderate	Moderate
41	3	MAP 5, South Finegayan (Residential Gate); existing Control Tree Drive	Moderate	Moderate	Moderate	Moderate
42	9	MAP 6, Andersen Air Force Base (AFB) (North Gate); between Route 3 and Route 1	Moderate	Moderate	Moderate	Moderate

Pavement Strengthening Projects

Because pavement strengthening projects cover many different corridors on the island, the existing visual character of the specific corridor varies depending on the location. One common thread is the presence of the roadway within the view, particularly for those traveling on the roadway. Development adjacent to the

roadway would have a direct influence on the character of the roadway with the urban character of the denser developed corridors versus the rural character of the roadways through forested sections.

As with character, the overall visual quality of a corridor varies depending on its specific location. In general, the more urban areas have a moderate to moderately low visual quality, given the development patterns along the roadway and the level of maintenance of many of the strip commercial areas. Many of these areas have a moderate to moderately low vividness, moderately low intactness, and moderate unity. Residential areas tend to have higher visual quality, in the moderate range, with moderate vividness, intactness, and unity. Rural areas generally have a moderate to moderately high overall visual quality, with moderate to moderately high vividness, intactness, and unity.

Pavement strengthening projects within the North Region of the island are listed in Table 13.1-2, and typical views for these project corridors can be found in Figure 13.1-26. The North Region is less mountainous than the southern volcanic portion of the island. Development in this region is less dense and more suburban in nature, with primarily single-family residential on lots interspersed with forested areas.

Table 13.1-2. Existing Visual Quality for Pavement Strengthening Projects – North Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
8	3	Route 1 to Route 28	Moderate	Moderately Low	Moderate	Moderate
22A	9	Andersen AFB North Gate to Route 1 (Andersen AFB Main Gate)	Moderate	Moderate	Moderate	Moderate
23	1	Chalan Lujuna to Route 9	Moderate	Moderate	Moderate	Moderate

The overall visual quality of the North Region is moderate, with moderate vividness, intactness, and unity. The overall visual quality in this region relies in part on the less developed, more forested nature of the areas adjacent to the roadways. Where development has occurred, it tends to be less dense and less of a presence in the landscape.

Bridge Replacement Projects

No replacement bridge projects are located in the North Region.

Figure 13.1-26
Typical Views for Pavement Strengthening Projects - North Region

Roadway and Intersection Widening Projects

In the North Region, five intersection improvement and road widening projects are proposed, as listed in Table 13.1-3. Typical views for the corridors can be seen in Figure 13.1-27. Descriptions of the character of the individual corridors or intersection areas are described below.

Table 13.1-3. Existing Visual Quality for Roadway and Intersection Widening Projects – North Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
9	3	NCTS Finegayan to Route 28	Moderate	Moderate	Moderate	Moderate
10	3	NCTS Finegayan to Route 9	Moderate	Moderate	Moderate	Moderate
22	9	Route 3 to Andersen AFB (North Gate)	Moderate	Moderate	Moderate	Moderate
57	28	Route 1 to Route 3	Moderately High	Moderate	Moderate	Moderately High
117	15	Route 15/29 Intersection	Moderate	Moderate	Moderately Low	Moderate

- GRN #9, Route 3 from Naval Computer and Telecommunications Station (NCTS) Finegayan to Route 28: The existing road corridor is a two-lane corridor with grassy, mowed shoulders. A substantial power line parallels the road. Development adjacent to the roadway consists of residential, with a rural appearance, and large areas that are forested. The existing visual quality for the route is moderate, with moderate vividness, intactness, and unity.
- GRN #10, Route 3 from NCTS Finegayan to Route 9: The existing visual character of this corridor is very similar to that described in GRN #9. It is along the same roadway (Route 3) and has the same two-lane configuration as the previous project. The overall visual quality of the road is moderate, with moderate vividness, intactness, and unity.
- GRN #22, Route 9 from Route 3 to the Andersen Air Force Base (AFB) North Gate: The existing visual character for the road corridor is that of a two-lane road, with forested areas on one side and either forested or scattered residential on the other side. A large power line parallels the road on one side. The overall visual quality of the corridor is moderate, with moderate vividness, intactness, and unity.
- GRN #57, Route 28 from Route 1 to Route 3: The existing Route 28 is a two-lane road. The southern section of the road, beginning at the intersection with Route 1, is primarily residential, with single- and multi-family residential on both sides of the roadway and several small commercial stores included in the mix. As the road stretches first north then west, the residential area becomes more spread out on larger lots, and the forest takes up a bigger presence in the view. The overall visual quality of the roadway is moderately high, with moderately high vividness, moderate intactness, and moderate unity.
- GRN Project #117, Route 15/29 Intersection: Routes 15 and 29 are narrow two-lane roads with surrounding residential development. The overall visual quality of the area is moderate, with moderate vividness, moderate intactness, and moderately low unity.

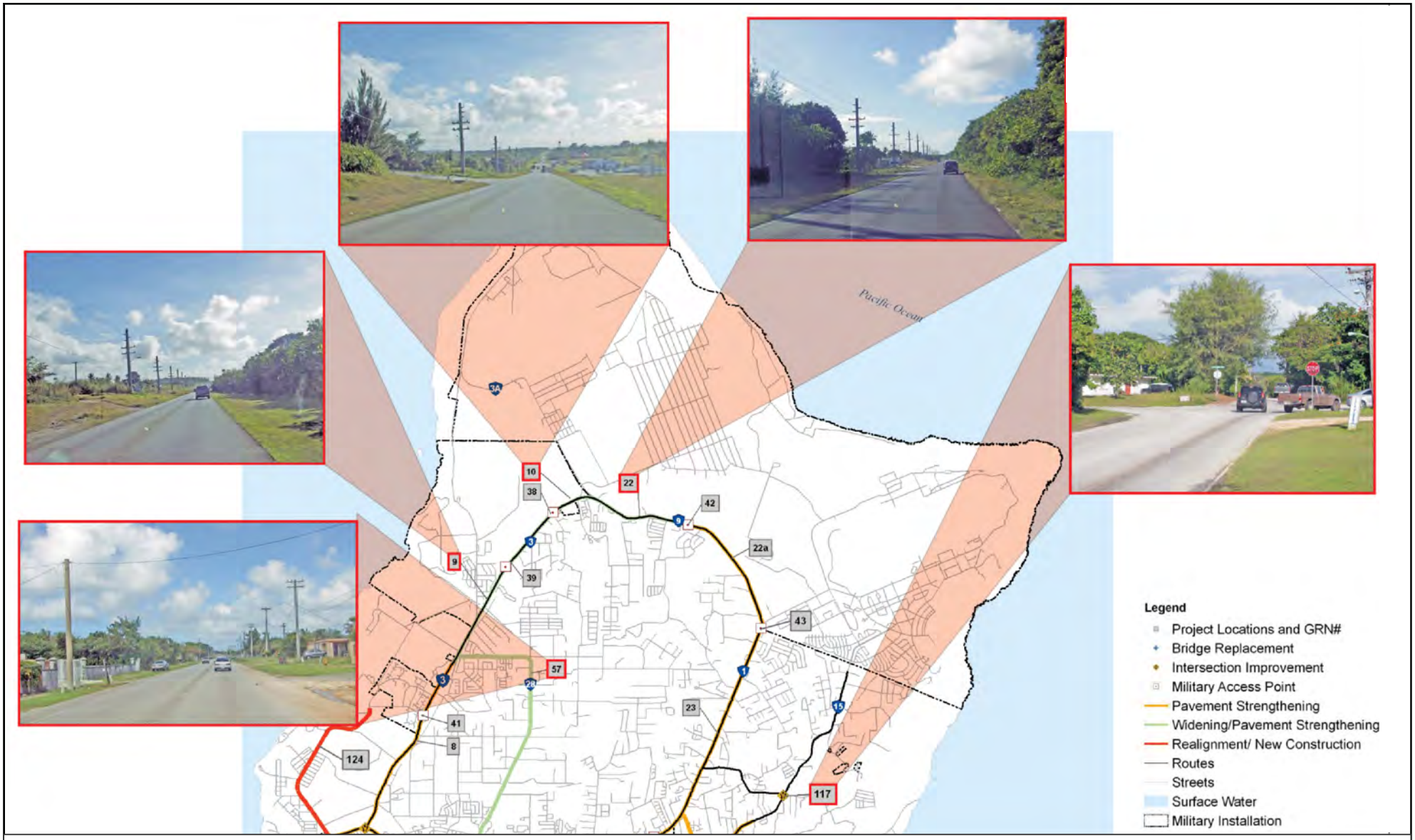


Figure 13.1-27
Typical Views for Roadway and Intersection Widening Projects - North Region

Road Realignments and New Road Projects

In the North Region, a new roadway (i.e., Finegayan Connection [GRN #24], is proposed. The alignment for the new roadway would begin at the Route 1/16 intersection. This intersection would be widened along Route 1 to accommodate new turn lanes. The new roadway generally travels north from this intersection through forested and non-forested areas. Many dirt roads, both formal and informal roads, crisscross the area of the new alignment. The most prominent of these is Tanguisson Road. Little development currently exists along the proposed alignment.

The general visual quality of the area is moderately high, with a moderately vividness, moderate intactness, and moderately high unity, as summarized in Table 13.1-4. Existing views for the project area can be seen in Figure 13.1-28.

Table 13.1-4. Existing Visual Quality for Road Realignment and New Road Projects – North Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
124	New	Finegayan Connection	Moderately High	Moderate	Moderately High	Moderately High

13.1.2 Central

Of the three areas, Central Guam is the most populated, and overall its landscape can generally be characterized as primarily urban and suburban in nature. The Tumon Bay area (tourist center) and Hagatna (central business district) along the eastern shoreline are urban environments with multi-story buildings visible from many locations throughout the area. These high-rise buildings provide a distinctly urbanized sense of a place from the street level as well as views from the ocean or coastline. Many of Guam's most populated residential communities are located in this area and take on a mainly suburban appearance – including one to two story single family homes, associated roadways, and numerous and strip malls.

13.1.2.1 Andersen South

Located about 4 mi (6.4 km) south of Andersen AFB, Andersen South is an abandoned Air Force housing area now used as a joint services ground training site. The abandoned structures, which are situated adjacent to Route 15 along a relatively small portion on the southwest side of the site, are used for urban warfare training (Figure 13.1-29, Figure 13.1-30, Figure 13.1-31, and Figure 13.1-32). The remainder (and majority) of the Andersen South site is largely composed of an old road network and a few dispersed facilities that are surrounded by moderate-to-dense vegetation. Andersen South and the surrounding community of Yigo are situated on relatively flat topography and thus do not afford much in the way of views from adjacent roadways which are blocked by the dense vegetation.

Figure 13.1-28
Typical Views for Road Realignment and New Road Projects - North Region

Figure 13.1-29. View of Andersen South Gate from Route 15
Source: EDAW 2008.

Figure 13.1-30. View of Andersen South from Route 15
Source: Matthew Chong Photo Gallery 2008.

Figure 13.1-31. View of Abandoned Housing and Overgrowth at Andersen South
Source: Google Earth 2008.

Figure 13.1-32. View of Abandoned Housing at Andersen South
Source: EDAW 2009.

13.1.2.2 Non-DoD Land

Scenic Points in Western Central Guam

Two Lovers Point

Two Lovers Point, also known as Puntan dos Amantes, is one of the most legendary scenic points on Guam (refer to Figure 9.1-1). It is not only famous for the ancient legend involving two young lovers but also for its dramatic views from the cliff top. It is a 'pay-to-view' area and popular tourist attraction. Views from south to north are Tumon Bay, the Philippine Sea, and the west-facing cliffs to the north (Figure 13.1-33).

Figure 13.1-33. An Aerial View of Two Lovers Point Looking South with Tumon Bay Visible on the Far Right Side of the Picture

Source: Google Earth 2008.

Tumon Bay

Tumon Bay is located at the center of Guam between South Finegayan and Apra Harbor on the western coast (Figure 13.1-34). The bay is a marine preserve with extensive coral barrier reef and a long white sandy beach. It also serves as Guam's primary tourist district drawing hundreds of thousands of tourists a year to the numerous hotels lining the length of the bay (Bureau of Statistics and Plans 2006). Resultant hotel and commercial development along Tumon Bay has resulted in a highly urbanized cityscape alongside the natural features of the beach and bay.

Figure 13.1-34. View of Tumon Bay Looking South from Two Lovers Point
Source: EDAW 2009.

Tumon Bay also provides onlookers a panoramic view of the bay from the ocean. The many vertical structures offer a completely different perspective in contrast to the natural landscape. Because of its extensive tourist-oriented development, the streetscape in the Tumon Bay area tends to be more modern and urbanized than other areas of Guam (Figure 13.1-35 and Figure 13.1-36).

Figure 13.1-35. Street View of Tumon Bay Tourist District
Source: Google Earth 2008.

Figure 13.1-36. Panoramic View of a part of the Tumon Bay Tourist District
Source: Guampedia 2008.

Scenic Points in Eastern Central Guam

Pagat Point

Pagat Point is located to the east of Andersen South. It provides views of the rugged eastern coastline and the remnants of a preContact Chamorro village (Figure 13.1-37). This area contains high cliffs and a rocky coastline with adjacent deep blue waters. Further to the south, a view to Sasayan Valley is provided (Figure 13.1-38).

Figure 13.1-37. A View of Pagat Point
Source: Dzer's Guam Pictures 2008.

Figure 13.1-38. A View of the Sasayan Valley and Beyond Pagat Point
Source: EDAW 2009.

Guam International Country Club

The Guam International Country Club is located west side of Andersen South and offers a panoramic view of landforms within and around the village of Dededo (Figure 13.1-39).

Figure 13.1-39. A Panoramic View of the Guam International Golf Course
Source: Onward Resort and Golf 2008

Marine Corps Drive (Route 1)

Route 1, also known as Marine Corps Drive, is situated on the northeastern side of Guam, providing a significant transportation connection from Andersen AFB to Apra Harbor. Due to its path through several villages and the downtown area, Route 1 provides primarily urban and suburban views through most of central Guam (Figure 13.1-40).

Figure 13.1-40. Typical Streetscape of Marine Corps Drive (Tamuning)
Source: Google Earth 2008.

13.1.2.3 Barrigada

The Barrigada area is located in the eastern portion of central Guam, west of Guam International Airport and Route 16, and east of Route 15. The NCTS or Navy Barrigada site and adjacent Andersen AFB Communications Annex are in this area. These sites are relatively flat and vary from mowed grassland to dense, naturally-appearing vegetation. Rural and suburban lands surround the Barrigada sites. Due to the relatively flat topography and moderate to heavy vegetation, the surrounding community of Barrigada has limited views into the Navy and Air Force Barrigada sites. One exception to this are the views afforded from Mount Barrigada just north of Navy Barrigada.

The Admiral Nimitz Golf Course is located on the southern end of Navy Barrigada and extends outward to touch the Air Force Barrigada site further to the south. Though the golf course is operated by the Navy, it is accessible to the public. The golf course is not readily visible from any point in the surrounding community. Views from the golf course are generally of manicured greens with a backdrop of either dense vegetation or in a few cases distant views through open areas (Figure 13.1-41).

Figure 13.1-41. A View of the Admiral Nimitz Golf Course Looking East
Source: Google Earth 2008

Non-DoD Land

Mount Barrigada

Mount Barrigada is located in east-central Guam approximately 1.5 mi (2.4 km) east of Guam International Airport and just north of Navy Barrigada. Mount Barrigada is at an elevation of 650 feet (ft) (198 meters [m]) above sea level. The Pacific Presbyterian Church, the site of a scenic vista situated on Mount Barrigada, provides views of the airport, as well as the villages of Barrigada, Tamuning and Dededo. Further east, there is a second scenic vista which provides views of Mangilao village and Mount Santa Rosa to the north.

Mangilao Golf Course

Most of Guam's golf courses are well known for their scenery and well maintained fairways. Located at the central eastern coastline of Guam, Mangilao Golf Course provides visitors with views of the Pacific Ocean and cliff lines along the fairways (Figure 13.1-42). Thousand Steps, an extremely steep trail linking Mangilao Golf Course with a beach below, also offers expansive ocean views.

Figure 13.1-42. An Aerial View of Mangilao Golf Course and its Surrounding Vegetation
Source: Google Earth 2008.

Taguan Point

Taguan Point is located on the eastern side of central Guam, northeast of Mangilao Golf Course (Figure 13.1-43). It offers a panoramic view of the Pacific Ocean. Dense foliage covers the seashore along the ridge in shapes that resemble ocean waves.

Figure 13.1-43. An Oceanic View at Taguan Point
Source: Google Earth 2008.

Fadian Point

Fadian Point is located on the central eastern side of Guam about 2 mi (3.2 km) away from Taguan Point to the south. Fadian Point is famous for its view of the Pacific Ocean and steep sloping ridgeline and cove. Seashore vegetation such as Nigas, a salt-tolerant shrub, cover the rugged limestone surface offering a unique scene.

University of Guam / Guam Community College

The University of Guam is a distinct man-made feature along the east coast of Guam. These low-rise buildings and large green spaces were sited relative to the natural landform and cliff line so that the Pacific Ocean can be viewed from the campus.

Pago Bay

Pago Bay is located in southeast Guam, in Yona Village. The Pago Bay Overlook provides a natural panoramic view of the shallow bay and adjacent cliff line. This area has attracted several resort and housing developments to the area (Figure 13.1-44).

Figure 13.1-44. A View of Pago Bay
Source: Google Earth 2008.

13.1.2.4 Piti/Nimitz Hill

Asan Bay Overlook

The Asan Bay Overlook is located in the War in the Pacific National Historical Park on the southwest coast of Guam. The historical park consists of several units including the Asan Bay Overlook, Piti Guns Unit, Asan Beach Unit, and the Mount Chachao/Mount Tenjo Unit. The site provides a panoramic view of the shoreline and Philippine Sea.

Asan Beach Unit

The Asan Beach Unit is located in the War in Pacific National Historical Park approximately one mile from the Asan Bay Overlook. A panoramic ocean view is available as well as a mountain view of the Asan Point Ridge.

13.1.2.5 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

The proposed roadway improvement projects in the central region are located along existing Routes 1, 8, 8A 10, 15, 16, 25, 26, and 27, and Chalan Lujuna Road. The following subsections describe the nature of each roadway improvement type within the Central Region.

Military Access Point (MAP) Projects

Six MAP projects are proposed within the central region. Because these projects are located within DoD land, in which photographing is not permitted, typical views are not included in this report; however, descriptions are included here.

The visual character and quality of each of the MAP locations is similar to the adjacent roadway network. These point locations are generally off of main routes by a short distance, usually less than 1.0-mi (1.6-km), except for MAP 10 off Route 15, which is located 1.16 mi (1.87 km) from the main route. In most cases, the MAPs are existing gates that are already part of the visual environment and include low buildings, roadways, fencing, and security gates. Table 13.1-5 identifies the existing visual quality for each MAP planned within the Central Region.

Table 13.1-5. Existing Visual Quality for Military Access Point Projects – Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
44	1	MAP 8, Andersen South (Main Gate); on Turner Street	Moderate	Moderate	Moderate	Moderate
46	15	MAP 10, Andersen South (Secondary Gate); 1.16 mi (1.87 km) east of Route 26 on unnamed road	Moderately High	Moderate	Moderately High	Moderately High
47	16	MAP 11, Navy Barrigada; at Sabana Barrigada Drive	Moderate	Moderate	Moderate	Moderate
48	8A	MAP 12, Navy Barrigada; extension of north/south road from Route 16/Sabana Barrigada Drive to Route 8A	Moderate	Moderately High	Moderately High	Moderately High
49	15	MAP 13, Air Force Barrigada; new access road from Fadian Point Road	Moderately High	Moderate	Moderately High	Moderately High
49A	15	MAP 13A, Air Force Barrigada; new access road from Fadian Point Road	Moderately High	Moderate	Moderately High	Moderately High

Pavement Strengthening Projects

Pavement strengthening projects within the central region of the island are listed in Table 13.1-6, with typical views seen in Figure 13.1-45. In general, the central area is the most densely developed area on the island and includes the capitol, main commercial areas, and resorts. Because of the volcanic past of the southern portion of the island, the southern sections of the Central Region have river crossings that are not found in the limestone areas in the North Region.

The overall visual quality of the central region is generally moderate to moderately low, with moderate to moderately low vividness, low intactness, and moderate unity. Because much of this region is developed, it is the pattern and level of maintenance of the development that give this region its overall visual quality. In general, development consists of strip commercial, single-family residential, and multi-family residential along many of the corridors. There are isolated high-rise structures along some of the main roadway. Many of the roads in this region are four- to six-lane roadways, with limited or no sidewalk or streetscape design that might provide visual relief to the scale of the roadway.

This region also has some of the most scenic roadside development on the island. The portions of Route 1 (i.e., Marine Corps Boulevard) between the Governor's Complex and the Port Area have scenic views of the blue waters of the Philippine Sea along grassy benches with palm trees punctuated with forested knobs that jut into the Sea. These areas have a moderately high to high overall visual quality, with a moderately high to high vividness and moderately high intactness and unity.

Table 13.1-6. Existing Visual Quality for Pavement Strengthening Projects – Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
6	1	Route 27 to Chalan Lujuna	Moderate	Moderate	Moderate	Moderate
7	1	Route 3 to Route 27	Moderate	Moderate	Moderate	Moderate
11	Chalan Lujuna	Route 1 to Route 15	Moderately High	Moderately High	Moderate	Moderately High
12	15	Chalan Lujuna to Smith Quarry	Moderately High	Moderate	Moderately High	Moderately High
13	1	Route 11 to Asan River	Moderately High	Moderately Low	Moderate	Moderate
14	1	Asan River to Route 6	Moderate	Moderate	Moderate	Moderate
15	1	Route 6 to Route 4	Moderately High	Moderate	Moderately High	Moderately High
17	8	Tiyan Parkway/Biang Street to Route 10	Moderate	Moderate	Moderate	Moderate
18	16	Route 27 to Route 10A	Moderate	Moderate	Moderate	Moderate
19	16	Route 10A to Sabana Barrigada Drive	Moderate	Moderate	Moderate	Moderate
20	16	Sabana Barrigada Drive to Route 8/10	Moderate	Moderate	Moderate	Moderate
21	27	Route 1 to Route 16	Moderate	Moderate	Moderately Low	Moderate
30	10	Route 15 to Route 8	Moderate	Moderate	Moderate	Moderate
31	8A	Route 16 to Naval Communication Area Master Station (NAVCAMS) Barrigada	Moderate	Moderately High	Moderately High	Moderately High
32	15	Route 10 to Chalan Lujuna	Moderately High	Moderate	Moderately High	Moderately High
33	1	Route 8 to Route 3	Moderate	Moderate	Moderate	Moderate

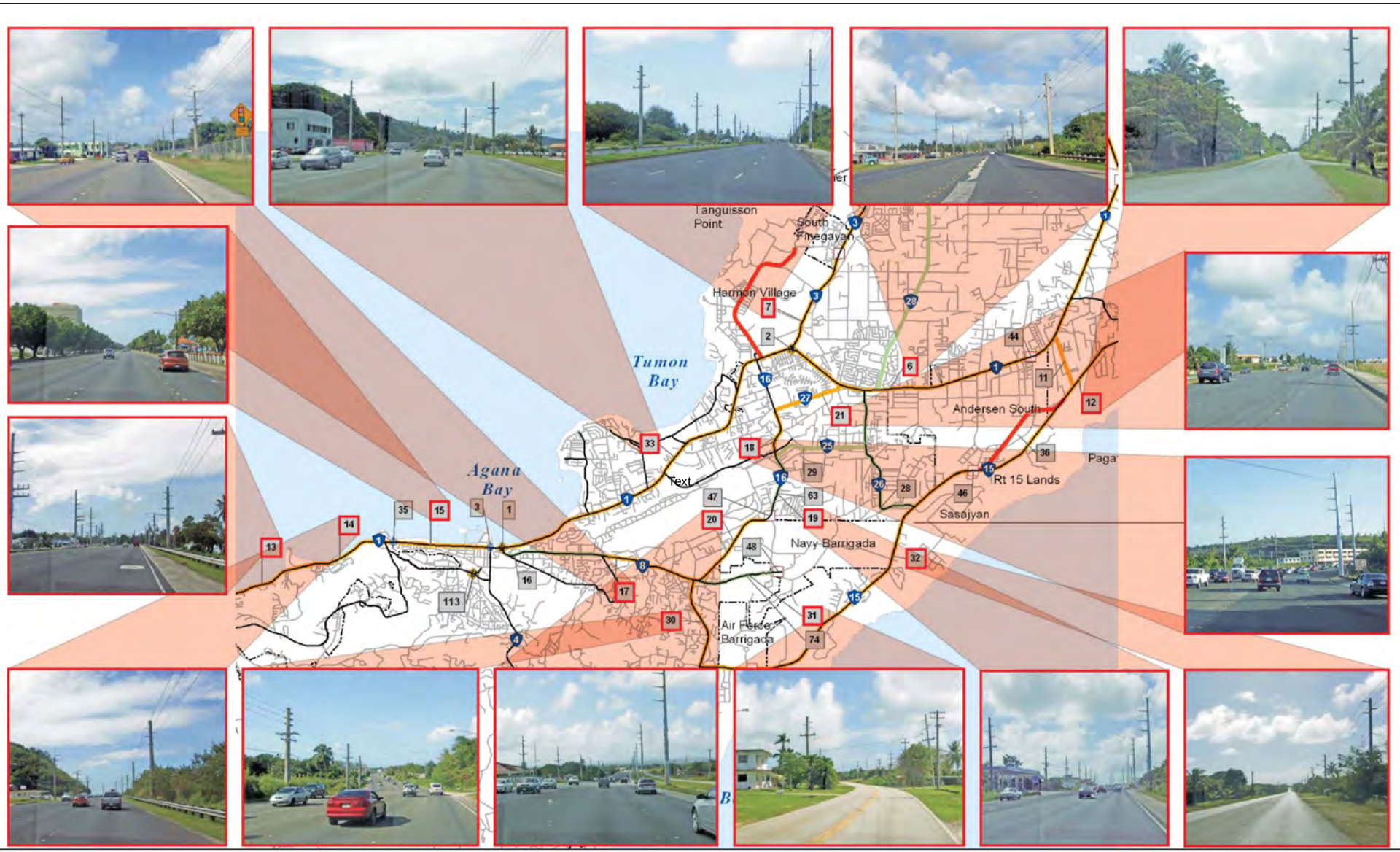


Figure 13.1-45
Typical Views for Pavement Strengthening Projects - Central Region

Bridge Replacement Projects

The proposed bridge replacement projects are located along Route 1 (i.e., Marine Corps Drive); two are within the Central Region. The bridges are each associated with a river channel, and there are similarities between the locations. One common thread is the presence of the roadway and the bridge railings within the view, particularly for those traveling on Route 1. Most river crossings have much vegetation associated with the river banks. The vegetation along the channel often blocks views to the bridges from outside of the roadway, so the bridges are generally not a viewable element in the landscape.

Development along the roadway, adjacent to the river channels, would have a direct influence on the visual character of the bridge setting, with an urban character in the more densely developed areas versus the rural character in the forested sections. The replacement bridge and general visual characteristics are listed in Table 13.1-7, and typical views of the existing bridge can be seen in Figure 13.1-46.

Table 13.1-7. Existing Visual Quality for Bridge Replacement Projects – Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
3	1	Agana Bridge Replacement	Moderate	Moderate	Moderate	Moderate
35	1	Fonte Bridge Replacement	Moderately High	Moderate	Moderate	Moderate

As with character, the overall visual quality of a corridor varies depending on its specific location. In general, more urban areas have a moderate to moderately low visual quality, given the development patterns along the roadway and the level of maintenance of many of the strip commercial areas. Many of these areas have a moderate to moderately low vividness, moderately low intactness, and moderate unity. Residential and rural areas tend to have higher visual quality, in the moderate range, with moderate vividness, intactness, and unity.

- Agana Bridge: The Agana Bridge is located in the downtown area near the Route ¼ intersection, near the Chamorro Village tourist site. The riverbanks are heavily vegetated with trees and shrubs that effectively screen the views to the bridge from adjacent properties. Reconstruction of the bridge would require the removal of some of this vegetation. The existing visual quality of the Agana Bridge crossing is moderate, with moderate vividness, intactness, and unity.
- Fonte Bridge: The Fonte Bridge is located closer to the developed areas on the island and is adjacent to one of the cemeteries on the island. The bridge railing provides some opening, but not to the extent of the Atantano Bridge. As with the Sasa Bridge, utilities are suspended across the bridge and can be seen from the banks on the downstream side of the bridge. The visual quality of the bridge and area is moderate, with moderately high vividness, moderate intactness, and moderate unity.

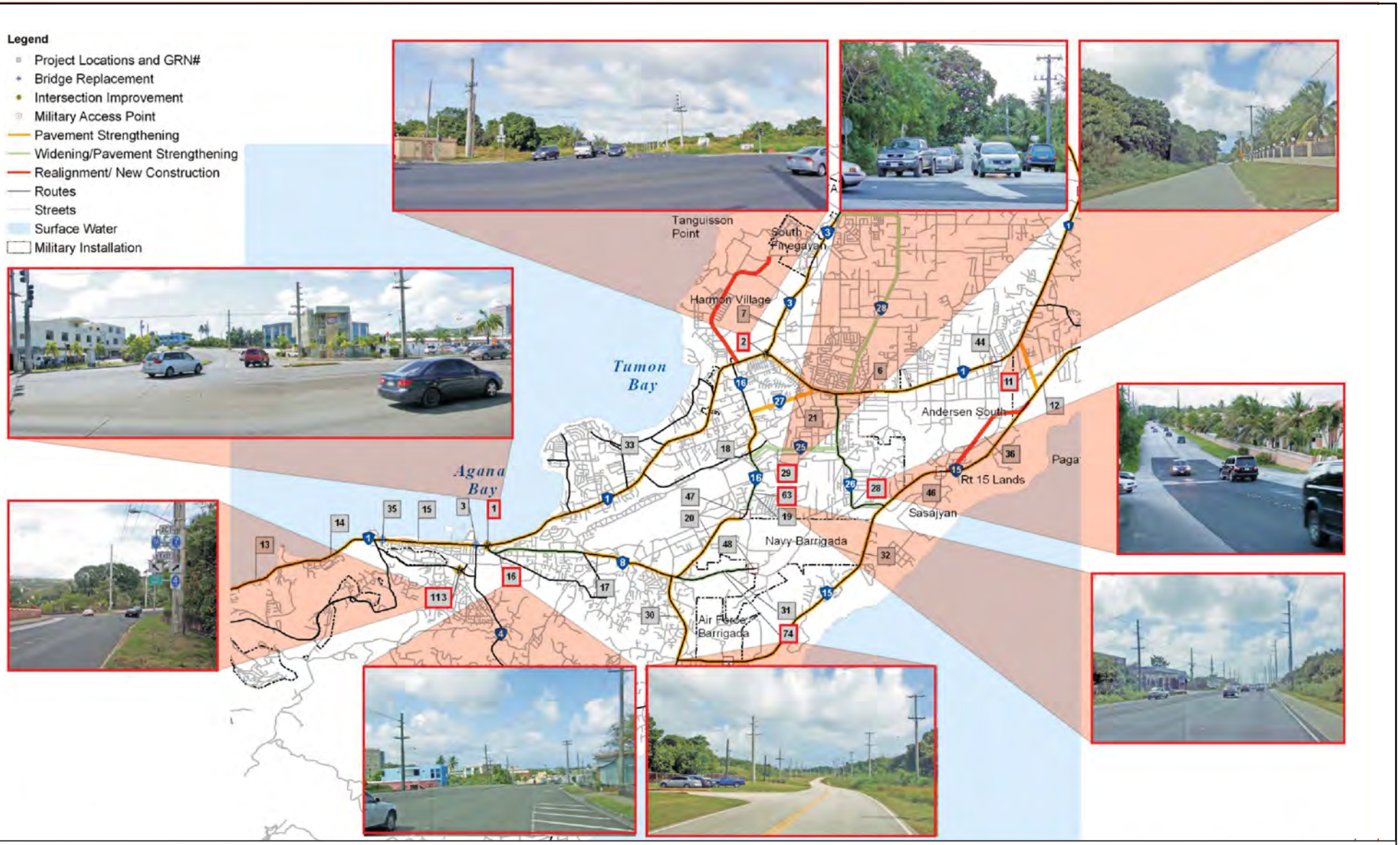


Figure 13.1-46
Typical Views for Roadway and Intersection Widening Projects - Central Region

Roadway and Intersection Widening Projects

The proposed road widening or intersection improvement projects in the Central Region are summarized in Table 13.1-8. Typical views can be seen in Figure 13.1-47.

Table 13.1-8. Existing Visual Quality for Roadway and Intersection Widening Projects – Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
1	1	Route 1/8 Intersection	Moderate	Moderate	Moderately Low	Moderate
2	1	Route 1/3 Intersection	Moderately High	Moderately High	Moderate	Moderately High
16	8	Tiyan Parkway/Route 33 (east) to Route 1	Moderate	Moderate	Moderate	Moderate
28	26	Route 1 to Route 15	Moderately High	Moderately High	Moderately High	Moderately High
29	25	Route 16 to Route 26	Moderately High	Moderately High	Moderately High	Moderately High
63	16	Route 10A to Sabana Barrigada Drive	Moderate	Moderate	Moderate	Moderate
74	8A	Route 16 to NAVCAMS Barrigada	Moderately High	Moderately High	Moderate	Moderately High
113	7	Route 7/7A Intersection	Moderately High	Moderate	Moderately High	Moderately High

- GRN #1, Route 1/8 Intersection: The Route 1/8 intersection is located in a heavily developed area of the island, with multi-story buildings and commercial properties. The area is highly developed. The overall visual quality of the area is moderate, with moderate vividness, moderate intactness, and moderately low unity.
- GRN #2, Route 1/ 3 Intersection: The Route 1/3 intersection is to the northern side of the island where the area is characterized by more suburban residential development and open forested land. The overall visual quality of the area is moderately high, with moderately high vividness, moderately high intactness, and moderate unity.
- GRN #16, Tiyan Parkway (Route 33 East) to Route 1: The area traversed by Route 8 is very developed with multi-story commercial and residential properties. The general visual quality of the roadway is moderate, with moderate vividness, intactness, and unity.
- GRN #28, Route 26 from Route 1 to Route 15: Route 26 is through a heavily residential area of the island. The current configuration is a two-lane road with grassy shoulders. The general visual quality of the roadway is moderately high, with moderately high vividness, moderately high intactness, and moderate unity.
- GRN #29, Route 25 from Route 16 to Route 26: The current Route 25 is a narrow two-lane road that winds through a residential area of the island. In some locations, trees along the roadway overhang the roadway, adding to the overall visual quality of the roadway. The general visual quality is moderately high, with moderately high vividness, intactness, and unity.

Figure 13.1-47
Typical Views for Road Realignment and New Road Projects - Central Region

- GRN #63, Route 16 from Route 10A to Sabana Barrigada Drive: Route 16 is in a heavily developed area. It is currently a four-lane road with turn lanes. It also has one of the only grade-separated intersections (with Route 10A) on the island. The overall visual quality of the roadway is moderate, with moderate vividness, intactness, and unity.
- GRN #74, Route 8A from Route 16 to NAVCAMS Barrigada: Route 8A is a narrow two-lane road. Near its intersection with Route 16, commercial businesses quickly give way to single-family residential, including an elementary school. Farther east on the road, less development can be found. The existing overall visual quality for the roadway is moderately high, with moderately high vividness, moderately high intactness, and moderate unity.
- GRN #113, Route 7/ 7A Intersection: Because this intersection sits on an elevated area, the views from the intersection area provide some distant views to the water and nearby hills. In addition, a park located at the intersection adds open space to this densely developed area on the island. The overall existing visual quality of the intersection is moderately high, with moderately high vividness, moderate intactness, and moderately high unity.

Road Realignments and New Road Projects

Within the central region, one road realignment is proposed, which is the relocation of Route 15 (GRN #36). The portion of Route 15 that would be relocated is situated in the northeastern area of the island. Typical to the island, the area on either side of the existing alignment is forested. Large portions of the new alignment would be on Andersen South. Approximately 66% of this new alignment would cut through the forested area. The remaining 33% would be through an area that once served as military housing, which has since been removed. Old roads and cleared areas remain in this area. Typical views for the project area can be seen in Figure 13.1-48.

The general visual quality of the area is moderately high, with a moderate vividness, moderately high intactness, and moderately high unity. These are summarized in Table 13.1-9. The high ratings are due to the forested areas surrounding the roadway. The forest limits the views out while providing a green screen along the roadway, so the memorability of the area (vividness) has a lower rating (at moderate), while the lack of encroaching elements and the composition of the view have higher ratings (at moderately high). The old housing areas have a lower visual quality (i.e., moderate overall) than the forested area, with moderately low vividness, moderate intactness, and moderate unity.

Table 13.1-9. Existing Visual Quality for Road Realignment and New Road Projects – Central Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
36	15	Route 15 Realignment	Moderate	Moderately High	Moderately High	Moderately High

13.1.3 Apra Harbor

13.1.3.1 Harbor

Apra Harbor is considered to be one of the best ports in the Pacific Ocean. A unique visual element of the harbor is the integration of man-made and natural landscape. The southern part of Apra Harbor is currently occupied by the Naval Station and no primary scenic sites are open to the public.

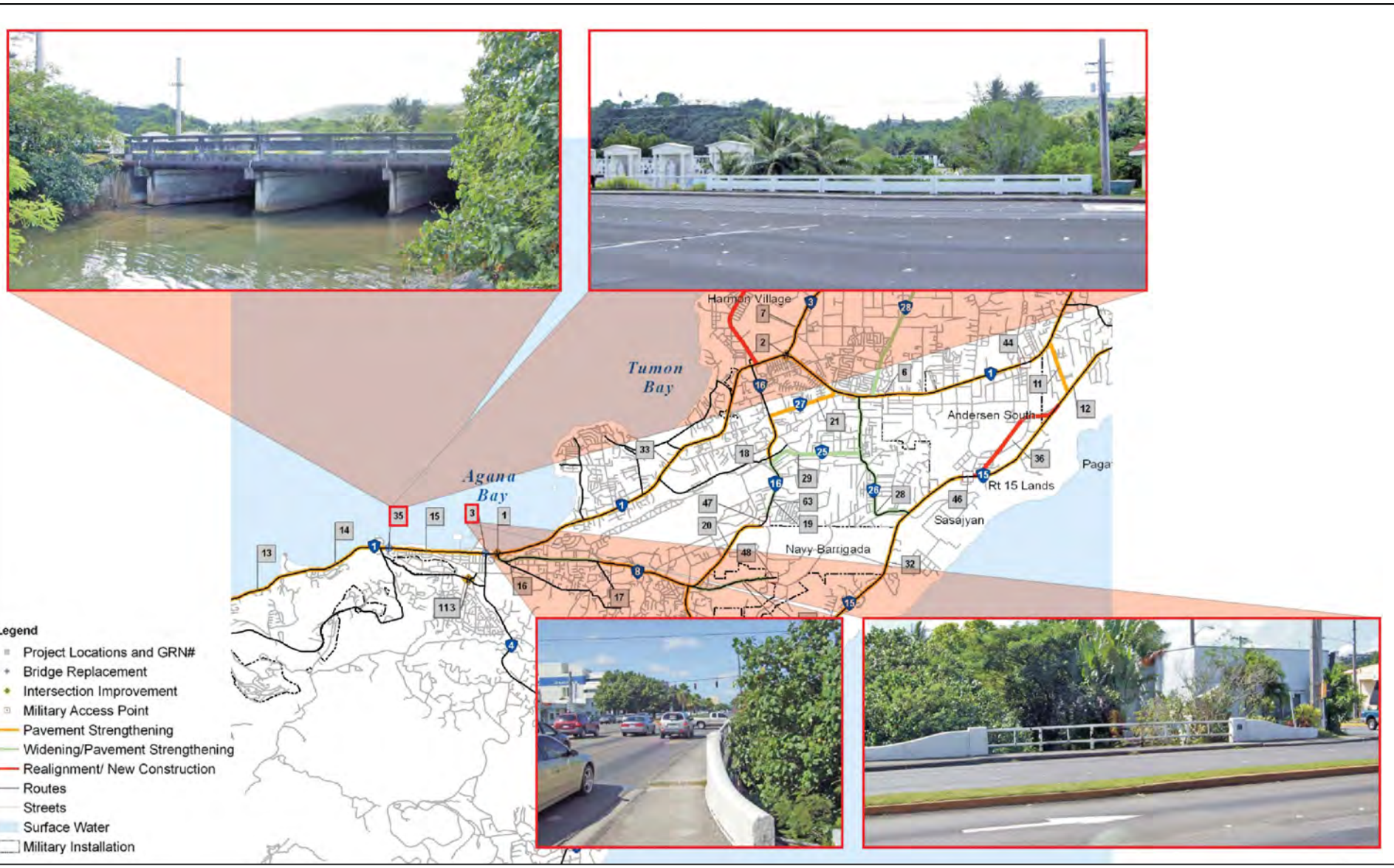


Figure 13.1-48
Typical Views for Bridge Replacement Projects - Central Region

The most valuable visual resources are distant views of the harbor from inland locations, such as Nimitz Hill. The Glass Breakwater is a partially man-made breakwater that along with the Orote Peninsula provides the boundaries of the harbor (Figure 13.1-49).

Figure 13.1-49. Aerial View of Orote Peninsula and Outer Apra Harbor
Source: Google Earth 2008.

13.1.3.2 Naval Base Guam

There are several scenic points and vistas associated with the Naval Base, however, accessibility to these areas are restricted to military personnel only.

Orote Point Scenic Vista

Orote Point is located at the westernmost point of Orote Peninsula. The Orote Point Scenic Vista, which is about 4 mi (6.4 km) east of the Naval Station front gate, provides unobstructed views of the deepwater port to the south (Figure 13.1-50). It is also the location of the Spanish Steps, which provide a trail to the beach below. The views at Orote Point are not limited to the overlook. Upon descending the Spanish Steps, a sea-level view of the harbor is provided. Visitors, who are restricted to military personnel, come here to enjoy the crystal water and observe the rock formations (Figure 13.1-51).

Tipalao/Dadi Beach

Dadi Beach is located at the south end of the Tipalao Housing Area, approximately 1.3 mi (2.1 km) from the Naval Base Main Gate. Dadi Beach offers a wide range of views of Agat Bay and its neighboring shoreline (Figure 13.1-52). Thick tropical vegetation grows along the beach forming a natural wall blocking the view looking inward from the ocean. Just to the north of Dadi Beach is the Tipalao area which consists of a housing area and adjacent beach.

Figure 13.1-50. View from Orote Point, the Top of the Spanish Steps
Source: Google Earth 2008.

Figure 13.1-51. Below the Orote Point Overlook
Source: Google Earth 2008.

Figure 13.1-52. Dadi Beach
Source: Google Earth 2008.

13.1.3.3 Non-DoD Land

Cabras Island Scenic Vista

Cabras Island is a finger-like reef island that has been extended by the Glass Breakwater, which forms the shoreline of Apra Harbor with Orote Peninsula. Cabras Island offers a view of the west coast of Guam. A perspective of Two Lovers Point and even farther towards Ritidian Point is available from this vantage point.

Mount Chachao Scenic Vista

Mount Chachao is one of the designated units in the War in Pacific National Historical Park. Mount Chachao is linked with Mount Alutom and Mount Tenjo, which form the highest terrain that United States (U.S.) forces captured in 1944. Historically, Mount Chachao provided the Japanese defenders with a view of American troops landing at Asan Beach. Today, an overview of Apra Harbor and Orote Point is provided at this summit (Figure 13.1-53).

Figure 13.1-53. View from Mount Chachao Scenic Vista
Source: Google Earth 2008.

13.1.3.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

The following subsections describe the nature of the proposed road improvement projects in the Apra Harbor Region.

Military Access Point Projects

Only one MAP project is proposed within the Apra Harbor Region. Because the project is located within DoD land, in which photographing is not permitted, typical views are not included in this report; however, descriptions are included here.

The visual character and quality of the MAP location is similar to the adjacent roadway network (i.e., Route 1). The proposed project includes improvements to an existing MAP location. Table 13.1-10 identifies the existing visual quality the proposed MAP project.

Table 13.1-10. Existing Visual Quality for Military Access Point Projects – Apra Harbor Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
50	1	MAP 14, Naval Base Guam; at Route ½A intersection	Moderate	Moderate	Moderate	Moderate

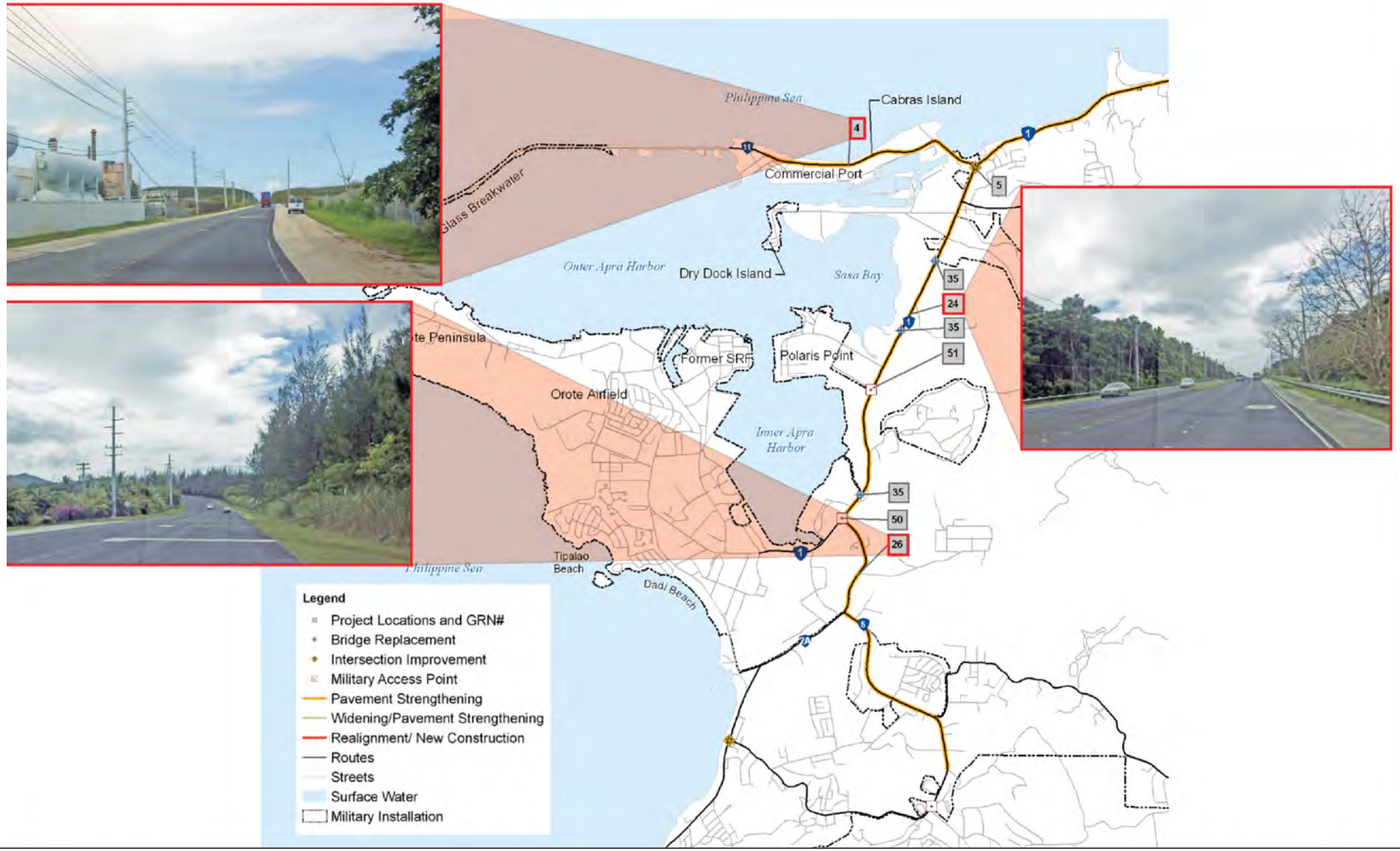


Figure 13.1-54
Typical Views for Pavement Strengthening Projects - Apra Harbor Region

Pavement Strengthening Projects

There are three pavement strengthening projects within the Apra Harbor Region, as shown in Table 13.1-11. Typical views for the region can be found in Figure 13.1-54. The Apra Harbor Region is one of the most industrialized locations on the island. Two prominent features that are found here and can be seen at least as far away as the resorts in Tamuning are the concrete silos and the power plant for the island. Large portions of the land adjacent to the roadway are paved for shipping containers and truck storage. Because the port area juts out into the Philippine Sea, the ocean is a prominent element, particularly along the north side of Route 11.

Table 13.1-11. Existing Visual Quality for Pavement Strengthening Projects – Apra Harbor Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
4	11	Port to Route 1	Moderately Low	Moderately Low	Moderately Low	Moderately Low
24	1	Route 2A to Route 11	Moderate	Moderate	Moderate	Moderate
26	2A	Route 5 to Route 1	Moderately High	Moderately High	Moderate	Moderately High

Given the industrial nature of the area, the existing visual quality of the region is generally low. The overall vividness of the area is low, with low intactness and unity. Views out to sea tend to increase the vividness of the area, but the industrial development, truck facilities, and shipping containers that make up the port area overwhelm the positive qualities and contribute to the low vividness.

Bridge Replacement Projects

Three bridge replacement projects are proposed along Route 1 in the Apra Harbor Region. The existing visual quality for the bridge areas is summarized in Table 13.1-12, and typical views can be seen in Figure 13.1-55.

Table 13.1-12. Existing Visual Quality for Bridge Replacement Projects – Apra Harbor Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
35	1	Atantano Bridge Replacement	Moderately High	Moderately High	Moderate	Moderately High
35	1	Laguas Bridge Replacement	Moderately High	Moderate	Moderate	Moderate
35	1	Sasa Bridge Replacement	Moderate	Moderately Low	Moderate	Moderate

- Atantano Bridge: This bridge is located in a rural area along Route 1, with little development adjacent to the riverbanks. Views from the bridge are to forested areas on either side of the bridge. The general visual quality in the bridge area is moderately high, with moderately high vividness, moderately high intactness, and moderate unity. The open railing of the bridge affords travelers on Route 1 views out into the surrounding landscape, increasing the visual quality of the bridge area.
- Laguas Bridge: The bridge over the Laguas River is located in an area of less development, and there are no adjacent structures in the bridge area. The existing visual quality of the bridge area is moderate, with moderately high vividness, moderate intactness, and moderate unity.

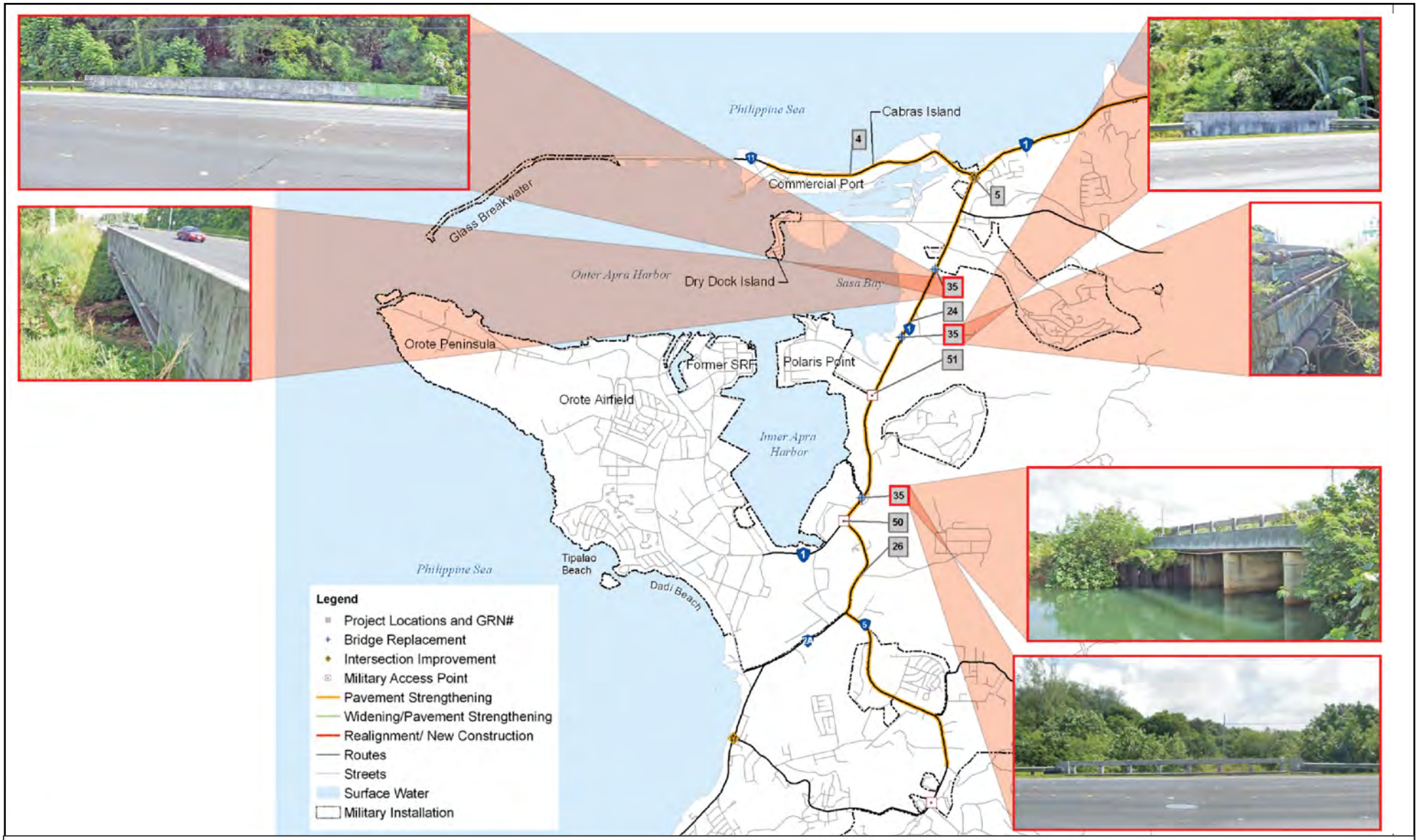


Figure 13.1-55
Typical Views for Bridge Replacement Projects - Apra Harbor Region

- Sasa Bridge: The Sasa Bridge is also located in an area without large-scale development. The surrounding landscape is well forested. The bridge itself has a substantial number of utilities hanging off the bridge, which detracts from the overall visual quality of the area. The visual quality of the area is moderate, with moderate vividness, moderately low intactness, and moderate unity.

Roadway and Intersection Widening Projects

There is one intersection improvement project within the Apra Harbor Region at the Route 1/11 (GRN #5). The Route 1/11 intersection in the port area has an industrial character to the west but an undeveloped and forested area to the east. Because of the presence of the power plant, there are many large utility poles along the roadways. The overall visual quality for the Route 1/11 intersection is moderate, with moderate vividness, moderate intactness, and moderately low unity.

The existing visual quality for the project area is summarized in Table 13.1-13, and typical views for the intersection can be seen in Figure 13.1-56.

Table 13.1-13. Existing Visual Quality for Roadway and Intersection Widening Projects – Apra Harbor Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
5	1	Route 1/11 Intersection	Moderate	Moderate	Moderately Low	Moderate

Road Realignments and New Road Projects

There are no proposed road realignment or new road projects proposed within the Apra Harbor Region.

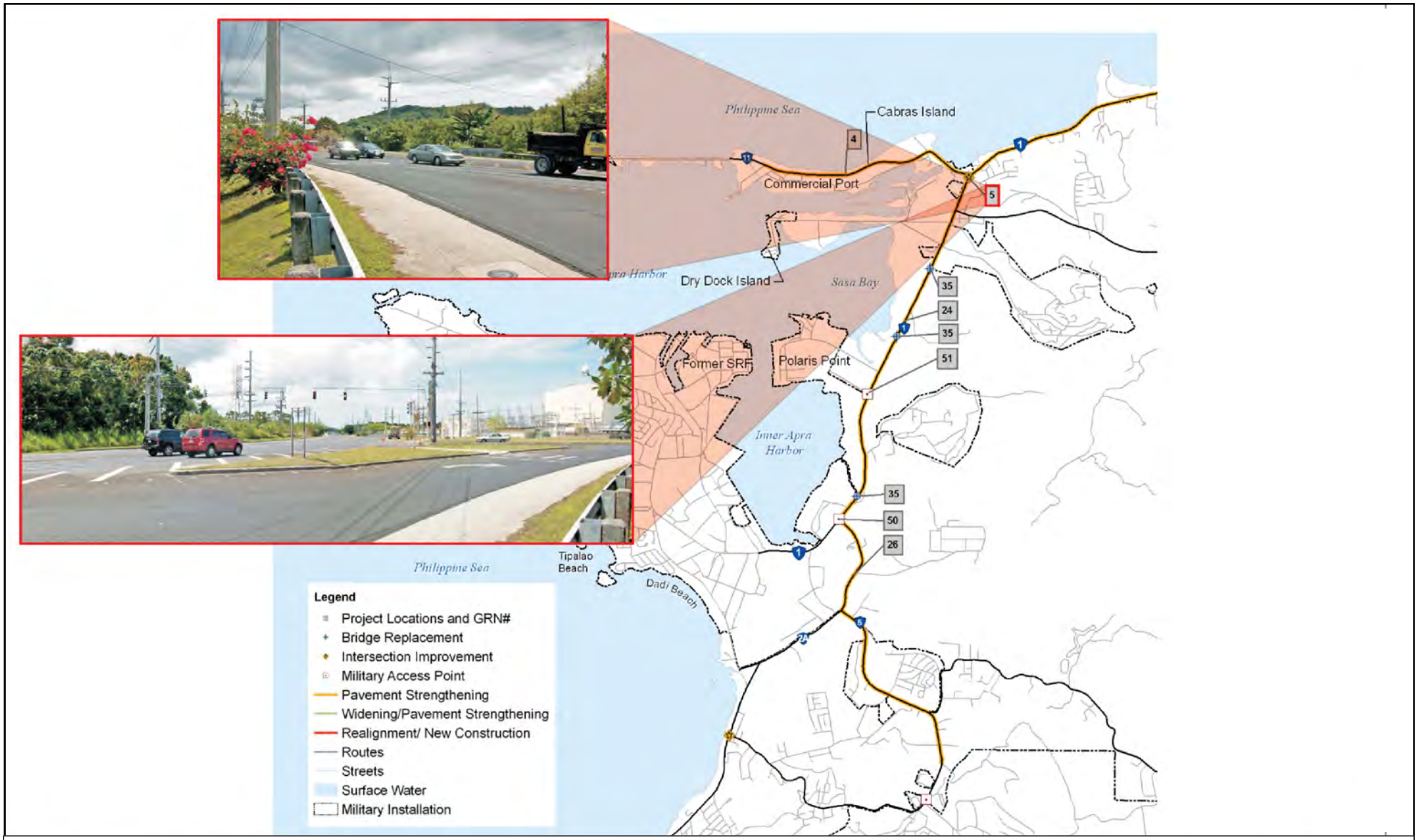


Figure 13.1-56
Typical Views for Roadway and Intersection Widening Projects - Apra Harbor Region

13.1.4 South

13.1.4.1 Naval Munitions Site

The Naval Munitions Site (NMS) is located on the southwestern side of Guam and is primarily used as a weapons storage area. NMS is located in a large bowl-shaped valley that is surrounded by rugged terrain and several mountain peaks. Generally speaking, the southern half of Guam can be characterized as having much more topographic relief than the northern half of the island and is much more sparsely populated. Because of these factors, as well as its interior location and more isolated environment overall, NMS is almost entirely out of the public's view. Views from within the northern part of the area are a blend of a naturally appearing landscape, interspersed with areas of earth covered magazines. The southern area of NMS is mountainous and very rugged terrain, and with the exception of some jeep roads, there are almost no man-made features covering the landscape. Located within NMS, Fena Valley Reservoir is the largest water body on the island of Guam and provides the potable water supply for central and southern Guam (Figure 13.1-57). Like the rest of NMS, Fena Valley Reservoir is restricted to no public access.

Figure 13.1-57. Fena Valley Reservoir
Source: Google Earth 2008.

Along the west side of the NMS boundary is a sequence of mountains including Mount Alifan, Mount Almagosa, Mount Lamlam and Mount Humuyong Manglo. The greenery in this area complements picturesque mountain views (Figure 13.1-58). The view from Mount Humuyong Manglo Overlook encompasses the Fena Valley Reservoir. Mount Lamlam is the tallest mountain on Guam, rising to an elevation of 1,334 ft (407 m) above sea level. The summit overlook provides a 360-degree view of the island and the surrounding ocean. In addition to the mountain lookout sites, there are several waterfalls and springs within the Southern Mountains group that provide valuable scenic views.

Figure 13.1-58. A View of Southern Mountains from Mount Lamlam
Source: Google Earth 2008.

Mount Alifan is located at the northwestern edge of NMS. It is part of the Southern Mountain Group and it climbs to 768 ft (234 m) above sea level providing a panoramic view of Agat Bay and the Orote Peninsula. Japanese Lookout is a scenic point located at the top of Mount Alifan.

13.1.4.2 Non-DoD Land

Facpi Point Lookout

Facpi Point is located at the tip of Facpi Island in southwestern Guam approximately 1.5 mi (2.4 km) from Sella Bay. Facpi Point provides a view of the Umatac ridgeline and a panoramic view of corals and caves during low-tide (Figure 13.1-59).

Figure 13.1-59. A View of Facpi Point
Source: Google Earth 2008.

Sella Bay Overlook/Spanish Bridge and Oven

The Sella Bay Overlook is situated approximately one mile away from the Cetti Bay Overlook (description below). Both are located on Route 2 near the village of Agat (Figure 13.1-60).

Cetti Bay Overlook

Cetti Bay is situated on southwestern side of Guam. The Cetti Bay Overlook provides a wide range of views to the bay area and even farther south to Cocos Island as well as Cocos Lagoon (Figure 13.1-61). The low, natural-appearing groundcover allows a clear, unobstructed panoramic view looking out to the Philippine Sea.

Figure 13.1-60. A View of Sella Bay Looking Towards the Philippine Sea
Source: Google Earth 2008.

Figure 13.1-61. A View of Cetti Bay
Source: Google Earth 2008.

Fouha Bay Scenic Vista

Fouha Bay is located north of Umatac Village on the southwestern coast of Guam about 0.5 mi (0.8 km) to the south of Cetti Bay. The Fouha Bay Scenic Vista provides a view of Fouha Bay and the Philippine Sea (Figure 13.1-62).

Talifak Spanish Bridge

Talifak Spanish Bridge, located on the southwestern side of Guam, bridges the Talifak River. The bridge is a historic asset built during the Spanish occupation of Guam. The aesthetic value of the Talifak Bridge is highly appreciated by many, with not only its unique arch shape but also the visual harmony between the bridge and its surroundings (Figure 13.1-63).

Figure 13.1-62. A View of Fouha Bay
Source: Google Earth 2008.

Figure 13.1-63. Talifak Spanish Bridge
Source: Google Earth 2008.

13.1.4.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Military Access Point Projects

Only one MAP project is proposed within the south region. Because the project is located within DoD land, in which photographing is not permitted, typical views are not included in this report; however, descriptions are included.

The visual character and quality of the MAP location is similar to the adjacent roadway network (i.e., Route 12). Table 13.1-14 identifies the existing visual quality of the proposed MAP project.

Table 13.1-14. Existing Visual Quality for Military Access Point Projects – South Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
52	12	MAP 16, Naval Munitions Site	Moderate	Moderate	Moderate	Moderate

Pavement Strengthening Projects

Like the north region, the South Region is more suburban to rural in character; however, the South Region has a more volcanic past that is reflected in its appearance today. In general, it has more dramatic topographic relief in some locations. These steeper areas also tend to be more forested, given the difficulty in building in these locations. The pavement strengthening projects for the South Region are listed in Table 13.1-15, and the typical views for these projects can be seen in Figure 13.1-64.

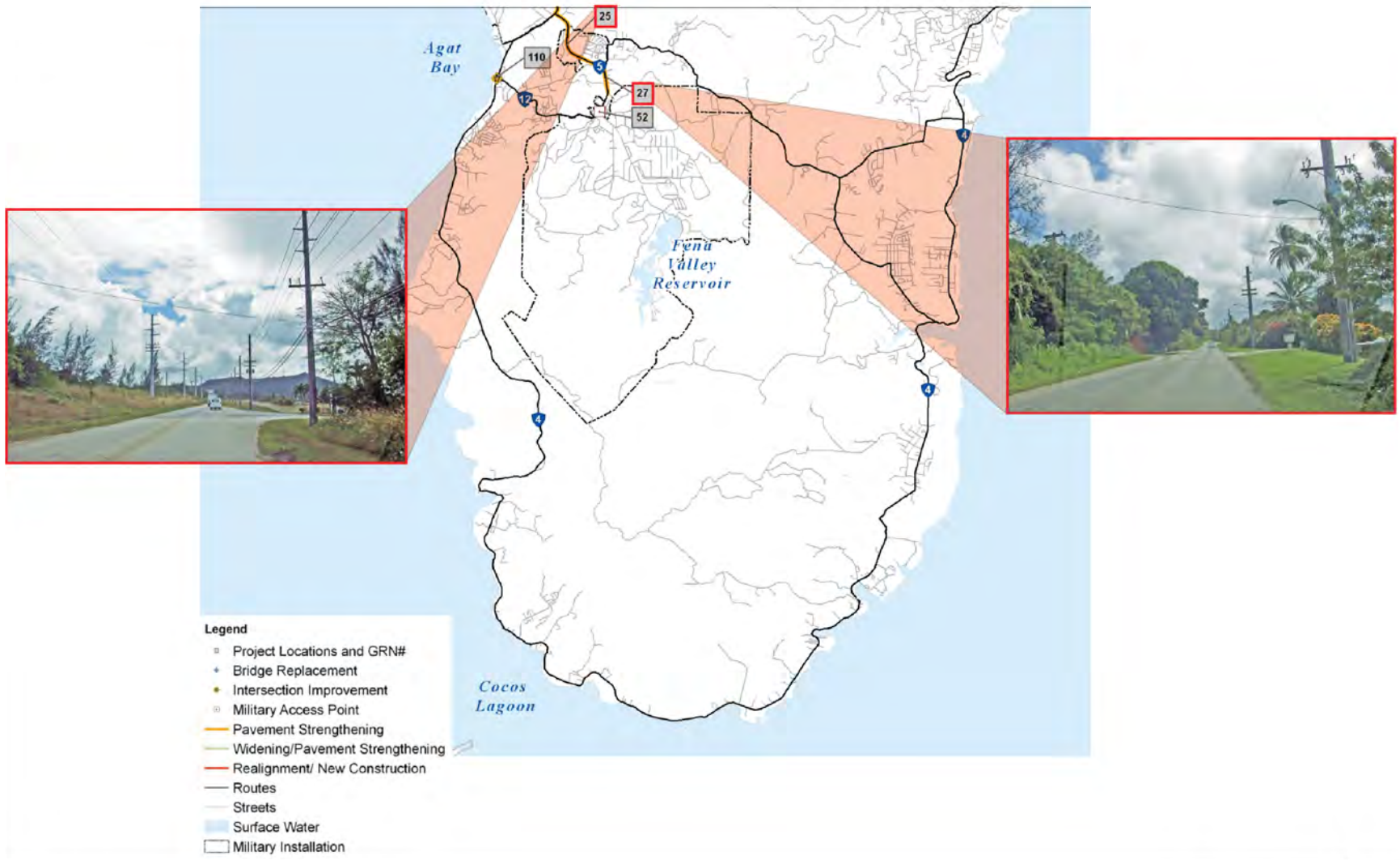


Figure 13.1-64
Typical Views for Pavement Strengthening Projects - South Region

Table 13.1-15. Existing Visual Quality for Pavement Strengthening Projects – South Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
25	5	Route 17 to Route 2A	Moderate	Moderate	Moderate	Moderate
27	5	Harmon Road to Route 17	Moderately High	Moderately High	Moderate	Moderately High

The overall visual quality for the South Region is moderately high overall, with moderately high vividness, moderately high intactness, and moderate unity. The overall visual quality rating is based on the general rural appearance along the roadways, as well as the forested areas.

Bridge Replacement Projects

No replacement bridge projects are located in the South Region.

Roadway and Intersection Widening Projects

There is one intersection improvement project within the South Region at the Route 2/12 intersection. This intersection has a mix of commercial and residential development. At the intersection, the roads are multilane to accommodate turning movements. There are distant views between the surrounding landscaping and under the power lines to the ocean. The overall visual quality of the intersection is moderate, with moderate vividness, moderately low intactness, and moderate unity. The existing visual quality for the project area is summarized in Table 13.1-16, and typical views can be seen in Figure 13.1-65.

Table 13.1-16. Existing Visual Quality for Roadway and Intersection Widening Projects – South Region

GRN #	*Route Number*	*Segment Limits*	*FHWA Visual Assessment Criteria*			*Overall Visual Quality (V + I + U/3)*
			Vividness	*Intactness*	*Unity*	
110	2	Route 2/12 Intersection	Moderate	Moderately Low	Moderate	Moderate

Road Realignments and New Road Projects

There are no proposed road realignment or new road projects proposed within the south region.

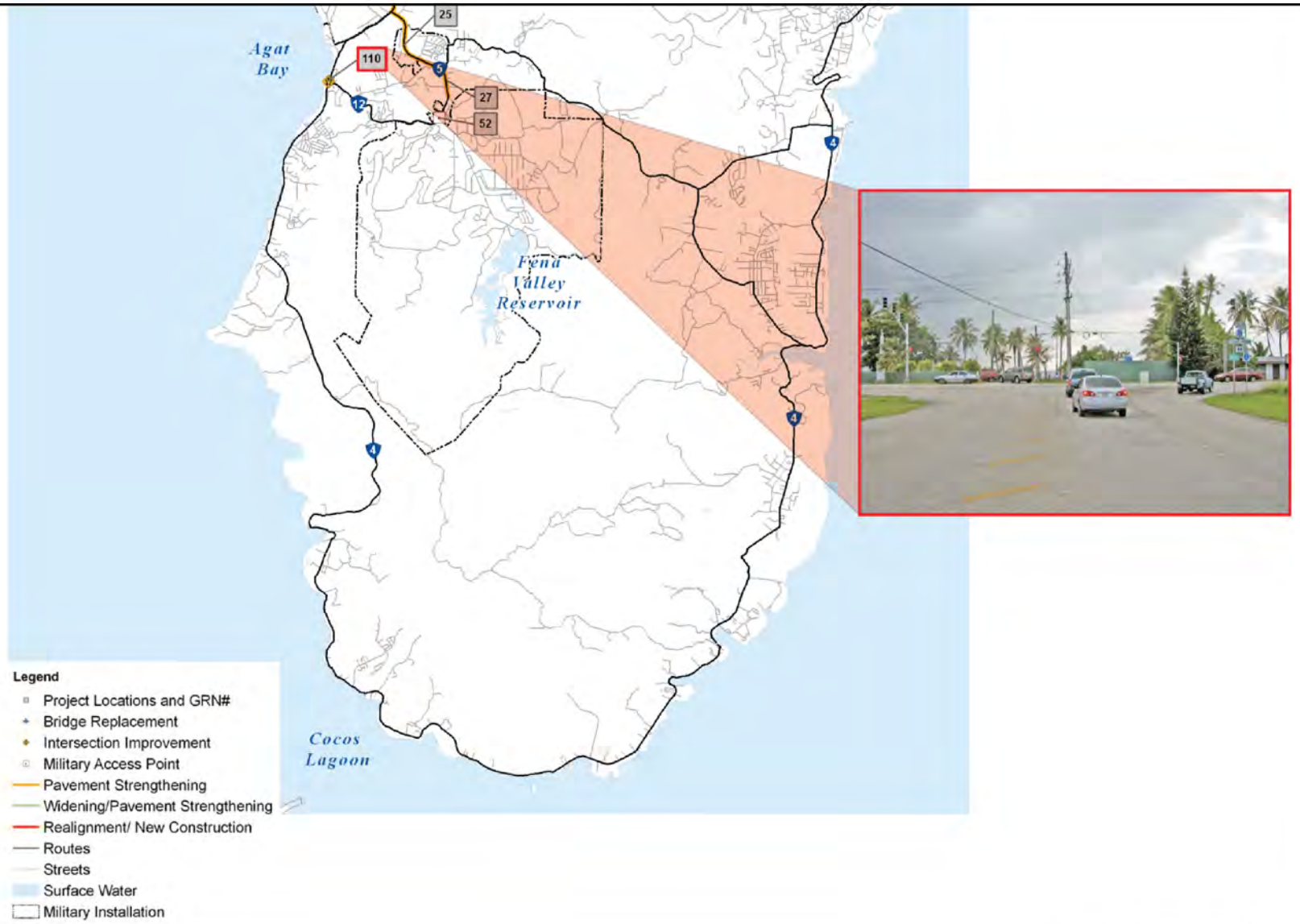


Figure 13.1-65
Typical Views for Roadway and Intersection Widening Projects - South Region

13.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

13.2.1 Approach to Analysis

13.2.1.1 Methodology

Information on visual resources was gathered through on-site visits, background research, and participation in stakeholder and public meetings. The analysis of potential impacts to visual resources is based on the long term (operational) effects – i.e., after construction has occurred and all buildings, facilities, and structures are in place. Construction-related activities related to the development of the Marine Corps facilities would be relatively minimal in their impacts (i.e., earth-moving equipment clearing vegetation and constructing facilities).

13.2.1.2 Determination of Significance

For the purpose of this EIS/OEIS, the proposed action and alternatives would cause a significant impact to visual resources if they:

- Would substantially alter the views or scenic quality associated with particularly significant and/or publicly recognized vistas, viewsheds, overlooks, or features;
- Would substantially change the light, glare, or shadows within a given area; and
- Would substantially affect sensitive receptors – i.e., viewers with particular sensitivity (or intolerance) to a changed view (e.g., a hillside neighborhood with views of a relatively undisturbed, naturally-appearing landscape)

Significant impacts that cannot be mitigated to less-than-significant levels are considered unavoidable.

A discussion is presented for each significance criterion listed that would be triggered by the alternatives.

13.2.1.3 Issues Identified during Public Scoping Process

No visual resource issues regarding the proposed action were raised at the April 2007 public scoping meetings.

13.2.2 Alternative 1

13.2.2.1 North

<u>Andersen AFB</u>

The North Ramp Area would see the largest amount of new development at Andersen AFB for proposed airfield functions associated with the proposed action, including the addition of several new hangars, warehouses, administrative buildings, maintenance facilities, parking areas, and new ramp space to accommodate Marine Corps aviation needs. The new buildings would range in height from approximately 20 to 60 ft (6 to 18 m). Figure 13.2-1 shows the primary area of proposed Marine Corps development at

the North Ramp Area. The additional Marine Corps facilities would add a substantial amount of new buildings and infrastructure to an area already dominated by a similar landscape – i.e., active runways, ramps, hangars, etc. Additionally, public views into this area can only be seen from the distant point on Mount Santa Rosa; and from that distance the North Ramp Marine Corps expansion area would blend into the rest of the Air Force facilities and paved areas. Therefore, any impacts to visual resources are anticipated to be less than significant.

Figure 13.2-1. Aerial View of the North Ramp Area with Depiction of Where Most New Development would be Located

Neither the Tarague Embayment Overlook nor the Pati Point Overlook would be impacted in any way by the North Ramp Area development.

South Ramp Area

The Air Mobility Command (AMC) Campus proposed for the South Ramp Area of Andersen AFB would include the addition of several buildings and parking areas to accommodate Marine Corps and Air Force air embarkation needs. The new buildings would be no more than two stories (approximately 25 ft [8 m] high). Figure 13.2-2 and Figure 13.2-3 show the primary area of proposed development at the South Ramp Area. Similar to the North Ramp Area, but to a lesser degree, the additional facilities would add a few new buildings and infrastructure to an area already dominated by a similar landscape – i.e., active runways, ramps, hangars, etc. Also similar to the North Ramp, public views into the South Ramp Area can only be seen from the distant point on Mount Santa Rosa; and from that distance the South Ramp AMC Campus expansion area would blend into the rest of the Air Force facilities and paved areas. Therefore, any impacts to visual resources are anticipated to be less than significant.

There would be no visual impacts to the Palm Tree Golf Course as part of the AMC Campus development.

Figure 13.2-2. Aerial View Looking East South with Depiction of Where the Proposed New AMC Campus Would be Located Adjacent to South Ramp

Figure 13.2-3. Aerial View Looking Northwest Northeast With Depiction of Where the Proposed New AMC Campus Would be Located Adjacent to South Ramp

Air Force MSA

Several new earth covered magazines are proposed for MSA1, including roads and associated infrastructure. These facilities and infrastructure would be in keeping with the current features of the area. Furthermore, there are no public views into MSA1. Therefore, no impacts to visual resources are anticipated from the expanded facilities at the MSA1.

Northwest Field

Proposals related to NWF include intermittent aviation-related training activities; no permanent facilities are proposed. Therefore, no impacts to visual resources are anticipated.

Finegayan

Under Alternative 1 of the Main Cantonment alternatives, development of the Finegayan area would result in substantial alteration of much of the existing landscape. The mostly vegetated Federal Aviation Administration (FAA) property and Harmon Area and relatively open visual character of the southern half of NCTS and South Finegayan would be completely transformed into a relatively dense area with numerous buildings, roads, parking lots, sidewalks, and landscaping. While this would represent a major change over the existing visual conditions and interior views at Finegayan, it would be expected to be less than significant because most of the property is already under DoD ownership and there are few if any sensitive views or receptors that currently exist on these sites.

Public views from Highway 3 into the areas proposed for development would take on a more urban/suburban character. The major changes would be on the FAA and Harmon properties, where naturally-appearing, densely-forested landscape would be replaced with a mix of housing (two stories) and barracks (four stories). Views of the proposed development on South Finegayan from Highway 3 and NCTS would be altered but not quite as striking because of the existing naval facilities already located on these sites.

Figure 13.2-4 shows the future northward looking view of South Finegayan (foreground) and the FAA parcel and NCTS Finegayan (middle ground) from Highway 3, respectively. Figure 13.2-5 shows the future northward looking view of NCTS Finegayan from Highway 3. Figure 13.2-6 shows the future northward looking view of the northern extent of the proposed developed area at NCTS Finegayan from Highway.

None of the public views into the Finegayan area are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in a substantial change to the existing landscape along a major and well-traveled public roadway it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with mitigation measures in place.

Haputo Beach, Double Reef, and North Double Reef would not be affected by the proposed development on Finegayan, however Haputo Point Overlook could be adversely impacted. Adverse impacts to this overlook could be lessened to a level of less than significant with mitigation.

Non-DoD Land

None of the recognized viewpoints, vistas, or overlooks located on non-DoD lands would be expected to be impacted by the various developments being proposed in the north area because of the distances and vegetation between them.

Figure 13.2-4. Alternative 1: View from Route 3 Looking Northward with New Family Housing in the Foreground and Middle Ground and the Main Cantonment in the Background (RESULTING VIEW)
Source: EDAW 2009.

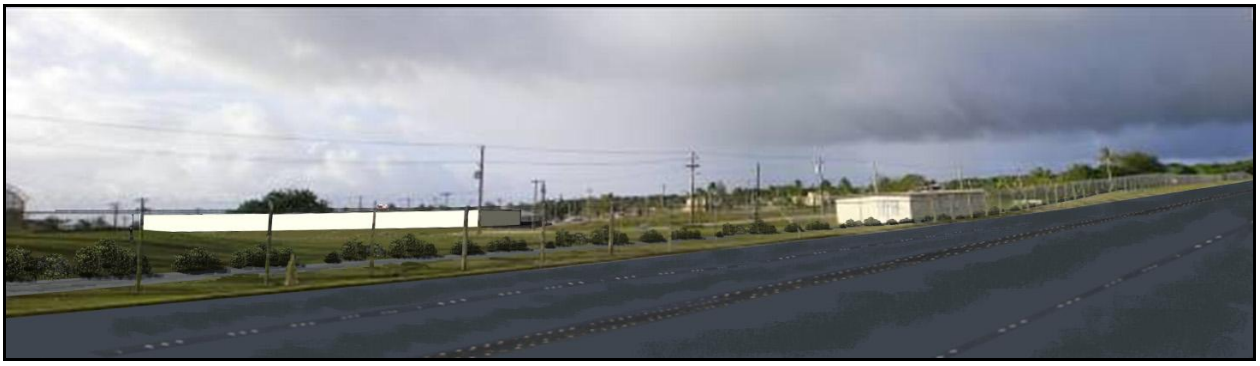


Figure 13.2-5. Alternative 1: Panoramic View from Route 3 Looking Northwestward into the Central Part of NCTS with New Warehouse in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

Figure 13.2-6. Alternative 1: View from Route 3 Looking Northward into the North Part of NCTS (RESULTING VIEW)

Source: EDAW 2009.

13.2.2.2 Central

Andersen South

Under the non-firing training functions, development of Andersen South and land adjacent to Route 15 for non-fire and live-fire training would result in moderate to substantial alteration of the existing landscape. Currently, publicly accessible views (primarily from Highway 1 and 15) into these areas are very limited due to the relatively flat topography and dense vegetation. Interior views within Andersen South would be of a large-scale, busy training environment with organized activities running in parallel throughout the complex. Derelict and overgrown buildings, and old crumbling roadways would be replaced with a network of facilities and infrastructure serving the multiplicity of required training functions. While this would represent a major change over the existing visual conditions and interior views at Andersen South, it would be expected to be less than significant because of the property is already under DoD ownership and there are no sensitive views or receptors that currently exist on this site.

Non-DoD Land

Regardless of the live-fire training alternative — Alternative A: Route 15 relocation; Alternative B: no road relocation — views from Highway 15 would likely be the most affected by the proposed development to this area. Essentially, views would change from primarily a densely vegetated landscape on both sides of Highway 15 to views composed of cleared areas, berms, structures, buildings, roadways, parking areas, fencing, and entry gates. Additionally, the ranges would require relatively large cleared areas, which would likely result in opening up ocean views to the east which currently do not exist. In any case, the proposed non-firing and live-fire training and ranges would represent a major change over the

existing visual conditions. None of the public views into these areas are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in such a substantial and dramatic change to the existing landscape along a major and well-traveled public roadway it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with mitigation measures in place.

Barrigada

No development is proposed for Barrigada under Main Cantonment Alternative 1, therefore, no impacts are anticipated.

13.2.2.3 Apra Harbor

Harbor

There would be a variety of different in-water and waterfront improvements carried out under the proposed action. The visual appearance of all of the improvements (wharves and associated shore-side supports facilities) would be similar to and in keeping with the visual conditions of the current harbor environment. Therefore, no impacts are anticipated.

Naval Base Guam

The various projects proposed for Navy Base under the proposed action (Apra Clinic, Dog Kennel, U.S. Coast Guard relocation, etc.) are in keeping with the overall visual appearance at the Navy Base. Therefore, no impacts are anticipated.

13.2.2.4 South

The projects and activities proposed within the South area are the 11 new earth-covered magazines (ECM) and maneuver training at NMS. The new ECMs, including roads and associated infrastructure would be adjacent or near the existing ECMs for both alternatives. It is expected that this new development would result in clearing of vegetation and the addition of manmade structures, thus increasing the amount of modified landscape in this otherwise natural-appearing environment. However, this area is entirely under DoD ownership and it is mountainous with very rugged terrain, therefore, public views into the area are very limited. Furthermore, these facilities and infrastructure would be in keeping with the current features of the area. Therefore, no impacts to visual resources are anticipated from the expanded facilities at NMS.

13.2.2.5 Summary of Impacts

Impacts to visual resources would be less than significant due to operations under Alternative 1 of the Main Cantonment alternatives, the airfield areas on Andersen AFB, and the ammunition storage alternatives at the NMS. Significant impacts to visual resources would occur at Route 15 due to operations of either of the Training Range Complex alternatives.

13.2.2.6 Potential Mitigation Measures

Potential mitigation measures include the following:

- To alleviate the impact on public views, develop and implement a landscape plan focused on retention of mature specimen trees during construction (where possible) and the establishment of a full suite of vegetation in keeping with Guam's native flora.
- To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads..

13.2.3 Alternative 2 (Preferred Alternative)

13.2.3.1 North

Andersen AFB

The impacts under Alternative 2 would be the same as those described for Alternative 1.

Finegayan

The impacts under Alternative 2 would be nearly identical to those described for Alternative 1. The primary difference as it affects visual resources is that under Alternative 2 the Harmon property would not be developed and more of NCTS would be; in particular, additional development to the north along approximately half a mile of Highway 3 would be altered from its current status (natural-appearing landscape) to a landscape that is light industrial in appearance – warehouses, parking lots, vehicle maintenance areas, etc. Figure 13.2-7 identifies the northern extent of the proposed developed area at NCTS Finegayan, which would accommodate the Army Air and Missile Defense Task Force (AMDTF) administration and operations complex, and the Marine Logistics Group operations and support facilities, as well as the Commercial Gate. The proposed development would represent a major change over the existing visual conditions.

Public views from Highway 3 into the areas proposed for development would take on a more urban/suburban character. The major changes would be on the FAA and Harmon properties, where naturally-appearing, densely-forested landscape would be replaced with a mix of housing (two stories) and barracks (four stories). Views of the proposed development on South Finegayan from Highway 3 and NCTS would be altered but not quite as striking because of the existing naval facilities already located on these sites.

Figure 13.2-7 shows the future northward looking view of South Finegayan (foreground) and the FAA parcel and NCTS Finegayan (middle ground) from Highway 3, respectively. Figure 13.2-8 shows the future northward looking view of NCTS Finegayan from Highway 3. Figure 13.2-9 shows the future northward looking view of the northern extent of the proposed developed area at NCTS Finegayan from Highway with new facilities in the foreground and water tower/tank in the background.

None of the public views into the Finegayan area are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in a substantial change to the existing landscape along a major and well-traveled public roadway it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with mitigation measures in place.

As previously noted, none of the public views into the Finegayan area are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in a substantial change to the existing landscape along a major and well-traveled public roadway, particularly in the northern portion of NCTS Finegayan, it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with the same mitigation measures in place as described for Alternative 1.

Non-DoD Land

The impacts under Alternative 2 would be the same as those described for Alternative 1.

Figure 13.2-7. Alternative 2: View from Route 3 Looking Northward with New Family Housing in the Foreground and Middle Ground and the Main Cantonment in the Background (RESULTING VIEW)

Source: EDAW 2009.

Figure 13.2-8. Alternative 2: Panoramic View from Route 3 Looking Northwestward into the Central Part of NCTS with New Warehouse in the Foreground (RESULTING VIEW)

Source: EDAW 2009.

Figure 13.2-9. Alternative 2: View from Route 3 Looking Northward into the North Part of NCTS with New Facilities in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

13.2.3.2 Central

Andersen South

The impacts under Alternative 2 would be the same as those described for Alternative 1.

Non-DoD Land

The impacts under Alternative 2 would be the same as those described for Alternative 1.

Barrigada

The impacts under Alternative 2 would be the same as those described for Alternative 1.

13.2.3.3 Apra Harbor

Harbor

The impacts under Alternative 2 would be the same as those described for Alternative 1.

Naval Base Guam

The impacts under Alternative 2 would be the same as those described for Alternative 1.

13.2.3.4 South

The impacts under Alternative 2 would be the same as those described for Alternative 1.

13.2.3.5 Summary of Impacts

Impacts to visual resources are the same as for Alternative 1 with the addition of more development and an increased visual impact at Finegayan.

13.2.3.6 Potential Mitigation Measures

Same as Alternative 1.

13.2.4 Alternative 3

13.2.4.1 North

Andersen AFB

The impacts under Alternative 3 would be the same as those described for Alternative 1.

Finegayan

The impacts under Alternative 3 would be similar to, but reduced from those described for Alternative 1. The primary difference as it affects visual resources is that under Alternative 3 the FAA property would not be developed for housing and related supporting facilities (they would be developed at Barrigada instead – refer to Section 13.2.4.2, Central, Barrigada below).

Figure 13.2-10 shows the future northward looking view of South Finegayan (foreground) and the FAA parcel and NCTS Finegayan (middle ground) from Highway 3, respectively. Figure 13.2-11 shows the future northward looking view of NCTS Finegayan from Highway 3. Figure 13.2-12 shows the future northward looking view of the northern extent of the proposed developed area at NCTS Finegayan from Highway with new facilities in the foreground.

Figure 13.2-10. Alternative 3: View from Route 3 Looking Northward with New Family Housing in the Foreground, Undeveloped FAA Parcel in the Middle Ground and Main Cantonment in the Background (RESULTING VIEW)

Source: EDAW 2009.

Figure 13.2-11. Alternative 3: Panoramic View from Route 3 Looking Northwestward into the Central Part of NCTS with New Warehouse in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

Figure 13.2-12. Alternative 3: View from Route 3 Looking Northward into the North Part of NCTS with New Facilities in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

As previously noted, none of the public views into the Finegayan area are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in such a substantial and dramatic change to the existing landscape along a major and well-traveled public roadway it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with the same mitigation measures in place as described for Alternative 1.

Non-DoD Land

The impacts under Alternative 3 would be the same as those described for Alternative 1.

13.2.4.2 Central

Andersen South

The impacts under Alternative 3 would be the same as those described for Alternative 1.

Barrigada

Under Alternative 3, approximately half of the Navy and Air Force Barrigada properties would be developed for housing and related supporting facilities. While both of these areas primarily consist of mowed grass and low shrubs with antennae and associated facilities and structures, a large portion of both are currently heavily vegetated and appear in a more natural state. Development at the Barrigada areas would occur in both the previously disturbed and the densely vegetated areas, thus replacing much of the low and shrub-type landscape, as well as the naturally-appearing landscape with one that is more suburban.

Potentially sensitive receptors include people traveling along Highways 15 and 16, residents of Barrigada Heights in the north adjacent to Navy Barrigada, residents of Barrigada neighborhoods to the east and south of Air Force Barrigada, and viewers from Mount Barrigada. Proposed buildings and structures are not expected to be more than two stories high and the area would generally be in keeping with other land uses in the nearby vicinity, which are residential neighborhoods. Nevertheless, this development would result in a substantial modification to the existing landscape causing a significant impact to visual resources. However, these impacts could be expected to be reduced to a level less than significant with mitigation measures in place.

Non-DoD Land

The impacts under Alternative 3 would be the same as those described for Alternative 1.

13.2.4.3 Apra Harbor

Harbor

The impacts under Alternative 3 would be the same as those described for Alternative 1.

Naval Base Guam

The impacts under Alternative 3 would be the same as those described for Alternative 1.

13.2.4.4 South

The impacts under Alternative 3 would be the same as those described for Alternative 1.

13.2.4.5 Summary of Impacts

Impacts to visual resources would include adverse impacts due to development at Barrigada. All other impacts would be the same as Alternative 1.

13.2.4.6 Potential Mitigation Measures

To alleviate the impact on public views, develop and implement a landscape plan focused on retention of mature specimen trees during construction (where possible) and the establishment of a full suite of vegetation in keeping with Guam's native flora.

To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads.

13.2.5 Alternative 8

13.2.5.1 North

Andersen AFB

The impacts under Alternative 8 would be the same as those described for Alternative 1.

Finegayan

The impacts under Alternative 8 would be similar to, but reduced from those described for Alternative 1. The primary difference as it affects visual resources is that under Alternative 8 the Harmon area would not be developed for housing and related supporting facilities (they would be developed at Barrigada instead – refer to Section 13.2.5.2, Central, Barrigada below).

Figure 13.2-13 shows the future northward looking view of South Finegayan (foreground) and the FAA parcel and NCTS Finegayan (middle ground) from Highway 3, respectively. Figure 13.2-14 shows the future northward looking view of NCTS Finegayan from Highway 3. Figure 13.2-15 shows the future northward looking view of the northern extent of the proposed developed area at NCTS Finegayan from Highway with the new water tower/tank in the background.

Figure 13.2-13. Alternative 8: View from Route 3 Looking Northward with New Family Housing in the Foreground and Middle Ground, and Main Cantonment in the Background (RESULTING VIEW)

Source: EDAW 2009.

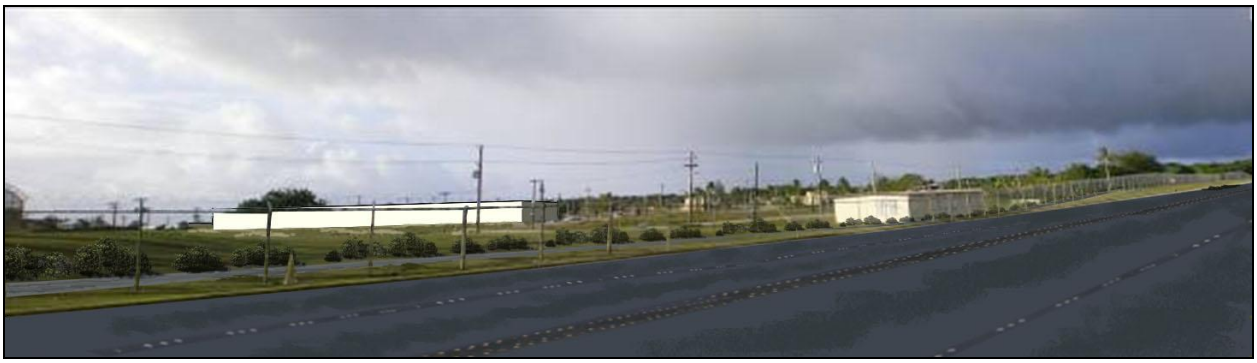


Figure 13.2-14. Alternative 8: Panoramic View from Route 3 Looking Northwestward into the Central Part of NCTS with New Warehouse in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

Figure 13.2-15. Alternative 3: View from Route 3 Looking Northward into the North Part of NCTS with New Facilities in the Foreground (RESULTING VIEW)
Source: EDAW 2009.

As previously noted, none of the public views into the Finegayan area are of any particular significance, e.g., a recognized vista or overlook. However, because the proposed development would result in such a substantial and dramatic change to the existing landscape along a major and well-traveled public roadway it is anticipated that it would have a significant impact to visual resources. These impacts could be reduced to a level less than significant with the same mitigation measures in place as described for Alternative 1.

Non-DoD Land

The impacts under Alternative 8 would be the same as those described for Alternative 1.

13.2.5.2 Central

Andersen South

The impacts under Alternative 8 would be the same as those described for Alternative 1.

Barrigada

Under Alternative 8, all of the Air Force Barrigada property would be developed for housing and related supporting facilities. While much of this area is composed of mowed grass and low shrubs with antennae and associated facilities and structures, a large portion is currently heavily vegetated and appears in a more natural state. Development of Air Force Barrigada would occur in both the previously disturbed and the densely vegetated areas, thus replacing much of the low and shrub-type landscape, as well as the naturally-appearing landscape with one that is totally suburban.

Potentially sensitive receptors include people traveling along Highway 15, residents of Barrigada neighborhoods to the east and south of Air Force Barrigada, and to a lesser extent viewers from Mount Barrigada. Proposed buildings and structures are not expected to be more than two stories high and the area would generally be in keeping with other land uses in the nearby vicinity, which are residential neighborhoods. Nevertheless, this development would result in a substantial modification to the existing landscape causing a significant impact to visual resources. However, these impacts could be expected to be reduced to a level less than significant with mitigation measures in place as described under Alternative 3.

Piti/Nimitz Hill

The impacts under Alternative 8 would be the same as those described for Alternative 1.

Non-DoD Land

The impacts under Alternative 8 would be the same as those described for Alternative 1.

13.2.5.3 Apra Harbor

Harbor

The impacts under Alternative 8 would be the same as those described for Alternative 1.

Naval Base Guam

The impacts under Alternative 8 would be the same as those described for Alternative 1.

13.2.5.4 South

The impacts under Alternative 8 would be the same as those described for Alternative 1.

13.2.5.5 Summary of Impacts

Impacts to visual resources would include adverse impacts due to development at Barrigada. All other impacts would be the same as Alternative 1.

13.2.5.6 Potential Mitigation Measures

Same as Alternative 3.

13.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would

occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions, and there would be no impacts associated with the proposed action and alternatives. Existing operations at the proposed project areas would continue. Therefore, the no-action alternative would not have significant impacts to visual resources. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

13.2.7 Summary of Impacts

The Marine Corps build-up would result in substantial changes to the visual environment at specific locations on Guam. None of the affected areas are publicly recognized vistas, viewsheds, overlooks, or features of particular significance. However, the changed visual environment would affect public views by substantially modifying naturally-appearing landscapes located adjacent to public roadways. These changes to the visual environment, while substantial in scale and potentially significant in nature, would be expected to be brought to a level of less than significant with mitigation measures in place. Table 13.2-1 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 13.2-2 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 13.2-3 and 13.2-4 summarizes the impact at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives, respectively. A summary of potential visual impacts due to Other Training, Airfield, and Waterfront is provided in Table 13.2.2-5. A text summary follows the summary tables.

Table 13.2-1. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
NI • There would be no impacts from construction.	NI • There would be no impacts from construction.	NI • There would be no impacts from construction.	NI • There would be no impacts from construction.
Operation			
SI-M • The mostly vegetated former FAA and Harmon parcels and relatively open visual character of the southern half of NCTS and South Finegayan would be completely transformed into a densely developed area with numerous buildings, roads, parking lots, sidewalks, and landscaping. While this would represent a major change over the existing visual conditions and interior views at Finegayan, most of the property is already under DoD ownership and there are few, if any, sensitive views or receptors that currently exist on these sites.	SI-M • The impacts would be almost the same as for Alternative 1. The primary difference is that the Harmon parcel would not be developed and more of NCTS would be. As seen from Route 3, the major changes would be on the former FAA and Harmon parcels, where naturally-appearing, densely forested landscape would be replaced with a mix of housing and barracks. Views of the proposed development on South Finegayan from Route 3 would be altered but not would not be quite as striking due to existing naval facilities.	SM-I • Impacts to NCTS and South Finegayan would be similar to, but reduced from, the impacts described under Alternative 1. However the former FAA parcel would not be developed. Approximately half of the Navy and Air Force Barrigada properties would be developed for housing and related supporting facilities. While both areas primarily consist of mowed grass and low shrubs with antennae and associated facilities and structures, a large portion of both areas are currently heavily vegetated and appear in a more natural state. • Development would occur in both previously disturbed and densely vegetated areas, thus replacing much of the low and shrub-type landscape, as well as naturally-appearing landscape with one that is more suburban.	SM-I • Impacts to NCTS and South Finegayan would be similar to, but reduced from the effects described under Alt 1. The primary difference is that the Harmon property would not be developed for housing and related supporting facilities (they would be developed at Barrigada). All of the Air Force Barrigada property would be developed . The effects to Air Force Barrigada would be similar to those described under Alternative 3 but would occur over a larger area. • There would be no impacts to the Navy Barrigada property.

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
NI • None of the recognized viewpoints, vistas, or overlooks on non-DoD lands would be expected to be impacted by the various developments being proposed in the north area because of the distances and vegetation between them.	NI • None of the recognized viewpoints, vistas, or overlooks on non-DoD lands would be expected to be impacted by the various developments being proposed in the north area because of the distances and vegetation between them.	NI • None of the recognized viewpoints, vistas, or overlooks on non-DoD lands would be expected to be impacted by the various developments being proposed in the north area because of the distances and vegetation between them.	NI • None of the recognized viewpoints, vistas, or overlooks on non-DoD lands would be expected to be impacted by the various developments being proposed in the north area because of the distances and vegetation between them.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 13.2-13.2-2. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
NI • There would be no impacts from construction.	NI • There would be no impacts from construction.
Operation	
SI-M • Development of land adjacent to Route 15 for live-fire training would result in moderate to substantial alteration of the existing landscape. Publicly accessible views into these areas are limited due to the relatively flat topography and dense vegetation. Regardless of the live-fire training alternative, views from Route 15 would likely be the most affected; views would change from a primarily a densely vegetated landscape on both sides of Route 15 to views composed of cleared areas, berms, structures, buildings, roadways, parking areas, fencing, and entry gates. The ranges would require relatively large cleared areas, resulting in opening up ocean views to the east which currently do not exist.	SI-M • Development of land adjacent to Route 15 for live-fire training would result in moderate to substantial alteration of the existing landscape. Publicly accessible views into these areas are limited due to the relatively flat topography and dense vegetation. Regardless of the live-fire training alternative, views from Route 15 would likely be the most affected; views would change from a primarily a densely vegetated landscape on both sides of Route 15 to views composed of cleared areas, berms, structures, buildings, roadways, parking areas, fencing, and entry gates. The ranges would require relatively large cleared areas, resulting in opening up ocean views to the east which currently do not exist.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 13.2-3. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • There would be no impacts from construction.	NI • There would be no impacts from construction.
Operation	
NI • There would be no impacts from operations.	NI • There would be no impacts from operations.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 13.2-4. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • There would be no impacts from construction.	NI • No construction.
Operation	
NI • There would be no impacts from operations.	NI • There would be no impacts from operations.

Table 13.2-5. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • There would be no impacts from construction	NI • There would be no impacts from construction.	NI • There would be no impacts from construction
Operation		
SI-M • Development of Andersen South for non-fire training would result in moderate to substantial alteration of the existing landscape. Publicly accessible views into these areas are limited due to the relatively flat topography and dense vegetation. Views from Route 15 would likely be the most affected; views would change from a primarily a densely vegetated landscape on both sides of Route 15 to views composed of cleared areas, berms, structures, buildings, roadways, parking areas, fencing, and entry gates.	LSI • The proposed Marine Corps facilities would add a substantial amount of new buildings and infrastructure to an area already dominated by a similar landscape—i.e., active runways, ramps, hangars, and etc. There are limited public views from a distance on Mount Santa Rosa. • The North Ramp Marine Corps expansion area would blend into the rest of the Air Force facilities and paved areas. No impacts anticipated from the Tarague Embayment Overlook nor the Pati Point Overlook. • facilities would add a substantial amount of new buildings and infrastructure to an area already dominated by a similar landscape—i.e., active runways, ramps, hangars, and etc. There is a limited public views from a distance on Mount Santa Rosa.	NI • The visual appearance of all the improvements (wharves and associated shore-side supports facilities) would be similar to, and in keeping with the visual conditions of the current harbor environment. • The proposed components of the project (Apra Clinic, Dog Kennel, U.S. Coast Guard relocation, and etc.) would be keeping with the overall visual appearance at the Navy Base.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

13.2.8 Summary of Potential Mitigation Measures

Mitigation measures would include implementing a landscape plan focused on retention of mature specimen trees during construction, the establishment of a full suite of vegetation in keeping with Guam's native flora, and using native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads..

Table 13.2-6. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
• To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads for the Main Cantonment • Implement a landscape plan focused on retention of mature specimen trees during construction • Minimize open areas along the perimeter of the Range Complex and non-fire training area if security requirements permit.	• To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads for the Main Cantonment • Implement a landscape plan focused on retention of mature specimen trees during construction • Minimize open areas along the perimeter of the Range Complex and non-fire training area if security requirements permit.	• To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads for the Main Cantonment • Implement a landscape plan focused on retention of mature specimen trees during construction • Minimize open areas along the perimeter of the Range Complex and non-fire training area if security requirements permit.	• To alleviate the impact on public views, use native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads for the Main Cantonment • Implement a landscape plan focused on retention of mature specimen trees during construction • Minimize open areas along the perimeter of the Range Complex and non-fire training area if security requirements permit.

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CHAPTER 14. MARINE TRANSPORTATION

14.1 AFFECTED ENVIRONMENT

14.1.1 Definition of Resource

Marine transportation refers to marine vessels and facilities used to support commercial, military, and recreational uses. The primary military, commercial, and recreational port facilities on Guam are located in Apra Harbor, the main berthing facility on the island. Apra Harbor provides deep water and protected loading and off-loading facilities. Apra Harbor consists of a commercial harbor, a naval complex, and a repair facility. The port handles both containerized and conventional cargo from the United States (U.S.) and other countries.

This chapter describes existing facilities in Apra Harbor and the activities that occur there. The possible effects on the capacity of the harbor to accommodate the increase in the number of ships and ship movements from the proposed relocation of Marines from Okinawa to Guam are also assessed and presented in the Environmental Consequences section (Section 14.2) of this chapter. This chapter covers marine transportation. See Volume 6 Chapter 4 for a discussion of on base and off base roadways and related ground transportation impacts.

14.1.2 North

No marine transportation occurs in the North area.

14.1.3 Central

14.1.3.1 Andersen South

No marine transportation occurs at this location.

14.1.3.2 Barrigada

No marine transportation occurs at this location.

14.1.3.3 Non-DoD Land

No marine transportation occurs at this location.

14.1.4 Apra Harbor

Apra Harbor is located on the western side of Guam. It is a natural harbor protected by Orote Peninsula on the south and Cabras Island and the Glass Breakwater on the north. The Glass Breakwater provides wind and wave protection from the Philippine Sea. The average height of the breakwater is approximately 15 feet (ft) (4.6 meters [m]) above mean sea level (MSL).

Apra Harbor comprises both an outer harbor area (Outer Apra Harbor) and an inner harbor area (Inner Apra Harbor). Navy waterfront facilities are located in both the outer harbor and the inner harbor. Waterfront facilities for the U.S. Coast Guard (USCG) are located in the inner harbor, while commercial and recreational facilities are located in the outer harbor. Most of Outer Apra Harbor and the entire Inner Apra Harbor are under the jurisdiction of the Navy. Use of these waters is restricted because they are adjacent to Naval Base Guam facilities.

Inner Apra Harbor is located to the southeast of Outer Apra Harbor; it is separated from Outer Apra Harbor by the Guam Shipyard and Polaris Point. Outer Apra Harbor is the west-facing entrance way into Apra Harbor. It is 1,500-ft (457-m) wide and more than 100-ft (30.5-m) deep. Although Outer Apra Harbor has many areas where depths exceed 100 ft (30.5 m), it also contains several shoal and reef areas, primarily in the eastern portion of the harbor close to the entrance to Inner Apra Harbor. While these shallow areas pose only a limited threat to normal operations, they represent a major hazard to navigation during periods of high winds. Outer Apra Harbor extends westerly from the harbor entrance toward Drydock Point. To avoid the shoal areas, the channel into the Harbor extends southeasterly to the entrance at Inner Apra Harbor and then due south. Outer Apra Harbor contains several mooring buoys and anchorages used by both military and commercial vessels.

Inner Apra Harbor is separated from Outer Apra Harbor (located to the southeast) by the Guam Shipyard and Polaris Point. Vessels entering Inner Apra Harbor are limited to a maximum draft of 32 ft (9.8 m). The primary Inner Harbor Channel (also termed the Fairway) from Outer Apra Harbor to Inner Apra Harbor is marked at the entrance with two lighted buoys. The centerline of this channel is defined for navigation by two entrance range lights.

More details on Apra Harbor facilities, including Kilo Wharf, are presented below in Section 14.1.4.2, Naval Base Guam.

14.1.4.1 Harbor

USCG

Accoridng to *Sector Guam Relocation Feasibility Study* (Navy 2007), Sector Guam is the center of USCG activities within the Territory of Guam and the Commonwealth of Northern Mariana Islands. It is the USCG base of operations for one 225-ft (69-m) buoy tender, two 110-ft (34-m) patrol boats, and several small response boats that are berthed at Victor Wharf. All Sector Guam facilities are located within a 13-acre (ac) (5.3-hectare [ha]) compound owned by the USCG adjacent to Victor Wharf.

Sector Guam serves a variety of missions including:

- Providing maritime security
- Enforcement of the Maritime Transportation Security Act of 2002
- Maritime safety
- Protection of natural resources and fisheries
- foreign vessel inspections
- Vessel escorts
- Aids to navigation
- General defense duties in support of homeland security

Commercial Port Facilities

Guam's commercial port, Jose D. Leon Guerrero Commercial Port, is managed by the Port Authority of Guam (Port Authority of Guam 2008a). The Port Authority of Guam is a public corporation and autonomous agency of the Government of Guam (GovGuam). The main commercial port facilities are located on 74 ac (30 ha) of Cabras Island. The operation of commercial vessels in Outer Apra Harbor are regulated by the Harbor Rules and Regulations of the Port Authority of Guam (Public Law 26-172 [December 27, 2001]).

Jose D. Leon Guerrero Commercial Port consists of the following:

- Foxtrot 3 wharf is used for general cargo, passenger vessels, and fishing vessels. The wharf is 750 ft (229 m) long and has a water depth of 34 ft (10 m).
- Foxtrot 4, 5, and 6 wharfs are used for container and general cargo. The wharf complex is 1,975 ft (602 m) long with a water depth of 34 ft (10 m).
- Golf (Mobil) Pier is used by liquid bulk tankers; it is operated by Mobil Oil, Guam. The pier is 370 ft (113 m) long. The water depth is 50 ft (15 m).
- Hotel Wharf is used for passenger vessels, fishing vessels, and some general cargo. The wharf is 500 ft (152 m) long and has a water depth of 34 ft (10 m).
- Container Yard provides 26.5 ac (107 ha) for container storage.
- Gregorio D. Perez Marina, which has a capacity of 59 vessels.
- Agat Small Boat Marina, which has a capacity of 163 vessels.
- Four gantry cranes, one mobile harbor crane, four side loaders, and one reach stacker.

Guam Shipyard is a privately operated commercial ship repair yard located at the site of the former Navy Ship Repair Facility, on the west side of the entrance to Inner Apra Harbor. Guam Shipyard leases three floating dry docks from the Naval Sea Systems Command for the repair of Military Sealift Command ships and commercial vessels. The Guam Shipyard provides shore industrial support, repair, maintenance, overhaul, and dry docking services. These services are provided to ships from the Seventh Fleet, Commander Submarine Squadron 15, Military Sealift Command, USCG, local federal agencies, and commercial businesses.

Aquaworld and Harbor of Refuge are private marinas located in the inner Cabras Island area, operated under a management agreement with the Port Authority of Guam. They provide piers for recreational and commercial vessels. In recent years, the sport fishing charter boat industry has increased significantly (GDAWR 2008).

The Port Authority of Guam tracks information on vessels and their cargo. Total vessel visits are known for the years 1995 through 2008 (Table 14.1-1). Vessel tallies are presented for the following categories: Container Ship, Breakbulk/Roll on-Roll off (RoRo)/Bulk, Barges, Fishing, and Total. Breakbulk is cargo which is packed in cases, bales, cartons, drums, or carboys. RoRo is roll-on roll-off (e.g. automobiles), and bulk is general cargo. The overall number of vessels calling on the Port of Guam steadily and substantially decreased between 1995 (2,924 vessels) and 2008 (1,022 vessels); a decrease between those years of about 65 percent (1,902 vessels). However, the number of container ships and the number of containers handled by the Port of Guam has remained relatively constant during the period of 1995 through 2006. The average number of container ships was 119; the average number of containers handled was 84,356. For the years 2007 and 2008, there was a substantial increase in the number of container ships to 153 (2007) and 165 (2008). The number of containers handled also increased substantially in 2007 (99,630) and 2008 (99,908).

Table 14.1-1. Port of Guam Vessel Visits 1995 through 2008

Year	*Container Ship*	*Breakbulk/ RoRo/Bulk*	*Barges*	*Fishing*	*Total*
1995	117	477	169	2,161	2,924
1996	124	296	138	2,351	2,909
1997	130	212	167	2,205	2,752
1998	151	365	106	2,107	2,765
1999	146	296	155	1,942	2,569
2000	114	418	112	1,906	2,529
2001	111	422	111	1,960	2,697

Year	*Container Ship*	*Breakbulk/ RoRo/Bulk*	*Barges*	*Fishing*	*Total*
2002	105	412	102	1,481	2,139
2003	103	433	94	1,332	1,983
2004	109	377	97	1,044	1,648
2005	103	305	60	800	1,327
2006	109	316	17	771	1,289
2007	153	165	21	651	1,113
2008	165	171	17	586	1,022

Source: Port Authority of Guam 2008a and 2008b

Shipping

Vessel traffic in U.S. ports and harbors is governed by a system of traffic separation schemes. Traffic separation schemes are internationally recognized routing designations created by the USCG that separate opposing flows of vessel traffic into lanes (fairways), including a zone between lanes where traffic is to be avoided (33 Code of Federal Regulations [CFR] 166). Safety fairways are lanes or corridors in which no artificial island or fixed structure, whether temporary or permanent, is permitted (33 CFR 167). These fairways, which are also delineated by a series of geographic coordinates, provide unobstructed approaches for vessels using U.S. ports. Vessels are not required to use the fairways, but failure to use one, if available, would be a major factor for determining liability in the event of a collision with another ship or an underwater structure.

Shipping lanes (fairways) in the vicinity of Guam are shown on Figure 14.1-1. In the western Pacific Ocean, commercially navigable waterways link Guam and the Commonwealth of the Northern Mariana Islands (CNMI) with major ports in both the east and west. The waterways running east and northeast serve ship traffic going to and from Hawaii and the mainland U.S., while the waterway running west connects Guam and the CNMI with ports in Asia. Commercial ships travel weekly from the mainland U.S. or Hawaii to Micronesia making their first stop in Guam with later stops at the neighboring islands of Saipan, Tinian, Rota, Yap, Chuuk, Pohnpei, Kosrae, Kwajalein, Majuro, and Ebeye (Matson 2008).

Inter-island shipping is conducted from Guam by three companies:

- Seabridge, Inc. operates weekly shipping services between Guam and the CNMI (www.seabridgeinc.com).
- Maersk Inc. provides weekly shipping between Hawaii, Guam, and China (www.maerskline.com).
- SWIRE Shipping provides service between Guam and Australia and New Zealand once every 35 days (www.swireshipping.com).

14.1.4.2 Naval Base Guam

Apra Harbor can accommodate the largest of Navy ships, including aircraft carriers. Guam Shipyard provides repair and maintenance facilities for these ships. The primary facility located in Outer Apra Harbor is Kilo Wharf, a munitions wharf. It is located on the south side of Outer Apra Harbor approximately 3,600 ft (1,100 m) east of the outer harbor entrance. This wharf is 400 ft (122 m) long. As a result of dredging, depths alongside Kilo Wharf are 45 to 50 ft (13.7 to 15.2 m). Kilo Wharf is the only deep water port in the western Pacific where a loaded munitions ship can berth at a pier to obtain repair and maintenance services. Apra Harbor currently supports an average of two Carrier Strike Group port visits per year for an average of up to 7 days per year, though actual port visits and duration are subject to change based upon Fleet operational requirements. Nuclear powered aircraft carriers berth at Kilo Wharf

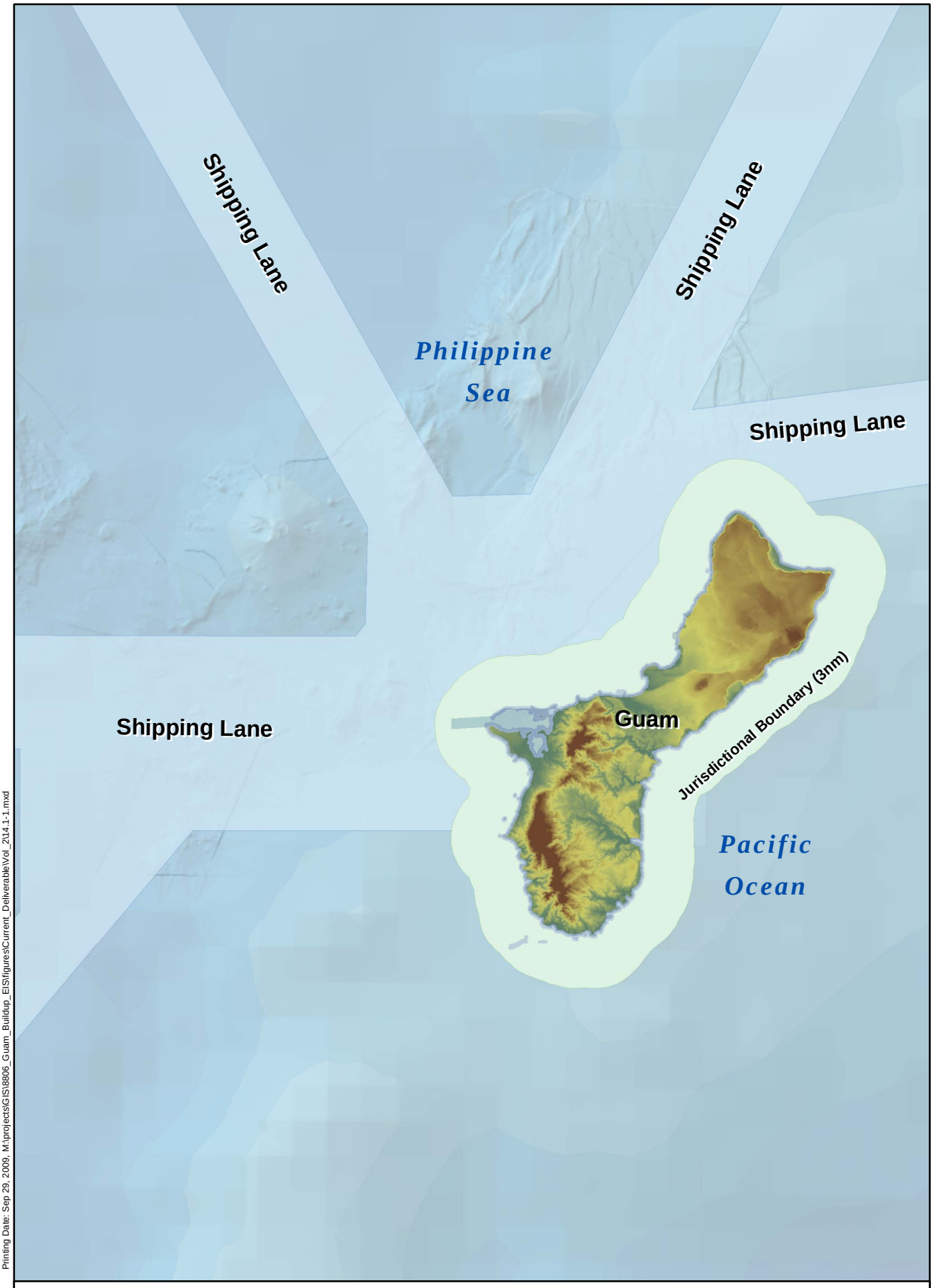

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Figure 14.1-1
Guam Shipping Lanes

because it is the only wharf that meets their draft requirements. Kilo Wharf currently lacks full "hotel" utilities necessary to support the ship (Global Security 2008 and GEDCA 2008).

The existing facilities located in Inner Apra Harbor include the following:

- Alpha and Bravo Wharves are located at the site of the former Navy Ship Repair Facility on the west side of the entrance to Inner Apra Harbor. These wharves are used for submarine berthing.
- Romeo and Sierra Wharves provide berthing services to Navy ships. Sierra Wharf was extensively damaged in an earthquake so only the southwest half of the wharf is now usable. The water depth at these wharves is 35 ft (11 m).
- Tango Wharf is 35 ft (11 m) deep; however, the wharf has been damaged and is currently not used.
- Uniform Wharf, which was damaged in an earthquake and is still unusable.
- Victor Wharf, which is used as the primary wharf for visiting combatant ships, Military Sealift Command, foreign navy vessels, and the USCG. The wharf provides about 700 linear ft (213 m) of berthing space.

A summary of the number of Navy ships recently visiting Apra Harbor was prepared by the Navy in May 2008 (Navy 2008). Information was provided on ship movements: a ship transit into and back out of the harbor is counted as two movements and as one visit. In 2007, 100 ships visited Outer Apra Harbor. From January through May 2008, 50 ships visited Outer Apra Harbor. For Inner Apra Harbor, 220 ships visited in 2007, and 115 ships visited during the first 5 months of 2008.

14.1.5 South

14.1.5.1 Naval Munitions Site

No marine transportation occurs at this location.

14.1.5.2 Non-DoD Land

No marine transportation occurs at this location.

14.2 ENVIRONMENTAL CONSEQUENCES

14.2.1 Approach to Analysis

The primary concern regarding marine transportation is the impact of the proposed action and alternatives on the military, commercial, and recreational navigational usage in Apra Harbor. It is critical that navigational access to the channels be maintained for these users. The consequences of the alternatives for the proposed action and the no-action alternative have been evaluated based upon the magnitude and duration of impacts to navigation. For activities that would have an adverse impact on navigation, appropriate mitigation measures would be required. Although organized by the Main Cantonment alternatives, a full analysis of Waterfront actions is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. See Volume 6 Chapter 4 for a discussion of on base and off base roadways.

14.2.1.1 Methodology

Apra Harbor is the only DoD harbor that could accommodate the ships required for the relocation of the Marines to Guam; no other alternatives were feasible.

To determine the impacts of the proposed action on marine transportation, the anticipated annual number of vessels that would visit Apra Harbor is compared to the annual number of vessels that have visited Apra Harbor since 1995. Based upon the maximum number of vessels that visited the harbor during the period of 1995 through 2008, a comparison is made with the anticipated maximum number of vessels that would visit the harbor during the period of 2008 through 2018 (the embarkation period).

14.2.1.2 Determination of Significance

If the maximum annual number of vessels that would visit the harbor during the embarkation period exceeds the annual maximum since 1995, then a significant impact to marine transportation may occur. If the maximum annual number of vessels that would visit the harbor during the embarkation period is equal to or less than the annual maximum number of vessels since 1995, then there would be a less than significant impact to marine transportation.

14.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, the concerns relating to navigation that were identified by the public, including regulatory stakeholders, during scoping meetings were reviewed. These concerns related to potential access restrictions to areas in Outer Apra Harbor as a result of increased military vessel traffic.

14.2.2 Alternative 1

14.2.2.1 North

Andersen AFB

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Finegayan

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Non-DoD Land

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

14.2.2.2 Central

Andersen South

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Barrigada

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Non-DoD Land

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

14.2.2.3 Apra Harbor

14.2.2.4 Harbor

Construction

To facilitate the berthing of the escort combatant ships, it would be necessary to dredge Sierra Wharf to remove about 508,900 cubic yards (CY) (386,000 m^3) of sediment. It has not been determined whether the dredged material would be disposed in the proposed ocean dredged material disposal site offshore of Guam, or one or more upland placement sites with or without possible beneficial re-use on Navy land on Guam or a combination of all disposal options. If the dredged material is disposed at the ocean disposal site, there would be an increase in the use of the Apra Harbor navigation channels by the vessels transporting the dredged material. It is anticipated that, due to the hard substrate to be dredged, that about 2,000 CY of dredged material would be dredged each day over a period of about 6 to 9 months. One tug would tow a 4,000 CY (3,053 cubic meters [m^3]) scow filled with dredged material to the ocean disposal site and then return to the dredging site. The vessel carrying the dredged material from Apra Harbor would travel along existing shipping lanes and be subject to USCG rules and regulations. A total of about 127 trips would be needed to the ocean disposal site to transport the dredged material from Sierra Wharf. In consideration of the number of vessels that visit the Port of Guam each year (1,022 vessels in the year 2008), the addition of 127 vessel trips by the tug and scow would total 1,149 vessel visits to the Port of Guam during that year (a 12% increase). This number of vessels is much less than the number that visited the Port of Guam in 1995 (2,924 vessels). It is expected that the addition of about 127 vessel trips to transport the dredged material over the period of 6 to 9 months would result in less than a significant impact on marine transportation in Apra Harbor.

Operation

The relocation of Marine Corps forces to Guam would result in frequent embarkation operations. The Navy's amphibious task forces and the Marine Expeditionary Units (MEU) are transient forces that have traditionally come to Guam for port visits and training. These transient port calls do not represent a new mission but an increase in frequency with the proposed relocation.

Typically, there would be three ships carrying amphibious vessels, and sometimes an additional four combatant ships as escort. The amphibious ships would deploy amphibious craft (Landing Craft Air Cushion, Landing Craft Utility, Amphibious Assault Vehicle, or small reconnaissance boats) in either the Outer or Inner Apra Harbor; the craft would then travel to an amphibious laydown area. The duration of each amphibious task force visit would range between 6 and 21 days. No amphibious beach training is planned within Inner Apra Harbor. The MEU training would occur at a minimum of two times per year for three weeks duration each visit on Guam. In consideration of the substantial reduction in the number of annual visits by vessels to the Port of Guam since 1995 (as described above), it is expected that the number of visits of amphibious vessels and combatant ships would result in less than a significant impact on marine transportation in Apra Harbor.

The projected number of containers to be handled in the Port of Guam during the years 2008 through 2018 is presented in Table 14.2-1. The average number of containers to be handled per year during this period is 153,636 with the highest projected total in 2015 (190,000). After 2018, the annual number of military containers is projected to remain at 38,000 until at least 2027 (Port Authority of Guam 2008c).

Table 14.2-1. Port of Guam Total Containers to be Handled 2008 through 2018

Year	*Commercial**	*Military*	*Total*
2008	85,000	19,000	104,000
2009	87,000	21,000	108,000
2010	90,000	39,000	129,000
2011	91,000	58,000	149,000
2012	94,000	78,000	172,000
2013	97,000	81,000	178,000
2014	97,000	85,000	182,000
2015	101,000	89,000	190,000
2016	104,000	76,000	180,000
2017	106,000	46,000	152,000
2018	108,000	38,000	146,000

Notes: * Includes trans-shipment and local/tourist volumes.
Source: Port Authority of Guam 2008c.

The projected average number of containers to be handled each year during the period of 2008 through 2018 is about twice the average number of containers handled during the period of 1995 through 2008 (86,558). The average number of container ships that visited the Port of Guam each year over the period of 1995 through 2008 is 124. However, it is not expected that there would be twice as many visits by container ships to the Port of Guam during the embarkation period because the capacity of container ships has been increasing (Global Security 2009). The maximum number of containers to be handled during the period of 2008 through 2018 is 190,000 (in the year 2015). If the number of containers per ship remains the same as during the period of 1995 through 2008 (average of 706 containers per ship), there would be approximately 269 container ships visiting the Port of Guam during 2015.

As indicated in Table 14.1-1, the total number of commercial (non-fishing) vessels visiting the port of Guam has decreased substantially from 1995 (763 vessels) to 2008 (436 vessels). Assuming a channel

occupancy time of one hour for passage of a vessel into and out of the harbor, channel occupancy has declined from 17% to 9.7%. Even after allowing for military vessels (including priority vessels such as aircraft carriers) and weather interruptions, the harbor's navigation channels appear to have a substantial capacity for additional vessels. Because the annual number of vessels visiting the Port of Guam has decreased by 1,902 vessels over the period of 1995 to 2008, it is expected that the addition of 149 container vessels above the average visiting the Port of Guam over a one year period would result in less than a significant impact on marine transportation in Apra Harbor.

Naval Base Guam

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

14.2.2.5 South

Naval Munitions Site

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Non-DoD Land

Construction

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

Operation

No impacts on marine transportation resulting from the proposed action and alternatives are expected.

14.2.2.6 Summary of Impacts

There would be additional vessels visiting Apra Harbor as a result of the proposed relocation of Marines from Okinawa to Guam. Additional container ships would be required to transport the equipment and supplies necessary to support the relocation. There would be about 145 container ships required in 2015 (the peak year of container shipments) above the annual average of 124 container ships. In addition, there would be about 127 trips over a period of 6 to 9 months by a tug and scow to dispose of dredged material from Sierra Wharf. Because there has been a steady and substantial decline in the number of commercial vessels visiting the Port of Guam from 1995 through 2008 (2,924 to 1,022 vessels), the addition of up to 272 vessels is still be well below the total number of vessels visiting the Port of Guam in 1995. These additional vessel trips would result in less than a significant impact on marine navigation in Apra Harbor.

14.2.2.7 Potential Mitigation Measures

No mitigation measures are needed.

14.2.3 Alternative 2 (Preferred Alternative)

14.2.3.1 North

Andersen AFB

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Finegayan

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

14.2.3.2 Central

Andersen South

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Barrigada

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

14.2.3.3 Apra Harbor

Harbor

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Naval Base Guam

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

14.2.3.4 South

Naval Munitions Site

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 2 are the same as Alternative 1.

Operation

The impacts for Alternative 2 are the same as Alternative 1.

14.2.3.5 Summary of Impacts

The impacts for Alternative 2 are the same as Alternative 1. The additional vessel trips due to construction, dredging, and operations would result in less than a significant impact on marine navigation in Apra Harbor.

14.2.3.6 Potential Mitigation Measures

No mitigation measures are required.

14.2.4 Alternative 3

14.2.4.1 North

Andersen AFB

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Finegayan

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

14.2.4.2 Central

Andersen South

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Barrigada

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

14.2.4.3 Apra Harbor

Harbor

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Naval Base Guam

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

14.2.4.4 South

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 3 are the same as Alternative 1.

Operation

The impacts for Alternative 3 are the same as Alternative 1.

14.2.4.5 Summary of Impacts

The impacts for Alternative 3 are the same as Alternative 1. The additional vessel trips due to construction, dredging, and operations would result in less than a significant impact on marine navigation in Apra Harbor.

14.2.4.6 Potential Mitigation Measures

No mitigation measures are required.

14.2.5 Alternative 8

14.2.5.1 North

Andersen AFB

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Finegayan

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

14.2.5.2 Central

Andersen South

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Barrigada

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

14.2.5.3 Apra Harbor

Harbor

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Naval Base Guam

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

14.2.5.4 South

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

Non-DoD Land

Construction

The impacts for Alternative 8 are the same as Alternative 1.

Operation

The impacts for Alternative 8 are the same as Alternative 1.

14.2.5.5 Summary of Impacts

The impacts for Alternative 8 are the same as Alternative 1. The additional vessel trips due to construction, dredging, and operations would result in less than a significant impact on marine navigation in Apra Harbor.

14.2.5.6 Potential Mitigation Measures

No mitigation measures are required.

14.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative

would maintain existing conditions, and result in no impacts. The number of military vessels visiting Guam would not change from current conditions. The number of non-military vessels visiting the Port of Guam would continue to decline or remain at about the current level. There would be no dredging of Sierra Wharf to accommodate the escort ships. Therefore, the no-action alternative would result in no impact on marine transportation. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

14.2.7 Summary of Impacts

Table 14.2-2, 14.2-3, and 14.2-4, and 14.2-5 summarize the potential impacts of each action alternative (Alternatives 1, 2, 3, and 8) associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 14.2-6 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 14.2-2. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternatives 1, 2, 3, and 8
Construction
NI • No impacts on marine transportation are expected.
Operation
NI • No impacts on marine transportation are expected.

Legend: NI = No impact.

Table 14.2-3. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternatives A and B
Construction
NI • No impacts on marine transportation are expected.
Operation
NI • No impacts on marine transportation are expected.

Legend: NI = No impact.

Table 14.2-4 Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternatives A and B
Construction
NI • No impacts on marine transportation are expected.
Operation
NI • No impacts on marine transportation are expected.

Legend: NI = No impact.

Table 14.2-5 Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternatives A and B
Construction
NI • No impacts on marine transportation are expected.
Operation
NI • No impacts on marine transportation are expected.

Legend: NI = No impact.

Table 14.2-6. Airfield and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • No impacts on marine transportation are expected.	NI • No impacts on marine transportation are expected.	LSI • Adequate capacity to accommodate increased vessel traffic would result in less than significant impacts on marine transportation at Apra Harbor
Operation		
NI • No impacts on marine transportation are expected.	NI • No impacts on marine transportation are expected.	LSI • Adequate capacity to accommodate increased vessel traffic would result in less than significant impacts on marine transportation at Apra Harbor

Legend: LSI = Less than significant impact, NI = No impact.

The primary military, commercial, and recreational port facilities on Guam are located in Apra Harbor. It is critical that navigational access to the channels be maintained for these users. The number of vessels visiting the harbor has decreased steadily and substantially between the period of 1995 to 2008. The proposed relocation of the Marines would result in an increase in the number of vessels using Apra Harbor primarily during the period of 2010 through 2017. It is expected that the increased vessel traffic could be accommodated by the navigation channels in the harbor since the annual number of vessels visiting the harbor during even the peak year of container shipments would be less than the number of vessels visiting the harbor in 1995. Therefore, the proposed relocation of the Marines would result in less than significant impacts on marine transportation in Apra Harbor.

14.2.8 Summary of Potential Mitigation Measures

No significant impacts on marine transportation would result from the proposed action and alternatives. No mitigation measures are required.

CHAPTER 15. UTILITIES

For a complete look at utilities, please see Volume 6.

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CHAPTER 16. SOCIOECONOMICS AND GENERAL SERVICES

Because of the relatively small size of the island of Guam, most of the anticipated socioeconomic impacts of the proposed action are expected to affect the island as a whole. Therefore, many of the sections in this chapter are not divided by geographical area, as on other chapters of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS). Instead, this chapter begins with an Affected Environment section that provides a current and historical perspective on the socioeconomic status of the island of Guam, including Population Characteristics, Economic Characteristics, Public Services, and Sociocultural Issues. This affected environment section provides the baseline context for the analysis of the relocation of Marines to Guam and other proposed and connected actions, including off base roadways. A socioeconomic impact analysis is then provided with respect to four major components of Environmental Consequences: Population Impacts, Economic Impacts, Public Services, and Sociocultural Impacts. This chapter then concludes with a Summary of Impacts and a Summary of Potential Mitigation Measures.

As part of the analysis, this chapter summarizes a detailed socioeconomic analysis performed in 2008-2009 and documented in a Socioeconomic Impact Analysis Study (SIAS) that is provided in its entirety in Appendix F. This impact analysis was prepared with the best currently available information on relevant topics such as construction conditions, military personnel numbers, and relocation schedules. However, ongoing federal legislative, planning, and scheduling decisions could result in changes to various input assumptions and thus also to the projected impacts.

16.1 AFFECTED ENVIRONMENT

16.1.1 Definition of Resource

Socioeconomics is defined as the basic attributes and resources associated with the human environment. Socioeconomic "resources" include population size and demographics; employment and income; economic activity (including interaction of economic sectors with the military); government-funded health and human services; and social cohesion (including, but not limited to, Chamorro issues and military-civilian relations).

Because of the diversity of these topics, other resource chapters in Volume 2 of this EIS/OEIS discuss related concerns for the proposed relocation of Marines to Guam. When appropriate, the reader will be referred to such chapters for further information and discussion.

16.1.2 Historical and Economic Overview

The discussion in this section is limited to the time period following World War Two (WWII). However, it should be noted that Guam's socioeconomic history was heavily influenced by 400 years of Spanish rule, historic American occupation, the battles of WWII, and the Japanese occupation. Since WWII, Guam's economic history has been volatile, led by changes in population and global events in the military, social, and natural spheres. This section chronologically presents the most important changes.

Post-war reconstruction and the formation of new United States (U.S.) military bases were the basis for Guam's first major economic expansion and the initial placement of contemporary infrastructure. During this period of reconstruction, Guam's population experienced substantial increase – from a pre-war 1940

level of 22,900 (with a military and dependent population of 1,427) to 59,498 (with a military and dependent population of 26,617) in 1950 (U.S. Census Bureau 2008a).

The 1950s brought with it a shift in military governance, presence, and focus on Guam. Two important events took place in 1950: Congress enacted the Organic Act of 1950 and the major hostilities of the Korean War began. The Organic Act re-designated the island of Guam as an unincorporated territory of the U.S., passing its control from the U.S. Navy to the Department of the Interior (DoI) and granting a greater measure of self-governance to the people of Guam. The destruction caused by Typhoon Alice in 1954 required that the U.S. military shift its focus on Guam from base construction to the island's public works. Although the ongoing Korean War and the Cold War with the Soviet Union required a continued military presence on Guam, the island's military population experienced an overall decline of 15% between 1950 and 1960 (Table 16.1-1).

Table 16.1-1. Combined Military and their Dependents Population on Guam, Selected Years

1950	*1960*	*1970*	*1980*	*1987*	*1990*
26,617	23,300	19,777	20,000	23,790	19,610
1993	*1994*	*1997*	*2000*	*2003*	*2007*
22,077	15,865	13,002	11,624	11,832	14,110

Source: U.S. Census Bureau 2008a

In the 1960s, Super Typhoon Karen brought considerable damage to Guam, destroying temporary and permanent structures, and leaving many residents homeless in its wake. The lifting of visitor security clearance requirements, combined with the initiation of Pan American Airway services from Japan to Guam in 1967, sparked opportunities for direct growth of Guam's tourist industry. This growth also led to indirect growth in related industries such as construction, recreational fishing and diving, commercial fishing and retail trade.

Guam's economy stagnated in the 1970s and early 1980s, partially in response to the 1973 Organization of the Petroleum Exporting Countries (OPEC) oil embargo. Construction activity and visitor arrivals declined over the decade. Poor economic conditions continued into the 1980s. However, the economic trend stabilized from 1982 to 1984 and improved between 1985 and the end of the decade. In the latter part of the 1980s, Cold War military spending and the closing of U.S. bases in the Philippines increased Guam's military population (including dependents) to a level not seen since the 1960s (23,800 in 1987), thereby adding to its economic base.

The late 1980s brought fluctuation and an eventual decrease to military population levels on Guam that lasted through the 1990s. Troops temporarily transplanted from closed Philippine bases were relocated at the end of the 1980s resulting in a new post-war military population low of 19,600 in 1990. The Base Realignment and Closure (BRAC) process led to the closure of Naval Air Station Hagatna (also referred to as Naval Air Station Agana) causing the military population on Guam to fall from 22,077 in 1993 to 15,865 in 1994. By 2000 Guam's military and dependent population was 11,624.

Guam's Asia-oriented visitor base expanded and peaked between 1995 and 1997, generating substantial increases in the construction of hotels and condominiums. However, the 1997 collapse of Asian financial markets, compounded by the crash of a Korean Air Lines plane full of visitors, led to a 12.4% decline on Guam's primary Japanese market and an 83% decline in its secondary Korean market from 1997 to 1998 (Guam Bureau of Statistics and Plans 2006). While visitor numbers have increased since that low mark, the peak levels experienced in the mid-1990s have yet to be recaptured.

From 2000 through 2008, Guam's economy has continued to mirror its volatile recent past. In 2000, the visitor industry appeared poised to regain health. This was stymied however by the attacks of September 11 in 2001, the costly Super Typhoon Pongsona in 2002, and the pandemic of severe acute respiratory syndrome in 2003. From 2001 to 2003, Guam's economy contracted: unadjusted for inflation, total payroll declined by 2%, employment declined by 4%, and individual salaries increased by only 1%. From 2004 to 2006, partially in response to the announcement of the proposed action, Guam's economy has once again showed signs of expansion. Using 2005 data, a study for the Guam Visitors Bureau (GVB) (GVB 2007) found that tourism was the island's second largest private industry (following Finance, Insurance, and Real Estate) and both the primary Japanese and second Korean market were growing at that time.

As of the end of 2008, Guam's real estate market has shown signs of slowing. Commercial real estate on Guam has declined in value due to worldwide issues of tight credit and declines in consumer discretionary spending. Reports show that Guam real estate sales and construction activity have dropped from 2007 levels due to the global economic decline coupled with a moratorium on development in the Tumon Bay area, that at the time of writing continues to be under debate (Captain 2008b). By the end of 2008, international economic conditions plus other market and demographic factors produced declining year-over-year trends for a variety of key tourism indicators, including total arrivals, hotel occupancy rates and taxes, and hotel room-nights sold (GVB 2008, Guam Hotel and Restaurant Association 2008).

16.1.3 Population Characteristics

16.1.3.1 Overall Trends

As of the most recent full U.S. Census of 2000, Guam's population was 154,805. In 2008, the U.S. Census Bureau provided a more recent estimate of Guam's population of 175,877 (U.S. Census Bureau 2008a). The island's population has grown substantially since becoming a U.S. Territory. From 1950 to 2000 Guam's population grew at an average rate of 21% per decade (about 2.1% annually). However, as is shown in Table 16.1-2, the Census Bureau projects (without the proposed action) that this growth will taper off, possibly due to out-migration rates observed around 2002, when the estimates in this table were made.

Table 16.1-2. Annual Rate of Increase on Guam's Population

	1950-1960	*1960-1970*	*1970-1980*	*1980-1990*	*1990-2000*	*2000-2008*	*2010-2020**	*2020-2030**
Annual Population Increase	1.2%	2.4%	2.2%	2.3%	1.5%	1.6%	1.2%	0.9%

* Estimated.

Source: U.S. Census Bureau 2008a

16.1.3.2 Demographics

Table 16.1-3 shows Guam's population growth and changing ethnic mix from 1920 to 2000. Between 1990 and 2000, the percentage representation of Chamorro and Caucasian ethnicities on Guam's population declined, while Filipino and "Other" ethnicities (most often composed of other Asian or Pacific Islander ethnicities) increased. Some changes in ethnic percentages reflect differences in Census definitions over time. However, the dramatic changes in the Chamorro and Caucasian percentages from 1940 to 1950 are a product of WWII, when the U.S. military buildup resulted in population increases of other ethnicities on Guam.

Table 16.1-3. Guam-Wide Total Population and Ethnicity, 1920-2000

	1920	*1930*	*1940*	*1950*	*1960*	*1970*	*1980*	*1990*	*2000*
Total Population	13,275	18,509	22,290	59,498	67,044	84,996	105,979	133,152	154,805
Ethnicity									
Chamorro/Part-Chamorro	92%	89%	91%	46%	52%	N/A	45%	43%	42%
Caucasian	2%	7%	4%	39%	31%	N/A	8%	14%	7%
Filipino	3%	2%	3%	12%	13%	N/A	21%	23%	26%
Other	3%	3%	3%	4%	4%	N/A	26%	20%	25%

Source: U.S. Census Bureau 2000a

Table 16.1-4 provides demographic information for Guam and the island's individual villages for the year 2000. The three largest village populations are in the northern villages of Dededo and Yigo and the centrally-located village of Tamuning.

Table 16.1-4. Demographic Characteristics 2000, Guam Total and Individual Villages

		Population/Gender			Ethnicity					Median Age	Place of Birth				Education (25 yr. and over pop)	
		Total	Male	Female	Chamorro/ Pt Chamorro	Filipino	Caucasian	Other Pacific Islander	Other		Guam	Other U.S.	Philipines	Other Pacific Islands	High School	College Degree
Guam Totals		154,805	79,181	75,624	42%	26%	7%	8%	17%	27.1	52%	12%	21%	7%	52%	25%
North	Dededo	42,980	21,645	21,335	30%	45%	3%	8%	13%	27	46%	7%	35%	7%	50%	23%
North	Yigo	19,474	9,999	9,475	27%	31%	15%	8%	19%	25	40%	23%	25%	7%	53%	26%
Central	Tamuning	18,012	9,420	8,592	18%	26%	8%	10%	37%	32	31%	11%	22%	9%	49%	31%
Central	Barrigada	8,652	4,320	4,332	56%	19%	5%	7%	13%	28.3	62%	9%	15%	7%	53%	25%
Central	Mangilao	13,313	6,958	6,355	47%	22%	4%	11%	16%	27.4	55%	8%	18%	10%	50%	23%
Central	Mongmong-Toto-Maite	5,845	2,895	2,950	53%	16%	4%	13%	15%	27.1	60%	8%	13%	11%	54%	22%
Central	Hagåtña	1,100	672	428	49%	16%	4%	17%	14%	31.8	52%	8%	14%	15%	51%	21%
Central	Sinajana	2,853	1,433	1,420	73%	7%	4%	6%	9%	28.7	73%	10%	6%	6%	55%	23%
Central	Agana Heights	3,940	1,946	1,994	68%	10%	6%	7%	8%	28.1	68%	13%	9%	6%	53%	28%
Central	Chalan Pago-Ordot	5,923	3,011	2,912	53%	11%	5%	6%	26%	27.3	66%	10%	11%	7%	55%	22%
Central	Asan	2,090	1,078	1,012	71%	8%	8%	5%	8%	28.9	70%	15%	6%	5%	56%	24%
Central	Piti	1,666	882	784	60%	7%	16%	3%	14%	30.3	60%	22%	7%	4%	50%	31%
South	Yona	6,484	3,242	3,242	70%	5%	6%	4%	15%	24.3	76%	12%	4%	4%	53%	25%
South	Agat	5,656	2,910	2,746	67%	23%	3%	3%	4%	25.3	70%	7%	18%	3%	52%	19%
South	Santa Rita	7,500	4,028	3,472	31%	20%	24%	1%	24%	26.3	38%	38%	17%	1%	58%	30%
South	Talofofo	3,215	1,641	1,574	79%	3%	7%	5%	6%	24.8	78%	12%	2%	5%	55%	22%
South	Umatac	887	465	422	95%	1%	1%	1%	2%	21.9	91%	6%	1%	1%	66%	6%
South	Inarajan	3,052	1,546	1,506	86%	2%	2%	2%	8%	23.5	86%	7%	2%	3%	57%	11%
South	Merizo	2,163	1,090	1,073	89%	1%	3%	2%	5%	23.3	86%	9%	2%	2%	62%	11%

Source: U.S. Census Bureau 2000a

<u>North</u>

As of 2000, 40% of Guam's population resided in the Northern region. That percentage has likely increased since that time as Dededo and Yigo have been growing quickly over the past 10 years.

The region was 50.06% male, 49.94% female compared to the overall Guam population (51.15% male, 48.84% female). Ethnically, the Northern region was less Chamorro than the rest of Guam; Dededo was far more Filipino than the rest of Guam (45% vs. 26%) and Yigo was more heavily populated with Caucasians than the Guam average (15% vs. 7%).

The median age of the population in the Northern region was similar to that of Guam's overall population; Dededo's median age was 27 years old and Yigo's was 25 years old compared to Guam's overall median age of 27.1 years old.

A lower percentage of people in the Northern region was born on Guam compared to the rest of the Island; similar to the ethnicity of the areas, a proportionally large percentage of Dededo's population was born in the Philippines (35%) and a proportionally large percentage of Yigo's population was born in other areas of the United States.

In terms of education level, the 2000 Northern region was very similar to the rest of Guam. Dededo has slightly lower percentages of people who have completed high school or college while Yigo had slightly higher percentages than Guam overall.

Central

As of 2000, 41% of Guam's population resided in the Central region. The most populous villages in the region were Tamuning (18,012) and Mangilao (13,313). Piti and Hagatna were the least populous (1,666 and 1,100, respectively). The Central region was 51.44% male, 48.56% female compared to Guam's overall population (51.15% male, 48.84% female).

Ethnically, the Central region was slightly more Chamorro than the rest of Guam (45% vs. 42%) with the largest Chamorro populations residing in Mangilao and Barrigada. On a percentage basis, Sinajana and Asan were the most heavily Chamorro. Tamuning had the largest Filipino population in 2000; however, the central region is less Filipino than Guam overall (19% vs. 26%).

The Central region tended to be older than Guam overall; the median age in the region was 29.4 years old compared to the overall median age of 27.1 years old. Tamuning had the oldest population on Guam with a median age of 32 years old.

A total of 57% of Central region residents were born on Guam, which is greater than Guam's overall rate of 52%. Mangilao had the highest number of residents who were born on Guam.

In terms of education, the Central region was similar to the rest of Guam. For residents over the age of 25, both had rates of 52% who had completed high school and 25% who had completed college.

South

As of 2000, about 19% of Guam's population resided in the Southern region. The most populous villages in the region were Santa Rita (7,500) and Yona (6,484). Umatac was the least populous (887).

The Southern region was 51.53% male, 48.46% female compared to Guam's overall population (51.15% male, 48.84% female). The Southern region was 64% Chamorro in 2000, by far the most heavily Chamorro of the three regions. Umatac, Merizo and Inarajan were each over 85% Chamorro. Agat and Santa Rita were each over 20% Filipino and Santa Rita had the highest percentage of Caucasians in all of Guam.

The Southern region tended to be younger than Guam overall; the median age in the region was 25.3 years old compared to the Guam overall median age of 27.1 years old. Umatac had the youngest population on Guam with a median age of only 21.9 years old.

A total of 76% of Southern region residents were born on Guam that was greater than Guam overall (52%). In Umatac, Merizo, and Inarajan, over 85% of residents were born on Guam.

In terms of education, the Southern region had a higher percentage of high school graduates when compared to the rest of Guam (57% vs. 52%), but a lower percentage of college graduates (22.8% vs. 25%).

16.1.3.3 Household Characteristics

Table 16.1-5 provides demographic information for Guam and the island's individual villages for the year 2000.

Table 16.1-5. Household Characteristics 2000, Guam Total and Individual Villages

		Population in HHs	Number of HHs	Avg HH Size	% of HHs that are Family HHs	% of HHs that are Married	% of HHs that are Families	Median HH Income	Income per HH member	% HHs below poverty line
Guam Totals		150,928	38,769	3.89	83%	59%	36%	$39,317	$10,107	22%
North	Dededo	42,635	10,016	4.26	89%	63%	39%	$37,654	$8,839	23%
North	Yigo	18,947	4,634	4.09	91%	70%	48%	$37,415	$9,148	19%
Central	Tamuning	17,619	5,953	2.96	68%	48%	27%	$35,347	$11,942	24%
Central	Barrigada	8,481	2,097	4.04	87%	61%	36%	$49,974	$12,370	16%
Central	Mangilao	12,474	3,190	3.91	83%	55%	34%	$39,754	$10,167	26%
Central	Mongmong-Toto-Maite	5,833	1,633	3.57	76%	47%	28%	$31,134	$8,721	31%
Central	Hagåtña	822	268	3.07	69%	43%	22%	$31,136	$10,142	27%
Central	Sinajana	2,850	742	3.84	82%	50%	25%	$48,750	$12,695	20%
Central	Agana	3,862	1,058	3.65	81%	51%	29%	$47,396	$12,985	14%
Central	Chalan Pago-Ordot	5,846	1,573	3.72	79%	50%	30%	$36,506	$9,813	30%
Central	Asan	2,089	552	3.78	84%	52%	30%	$48,611	$12,860	19%
Central	Piti	1,613	474	3.4	77%	53%	31%	$54,167	$15,931	13%
South	Yona	6,434	1,486	4.33	89%	61%	38%	$52,955	$12,230	20%
South	Agat	5,633	1,298	4.34	86%	54%	32%	$37,398	$8,617	24%
South	Santa Rita	6,512	1,780	3.66	87%	73%	48%	$41,928	$11,456	9%
South	Talofofo	3,192	738	4.33	88%	59%	37%	$47,885	$11,059	22%
South	Umatac	887	162	5.48	93%	54%	35%	$34,286	$6,257	33%
South	Inarajan	3,036	644	4.71	91%	60%	38%	$42,361	$8,994	24%
South	Merizo	2,163	471	4.59	89%	57%	34%	$39,940	$8,702	23%

Source: U.S. Census Bureau 2000a; HH refers to Households.

North

As of 2000, almost 41% of Guam's population living in households resided in the Northern region; Dededo was the single largest village on Guam in terms of population in households and number of households.

Both villages in the Northern region had larger average household sizes (Dededo, 4.26 people and Yigo, 4.09 people) than Guam's overall household counts (3.89 people).

Compared to Guam overall, Dededo and Yigo had a higher percentage of family households, married family households, and family households with children.

Household incomes in Dededo ($37,654) and Yigo ($37,415) were lower than Guam overall ($39,317); also, each had lower incomes per household member. Dededo had a higher percentage of households below the poverty line than Guam overall but Yigo had a far lower percentage; the region, on average, had a similar percentage of households below the poverty line (21.5% vs. 22%).

Central

The Central region, similar to the Northern region, was occupied by about 41% of Guam's population living in households. Tamuning and Mangilao were the largest villages in the region in terms of population living in households and number of households.

The Central region had a much lower number of persons per household than Guam overall (3.51 vs. 3.89). The low number for the region was greatly influence by Tamuning that had only 2.96 persons per household – the lowest number on Guam.

The Central region had lower percentages of households that were family households, married family households, and family households with children than did Guam overall.

Households in the Central region had higher incomes than Guam overall ($39,764 vs. $39,317); the region also had a higher income per household member ($11,383 vs. $10,107). The village of Piti had the highest household income and income per household member on Guam. While the Central region had higher incomes in general, the region had a higher percentage of households below the poverty line; two of the regions villages, Mongmong-Toto-Maite and Chalan Pago-Ordot, had 30% or more households below the poverty line.

South

As of 2000, the Southern region was occupied by about 18% of Guam's population living in households. Santa Rita and Yona were the largest villages in the region in terms of population living in households and number of households.

The Southern region had more persons per household than Guam overall (4.23 vs. 3.89). Umatac had the most persons per household on Guam (5.48).

Compared to Guam overall, the Southern region had higher percentages of households that were family households, married family households, and family households with children.

Households in the Southern region had higher incomes than Guam overall ($43,905 vs. $39,317); the region also had slightly higher income per household member ($10,460 vs. $10,107). While incomes, on average, in the Southern region were higher than Guam overall, some of Guam's poorest villages were located there; Agat, Inarajan, Merizo and Umatac each had incomes that were well below the Guam overall average. Umatac had a higher percentage of households below the poverty line than any other village on Guam.

16.1.3.4 Military Demographics

Military populations can affect the composition and growth of villages on Guam (Table 16.1-6). Dededo and Yigo cover military-owned land and have high proportions of military residents relative to other villages. Between 1990 and 2000, these two villages experienced rapid population growth: Yigo's by 37% and Dededo's by 35%. The more service- and tourism-based village, Tamuning, experienced population growth of 8% during the same period. Guam's active duty military population has remained constant at about 6,200 over the past ten years, with a slight dip from 2000 through 2003.

Table 16.1-6. Active Duty Military Population on Guam, 1998-2007

	1998	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Total Active Duty	6,379	6,155	5,806	5,974	5,820	5,944	6,220	6,514	6,253	6,286
Navy	3,946	3,902	3,741	3,626	3,810	3,760	3,922	4,085	3,867	3,879
Air Force	2,119	1,964	1,752	1,981	1,670	1,828	1,950	1,844	1,596	1,596
Army	178	158	172	183	200	217	211	422	606	632
Coast Guard	134	130	136	180	136	136	134	160	180	175
Marine Corps	2	1	5	4	4	3	3	3	4	4

Sources: Guam Bureau of Statistics and Plans 2006, COMNAV Marianas 2008

The demographic characteristics of military personnel and their dependents living on Guam in 2000 are shown in Table 16.1-7. Military and military dependents on Guam were younger than Guam overall. Additionally, there were more Caucasians and fewer Pacific Islanders among the group. Military households had a lower median income than Guam overall. However, military households also had fewer persons per household to the extent that income per household member was greater than Guam overall ($10,963 vs. $10,107). It should also be noted that Military households also receive a basic allowance for housing which provides them with more disposable income. Military and military dependents had slightly higher educational attainment; 58% completed high school and an additional 36.6% obtained a college degree.

Table 16.1-7. Active Duty Military and Military Dependent Demographic Characteristics, 2000

Median Age	*Gender*		*Ethnicity*					*Median Household (HH) Income*	*Median HH Size*	*Income Per HH Member*	*Education (25 yr. and over pop)*	
	Male	*Female*	*White*	*Asian*	*Native Hawaiian/ Other Pacific Islander*	*Black or African American*	*Other*				*High School*	*College Degree*
23	52.2%	47.8%	44.6%	16.0%	11.8%	8.2%	19.4%	$33,000	3.01	$10,963	58%	36.6%

Source: U.S. Census Bureau 2000c

16.1.4 Economic Characteristics

16.1.4.1 Employment and Income

Employment by Industry

As of 2000, Guam's industrial employment composition was quite different than that of the U.S. as a whole. Guam's economy was more government- and service-oriented and less production-oriented.

Table 16.1-8 shows that GovGuam is the major employer on Guam. Furthermore, it shows that the percentage of Guam's payroll employment in the Government sector is high compared to the U.S. overall.

Table 16.1-8. Government's Share of Employment (June 2009)

Country/Territory	*Payroll Employment*	*Government Workers*	*Government Workers (% of Labor Force)*
U.S.	132,609,000	22,511,000	17%
Guam	59,340	14,430	24.3%

Sources: U.S. Bureau of Labor Statistics 2009, Guam Department of Labor 2009b

Table 16.1-9 shows the industrial employment composition of Guam's economy. Between 2000 and 2009 the number of construction jobs has increased. Over the same period, the number of jobs in the retail trade industry declined, possibly due to lower spending by Guam residents coping with decreasing price-adjusted incomes (see subsequent discussion).

Table 16.1-9. Guam Civilian Employment by Industry, 2000 and 2009

Industry	*2000 Number*	*% of 2000 Total*	*2009 Number*	*% of 2009 Total*	*Change 2000-2009 Number*	*% Change 2000-2009*
Agriculture	288	0%	410	1%	122	42%
Construction	4,430	7%	6,790	11%	2360	53%
Manufacturing	1,619	3%	1,690	3%	71	4%
Transportation & Public Utilities	4,981	8%	4,690	8%	-291	-6%
Wholesale Trade	1,942	3%	2,050	3%	108	6%
Retail Trade	12,324	20%	11,190	19%	-1134	-9%
Finance, Insurance & Real Estate	2,657	4%	2,580	4%	-77	-3%
Services	15,129	25%	15,510	26%	381	3%
Federal Government (excl. active-duty military)	4,436	7%	3,790	6%	-646	-15%
GovGuam	12,741	21%	10,640	18%	-2101	-16%
Totals	**60,547**	**100%**	**59,340**	**100%**	**-1207**	**-2%**

Source: Guam Department of Labor 2008a

Occupational Profile

Whereas Table 16.1-9 showed employment on Guam by industry classifications 2000 and 2009, in contrast Table 16.1-10 shows Guam employment by occupational classifications in 2000 and 2008. Industry and occupational employment are different classifications of employment. For instance, construction industry employment includes all employees working for firms in the construction industry (including sales, office support etc.) while construction occupational employment includes only employment related to actual construction work.

As shown in Table 16.1-10 from 2000 to 2008, as measured by the U.S. Bureau of Labor Statistics, Guam added 1,800 jobs (from 57,000 to 58,810) an increase of 3.2%.

More jobs were held in Office and Administrative Support occupations than any other occupation; common jobs under this category include Executive Secretaries and Administrative Support, Customer Service Representatives, and various clerking positions. Jobs in Community and Social Services, Computer and Mathematical, and Legal occupations increased at high rates while jobs in Transportation and Materials Moving, Production, and Healthcare Support each declined by over 10%.

Table 16.1-10. Guam Employment by Occupation, 2000 and 2008

Occupation	*Employment*		
	2000	*2008*	*% Change*
Office and administrative support	10,090	10,660	6%
Food preparation and serving related	6,360	5,790	-9%
Sales and related	5,530	5,500	-1%
Management analysts	4,960	4,590	-8%
Construction and extraction	3,380	4,510	33%
Education, training, and library	3,600	4,170	16%
Transportation and material moving	4,120	3,420	-17%
Building and grounds cleaning and maintenance	3,660	3,360	-8%
Installation, maintenance, and repair	3,000	3,140	5%
Personal care and service	1,720	2,430	41%
Protective service	2,370	2,420	2%
Business and financial operations	2,090	2,060	-1%
Production	1,810	1,510	-17%

Occupation	*Employment*		
	2000	*2008*	*% Change*
Healthcare practitioners and technical	1,230	1,500	22%
Architecture and engineering	750	810	8%
Community and social services	360	710	97%
Healthcare support	690	620	-10%
Arts, design, entertainment, sports, and media	590	540	-9%
Computer and mathematical	260	460	77%
Life, physical, and social science	290	370	28%
Legal	140	240	71%
Total	**57,000**	**58,810**	**3%**

Source: U.S. Bureau of Labor Statistics 2009.

Income Profile

Table 16.1-11 shows median annual salary by occupation for Guam during 2000 and 2008, and includes the percentage change in salary in each occupation over that period. From 2000 to 2008, as measured by the U.S. Bureau of Labor Statistics, median salary for Guam jobs increased by $3,041 per year (from $22,890 to $25,931) an increase of 13%.

The highest salaries were found in Legal, Management Analyst, and Architecture and Engineering occupations. Salaries in Education, Training and Library, and Arts, Design, Entertainment, Sports and Media occupations increased at high rates while salaries in Legal, Community and Social Services, and Life, Physical, and Social Science occupations declined.

Table 16.1-11. Guam Median Annual Salary by Occupation, 2000 and 2008

Occupation	*Median Annual Salary*		
	2000	*2008*	*% Change*
Legal	$61,460	$55,850	-9%
Management analysts	$43,320	$47,270	9%
Architecture and engineering	$37,700	$43,000	14%
Computer and mathematical	$37,770	$40,860	8%
Healthcare practitioners and technical	$34,870	$39,940	15%
Business and financial operations	$36,660	$39,540	8%
Life, physical, and social science	$38,870	$38,000	-2%
Education, training, and library	$27,960	$37,740	35%
Community and social services	$30,320	$29,810	-2%
Installation, maintenance, and repair	$24,420	$25,860	6%
Construction and extraction	$24,710	$25,750	4%
Arts, design, entertainment, sports, and media	$19,920	$24,560	23%
Protective service	$23,820	$24,510	3%
Office and administrative support	$20,320	$23,480	16%
Healthcare support	$20,180	$21,380	6%
Production	$19,350	$21,030	9%
Personal care and service	$18,100	$20,150	11%
Transportation and material moving	$16,900	$19,390	15%
Sales and related	$15,330	$15,830	3%
Building and grounds cleaning and maintenance	$13,490	$15,350	14%
Food preparation and serving related	$13,670	$15,180	11%
Employment Weighted Average	**$22,890**	**$25,931**	**13%**

Source: U.S. Bureau of Labor Statistics 2009

Price Adjusted Income

Changes in salary, over-time, should be understood in terms of purchasing power. Purchasing power is how much people can buy with their income. How much an individual can buy with their income depends on the prices of the goods and services they purchase. Purchasing power will increase if salaries increase faster than prices but purchasing power will decrease if prices increase faster than salaries.

As shown in the table above, salaries on Guam increased by an average of 13% from 2000 to 2008. However, during that same period consumer prices on Guam increased by 47.3%, as shown in Table 16.1-12. This means purchasing power on Guam decreased substantially.

Table 16.1-12. Guam and U.S. Consumer Price Index (CPI) Comparison, (All Items, Index, Year 2000 = 100)

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Guam CPI	100	98.6	99.3	102.0	108.2	116.5	129.9	138.7	147.3
U.S. CPI	100	102.8	104.5	106.9	109.7	113.4	117.1	120.4	125

Sources: Guam Bureau of Statistics and Plans 2009, U.S. Bureau of Labor Statistics, Division of Consumer Prices 2008.

To illustrate the impacts that price changes have on income, Table 16.1-13 uses information from the previous two tables. Salaries in Table 16.1-11 are divided by the Guam price index in Table 16.1-12. Since the price index begins in 2000 and the value is set at 100, year 2000 salaries are divided by 1 and are thus unchanged. The price index in 2008 reaches a value of 147.3 so 2008 salaries are divided by 1.473 and are thus reduced by 47.3%.

When adjusted for price change, the median salary on Guam decreased by 30% from 2000 to 2008, though it shows a 13% increase in the table above. A 30% decline in price adjusted income means that the same person working the same job could purchase 30% fewer goods and services in 2008 than they could have in 2000.

Table 16.1-13. Guam, Price Adjusted Median Annual Salary by Occupation, 2000 and 2008

Occupation	*Median Annual Salary (Adjusted for Prices)*		
	2000	*2008*	*% Change*
Legal	$61,460	$37,912	-62%
Management analysts	$43,320	$32,087	-35%
Architecture and engineering	$37,700	$29,189	-29%
Computer and mathematical	$37,770	$27,736	-36%
Healthcare practitioners and technical	$34,870	$27,112	-29%
Business and financial operations	$36,660	$26,840	-37%
Life, physical, and social science	$38,870	$25,795	-51%
Education, training, and library	$27,960	$25,618	-9%
Community and social services	$30,320	$20,235	-50%
Installation, maintenance, and repair	$24,420	$17,554	-39%
Construction and extraction	$24,710	$17,479	-41%
Arts, design, entertainment, sports, and media	$19,920	$16,672	-19%
Protective service	$23,820	$16,638	-43%
Office and administrative support	$20,320	$15,938	-27%
Healthcare support	$20,180	$14,513	-39%
Production	$19,350	$14,275	-36%
Personal care and service	$18,100	$13,678	-32%
Transportation and material moving	$16,900	$13,162	-28%
Sales and related	$15,330	$10,746	-43%
Building and grounds cleaning and maintenance	$13,490	$10,420	-29%

Occupation	*Median Annual Salary (Adjusted for Prices)*		
	2000	*2008*	*% Change*
Food preparation and serving related	$13,670	$10,304	-33%
Employment Weighted Average	**$22,890**	**$17,602**	**-30%**

Source: U.S. Bureau of Labor Statistics 2009.

Unemployment

Table 16.1-14 summarizes Guam's civilian labor force between 2000 and 2007, the last year that data are available.

Between 2000 and 2004, Guam's civilian labor force experienced drastic decline. It began expanding again following 2004, possibly due to news announcements of the proposed action and/or to increases in the number of H-2B workers (see below).

As of 2007, the expansion on Guam's labor force still had not brought the island back to its 2000 level. This is an indicator that Guam's recent economy remains unsettled, despite decreases in unemployment and small increases in total employed persons that have been tracked over the same period. A reduced labor force reflects probable out-migration of Guam's skilled workers and/or is an indicator that "discouraged workers" are dropping out of Guam's economy. Furthermore, Guam's unemployment rate of 8.3% in September 2007 was higher than the national figure (4.4%) at that time (though the U.S. rate has since increased, to 9.5% as of September 2009). Guam has no unemployment insurance program.

As of July 2008 there were 1,619 H-2B workers on Guam (Guam Department of Labor 2008b). The H-2B temporary worker program is for "temporary service or labor if unemployed persons capable of performing such service or work cannot be found in this country." (8 U.S. Code (USC) 1101(a) (15) (H))

Table 16.1-14. Guam Employment Trends 2000-2007

Year	*Civilian Labor Force*	*Labor Force Participation Rate*[1]	*Employed*	*Unemployment Rate*
2000	70,800	67.8%	59,950	15.3%
2001	64,800	64.5%	56,040	13.5%
2002	62,050	62.4%	54,980	11.4%
2004	61,520	61.7%	56,810	7.7%
2005	64,130	61.1%	59,630	7.0%
2006	65,940	62.9%	61,390	6.9%
2007	63,600	57.8%	58,290	8.3%

[1]The labor force participation rate is the percentage of the adult population 16+ either employed or unemployed but actively seeking employment.
Source: Guam Department of Labor 2007b

16.1.4.2 Housing Supply and Characteristics

As of the 2000 Census there were approximately 48,000 housing units on Guam.. Overall, Guam at that time had a very high vacancy rate (19%) as compared to the U.S. nationwide figure for 2000 (9%).

During the early 2000s, while Guam's economy was in recession, both real estate prices and the construction of new housing units fell. Decreased new home construction led to historically low values of new residential building permits from 2000-2002. Housing price declines continued into 2003, when home prices bottomed at a median price of around $110,000 for a single-family home (First Hawaiian Bank 2007).

In 2004, real estate prices began to rise again, in response to improving worldwide economic conditions and initial discussions of the proposed action. This in turn spurred new construction. From the time the market bottomed in 2003 through 2006, home prices rose 41% and condo prices rose 74% (First Hawaiian Bank 2007). Data showed prices increasing through 2007 (Captain 2008a), and anecdotal evidence suggested that this trend was expected to continue through 2008 (First Hawaiian Bank 2008). However, while home prices have continued to increase, the rate of price increase has begun to decline in the currently slowing economy (Captain 2008b).

Table 16.1-15 illustrates declining home prices during the early part of the 2000s and rising home prices more recently. The home purchase component of Guam's Consumer Price Index (CPI) increased 98% from 2003 to 2006 while median salaries increased only 2.7% during the same period (U.S. Bureau of Labor Statistics Division of Occupational Employment Statistics 2008).

Table 16.1-15. Home Purchase Component of Guam CPI, 2000-2006

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
Home Purchase	100.0	98.6	86.5	94.5	124.7	155.9	187.3

Notes: The Guam CPI shows prices bottoming in 2nd quarter 2002 while some market research shows prices continuing to fall into 2003; the true bottom to housing prices probably falls somewhere in between.
Source: Guam Department of Labor 2006

Table 16.1-16 provides year 2000 housing characteristics information for Guam and each of Guam's villages.

Table 16.1-16. Housing Characteristics for Guam, 2000

		Total Housing Units	Vacant Units		Occupied Units		Median Rooms	Avg. Bedrooms	Median Value (Owner-Occupied)	Median Rent		Median Year Structure Built
			Total	For Rent	Total	Renter Occupied				Gross	Contract	
Guam Totals		47,677	19%	10%	38,769	52%	4.1	2.5	$171,900	$775	$645	1983
North	Dededo	12,119	17%	7%	10,016	45%	4.1	2.6	$163,100	$695	$590	1985
North	Yigo	5,489	16%	5%	4,634	57%	4.4	2.5	$161,800	$719	$609	1985
Central	Tamuning	8,108	27%	21%	5,953	75%	3.4	2.2	$273,600	$855	$720	1983
Central	Barrigada	2,307	9%	5%	2,097	38%	4.2	2.6	$190,900	$837	$705	1983
Central	Mangilao	3,926	19%	14%	3,190	50%	3.9	2.4	$182,700	$741	$626	1988
Central	Mongmong-Toto-Maite	2,102	22%	15%	1,633	62%	4	2.3	$179,900	$732	$620	1981
Central	Hagåtña	395	32%	27%	268	69%	3.5	2	$266,100	$665	$544	1976
Central	Sinajana	857	13%	10%	742	45%	4.5	2.7	$189,800	$852	$675	1976
Central	Agana Heights	1,193	11%	8%	1,058	50%	4.4	2.5	$194,200	$718	$623	1976
Central	Chalan Pago-Ordot	1,920	18%	6%	1,573	44%	4.1	2.5	$175,900	$884	$755	1990
Central	Asan	660	16%	3%	552	39%	4.7	2.6	$209,800	$814	$661	1979
Central	Piti	576	18%	15%	474	43%	4.8	2.9	$271,400	$1,025	$911	1977
South	Yona	1,745	15%	10%	1,486	32%	4.6	2.7	$173,100	$724	$547	1981
South	Agat	1,499	13%	8%	1,298	51%	3.8	2.4	$162,700	$585	$458	1982
South	Santa Rita	2,517	29%	2%	1,780	63%	5	2.8	$174,000	$1,006	$835	1976
South	Talofofo	849	13%	3%	738	34%	4.3	2.5	$170,400	$797	$663	1987
South	Umatac	179	9%	3%	162	35%	4.7	2.6	$152,100	$413	$213	1984
South	Inarajan	701	8%	2%	644	28%	4.2	2.5	$172,700	$768	$613	1986
South	Merizo	535	12%	8%	471	41%	4.2	2.4	$171,800	$679	$525	1984

Notes: "Median Rent" is the value where half the rents are higher and half lower. "Contract rent" is the monthly rent regardless of any costs for furnishings, utilities, fees, meals, etc. "Gross rent" includes those additional things.
Source: U.S. Census Bureau 2000a

North

As of 2000, the Northern region had a total of 17,608 housing units (12,119 in Dededo and 5,489 in Yigo); this comprised 37% of the total number of housing units on Guam.

Overall, Guam had a very high vacancy rate (19% compared to the U.S. Nationwide figure of 9%); the Northern region had a lower vacancy rate than Guam overall, but with a 17% rate in Dededo and a 16% rate in Yigo, the region still had a high vacancy rate.

About 7% of total units in Dededo and 5% in Yigo were available to be rented compared to the Guam overall rate of 10%.

The Northern region, on average, had fewer renter occupied units as a percentage than Guam overall; the relatively low rate in Dededo (45%) more than offset the relatively high rate in Yigo (57%).

Housing units were slightly larger in the Northern region compared to Guam overall; Yigo had more rooms per unit and Dededo had more bedrooms per unit than the Guam overall average.

Despite the slightly larger and newer (median year built in 1985 vs. 1983) housing units in the Northern region, prices were lower than Guam overall both in terms of median value and rents.

Central

As of 2000, the Central region had a total of 22,044 housing units; this comprised 46% of the total number of housing units on Guam.

Overall, Guam had a very high vacancy rate (19% compared to the U.S. Nationwide figure of 9%); the Central region had an even higher vacancy rate than Guam overall. Tamuning had a high percentage of units that were vacant (27%), most of that were available for rent (21%). In general, the Central region had a higher rate of renter occupied units than Guam overall.

Housing units were smaller in the Central region compared to Guam overall; Tamuning had the smallest sized units on Guam.

Despite the smaller units in the Central region, prices were higher than Guam overall both in terms of median value and rents.

Housing units in the Central region were about the same age as Guam overall, the median year units were built was 1983.

South

As of 2000, the Southern region had a total of 8,025 housing units; this comprised 17% of the total number of housing units on Guam.

Overall, Guam had a very high vacancy rate (19% compared to the U.S. Nationwide figure of 9%); the Southern region had a slightly lower vacancy rate than Guam overall and only a small percentage of these (5%) were available to be rented. On average, the Southern region had a lower rate of renter occupied units than Guam overall.

Housing units were larger in the Southern region compared to Guam overall; Santa Rita had the largest units on Guam in terms of number of rooms.

Despite the larger units in the Southern region, prices were generally lower than Guam overall.

Housing units in the Southern region were older than Guam overall, the median year units were built was 1981.

Temporary Workforce Housing

Based on information from Guam construction contractors and the Guam Department of Land Management (GDLM) there is presently capacity to house 3,700 temporary workers. Over half of this capacity (1,900) is owned and operated by one contractor at a single location in Harmon Industrial Park. The remainder of the capacity (1,800) is spread among 17 different locations, mostly in the north and central regions (JGPO & NAVFAC Pacific 2009).

16.1.4.3 Revenue Sources for the Government of Guam

Table 16.1-17 explains the tax rates, sources, and budgetary destinations for the major internal revenue sources (plus Compact Impact funding – reimbursements to the local government agencies of Guam, CNMI and Hawaii [HI] for costs incurred due to the in-migration of Micronesians, as per Section 104(e) of the Compact of Free Association). The subsequent Table 16.1-18 provides a more comprehensive breakdown of all projected revenues by source for Fiscal Year (FY) 2009.

Table 16.1-17. Revenue Sources for the GovGuam

Tax	*Tax Rate*	*Taxed Item*	*Budgetary*
Gross Receipts Tax	4%	Gross income	General Fund
Hotel Occupancy Tax	11%	Daily room rate	Tourist Attractions Fund
Personal Income Tax	10% - 35%	Income	General Fund
Corporate Income Tax (Guam Based)	15% - 35%	Net income	General Fund
Corporate Income Tax (Other Business on Guam)	15% - 35%	Guam source income	General Fund
Real Property Sales Tax	35% of the full cash value	Sale of land or buildings	Territorial Education Facility Fund
Annual Real Property Tax	0.005% for land	Assessed value	Territorial Education Facility Fund
Annual Real Property Tax	.01% for buildings	Assessed value	Territorial Education Facility Fund
Liquid Fuel Tax	$0.10 per gallon	Diesel	Highway Fund
Liquid Fuel Tax	$0.04 per gallon	Aviation fuel	Highway Fund
Liquid Fuel Tax	$0.11 per gallon	All other fuel	Highway Fund
Federal Grant	Total Federal Grant	Grant Base	Budgetary
Compact Impact Payment	$30,000,000	% of Insular FAS Population	Discretionary (Governor)
GG.501	Interior Department - Payments to the Territories	Various formulae for broad category of grants and programs[1]	Multiple

Legend: FAS= Freely Associated States of Micronesia.
[1]For FY 2008, GovGuam received $299 million.
Sources: Guam Department of Revenue and Taxation 2008, USDOI 2009.

Table 16.1-18. Projected FY 2009 Breakdown of GovGuam Projected Revenues

FY 2009 Revenue Source	*Amount*
Income tax	(see "Federal Sources" below)
Corporate	$104,039,979
Individual	$77,505,105
Withholding taxes, interest and penalties	$174,329,231
Provision for tax refund	$(88,600,000)
Total Income Taxes (listed above)	**$267,274,315**
Business privilege tax	$196,131,262
Other taxes	$1,468,543
Total Taxes	**$464,874,120**
Federal Sources	$48,351,222
Use of Money and Property	$3,293,486
Licenses, Fees, and Permits	$3,248,507
Department Charges	$954,462
Total General Fund Revenue	**$520,721,797**
Total Special Fund Revenue	**$108,007,741**
Administration	$928,738
Agriculture	$455,600
Attorney General	$3,254,724
Guam Council on the Arts and Humanities	$240,500
Guam Police	$740,911
Integrated Services for Individuals with Disabilities	$2,052,208
Judiciary of Guam	$545,825
Labor	$35,000
Military Affairs	$1,055,955
Public Health and Social Services	$23,298,212
UoG	$1,508,000
Total Federal Grant Revenue (listed above)	**$34,115,673**
Total Other Sources of Funding	**$406,941**
Grand Total	**$663,252,152**

Source: Guam Bureau of Budget and Management Research 2008.

GovGuam bases most of its Gross Receipts and Income taxes on the Internal Revenue Service code. Guam residents do not pay federal income taxes. Instead, GovGuam taxes resident income at the federal rates and passes the money to the federal government. The federal government then passes the same amount back. While real property taxes on Guam are relatively low, taxes on real estate transactions are 35%. The largest sources of tax revenue go to the Guam General Fund. Smaller tax revenues go into a variety of Special Funds for specific projects.

In FY 2008, GovGuam received $5.5 million in funding for health, education, social and public safety services, and for infrastructure related to services affected by qualified non-immigrants. It also received $6.1 million in Compact Impact funds for the Guam Schools Leaseback project (USDOI 2009).

By far the largest portion of federal grants-in-aid to GovGuam is for public health and social services. However, there are sizeable grants for the attorney general's office, people with disabilities, the University of Guam (UoG), and military affairs. Total federal grant revenue ($299 million) is about 5% of projected grand total revenues for FY 2009.

Federal Expenditures in the Economy

While federal expenditures represent an important element for the Guam economy, the per-capita level of total federal expenditures as of FY 2007 was barely above the national average (Table 16.1-19). As of

that FY, 21 states and the District of Columbia had higher per capita total federal expenditures than did Guam.

Table 16.1-19. Per Capita Federal Expenditures, Guam Versus U.S., FY 2007

	Total	*Retirement and Disability*	*Other Direct Payments*	*Grants*	*Procurement*	*Salaries and Wages*
Guam	$8,647.44	$1,464.16	$525.50	$1,745.75	$2,965.36	$1,946.67
U.S. Total	$8,339.18	$2,571.22	$1,926.36	$1,624.13	$1,392.57	$824.91

Source: U.S. Census Bureau 2008b.

It should also be noted that Guam's per capita federal total of $8,647 was the highest of all American "outlying areas," followed by the Virgin Islands ($5,976), Puerto Rico ($4,261), and American Samoa ($3,691). Amounts for the CNMI and other Micronesian areas were all below $2,000 as of fiscal 2007.

The same Census report cited above showed that total federal expenditures on Guam peaked in FY 2003 and fell back slightly thereafter. From 1998 to 2007, the national figure increased 72%, compared to just 48% for Guam.

Overview of Current GovGuam Capacity Issues

Because of its geographic and historical circumstances GovGuam faces two broad types of capacity challenges both of which will affect its ability to cope with the impacts of the proposed action: (1) human resources, and (2) financial resources.

Human Resources

Guam is geographically remote from any major population center and its population base is small. Guam's population is much smaller than any U.S. state and would rank only 126 among U.S. mainland cities (U.S. Census Bureau 2007). This small and remote population is a limiting factor to having a pool of available skilled, technical and managerial workers.

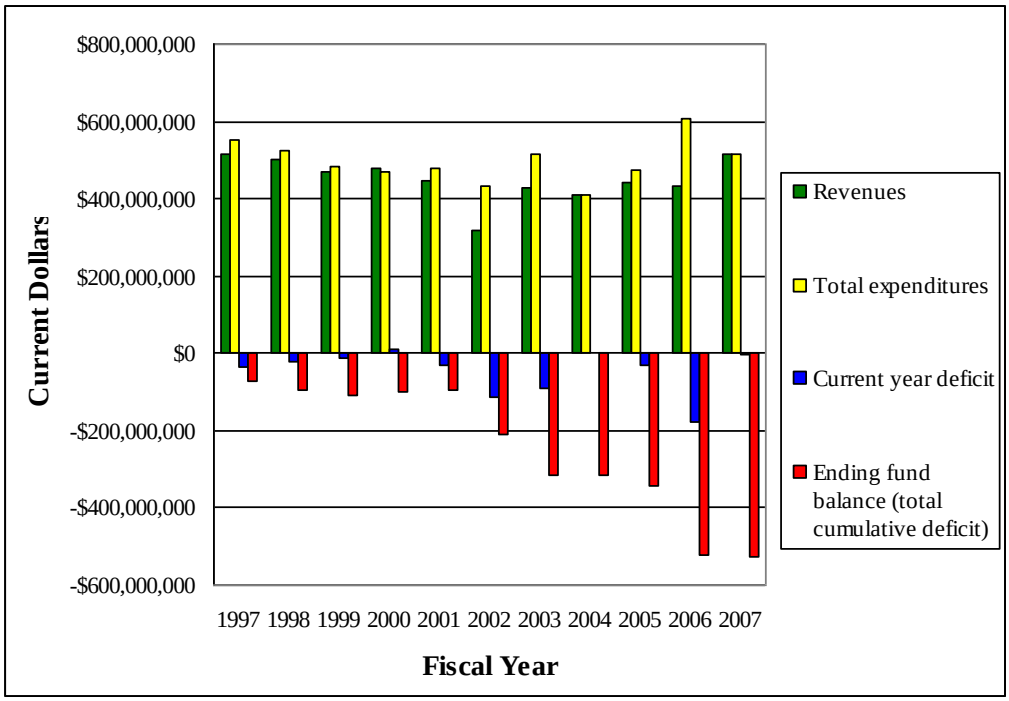
Additionally, Guam's history as a remote colony of Spain for 400 years, its 20th-century occupation by Japan, and being governed by U.S. Naval Officers until the passage of the Organic Act in 1950 has temporally limited Guam's experience at self governance as compared to most U.S. mainland local and state governments. This lack of governance experience has affected GovGuam's performance, especially in regard to handling of federal funds. Several GovGuam agencies have been put into federal receivership because of delinquent services or been cited for high-level administrative fraud.

Financial Resources

Guam's financial challenges involve both revenues for its normal operations and also ability to borrow money to provide infrastructure for either existing or potential population growth from the proposed action. Therefore, some detail is provided below to explain the status of Guam's government finances. Additional detail is provided in the Appendix F SIAS.

The General Fund is the primary operating fund of most American government units. It is used to account for all assets and liabilities of a government except those particularly assigned for other purposes in another more specialized fund. An example of a specialized fund is the capital projects fund that accounts for financial resources used for acquisition, construction, or operation of major capital facilities. Guam has had a persistent problem with deficits in its General Fund receipts and expenditures over the past 10 years. Figure 16.1-1 shows annual General Fund revenues, expenditures, and deficits from FY 1997 to FY 2007. General Fund Expenditures grew by an annual average of about 1.8% over FY 1996 to FY 2006,

primarily due to a jump in FY2006. However, revenues fell substantially over that period, resulting in a total cumulative deficit of $528 million by the end of FY 2007.



Sources: Banc of America LLC 2007, Guam Office of the Public Auditor 2008

Figure 16.1-1. Historical Guam General Fund Revenues, Expenditures, and Deficits

In part because deficits were affecting the ability to sell bonds for existing costs and new infrastructure, the government started a deficit reduction plan in FY 2007. This plan included tighter spending controls, more diligent revenue collection, more careful accounting systems, and more timely audits. Upon completion of audits, the FY 2008 balance is expected to show a small surplus (Banc of America LLC 2007). The current (2009) cumulative Guam General Fund deficit is also somewhat improved, at approximately $510 million (Standard & Poor's 2008). To achieve balanced budgets Guam has cut staffing and services.

Guam's efforts to reduce its outstanding $510 million debt are complicated by even larger "unfunded obligations," that are not included in its official cumulative debt estimates. Unfunded obligations refer to future commitments that were not backed up by reliable provisions to pay for those commitments. These unfunded obligations, in sum, are much higher than the official Guam total deficit. This means that Guam's capacity to borrow in order to correct its problems is very limited, creating extreme difficulty in maintaining current levels of service. In addition, both expansion of services and also building new infrastructure (such as could be necessary to accommodate the proposed action) may be difficult in the absence of adequate amounts and sources of borrowing. See the Appendix F SIAS for additional information.

The proposed action would generate more demands on Guam for roads, ports, sewer, water, power, and other necessary infrastructure. Part of these needs can be paid for by setting up private sector responsibilities for their provision, and/or user fees. However, in sum, these demands would increase the pressure for substantial borrowing.

16.1.4.4 Gross Island Product

Gross Island Product (GIP) measures the total value of all final goods and services produced in a particular island economy; it is the most commonly used benchmark to gauge the overall size of an island economy. The most recent measure of GIP on Guam was completed in 2002. It was estimated that Guam's GIP was about $3.4 billion. Table 16.1-20 details Guam's GIP from 1991 to 2002.

Table 16.1-20. Guam GIP 1991-2002 (Millions of Current $s)

	1991	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
GIP	$2,667	$2,902	$2,917	$3,014	$2,999	$2,993	$3,109	$3,551	$3,025	$3,420	NA	$3,428

Notes: "Current dollars" reflect the dollar value for the years data were recorded; for example, in the table above, 1991 GIP is in 1991 dollars, 1992 GIP is in 1992 dollars and et cetera.
Source: Guam Bureau of Statistics and Plans 2006.

16.1.5 Public Services

16.1.5.1 Education Services

Primary, secondary, and high-school education for the civilian residents of Guam is provided through the GPSS, and various private schools. Although there are currently no charter schools on Guam, the recently enacted (January 30, 2009) Guam Public Law 29-140 authorized the establishment of such schools. School-age children of active duty military and other federally-related populations on Guam are served by schools in the DoD Dependent Schools Pacific/DDESS Guam system.

Higher education services on Guam are provided by the UoG, Guam Community College (GCC), and the Pacific Islands University. UoG and GCC also provide vocational training and business development programs.

Primary, Secondary and High School Education

Public Schools (GPSS)

GPSS is one unified school district, supporting 40 schools (26 elementary, eight middle, five high and one alternative). GPSS plans to open three new schools. A large number of GPSS schools are located within Guam's central region, followed by the northern area, with the smallest number of schools in the south and Apra Harbor region. As of July 2008, GPSS employed about 4,000 employees and serviced approximately 31,000 students (Kelman 2008).

The student population of GPSS is very diverse. In school year 2007/2008, the largest student ethnic groups were Chamorro (46%), Pacific Islander (30%) and Filipino (21%). A total of 11,739 (37.79%) students were listed as Languages Other Than English students (Guam Department of Education 2008). There are also an estimated 100 military dependents that are part of the total GPSS student population (Appendix F SIAS - GPSS Interview).

Private Schools

Guam has approximately 27 private schools. Of these schools, 15 are Catholic; 11 are Christian; and one is non-denominational. Civilian and military families wishing for their dependents to receive a faith-based education often choose private schools. The Catholic Church opened a new high school in November 2008; is studying the possibility of building another in northern Guam whether or not the proposed action occurs; and could build more private schools if the buildup does occur (Kelman 2008). Overall, private schools on Guam have an enrollment of approximately 6,500 (Guam Civilian Military Task Force Education Sub-Committee 2009).

Military Schools (DDESS)

All information for this section was obtained from a 2009 interview with DDESS staff (Appendix F SIAS – DDESS Interview).

Education for military dependents in the U.S. is supplied by the umbrella organization, the DoD Educational Activity. Prior to 1997, military dependents on Guam enrolled in the GPSS. Guam's military school system was established during school year 1997/1998, citing that GPSS was unable to meet accountability expectations in school improvement. Currently, Guam's military schools are part of the DDESS system that manages military education in territories of the U.S. Although Guam is technically part of DDESS and the school system will be referred to as DDESS in this EIS/OEIS, the operational control of Guam's military school district was passed in school year 2004/2005 to DoD Dependent Schools-Pacific, headquartered in Okinawa, Japan.

DDESS runs two elementary schools, two middle schools and one high school on Guam. Andersen Elementary and Middle School are located in the north. McCool Elementary and Middle School is located near Apra Harbor. Most recently built (September 2007), Guam High School, is also located in central Guam, as is the District Superintendent's office. As of 2009, DDESS employed approximately 267 employees and had a student population of 2,672. Refer to Appendix F SIAS for details on DDESS enrollment by parental employer type.

Higher Education

GCC, UoG, and Pacific Islands University are located in Mangilao, in the central region of Guam. GCC and UoG are both fully accredited by the Western Association of Schools and Colleges. Pacific Islands University is accredited by the Transnational Association of Christian Colleges and Schools. See the Appendix F SIAS for additional information on these institutions.

Educational Attainment

Overall, data from the 2000 Census show a fairly high level of educational attainment on Guam although this attainment is slightly lower than the national average, as shown in Table 16.1-21.

Table 16.1-21. Guam Educational Attainment as of 2000

	Guam	*%*	*U.S.*	*%*
Total Population 25 Years & Over	**83,281**	**100%**	**182,211,639**	**100%**
Less than 9th grade	7,843	9%	13,755,477	8%
9th grade to 12th grade, no diploma	11,862	14%	21,960,148	12%
High school graduate (includes equivalency)	26,544	32%	52,168,981	29%
Some college or associate degree	20,398	24%	49,864,428	27%
Bachelor's degree	12,774	15%	28,317,792	16%
Graduate or professional degree	3,860	5%	16,144,813	9%
% High School Graduate or Higher		**76%**		**81%**
% Bachelor Degree or Higher		**20%**		**25%**

Source: U.S. Census Bureau 2000a.

16.1.5.2 Health and Human Services

Health services involve the preservation of health and prevention, treatment and management of illness through the professions of medicine, dentistry, nursing, and allied health. Human Services can incorporate a range of agencies and services including support of low-income, specially identified, or at-risk populations.

This section first gives brief detail of the overarching factors that affect health and human services on Guam. It then outlines the key public, nonprofit, private and military agencies that provide primary health and human services to Guam's population.

Guam's population currently experiences a variety of health concerns. Guam's Office of Vital Statistics lists heart disease, cancer, and cerebrovascular disease as the leading causes of death on Guam (Guam Memorial Hospital Authority 2008).

Challenges to the island also include fertility rates, communicable and infectious diseases, and obesity. Diabetes is a huge risk factor in the population, and the rate of dialysis has increased by 540% in the last 10 years, reaching five times the rate of the mainland U.S. (USDHHS 2008). In 2007, Guam recorded the highest number of reported influenza/flu symptoms since 1996. Furthermore, in 2007 Guam reported the most new cases of tuberculosis (TB) since 1997. Guam's TB infection rate is 53 new cases per 100,000 population, or 12 times the 2007 U.S. rate of 4.4 (GDPHSS Office of Epidemiology and Research 2007).

Guam's place as a hub in the Asia Pacific region is an additional factor affecting its overall health status. The island can be susceptible to health concerns that are emergent in neighboring areas, whose populations often have high health needs and often do not have immunization or health records. For example, populations in both Chuuk and the Philippines have experienced high levels of TB, with Chuuk recently experiencing incidents of drug-resistant versions of TB (U.S. Public Health Service Interview – Appendix F SIAS). Because individuals from these locations often come from disadvantaged socioeconomic conditions and backgrounds, upon immigrating to Guam they become eligible for federal public assistance. After arrival on Guam, these populations sometimes live in isolated, overcrowded and substandard conditions that include inadequate infrastructure for living (such as water and power supply) and poor quality public services (such as waste collection, fire and police protection). This leads to high rates of hepatitis B, TB, cholera, and Hansen's disease, among other public health concerns.

Since 1988, Guam has been considered a Medically Underserved Area (GDPHSS Maternal and Child Health Services 2007) that demonstrates the island's difficulty in meeting the above health care needs. The island is currently experiencing shortages of health care providers and lacks specific health care specialists. It is often difficult to recruit specialists from the U.S. mainland because of its remote location and a typically lower pay scale. In 2005, Guam had a total of 244 physicians serving its population, including physicians at the Guam Memorial Hospital and licensed military physicians working on a part-time basis (Western Pacific Region Health Databank 2007). Other statistics show a count of 14.1 active physicians per 10,000 residents, compared to the national average of 25.9 in 2005 (USDHHS 2006). Guam's dentist to population ratio (including private practice dentists) is 1:2,500 (GDPHSS Maternal and Child Health Services 2007). This indicates significantly lower coverage than the national average dentist to population ratio, where in 2000 it was 1:1,691 (American Dental Survey Center 2002).

Guam's distance also means that referral for specialized services in the U.S. require patients to take a seven-hour trip by commercial plane to HI. Flight times from Guam to various countries for treatment are as follows:

- Manila, Philippines – 3.3 hours
- Tokyo, Japan – 3.4 hours
- Hong Kong, China – 4.4 hours
- Cairns, Australia – 4.9 hours

Also affecting Guam's ability to meet the health care needs of its population is that a large percentage of the island's population does not have adequate health insurance to cover medical costs. Often, immigrants

arriving on Guam through the Compact of Free Association agreement are without insurance. The Guam Department Public Health and Social Services (GDPHSS) has estimated that 60,000 individuals on Guam are uninsured or underinsured, out of a total population of approximately 160,000 (Guam Memorial Hospital Authority 2008). An individual may be considered underinsured if they possess private health insurance but that insurance does not adequately cover necessary treatments. Furthermore, many individuals that have health insurance are unable to afford the co-pays for treatments or medications and will turn to government health agencies for free services. The agencies' mandates are to serve all those that come in through the door. Although they do have processes to verify whether an individual is insured or not, private insurance companies are unwilling to release the names of their clients due to confidentiality issues. Often if an individual states he or she does not have health insurance, agency staff must take their word for it.

Finally, the funding of Medicaid and Medicare programs also provide unique challenges to the Guam healthcare system. For example, by statute Guam's Medicaid funding is capped and annual increases are based on the CPI. Federal matching funds for Medicaid (the Federal Medical Assistance Percentage) is set for 50%, the minimum rate. Once Guam has exhausted this capped Medicaid funding, all Medicaid costs must be assumed by GovGuam. Medicare funding on Guam is still paid under the system of the Tax Equity and Fiscal Responsibility Act of 1982 that limits Guam Memorial Hospital's reimbursement to $6,000 per discharge. This is a lower rate than allowed to most other U.S. states and territories (USDHHS 2008).

Guam Memorial Hospital Authority

Unless otherwise noted, all information for this section was obtained from a 2008 survey and 2009 interview with Guam Memorial Hospital Authority (GMHA) staff (Appendix F SIAS - GMHA Interview).

GMHA is Guam's only civilian general hospital, servicing the entire population's primary health care needs. In 1964, a public law was passed for GovGuam to administer and operate GMHA. In 1978, the hospital moved to its current location in Tamuning, a building originally built for the Catholic Diocese to serve as a private acute care facility. In 1996, GMHA opened a Skilled Nursing Unit (SNU) facility in Barrigada Heights. GMHA employs 105 medical staff. Approximately 77% of GMHA staff is board certified.

Currently, the 22,000-square-foot GMHA provides a total of 250 beds including 158 acute care beds. The SNU has 40 beds. GMHA is often at capacity.

GMHA is funded primarily through patient payment. Patients are mostly civilian, although military dependents do at times access GMHA services, after that the hospital can bill TRICARE (military health plan provider).

Guam Department of Public Health and Social Services

The GDPHSS provides various health services to the public including primary and acute health care.

Bureau of Primary Care Services

The GDPHSS Bureau of Primary Care Services (BPC) was established in 1998 to administer two Community Health Clinics (CHCs): the Northern Region Community Health Center (NRCHC) and the Southern Region Community Health Center (SRCHC). These centers are Federally Qualified Health Centers that provide primary, acute and preventative care on an outpatient basis only. Prior to 1998, primary care services from GDPHSS did not exist, and services were limited to preventive services under

the Maternal Child Health Program of the GDPHSS Bureau of Family Health and Nursing Services (BFHNS).

Anyone is able to use the services of the CHCs regardless of income, family size, or ability to pay, however, the Clinics focus on low income, uninsured and medically underserved populations. Their Sliding Fee Program is based on the federal income poverty guidelines that take into account income and family size. Through this program, patients receive discounts of 100%, 75%, 50% or 25%. Furthermore, GMHA will refer patients who have no primary care provider and/or health care to CHCs after they are discharged from the GMHA Emergency Room or after hospitalization (Appendix F SIAS - GDPHSS BPC Interview).

Bureau of Family Health and Nursing Services

The GDPHSS BFHNS provides health and social services, mostly to individuals with no insurance, except in the case of TB or sexually transmitted diseases (STDs). It is located at the central GDPHSS location, has one room at the NRCHC, and its staff makes visits to the SRCHC. The BFHNS provides: women's health services, family planning services, child health services, services for children with special health needs, home care services, communicable disease services (e.g. immunization, TB clearance, health certificate, and skin tests), chronic screenings in the community, and information to the public through information booths. BFHNS has experienced a dramatic increase in access of communicable disease services between 2007 and 2008. Decreases in various other services accessed do not necessarily indicate a decreasing need for these services, but rather the inability for BFHNS to meet these needs. Because of staffing and supply shortfalls, the BFHNS currently prioritizes its work in the following order: infectious diseases, child health, prenatal care, women, chronic needs, and family planning. Integral to the work of the BFHNS is its staff of nursing personnel. Community Health Nurses at the BFHNS travel to different villages on Guam, making visits in order of priority (Appendix F SIAS - BFHNS Interview).

Bureau of Communicable Disease Control

All information for this section was obtained from a 2009 interview with Bureau of Communicable Disease Control (BCDC) staff (Appendix F SIAS – CDC Interview). The Center for Disease Control (CDC) provides STD, human immune-deficiency virus (HIV), and tuberculosis (TB) related services, children and adult immunizations, and laboratory services. These services are provided at the central GDPHSS location, as well as at the NRCHC and SRCHC through Memoranda of Understanding agreements. Services at the main location are completely free of charge while the Community Health Clinics charge a fee for service. The Community Health Clinics see approximately 22,000 clients a year, with higher morbidity rates in the northern areas of Guam.

Division of Public Welfare

All information for this section was obtained from a 2009 interview with Division of Public Welfare staff (Appendix F SIAS – DPW Interview). The Division of Public Welfare is responsible for a wide array of social services, administered through a number of different Bureaus. The Division's administrative headquarters are located in the main building, while eligibility sites for each of the social services it administers are scattered throughout the island. Bureaus and sections encompassed by the Division of Public Welfare are the Bureau of Social Services Administration, Bureau of Health Care Financing Administration, Bureau of Economic Security, and the Work Programs Section.

Division of Environmental Health

The DEH provides regulatory services including the generation of sanitary permits and health certificates, and the issuance of health citations. The DEH will perform pre-operation inspections of new permanent or temporary facilities, issue permits for their operation, and continue to perform periodic inspections of these facilities during operations. DEH also generates health permits for employees requiring such a permit (such as those working with food, at massage parlors, or cosmetologists), making sure that the employees have completed their TB skin test and any food safety workshops (offered at GCC) that are required.

In 2008, DEH generated 2,841 sanitary permits for permanent establishments, conducted 1,112 facility inspections, and generated 22,573 health certificates (Appendix F SIAS – DEH Interview).

Guam Department of Mental Health and Substance Abuse

Guam's behavioral health service providers are made up of the GDMHSA, the single state agency offering comprehensive behavioral health services to adults and children on Guam, as well as private and non-profit providers. The Guam Department of Mental Health and Substance Abuse (GDMHSA) is located next to the Guam Memorial Hospital.

All individuals are eligible for services at GDMHSA, although the agency prioritizes the most indigent clients. Prioritization of GDMHSA's work is as follows: emergency services, inpatient acute care, medication dispensation, residential treatment services, outpatient services and prevention and outreach activities. Those with insurance will typically be seen in a private practice environment. However, insured individuals wishing to access free medication will sometimes go through GDMHSA's diagnosis system (Appendix F SIAS - GDMHSA Interview).

Guam Department of Integrated Services for Individuals with Disabilities

All information for this section was obtained from a 2009 interview with GDISID staff (Appendix F SIAS – GDISID Interview).

GDISID was created to be a single point of entry to services for Guam's disabled population. It is made up of three departments: the Division of Vocational Rehabilitation, the Division of Support Services, and the Division of Evaluation Enforcement and Compliance. GDISID manages the Guam Get Care System, a web-based comprehensive directory of services, funded by a grant from the Aging and Disability Resource Center through the year 2010. Divisions encompassed by GDISID include the Division of Vocational Rehabilitation, Division of Support Services, and Division of Evaluation Enforcement and Compliance.

Naval Hospital Guam

The Naval Hospital Guam in Agana Heights offers medical care to military personnel, military dependents, veterans, and in case of emergency, civilians. The military also runs small outpatient clinics at Andersen Air Force Base (AFB) and on the Naval Base, as well as a dental clinic. The current Naval Hospital Guam facility was opened in 1954, is 306,000 square feet, and houses 38 active beds including six intensive care unit beds, plus an additional 64 contingency beds (Naval Hospital Guam 2008).

Collaboration between the military and public health systems includes limited consultation and treatment services by specialized military medical officers, assistance when GMHA or the GDPHSS encounter supply or pharmaceutical shortages, as well as a source of back up during times of human or natural disaster.

The military sector provides mental health services to active duty members and their dependents, while the Veterans Affairs (VA) Administration services the mental health needs of veterans and their families.

Guam VA Office

All information for this section was obtained from a 2009 interview with the Guam VA that advocates for veterans and active-duty personnel on Guam for access to veterans' benefits (Appendix F SIAS – VA Interview).

The U.S. Department of VA is responsible for the provision of benefits for qualified veterans. The Guam VA office, currently run by a staff of two individuals, assists veterans with information and applications for their benefits and claims. Guam also provides veterans with free driver's licenses and veterans license plates that can be processed on Guam. However, most of the forms and claims filed by Guam veterans are sent to the U.S. Department of Veterans Affairs in Honolulu, where they are reviewed and processed.

Private Providers

There has been a recent increase in private mental health providers on Guam. Private providers are mostly psychiatrists, clinical psychologists, and individual, marriage, and family therapists. Private clinics also provide mental health services. Only a limited number of private providers and pharmacies accept government insurance such as the MIP and Medicaid due to factors such as slow reimbursement.

Non-Profit or Academic Centers/Providers

Currently there are no non-profit groups on Guam providing health care and no academic medical centers. Various non-profit providers on Guam serve both adults and youth, and provide ancillary and support services, as well as emergency, homeless, and youth shelter. Some examples of these include: the Guam Salvation Army, Sanctuary, Inc., and Catholic Social Services. These organizations are important elements in supporting the health and human service system on Guam. Often, local and federal government agencies contract with these organizations for services.

16.1.5.3 Public Safety

Public Safety includes the protection from and prevention of events endangering the general public's safety, including crime and disasters, both natural and man-made. Government agencies on Guam involved in law and traffic enforcement, fire suppression, emergency medical response, safety inspections, civil and criminal litigation, justice, and corrections are all considered public safety agencies.

While overall crimes as processed by the Guam Police Department (GPD) increased by about 9% between 2002 and 2006, the territory had significantly lower reported rates of both violent and property crimes per 100,000 residents when compared to U.S. averages. Table 16.1-22 compares recent crime rates for Guam and the U.S. (using Part I or "serious" crime as defined by the Federal Bureau of Investigation). The violent crime rate on Guam has recently been trending down while the property crime rate has been trending up. In 2006, larceny-theft (2,639 cases) was the most common offense known to GPD. Vandalism (1,500 cases), burglary (1,292 cases) and disorderly conduct (1,156 cases) were other common offenses. Other than disorderly conduct, each of the crimes mentioned had increased from 2002 levels.

Guam is a high-risk public safety area during times of natural and man-made disasters. The remaining information in this section is from the Guam Emergency Response Plan (Guam Homeland Security Office of Civil Defense 2009), unless otherwise noted.

Table 16.1-22. Comparison of Violent and Property Crime Rates, Guam Versus U.S., 2002-2006

Year	*Violent crime rate per 100,000 residents*		*Property crime rate per 100,000 residents*	
	Guam	*U.S.*	*Guam*	*U.S.*
2002	292.4	494.4	2,188.7	3,630.6
2003	302.0	475.8	2,332.6	3,591.2
2004	277.8	463.2	2,189.2	3,514.1
2005	230.2	469.0	2,749.1	3,431.5
2006	239.7	473.5	2,423.1	3,334.5

Sources: Guam Police Department 2007, U.S. Department of Justice, Federal Bureau of Investigation 2006

The territory's location makes it vulnerable on a number of levels. Guam is located in an area of high risk for natural disasters including typhoons, tropical storms, and tsunamis. Its remoteness means that it cannot depend on aid from contiguous regions in the event of disaster (Suburban Emergency Management Project 2007). Guam's geographic location is also one that places it in close proximity to areas such as North Korea and China, and the proposed action itself is meant to utilize this strategic positioning to "…fulfill U.S. government national security and alliance requirements in the Western Pacific Region" (Suburban Emergency Management Project 2007).

The Emergency Operations Center at the Office of Civil Defense (whose administrator is designated by the Governor of Guam) is the primary agency responsible for coordinating Guam's response to all emergencies and disasters through the National Incident Management System. The primary federal agency that works with the territory of Guam in times of emergency is the Federal Emergency Management Agency (FEMA), and more specifically, the FEMA Region IX Pacific Area and Regional offices.

The next section gives brief overviews of the key GovGuam agencies responsible for public safety on Guam and concludes with a description of some of the local and military collaborations. More information on Guam's public safety agencies is provided in the Appendix F SIAS.

Guam Police Department

GPD is the law enforcement agency for the entire territory, outside of federal property. GPD's four precincts include: Hagatna, Dededo, Agat, and Tumon/Tamuning. Police stations are located in, respectively, Hagatna, Dededo, Agat, and the Tumon Bay resort area. A new Yigo precinct is also planned for the near future. The 2006 precinct population was as follows:

- Dededo 68,996
- Hagatna 53,148
- Agat 28,976
- Tamuning 19,899

In 2007, GPD employed 309 sworn personnel and 66 civilian employees. The total number of arrests in 2007 were 3,315 (Guam Police Department 2007).

Guam Fire Department

GFD is the primary agency responsible for fire suppression, search and rescue, and emergency medical response for the territory of Guam. GFD operates 12 fire stations (5 in the northern district and 7 in the southern district), two rescue bases, and the E911 Integrated Emergency Communications Center. Guam experiences weather conditions that make it vulnerable to wildland/urban interface brush fires. GFD is

usually the first responder in such incidents. GFD currently employs approximately 200 full time sworn personnel, including emergency medical technicians. Approximately 32 of these personnel are equipped to perform open water rescues.

GFD cooperates with military fire response agencies through the National Incident Management System. For land-based search and rescue incidents that occur on federal or military property, military responders take the lead on emergency coordination, supported by GovGuam agencies. For sea-based incidents beyond the GFD's capacity, the USCG takes operational lead (Guam Homeland Security Office of Civil Defense 2009).

GFD also employs two inspectors that work in cooperation with the Guam Department of Public Works (GDPW) to ensure that any construction plans are reviewed for compliance with fire codes prior to being approved. The GFD's Code Enforcement Section performs inspections of facilities for code compliance (Appendix F SIAS - GFD Interview).

Guam Department of Corrections

The Guam Department of Corrections (GDoC) is responsible for the handling of persons after their conviction of a criminal offense. The Department is organized into four divisions: Administration, Prison Security, Diagnostic Treatment Services, and Parole Services.

Space constraints currently exist for GDoC facilities. Overcrowding at the Hagatna Detention Facility necessitates that the Adult Correctional Facility be used to house some pre-trial individuals. GDoC has considered building a new facility to meet housing needs, but there have been no firm plans to do so (GDoC 2008).

Guam Department of Youth Affairs

The Guam Department of Youth Affairs (GDYA) runs a variety of programs geared toward youth development, rehabilitation, and involvement with the community. Its youth programs and facilities include Youth Correctional Facility and Cottage Homes, Counseling/Case Management, and Community Social Development Resource Centers and Prevention.

Military Security

While Navy and Air Force security personnel work independently, they share facilities and training. In addition, if military personnel are given base suspension or debarment on one military property, they lose privileges on all military bases. Currently the Air Force and Navy are adapting to new Joint Region Marianas requirements, whereby the Navy will take the lead for the joint region. In the 1980s, a military corrections facility existed on the Naval Base, but that facility has since been closed due to underuse. Andersen AFB maintains a small correctional facility of four cells (Appendix F SIAS - Naval Security Interview).

In addition to on-base patrol, military security plays a role outside the fence. There is a close working relationship between GPD and military security. GPD headquarters are located in old Navy facilities that GPD provides safety briefings for the military and have recently begun working together to patrol the Tamuning/Tumon area. Furthermore, when large ships come in to port, shore patrol is a requirement (Appendix F SIAS - GPD Interview).

16.1.5.4 Agencies Affected by Population Growth

The agencies discussed in this section were selected because they will likely be impacted by increases in service population or an increase in H-2B construction workers.

Guam Department of Parks and Recreation

The Guam Department of Parks and Recreation (GDPR) administers approximately 70 public parks and recreational facilities, including beach parks, community parks, skate parks, historic parks, baseball fields, a baseball stadium, a sports complex, tennis courts and a public pool. All other community centers and parks fall under the 19 village mayors, who work closely with GDPR. GDPR also runs sports leagues and provides swimming and tennis lessons among others. A sports complex is in the process of being built in Dededo, and it will include baseball fields and a swimming pool (Appendix F SIAS – GDPR Interview).

GDPR current staffing runs less than 80 employees. Staffing for park rangers, teaching positions, and park maintenance is primarily outsourced. GDPR's Historic Preservation Office (HPO) conducts cultural resource review under federal law and engages a comprehensive historic preservation program on Guam. It also conducts permit reviews. This office has a staff of approximately 13 people (Appendix F SIAS – GDPR Survey).

Further discussion on Guam recreational assets and facilities may be found in Chapter 9, Recreation, of this volume.

Guam Public Library System

The Guam Public Library System (GPLS) provides one main library in Hagatna, five branch libraries in the villages of Agat, Barrigada, Dededo, Merizo, and Yona, and a bookmobile. Currently, GPLS employs a staff of 28. GPLS supports the needs of the public, as well as schools and government agencies, providing library services, programs for school children and families, and reference and internet searching. All residents on Guam are eligible for a library card.

Library resources are also available at all public and some private schools on Guam, institutions of higher education, and other institutions such as the Territorial Law Library (Appendix F SIAS – GPLS Survey).

Judiciary of Guam

The Judiciary of Guam is comprised of the Courts and Ministerial Division, Probation Services Division, Marshal's Services Division, Client Services and Family Counseling Division, and Procurement and Facilities Management Division.

Until recently, the Judiciary was housed on one site in Hagatna. As of August 2009, it opened up a Northern Court Satellite in the Dededo Mall, where there is room for one court room that will process small claims and traffic violations, among others (Appendix F SIAS – Guam Judiciary Interview).

Guam Department of Labor

The Guam Department of Labor (GDoL) consists of numerous divisions, bureaus, and programs related to employment. The agency's organizational chart presents three main clusters: (1) "Statistics," including the Bureau of Labor Statistics and its Economic Research Center; (2) "Employment and Training," including various employment assistance and job training programs; and (3) "Regulatory and Compliance," including divisions for occupational safety and health, fair employment, etc. The Workforce Investment Board is also attached to the Director's Office.

While all parts of GDoL would be affected by the proposed action, the Agency for Human Resources Development and the Alien Labor Processing and Certification Division (ALPCD) are among those particularly likely to be affected, and in fact are already heavily involved. The Agency for Human Resources Development works to increase the pool of labor on Guam by identifying actual or potential discouraged workers – including those deficient in basic skills – and improving their skills through means

ranging from classroom training to on-the-job training with private-sector partners. The ALPCD is responsible for processing applications to bring foreign ("alien") workers into Guam and assuring compliance with federal Department of Homeland Security requirements (Guam Department of Labor 2009a).

ALPCD is the primary Guam entity reviewing and issuing permits under the H-2B work visa program of the U.S. Citizenship and Immigration Service (USCIS), and would be the primary unit of GovGuam affected by the proposed project's use of H-2B workers (indirect effects arising from housing these workers on GDPW and possibly GDLM would occur).

ALPCD manages the H-2B program's Guam components (with oversight by the Governor and in cooperation with the U.S. State Department), and is involved in the H-2B process in six ways:

1. Prospective employers file applications for Temporary Labor Certification with ALPCD
2. ALPCD adjudicates these applications, recommending approval or denial to the Governor of Guam (the Governor's recommendation, further interviewing, and visa issuance are handled by the U.S. State Department)
3. If ultimately approved by the USCIS, once the worker arrives on Guam, he/she must report to the ALCPD to file an Application for Registration and get a worker identification card issued by ALPCD
4. ALPCD conducts labor law enforcement, compliance monitoring, job site and temporary worker housing inspections
5. ALPCD processes Exit Clearance forms two weeks before the worker is ready to depart the U.S.
6. Statistics, data gathering, and recordkeeping on ALPCD programs

H-2B workers are issued one-year permits, renewable up to three years. For the proposed action, it is likely that most workers hired before 2015 would stay for more than one year, meaning extensions would have to be granted by ALPCD.

For the most recently completed FY2007 and FY2008, staffing of the ALPCD totaled 5 full-time equivalents (FTEs).

16.1.5.5 Agencies Affected by Development on Guam

The agencies discussed in this section were selected because they will likely be impacted by increases in development and construction on Guam as a result of the proposed action. They are GovGuam agencies responsible for issuing, monitoring, and enforcing development permits on Guam.

Because actions taken on federal land do not require local development permits, most of the impact on GovGuam development permitting functions would come from off-base growth generated by the proposed action (i.e., purchases from construction or operations and from indirect growth). In a few cases – such as the Guam Environmental Protection Agency (GEPA) – federal agencies have delegated responsibility for oversight of direct project activities to local agencies, and so the direct project impacts also affect local permitting, monitoring, and enforcement to some extent.

For private-sector development permits, two primary agencies are involved: GDLM for rezoning proposals and GDPW for building permits. If rezoning (including conditional use permits) is required, developers apply with GDLM (that acts as technical arm for the Guam Land Use Commission [GLUC] and also makes referrals to other agencies for rezone reviews). If the rezoning action is allowed, developers then go to the "one-stop permitting" center with GDPW (GDPW in turn, typically refers part

of the building permit review to GDLM). If no rezoning is needed, the GDPW one-stop permitting center is the primary point of contact for applicants. GDPW typically refers building permit applications for review by any or all of the agencies addressed in this section (listed above).

Guam Environmental Protection Agency

GEPA was initially established in 1973 as prescribed in Guam Public Law 11-191, signed into law on December 7, 1972. The Agency has six divisions: Administrative Services, Water Programs, Environmental Monitoring and Analytical Services, Air and Land Programs, Environmental Planning and Review, and Energy, Sustainable Development, and Outreach. This last division is new and was approved in GEPA's 2009-2013 work plan. GEPA's jurisdiction includes wastewater; clearing, grading, and excavation; drinking water and water quality certification; groundwater management and water quality monitoring; hazardous waste and clean-up of toxic waste sites air quality; air quality; land use impacts; and water pollution control; clearing, grading, stockpiling and stormwater management (GEPA 2009).

GEPA is delegated authority by USEPA to carry out USEPA mandates on Guam. GEPA has several divisions, including Air and Land, Water, Environmental Planning and Review, and Monitoring.

Guam Department of Public Works

GDPW is a multi-purpose agency with responsibility for: highway maintenance, construction, and safety; bus operations; housing management; solid waste management; administration of capital improvement projects; and operation of the "one-stop permitting" center. The focus of this EIS/OEIS is on this agency's permitting operations – namely, building (architectural and structural), electrical, plumbing, flood control, and highway encroachment, as well as management of the one-stop permitting center (Guam Department of Public Works 2009).

GDPW is a "one-stop" permitting center where those needing development permits can get referred to the full range of permits needed for their projects. GDPW not only reviews the permits, but also routes applications to other agencies for their review.

Guam Department of Land Management

GDLM has five operating divisions: Land Planning; Land Administration; Land Survey; Land Records, and Geographic Information System (GIS)/Land Information System. The focus of this EIS/OEIS for GDLM is on the Planning Division that has clearance responsibilities relating to building, occupancy, and clearing and grading permits; business, liquor and contractor licenses; temporary worker housing facilities; and childcare facilities. Under the auspices of the Land Use Commission and the Shoreline Protection Commission (as of writing, the latter Commission was to soon be transferred to the Coastal Management Program [CMP]), the Planning Division is responsible for processing zoning changes and variances, subdivision applications, development plans, conditional use and wetland permits, and horizontal property regime requests (Guam Department of Land Management 2009).

Much of GDLM's permitting activity is driven by referrals from GDPW, through GDPWs one-stop permit center. However, other permitting issues arise, especially rezoning proposals previous to issuance of building permits that are heard by the GLUC with staff assistance primarily by GDLM, the GLUC chair.

Bureau of Statistics and Plans

The Guam Bureau of Statistics and Plans (GBSP) is responsible for collection and dissemination of economic and business statistics, coordinating information management throughout the government,

producing mapping tools and products that facilitate the use of data by governmental agencies, and the administration of the CMP.

The focus of the analysis for this agency is on CMP administration. The entire island of Guam is designated a Coastal Zone. CMP conducts a number of programs, including public education, permit review, consistency reviews, and policy planning. The agency is responsible for reviewing a wide variety of applications for developments including requests for zone changes; issuing seashore reserve permits; making federal consistency determinations; conducting site inspections; monitoring activities and developing mitigation strategies. When the new Seashore Reserve Plan is adopted, this agency will administer it (Appendix F SIAS – GBSP Interview).

Guam Economic Development Authority

The Guam Economic Development Authority (GEDA) (formerly known as the Guam Economic Development and Commerce Authority [GEDCA]), a public corporation, is an autonomous agency of GovGuam. Its mission is to promote a sustainable economy for Guam. It manages three industrial parks as well as several parcels for the Guam Ancestral Land Commission. It provides investor incentives and commercial loans. The Authority generates its own revenues (Guam Economic Development Authority 2009).

Guam Department of Agriculture

The Guam Department of Agriculture (GDA) is organized into five divisions: Aquatic & Wildlife Resources, Forestry and Soil Resources, Agricultural Development Services, the Plant Inspection Facility, and Animal Control. It operates five marine reserves and has played an important role in the restoration of coral reefs and fishery resources. The Department must sign off on any construction permits that would impact the environment (Guam Department of Agriculture 2009).

16.1.6 Sociocultural Issues

The announcement of the proposed action necessitated public scoping meetings be conducted (Earth Tech 2007). Several meetings were conducted in 2007. During that time public comments were collected. Of interest in this section are some categories of expressed concerns that relate to the socioeconomic impact of the proposed buildup, above and beyond those discussed above. The section below lists the categories most often mentioned in the public scoping meetings, and provides a summary of historical and current background to these issues. Refer to the Appendix F SIAS for a more detailed discussion.

16.1.6.1 Chamorro Issues and Interests

Chamorros were first conquered by the Spanish soon after contact with Magellan's expedition. Most died of disease within a hundred years after contact. Guam was administered under a U.S. Naval Governor after it was taken from Spain in 1898. The Japanese occupation from 1941 to 1944 was marked by forced labor, cultural assimilation, and violence. The island was a restricted U.S. Navy zone until 1961.

The topics of political minoritization and WWII Reparations discussed below are linked to the military in the minds of many Chamorro and other Guam residents. While they would not technically be "impacted" by the proposed action, the issues are frequently raised in the context of military planning.

To some extent, all these issues have in common a sense of concern over perceived past wrongs that some Guam residents argue should be "made right" by the military and/or the federal government in the course of the planned buildup.

Cultural Artifacts

The Department of Chamorro Affairs (DCA) is charged with administering and expanding Guam's current relatively small museum for archaeological or other cultural artifacts. An expression of interest has been made that artifacts discovered in archaeological excavations during this EIS/OEIS investigations or subsequent military construction to be stored at this Museum.

Political Status

Chamorro sovereignty groups feel U.S. military presence works against self-government and strengthens the sense of "colonization" on Guam. As a result of the Spanish-American War, Guam was sold to the U.S. in 1898. During the early period of the U.S. governance of Guam, the island was administered under the authority of the Navy. Naval policies included the intention to assimilate the Chamorro population, and included a banning of the use of Chamorro language in schools (United Nations 1963). Prominent local Chamorro residents drafted a 1902 petition arguing that the non-representative form of government existing at that time went against the ideals of American democracy, and asked for further clarification of Guam's political status.

The Navy's administration of Guam was disrupted during WWII, when in 1941, following the invasion of Pearl Harbor, Japanese military forces bombed Guam. The Japanese took control of the island for two and a half years, where strict social standards were imposed, including restrictions in the use of the Chamorro language as well as English in local education. Guamanians were also used as forced-labor on a variety of Japanese military construction projects. Through alignment with U.S. naval officials and other methods, including prayer and the singing of songs, Chamorro resisted Japanese occupation. Eventual return of the island to the U.S. occurred on July 21, 1944. The end of Japan's occupation was welcomed by local Chamorro. However, renewed U.S. military and political presence on Guam at the end of WWII included policies that put less emphasis on issues such as Chamorro reparations from the Japanese occupancy (see below) or land rights, causing some Chamorro opposition.

The passage of the Organic Act in 1950 provides context for the current political, legal and social relationship of Guam to the U.S. government. Although the Act did not provide full self-determination for Guamanians, it did bring stability as local citizens were given some opportunity to influence the island's governance. The Organic Act extended U.S. citizenship to indigenous and non-indigenous citizens on Guam and contained a bill of rights similar to that found in the amendments to the U.S. Constitution, but not including the provision of a trial by jury. Three branches of government were created, and decision making for the island was given to a local legislature composed of civilians. This ended more than 50 years of Navy administration of Guam. In an island wide 1976 referendum, island residents voted to maintain close ties with the U.S., but to also begin negotiations to improve the Territory's status. A 1979 draft constitution was rejected by a vote of five to one, particularly because of the need for continued discussion on Guam's political status. Seeking to improve its current political status, the Guam Commission on Self-Determination has drafted a proposed Guam Commonwealth Act, which was approved in two 1987 plebiscites. In February 1988, the document was submitted to the Congress for its consideration and was introduced in four consecutive Congresses--the 100th through the 104th (USDOI 2009).

Guam is currently an unincorporated Territory administered by the U.S. DOI. As an unincorporated Territory, the island is a possession of the U.S., but not part of the U.S. and not all provisions of the U.S. Constitution apply to the island. While universal suffrage applies to Guamanians 18 years and older, and Guamanians are considered citizens of the U.S.; they are not eligible to vote in U.S. presidential elections;

and Guam's Congressional representative does not have the right to vote on national laws (except in committees).

Political Minoritization

Related to the issue of political status is a concern about the growing "minoritization" of Chamorro as other ethnic groups – Mainlanders, Filipinos, or non-Chamorro Micronesians – increase as a percentage of the population. Prior to WWII, Chamorros comprised more than 90% of Guam's population. The percentage dropped below 50% by 1980 and was 42% in 2000.

Past labor shortages have resulted in increases in Filipinos and non-Chamorro Micronesians, while the military has been a driver of Caucasian or other Mainlanders coming to Guam. Inter-marriage among ethnic groups on Guam is rare and/or new; the 2000 Census found just 10% of the population identified themselves or household members as being of two or more ethnic groups, and more than 60% of these were children. Most young people are assimilating in the sense that they speak "only English" (65% for those five to 17 in 2000, versus 28% "only English" for those 18 and over). Among the 11% of children who were Chamorro speakers, two-thirds spoke it less frequently than English – while among the 26% of adults who were Chamorro speakers, only one-third spoke it less frequently than English.

World War II Reparations

Wartime reparations from the Japanese occupation remain a highly contentious issue, particularly because the elderly victims of that period are now reaching the end of their life spans. Guamanians suffered under the Japanese military administration from 1941 to 1944, and some believe that this occupation was the result of U.S. military presence on Guam. Although the U.S. guaranteed Japan immunity from reparations claims through Article 14 of the Treaty of Peace in 1946, Guamanians continue to request that the U.S. federal government pressure Japan to pay war reparations, or that the federal government pay them in Japan's stead. However, neither the U.S. Department of Insular Affairs nor the U.S. State Department has expressed a strong desire to pursue this request and Congress has refused to waive protections in Article 14 (USDOI 2004).

Military-Civilian Social Issues on Okinawa that Affect Public Perceptions on Guam

Public perception on Guam regarding the proposed action is affected in part by social issues that have emerged on Okinawa. In short, these issues are:

- Use of land
- Economic development
- Environmental damage
- Military-related accidents
- Crime and social order
- Prostitution and crimes against women

Thus, a brief overview of such issues on Okinawa is warranted as background for impact assessment.

Okinawa Prefecture in Japan consists of 49 inhabited and 110 uninhabited islands including the actual island of Okinawa (the largest island in the prefecture).

U.S. military presence on Okinawa began in the closing weeks of WWII with the Battle of Okinawa. Although the U.S. occupation of the main Japanese islands ended in 1952, the U.S. continued administration of the Ryukyu Islands, including Okinawa, until 1972. Over the years, the presence of the

U.S. bases has incurred protests from anti-war organizations, labor and religious groups, women's organizations, and political factions. Some of the major concerns are detailed below.

One stated concern is that while Okinawa comprises a small percentage of Japan's total land area (0.6%), a large amount (approximately 75% of the total land area) of facilities used exclusively by the U.S. Forces in Japan is located in the prefecture. In addition, a majority of U.S. service members in Japan (an estimated 60%) are stationed here, 60% of whom belong to the Marine Corps (Okinawa Prefecture 2009).

Some Okinawa residents perceive military bases as hindering regional economic development. Since 1972, three sets of plans have been set forth to improve the prefecture's infrastructure and incorporated plans for roadways, harbors, airports, and educational facilities. However, the locations and size of U.S. military bases have impeded the planned urban redevelopment. Military bases occupy approximately 10.4% of prefectural land and 18.8% of the main island of Okinawa where most of the population and industries are concentrated (Okinawa Prefecture 2004).

Additional concerns include noise pollution. In "A Report on the Aircraft Noise as a Public Health Problem in Okinawa," studies showed that aircraft noise exposure resulted in a wide range of physical and mental consequences that included sleep disorders, hearing loss, higher rates of low birth weight infants, fatigue, neurosis, and negative effects on children (Asahikawa Medical College 2000).

Environmental damage has also been cited. Reports claim that highly carcinogenic materials (fuels, oils, solvents, and heavy metals) are regularly released (Okinawa Prefecture 2004). Training exercises using live ammunition have caused forest fires, soil erosion, earth tremors, and accidents. Among the results, soil runoff has polluted the coral reef (Okinawa Prefecture 2004).

Military-related accidents and incidents, including helicopter and aircraft crashes, have also been a source of concern. Between Okinawa's reversion and the end of December 2003, 275 U.S. military aircraft-related accidents were recorded (40 of these were aircraft crashes) (Okinawa Prefecture 2004).

Crime and social order issues involving Status of Forces Agreement (SOFA) personnel on Okinawa are also of concern to Guam residents. Available crime counts in Okinawa include active duty military, civilians associated with military, and their dependents. Data from Japan's National Police Agency show that arrests for major crimes have been relatively low from 2003 to 2007, but increased by 11.1% in 2008. Despite this increase, Okinawa police are hesitant to make too much of the numbers, pointing out that the numbers are too small and appear to be more significant than they actually are. Analysts have stated that crimes by Americans are perceived as a major problem largely because of the attention they get in the local and international press and protests by anti-base groups on the island (Allen 2008).

Nevertheless, Americans connected to the military commit far fewer crimes per capita than their Okinawan counterparts. In 2008, SOFA-status people made up 3.28% of the island's population but accounted for 1.62% of all arrests. Previous years' statistics show similar low rates (Allen 2008, 2009; Allen and Sumida 2008; Republic of Korea Drop 2008; Weaver and Kusumoto 2008). During 2008, the Marine Corps made several changes to help prevent misconduct among its service members in Okinawa. Some of the changes included an expansion of uniformed courtesy patrols, a new liberty card policy, checks of outgoing vehicles at Marine Corps installations, and additions to the orientation and education seminar that all newcomers must attend (Allen 2009).

A critical event occurred in September 1995 with the abduction and rape of an Okinawan schoolgirl by three U.S. service members. Widespread public protests led to bilateral negotiations between the U.S. and Japan and led to the establishment of the Special Action Committee on Okinawa.

In looking at the history of U.S. military presence in Okinawa, arguments of justice and jurisdiction surround hundreds of allegations of sexual crimes that have been reported through the years. From 1945 to 1950, 278 rapes by U.S. servicemen were reported and an additional 200 rapes by U.S. military personnel were reported between 1972 and 1997 (Caron 1999). While the military views each crime as an individual incident, local protestors of these sexual crimes see gender-related violence as a structural issue that is perpetuated by legal, political, economic, and social structures (Cachola et al. 2008).

SOFA-related data rely on Okinawa prefecture records that group crime statistics into six major categories:

- Heinous crimes – murder, rape, robbery, arson
- Violent crimes – assaults, blackmail, extortion
- Thefts – burglaries, car thefts, muggings
- Intellectual crimes – fraud, counterfeiting
- Moral offenses – gambling, indecent assault, molestation
- Other, that includes vandalism and trespassing

The only quantitative data available are for "Heinous Arrests." Information on Moral Offenses is combined with Other Arrests and is therefore not listed in the table below (Table 16.1-23).

Table 16.1-23. SOFA-Status Total and Heinous Arrests on Okinawa, 2003-2008

Year	*Total Arrests*		*Heinous Arrests*	
	# of Individuals	*Cases*	*# of Individuals*	*Cases*
2003	133	112	12	7
2004	72	59	1	1
2005	65	66	4	2
2006	63	57	5	3
2007	46	63	6	6
2008	63	70	13	7

Source: Allen 2009.

The number of SOFA-status individuals arrested for Heinous Crimes is low, although the specific crime of rape cannot be distinguished from murder, robbery, and arson. Also, low numbers may be attributable to the widely accepted idea that sexual crimes are consistently underreported.

In 1969, at the height of the Vietnam War, the Okinawan police estimated that 7,362 Okinawan women were working in prostitution, though others estimated this number to be 10,000 or more. According to an Okinawan activist group (Okinawa Women Act Against Military Violence 2009), an estimated 7,000 Filipinas today serve as prostitutes – on entertainment visas – for U.S. military personnel in Okinawa, even though prostitution is illegal in Japan.

16.1.6.2 Land Issues

Guam's land issues have included debate over the large areas of military land on the island restricted from public access and concerns over nonpayment or perceived inadequate payment for land used as military bases during and after WWII. More recently, tighter national security measures following the attacks of September 11, 2001 resulted in the Air Force restricting access to tour groups that had previously accessed to two beaches (Tarague and Jinapsan) on the shores below Andersen AFB. Landowners themselves now must access these properties using all-terrain vehicles along the coastline rather than having direct access through Andersen AFB.

Agencies involved in land issues include the Chamorro Land Trust Commission (CLTC) and the Guam Ancestral Lands Commission.

Chamorro Land Trust Commission

The five-member CLTC, assisted by its staff, was set up by Guam Public Law 25-45 to pass title of federal excess lands, once returned to the GovGuam, back to original landowners or their heirs. Guam Public Law 25-178 sets the missions, mandates, powers and jurisdiction of the CLTC in processing claimant applications for Deed of Title.

Guam Ancestral Lands Commission

The five-member GALC aided by its staff, controls the Chamorro homelands. It makes these lands available to qualified applicants (native Chamorro or descendents thereof) through residential, agricultural and grazing leases. For purposes of this land trust, a "native Chamorro" is defined as anyone descended from people residing on Guam from the period between 1898 and prior to the 1950 Organic Act (Appendix F SIAS - CLTC Interview).

The GALC also issues commercial licenses to generate the revenue necessary for operating the Program (21 Guam Code Annotated, Chapter 75; Guam Public Law 22-18, and Guam Public Law 23-38 as amended). However, in June 2009 the Legislature passed a bill imposing a moratorium on commercial leases until the CLTC develops regulations and a land use plan designating specific lands available for commercial leases (Hart 2009). This bill was the culmination of a critical report by the Office of the Public Auditor on, and subsequent legislative attention to, a variety of questions about CLTC management and staffing capacity to deliver all its services to native Chamorros. Part of the intent of the bill was to ensure residential leases are prioritized over commercial leases (Gesick 2009).

16.1.6.3 Crime, Vice, and Social Order

Tourism, the military, and periodic construction spikes have all been perceived to create markets for alcohol, illegal drugs, prostitution, and illegal gambling on Guam. Such issues have emerged as significant during public dialogue about the proposed action and its attendant construction phase.

The first U.S. military-civilian conflicts on the island back in 1899 centered on fights due to the sale of liquor to Sailors and Marines, and subsequent "drunkenness" (Rogers 1995). Guamanians also remain particularly concerned about the abuse of local women, due to reports of rapes by military personnel on Okinawa.

Recent figures from 2006 show Part I Offenses account for 26.02 cases per 1,000 residents, while Part II Offenses tally at 42.65 cases per 1,000 residents (Guam Police Department 2007).

As for crimes on-base, Guam has concurrent jurisdiction that allows civilian law enforcement personnel access to the base. For example, U.S. Marshals can go on-base to serve court orders (Guam Judiciary 2008). Depending on the type of case, the military can take jurisdiction. For example, if Child Protective Services is involved, the military and civilian agencies work together, and the information is public. However, if cases are handled by internal base procedures, no public disclosure is necessary (Guam Civilian Military Task Force Committee on Public Safety 2008).

16.1.6.4 Sociocultural Changes

When overseas bases are placed in areas culturally different from the majority of military personnel, there often exists a feeling of disconnect between incoming military personnel's culture and customs and that of the local population. On Guam, discussions on this often involve the concept of military personnel's

respect for Guam's people. There is no clear evidence that this feeling is any more or less pronounced on Guam than elsewhere. However, the most common suggestion for the military in conducting the proposed action was better communication (KUAM 2008).

Community surveys capture the diversity of community sentiment toward the proposed action. A March 2007 survey by the Guam Chamber of Commerce found 71% of those polled support an increased military presence (Partido 2007). A subsequent survey conducted by the UoG Public Affairs and Legal Studies Club in 2008 found that 52% of those surveyed think that the proposed action is a good thing for Guam and 88% expect the buildup to bring jobs and other economic benefits to Guam. The Guam Chamber of Commerce then conducted a follow-up survey in early 2009 and again found about a 70% favorable response, with slightly higher support among less affluent households (Tamondong 2009).

16.1.6.5 Quality of Life

The concept "quality of life" overlaps with virtually all topics covered by this EIS/OEIS, and concerns in general the ability of the island to adequately support the proposed action, including how it would affect the island's general tranquility, quality of family and community relations, and standards of living.

The 2007 Guam Chamber of Commerce survey noted above found that 60% of polled Guam residents thought the proposed action would improve quality of life. However, there remain concerns that are heightened by the fact that military facilities are segregated from public facilities, and are ultimately seen as better quality than the latter. For instance, DoD's decision to establish its own school system in the late 1990s was interpreted as a "hostile" action by some elected officials (Underwood 1997), removing funding from a public school system to establish a separate, competing system. This feeling can be extended to health care infrastructure, housing costs and availability, access to recreational facilities, and competitive pricing (on-base versus off-base).

16.2 ENVIRONMENTAL CONSEQUENCES

16.2.1 Approach to Analysis

This Environmental Consequences section presents impact analysis under the proposed action and the no-action alternative. As the socioeconomic impacts would be islandwide in nature with little difference in effects among the various alternatives, the summary of impacts presented below covers all of the alternatives except the no-action alternative, which is treated separately in Section 16.2.4. For the island of Guam, this analysis addresses potential population impacts, economic impacts, public service impacts, and sociocultural impacts from both construction and operational phases of the proposed action. An analysis of the impacts associated with the off base roadways is discussed in Volume 6 and a summary of impacts from all of the proposed actions is addressed in Volume 7.

Direct, indirect, and combined or "total" impacts of the proposed action are addressed in this section. Direct impacts are impacts that come from *direct expenditures*, or the first round of spending. These include expenditures related to the construction phase first, and then ongoing military expenditures during the operational phase. Indirect impacts are impacts that are stimulated by *indirect expenditures*, or subsequent rounds of spending. These expenditures circulate through the economy, generating "spin-off" sales and businesses. The term "indirect impacts" is used to cover both *indirect effects* and *induced effects*.

The environmental consequences analytical results reported in this chapter are calculated for a maximum potential scenario that assumes there would be no constraints (blockages) to the rapid development of

spin-off private-sector economic activity driven by the military construction and permanent military operational stages.

16.2.1.1 Methodology

Methodology for assessed impacts varied. Following is a brief summary. Refer to the Methodology Chapter (Chapter 2) of the Socioeconomic Impact Assessment Study (SIAS) for details of this methodology (Located in Appendix F).

Methods for Population and Economic Sections

Labor force, population, and housing demand estimates all flow from specific economic assumptions about workers per million dollars of expenditures, non-working dependents per worker, and workers per housing unit.

For economic impacts, standardized economic impact models and techniques were used for both construction and operational phases. To calculate the indirect impacts of spending, the 2005 State of HI Input-Output (I-O) model was used to estimate how many jobs and other economic variables are created as initial new spending and later rounds of spending flow through the Guam economy. Since there is no specific updated economic model for Guam, HI models are used to represent Guam's similar island-based economy.

Methods for Public Service Sections

Impacts on GovGuam public service agencies were estimated based on information from literature reviews, searches of online and historical data sources, written surveys, key informant interviews, and agency data sources when available.

The basic method of analysis involved first determining the number of key professional staff currently working at each agency and providing the existing population with necessary services. Care was taken to determine an appropriate baseline measure by seeking historical data from the agencies, to reduce the odds that the most recent available figures came from years with unusually high or low standards of service. Then the number of each agency's "service population" (i.e. the people using the services) was determined, and care was taken to determine whether this meant the population in general or just some portion, such as civilians only or children only. Finally, these two numbers were used to develop an agency-specific ratio of key professional staff positions to service population.

Once the above calculations were completed, population increases associated with the proposed action could be applied to the ratios to determine the additional professional staff that would be associated exclusively with the proposed action.

Methods for Sociocultural Sections

Sociocultural topics are addressed in a more qualitative fashion. Analysis used available evidence from published sources, interviews, and historical evidence. Some social issues could have many outcomes and are more important to manage than to predict. There are also pre-existing social issues that, due to the nature of the proposed action, may be more often discussed or remembered by residents; issues such as these were acknowledged in the "Affected Environment" sections above.

16.2.1.2 Determination of Significance

It is difficult to assign significance levels to socioeconomic impacts because (1) there is no "national" standard or definition embedded in legislation that defines what constitutes a "significant" socioeconomic impact (i.e., there is no legislation comparable to the Clean Air Act, Clean Water Drinking Act, Historic

Preservation Act, etc.); (2) there are few objective or widely accepted criteria of either the magnitude or valuation, and what might be "beneficial" (or good) to one person could be "mixed" to another and "adverse" (or bad) to yet another; (3) related socioeconomic topics often are like two sides of the same coin, one "beneficial" (such as increased job opportunities) and the other mixed or "adverse" (such as social stress from in-migrant workers attracted by new jobs); (4) some topics have multiple dimensions or sub-topics, and different conclusions may be reached for different aspects; and (5) short-term impacts can differ from long-term ones – especially for the construction period (for instance the construction period would include both a rapid increase in beneficial economic activity and then a decline so sharp that it would meet normal definitions of an economic "recession").

The U.S. Council on Environmental Quality regulations for implementation of National Environmental Policy Act provides 10 broad guidelines about determining whether the intensity of an impact is "significant." None are specific to socioeconomic topics but three do refer to the "public" or the "human environment" rather than physical resources or places:

- "The degree to which the proposed action affects public health or safety." (Code of Federal Regulations [CFR]Title 40 Sec. 1508.27(b)(2))
- "The degree to which the effects on the quality of the human environment are likely to be highly controversial." (40 CFR 1508.27(b)(4))
- "The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks." (40 CFR 1508.27(b)(5))

While these are insufficient by themselves to generate criteria for significance of socioeconomic impacts, they help in the following formulations.

Significance Criteria for Population/Economic Sections

Although there is no national legislation that establishes criteria for defining socioeconomic impacts, there is DoD specific legislation (P.L. 110-17 10 U.S.C. 2391: Military base reuse studies and community planning assistance) and implementing DoD Directives (DoD 3030.01 and 5410.12) that do address the issue of what is a significant impact on communities due to changes in Defense Programs. Collectively these documents establish "thresholds" that allow the DoD's Office of Economic Adjustment (OEA) to provide communities with technical and financial assistance for organizing and planning for Defense impacts. To qualify for financial assistance, the magnitude of the DoD personnel increases must meet the following statutory thresholds:

- More than 2,000 direct military civilian and contractor DoD personnel (i.e., net additional) or
- More military, civilian and contractor personnel than equal to 10 percent of the number of persons employed in the counties or independent municipalities within 15 miles of the installation, whichever is less, and;
- Federal, state or local community impact planning assistance is not otherwise available.

Additionally, OEA must make a finding that the affected community will experience a "direct and significantly adverse consequence" based on the DoD impacts in light of community-specific needs and resources (Economic Adjustment Technical bulletin 5: Managing Community Growth).

The above thresholds are population/economic and capacity driven and they have been applied by OEA to make financial grants to GovGuam.

The Population/Economic analysis in this document focuses primarily on the impact the proposed action alternatives would have on the economy of Guam and the prosperity of its people.

Given that the OEA threshold criteria have already been met, for purposes of this analysis any population or economic impact was considered "significant" if it would add 2% or more at any point in time to expected population or economic levels without the proposed action. The literature on growth rates that communities can absorb without experiencing serious consequences to their physical and social infrastructure and fiscal health does not provide an absolute threshold. Rather the literature points to the relative abilities of communities to absorb growth based on their existing capacities and contextual settings. The value of 2% was selected for purposes of this study because of the small size and remoteness of Guam's economy and its relatively limited financial resources. Another value often used for statistical comparisons is 5%, but given Guam's existing infrastructure capacities and financial capabilities, 5% was deemed too stringent. However, during the construction phase of the proposed action the 5% value is also exceeded.

Quantifiable impacts related to jobs and dollars – the usual measures of prosperity – were considered "beneficial" impacts if they increased the expected level of jobs or dollars by 2% or more. While the potential for economic downturns after the construction boom peak will be noted, they are not considered sufficient to change the overall impact assessment from "beneficial" to "adverse."

Impacts that are either qualitative (such as effects on tourism) or where precise numbers cannot be predicted (such as cost of living) were given significance ratings on a judgmental basis considering the overall information available from surveys or interviews conducted as part of this study. In some cases the results of these efforts were too mixed in nature to be clearly call an impact as either beneficial or adverse.

Population increases in particular were considered as inherently mixed (both beneficial and adverse), because population growth fuels economic expansion, but sudden growth also strains government services and the social fabric.

Significance Criteria for Public Service Sections

The Public Service sections focus primarily on the impact the proposed action alternatives would have on GovGuam public service agencies, especially key professional staff. The proposed action is expected to increase population in the area, resulting in more demands for services. Significance of additional demand was assessed through qualitative and quantitative calculation of whether this increase would necessitate substantial increases in 1) staffing (including consideration of whether staffing needs could easily be met), 2) new or physically altered facilities, and/or 3) equipment/vehicles. In general, however, the 2% criteria was be applied, although in relation to the reported actual staffing levels in the "baseline year" (generally 2005) for agencies supplied information. Given the financial challenges facing GovGuam (discussed in Volume 9, Appendix G), demands for additional staffing were considered adverse in nature.

Significance Criteria for Sociocultural Sections

Sociocultural impacts are largely qualitative in nature, and the analysis focused less on predicting quantifiable impacts than on identifying potential problems and opportunities. However, sociocultural impacts remain an important element of the proposed action and have attracted much public attention and comment. Many sociocultural impacts tend to be mixed in nature. To the extent their "significance" can be assessed, it was based on the relative magnitude of the proposed action under consideration. They were regarded as "adverse" if they threatened public safety or order, and "beneficial" if they preserved or enhanced the social fabric.

16.2.1.3 Issues Identified During Public Scoping Process

The citizens and governments of Guam and CNMI commented on a variety socioeconomic issues during public scoping meetings held on Guam, Saipan, and Tinian on April 17-20, 2007. The importance of these issues was reinforced as additional public comments were received via mail and email. Additionally, these issues have been stressed in studies and publications released by GovGuam and covered in the public media on Guam. This Environmental Consequences section addresses these issues.

Citizens expressed concerns about the following:

- *Social Infrastructure:* e.g., education, healthcare, childcare, and mental health services etc.
- *Community Infrastructure:* e.g., power, water, wastewater, solid waste etc.
- *Labor Impacts:* availability of labor and material for non-defense projects etc.
- *Housing:* e.g., housing supply and demand, affordability, etc.
- *Public Safety:* e.g., police, courts, fire protection, etc.
- *Tourism/recreation:* e.g., effects on tourism and recreational assets and access, etc.
- *Private Property:* concern for use and access to private property, etc.
- *Cultural Impacts:* effects on Chamorro culture of off-island construction workers, etc.

Issues raised during scoping meetings with GovGuam included:

- GovGuam capacity and impacts on agencies
- Federal agencies capacity
- Increasing immigration
- Lack of existing socioeconomic data
- Availability of local trained labor
- Sources of off-island labor
- Housing impacts, especially during the construction stage for off-island workers.

16.2.2 Proposed Action

16.2.2.1 Population Impacts

Population impacts include analysis of:

- Project Related Population
- Demographic Characteristics
- Household Characteristics

Project Related Population

Approach to Analysis

Project related population impacts predict all new populations on Guam related to the proposed action.

Direct new populations include construction workers from off-island and their dependents, active duty military, military dependents, new residents filling on-base civilian jobs and their dependents, and new residents filling jobs created by the first round of spending and their dependents.

Indirect new populations include new Guam residents who may move to Guam to fill jobs created by subsequent rounds of spending and their dependents If there are a large number of "stay-behind" workers (in-migrants that migrate for construction-period jobs and stay on Guam), the decline in population from the beginning of 2014 to the end of 2016 will not be as dramatic as shown in the population impact

calculations below. If the stay-behind worker phenomenon leads to increased in-migration over time, then the population in the years 2017 forward would increase at a faster rate than illustrated. Since it is expected that a large percentage of immigrant workers will originate from the Philippines, population growth related to. stay-behind workers would likely, disproportionately, originate from there.

Table 16.2-1 provides assumptions made in conducting analysis for the construction phase, as well as the source of or rationale for those assumptions.

Table 16.2-1. Construction Component Assumptions for Project Related Population Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Average number of dependents for in-migrating direct, on-site, construction jobs	0.20 – 0.35	Contractor interviews
Average number of dependents for in-migrating direct from purchases jobs	0.95 - 1.0	U.S Census data on persons per jobs (U.S. Census Bureau 2000d) and GDoL interviews
Average number of dependents for in-migrating indirect/induced jobs	0.95 - 1.0	U.S Census data on persons per jobs (U.S. Census Bureau 2000d) and GDoL interviews

Table 16.2-2 provides assumptions made in conducting analysis for the operations phase, as well as the source of or rationale for those assumptions.

Table 16.2-2. Operational Component Assumptions for Project Related Population Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Number of Marines by 2014	8,552	Description of Proposed Action and Alternatives (EIS/OEIS)
Number of Marine dependents by 2014	9,000	same as above
Number of rotational transient Marines by 2014	2,000	same as above
Average number of dependents for in-migrating civilian military personnel	0.95	U.S Census data on persons per jobs (U.S. Census Bureau 2000d)
Average number of dependents for in-migrating direct from purchases jobs	0.95 - 1.0	U.S Census data on persons per jobs (U.S. Census Bureau 2000d) and GDoL interviews
Average number of dependents for in-migrating indirect/induced jobs	0.95 - 1.0	U.S Census data on persons per jobs (U.S. Census Bureau 2000d) and GDoL interviews

Impacts

The projected project related impact on population is shown in Table 16.2-3. As the table indicates, a 2014 peak-year total impact would result in population increase of 65,527, falling to a steady 31,071 as increases in base operational expenditures cease by 2019.

Table 16.2-3. Estimated Population Increase Associated with Proposed Marine Corps Action

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Population[1,]	9,239	22,667	33,916	41,464	65,527	54,799	38,612	30,894	30,894	31,071	31,071

[1] Marine population numbers include: uniformed Marines, associated civilian workers and their dependents from off-island.

Figure 16.2-1 compares total population on Guam with and without the proposed action. At the 2014 peak, population with the proposed action is 34% higher than it otherwise would have been, without the project. At 2020, the difference declines to 15%.

Figure 16.2-1 indicates significant project related impact. Population increases are considered to be inherently mixed (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric.

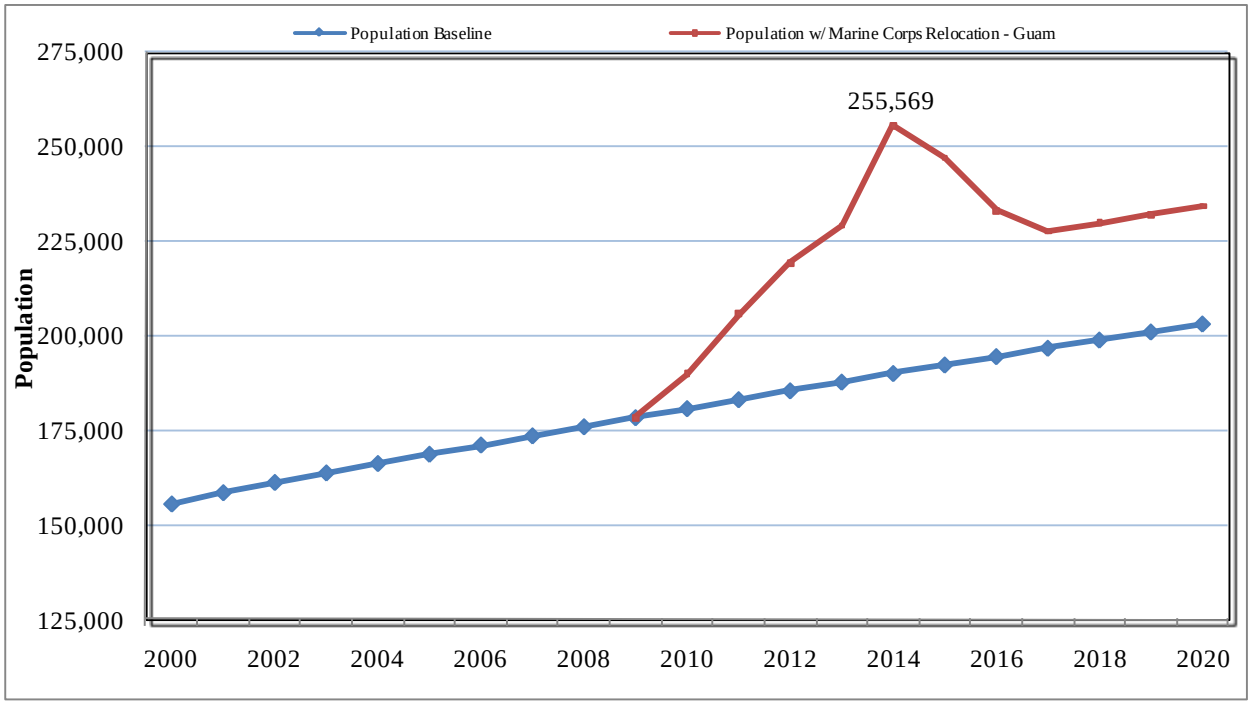


Figure 16.2-1. Population with and without Proposed Action

Demographic Characteristics

Approach to Analysis

New population on Guam related to the proposed action would have a different demographic composition than what currently exists on Guam, and will thus affect the island's demographic composition.

Demographic impact data discussed here are broken out into two components. One is for those individuals coming to Guam as part of the proposed action (i.e. marine relocation). The other is for people who are likely to come to Guam seeking employment. The analysis is based on the historic characteristics of in-migrating groups and the military population. Results from this analysis are compared to the demographic characteristics of Guam presented in the Affected Environment Section.

Table 16.2-4 provides assumptions made about the demographic characteristics of population related to the employment component as well as the source of or rationale for those assumptions.

Table 16.2-4. Employment Component Assumptions for Demographic Characteristic Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Number of Cases Studied (Not born on Guam, moved to Guam for employment)	1,525	U.S. Census. Guam 10% PUMS data, 2000
Average Year of Entry	1987	U.S. Census. Guam 10% PUMS data, 2000
Median Age when moved to Guam	32	U.S. Census. Guam 10% PUMS data, 2000. Reported median age adjusted for year of entry
Gender		
Male	74.2%	U.S. Census. Guam 10% PUMS data, 2000
Female	25.8%	U.S. Census. Guam 10% PUMS data, 2000
Ethnicity		
Asian Alone	56.1%	U.S. Census. Guam 10% PUMS data, 2000
Native Hawaiian/Other pacific Islander	24.8%	U.S. Census. Guam 10% PUMS data, 2000

Assumption	*Assumed Value*	*Source/Rationale*
White Alone	13.1%	U.S. Census. Guam 10% PUMS data, 2000
Other	6.0%	U.S. Census. Guam 10% PUMS data, 2000
Predominant Places of Birth		
Philippines	44.8%	U.S. Census. Guam 10% PUMS data, 2000
U.S.	18.1%	U.S. Census. Guam 10% PUMS data, 2000
Micronesia	13.4%	U.S. Census. Guam 10% PUMS data, 2000
Korea	5.6%	U.S. Census. Guam 10% PUMS data, 2000
China	5.0%	U.S. Census. Guam 10% PUMS data, 2000
Japan	3.9%	U.S. Census. Guam 10% PUMS data, 2000
Palau	2.4%	U.S. Census. Guam 10% PUMS data, 2000
CNMI	1.4%	U.S. Census. Guam 10% PUMS data, 2000
Educational Attainment (25 yrs. and older)		
High School Grad.	42.5%	U.S. Census. Guam 10% PUMS data, 2000
College Degree	33.4%	U.S. Census. Guam 10% PUMS data, 2000

Table 16.2-5 provides assumptions made about the demographic characteristics of population related to the military operational component as well as the source of or rationale for those assumptions.

Table 16.2-5. Military Component Assumptions for Demographic Characteristic Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Number of Cases Studied (Military & military dependents)	1,995	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Median Age	24	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Gender		
Male	56.7%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Female	43.3%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Ethnicity		
White alone	61%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Asian alone	12%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Black or African American alone	7%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Some other race alone	5%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Two or more major race groups	12%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Predominant Places of Birth		
U.S.	86.6%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Philippines	2.5%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Japan	1.8%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Germany	1.5%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Puerto Rico	1.1%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates

Assumption	*Assumed Value*	*Source/Rationale*
Korea	0.8%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Guam	0.7%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Educational Attainment (25 yrs. and older)		
High School Graduate	47.2%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
College Degree	50.7%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates

Impacts - Employment Component

Populations who move to Guam for employment purposes are made up of more males than females. Therefore, the proposed action would increase the percentage male population on Guam.

Populations who move to Guam for work have historically moved at an average age of 32. This is an older population than Guam's current population. Therefore the employment component of the proposed action would increase the average age of the Guam population slightly.

Populations who have moved to Guam for employment purposes in the past have relocated largely from Asian or Other Pacific Island areas, with places of birth located mainly in the Philippines, the U.S., or Micronesia. This component of the proposed action would thus result in the population of Guam being made up of a relatively smaller population of Chamorros and Guam-born individuals, and a relatively higher population of Filipinos, Caucasians from the U.S Mainland, and Micronesians.

The educational attainment levels of people who move to Guam for employment purposes are variable, displaying low levels of high school graduation but high levels of college graduation. This likely represents the historical type of employment available on Guam (typically trades-related or requiring a specialty skill). Overall, the analysis shows that the in-migrant population would have a similar educational attainment as those currently living on Guam (most would have at least a high school diploma).

Impacts - Military Component

The military component incoming population will have a higher ratio of males to females than currently reside on Guam. Therefore, the proposed action would increase the percentage male population on Guam.

The military component incoming population will generally be younger than Guam's population. Therefore this component of the proposed action would decrease the average age of the Guam population slightly.

The military component incoming population will be composed of more Caucasian backgrounds than Guam's current population. This component of the proposed action would thus result in the population of Guam being made up of a relatively smaller population of Chamorros and Guam-born individuals, and a relatively higher population of Caucasians from the U.S Mainland.

There is a higher overall level of educational attainment among the expected military population than is currently present on Guam. Therefore the proposed action would increase the number of people on Guam who possess a college degree.

Household Characteristics

Approach to Analysis

If a new population on Guam related to the proposed action had a different household composition than what currently exists on Guam, it would affect the island's household composition.

Impacts are presented in *employment component* and *military operational component* phases. Results from this analysis are compared to the household characteristics of Guam presented in the Affected Environment Section.

Table 16.2-6 provides assumptions made about the household characteristics of population related to the employment component as well as the source of or rationale for those assumptions.

Table 16.2-6. Employment Component Assumptions for Household Characteristics Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Number of Cases Studied (Not born on Guam, moved to Guam for employment)	1,525	U.S. Census. Guam 10% PUMS data, 2000
Average Household Size	3.58	U.S. Census. Guam 10% PUMS data, 2000
Median Household Income	$39,580	U.S. Census. Guam 10% PUMS data, 2000
Income per Household Member	$11,055	U.S. Census. Guam 10% PUMS data, 2000
Family Households	80%	U.S. Census. Guam 10% PUMS data, 2000
Households with Children	42.4%	U.S. Census. Guam 10% PUMS data, 2000
% of Households Below the Poverty Line Below	23.3%	U.S. Census. Guam 10% PUMS data, 2000

Table 16.2-7 provides assumptions made about the household characteristics of population related to the construction component as well as the source of or rationale for those assumptions.

Table 16.2-7. Military Component Assumptions for Household Characteristic Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Number of Cases Studied (Military & military dependents)	1,995	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Average Household Size	3.4	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Family Households	87.1%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
Households with Children	31.9%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates
% of Households Below the Poverty Line Below	1.1%	U.S. Census American Community Survey, PUMS 2005-2007 3-yr estimates

Impacts - Employment Component

The household characteristics of populations who come to Guam for employment purposes are very similar to Guam overall. Households that include persons who moved to Guam for employment purposes have:

- Only a slightly smaller number of people per household
- Slightly more children per household
- The same rate of poverty
- Slightly higher income per household

Impacts to Guam's overall household composition would be fairly negligible.

Impacts - Military Component

The expected military population would have:

- About one-half fewer persons per household
- Fewer children

Military household income in HI was slightly lower than HI households overall. However, this may or may not be the case for the military population on Guam. In 2000, military household income was lower than Guam overall, however, income per household member was higher than Guam overall. The expected impact is that military households would have similar household income but higher income per household member. Only 1.1% of military households lived below the poverty line. Thus, Guam's overall poverty rate will be lowered.

Summary of Population Impacts

The population impacts analysis indicates direct and indirect significant impacts – of mixed beneficial/adverse nature – due to construction impacts peaking in 2013 at 36,811 additional population (not counting overlap with operations) and final operational impacts of 27,156 military and civilian population.

16.2.2.2 Economic Impacts

Economic impact analysis primarily includes topics for which numerical estimates can be made, including:

- Civilian employment and income
- Housing for civilian population
- Government revenues and sources
- Gross Island Product (GIP)

Some economic topics are less conducive to quantification, but qualitative information about their impacts is presented in the section for:

- Potential effects on standard of living
- Unemployment
- Local business opportunities and constraints
- Effects on tourism

Employment and Income

Employment and income impacts include the following topics:

- Civilian Labor Force Demand
- Civilian Labor Force Supply
- Civilian Labor Force Income
- Standard of Living
- Unemployment

Civilian Labor Force Demand - Approach to Analysis

Labor force "demand" refers to the jobs created by the proposed action and the workers needed to fill them. The analysis focused on civilian jobs only, including federal civilian workers and other jobs from spin-off economic growth. Calculations are in terms of full-time equivalents (FTEs). For example, two

half-time jobs would be counted as one FTE. The number of FTE jobs is assumed to be equal to the number of required workers.

Table 16.2-8 provides assumptions made in conducting the civilian labor force demand analysis for the construction phase as well as the source of or rationale for those assumptions.

Table 16.2-8. Construction Component Assumptions for Civilian Labor Force Demand

Assumption	*Assumed Value*	*Source/Rationale*
Worker Requirement Factor	75 Workers Per $10 Mil Project Cost	Guam Contractors Association interviews
Supervisory Worker Requirement Factor	4 Supervisory Workers Per $100 Mil Project Cost (not additional to other workers)	Guam Contractors Association interviews
Labor Cost as % of Total Project Cost	21%	Calculated as verification of worker requirement factor. Consistent with contractor projections.
Current H-2B Construction Labor on Guam	1,443	GDoL Employers Workplace Monthly Report Summary July, 2008
Guam Construction Workforce	2,531	Average of two estimates. The first estimate is based on GDoL June 2008 Current Employment Report construction industry production workers (with present H-2B construction workers excluded). The second estimate is based on estimates made by contractors during interviews.
Percentage of On-Site Workforce from H-2B	56%-61%	Contractor interviews

Table 16.2-9 provides assumptions made in conducting the civilian labor force demand analysis for the operations phase, as well as the source of or rationale for those assumptions. Table 16.2-10 shows key intermediate calculations feeding into subsequent estimates of the impact on total labor force demand from operations.

Table 16.2-9. Operational Component Assumptions for Labor Force Demand

Assumption	*Assumed Value*	*Source/Rationale*
Civilian Military Workers per Active-Duty Marine	0.4	Description of Proposed Action and Alternatives (EIS/OEIS)

Table 16.2-10. Intermediate Operations-Related Calculations for Civilian Labor Force Demand

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Civilian Military Employees	204	468	468	468	3,421	3,421	3,421	3,421	3,421	3,421	3,421

Civilian Labor Force Demand – Impacts

Collectively, employment impacts are beneficial (especially during the construction phase). However, total employment after the construction peak will decline substantially but will be above pre-project levels.

Table 16.2-11 shows the proposed action would support a combined 32,980 workers at the 2014 peak, but only 6,146 after construction abates in 2017.

Table 16.2-11. Impact on Civilian Labor Force Demand (FTE Jobs)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Employment	6,041	14,440	22,701	28,741	32,980	24,712	13,040	6,146	6,146	6,146	6,146

Figure 16.2-2 compares total labor force demand on Guam with and without the proposed action. At the 2014 peak, civilian labor force demand with the proposed action is 75% higher than it otherwise would have been, without the project. At 2020, the difference declines to 12%.

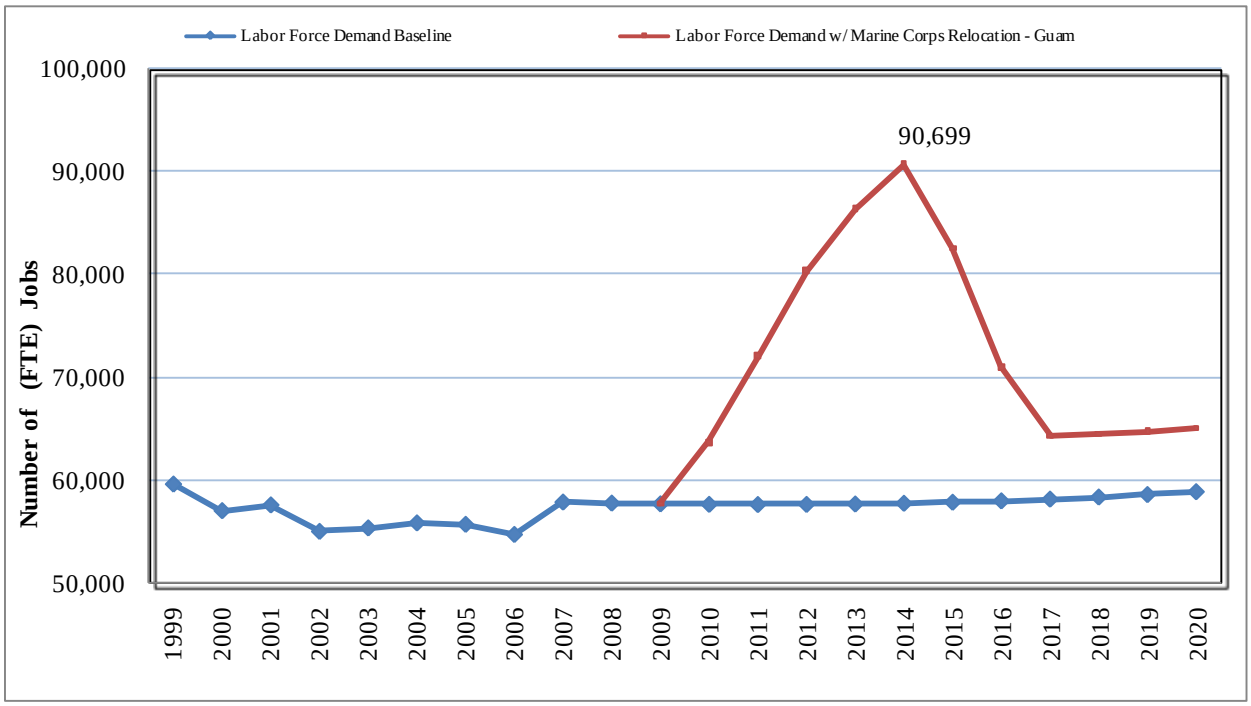


Figure 16.2-2. Labor Force Demand with and without Proposed Action

Civilian Labor Force Supply - Approach to Analysis

Evidence for potential labor supply sources is provided for:

- Direct on-site military construction
- Other employment (direct construction jobs from purchases or civilian operational jobs, as well as indirect workers)

Analysis was conducted to address the following two questions:

- How many of the civilian jobs (on a net basis) are likely to accrue to currently unemployed Guam residents?
- From what countries or regions are the rest of the workers likely to in-migrate?

Possible sources for direct on-site military construction workers include:

- Current Guam Residents
- Temporary Foreign Workers
- CNMI and Other U.S. Pacific Islands
- Other Workers from the continental U.S. (CONUS) or Hawaii

Table 16.2-12 presents assumptions about labor sources for direct on-site military construction labor, and the source or rationale for these assumptions. Refer to the Appendix F SIAS for additional descriptions of and historical information regarding each of these sources.

Table 16.2-12. Assumptions for Origins of Direct On-Site Labor Force Construction Supply

Assumption	*Assumed Value*	*Source/Rationale*
Quantitative Assumptions		
Construction employment	75 workers per $10 million total construction cost	Guam Contractors Association interviews
Guam residents holding construction jobs	Up to 2,670 jobs at peak	GCA and Guam DOL employment by industry data
CONUS/HI/Japan % of workforce	4 supervisory workers from U.S. or Japan per $10 million project cost.	Guam Contractors Association interviews
Supervisor/Labor split of CONUS/HI/Japan	4% / 96%	Guam Contractors Association interviews
Philippines/Other split of H-2B workforce	85% / 15%	Guam Contractors Association interviews
Other U.S. Pacific Island % of workforce	residuals of work force	Guam Contractors Association interviews
Qualitative Assumptions		
Fees for H-2B workers	They do not become an impediment to recruiting affordable labor	Entire project could founder if the economics are impractical
Competition for CONUS workers from federal stimulus spending	This would alone not be sufficient or widespread enough to deter at least some CONUS workers from Guam	This is a matter of great uncertainty, but there is a strong commitment by government to seek out U.S. workers

Notes: No assumption is made about the likely split of "Other Pacific Island" workforce among the CNMI, Federated States of Micronesia, Republic of the Marshall Islands, Palau, and American Samoa. This reflects conflicting evidence in the foregoing table and the general difficulty of predictions for specific small areas.

Possible sources for construction-related jobs other than direct on-site jobs (i.e., direct from purchases and indirect); direct federal civilian jobs associated with the military; and spin-off jobs include:

- Guam Residents
- Temporary Foreign Workers (H-2B visa workers)
- Other U.S. Pacific Island Workers
- Other Workers from CONUS, Hawaii, or Okinawa Transfers

Given the uncertainties involved for various potential off-island labor sources, this analysis is restricted to assumptions and estimates strictly about "on-island" and "off-island" labor force sources (Table 16.2-13). Refer to the Appendix F SIAS for additional descriptions of and historical information regarding these sources.

Table 16.2-13. Assumptions for Origins (On vs. Off-Island) of Labor Force Supply for Employment Other Than Direct On-Site Construction

Assumption	*Assumed Value*	*Source/Rationale*
Sources of direct federal civilian employment.	50% Okinawa transfers, 25% military spouses, 25% other off-island.	Planning assumption provided by NAVFAC Pacific
Absorption of Guam's pool of unemployed workers.	By 2014, Guam's unemployment rate would decline to 4.0%, then gradually rise somewhat thereafter.	For analysis/modeling purposes, currently unemployed Guam residents were assigned to Indirect employment

Civilian Labor Force Supply - Impacts

Table 16.2-14 shows the probable origins of the labor force supply for direct onsite military construction jobs.

Table 16.2-14. Estimated Origin of Workers Constructing Military Facilities

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
TOTAL	**3,186**	**7,672**	**12,358**	**15,816**	**15,257**	**10,572**	**3,928**
GUAM	**562**	**1,226**	**1,768**	**1,999**	**1,929**	**1,336**	**497**
OFF-ISLAND	**2,622**	**6,443**	**10,584**	**13,810**	**13,322**	**9,231**	**3,430**
H-2B Workers	1,775	4,401	7,295	9,600	9,261	6,417	2,384
Philippines	1,508	3,741	6,201	8,160	7,872	5,455	2,027
Other	266	660	1,094	1,440	1,389	963	358
CONUS/HI/Japan	499	1,202	1,936	2,478	2,391	1,656	615
Supervisor (U.S., Japan)	21	50	85	106	100	64	23
Labor	478	1,151	1,854	2,372	2,289	1,586	589
Other U.S. Pacific Islands	349	840	1,353	1,731	1,670	1,157	430

Notes: Numbers may not add exactly due to rounding.

Table 16.2-15 indicates that Guam residents are expected to capture 2,566 jobs at the 2014 construction peak; these jobs include civilian military jobs, direct from purchases jobs and indirect/induced jobs. By 2020, 2,211 jobs related to the proposed action will go to Guam residents. Table 16.2-16 shows that at the 2014 peak, 15,157 jobs would be taken by off-island workers with that number decreasing to 3,935 by 2020.

Table 16.2-15. Estimated Numbers of On-Island Workers for Various Job Categories Excluding Direct On-Site Construction

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Jobs, for On-Island Workers (Excluding Direct Military Construction)	479	948	1,334	1,812	2,566	2,466	2,433	2,302	2,302	2,211	2,211

Notes: Demand is in terms of FTE jobs, and assumes one worker per FTE job

Table 16.2-16. Estimated Numbers of Off-Island Numbers of Workers for Various Job Categories Excluding Direct On-Site Construction

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Jobs, Excluding Direct Military Construction, for Off-Island Workers	2,376	5,819	9,009	11,112	15,157	11,674	6,678	3,845	3,845	3,935	3,935

Notes: Demand is in terms of FTE jobs, and assumes one worker per FTE job

Civilian Labor Force Income - Approach to Analysis

Civilian labor force income refers to the cumulative gross wages and salaries (before deductions for taxes) earned by the civilian workers. This information is important for later GovGuam revenue calculations.

Table 16.2-17 provides assumptions made in conducting civilian labor force income analysis for the construction phase, and the source or rationale for these assumptions.

Table 16.2-17. Construction Component Assumptions for Civilian Labor Force Income

Assumption	*Assumed Value*	*Source/Rationale*
Non-Supervisory Worker Annual Wage	$27,999	GDoL Current Employment Report June, 2008 - Construction Industry Average Weekly Earnings multiplied by 52.
Supervisory Worker Annual Wage	$85,830	U.S. Bureau of Labor Statistics Occupational Employment Statistics - Mean annual wage for "Construction Managers."

Table 16.2-18 provides assumptions made in conducting the civilian labor force income analysis for the operations phase, and the source or rationale for these assumptions.

Table 16.2-18. Operational Component Assumptions for Civilian Labor Force Income

Assumption	*Assumed Value*	*Source/Rationale*
Civilian Military Worker Average Total Income.	$51,793	Median value of GS Summary Table

Notes: "GS" stands for "General Schedule," that is a pay scale for federal Employees and is developed by the U.S. Office of Personnel Management (OPM). The OPM produces a table with Grade level on the vertical axis and Time-in-Grade on the horizontal axis. The median value pinpoints the mid-point of the Grade axis and the mid-point of the Time-in-Grade.

Civilian Labor Force Income - Impacts

The civilian labor force income amounts presented below apply to the entire labor force rather than to the incomes of individual workers. Collectively, income impacts are beneficial (especially during the construction phase). However total income after the construction peak will decline substantially but will be above pre-project levels.

Table 16.2-19 shows that the peak figure is $1.1 billion in 2014, falling back to $246 million as construction ends after 2016.

Table 16.2-19. Impact on Civilian Labor Force Income (Millions of 2008 $s)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Income	$203	$484	$761	$959	$1,134	$857	$472	$246	$246	$246	$246

Figure 16.2-3 compares total income on Guam with and without the proposed action. At the 2014 peak, civilian labor force income with the proposed action is 70% higher than it otherwise would have been, without the project. At 2020, the difference declines to 14%.

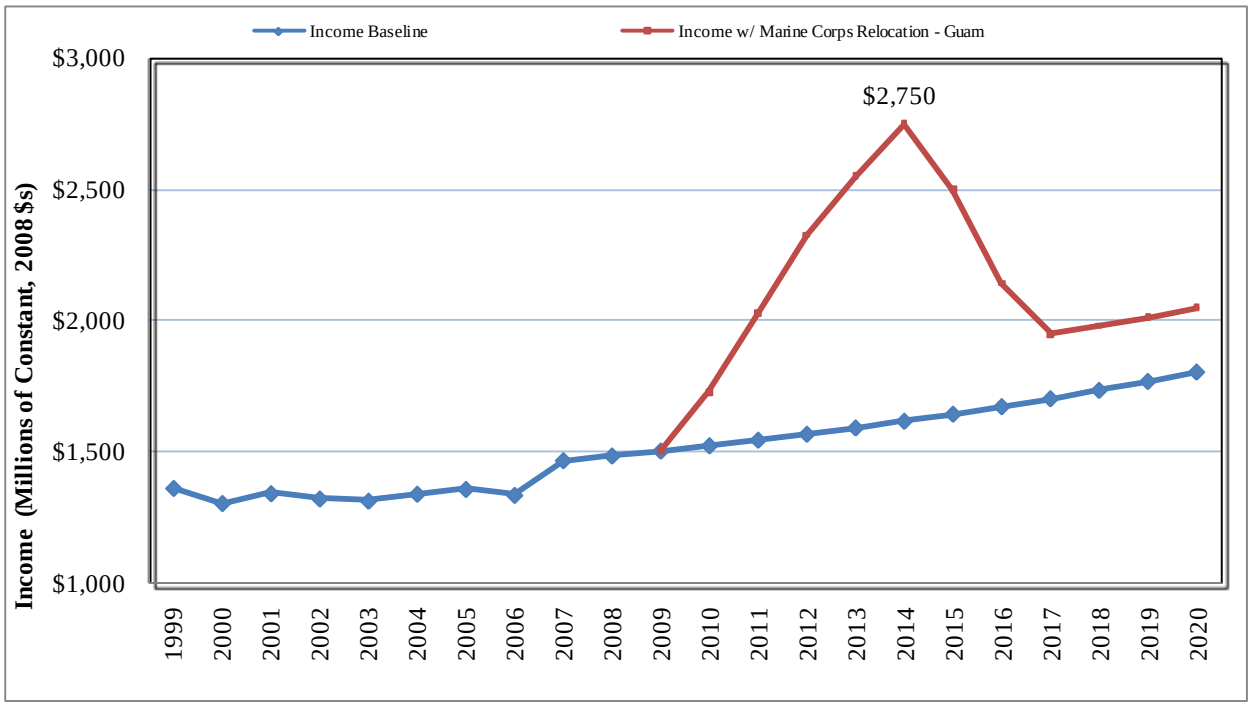


Figure 16.2-3. Labor Force Income with and without Proposed Action

Standard of Living - Approach to Analysis

Standard of living is a measure of purchasing power. If the standard of living increases for a person it means they can purchase more goods and services. If the standard of living declines for that person, he or she can purchase fewer goods and services.

Changes in a person's standard of living are determined by their income and the prices of the goods and services they tend to purchase. A person's standard of living will increase if their income rises faster than the prices of goods and services they tend to purchase. A person's standard of living will decline if the prices of goods and services they purchase rise faster than the person's income.

The average FTE salary for jobs related to the construction phase (including indirect jobs) was derived using current construction worker wages and outputs from the Input-Output Model (I-O). The total income of new jobs (direct and indirect) created was divided by the total number of jobs created.

The average FTE salary for jobs related to the military operational phase (including indirect jobs) was based on estimated civilian military worker current incomes and incomes derived in the modeling process.

Standard of Living - Impacts

In both the construction and operational components, the average wage of workers would increase as a function of greater demand for labor. However, the price of goods and services purchased by individuals would rise as well.

Guam incomes are expected to rise; it is estimated that the average FTE salary for jobs related to the construction phase would rise to $33,500 (compared to 2007 Guam average FTE salary of $28,150). Construction component salaries are expected to be higher due to the creation of higher-paying jobs in the architecture and engineering, wholesale trade, and health services industries. With a rapid increase in economic activity and a limited pool of on-island labor, there would likely be competition for labor and thus upward pressure on wage rates. The market wage may increase over the estimated $33,500 due to the fact that the estimation procedure has no basis for estimating the extent of upward pressure on rates.

It is estimated that the average FTE salary for jobs related to the military operational phase would rise to $40,000 (compare to 2007 Guam average FTE salary of $28,150). Operational component salaries are expected to be higher, in large part, due to additional higher-paying on-base civilian military jobs. As previously noted, most civilian military jobs would likely go to either spouses of new active duty personnel or to labor brought in from off-island; only about 25% of civilian military jobs are expected to be filled by current Guam residents.

General inflation, arising from the increase in economic activity (and money supply), would likely create an adverse significant impact on household purchasing power. This impact would be more acute during the construction period because of the sudden spike in demand for all types of goods and services. Rates of inflation would likely fall to less than significant levels thereafter. From 2000 to 2008 Guam workers have seen their standard of living decline by 30% and there is no reason to expect the military buildup to reverse that trend – Guam workers will likely continue to see the cost of goods and services rise faster than their incomes. While the proposed action may not represent a reversal of this trend, it will slow the rate of decline in the standard of living that has been prevalent since 2000.

It should be noted that it cannot be definitively predicted whether wages or the price of goods and services would increase at a faster pace. If wages earned by a particular household rise more quickly than the price of goods and services, then the standard of living would increase. If the price of goods and

services rises more quickly than wages, the standard of living would decrease. Thus, households on fixed incomes would experience reduced purchasing power. Those with the ability to quickly renegotiate their wages will have a better chance at maintaining or increasing their standard of living. Overall, the military buildup would likely bring more high skilled, high paying jobs that provide employees more flexibility to have their wages adjusted to meet price increases.

Unemployment - Approach to Analysis

The proposed action would bring many new jobs to Guam but it would also bring a large new population from off-island. Analysis was done to determine how these two factors would affect the unemployment rate on Guam.

The large influx of new jobs would provide employment opportunities for most that seek them. Therefore, the unemployment rate during the construction component would be lower than current levels and full-employment should be reached or exceeded.

Though not as many new jobs would be available during the operational component as during the construction component there will be many more jobs than at present. Therefore, the impact would result in a generally lower rate of unemployment than there otherwise would have been.

Unemployment - Impacts

It is projected that the impact of the buildup would be to reduce the rate of unemployment on Guam from the most recently published rate of 8.3% (Guam Department of Labor 2007a). Guam's unemployment rate would ultimately be lowered by the construction and operational phases of the proposed action.

Housing

Topics in the housing analysis include:

- Civilian Housing Demand
- Housing Supply

The following factors are *not* included in the housing analysis:

- "Stay-Behind" Worker Housing
- Housing for on-base active-duty military and dependents
- Household formation for additional Guam residents
- Temporary Workforce Housing (a description however, is provided below)

Refer to the Appendix F SIAS for more information on these topics. This analysis provides an overview of current plans for temporary workforce housing possibilities, but these plans not included in housing analysis beyond this inclusion.

Temporary Workforce Housing

Temporary workforce housing is not included in the housing analyses because it is assumed that all H-2B worker housing would be provided by construction contractors and would not generate demand in the private-market. Immigration law requires that employers provide housing for each H-2B worker they bring in. This section reviews current plans for temporary workforce housing.

With 9,600 H-2B workers expected at peak, a large number of new workforce housing units would be required.

There are a number of ways that this demand may be met, including:

- New worker housing.
- Retrofit existing vacant construction workers housing (from past construction booms) or vacant residential apartments.
- Construct new apartment structures.
- Convert large shipping containers into temporary housing units.

DoD would rely on construction contractors, who have significant expertise in the areas of workforce housing and logistics, to support temporary foreign worker housing requirements. While GovGuam and federal agencies would retain their authority to conduct inspections and enforce laws, DoD contract provisions would require quality control, oversight and the hiring of contractors with proven track records. Well thought-out plans related to workforce housing, including quality of life requirements, would be given award preference. Contract provisions would also include requirements to provide workforce medical, dining, transportation and safety/security. There would be health screening of all workers to reduce health risk to the Guam population. Contractors would be required to provide health care either by supplementing local Guam staff and resources or building their own clinic.

Contractors anticipating Navy contract awards would likely proceed with plans on how to provide housing for their temporary workers prior to the Record of Decision.

Table 16.2-20 and Figure 16.2-4 provide further information on existing and planned temporary workforce housing units. The largest planned facility would be located in North Tumon, near Two Lovers Point, and would be built on a currently undeveloped 250 acre (101 hectare) parcel of land; the planned facility has the potential to house up to 18,000 temporary workers.

Table 16.2-20. Temporary Workforce Housing Locations and Attributes (Map Key for Figure 16.2-4)

Figure 16.2-4 Key	*Name/Location*	*Estimated Worker Capacity*	*Planned/Existing/ Retrofit*	*Site is Developed/Paved? (Yes/No)*
1	North Tumon, (Near Two Lovers Point)	2,000-18,000	Planned (250 Acre Parcel)	No
3	Upper Tumon, (Former Tumon Village, El Dorado Apts.)	3,500-4,000	Retrofit	Yes
4	Harmon Industrial Park	1,900	Existing	Yes
6	Barrigada, Former Naval Air Station Barracks	1,600	Retrofit	Yes
2	Dededo	1,800	Existing	Yes
5	Tamuning		Existing	Yes
7	Yona		Existing	Yes
8	Agat		Existing	Yes

Notes: Planned refers to housing being planned by contractors.
Source: JGPO and NAVFAC Pacific 2009

Civilian Housing Demand and Supply - Approach to Analysis

The civilian housing unit demand in this section is an estimate of the number of *required* units (demand) for the in-migrating Guam civilian population. For discussion of the *supply* of housing in response to these requirements, see the following Housing Supply, Deficits and Prices section.

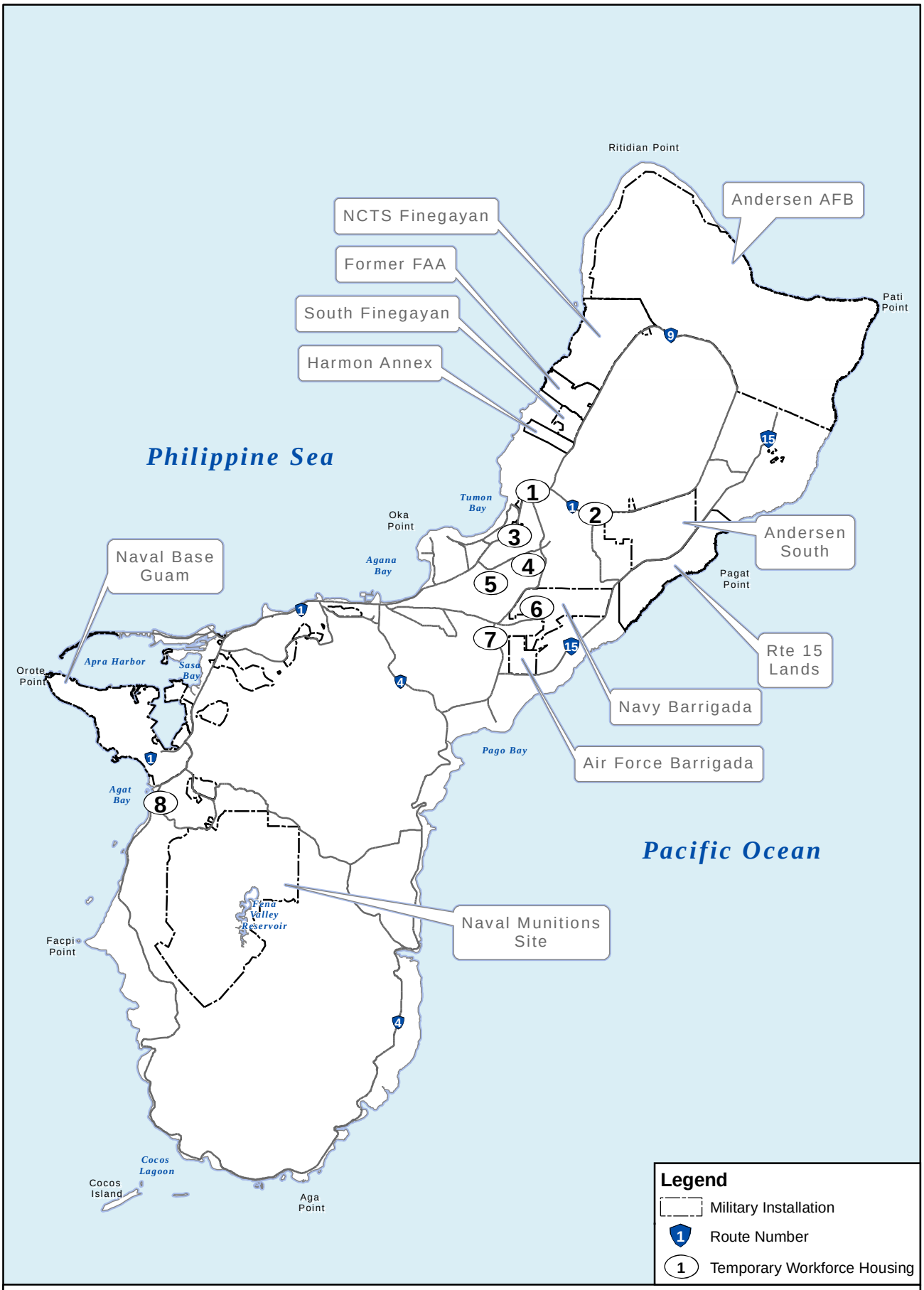


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Figure 16.2-4
Current and Expected Future Location and Capacity of Temporary Workforce Housing

It should be noted that the Guam Housing and Urban Renewal Authority (GHURA) has recently released a detailed housing needs assessment study. The supply estimates presented herein are therefore provisional and may be revised and further informed based on the more detailed housing study by GHURA (GHURA 2009).

The primary focus of this analysis is demand and supply for the private-sector Guam housing market affected by in-migrating civilian populations.

Construction phase impacts on private market housing would arise primarily from the in-migration of:

- non-H-2B workers who are directly employed at the various military construction sites
- non-H-2B workers who take other direct or indirect construction-related jobs.

Table 16.2-21 shows critical assumptions for the construction phase, as well as the source or rationale of those assumptions.

Table 16.2-21. Construction Component Assumptions for Civilian Housing Demand

Assumption	*Assumed Value*	*Source/Rationale*
Average Household Population for in-migrants	3.89	U.S. Census Bureau Guam 2000 average
H-2B worker housing	To be provided by employer and would involve predominantly new construction of quarters, with negligible conversion of existing housing stock to H-2B housing. Military contractual requires all construction contractors to provide housing for their H-2B employees	Employers of H-2B workers are allowed to deduct only a limited amount from H-2B workers' paychecks for housing costs (currently, $320 per month). This very low allowance means almost all H-2B workers would be likely to be housed dormitory-style
New household formation by Guam residents	Negligible effect	Guam residents directly or indirectly employed due to the proposed action would, on average, make somewhat more money than without the project. However, the number of residents previously living with family or friends to save money, who would move to their own housing units due to the increased pay, is likely to be minimal

During the operational phase, all Marines and their dependents would be housed on-base, per specifications of the proposed action. Thus no off-base housing demand would stem directly from that population.

The housing demand during the operations phase is generated by:

- Civilian military workers
- In-migrating direct and indirect workers

Table 16.2-22 provides assumptions made in conducting the housing demand analysis for the operations phase, as well as the source or rationale for those assumptions.

Table 16.2-22. Operational Component Assumptions for Housing Demand

Assumption	*Assumed Value*	*Source/Rationale*
Average Household Population for in-migrants	3.89	U.S. Census Bureau Guam 2000 average
Military personnel off-base housing impact	All military personnel would be housed on-base	Master Planning Assumption

Table 16.2-23 provides assumptions made in conducting housing supply analysis for both the construction and military operational phases of the proposed action, and the source or rationale for these assumptions.

Table 16.2-23. Construction and Operational Assumptions for Civilian Housing Supply

Assumption	*Assumed Value*	*Source/Rationale*
Number of currently vacant, for-rent housing units	1,915	GBSP (2008)
Current vacant, for sale housing units	467	Multiple Listing Service data provided by Bank of Guam (2009)
Housing units with building permits but that currently have not been completed	500	There are approximately 2,000 such building permits currently, but most are viewed as unlikely to have construction complete at the start of project construction. A factor of 25% was applied
Core total housing vacancy rate	4%	Reflects market delays in matching renters with landlords, and administrative and maintenance factors that would results in some units always being vacant

Notes: Of the 467 units vacant for sale, 273 are single-family units (Bank of Guam 2009). Many units currently for sale are "executive units" (priced above $500,000) that would not be suitable for all but a handful of the expected new population generated by the proposed action.

Civilian Housing Demand and Supply – Impacts

Civilian housing demand and supply impacts were found to be significant.

Table 16.2-24 indicates the combined total impact of the proposed action would be a demand for 9,431 new units in the peak year of 2014, falling to 2,959 by 2020.

Table 16.2-24. Demand for New Civilian Housing Units

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Housing Demand	1,648	3,972	6,119	7,465	9,431	7,406	4,283	2,913	2,913	2,959	2,959

Figure 16.2-5 compares total housing demand on Guam with and without the proposed action. At the 2014 peak, housing demand with the proposed action is 14% higher than it otherwise would have been, without the project. At 2020, the difference declines to 4%.

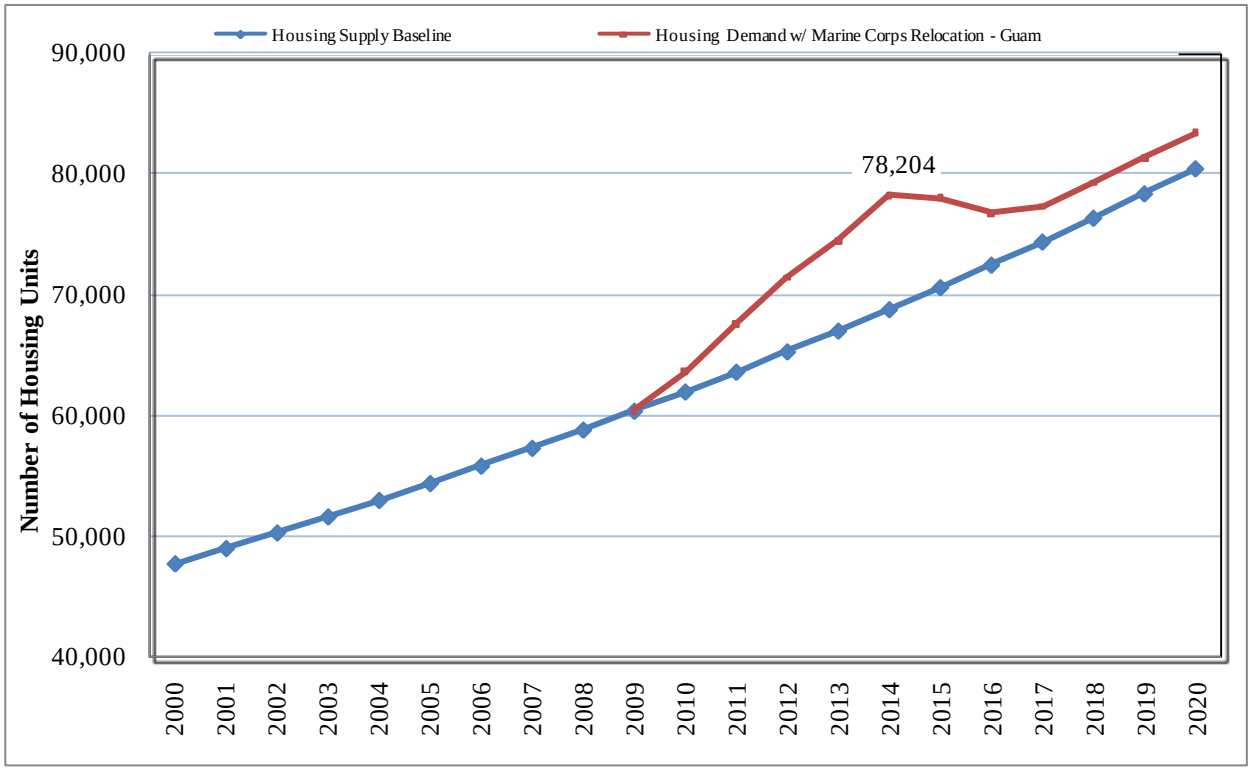

Figure 16.2-5. Housing Demand with and without Proposed Action

Based on assumptions, the stock of likely available housing was estimated at 2,787 units at the start of project construction in 2010.

Table 16.2-25 shows an estimated housing surplus in the years subsequent to the construction phase if the market were to provide all the needed housing during the construction-period. The recently released housing needs assessment study by the Guam Housing and Urban Renewal Authority may provide an updated estimate of the available housing and the market's ability to respond to the additional housing unit demands.

Table 16.2-25. Demand and Supply for New Civilian Housing Units

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Action Total Impact	1,648	3,972	6,119	7,465	9,431	7,406	4,283	2,913	2,913	2,959	2,959
Annual Change in Demand	1,648	2,324	2,147	1,346	1,966	(2,025)	(3,123)	(1,370)	0	46	0
Available Housing Supply (vacant, likely available)	2,787	1,139	0	0	0	0	0	0	0	0	0
Annual Construction Needed to Eliminate Housing Deficit	0	1,185	2,147	1,346	1,966	0	0	0	0	0	0
Surplus Units if Supply Increases to Eliminate Deficit	**0**	**0**	**0**	**0**	**0**	**2,025**	**5,148**	**6,518**	**6,518**	**6,472**	**6,472**

It should be noted that the estimates provided here are theoretical, and meant to be indicative of the amount of housing construction that would be needed to satisfy the increased demand.

In reality it is unlikely that construction of new housing would fully respond to the demand to eliminate a housing deficit. The main challenges to increase housing supply in the face of projected rapid demand increases would occur mostly during the construction phase, and generally fall into three categories:

- Scarcities of labor and materials to build new housing (supply bottlenecks)
- Financial feasibility of constructing housing for short-term demand increases
- Bottlenecks in the Guam housing permitting system to accommodate rapid increases in permit demand

Another factor that should be recognized is the possibility of a typhoon disaster. If a typhoon were to hit Guam, some currently available housing units may be destroyed that would create higher demand for new housing units than shown in tables. Higher demand would stem from a lower number of currently available housing units and a possible spike due to the presence of temporary relief workers.

Housing supply during the post-construction timeframe would be less challenging because local contractors and housing supply materials would have been freed up to meet housing demand more competitively than during the construction period.

Impacts would be adverse if sufficient housing supply cannot be developed and results in crowding, continued price increases, and/or substandard housing development (Refer to the Appendix F SIAS for more detailed discussion).

Local Government Revenues

This section provides an estimate of revenues accruing to GovGuam from the primary sources identified in the Affected Environment Section 16.1. The analysis does not specify all governmental costs but does make note of likely differences in timing between costs and revenues.

Approach to Analysis

Government revenue sources that are analyzed include gross receipts tax, corporate income tax, and personal income tax. These taxes are collected quarterly or annually and there may be a time lag between when government revenues are needed and when they are actually available for use. The analysis assumes GovGuam collects all tax revenues that it would be owed.

Table 16.2-26 provides assumptions made in conducting local government revenue analysis for the construction and operational phases, as well as the source or rationale for these assumptions.

Table 16.2-26. Assumptions for Local Government Revenue

Assumption	*Assumed Value*	*Source/Rationale*
GRT	0.04	GovGuam GRT tax rate
Profit	0.06	Based on market conditions
Corporate income tax rate	0.17	Based on GovGuam Corporate Income tax rate
Personal income tax rate (applies to military as well as to civilians)	0.15	Based on IRS Tax tables

Notes: Guam residents do not pay federal income taxes. Instead, GovGuam taxes resident income at the federal rates passes the money to the federal government that then passes the same amount back. Military personnel income taxes are also returned.

Impacts

Table 16.2-27 provides GovGuam tax revenue impact summary data. Year-by-year impacts can be found in the Appendix F SIAS.

Revenue impacts are beneficial to GovGuam, subject to the issues of timing and the fluctuation associated with construction ramp-up and decline.

Table 16.2-27. Impact on GovGuam Tax Revenue Summary (Thousands of 2008 $s)

Tax	*Peak Impact*	*Steady Impact*
GRT	$107,638	$8,433
Corporate Income	$27,448	$2,150
Personal Income	$192,585	$86,030
Total	**$327,671**	**$96,614**

Figure 16.2-6 compares total GovGuam tax revenue with and without the proposed action. At the 2014 peak, tax revenues with the proposed action are 81% higher than they otherwise would have been without the project, representing a beneficial increase. At 2020, the difference declines to 25%, a lesser but still beneficial increase.

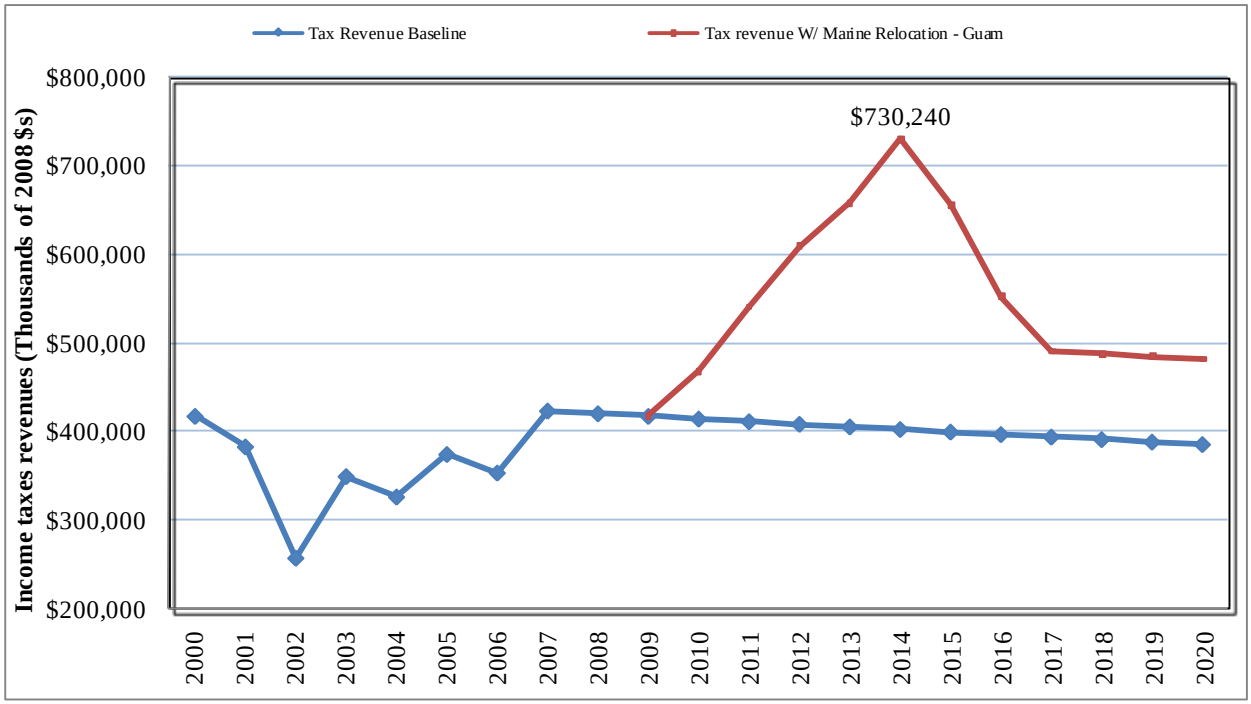

Figure 16.2-6. GovGuam Tax Revenues with and without Proposed Action

Gross Island Product

Approach to Analysis

GIP for Guam represents the total market value of all final goods and services produced in a given year. The concept is generally referred to as Gross Domestic Product (GDP) and it the most commonly used benchmark to assess the overall strength of an economy; when the term economic growth is mentioned it usually refers to an increase in Gross Product from one time period to another.

Table 16.2-28 provides assumptions made in conducting the GIP analysis for the construction phase. Table 16.2-29 shows key intermediate calculations feeding into subsequent estimates of the impact on GIP from construction.

Table 16.2-28. Construction Component Assumptions for GIP

Assumption	*Assumed Value*	*Source/Rationale*
Gross value of military contracts – 2010	$425 million	NAVFAC Pacific 2009
Gross value of military contracts – 2011	$1,023 million	NAVFAC Pacific 2009
Gross value of military contracts – 2012	$1,648 million	NAVFAC Pacific 2009
Gross value of military contracts – 2013	$2,109 million	NAVFAC Pacific 2009
Gross value of military contracts – 2014	$2,034 million	NAVFAC Pacific 2009
Gross value of military contracts – 2015	$1,410 million	NAVFAC Pacific 2009
Gross value of military contracts – 2016	$524 million	NAVFAC Pacific 2009
Percent of expenditures made on Guam – Equipment	6%	Interviews with GCA
Percent of expenditures made on Guam – Design	2%	Interviews with GCA
Percent of expenditures made on Guam – Materials	5%	Interviews with GCA
Percent of expenditures made on Guam – Supplies	6%	Interviews with GCA
Construction employment.	75 workers per $10 million total construction cost	Interviews with GCA
Average construction wages – Supervisory	$85,830/yr.	U.S. BLS Occupational Employment Statistics
Average construction wages – overall	$27,999/yr.	GDoL
Percent of gross pay spent on Guam economy – Guam workers	47%	State of HI I-O PCE, adjusted by John M. Knox & Associates
Percent of gross pay spent on Guam economy – High-skilled construction and construction in-migrants from CONUS/FAS/HI	45%	State of HI I-O model PCE, adjusted by John M. Knox & Associates
Percent of gross pay spent on Guam economy – Construction H-2B workers	20%	State of HI I-O model PCE, adjusted by John M. Knox & Associates
Ratio of GIP to Output	0.75	Output is always larger than GIP as GIP represents only final purchases. Output adjusted downward to represent GIP. Based on ratio of total sales from 2002 economic census to Guam GIP from 2002 Bureau of Statistics and Plans

Table 16.2-29. Intermediate Construction-Related Calculations for GIP

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Direct Non-Labor Construction Spending on Guam Economy	$74	$179	$288	$369	$356	$246	$92	N/A	N/A	N/A	N/A
Personal Spending of Direct, On-Site, Construction Workers on Guam	$19	$46	$74	$92	$88	$60	$22	N/A	N/A	N/A	N/A

Notes: All figures are in millions of 2008 dollars.

Table 16.2-30 provides assumptions made in conducting the GIP analysis for the operations phase.

Table 16.2-30. Operational Component Assumptions for GIP

Assumption	*Assumed Value*	*Source/Rationale*
Total expenditure, base operations – 2010	$4.7 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Total expenditure, base operations – 2011	$8.7 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Total expenditure, base operations – 2012	$9.4 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Total expenditure, base operations – 2013	$9.9 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Total expenditure, base operations – 2014	$47.8 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Total expenditure, base operations – 2015-2020	$52.4 million	Estimate based on historical Guam military (USAspending.gov 2008) contracts data scaled over time according to estimated change in on-base population
Percent of military operations contracts awarded to Guam firms	17%	Historical local contract award expert advice, provided by GCA
Average annual wages of enlisted personnel	$28,895	Western Pacific Alignment Plan (WAP)
Average annual wages of military support personnel	$41,435	Estimate based on Government Service (GS) pay scale (Office of Personnel Management 2008)
Percent wages spent on Guam economy, enlisted military	12%	State of HI I-O model, adjusted by John M. Knox & Associates
Percent wages spent on Guam economy, military support	47%	State of HI I-O model, adjusted by John M. Knox & Associates
Federal Military Output Multipliers	1.7	HI 2005 I-O Model
Personal Expenditures Output multiplier	1.89	Based on various multipliers from HI I-O Model weighted by expenditures category
Ratio of Output to GIP	0.75	Output is always larger than GIP as GIP represents only final purchases. Output adjusted downward to represent GIP. Based on ratio of total sales from 2002 economic census to Guam GIP from 2002 Bureau of Statistics and Plans.
Total relocation of all active-duty military personnel to Guam	Complete by 2014	DoD policy – necessary to meet agreement with Government of Japan

The Table 16.2-31 below shows key intermediate calculations feeding into subsequent estimates of the impact on GIP from operations.

Table 16.2-31. Intermediate Operations-Related Calculations for GIP

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Base Operational Expenditures on Guam	$5	$9	$9	$10	$48	$48	$48	$48	$48	$48	$48
On-Base Personnel (includes Active Duty and Civilian Military Employees) Direct Personal Expenditures in Guam economy	$2	$4	$4	$4	$28	$28	$28	$28	$28	$28	$28

Notes: All figures are in millions of 2008 dollars.

Impacts

The following impacts are significant. Collectively, GIP impacts are beneficial (especially during the construction phase). However total GIP after the construction peak will decline substantially but will be above pre-project levels.

Table 16.2-32 shows the combined total impact on GIP would be $822 million in 2014, declining to a stable figure of $157 million beginning in 2017 during the steady-state operational phase.

Table 16.2-32. Impact on GIP (Millions of 2008 $s)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Total Impact on GIP	$152	$361	$566	$714	$822	$616	$327	$157	$157	$157	$157

Figure 16.2-7 compares Guam's GIP with and without the proposed action. At the 2014 peak, GIP with the proposed action is 18% higher than they otherwise would have been, without the project. At 2020, the difference declines to 3%.

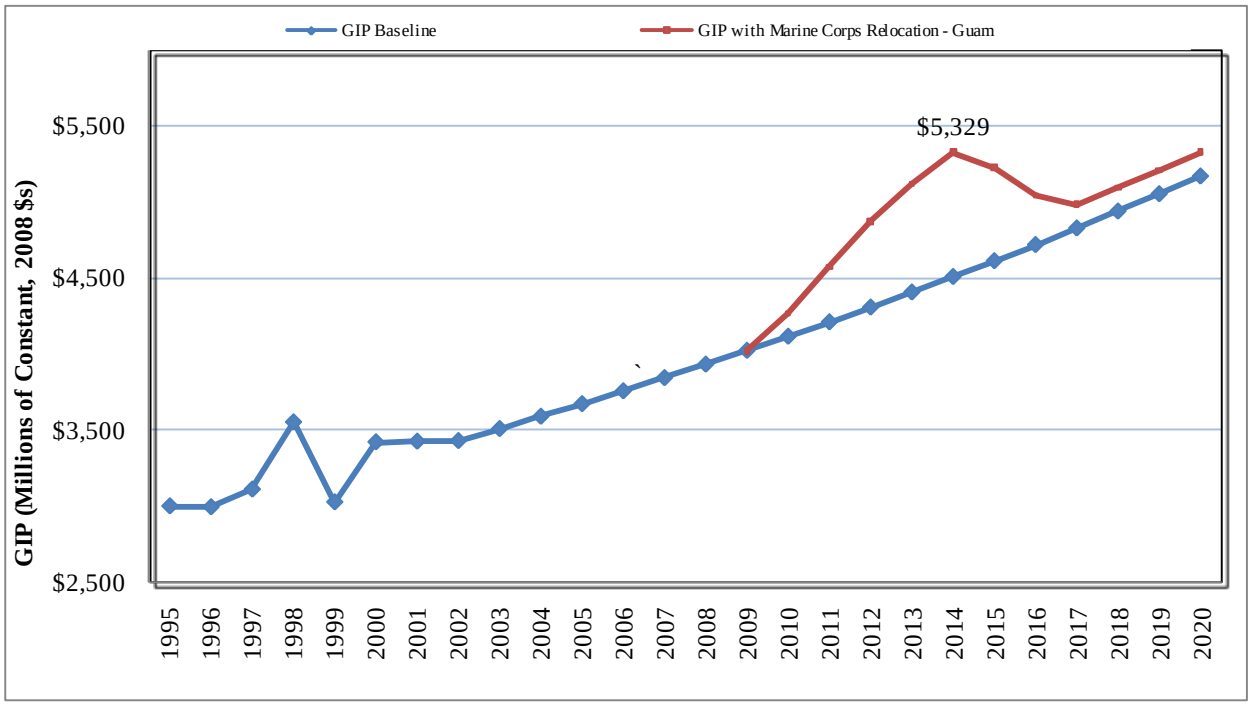

Figure 16.2-7. Guam Gross Island Product with and without Proposed Action

Local Business Contracts

Guam businesses have historically expressed concern about being under-bid by Alaskan contractors using minority-owned small-business status. To address such concerns, this section provides information on relevant legalities, and possible opportunities and constraints.

Approach to Analysis

Recent legal changes have resulted in a switch from ethnically-based preferences in contracting to geographically-based preferences (Refer to the Appendix F SIAS for more detailed information). With these legal parameters in mind, Naval Facilities Engineering Command Pacific (NAVFAC Pacific) is creating a system of preferences worth $1 billion for small and local businesses specific to the proposed action (Murphy 2009). The incentives in this system would hold valid for the duration of the action. Also, the Defense Logistics Agency is providing $386,000 to establish the new Guam Procurement Technical Assistance Center at the UoG School of Business and Public Administration. The Procurement Technical Assistance Center would help small businesses on Guam navigate the DoD's procurement bureaucracy in hopes of increasing the share of contracts awarded (Hodai 2008).

Impacts

While the topic of local business contract opportunities is important to the Guam business community, exact impacts or results cannot be predicted, other than to say that business opportunities would increase and constitute a beneficial impact.

The main driver of local business impacts during the construction phase would be the specific preferences written by NAVFAC Pacific, especially their application of the Price Evaluation Adjustments on bidding for smaller contracts based on the HUBZones program. These preferences would determine how much of the total construction budget is awarded to Guam companies.

There may also be service contract opportunities (especially food and supplies), for H-2B worker camps during the construction phase. As of March 2009, NAVFAC Pacific was using the legal framework described above to map out set-asides for small businesses on Guam during the construction phase.

The operational phase may bring enhanced business opportunities for Guam companies. Guam businesses tend to compete better for military *service* contracts, as opposed to *construction* contracts (Guam Chamber of Commerce 2008). Although all supplies and products are imported from off-island services, local companies can manage service facilities such as gyms, libraries, and fast food franchises (Appendix F SIAS - Global Facilities Services Interview).

Tourism

Tourism is Guam's second largest private industry (GVB 2007) and is likely Guam's primary private-sector source of outside dollars injected into the economy.

Approach to Analysis

Guam's resort hub, Tumon Bay, is located in the central part of Guam and much of the commercial marine tourism activities (e.g., water skiing or scuba diving) also occur in the central area or Apra Harbor. However, both optional tour activities and economic effects of tourism are island wide in nature.

Scoping comments and interviews with industry leaders were used to identify probable tourism impacts of the proposed action. This analysis is qualitative and based largely on interviews with industry leaders in 2008 and early 2009.

Topics identified and addressed include:

- Increased Construction-Related Business Travel
- Infrastructure Improvement
- Loss of Workforce and/or Wage Increases
- Impacts on Ocean-Based Tourism from Environmental Degradation
- Blocked Growth of Chinese and Russian Markets
- Loss of Possible Tourism Attractions from DoD Acquisition of New Land
- Tourism Market Loss Due to Construction Chaos
- Increased Operations-Related Business and Leisure Travel
- Growth in Support Businesses for Ocean-Related Tourism
- Market Loss Due to Conflict Between "Militarization" of Guam and Cultural Tourism
- Impacts on Ocean-Based Tourism from More Population and Competition

Impacts

Overall, tourism impacts would be mixed (both beneficial and adverse). Although numerically more negative than positive consequences were identified, industry leaders stressed they were not opposed to the proposed action because they felt on balance that the positives out weighted the negatives and they felt that they could work with the military to mitigate many of their concerns.

During the construction phase, the following tourism impacts would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS):

Increased Construction-Related Business Travel: Hoteliers and other industry leaders interviewed for this analysis reported an increasing amount of recent new business associated with planning for construction. They anticipate additional business from construction contract managers as military construction begins.

Infrastructure Improvement: Infrastructure improvement is an over-arching consideration that would result in positive impacts for all business on Guam.

Loss of Workforce and/or Wage Increases: The possibility of wage increases or loss of labor to higher-paying jobs during the construction component is a highly likely outcome, as wages in the construction sector are larger than those in the tourism sector.

Impacts on Ocean-Based Tourism from Environmental Degradation: Guam's warm waters attract tourists to commercial activities such as scuba diving and submarine rides. Potential impacts could occur as a result of dredging and construction activities. Volume 2, Chapter 4 of the EIS/OEIS states that dredging at Apra Harbor will not produce impacts, and Volume 2, Chapter 3 states that Low Impact Development (LID) and applicable laws concerning storm water run-off will mitigate impacts. Therefore, based on these conclusions, there would be no impact on marine-based tourism.

Loss of Possible Tourism Attractions from DoD Acquisition of Property: There is some concern that DoD acquisition of land could affect tourism assets. When considering the proposed acquisition sites however, no specific tourism assets have yet been identified in those locations. However, the GVB (Appendix F SIAS – GVB Interview) specified the Guam International Raceway as a prime focus of concern due both to its economic role in attracting racers from Asia and also because of its general social value as a place where military and civilians mingle and a venue for keeping young hot-rodders off the public roads.

Tourism Market Loss Due to Construction: Although there was initial concern about this issue, industry leaders interviewed for this analysis now consider it a minimal risk. Historical evidence also shows that

the hotel construction boom during the 1980s and 1990s was centered in the Tumon Bay resort district itself, and the tourism market was able to grow nevertheless. During the operations phase, the following tourism impacts would be possible.

Increased Operations-Related Business and Leisure Travel: It is likely that a significant increase in military personnel would generate more visits from friends and family, as well as more business travel. Additionally, off-duty military personnel and their families are likely to patronize retail and restaurants island wide, including the central entertainment district of Tumon Bay.

Growth in Support Businesses for Ocean-Related Tourism: Population increases are likely to provide expanded markets for support businesses.

Market Loss Due to Conflict Between "Militarization" of Guam and Cultural Tourism: In late January 2009, the GVB launched a rebranding of Guam tourism focused away from the traditional "sun-and-sand" marketing and focused instead on Chamorro cultural and historical assets that are unique to Guam. There is a concern that publicity of the proposed action on Guam and an increase in military activities and imagery on the island would affect visitors' on-island experiences, supplanting the desired tourism branding with a "military base brand" instead. The supplanting of a cultural tourism branding for one that is more militarized appears to be a strong possibility, as Japan remains the source of 80% of Guam's visitors, and there has been extensive publicity in Japan about the proposed action. However, a maximum potential adverse outcome is not inevitable. Among the factors that could determine what does actually happen would be:

- Military cooperation in exposing personnel to Chamorro culture and history themselves
- Visible presence of military police in tourist areas frequented by many off-duty Marines, to reassure Japanese visitors with negative perceptions from media accounts
- Overall military-civilian relations and communications efforts that would also affect a sense of partnership with the visitor industry

Impacts on Ocean-Based Tourism from More Population and Competition: Military personnel and their families, as well as additional population from spin-off economic growth, would generate both more business for ocean-based commercial activities and also more participants in non-commercial activities such as boating and diving.

16.2.2.3 Public Service Impacts

Public service impact analysis includes:

- Public Education
- Public Health and Human Services
- Public Safety Services
- Other Selected General Services
- Growth Permitting and Regulatory Agencies

Public Education

Approach to Analysis

This section assesses the proposed action's impact on:

- GPSS – Elementary Schools, Middle Schools and High Schools
- GCC – Post-Secondary School Programs

- UoG – All Programs

In particular, quantitative impact analysis was conducted on:

- Student population numbers
- GPSS teacher and GCC and UoG non-adjunct faculty requirements

The capacity of private or military schooling on Guam was not analyzed, although the presence of such resources was taken into account when analyzing impact on public facilities.

The impacts discussed are independent of any needs that may result from non-project related general population growth.

Table 16.2-33 presents the key construction component assumptions used in analysis of impacts as well as the source or rational of these assumptions. These include:

- Analysis used the current teacher to student ratios determined through agency surveys.
- The most recent available statistics were used to determine the percentage breakdown of the new *civilian* population that would attend GPSS and private schools at the various levels as well as UoG and GCC.
- Analysis assumed no H-2B population impact on primary, secondary or higher education.

Table 16.2-33. Construction Component Assumptions for Public Education Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Elementary Teacher : Student Ratio	1 : 14	GPSS elementary teacher to student ratio (2005-2008). This ratio is supported by the agreement between the Guam Federation of Teachers AFT Local 1581 AFL-CIO and the Guam Education Policy Board (GEPB) contract requirements that mandates specific GPSS teacher to student ratios. (Agreement between the Guam Federation of Teachers AFT Local 1581 AFL-CIO and the Guam Education Policy Board for GPSS Teachers).
Middle School Teacher : Student Ratio	1 : 14	GPSS middle school teacher to student ratio (2005-2008). Remained at 1:14 from 2005 - 2008. This ratio is supported by the GEPB agreement mentioned above.
High School Teacher : Student Ratio	1 : 19	GPSS high school teacher to student ratio (2005 – 2008). Remained at 1:19 from 2005 through 2008. This ratio is supported by the GEPB agreement mentioned above.
GCC Non-adjunct Faculty : Post-Secondary Student Ratio	1 : 18	2007 GCC non-adjunct faculty to post-secondary student ratio (GCC 2007)
UoG Non-adjunct Faculty : Post-Secondary Student Ratio	1 : 18	2000-2007 non-adjunct faculty to student ratios remained relatively steady at 1:18 (University of Guam Survey [Appendix F SIAS]).
% civilian island population composed of primary, middle, and high school age youth	Primary – 14% Middle – 5% High – 6%	Primary school age used: 5-11 years old Middle school age used: 12-14 years old High school age used: 15-18 years old, (U.S. Census Bureau 2000a)
% civilian school-age population attending public and private schools	Public – 86% Private – 14%	1991-2004 Guam public and private school enrollments. (Guam Bureau of Statistics and Plans 2008)

Assumption	*Assumed Value*	*Source/Rationale*
% adult (18 years and above) civilian population attending GCC or UoG	GCC – 2% UoG – 3%	2007 GCC and UoG enrollment (GCC and UoG Surveys [Appendix F SIAS] compared with 2007 adult civilian population estimate.
Number of school-age dependents accompanying H-2B workers	0	Interviews with contractors, GCA, and GDoL (Appendix F SIAS)
Number of H-2B workers attending GCC or UoG	0	Although H-2B workers are able to access some continuing education classes, their numbers are not tracked. To the extent that GCC might accommodate cohorts of H-2B workers in continuing education classes such as ESL, these cohorts would most likely be arranged by sponsoring construction companies and GCC and staffing for the classes taken care of on an as-needed basis. (GCC Interview [Appendix F SIAS]).

Table 16.2-34 presents the key operational component assumptions used in analysis of impacts, as well as the source or rationale of these assumptions. Assumptions include:

- The assumption that increases in DoD school population will be absorbed by existing or new Domestic Dependent Elementary and Secondary Schools (DDESS) schools.
- The most recent available statistics were used to determine the percentage breakdown of the new military population that would take classes at UoG and GCC.

Table 16.2-34. Operational Component Assumptions for Public Education Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
All quantitative assumptions for construction component also apply for the operational component, unless negated by the assumptions listed below.		
% of civilian DoD workers whose dependents would be attending DDESS schools.	75%	Assumption is that 50% of civilian DoD workers would be from off-island. Additionally, 25% of civilian DoD workers would be the spouses of active duty military. The dependents of these individuals would be eligible for education through the DDESS system. See above labor section for rationale of DoD worker percentage assumptions.
% students eligible to attend DDESS schools that would go to GPSS schools instead.	0%	Assumption is that – of those dependents of active duty military and DoD civilian workers eligible to attend DDESS schools – none would attend GPSS schools, although some might choose to attend faith-based or other private schools. (Guam DDESS and Guam Public School System Interviews [Appendix F SIAS]).
% of active duty military population enrolled in UoG classes.	0.2%	Number of 2005 UoG active duty military enrollments and total 2005 active duty military population numbers. (UoG Survey [Appendix F SIAS]).
% of military dependent population enrolled in UoG classes.	0.3%	Analysis of 2005 UoG military dependent enrollment statistics and total military dependent population numbers.

Impacts

Table 16.2-35 provides an overview of the proposed action's impacts on GPSS student populations for the action's peak year and steady-state. Table 16.2-36 provides an overview of the proposed action's impacts on GPSS staffing for the action's peak year and steady-state. Year by year breakdowns of impacts are provided in the Appendix F SIAS.

Table 16.2-35. GPSS Student Population Impacts Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady State Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GPSS Elementary	14,436	2014	3,173	22%	847	6%
GPSS Middle	6,887	2014	1,331	19%	355	5%
GPSS High	9,661	2014	1,764	18%	471	5%

Table 16.2-36. Primary and Secondary Education Teacher Requirements Impacts Summary

Agency	*Baseline Teacher Numbers*	*Peak Year*	*Peak Year Additional Teacher Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Teacher Requirements (going forward)*	*Steady Requirements Percentage Increase*
GPSS Elementary	1,035	2014	229	22%	61	6%
GPSS Middle	504	2014	97	19%	26	5%
GPSS High	514	2014	94	18%	25	5%

Table 16.2-37 and Table 16.2-38 provide overviews of the proposed action's impacts on GCC and UoG student populations and non-adjunct faculty requirements for the action's peak year and steady-state.

Table 16.2-37. Higher Education Student Population Impacts Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady State Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GCC	1,806	2014	455	25%	155	9%
UoG	3,282	2014	790	24%	244	7%

Table 16.2-38. Higher Education Faculty Requirement Impacts Summary

Agency	*Baseline Non-adjunct Faculty Numbers*	*Peak Year*	*Peak Year Additional Non-adjunct Faculty Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Non-adjunct Faculty Requirements (going forward)*	*Steady Requirements Percentage Increase*
GCC	100	2014	25	25%	9	9%
UoG	185	2014	45	24%	14	8%

Other factors regarding the impact of the proposed action on Guam's public education system include (refer to the Appendix F SIAS for more detailed discussion):

GPSS Teacher to Student Ratios: The GPSS ratios do not capture problems with teacher absenteeism. Reports in 2008 indicate the absenteeism of Guam teachers overtook that of students and that on an average school day on Guam 12% of GPSS employees were absent versus less than 7% of GPSS students (Guam Department of Education 2008).

GPSS Teacher Recruitment: GPSS's ability to meet the demand for new GPSS teachers depends on Guam's teacher supply. Administrators believe that the expansion of the DDESS system to meet the increasing educational needs of Guam's military population might siphon off GPSS teachers. On the other

hand, the proposed action brings the benefit that some incoming military spouses might be qualified to teach in the public schools.

GPSS Administrative Staffing: Other staff positions in GPSS represent an important aspect not included in the analysis above. Examples of these positions include: principals and assistants, administrators, health counselors, cafeteria, custodial/maintenance, and school aides. Survey results indicate that there is an approximate 2:1 ratio between teachers and administrative staff in the GPSS school system. Thus the number of required additional teachers indicated in the tables above could be cut in half to indicate the number of additional GPSS administrative staffing that would be required.

GPSS Facilities: GPSS facilities also should be considered in a discussion of the proposed action's impact. There is an existing need for improvement of GPSS classrooms. Three new schools are currently being planned. New schools are most required in the north and central areas, areas of current school over-crowding (for example JFK and George Washington high schools). Schools in the southern region, on the other hand, often have vacant spaces.

Additional GCC Service Population: The analysis does not analyze GCC's secondary school age population. This population represents almost 50% of its student body. In 2007, GCC employed 32 faculty and 4 counselors in its secondary school program. It also does not take into account any changes in GCC classes offered that may be determined by the need for additional career and technical education workers and the demand for such classes from buildup-related industries such as construction, or an increase in enrollment that might occur due to the opening of GCC's new allied health building in September of 2009.

GCC and UoG Adjunct Faculty: Adjunct faculty are not included in the GCC or UoG calculations, and may be used to meet some of the noted requirements for additional faculty. In 2007, GCC employed 59 adjunct faculty, making up 37% of the GCC faculty population (Guam Community College 2007). Survey results show that in 2007, UoG employed 62 adjunct faculty, making up about 25% of the UoG faculty population (Appendix F SIAS – UoG Survey). GCC and UoG have some flexibility in hiring adjunct faculty to meet specific needs. GCC only hires such faculty if there is a need in upcoming adult education, apprenticeship, or continuing education courses.

GCC and UoG Administrative Staffing: Administrative staffing numbers are also not included in the tables above. In 2007, GCC faculty made up 46% of its full-time employee pool. Staff made up another 39% and Administrators the remaining 16% (Guam Community College 2007). In 2008, UoG employed a total of 550 full-time employees. Of these 182 were faculty, 104 performed clerical and secretarial functions, 34 were administrators, and the remaining performed a variety of professional, technical or maintenance jobs.

GCC and UoG Facilities: Survey results show that the GCC main campus is currently able to support the number of students being educated there. An increase in study population however would require expansion and renovation of the existing facilities. UoG survey results (Appendix F SIAS) show that of 21 listed University facilities, all except one (the community lecture hall) are currently able to meet the needs of the student population, and a majority would be able to meet the needs of an expanded student population.

Public Health and Human Services

Approach to Analysis

An analysis was performed of potential impact on the following GovGuam public health and human service agencies that were described in Section 16.1:

- GMHA
- GDPHSS
- GDMHSA
- GDISID

In particular, quantitative analysis was conducted on the proposed action's impact on:

- Service population numbers
- Key public health and human services staffing requirements

The capacity of private or military health care facilities on Guam were not analyzed, although the presence of such resources were taken into account when analyzing impact on public facilities, and are discussed as they pertain to possible overflow into health service demands on public service agencies.

The impacts discussed are independent of any needs that may result from non-project related general population growth.

Table 16.2-39 presents the key construction component assumptions used in analysis of impacts, and the source or rationale for these assumptions. These include:

- Analysis used the current Health Professional to Service Population ratios determined through agency surveys.
- The percentages of *civilian* population are considered part of the service population for the various Health and Human Service agencies of GovGuam.
- The service population of GDPHSS and GDMHSA was defined as 37.5% of Guam's total island population, the percentage of Guam's population that is underinsured (as estimated by GDPHSS), and are thus likely to utilize the services of these two agencies. The term underinsured is used to mean individuals that possess health coverage that does not adequately protect them from high medical expenses.

Table 16.2-39. Construction Component Assumptions for Public Health Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
% of Guam's civilian population supported by GMHA services	100%	All incoming population would be part of the service population of GMHA. Although some may choose to access services from private or GDPHSS clinics, they are still considered part of the public and, if in case of medical emergency, would be seen at GMHA. (GMHA Interview [Appendix F SIAS]).
% total island population supported by GDPHSS and GDMHSA Services	37.5%	This is the % total population on Guam that is uninsured or underinsured (GDPHSS estimate). These are the most likely populations to access services from GDPHSS and GDMHSA and the results of this analysis was used as the estimated service population for all impact analyses for GDPHSS and GDMHSA. (GDPHSS and GDMHSA Interviews [Appendix F SIAS])
% of Guam's civilian population supported by GDISID services	100%	All incoming civilian populations would be part of the service population of GDISID, as the agency would provide services to anyone on the island that is or becomes disabled and meets agency criteria. (GDISID Interview

Assumption	*Assumed Value*	*Source/Rationale*
		[Appendix F SIAS])
GMHA Physician : Service Population Ratio	1 : 2,821	2008 GMHA physician to island civilian population ratio - GMHA Survey (Appendix F SIAS)
GMHA Nurse/Allied Health Staff : Service Population Ratio	1 : 453	2008 GMHA nurse and allied health staff to island civilian population ratio - GMHA Survey (Appendix F SIAS).
GDPHSS Bureau of Primary Care Ratio of Providers and Nursing Staff : Service Population Ratio	1 : 1,499	2008 agency bureau provider and nursing staff numbers to service population estimates - GDPHSS Bureau of Primary Care Survey (Appendix F SIAS)
GDPHSS BCDC Ratio of Communicable Disease Prevention Specialists : Service Population Ratio	1 : 1,999	2008 agency specialist numbers to service population estimates - GDPHSS BCDC Survey (Appendix F SIAS)
GDPHSS BFHNS Ratio of Nursing Personnel : Service Population Ratio	1 : 2,915	Midpoint of agency bureau nursing personnel numbers (2005-2008) of staffing data - GDPHSS BFHNS Survey (Appendix F SIAS)
GDMHSA Ratio of Mental Health Professionals : Service Population Ratio	1 : 507	Midpoint of GDMHSA mental health professional numbers (2000-2008) to service population estimate - GDMHSA Survey (Appendix F SIAS)
GDISID Ratio of Social Workers and Counselors : Service Population Ratio	1 : 12,086	2008 agency staffing data to service population ratio - GDISID Survey (Appendix F SIAS).

Table 16.2-40 presents the key operational component assumptions used in the analysis of impacts, and the source or rationale for these assumptions. These include:

- No military or dependents are considered part of the service population of GMHA.

Table 16.2-40. Operational Component Assumptions for Public Health Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
All quantitative assumptions for construction component also apply for the operational component, unless negated by the assumptions listed below	See above	See above
% active duty military and military dependent population supported by GMHA	0%	Although there is anecdotal information mentioned in the text below that indicates active duty military and their dependents would sometimes access GMHA services, no quantitative data were available to support this analysis as in general GMHA does not record whether a patient is military or civilian. In certain circumstances, when GMHA does knowingly serve a military individual, they can bill TRICARE for the services.
% of civilian DoD workers supported by GMHA	25%	Assumption is that 50% of civilian DoD workers would be from off-island. Additionally, 25% of civilian DoD workers would be the spouses of active duty military. It is assumed that these populations would be eligible for medical services from the Naval Hospital. The other 25% would be serviced by GMHA. Assumption derived from labor force analysis in above sections.

Impacts

Table 16.2-41 provides an overview of the proposed action's impacts on GMHA, GDPHSS, GDMHSA and GDISID service populations for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-41. Impact on Public Health and Human Services, Service Population Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GMHA	160,797	2014	41,062	26%	5,437	3%
GDPHSS	65,954	2014	23,543	36%	10,183	15%
GDMHSA	65,954	2014	23,543	36%	10,183	15%
GDISID	169,209	2014	54,228	32%	18,604	11%

Table 16.2-42 provides an overview of the proposed action's impacts on various public health and human services agency staffing requirements for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-42. Public Health and Human Services Impact Summary

Agency and Staffing Type	*Baseline Staffing Numbers*	*Peak Year*	*Peak Year Additional Staffing Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Staffing Requirements (going forward)*	*Steady Staffing Requirements Percentage Increase*
GMHA Physicians	57	2014	15	26%	2	4%
GMHA Nurses and Allied Health Professionals	355	2014	91	26%	12	3%
GDPHSS - Primary Care Medical Providers and Nursing Staff	44	2014	16	36%	7	16%
GDPHSS – BCDC Communicable Disease Prevention Professionals	33	2014	12	36%	5	15%
GDPHSS - BFHNS Nurses	22	2014	8	36%	4	18%
GDMHSA – Mental Health Professionals	130	2014	46	35%	20	15%
GDISID Social Workers and Counselors	14	2014	4	29%	2	14%

In July of 2008, The U.S. Department of Health and Human Services provided a Guam Issues Inventory response to GovGuam prioritized health and human services issues related to the proposed action (USDHHS 2008). These priorities included acquisition of critical staffing, and capital improvement and funding for infrastructure and services.

Thus, other factors regarding the impact of the proposed action on Guam's public health system include (refer to Appendix F SIAS for more detailed discussion):

Existing Professional Staffing Deficits: For many of the GovGuam public health agencies listed above, the existing professional staffing to service population ratios that were used in this analysis are ratios that show existing deficits. Since the above staffing analyses are based upon existing ratios rather than standards, they preserve any professional shortages that currently exist on the Island of Guam.

Additional Staffing Requirements: While the analysis above provides an outline of impacts on health professional requirements related to the proposed action, an important caveat to this analysis is that for every one of the public health professional positions required, additional administrative staff are required to support the work of that professional. The GDPHSS Bureau of Primary Care Services (BPC) for example, noted that for each health professional it employs, four additional support staff such as nurse aids and medical records clerks are required. The implications of such a ratio can be far reaching. In the case of the BPC, the project's direct impact peak in 2014 would require the hiring of 48 support staff in addition to the professionals noted in the analysis above. Additional staffing requirements of recent or future public health facility developments (for example, the newly expanded Northern Region Community Health Center [NRCHC] and the soon-to-be expanded Southern Region Community Health Center [SRCHC]) can also affect staffing requirements.

There is also the possibility that the incoming populations associated with the proposed action might require additional staff time and agency resources. For example, GDMHSA staff members have observed that workers from off-island, such as those that would arrive on Guam during the construction phase, often work in stressful and intense situations that increase the prevalence of substance abuse. Similarly, military individuals transferring to a new, remote island location sometimes experience difficulty adapting to a different culture. It has been observed that both these populations would sometimes be inclined to access the confidential and free services of GDMHSA, despite having health insurance, because of the fear that their condition might affect their terms of employment.

Underinsured Populations: GDPHSS and GDMHSA target the most indigent populations for health care (see Affected Environment section). Thus the majority of individuals accessing services are uninsured. However, GDPHSS and GDMHSA staff members note that many individuals accessing services do have health insurance, but unaffordable co-payments for services or medications, or missing coverage of specific services and medications makes it necessary that these individuals access the free services of these two agencies. The population growth associated with the proposed action would contribute to these uninsured and underinsured populations, especially in the form of residents entering Guam through the Compact of Free Association agreement that does not require individuals have health coverage before arriving on Guam.

Military and Civilian Health Care System Overlap: Note that the GMHA service population analysis is not able to capture some nuances to utilization of GMHA and Navy Hospital Services on Guam:

- In emergency situations, an individual, civilian or military, would be taken to the closest hospital emergency room (GMHA or Naval Hospital) until they are stable enough to be transported to the appropriate facility (Guam Memorial Hospital Interview – Appendix F SIAS).
- Because the Naval Hospital's capacity is low, military dependents do occasionally use GMHA services, that GMHA can bill TRICARE, the military health insurance system (Guam Memorial Hospital Interview [Appendix F SIAS]).
- There are also plans to build a replacement Naval Hospital as well as a separate 6,000 square-foot outpatient clinic for veterans. (The current clinic is located within the current hospital.)

Facility and Supply Requirements: Through the process of interviews, qualitative data was collected regarding capital improvement and medical supply needs of various GovGuam public health agencies. GDMHSA reported substandard air quality in the building, fire suppression risks, and mold problems. GDPHSS's TB treatment program was housed in the windowless main public health building. GDPHSS BFHNS indicated a lack of clinical supplies (such as syringes) and antibiotics. GovGuam public health-related capital improvement and feasibility studies are currently being conducted.

Funding Issues: The procurement of funding for additional staff, capital improvements, and medical supplies for GovGuam public health agencies is a complex one. In 2008, GovGuam received a total of $43,283,170 from various federal health and human service funding programs.

In some instances, low staffing numbers or lack of technological capacity inhibits agencies from harnessing the funding that is available. For example, GDMHSA is not able to bill the military TRICARE system for the services they provide, due to technological and staffing capacity issues.

In other instances, lack of funding precludes an agency's ability to operate efficiently and effectively. For example, although the building of a permanent one-stop GDISID facility would eliminate the costly leasing of office space, GDISID lacks the capital to implement the project, even though the agency already has the plan and the land for a facility. As another example, to meet the costs of hiring additional staffing as required by the permanent injunction, GDMHSA must take out loans.

Public Safety Services

Approach to Analysis

Analysis was performed on impact on the following GovGuam public safety agencies:

- Guam Police Department (GPD)
- Guam Fire Department (GFD)
- Guam Department of Corrections (GDoC)
- Guam Department of Youth Affairs (GDYA)

In particular, quantitative analysis was conducted on the proposed action's impact on:

- Service population numbers
- Key public safety services staffing requirements

The capacity of military security services were not analyzed, although military security departments are discussed in view of their interaction with government agencies in maintaining public safety on the island.

The impacts discussed are independent of any needs that may result from non-project related general population growth.

Further discussion on public safety implications can be found in Chapter 18 of this Volume, Public Health and Safety.

Table 16.2-43 presents the key construction component assumptions used in analysis of impacts, and the source or rationale for these assumptions. Key assumptions include:

- All incoming population is considered part of the GPD service population. GPD's service population is defined in this analysis as Guam's total population, including active-duty military. This is because even active duty military personnel charged with crimes off-base would go through the GPD and judiciary systems.

- During the construction phase, additional firefighting personnel will be needed due to high hazard conditions on island. This is incorporated into the analysis through the use of an adjusted growth in service population, in order to capture the impact of increased construction and worker housing on the Island of Guam. The National Fire Protection Association (NFPA) Standard #1710, titled the "Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments" (2001 Edition), recommends five to six on-duty personnel per engine company in jurisdictions with tactical hazards, high hazard occupancies, high incident frequencies, geographical restrictions or other pertinent factors as identified by the authorities having jurisdiction. This is compared with the recommendation for four on-duty personnel per engine company in other jurisdictions. Worker housing and working areas fall under such high hazard jurisdictions and would impact GFD staffing requirements more heavily.
- Analysis used the current Safety Professional to Service Population ratios determined through agency surveys.

Table 16.2-43. Construction Component Assumptions for Public Safety Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
% island population under the protection of GPD	100%	GPD and Navy Security Interviews (Appendix F SIAS)
% increase over current firefighter to population ratio due to high hazard situations, per year	2010 – 6% 2011 – 11% 2012 – 12% 2013 – 12% 2014 – 10% 2015 – 9% 2016 – 9 %	H-2B housing meets the NFPA definition of high hazard jurisdictions. This would require an additional % increase in required GFD staffing during the construction phase.
% increase in inmates in jail, prison, and federal holds at GDoC per year	2010 – 3% 2011 – 8% 2012 – 13% 2013 – 16% 2014 – 15% 2015 – 10% 2016 – 3%	Percent of adult civilian population increase over baseline as a result of proposed action (construction phase). To produce increase in service population, these percentages were then multiplied by inmate population numbers - GDoC Survey (Appendix F SIAS)
GDYA service population	Ages 10-17	GDYA Interview (Appendix F SIAS)
GPD Sworn Police Officer : Service Population Ratio	1 : 561	2007 GPD staffing numbers to service population ratio - GPD Survey (Appendix F SIAS)
GFD Firefighter : Service Population Ratio	1 : 846	2008 GFD staffing numbers to service population ratio - GFD Survey (Appendix F SIAS)
GDoC Corrections Officer : Inmate Ratio	1 : 6	2008 GDoC staffing to inmate numbers - GDoC Survey (Appendix F SIAS)
GDYA Youth Service Worker : Service Population Ratio	1 : 316	2008 GDYA youth service worker numbers to service population estimates - GDYA Survey (Appendix F SIAS)

Table 16.2-44 presents the key operational component assumptions used in analysis of impacts and the source or rationale for these assumptions. These assumptions are much the same as those used for the construction phase analysis.

Table 16.2-44. Operational Component Assumptions for Public Safety Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
All quantitative assumptions for construction component also apply for the operational component, unless negated by the assumptions listed below.		
% increase in inmates in jail, prison or federal holds at GDoC per year.	2010 – 1% 2011 – 1% 2012 – 1% 2013 – 1% 2014 – 4% 2015 – 4% 2016 – 4% 2017 – 4% 2018 – 4% 2019 – 4% 2020 – 4%	Percent of adult population (not including active duty) increase over baseline as a result of proposed action. To produce increase in service population, these percentages were then multiplied by inmate population numbers provided in the GDoC Survey (Appendix F SIAS).

Impacts

Table 16.2-45 provides an overview of the proposed action's impacts on GPD, GFD, GDoC, and GDYA service populations for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-45. Impact on Public Safety Service Population Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady State Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GPD	160,797	2014	65,527	41%	31,071	19%
GFD	175,877	2014	49,895	28%	9,604	5%
GDoC	1,035	2014	240	23%	80	8%
GDYA	24,987	2014	9,263	37%	5,731	23%

Table 16.2-46 provides an overview of the proposed action's impacts on various public safety services agency staffing requirements for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-46. Public Safety Services Staffing Impacts Summary

Agency and Staffing Type	*Current Staffing Numbers*	*Peak Year*	*Peak Year Additional Staffing Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Staffing Requirements (going forward)*	*Steady Staffing Requirements Percentage Increase*
GPD – Police Officers	309	2014	117	38%	55	17%
GFD - Firefighters	190	2014	59	31%	11	6%
GDoC – Custody and Security Personnel	188	2014	44	23%	15	8%
GDYA – Youth Service Professionals	79	2014	29	37%	18	23%

Other factors regarding the impact of the proposed action on Guam's public safety system include (refer to Appendix F SIAS for more detailed discussion):

Other Staffing Factors: Support staff numbers are not included in the analysis above, but are large components of agency staffing. For example, 2006 data show that for every five police officers, approximately one civilian staff member was employed by GPD. Similarly, for every 6 custody and security staff at GDoC, 1 administrative or fiscal employee was employed in the parole division. These staffing ratios would add at the peak impact year of 2014, the requirement of 19 additional civilian staff at GPD and an additional 6 administrative or fiscal employees at GDoC.

Existing Professional Staffing Deficits: The GFD analysis is based upon a baseline staffing ratio that does not allow the meeting of certain NFPA fire protection standards on a consistent basis. While GFD is able to meet the response time requirements, the agency is currently unable to meet the recommended staffing ratio per engine company on a consistent basis, due to sick leave, vacations, and deployment of staff through the National Guard. This will be exacerbated due to the proposed action's fire prevention requirements.

Regional Issues: Regional aspects of the island affect both GFD and GPD's public safety responsibilities and would affect the number of additional staff that would be required at various locations. High hazard areas GFD must take into consideration include industrial regions where hazardous materials are stored, areas such as the Port Authority, regions with high rise buildings, and the remote and hilly southern regions of the island. Road and traffic congestion as well as lack of water pressure, due to the impacts of construction and a general increase in population would also impact safety and rescue operations. These regions require more staffing than others.

Precinct-specific police officer to population ratios are dependent on demographic traits and characteristics, and would be impacted by incoming population groups. Areas requiring more law enforcement presence include: those with an urban center (businesses), with legal gambling (game rooms), or highly mobile/seasonal populations (Guam Police Department 2007). In 2006, the ratio of sworn police officers to 1,000 inhabitants was as follows:

- Tamuning/Tumon Precinct: 2.0
- Agat Precinct: 1.0
- Dededo (including Yigo) Precinct: 0.5
- Hagatna Precinct: 0.5

Jurisdictional Issues: Because of the large military presence on the Island of Guam, issues of jurisdiction require close collaboration between local and federal public safety agencies, and such collaboration would require strengthening. In the past and currently, cases involving jurisdictional issues require that federal and local officials talk through the case and decide how the case is best prosecuted. This discussion includes issues such as what is best for all parties, what is best use of taxpayer resources, government assets and the best way to adjudicate and work through issues (Guam-JGPO Public Safety Forum 2008). Overall, collaboration between civilian and military safety agencies has been good, and these positive relationships and formal guidelines would require further development.

Additional Facilities and Equipment Needs: Public safety agencies indicate that they deal with current issues of overcrowding and inadequate facilities. Increased staffing population numbers at these agencies would necessarily require upgrades of facilities so that new personnel can work productively. Increased service population numbers would also require additional space.

An increase in agency staff combined with project-related safety incidents would require that GovGuam agencies acquire additional equipment and vehicles. It is difficult to assess the proposed action's impact on type public safety incidents that are likely to occur, and the connected equipment and vehicles that might be required. For instance, while hazardous conditions on road due to construction might cause increased traffic accidents, increased traffic due to a growing population may lead to slower traffic and a lower number of fatalities. It is expected that water emergency incidents such as boating accidents and drowning would increase with population numbers and equipment such as rescue boats and jet skis are used in such incidents.

Current Facilities and Equipment Deficits: A number of GFD fire stations were originally built for other purposes and do not house the equipment properly, exposing fire trucks and rescue boats to weather damage. In particular, the fire stations at Sinajana, Agat, and Piti are over capacity, while the stations at Tamuning, Yigo, Astumbo, Inarajan, Umatac, Yona and Talofofo are at maximum capacity.

The GDoC is unable to house all its inmates, overnighters and parolees that are being held on an infraction, and must shift individuals between its Adult Correctional Facility and Hagatna Detention Facility (DoC 2008). GDYA also has crowding issues. While the agency's Dededo facility and one of its Agat facilities would be able to accommodate additional service population, GDYA's remaining four facilities are either at or above capacity currently.

Other Selected General Services

Approach to Analysis

Analysis was performed on the following GovGuam agencies that would be impacted by population growth:

- GDPR
- GPLS
- Guam Judiciary

In particular, quantitative analysis was conducted on the proposed action's impact on:

- Service population numbers
- Key staffing requirements for the three agencies

The impacts discussed are independent of any needs that may result from non-project related general population growth. Also, it should be noted that many parks and community centers on Guam are not under the purview of GDPR, but rather are maintained and managed by the 19 mayors on Guam. Information on these facilities was not available at time of writing.

Table 16.2-47 presents the key construction and operation component assumptions used in analysis of impacts. These include:

- Analysis used the current professional to service population ratios determined through agency surveys.
- This analysis considers the service populations of GDPR, GPLS, and the Guam Judiciary as the entire island population. Each of these agencies service both civilian and military population needs.

Table 16.2-47. Assumptions for Other Selected Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
% of island population assumed to be in GDPR service population	100%	The entire island population is allowed access to the parks and recreation areas run by GDPR
% of island population assumed to be in GPLS service population	100%	All island residents and visitors are allowed access to the GPLS libraries, and all individuals with a valid form of identification are allowed to obtain a library card - GPLS Survey (Appendix F SIAS)
% of island population assumed to be on Guam Judiciary's service population	100%	All civil and criminal activity processed and litigated on the Island of Guam would go through the Judiciary system - Guam Judiciary Interview (Appendix F SIAS).
GDPR Staff : Service Population Ratio	1 : 1,954	Midpoint of agency staff (2000-2008) to service population estimates - GDPR Survey (Appendix F SIAS).
GPLS Staff : Service Population Ratio	1 : 6,281	2008 GPLS staff to service population ratio - GDPR Survey (Appendix F SIAS).
Guam Judiciary Judge : Service Pop Ratio	1 : 29,313	2007 Judiciary judges to service population ratio (Guam Judiciary 2008)

Impacts

Table 16.2-48 provides an overview of the proposed action's impacts on GDPR, GPLS and Guam Judiciary key staffing requirements for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-48. Impact on Other Selected General Service Agency Service Population

	Baseline Service Population Numbers	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady State Additional Service Population Numbers (going forward)*	*Steady Service Population Percentage Increase*
GDPR, GPLS, and Judiciary Service Population	160,797	2014	65,527	41%	31,071	19%

Table 16.2-49 provides an overview of the proposed action's impacts on GDPR, GPLS and Guam Judiciary key staffing requirements for the action's peak year and steady-state. Year by year breakdowns of impacts are available in the Appendix F SIAS.

Table 16.2-49. Other Selected General Service Agency Impacts Summary

Agency and Staffing Type	*Baseline Key Staffing Numbers*	*Peak Year*	*Peak Year Additional Key Staffing Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Key Staffing Requirements (going forward)*	*Steady Requirements Percentage Increase*
GDPR – General Staff	90	2014	34	38%	16	18%
GPLS – General Staff	28	2014	10	36%	5	18%
Judiciary - Judges	6	2014	2	33%	1	17%

Other factors regarding the impact of the proposed action on these agencies include (refer to Appendix F SIAS for more detailed discussion):

Current Agency Capacity Deficits: The analysis ratios used in the calculations above do not take into account current agency capacity issues. For instance, due to government budget cuts, GDPR has experienced a 50% decrease in staffing in the space of 12 years and despite population increases and staffing numbers have not changed significantly since 2003. According to criteria for determining adequacy of Public Library Services set down by the GPLS Board, the Island of Guam presently lacks at least ten professional librarians. Finally, the Guam Judiciary currently requires three additional judges to manage the workload that is independent of the proposed action (Guam-JGPO Public Safety Forum 2008).

Additional Support Staff Requirements: Impacts on support staff (in addition to the "key professional" numbers above) are important aspects of the proposed action's effects on agency capacity. However, they are much more difficult to quantify because agency support staff numbers were not always available at time of writing or support functions were contracted out.

While staffing numbers in this analysis relate to overall GDPR staffing, the GDPR practices extensive outsourcing of various duties including: maintenance, teacher, lifeguard, and park attendant.

GPLS staffing numbers in this analysis included all staffing. However, it should be noted that because of the lack of professional librarians on Guam, GPLS Library Technicians are often put in charge of library operations.

The Guam Judiciary has engaged the support of the National Center State Courts to develop a comprehensive master plan addressing the entire agency's staffing needs, including parole, counselors, youth workers and marshals. Although current staffing numbers were not provided, a recent Judiciary needs assessment document indicated the need for nine additional support staff per judge, including chamber clerks, bailiffs, law clerks, and deputy clerks (Guam Judiciary Interview – Appendix F SIAS).

Facilities and Equipment: In addition to staffing, the equipment, materials and technology that these agencies currently utilize are often inadequate. The GPLS Five-Year Plan (2008-2012) indicates inadequate library equipment and furniture, and ineffective electronic archiving and catalog systems (GPLS 2007). The Guam Judiciary's Strategic Plan notes the trends of security technology, use of the Internet, and increased networking of information requiring improved information and telecommunications technology (Guam Judiciary 2006). The GDPR notes that all facilities including beach parks, historical parks and recreational facilities are in poor condition due to budget cuts.

Budgetary Constraints: Budgetary constraints are common among these agencies, and affect their ability to meet the requirements of the proposed action's impact. The Judiciary's 2009 budget was cut by 10% and the agency has begun to implement a range of cost-cutting measures including a delay in the opening of its satellite center, a hiring freeze, and monitoring and reducing operating expenses. The GDPR has current capacity issues due to government budget cuts – the department has experienced a 50% decrease in staffing in the space of 12 years and despite population increases, staffing has not changed significantly since 2003.

Growth Permitting and Regulatory Agencies

Approach to Analysis

Analysis was performed on the following GovGuam agencies responsible for issuing, monitoring and enforcing development permits on Guam:

- Guam Department of Public Works (GDPW) Building Permits and Inspection
- Guam Department of Land Management (GDLM)
- Guam Environmental Protection Agency (GEPA)
- Guam Coastal Management Program (CMP), within Guam Bureau of Statistics and Plans (GBSP)
- Guam Power Authority (GPA)
- Guam Water Authority (GWA)
- Guam Fire Department (GFD)
- Historic Preservation Office (HPO), within the GDPR
- Guam Division of Environmental Health (DEH), within the GDPHSS
- Guam Alien Labor Processing & Certification Division (ALPCD) within the GDoL

Unlike the previously described services, the permitting work of these agencies would be driven by increases in permit applications before and during the process of growth on Guam (rather than population increases). Note that impacts to GFD, GDPR and GDPHSS were also addressed in prior impact sections. This section analyzes only the impact on their permitting functions (only a small percentage of their overall functions).

There are no distinctions between construction and operation component assumptions for the agencies analyzed in this section. This is because impacts are driven by the number of development permits estimated to be required, regardless of the project phase. Therefore, the assumptions listed in Table 16.2-50 apply to both components.

Table 16.2-50. Assumptions for Growth Permitting Agency Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Permits other than building permits	Proportional to population growth	Environmental permits generally grow with population
Monitoring/enforcement	Proportional to population growth except as noted below	Environmental monitoring and enforcement generally grow with population
Department of Land Management Assumptions		
% permits received by GDPW that would be referred to GDLM	100%	Records show that GDLM processed several times the number of permits as did GDPW (Guam Department of Land Management and Guam Bureau of Statistics and Plans Survey Responses)
% FTEs in permitting	33%	2005 base year (GDLM Survey Response 2009)
% FTEs in monitoring/enforcement	11%	2005 base year (GDLM Survey Response 2009)
% FTEs in administrative/support	11%	2005 base year (GDLM Survey Response 2009)
Number permits processed per permitting FTE	1,569	2005 base year (GDLM Survey Response 2009)
Number of rezones	Increase from base year according to population impact with two-year lead time from	Rezoning assumed to be tied to population growth, with two years often needed from submittal to rezone to completion of construction.

Assumption	*Assumed Value*	*Source/Rationale*
	population increase	
Enforcement/monitoring	Increase according to permit increase	Enforcement assumed to be tied to population growth.
GEPA Assumptions		
% permits received by GDPW that would be referred to GEPA	74%	2005 base year (GEPA Survey Response 2009)
% FTEs in permitting	65%	2005 base year (GEPA Survey Response 2009)
% FTEs in monitoring/enforcement	15%	2005 base year (GEPA Survey Response 2009)
Number permits processed per permitting FTE.	52.3	2005 base year (GEPA Survey Response 2009)
On-site activities (direct project)	Equivalent of 200 permits on-site in 2010, increasing along with population impacts	Some set-up would be required early in project
Monitoring/enforcement	Proportional to population growth except 200 permit-equivalents needed in 2010	Environmental monitoring and enforcement generally grow with population but typically require effort closer to beginning of projects.
GFD Assumptions		
% permits received by GDPW that would be referred to GFD	% permits received by GDPW that would be referred to GFD	% permits received by GDPW that would be referred to GFD
% FTEs in permitting	% FTEs in permitting.	% FTEs in permitting
% FTEs in monitoring/enforcement	% FTEs in monitoring/enforcement.	% FTEs in monitoring/enforcement
Number permits processed per permitting FTE	Number permits processed per permitting FTE	Number permits processed per permitting FTE
DEH Assumptions		
% permits received by GDPW that would be referred to DEH	% permits received by GDPW that would be referred to DEH	% permits received by GDPW that would be referred to DEH
% FTEs in permitting.	% FTEs in permitting.	% FTEs in permitting
% FTEs in monitoring/enforcement	% FTEs in monitoring/enforcement.	% FTEs in monitoring/enforcement
Number permits processed per permitting FTE	Number permits processed per permitting FTE	Number permits processed per permitting FTE
Department of Parks and Recreation (HPO) Assumptions		
% permits received by GDPW that would be referred to DPR	% permits received by GDPW that would be referred to DPR	% permits received by GDPW that would be referred to DPR
% FTEs in permitting	% FTEs in permitting	% FTEs in permitting
% FTEs in monitoring/enforcement	% FTEs in monitoring/enforcement	% FTEs in monitoring/enforcement
Number permits processed per permitting FTE	Number permits processed per permitting FTE	Number permits processed per permitting FTE
Permits required for direct project activities	Permits required for direct project activities	Permits required for direct project activities
GDoL ALPCD Assumptions		
No H-2B Workers would be associated with operation of the	No H-2B Workers would be associated	No H-2B Workers would be associated with operation of the proposed project. H-2B workers

Assumption	*Assumed Value*	*Source/Rationale*
proposed project. H-2B workers would only be employed for direct construction, and not for any indirect or induced activities	with operation of the proposed project. H-2B workers would only be employed for direct construction, and not for any indirect or induced activities	would only be employed for direct construction, and not for any indirect or induced activitie
Ratio of H-2B workers to ALPCD staff	Ratio of H-2B workers to ALPCD staff	Ratio of H-2B workers to ALPCD staff

Impacts

Table 16.2-51 shows the estimated number of key growth permitting professional staff required due to the proposed action. The peak requirement in 2014 ranges from about 9% (GPA) up to 103% (Guam DLM) greater than baseline staffing levels, depending on the agency (except for ALPCD that would experience a 200% peak increase in required staffing due to large influx of H-2B workers). After construction ends by the end of 2016, the required staffing levels are 0% (DPR-HPO and ALPCD) to 64% greater (Guam DLM) than reported baseline staffing levels. By the criteria discussed previously, the overall effect would be considered a significant and adverse impact.

Table 16.2-51. Additional Growth Permitting Staff Required

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Guam DPW Permitting Staff	8	9	7	6	3	2	2	1	1	1	1
Guam DLM Permitting Staff	8	8	9	9	8	7	7	7	7	7	7
GEPA Permitting Staff	16	19	17	16	12	11	10	3	3	3	3
CMP Permitting Staff	2	2	4	5	5	3	3	2	2	2	2
GPA Permitting Staff	3	4	3	2	2	2	1	1	1	1	1
GWA Permitting Staff	3	4	3	3	2	2	2	1	1	1	1
GFD Permitting Staff	12	14	10	9	5	4	4	2	2	2	2
GDPHSS - DEH Permitting Staff	1	2	2	3	4	3	2	2	2	2	2
Guam DPR - HPO Permitting Staff	2	2	2	2	1	1	1	0	0	0	0
Guam Department of Labor - ALPCD Permitting Staff	6	9	10	8	0	0	0	0	0	0	0

Notes: Numbers show combined total impact. See Appendix F SIAS for a breakdown of the above numbers by construction and operations, as well as direct and indirect effects, for each agency.

16.2.2.4 Sociocultural Impacts

Sociocultural Impact analysis includes the following issues:

- Crime and Serious Social Disorder
- Chamorro Issues
- Community Cohesion

Crime and Serious Social Disorder

Approach to Analysis

Scoping comments and interviews were used to identify probable crime and social disorder impacts of the proposed action. Analysis is qualitative and based largely on interviews in 2008 and early 2009.

Topics identified and addressed include:

- Increase in overall crime
- Increase in prostitution
- Increase in drug use/substance abuse
- Increase in sexual assaults
- Increase in crimes against women and children
- Increase in military-civilian fights

Impacts – Construction Phase

During the construction phase, the following crime and social disorder impacts would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS):

Increase in Overall Crime: It is expected that a spike in the number of offenses and arrests would occur at the onset and for the duration of the construction component, especially considering that the overall social change at this time would be augmented by the relocation of all Marine Corps personnel.

Construction booms in general cause a variety of social disruptions. However, interviews with industry professionals that experienced Guam's hotel construction boom of the late 1980s and early 1990s indicate that Guam did not experience significant increases in crime or social disorder (Guam Contractors Association and Guam Visitors Bureau Interviews – Appendix F SIAS). More recent arrest data on Guam does not indicate an offenders' type of employment, so it is not possible to say whether construction workers in particular are more crime-prone than other types of workers.

The expected construction worker composition may also affect increase in crime, with H-2B workers having historically less of an impact than workers migrating from the Freely Associated States of Micronesia (FAS). Prior experience suggests that H-2B workers would be responsible for little if any increase in crime.

In contrast, in-migration of workers from the FAS (whether for direct construction work or to take new indirect jobs,) has been associated with increased crime. In-migrants from the FAS (including Palau, FSM, and the RMI) are disproportionately represented in arrests for Part I and Part II offenses in the most recent years that data were published. Notably, 2006 statistics show that FAS/FSM arrests were disproportionately high for serious Part I crimes such as Aggravated Assault (44%), Motor Vehicle Theft (43%) and Murder (33%); however, actual numbers of the latter two crimes are low and therefore statistically less reliable (Guam Police Department 2008). For Part II crimes, the FAS/FSM arrests were disproportionately high for offenses such as Other Assaults, Vandalism, Drunkenness, Liquor Laws, Driving Under the Influence, and Disorderly Conduct. Chuukese comprise 80% of indigent defendants currently in the court system. Micronesian gangs are also emerging as a problem, and especially involve Chuukese and Chamorro youth engaging in fights and retaliation actions.

The possibility of ethnic bias in arrest patterns must be acknowledged in reference to the above data.

Cultural differences affect arrest rates as well. Although Guam Police Department data combines FAS and FSM populations, immigrants from the FSM account for the majority of the FAS residents on Guam (U.S. Census Bureau 2009). These immigrants not only come from depressed economies, but also often live by different value systems that may manifest in behavior that is acceptable in their culture but not on Guam. For example, while educational requirements are nominal in FSM, not attending school is defined as truancy on Guam. It should also be emphasized that FAS residents' current apparent propensity for

more crime reflects cultural transition to a more modern society and would not necessarily continue indefinitely.

Increase in Prostitution: While the *volume* of prostitution may be assumed to grow consistent with the significant increase in transient population during the construction period, it cannot be conclusively determined whether the *rate* of prostitution would increase.

In general, prostitution prospers in boomtown settings. Thousands of men are added to the local population, and transient workers often have little stake in the community. As a result, drugs, alcohol abuse, and prostitution can become significant problems, and annual arrests can double or triple in a single year (Ortiz et al. 2009).

Inquiries to the Guam Police Department revealed an absence of quantitative data about those who patronize prostitutes. Arrest data refer only to prostitutes, not their clients. Thus, there is no clear evidence whether likely in-migrating groups are any more or less likely to patronize prostitutes. It is therefore not possible to say whether these groups of workers in particular would differ from other construction-related workers in contributing to prostitution.

Increase in Drug Use/Substance Abuse: The proposed action would likely increase the number of arrests for drug and alcohol-related offenses simply because of the population growth. Furthermore, rapid social and economic change can significantly impact drug and alcohol abuse.

It is not possible however, to determine whether construction workers in particular would incur more drug and alcohol-related arrests than other types of workers. The Guam Police Department reports on drug abuse arrests by age and types of drugs involved and Driving Under the Influence arrests are reported by outcomes (involving crash, injuries or fatalities) and ethnicity, not by type of employment.

Data is available on FAS/FSM alcohol offenses however, and in 2006 FAS/FSM arrests were disproportionately high for alcohol-related offenses though not for drug violations.

Finally, the flow of goods and legal and illegal immigrants into Guam presents opportunities for drug smuggling. The drug methamphetamine was involved in 54% of the drug arrests in 2006 (Guam Police Department 2008). The 2003 Drug Threat Assessment reported that methamphetamine is the most available, most abused illegal drug on Guam (U.S. Department of Justice 2003). It is readily available on Guam due to a steady supply from the Philippines, Hong Kong, China, Taiwan, and South Korea.

Impacts – Operations Phase

During the operational phase, the following crime and social disorder impacts would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS):

Increase in Overall Crime: It appears that the military operational component would have little impact on overall crime rates. This is determined with access to limited data, evidence that crime rates for U.S. military in Okinawa are low, and limited statistics on individual branches of the armed forces are available.

Quantitative military data on criminal arrests of Marine Corps personnel or for any branch of the armed services are limited to information on overseas Status of Forces Agreement (SOFA) personnel. The Guam Police Department does not gather specific data on military charged with crimes, and neither the DoD nor Marine Corps websites offer data. Thus the best reliable predictor for an increase in overall crime on Guam once the Marine Corps personnel are relocated is provided by the information on arrests of SOFA personnel while on Okinawa.

Increase in crime by the military dependents on Guam may also be a possible impact. Guam has experienced rising juvenile drug abuse arrests (from seven to 117 between 2002 and 2006) and other assaults from 39 to 160 between 2002 and 2006) (Guam Police Department 2008, Guam Judiciary 2008, Republic of Korea Drop 2008). Dependents of SOFA personnel on Okinawa do contribute to the overall crime statistic. Of the 46 arrests in 2007, 30 were active-duty service members; one was a civilian employee; and 15 were dependents. In 2006, arrests involved 38 service members, three civilians, and 22 dependents arrested. These arrests included 23 minors.

Increase in Sexual Assaults: In 2006, Guam Police Department recorded 141 arrests for forcible rape and seven arrests for sex offenses (Guam Police Department 2008). As noted previously, the Guam Police Department does not gather specific data on military charged with crimes.

Thus, quantitative data on sexual assault arrests of Marine Corps personnel or for any branch of the armed services are limited to information on overseas SOFA personnel. This data conveys the impression that the impact of sexual assaults by any branch of the military would not be significant. That conclusion, however, should be viewed with some caution, as detailed information on Marines is lacking.

Increase in Prostitution: The overall *volume* of prostitution may be assumed to grow consistent with the significant increase in both military and civilian population stemming from the buildup, but it cannot be conclusively determined whether the *rate* of prostitution would increase.

Historically, prostitution has long been associated with the presence of military bases. Prostitution is frequently cited as a problem around military bases in Korea, the Philippines, and more recently in Bosnia. However, local law enforcement policies are a major factor in determining whether prostitution is, first, considered an important issue, and, second, tolerated or not.

Regardless of the approach or enforcement policies of local authorities, the U.S. military has declared a "zero tolerance" policy regarding prostitution. Realistically, some military personnel, like some civilians, frequent houses of prostitution and engage in other types of commercialized vices. Given that there is already a fairly large military population on Guam, the few 2006 arrests on Guam for prostitution indicate that the problem is not a large one, is not considered so by the police, and/or is not a priority for enforcement by Guam authorities.

Research for this study found that general articles referring to prostitution and the military tend to focus on single events or areas of deployment. No statistical studies were found that give any quantitative data on discrepancies between Marines and other branches of the military in regards to whether one branch is more inclined to utilize the services of a prostitute.

Increase in Drug Use/Substance Abuse: "Substance abuse" can include alcohol. The drinking age on the Island of Guam is currently 18. There have been discussions about enforcing an on-base drinking age of 21 (and perhaps off-base as well). However, any off-base limits would be difficult to enforce, and would require the attention of the military.

Information on drug use/substance abuse (including alcohol) in the military is fragmented, but indications are that this may be a growing problem. In 2005, the DoD conducted a survey of 16,037 active-duty military personnel. In the survey, 43% of active-duty military personnel admitted to frequent binge drinking. In addition, 67.1% of binge-drinking episodes were reported by personnel aged 17-25 (representing nearly half of all active-duty military personnel), and a quarter of those episodes were reported by underage personnel (age 17-20) (Central Broadcasting Service News 2009). It should be noted, however, that published results did not compare rates among different military services or with civilians of comparable age and socioeconomic status.

In 2005, 10.5% of enlisted personnel left the military, an increase from 8.7% in 2002. This increase is blamed in part on drug use. The losses include soldiers, Sailors and airmen who are discharged before their term of enlistment is up and have risen among enlisted and officers alike in recent years. Discharges for drug use have risen 40% in the Army since 2002, although discharges for alcohol use declined (Join Together 2006).

Moreover, there is growing concern that military personnel returning from Iraq and Afghanistan are experiencing a range of difficulties, including traumatic brain injury, post traumatic stress disorder, depression, anxiety, and the abuse of tobacco, alcohol and illegal drugs. This has become a major issue to such an extent that a January 2009 conference was convened by the National Institute on Drug Abuse to address substance abuse and co-morbidities among military personnel, veterans, and their families.

No statistical studies were found on any specific branch of the military in regards to drug use and substance abuse. Thus, the conclusion of probable increase in alcohol or other substance abuse issues is based strictly on the addition of significantly more military troops to Guam's population, but not the Marine Corps in particular.

Increase in Offenses Against Women and Children: Domestic violence and child abuse were concerns frequently expressed in scoping comments. (Some of these overlap with concerns covered previously).

Despite data limitations, available information suggests the upcoming military re-deployment would cause an increase in offenses against women and children on Guam's military community, certainly in the overall volume and possibly in the rate as well. However, this is a function of increased presence of the military population in general, not the Marines in particular.

Guam data do not provide clear indications of a relationship between current military presence and family violence. In 2006, only 53 arrests for "Offenses Against the Family" were reported (Guam Police Department 2008). There is no indication whether the offenders were civilian or military. For a number of reasons including shame, secrecy, and isolation, both domestic violence and child abuse are typically under-reported (National Committee to Prevent Child Abuse 1996).

Nationally, there have been clearer indications that family violence is a serious military-wide concern, although even these are subject to data limitations.

Following a number of reported high-profile domestic violence cases involving soldiers who killed their spouses, Congress passed the National Defense Authorization Act for FY 2000. The Act required DoD to take several actions to address concerns about domestic violence in the military, including the establishment of a Defense Task Force on Domestic Violence. Over the next three years, the task force issued three reports that collectively contained almost 200 recommendations. The task force reported finding a system where military personnel rarely faced punishment or prosecution for battering their wives and where they often found shelter from civilian orders of protection. The overarching recommendation was for the military to implement a "culture shift" to zero tolerance for domestic violence by holding offenders accountable and by punishing criminal behavior. DoD accepted most of the recommendations and gradually made many changes, ranging from an increase in family counselors to domestic violence training for commanding officers (General Accounting Office 2006, Alvarez and Sontage 2008).

However, specific data on either the Marine Corps or any other branch of the military were not published. In fact, DoD's ability to record domestic violence incidents and disciplinary actions taken by commanders is hampered because the systems used are based on incomplete data (General Accounting Office 2006). DoD's domestic violence database does not capture data from all law enforcement systems. As yet, no

plans have been developed to address the data limitations. Given the incomplete information, DoD cannot know the size and nature of the problems nor have the ability to assess the effectiveness of its actions.

Since the beginning of the current wars in Afghanistan and Iraq, there has been a cluster of family murder-suicides suggesting a possible link between combat tours and domestic violence (Alvarez and Sontage 2008). Again, many questions have been raised about the actual strength of this link, although researchers have established a relationship between combat-induced post-traumatic stress disorder and domestic violence.

Increase in Military/Civilian Fights: Fights have occurred between military and civilian populations since the U.S. armed forces first came to Guam. Occasional personal conflicts occur around all military bases throughout the world and regardless of country or nationality. Despite Guam's existing military population, such conflicts are not considered a major issue at present, but interviews with various Guam civic leaders found significant concern based in part on a perception of the Marine's "warrior culture" and in part on widespread memories of violent encounters when there was a larger military presence on Guam during the Vietnam War period (Guam Civilian Military Task Force Committee on the Environment 2008, Guam Civilian Military Task Force Committee on Health and Social Services 2008, Guam Civilian Military Task Force Committee on Public Safety 2008).

Ultimate fighting and mixed martial arts training are currently popular among Guam's young civilian population, and there have been reports that the youth undergoing such training might test themselves against Marines who could react accordingly (Guam Police Department Interview – Appendix F SIAS). If such conflicts occur, they would likely represent a significant transitional "period of adjustment," but the length of this period is not predictable.

Chamorro Issues

Approach to Analysis

The biggest impact drivers on Chamorro cultural issues for both the construction and operational phases may be the introduction of military and DoD civilian workers into the population and the feeling of respect by the military for the Chamorro population on Guam. Acquisition or leasing of lands for development would also drive impacts to a lesser extent. In all cases, the more significant impacts on Chamorro issues would be felt during the operations phase as opposed to the construction phase.

Based on scoping input and interviews, Chamorro Issues analysis identifies and addresses the following topics:

- Political minoritization of Chamorros by temporary workers, permanent military population, and in-migration related to the proposed action
- License of public lands from the Chamorro Land Trust Commission
- Unearthing of Chamorro artifacts
- Perceptions of mutual respect from the U.S. military

Impacts – Construction Phase

During the construction phase, the following issues would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS):

Minoritization: At 42% of the population, Chamorros are already a minority on Guam (although they are still a plurality – i.e., the largest single group). Therefore, the incoming wave of temporary H-2B construction workers and other workers associated with a construction boom could increase Chamorro

feelings of marginalization. However, the portion of these workers from the FAS or on H-2B visas would lack political rights, and most of these workers would leave Guam after 2016. Therefore, the construction component should not have significant ongoing impacts on Chamorro political control.

Land Acquisition and Leasing: Under Alternative 1 of the proposed action, the military would acquire new lands for development. Assuming this is done through lease rather than condemnation, for parts of these parcels that are public, the military would require a license from the Chamorro Land Trust (CLT). By its charter, the CLT leases land to Chamorro farmers and business owners, or licenses land to non-Chamorros, using the revenues to promote health and development projects for Chamorros. The military's plans to license public lands from the CLT would determine, in part, the CLT's funds for development projects; and a large increase in development funds for the CLT would have a beneficial impact on the Chamorro population.

Artifacts: There is a concern that military development could unearth Chamorro artifacts. Chamorro groups such as the Department of Chamorro Affairs (DCA), the Guam Council on the Arts & Humanities Agency, and the Guam Museum are requesting the military give the anticipated artifacts and provide funding to the Guam Museum. Refer to Volume 2, Chapter 12, Cultural Resources for impact analysis.

Impacts – Operations Phase

During the operational phase, the following impacts would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS):

Minoritization: Overall, the analysis indicates a sustained increase of approximately 33,500 people on Guam. Most of these people would have political rights as U.S. citizens. Therefore, their sustained presence could affect Chamorro culture in a number of ways, politically and culturally.

Firstly, a reduction in Chamorro voting power would impact certain political issues important to the Chamorro population.

The incoming population would presumably be disinclined to vote for further moves away from the U.S., and this may affect the success or failure of future plebiscites involving Guam's political status. Guam's status and its relationship to the U.S. are largely legal affairs, such as the previous Constitutional Conventions. However, the constitution produced by that 1978 Convention was rejected by the voters the following year (Office of the Governor of Guam 2008). Subsequent attempts to change Guam from an organized but unincorporated territory into a commonwealth have so far collapsed.

A reduction in Chamorro voting power may also be felt on the policy level. For example, it is commonly agreed among Chamorro politicians that public funds should be spent to support funeral and wake activities. However, non-Chamorro elected officials may not appreciate this cultural tradition and support such things (Guam DCA Interview – Appendix F SIAS).

Another goal of Chamorros has been political self determination, and for some Chamorros, total sovereignty. While it is by no means certain that Guam residents would ever vote for full independence even if the military buildup does not take place, the addition of more non-Chamorro voters may make efforts at sovereignty less viable.

On a more purely cultural level, while the loss of the Chamorro language has been occurring for years on Guam, it may be accelerated with the military build-up.

Guam's integration into the larger English-speaking American society has been correlated with a loss of the use of Chamorro language in everyday life. A survey of Chamorro residents (Santos and Salas 2005)

found that 90% said the language was a source of pride, and students are learning to read and write the language with more comprehension than most of their elders. However, younger people are much less able to speak and comprehend the spoken language than their elders. Younger people speak the language primarily just with older relatives, not among their peers.

This loss of language skills is a common occurrence where a more dominant culture influences a minority culture.

Respect: Like many small island societies, Chamorros developed an interdependent culture, to achieve consensus whenever possible. Under this sort of consensus-based cultural system, exclusion from decision making may be equated with "disrespect." This could conflict with the military culture of chain-of-command and their mission of national defense, as opposed to local concerns.

The Chamorro concept of inafa'maolek holds that society is based on good relationships and mutual respect. Inafa'maolek is based on varying familial relationships, and reciprocal obligations between two people in any of these relationships. The relationships tend to be based on age, with the older person owing the younger person responsibility, and the younger owing the older deference. Chamorros expect people to approach their relationships with the wider society conforming to the philosophy of respetu (respect). This philosophy involves respecting the environment and society that the individual lives. Chamorros are held to infa'maolek and respetu by a strong sense of mamahlao, or shame. A proper Chamorro has a sense of mamahlao in social situations, and does not openly contradict a superior or act outside of social mores (Guam DCA 2003).

Nuanced aspects of the way the military deals with the Chamorro population on Guam would determine the perception of whether they respect the local population and culture. A survey by the Public Affairs and Legal Studies club at the UoG found over 80% of respondents wanted to tell the military that communication would be the surest sign of respect and path to smooth interaction on Guam (KUAM 2008).

Community Cohesion

Approach to Analysis

The negative interactions related to incoming new population discussed here do not rise to the level of major issues previously discussed under "Crime and Disorder," but are more likely to be irritants that may undermine a sense of mutual respect between groups.

Also, the arrival of new populations can bring positive benefits that infuse communities with opportunities for more meaningful interactions.

Topics identified and addressed include:

- Increase in Cultural Conflicts
- Increase in Military Outreach/Community Programs

Impacts – Construction Phase

During the construction phase, issues of cultural conflict would be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS). The following discussion outlines examples of cultural discontinuities that could emerge during the construction component, producing conflict. Such discontinuity and conflict could reach significant levels as greater numbers of immigrants arrive.

Large-scale in-migration of culturally different populations can easily lead to tension with the host community's longtime residents (United Kingdom Department of Communities and Local Government 2007). The main populations relevant to this proposed action are H-2B construction workers or groups from the Asia Pacific region that may in-migrate for available indirect jobs.

As previously discussed, Guam's temporary foreign workers (H-2Bs) are generally regarded as law-abiding, causing few disruptions to the community. However, there has been some historical experience with foreign construction workers who, due to unfamiliarity with local conditions and prohibition, have disturbed local customs or environments. For example, temporary foreign workers have upset residents by harvesting marine animals normally not consumed on Guam, and by taking shells and corals to the point where reefs have been damaged (Guam Bureau of Statistics and Plans Interview – Appendix F SIAS).

Problems related to immigrants from the FAS who come to Guam for direct construction work or new indirect jobs frequently arise in the areas of public health and education. A 2001 General Accounting Office report on Micronesian migration cited data showing that Compact of Free Association migrants were working low-paying jobs that required few skills, and that most (more than 50%) were living at poverty levels on Guam, HI, and the CNMI in conditions that places a strain on public services.

Conflicts between local and in-migrant customs related to housing and living conditions is also an issue on Guam. For example, up to 15 or 20 individuals from these groups have been reported to reside in a single housing unit, and there are stories of subdivided lots without sewer connections or other infrastructure being sold by unscrupulous developers to Micronesians, who find it natural to live in the "traditional" rural style found on their home islands (Guam Contractors Association 2008, Guam Housing and Renewal Authority 2008). However, it is also argued that these in-migrants accept such crowding and harmful living conditions because of economic reasons, not because it is a cultural norm – i.e., these same in-migrant groups do not live with the same household densities in their home islands (Center for Micronesian Empowerment Interview – Appendix F SIAS).

Cultural conflicts can also be observed in the education sector. Often FAS in-migrants are not highly educated, few have college degrees and just over 50% have graduated from high school (General Accounting Office 2001). However, as mentioned in the Crime and Social Disorder section, the comparatively minimal educational requirements in Micronesia are values that are sometimes brought to Guam by in-migrants, resulting in lax parental enforcement of school attendance, and ultimately resulting in high levels of truancy for Micronesian students.

Impacts – Operations Phase

During the operations phase, issues of cultural conflict would also be possible (more detailed discussion on each of these topics is available in the Appendix F SIAS).

As noted in the Chamorro Issues section, concerns about increased military-civilian conflict often reflect beliefs that incoming populations would not have sufficient knowledge of and respect for local culture. Also noted previously, the way the military works with the local population and efforts made to understand local issues, would determine whether increased cultural conflicts would occur in the military operational phase. Already in place is a newcomers' orientation program offered by the Navy and the Air Force that informs newly assigned service members and their families about the culture and uniqueness of Guam (Office of the Governor of Guam 2009).

Military outreach and community programs should increase during the operations phase. For decades, a variety of community service programs have encouraged positive interaction and cultural exchange

between the military and civilian populations on Guam. Many of these programs were instituted by the Naval and Air Force commands on the island (Office of the Governor of Guam 2009).

These programs have the potential to bring a beneficial impact to Guam to the point that positive interactions could strengthen military ties to local communities. For example, the larger military contingent would add greater numbers of volunteers to community service programs that would bring together both military and civilian groups working toward shared goals.

Some examples of these programs are:

1. Sister Village Program - Military units are paired with villages to foster mutual sharing and understanding between the people of Guam and the military personnel and their family members stationed on Guam. School partnerships with military units were established in 1987.
2. In 1997, volunteer efforts were formally expanded in five project categories to help strengthen education and the quality of life on Guam through joint military and community effort. Those project categories include:
    - Partnership in Education
    - Guest Teacher Program
    - Health, Safety, and Fitness
    - Environmental Stewardship
    - Campaign Drug
    - Project Good Neighbor (Pacific Daily News 2008)
3. Naval Hospital Guam Community Services
    - Staff contribute thousands of community service hours on projects such as school clean-up, work with Guam Animals in Need and countless other organizations
    - Naval Hospital received top honors in the 2008 Navy Environmental Stewardship Flagship Award for large, shore-based commands
    - Most notable is the nursing mentorship that is provided for seniors of the UoG nursing program (Naval Hospital Guam Interview – Appendix F SIAS)
4. Andersen Air Force Base Programs
    - Big Brother Big Sister
    - Donations to schools through the DoD Computers for Learning Program (Lessard 2008)
    - Air shows open to the community

16.2.3 Summary of Impacts

Socioeconomic impacts are anticipated to be largely islandwide in nature with little difference in effects among the various alternatives. The impacts in this chapter are calculated under a scenario that assumes there would be no constraints (blockages) to the rapid development of spin-off private-sector economic activity driven by the military construction and permanent military operational stages. Most impacts are characterized by a burst of activity and impacts in the 2013-2014 timeframe, followed by relatively much lower impacts when construction ends.

16.2.3.1 Population Impacts

Including active-duty Marines, dependents, and rotating transient Marines (about 19,500 people), the proposed action would add about 65,500 residents to Guam's population in 2014 and a subsequent more stable approximate of 31,000 by 2020.

16.2.3.2 Economic Impacts

Most long-term economic impacts would be beneficial, though the construction boom would entail substantial growing pains related to rapid population influx and housing shortages. These impacts, combined with others such as increased noise and traffic, would substantially impact quality of life on Guam for several years, until the steady-state military operational phase is in place.

Including all the spin-off activity, the proposed action would provide jobs for about 33,000 civilian workers at the 2014 peak and approximately 6,150 on a more permanent basis. Guam residents are estimated to capture about 2,000 of the direct on-site construction jobs for Marine Corps facilities at the 2013-2014 peak, as well as approximately 2,570 spin-off jobs that year, with a slight decline thereafter.

Although a more detailed fiscal impact assessment will be done by GovGuam using output from this EIS/OEIS, preliminary estimates in this chapter suggest revenues from the three most important tax sources – gross receipts, corporate income, and personal income – would exceed $325 million in 2014 and stabilize at nearly $97 million thereafter.

Civilian housing unit demand would peak at about 9,500 units in 2014 – an amount that is unlikely to be entirely met by new construction, resulting in consequences such as crowding, possible illegal units, and further increases in housing costs – falling to about 3,000 for the steady-state phase.

While Guam businesses are expected to benefit from various opportunities, including military set-asides, there could be a variety of impacts on tourism, both positive (e.g., increased hotel occupancies from business travelers and military families) and negative (a military "sense of place" competing with the historic/cultural milieu the GVB hopes to promote).

Guam's GIP, the total market value of all final goods and services produced in a given year, would increase by $822 million (2008 dollars) in 2014 and by nearly $157 million a year from 2017 on.

16.2.3.3 Public Service Impacts

Many public services offered by GovGuam would need to increase professional staff to service the new population. Most of these agencies would need to rapidly expand their services and staff during the 2013-2014 peak (raising serious issues of availability of qualified workers), then cut back them back as construction ends.

For public education services, the GPSS, GCC, and UoG together would need to hire a combined 490 teachers/faculty for the year 2014, falling to a combined 135 after construction ends.

For health and human services, this chapter considered impacts on various aspects of the GMHA, the GDPHSS, the GDMHSA, and the GDISID. These agencies would need a combined 192 new key professional workers by 2014, dropping to a combined 52 a few years later.

Public safety agencies – Police, Fire, Corrections, and Youth Affairs – would require a combined 249 key professionals in 2014, falling to a combined 99 a few years later.

Other selected general service agencies – Parks and Recreation, Libraries, and the Judiciary – would require a combined 46 key professionals in 2014, falling to a combined 22 after construction ends.

Agencies that deal with permitting and regulating growth are affected more by the initial requests for permits and then subsequent inspections and monitoring. For the agencies involved in development permitting, impacts on workloads would tend to be slightly earlier than for other agencies, because generally, rezoning and permit applications occur one to two years before construction projects are completed and occupied. The peak year of demand for permitting agency staffing was found to vary by

agency, rather than the 2014 standard. Of the permitting agencies providing information for this EIS/OEIS, the GEPA appeared to require the largest numeric staffing increase, at 19 FTEs in 2011. Other, smaller agencies such as the DLM would experience numerically smaller staff demand increases, but the proportional increases would be similar across permitting agencies.

16.2.3.4 Sociocultural Impacts

Sociocultural impacts by their nature are complex and have no single outcome measure.

Although available evidence does not suggest that Marines would have an impact on Guam's overall crime rates or assaults on women, there is cause for concern about impacts on crime and social order due to other factors. Construction booms are often accompanied by a sense of loosened norms and social disorder. In-migrants from the FAS – whose numbers may increase in both the construction and operational stages due to more job opportunities – have high crime rates associated with adapting to less traditional social structures. There is a potential for more prostitution, alcohol/substance abuse, and family violence associated with young military populations in general, not Marines in particular. However, the reputation of Marines as fighters could trigger a transitional period of adjustment that local young men test themselves against Marines in fights.

Long term, though, established patterns of military outreach to Guam's civilian community are likely to minimize the sort of day-to-day irritants that affect the average citizen, including the perceived insufficient respect that underlies one set of Chamorro concerns. Chamorro concerns involves political autonomy are impacted by the potential increase in non-Chamorro populations due to the buildup, increasing the likelihood of more non-Chamorro local political office-holders. More non-Chamorro voters would decrease the possibility of Chamorro political self determination. They would also decrease the possibility of successful plebiscites to achieve greater independence from U.S. control, although at present there is little evidence that a majority would support such moves at any rate.

Table 16.2-52 provides a summary assessment of the potential impacts of the proposed action.

Table 16.2-52. Summary of Impacts Associated with the Proposed Action

Proposed Action-All Alternatives
Construction
SI • Significant delayed adverse impact to civilian housing demand following construction phase if demand is met at the peak. Subsequent over-supply of housing units would follow the construction period, and result in declining housing values
SI-M • Significant adverse impacts to population due to strains placed upon government services and the social fabric (See Public Service and Sociocultural impacts below) • Significant adverse impact to civilian housing demand if construction phase housing demand is not met at the peak, resulting in high costs, crowding and/or homelessness • Significant adverse impacts to public service agencies influenced by population increases, due to difficulty in meeting fluctuating staffing requirements during the construction phase with an existing environment of staffing and budget shortfalls and recruitment complications • Significant construction-related adverse impacts to growth permitting and regulatory agencies due to difficulty in meeting fluctuating staffing requirements with an existing environment of staffing and budget shortfalls and recruitment complications • Significant adverse impacts to social fabric resulting in differences in norms and customs between longtime Guam residents and foreign workers or FAS in-migrants arriving on Guam for jobs • Significant adverse impact to crime and social order due to increased overall crime, prostitution, alcohol/substance abuse, domestic offenses, and fights.

Proposed Action-All Alternatives

BI

- Beneficial impact due to economic expansion fueled by increased population (see Economic impacts below)
- Beneficial impacts to civilian labor force demand due to provision of construction-related jobs on Guam
- Beneficial impacts to civilian labor force incomes due to infusion of income into the Guam economy
- Overall beneficial impacts to the standard of living associated with higher incomes reducing the rate of reductions in standard of living.
- Beneficial impacts to local business opportunities due to increased military service contract opportunities for local Guam businesses
- Overall, impacts to tourism would be mixed (both beneficial and adverse). On balance the positives outweigh the negatives.
- Beneficial impacts due to increase in local government revenue

Operation

SI

- Significant adverse impact to public service agencies influenced by population increases due to difficulty in recruiting and funding adequate staffing during operational phase

SI-M

- Significant adverse impacts to public service agencies influenced by population increases, due to difficulty in meeting fluctuating staffing requirements following the construction phase with an existing environment of staffing and budget shortfalls and recruitment complications
- Significant adverse impacts to indigenous Chamorro efforts to preserve political representation due to lower number of ethnic Chamorro voters, due to increase in non-Chamorro voting population on Guam

BI

- Beneficial impact due to economic expansion fueled by increased population (See Economic impacts below)
- Beneficial impacts to civilian labor force due to provision of permanent jobs on Guam
- Beneficial impacts to civilian labor force incomes due to permanent infusion of income into the Guam economy
- Beneficial impact to public service agencies influenced by population increases, due to provision of additional jobs on Guam, if labor supply and funding is available during operational phase
- Overall beneficial impacts to the standard of living associated with higher incomes reducing the rate of reductions in standard of living.
- Beneficial impacts to local business opportunities due to increased military service contract opportunities for local Guam businesses
- Overall, impacts to tourism would be mixed (both beneficial and adverse). On balance the positives outweigh the negatives.
- Beneficial impacts to Gross Island Product due to permanent increased GIP strengthening the Guam economy
- Beneficial impacts due to increase in local government revenue
- Beneficial operational phase impacts to civilian housing demand due to increase in competitive housing market on Guam
- Beneficial impacts to community cohesion resulting from increases in well-established and successful military community outreach programs
- Beneficial impacts to Chamorro Issues due to increased funding for development of agricultural, social, and business development programs for Chamorro people (only if military leasing of additional land on Guam through the Chamorro Land Trust occurs)

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

16.2.4 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue.

Unlike physical resources, socioeconomic systems do not tend to remain completely at "baseline conditions" if a proposed action is not implemented. Economies and population levels change due to other reasons as well. The various foregoing exhibits showing "baseline trends" for economic and demographic variables indicate long-term trends expected to continue without the proposed action, and Volume 7 lists a number of specific socioeconomic changes expected to occur independent of the proposed action. Furthermore, the announcement of the proposed action has already had socioeconomic consequences, such that a 2010 decision not to follow through on the proposed action would have short-term effects associated with a reversal of those existing consequences.

16.2.4.1 Population Impacts

Project related population in-migration would not occur. Nor would associated demographic and household characteristic impacts. Overall Guam population could be expected to increase according to the baseline trend noted above in Figure 16.2-1. The 2010 Census will provide an update on population trends for Guam.

16.2.4.2 Economic Impacts

In the short term, a decision not to implement the proposed action would deflate any current speculative activity attributable the proposed action. Real estate values in particular would likely drop, hurting investors but increasing the affordability of housing. The contrast between the business community's expectations and a negative Record of Decision would likely produce a period of pessimism about Guam's economic future, especially if the current national and international economic crisis has not yet abated. These effects, though, would be attributable to an unstable world economic landscape and poor decision making by investors – not to the proposed action.

Long term, the island's prospects would remain linked to international economic conditions and the health of its tourism industry. Conceivably, a smaller military profile might remove some barriers to growing the potential Chinese tourism market. Growth would resume, though probably with the same volatility experienced in recent decades (see Section 16.1.2).

16.2.4.3 Public Service Impacts

In the case of the no-action alternative, the specific agencies discussed earlier in this chapter would not face the listed pressures to expand professional staffing, and agencies involved in planning and regulating growth would not experience such a sharp increase in workload. Although this was not specifically covered in the foregoing analysis, it may also be noted that agencies that are required to implement major infrastructure developments – such as the ports and highways – would have substantially more time to implement long-term plans rather than having to achieve much of their objectives over the next few years.

16.2.4.4 Sociocultural Impacts

To the extent that Guam experiences job losses crime rates may rise in the short term. The political importance of some Chamorro issues would likely recede as the "militarization" of Guam as perceived by

Chamorro activists would be stabilized at something close to present levels. Military-civilian relations would likely remain at the current generally positive level.

The incentive for increased in-migration from the FAS would decrease, reducing sociocultural issues associated with assimilating that population. However, the current incentives for providing those populations – both on Guam and the Micronesian states themselves – would also be lessened, with detrimental implications for those populations.

16.2.5 Summary of Potential Mitigation Measures

A review of the above impacts shows that the proposed action has the potential to have beneficial as well as significant, adverse socioeconomic impacts on Guam. Mitigation measures noted in this section provide avenues to address the major adverse impacts identified in the analysis, as well as the unique position Guam is in, as an isolated island economy.

In particular, while the proposed action has the potential to have substantial beneficial economic impact to the Island of Guam during the operational phase, the large increase and subsequent rapid decrease in construction-related population in tandem with an increase in operational population increase means that the proposed action creates a boom-bust economic cycle on Guam that strains public services during the boom and could result in a recession-like environment following the construction phase.

Secondly, Guam is in a unique position, relying on a small isolated economy that is unable to absorb the large population increase brought about by the proposed action. Typically, local economies are able to absorb and mitigate the impacts to social services that have been discussed above, however, this is not possible in the case of Guam.

Finally, adverse sociocultural impacts are mitigable if the proper preparation in public awareness and cultural education can be implemented.

For this reason mitigations focus on possible approaches to reducing adverse impacts by reducing the impacts of peak population buildup, while also finding ways the DoD can assist the local Government to obtain the necessary capacity and support to meet the requirements of the buildup and reap beneficial impacts. DoD can convene a workgroup to determine possible involvement in assisting to implement the following mitigation measures. Furthermore, in order to assist with GovGuam planning efforts to prepare for the proposed action, the DoD can provide frequent updates to GovGuam on the current planning and construction process.

Table 16.2-53 summarizes potential mitigation measures.

Table 16.2-53. Summary of Potential Mitigation Measures

Impact Area	*Adverse Impacts*	*Mitigation Measures*
Population	• Significant adverse impacts due to strains placed upon government services and the social fabric (See Public Service and Sociocultural impacts below)	• DoD can relax the construction and operations timeline in order to smooth out the adverse impacts of a large jump in population on Guam – eliminating the boom and bust effect identified in the analysis. • DoD can decrease the rapid population increase associated with the operations phase by not allowing dependents to accompany Marines until the construction phase has ended.

Impact Area	*Adverse Impacts*	*Mitigation Measures*
Civilian Housing Demand	• Significant adverse impact if construction phase housing demand is not met at the peak, resulting in high costs, crowding and/or homelessness • Significant delayed adverse impact following construction phase if demand is met at the peak. Subsequent over-supply of housing units would follow the construction period, and result in declining housing values	• To reduce impacts on housing availability and expense, DoD can assist GovGuam could in seeking federal funding to expand the stock of low- to moderate-income housing on Guam.
Public Service and Growth Permitting and Regulatory Agencies	• Significant adverse impacts due to difficulty in meeting fluctuating staffing requirements during and following the construction phase with an existing environment of staffing and budget shortfalls and recruitment complications • Significant adverse impact due to difficulty in recruiting and funding adequate staffing during operational phase	DoD can implement: • incentive programs for military spouses and dependents that apply for and are hired into GovGuam public service agency employment. • volunteer programs for military, their spouses and dependents, linking them to long-term GovGuam public service agency volunteer positions. • Collaborative efforts with the federal government and GovGuam to identify and provide grant writing assistance to Guam public service organizations and agencies that have existing AmeriCorps program, or have the potential to host an AmeriCorps program, to facilitate an increase in AmeriCorps service on Guam. DoD can assist GovGuam in seeking federal funding for: • the necessary permanent number professional staff identified, as well as the number of administrative and supporting staff needed for these professions to perform their positions adequately. • an increase in the number of private staffing and service contractors currently working for service agencies, to match staffing requirements. • a one-time hiring bonus of 20% of base pay for all GovGuam agency positions, to increase interest in GovGuam agency employment and compete with wages offered by private offices. DoD can assist GovGuam with technical assistance, development and implementation of comprehensive data collection systems focused on: • public services provided to FAS citizens in order to facilitate GovGuam access of Compact Impact and other related funding. • public services provided to military individuals, in order to facility GovGuam access of TRICARE and other related funding. • patient information, records, and services accessed, in order to facilitate appropriate care administered in a timely manner. DoD can assist GovGuam in seeking federal funding for technical assistance, development, and implementation of a system of interpreters and translators available for the interpreting and translating needs of GovGuam public service agencies, to facilitate timely and appropriate provision of services for the English as a Second Language service population.

Impact Area	*Adverse Impacts*	*Mitigation Measures*
Crime and Social Order	• Significant adverse impact due to increased overall crime, prostitution, alcohol/substance abuse, domestic offenses, and fights.	• DoD can collaborate with GovGuam public safety agencies to develop a comprehensive and regular shore patrol system, and maintain a regular visible preventative presence. • DoD can develop community outreach task forces aimed at addressing community crime and social order concerns. These task forces would provide ongoing review, improvement and implementation of military policies related to such offenses or concerns. Members of these task forces would partner with existing civilian groups with similar concerns to share information regarding current policies and programs. The task forces would also implement volunteer programs for military spouses and dependents to link them to long-term volunteer positions at these civilian groups or similar non-profit entities on Guam. • DoD can assist GovGuam in seeking federal funding for collaborative efforts with FSM governments and relevant federal agencies to educate in-migrants on the laws and cultures of the Island of Guam, focused areas where there are known cultural differences.
Chamorro Issues/Community Cohesion	• Significant adverse impacts to indigenous Chamorro efforts to preserve political representation due to lower number of ethnic Chamorro voters, due to increase in non-Chamorro voting population on Guam • Significant adverse impacts to social fabric resulting in differences in norms and customs between longtime Guam residents and foreign workers or FAS in-migrants arriving on Guam for jobs.	• DoD can implement an orientation course on Guam local culture and history, designed in conjunction with the Guam Department of Chamorro Affairs, to be attended by all arriving active-duty DoD personnel and dependents. • DoD can collaborate with GovGuam, the University of Guam, and the Guam Chamber of Commerce to design and implement a scientifically valid semi-annual resident opinion survey, to accurately measure resident concerns and perceptions through the construction period and as needed in the operations phase. • DoD can assist GovGuam in seeking federal funding for technical assistance to identify, translate and produce all necessary GovGuam informational brochures and materials likely to be accessed by in-migrant groups. • To minimize local community perceptions of separation of local resident and military communities, DoD will consider developing a mayoral outreach task force aimed at developing military-civilian relationships. The task force would work with each mayor and their staff to integrate military participation in existing cultural or recreational community events, expand on existing military outreach activities, and develop new civilian-military collaborative projects as determined by the task force and mayors.

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CHAPTER 17. HAZARDOUS MATERIALS AND WASTE

17.1 AFFECTED ENVIRONMENT

17.1.1 Definition of Resource

The potential impacts hazardous materials and waste have on human health and the environment is largely dependent upon their types, quantities, toxicities, and management practices. There is cause for concern if the use of these substances violates applicable federal, state, or local laws and/or regulations. This includes potential non-compliance with Department of Defense (DoD) guidelines and policies for handling hazardous materials and waste. There is also cause for concern if the use of these substances increases risks to human health or the environment. This chapter describes current conditions resulting from past and present use of these substances and potential environmental consequences of the proposed Marine Corps relocation to Guam.

The current DoD region of influence (ROI) on Guam for hazardous materials and waste includes Air Force and Navy properties. Air Force properties include Andersen Air Force Base (AFB), which is composed of the main base, the munitions storage area, Northwest Field, Andersen Administration Annex (Andersen South), and the Andersen Communications Annex Barrigada site near Guam International Airport (IAP). Navy properties include Naval Base Guam at Apra Harbor, Naval Computer and Telecommunications Station (NCTS) Finegayan, Finegayan South Housing Area, NCTS Barrigada Transmitter Site, Naval Hospital area, Nimitz Hill, and the Naval Munitions Site.

Section 17.1.2 provides a summary of federal, DoD, and local Guam laws and regulations related to hazardous materials and waste that the DoD must comply with regardless of whether or not any military expansion occurs. Section 17.1.3 discusses the affected environment or present hazardous substances conditions on Guam prior to the proposed military buildup. Section 17.2 discusses potential hazardous materials and waste environmental consequences and potential mitigation measures associated with the proposed military expansion.

17.1.2 Regulatory Framework

A "hazardous substance" is any item or agent (i.e., biological, chemical, or physical) that has the potential to cause harm to humans, animals, or the environment. "Hazardous materials," "toxic substances," and "hazardous wastes," broadly defined, can all be classified as "hazardous substances" because they may present a threat to human health and/or the environment.

Hazardous substances are controlled in the United States (U.S.) primarily by laws and regulations administered by the U.S. Environmental Protection Agency (USEPA), the U.S. Occupational Safety and Health Administration (OSHA), and the U.S. Department of Transportation (DOT). Each agency incorporates hazardous substance safeguards according to its unique Congressional mandate. USEPA regulations focus on the protection of human health and the environment. OSHA regulations primarily protect employee and workplace health and safety. DOT regulations promote the safe transportation of hazardous substances used in commerce. Additionally, the U.S. territory of Guam oversees and administers its environmental laws and regulations through the Guam EPA (GEPA).

DoD installations are required to comply with all applicable federal, territorial (e.g., GEPA), and DoD laws and regulations and Executive Orders.

17.1.2.1 Federal Environmental Laws and Regulations

Hazardous substance federal laws and regulations that Guam DoD installations must comply with include, but are not limited to:

- Comprehensive Environmental Response, Compensation, and Liability Act (42 United States Code (USC) §9601–9675; 40 Code of Federal Regulations (CFR) 300-311; 40 CFR 373)
- Resource Conservation and Recovery Act (42 USC §6901-6992k and 40 CFR 260-272 as it relates to hazardous waste management)
- Emergency Planning and Community Right-to-Know Act (42 USC §11001et seq.; 40 CFR 350-372)
- Toxic Substances Control Act (15 USC §2601 et seq.; 40 CFR 700-723; 40 CFR 745-766; 40 CFR 790-799)
- Oil Pollution Act (33 USC § 2701 et seq.)
- Pollution Prevention Act (42 USC § 13101 – 13109)
- OSHA laws and regulations
- DOT laws and regulations, including the Transportation Safety Act (49 CFR 100 – 185)
- Federal Insecticide, Fungicide, and Rodenticide Act (7 USC § 136 et seq.)
- Federal Environmental Pesticide Control Act (7 USC § 136 – 136y)
- Federal Facilities Compliance Act (Public Law 102 – 386)
- Underground Storage Tank Regulations (40 CFR 280, 281, 282, and 283)

Comprehensive Environmental Response, Compensation, and Liability Act

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act, a hazardous substance is defined as one that poses a potential hazard to human health or the environment by virtue of its quantity, concentration, or physical/chemical characteristics. CERCLA has established a national process to identify, characterize, and clean-up hazardous waste sites.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments (HSWA), define hazardous waste as:

- A solid waste not specifically excluded from being classified as a hazardous waste under 40 CFR 261.4(b) that exhibits any of the characteristics (i.e., ignitability, corrosivity, reactivity, toxicity) described in 40 CFR 261 or
- Is listed in 40 CFR 261 Subpart D or
- Is a mixture containing one or more listed hazardous wastes from 40 CFR 261 Subpart D.

Hazardous wastes may take the form of a solid, liquid, contained gas, or semi-solid. In general, any combination of wastes that poses a substantial present or potential hazard to human health or the environment that has been discarded or abandoned is a hazardous waste.

RCRA requires that all hazardous waste be systematically tracked from cradle-to-grave. This hazardous waste tracking system mandates the collection and retention of key information including: the generator of the waste, how the waste is routed to the receiving facility, a description of the waste, the quantity of the waste, identification of the facility that receives the waste, and other relevant data.

RCRA grants USEPA, authorized states and U.S. territories the authority to regulate hazardous waste management facilities that treat, store, or dispose of hazardous waste. Furthermore, the RCRA Corrective Action Program compels responsible parties of active facilities to investigate and clean up hazardous waste releases.

Military Munitions Rule under RCRA

The Military Munitions Rule (MMR) was published as a final rule in 1997 and identifies when conventional and chemical military munitions become RCRA hazardous waste. Military munitions include, but are not limited to: confined gases, liquids, or solid propellants; explosives; pyrotechnics; chemical and riot agents; and smoke canisters (USEPA 2008b). Under the MMR, wholly inert items and non-munitions training materials are not defined as military munitions (USEPA 1997).

DoD has historically conducted live-firing, ordnance testing, and training exercises to ensure military readiness. Decades of these munitions-related activities have resulted in the presence of unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC). UXO, DMM, MC, and other material potentially presenting an explosive hazard are all collectively referred to as munitions and explosives of concern (MEC). In 1997, the Final MMR (40 CFR 266, Subpart M) was published defining MEC handling requirements.

Military munitions that are used for their "intended purposes" are not considered waste per the MMR (40 CFR 266.202). In general, military munitions become subject to RCRA transportation, storage, and disposal requirements (i.e., judged not to have been used for their "intended purposes") when:

- Transported off-range for storage
- Reclaimed and/or treated for disposal
- Buried or land filled on- or off-range or
- Munitions land off-range and are not immediately rendered safe or retrieved.

MEC is found on active, inactive, and closed military training ranges. Active ranges include areas being used on a periodic, ongoing basis for ordnance training purposes. Inactive ranges are: 1) not currently being used, 2) still are under military control and therefore may be used in the future as a military range, and 3) have not been put to a new use that is "incompatible" with range activities. Closed ranges are areas that have been taken out of service and put to a new use "incompatible" with range activities.

According to USEPA legal interpretation, the MMR "…applies only to the recovery, collection, and on-range destruction of UXO and munitions fragments during range clearance activities at active or inactive ranges. With regard to closed ranges, USEPA did not generally intend to include these range clearance activities to be within the scope…of the intended use …exception to Subtitle C of RCRA granted by the MMR…". MEC located on closed ranges "… would at some point become a solid waste potentially subject to RCRA and also may include hazardous substances, pollutants or contaminants subject to CERCLA…". In summary, MEC at closed ranges are classified as solid waste and would likely be subject to RCRA Subtitle C hazardous waste handling and disposal requirements as well (USEPA 2005).

Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) requires businesses and governments to report their use of hazardous and toxic chemicals. EPCRA also requires that workers be trained as to safe chemical handling protocols and specific chemical hazards and controls for substances used in the workplace. In addition, EPCRA requires that state and local communities be prepared to

respond to potential chemical accidents through the development of emergency response plans and other measures.

Toxic Substances Control Act

The Toxic Substance Control Act (TSCA) addresses concerns regarding chemical substances and mixtures whose manufacturing and use may pose an unreasonable risk of injury, adverse health, or adverse environmental consequences. TSCA is designed to regulate these substances and mixtures used in interstate commerce.

TSCA requires that prior to the manufacturing of a new substance(s), a pre-manufacture notice be filed with USEPA. This notice provides information describing the toxicity of the substance(s). Toxic chemical substances regulated under TSCA include asbestos, lead, polychlorinated biphenyls (PCBs), and radon as well as numerous other substances. The TSCA chemical substances inventory contains information on over 62,000 compounds.

Oil Pollution Act

The Oil Pollution Act (OPA) requires oil storage facilities and vessels to develop plans describing how spills or releases would be addressed. Specifically, OPA requires that facilities prepare and implement spill prevention, control, and countermeasures (SPCC) plans and facility response plans. These plans specify how these facilities would assess and respond to spills/releases. DoD is subject to OPA requirements to report spills and releases to applicable regulators. OPA also obligates DoD to properly contain, control, and remediate all spills/releases.

Pollution Prevention Act

The Pollution Prevention Act focuses on pollution source(s) reduction and promotes the implementation of new and innovative practices to conserve and protect natural resources. These measures may include, but are not limited to reducing pollution through process modifications and the use of different, less toxic materials and substances.

Occupational Safety and Health Administration Regulations

The OSHA requirements are designed to protect workers and prevent workplace accidents, injuries, or illnesses. One such requirement is the Hazard Communication Regulation (29 CFR 1910.1200) which defines a hazardous chemical as one that poses a physical or health hazard and requires that workers are trained and notified of specific hazards associated with hazardous workplace substances. The definition includes:

- Carcinogens, toxins, toxic agents, irritants, corrosives, and sensitizers
- Agents which act on the hematopoietic system
- Agents that damage the lungs, skin, eyes, or mucous membranes
- Chemicals which are combustible, explosive, flammable, unstable (reactive), or water-reactive
- Oxidizers
- Pyrophorics
- Chemicals which in the course of normal handling, use, or storage may produce or release dusts, gases, fumes, vapors, mists, or smoke that may have any of the previously mentioned characteristics

Currently, OSHA regulates workplace exposure to approximately 400 substances, including dusts, mixtures, and common materials such as paints, fuels, and solvents.

DOT Regulations

The DOT Hazardous Materials Regulations (49 CFR 171) define a hazardous material as a substance capable of posing an unreasonable risk to health, safety, and property when transported in commerce. The DOT definition includes hazardous substances, hazardous wastes, and marine pollutants. DOT regulations require the implementation of various protective and preventative measures designed to promote the safe transportation of hazardous materials in commerce.

Federal Insecticide, Fungicide, and Rodenticide Act

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides pesticide regulations designed to protect applicators, consumers, and the environment. Among other things, FIFRA establishes a registration process for all pesticides and provides strict pesticide labeling and application requirements.

Federal Environmental Pesticide Control Act

Federal Environmental Pesticide Control Act, enacted as Public Law 92-516, amended FIFRA and provides controls for the sale, use, distribution, and application of pesticides through an administrative registration process.

Federal Facilities Compliance Act

Federal Facilities Compliance Act enacted as Public Law 102-386 provides that all federal agencies are subject to all substantive and procedural requirements of federal, state, and local solid and hazardous waste laws in the same manner as any private party. Substantive and procedural requirements include administrative orders, civil and administrative fines and penalties, and reasonable charges imposed for issuing and reviewing permits, plans and studies, and inspecting facilities.

Underground Storage Tank Regulations

Underground Storage Tank (UST) regulations set forth various requirements to prevent unintended releases through the use of double walled tanks and associated piping, leak detection methods, inventory control procedures, and various other administrative and engineering design controls.

Ship-Borne Hazardous Substances Regulations

Existing environmental laws and regulations presented above are applicable to DoD land-based facilities and activities in Guam. However, these regulations are not applicable to Navy activities "at sea" defined as beyond three nautical miles from shore. However, certain international treaties apply to Navy activities while at sea. The primary international treaty regarding vessel waste disposal is the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (i.e., MARPOL 73/78 treaty).

Generally, Navy ships are exempt from MARPOL 73/78 requirements; however, the Navy is required to comply with Annex V of the MARPOL 73/78 treaty. Under Annex V, non-food solid waste materials controlled include: paper and cardboard, metal, glass, and plastics. Per Annex V, none of these materials may be discharged overboard by Navy vessels in "Special Areas" and plastics may not be discharged in the ocean anywhere. "Special Areas" are specifically designated ocean regions where it is deemed that more stringent discharge standards are required. Table 17.1-1 summarizes Navy discharge restrictions.

Table 17.1-1. Navy Discharge Restrictions

Area	*Sewage*[1]	*Graywater* [1]	*Oily Waste* [2]
U.S. Internal Waters and Territorial Seas 0-3 nautical miles (nm) (0-3.5 miles [mi])	No discharge of raw sewage from collecting and holding tank. Discharge of marine sanitation device- treated effluent allowed.	If capable of collecting and treating graywater do so. Otherwise, discharge allowed. [3]	No dumping of sheen allowed. Discharge must be through OWS and oil content monitor and contain less than 15 parts per million (ppm) of oil. [4]
U.S. Contiguous Zone (3-12 nm) (3.5 -13.8 mi)	Discharge allowed.	Discharge allowed.	Same as 0-3 nm (-3.5 mi).
12-25 nm (13.8 -28.8 mi)	Discharge allowed.	Discharge allowed.	Discharge must be through OWS and OCM and contain less than 15 ppm of oil.
25 - 50 nm (28.8-57.5 mi)	Discharge allowed.	Discharge allowed.	Same as 12-25 nm (13.8-28.5 mi).
> 50 nm (57.5 mi)	Discharge allowed.	Discharge allowed.	Discharge must be through OWS and OCM and contain less than 15 ppm of oil. Discharge of cargo wastes allowed if ship is enroute and discharging less than 30 liters of oil per nm.
MARPOL *"Special Areas"* [5]	Not applicable.	Not applicable.	No discharge if practical. If not practical, discharge must be through OWS and OCM and be as far from shore as feasible.
Foreign Countries (0-12 nm) (0-13.8 mi)	Discharge of marine sanitation device -treated effluent allowed. Also comply with COMSC policy. [3]	If capable of collecting and treating graywater through marine sanitation device, do so. Otherwise, discharge allowed. Also comply with COMSC policy. [3]	Discharge must be through OWS and OCM and contain less than 15 ppm of oil. Also comply with COMSC policy. [3]
General Requirements	Exemption allowed (direct discharge) to ensure safety of ship or those onboard. Also comply with COMSC policy. [3]	Contact local port authorities for local discharge guidelines. Obey state regulations regarding discharge of graywater. Exemption allowed to ensure safety of ship or those onboard. In the event local port authorities state the ship may not discharge graywater, coordinate the issue with local legal counsel.	State/local rules may vary; check with port authorities. Exemption is allowed to ensure safety of ship or those onboard. Ships must log discharges of oily wastes.

Legend: COMSC- Commander, Military Sealift Command; OCM= oil content monitor; OWS= oil water separator.
Notes: [1] Governing regulations include 33 CFR 159.
[2] Governing regulations include MARPOL Annex I, 33 CFR 155.
[3] Requirement imposed by COMSC policy.
[4] If operating properly, OWS discharge will typically be less than 15 ppm.
[5] Special Areas where these restrictions currently apply: Mediterranean Sea, Baltic Sea, Black Sea, and Antarctic Ocean.
Source: Navy 2004.

17.1.2.2 Guam Environmental Protection Agency Laws and Regulations

All public and private entities located on Guam are subject to GEPA environmental requirements. The GEPA Hazardous Waste Management Program (GEPA HWMP) has statutory authority based upon Title 10 Guam Code Annotated (GCA).

GEPA regulates hazardous substances through Title 10 GCA, Chapter 51, Solid Waste Management and Litter Control Act; and Title 10 GCA, Chapter 76, Underground Storage of Hazardous Substances Act. GEPA's Water Pollution Control Program administers Facility Response Plans /SPCC plan requirements under OPA for affected facilities per 40 CFR 112. GEPA has full authority to enforce RCRA and HSWA regulations.

The GEPA HWMP requires the permitting of hazardous waste collection, treatment, storage, and disposal facilities. The GEPA HWMP also mandates inspection, compliance monitoring, enforcement, and corrective action of all hazardous waste-related activities in Guam. The GEPA has a TSCA Compliance Guide and online Service that consists of a five volume set and online support for environmental managers, regulatory compliance officers, and legal counsel to keep abreast of and in compliance with TSCA relative to PCBs, asbestos, lead, radon and other toxic substances.

DoD functions conducted on Guam are required to fully comply with all applicable federal and Guam hazardous materials and waste laws and regulations.

17.1.3 Hazardous Materials and Waste on Guam

This section discusses the current status of hazardous substances on Guam and how these substances are being managed prior to any proposed military expansion.

17.1.3.1 Hazardous Materials Storage, Use, and Handling

Routine operations at DoD installations require the storage, use, and handling of a variety of hazardous materials, including petroleum, oils, and lubricants (POL), cleaning agents, paints, adhesives, and other products necessary to perform essential functions. Bulk quantities of fuels and other POLs are stored and distributed in above ground storage tanks (ASTs) and USTs, pumps, and pipelines. Fueling operations to support aircraft, watercraft, vehicle operations, and emergency power generation require the storage of these bulk quantities of this POL. These POL storage areas represent potential sources of releases or spills. For the purpose of this EIS/OEIS, the reference to POLs is intended to include petroleum, oils, and lubricant-based products. Examples of POLs would include various fuel and motor oils; fuels such as gasoline, jet fuels, and diesel fuels; and a variety of lubricant products.

DoD installations have management plans for fuels management, spill containment, and clean up of POL spills and releases. These plans specify that fuel storage facilities have primary and secondary containment and leak detection features to identify and contain unintended spills and leaks. In addition, these plans require that the use of hazardous materials be minimized by substituting less toxic products, modifying processes, and designing processes to be more efficient and require the use of less hazardous substances.

The Defense Reutilization and Marketing Office (DRMO) through its' contractors manages, stores, ships, and disposes of hazardous materials associated with all DoD installations and operations in Guam. DRMO maintains all hazardous materials documentation. Furthermore, DRMO contracts with licensed firms for proper disposal of these materials at permitted facilities. Currently, the DRMO disposes of approximately 32,389 pounds (lbs) (14,691 kilograms [kg]) of hazardous materials annually from Marine Okinawa operations (DRMO Okinawa 2009).

Air Force Hazardous Material Management

The 36th Civil Engineering Squadron Environmental Flight (CES/CEV) is responsible for overseeing the management of hazardous materials (and hazardous waste) at Andersen AFB, Andersen South, and the Andersen Communications Annex Barrigada site. CES/CEV's mission statement and operating policy is to (Andersen AFB 2008):

- Maintain a safe and healthy operation and environment
- Comply with all applicable laws and regulations
- Minimize the generation of all waste types
- Implement process changes that result in a reduced amount of waste used and recycle to the maximum practical extent

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 Materials Management Plan (HMMP) pursuant to the AFI designed to guide and instruct all Air Force personnel involved in authorizing, procuring, using, managing, or disposing of hazardous materials. This plan addresses hazardous materials/POL management, transportation, spill/release control and containment, and clean up.

Hazardous materials are managed by the base's hazardous materials pharmacy. This facility was established with the mission of overseeing, procuring, and minimizing the use of hazardous materials. 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. The resulting outcome is more effective control over the use of these materials.

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 base currently has the capacity to store 66,000,000 gallons of aviation fuel (Andersen AFB 2005). Fuel storage facilities on the base 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 base by tanker truck.

Navy Hazardous Material Management

Naval Facilities Engineering Command (NAVFAC) is responsible for overseeing the management of hazardous materials at all Navy installations on Guam. Specific written protocol for the management of hazardous materials at all Navy installations is provided by the following documents:

- Office of the Chief of Naval Operations Instruction (OPNAVINST) 5100.23G, Chapter 7- *Hazardous Material Control and Management.*
- Commander, Military Sealift Command Instruction (COMSCINST) 5090.1C, *Military Sealift Command Environmental Protection Program*, Chapter 4 §6- *Hazardous Materials and Hazardous Waste Control and Management Policy*.

OPNAVINST and COMSCINST incorporate the requirements of federal regulations and DoD directives for the reduced use of hazardous materials. COMSCINST 5090.1C, Chapter 5- *Oil and Hazardous Substance Spill Response Readiness*, establishes procedures for addressing oil and hazardous substance spill response activities. Navy operations on Guam are required to comply with these environmental procedures (Navy 1998 and 2004).

In addition, Naval Supply Systems Command Publication 573 - *Storage and Handling of Hazardous Materials*, establishes uniform procedures for the receipt, storage, and handling of hazardous materials and wastes by Navy installations. Publication 573 is to be used in conjunction with other pertinent procedures, regulations, and guidance manuals to support the safe, effective, and environmentally sound management of hazardous materials throughout their life cycle (Navy 2002).

NAVFAC has a comprehensive SPCC guidance manual. This document is required by 40 CFR 112, the Oil Pollution Prevention regulation, and OPNAVINST 5090.1C, for areas meeting the criteria in 40 CFR 112. Spill control measures are required for storage areas regulated by either 40 CFR 264 or 40 CFR 265. Additionally, spill control measures are required for USTs regulated by 40 CFR 280 (Navy 1999).

Hazardous substances spill contingency plans are provided to all ships operating in Guam waters pursuant to COMSCINST 5090.1C Chapter 5 §4-*Contingency Planning*. These plans specify procedures for reporting, containing, controlling, recovering, and disposing of all types of ship-born spills and releases. These plans provide detailed information regarding the use of protective clothing, spill clean-up materials (e.g., oil booms and other spill prevention materials and equipment), oil and hazardous substances properties, and appropriate emergency spill/release response telephone numbers.

Guam Hazardous Material Management

GEPA stipulates regulations for the management of hazardous materials on Government of Guam (GovGuam) lands. The GCA enforces federal and local regulations for management of hazardous substances. Title 10 GCA 76, *Underground Storage of Hazardous Substances Act*, establishes requirements for the management of hazardous substances stored underground.

DoD operations conducted on Guam must comply with all GEPA hazardous material management requirements.

Toxic Substances Management

Toxic substances associated with DoD operations in Guam include asbestos containing materials (ACM), lead-based paint (LBP), PCBs, and radon. LBP and PCBs in Guam are taken by licensed transporters and disposed of in permitted landfill facilities in accordance with applicable federal, state, and local laws and regulations. ACM is disposed of at federal facilities in Guam. Contract document specifications will specifically prohibit DoD contractors from the import and use of hazardous or toxic substances.

The collection, transportation, and disposal of these toxic substances is arranged by DRMO. DRMO coordinated the disposal of approximately 27,585 lbs (12,512 kg) of toxic substances annually from Marine Okinawa operations (DRMO Okinawa 2009). This quantity is applicable to this document because of the proposed Marine personnel transfer to Guam.

Asbestos

Asbestos is the name of a group of naturally occurring minerals that may separate into very fine fibers, which are extremely heat-resistant and durable. Asbestos and ACM have been used in a variety of applications, including being used to insulate boilers and pipes, and as a component of various construction and industrial materials.

Asbestos becomes a health hazard when microscopic-sized fibers become liberated or released into the air. Once emitted to the atmosphere, these fibers may remain suspended in the air for long periods of time. When ACM is inhaled, these fibers may become lodged in body tissues, especially the lungs. Inhalation of asbestos fibers is known to cause asbestosis, a chronic disease of the lungs, and

mesothelioma, a cancer of chest membranes. Other cancers, primarily of the digestive tract, have also been associated with exposure to asbestos.

DoD facilities scheduled for maintenance, renovation, remodeling, and demolition are inspected for the presence of ACM. When required by law, or as a precautionary measure, ACM is removed by licensed asbestos abatement firms. ACM is disposed of at federal facilities in Guam. DRMO arranges for these ACM disposal actions.

In accordance with DoD policy, ACM-free materials are to be used for new construction and the repair or maintenance of shore facilities. With regard to Navy ships, when suitable substitutes exist, ACM-free substitute materials are to be used during new construction, repair, or renovation activities.

Lead-Based Paint

In the past, lead pigments were used to increase the durability of paint and provide added anti-corrosion properties. Exposure to LBP is associated with adverse health effects, including permanent damage to the central nervous system. Lead exposure can result from the ingestion of paint chips or associated dust generated from deteriorating paints or from improper paint removal processes. Young children are at greatest risk from LBP exposure.

To ensure that DoD employees engaged in the maintenance and repair of surfaces with LBP are adequately protected, personnel involved in maintenance and repair activities where there is a potential exposure to LBP are required to attend annual LBP training. This training is designed to ensure use of appropriate engineering controls and work processes to reduce the risk of lead exposure.

The federal government banned the use of LBP in 1978. Consequently, DoD buildings constructed on Guam prior to 1978 may contain LBP (USEPA 2007). The LBP in these facilities is generally managed in place in accordance with accepted industry guidelines and practices. These guidelines focus upon minimizing the potential for LBP dust creation, direct contact with the LBP surfaces, and contamination of the surrounding environment. The future renovation of DoD facilities or construction of new facilities on Guam would not include the use of LBP.

DoD policy regarding LBP is to manage and dispose of it in a manner that is protective of human health and the environment and to comply with all applicable federal and local laws and regulations. LBP disposal is arranged by the DRMO.

Polychlorinated Biphenyls

PCBs are highly stable organic chemical compounds with low flammability, high heat capacity, and low electrical conductivity. In the past, PCBs were extensively used as a component of many materials, most notably as heat insulating materials and as dielectric fluids used in electrical transformers and capacitors. Due to these past uses, PCBs are known to exist at various identified waste sites discussed later in this chapter.

PCBs are known to cause skin irritation and cancer and are highly persistent in the environment. In 1979, USEPA banned most uses of PCBs. In addition, effective controls have been mandated related to existing PCB-containing equipment.

As part of existing DoD waste management plans, fluids that potentially contain PCBs are analyzed to ensure that they are properly disposed of in accordance with all federal, DoD, and local laws and regulations by licensed disposal contractors. DoD would not introduce new sources of PCBs to Guam and

is currently addressing existing PCB sources in accordance with federal, local and DoD laws and regulations. DoD-related PCB disposal on Guam is arranged by DRMO.

Radon

Radon is naturally occurring on Guam and is a colorless, odorless, radioactive gas produced by the decay of uranium in rock and soil.

Radon is a known carcinogen, responsible for increasing the risk of lung cancer when inhaled. Electrically charged radon atoms can attach to indoor air dust particles. Subsequently, these dust particles may be inhaled and adhere to the lung lining. The deposited atoms decay by emitting radiation that has the potential to cause cellular damage. Typically, outside air contains very low levels of radon (USEPA 2008a), but radon tends to accumulate in enclosed indoor spaces. When present, radon gas would typically concentrate in relatively airtight buildings with little outside air exchange.

Although there are no federal regulations that mandate an acceptable level of radon exposure, USEPA recommends the voluntary radon action level developed and issued by the American Society for Testing and Materials International, *Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings*, American Society for Testing and Materials International E-2121.

The USEPA recommended action level for radon is 4 picocuries per liter. Various areas on Guam encompasses a radon zone (Figure 17.1-1) (USEPA 2008a). According to GEPA, approximately 27% of homes on the island have elevated levels of radon (GEPA 2008). As a proactive and educational measure, GEPA conducts public radon awareness workshops designed to instruct participants on how to minimize potential radon exposures. As a proactive measure, DoD has ongoing radon monitoring and abatement programs to ensure that its existing facilities meet USEPA radon health recommendations (ATSDR 2002). In addition, for new facilities, radon resistant construction techniques, radon testing, and the installation of radon mitigation systems as appropriate are employed.

17.1.3.2 Hazardous Waste Generation and Disposal

Introduction

Operations at DoD installations generate a variety of hazardous wastes, including, but not limited to: medical supplies, adhesives, solvents, lubricants, contaminated absorbents, corrosive liquids, aerosols, herbicides, pesticides, and sludges. In accordance with DoD policies, all facilities must seek to reduce or eliminate hazardous waste generation by implementing best management practices (BMPs) and best available technologies. *DOD 4160.21-M, Defense Material Disposition Manual, August 1997,* sets forth DoD policy and prescribes uniform procedures for the disposition of DoD waste, including hazardous waste. DoD instruction 4715.4, *Pollution Prevention*, contains general hazardous waste policy. By policy, the generation and subsequent disposal of hazardous waste is considered by DoD to be a means of last resort. There are numerous BMPs used by DoD to minimize or eliminate the use of hazardous waste; these are discussed in Volume 7 of this EIS/OEIS.

Disposal of hazardous waste generated at DoD facilities in Guam is arranged by DRMO. Specifically, licensed hazardous waste contractors transport and dispose of hazardous waste at permitted facilities. Under this arrangement, DRMO maintains all hazardous waste documentation and ensures that all disposal actions are performed in accordance with pertinent federal, state, and local laws and regulations.

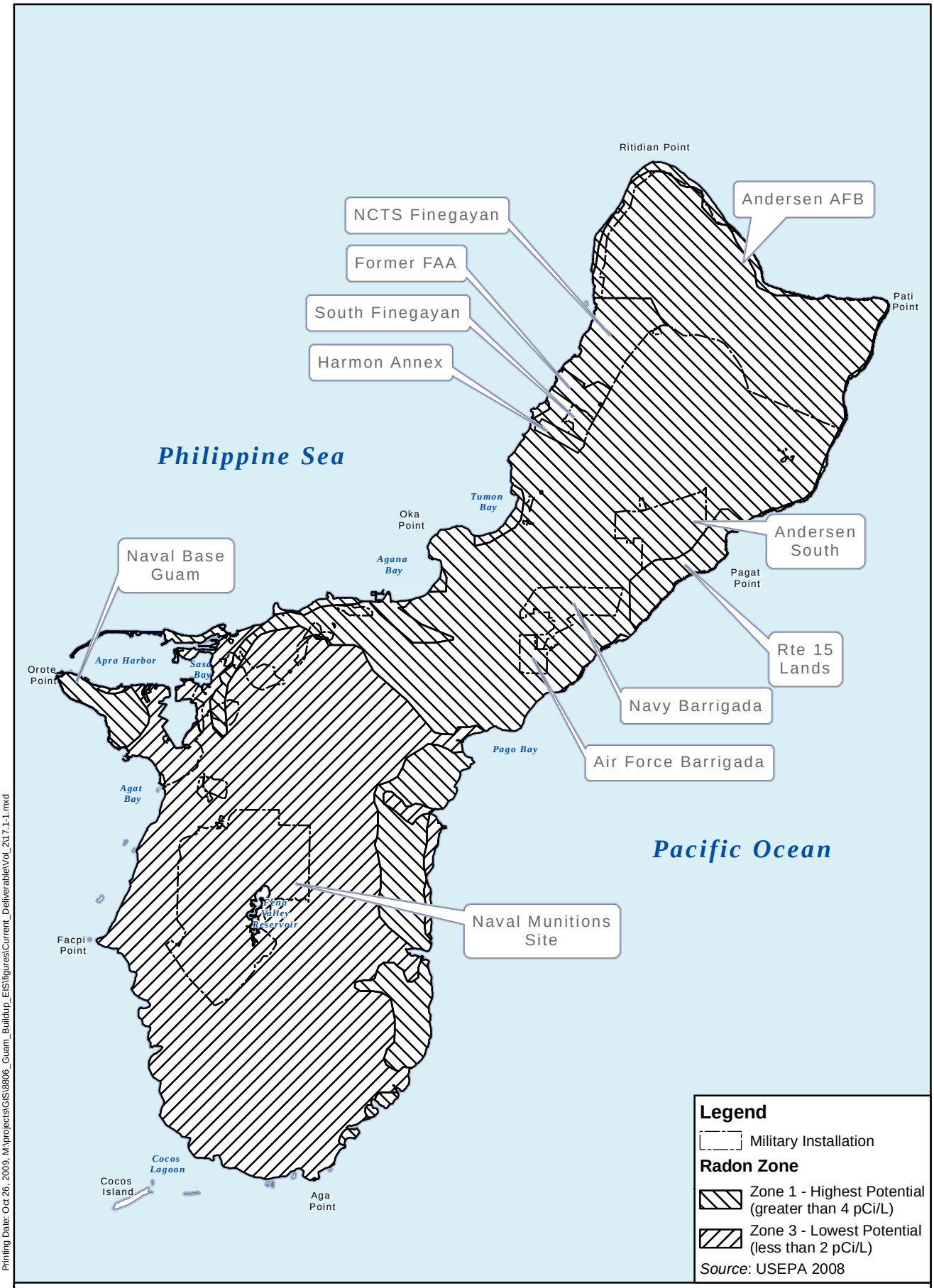

Figure 17.1-1
Guam Radon Zones

As part of the DRMO waste management system, centralized accumulation points (CAPs) and satellite accumulation points are utilized at DoD installations on Guam. The accumulation points often contain a variety of wastes, typically stored in 5-gallon (19 liters [L]) pails, 55-gallon (208 L) drums, and other approved hazardous waste containers. DRMO arranges for the disposal of approximately 594,494 lbs (269,658 kg) of hazardous wastes annually from DoD Guam operations (Table 17.1-2).

Table 17.1-2. Annual DoD DRMO Guam Hazardous Waste Disposal Quantities

Waste Category	*Total Waste Volume (in pounds)*	*Waste Codes*
Hazardous Waste	20	D001 and D022
Hazardous Waste	9,374	D001 and D007
Hazardous Waste	728	D001and D008
Hazardous Waste	71	D001and D009
Hazardous Waste	24,103	D001 and D018
Hazardous Waste	429	D001 and D002
Hazardous Waste	2,020	D001and D021
Hazardous Waste	10,320	D001 and D035
Hazardous Waste	238,622	D001
Hazardous Waste	13,576	D001 and D005
Hazardous Waste	15	D001 and D043
Hazardous Waste	24	D001 and U154
Hazardous Waste	58	D001 and U159
Hazardous Waste	320	D001 and F003
Hazardous Waste	6,872	D001 and D003
Hazardous Waste	1,124	D002 and D006
Hazardous Waste	256	D002 and D007
Hazardous Waste	10	D002 and D003
Hazardous Waste	930	D002 and D009
Hazardous Waste	60,312	D002
Hazardous Waste	2,364	D003
Hazardous Waste	2,868	D004
Hazardous Waste	248	D004 and D006
Hazardous Waste	44	D005 and D007
Hazardous Waste	2,016	D005
Hazardous Waste	36,268	D006
Hazardous Waste	7,984	D006 and D007
Hazardous Waste	220	D006 and D009
Hazardous Waste	16,542	D007
Hazardous Waste	5,032	D007 and D008
Hazardous Waste	12,966	D007 and D011
Hazardous Waste	300	D007 and D035
Hazardous Waste	691	D008 and D009
Hazardous Waste	31,438	D008
Hazardous Waste	1,862	D021
Hazardous Waste	55,411	D009
Hazardous Waste	6,769	D011
Hazardous Waste	33,422	D018
Hazardous Waste	60	D021 and D035
Hazardous Waste	906	D035
Hazardous Waste	800	F001
Hazardous Waste	920	F002
Hazardous Waste	4,078	F003
Hazardous Waste	620	F005
Hazardous Waste	284	F003 and F005

Waste Category	*Total Waste Volume (in pounds)*	*Waste Codes*
Hazardous Waste	18	U002
Hazardous Waste	14	U112
Hazardous Waste	20	U133
Hazardous Waste	153	U151
Hazardous Waste	81	U154
Hazardous Waste	316	U159
Hazardous Waste	203	U220
Hazardous Waste	144	U239
Hazardous Waste	248	High Mercury
Total Hazardous Waste	594,494	All Hazardous Waste Codes

Notes: Ignitability (D001): If the waste flashpoint is less than 140°F, the waste is "ignitable" and thus a hazardous waste. Corrosivity (D002): If the waste pH less than or equal to 2 or greater than or equal to 12.5, the waste is "corrosive" and thus a hazardous waste. Reactivity (D003): If a waste exhibits any of the criteria associated with the characteristic of "reactivity," it is a hazardous waste by virtue of its "reactivity". Toxicity (D004 through D043): Compare individual analytical results to corresponding regulatory limits. If the reported value is equal or greater than specified regulatory limits for particular compounds, then the waste exhibits the characteristic of "toxicity" and is therefore a hazardous waste. F-listed hazardous waste is generated from non-specific sources such as solvents, plating solutions, and chemical manufacturing processes and can be found in 40 CFR § 261.31. U-listed wastes include discarded commercial chemical products and/or residues in which the generic name of the product matches any chemical listed in 40 CFR §261.33 with an USEPA Waste Number beginning with the letter "U". Data are for the year 2007 (DRMO Guam 2009).

Defense Environmental Restoration Program

In 1986, Congress created the Defense Environmental Restoration Program (DERP). The DERP addresses the identification and cleanup of hazardous substances and military munitions remaining from past activities at DoD installations and formerly used defense sites (FUDS). Within DERP, DoD created two program categories, namely the IRP and the Military Munitions Response Program.

Installation Restoration Program

The IRP focuses on cleaning up releases of hazardous substances that pose risks to the public and/or the environment at active, base realignment and closure (BRAC), and FUDS military sites owned or used by the DoD, including the Navy and Air Force.

On Guam, Navy and Air Force have ongoing DERP site cleanup activities with GEPA and EPA oversight. The DoD and State/Territorial Memorandum of Agreement (DSMOA) established a program where GEPA staff work closely with DoD representatives to discuss and facilitate environmental restoration and clean-up work on Guam. Under the DSMOA program, GEPA maintains regulatory oversight of environmental restoration efforts undertaken on Guam by DoD to ensure compliance with applicable local and federal laws and regulations. The DSMOA oversees the following three DoD programs:

- BRAC - A clean-up program to ensure the environmental suitability of DoD properties planned for transfer
- IRP - The main DoD environmental restoration program which includes activities, such as investigations and cleanups at the Orote landfill at COMNAV Marianas, Construction Battalion Landfill at Finegayan, and various sites at Andersen AFB
- FUDS - The U.S. Army Corps of Engineers managed program designed to clean up military sites that are no longer owned by the U.S. government

In addition, to facilitate hazardous waste site restoration, the DoD has established restoration advisory boards (RABs). RABs are established to improve overall communications between all interested parties and expedite hazardous waste site cleanup. RABs act as a focal point for information exchange between

DoD and the local community. RAB members typically include DoD and regulatory agency representatives and community members and meet to discuss ongoing environmental studies and cleanup activities. RAB members in turn serve as a liaison to the overall local community to address issues of concern. RAB meetings are open to the general public and the community is actively encouraged to participate.

Air Force Active Environmental Restoration Sites

In 1983, Andersen AFB began an investigation to identify and correct environmental contamination from past hazardous waste activities. Early stages of this investigation show that waste from past day-to-day operations contaminated areas at the base. Andersen AFB was placed in the USEPA National Priorities List on October 14, 1992. Additionally, the Air Force entered into a formal federal facilities agreement with USEPA and GEPA to expedite installation environmental restoration efforts on March 30, 1993.

Appendix G contains tables that summarize Andersen AFB environmental restoration sites, SWMUs, and Areas of Concern (AOC) in the vicinity of the potential DoD expansion. Figure 17.1-2 through Figure 17.1-4 depict Air Force site locations in the vicinity of the potential DoD expansion.

Navy Active Environmental Restoration Sites

The Navy is also in the process of investigating and remediating environmental restoration sites that occurred as a result of past hazardous waste management practices at various Navy facilities located throughout Guam. Appendix G contains tables that summarizes the Navy's active Guam environmental restoration sites. Figure 17.1-5 through Figure 17.1-10 show the locations of these active Navy sites.

Military Munitions Response Program

In September 2001, DoD established the Military Munitions Response Program to address hazards associated with MEC within areas no longer used for operational range activities. These former range training areas are called munitions response areas (MRAs). MRAs often contain one or more discrete munitions response sites (MRSs). In December 2001, Congress passed the National Defense Authorization Act. This Act required DoD to develop an initial inventory of areas not located within operational ranges (i.e., active or inactive ranges) that are known or suspected to contain MEC. As part of this inventory process, DoD is coordinating with GEPA to conduct preliminary assessments and site inspections of AOCs on Guam. Figure 17.1-11 shows the locations of these MRAs currently under investigation. To address these and potential future DoD joint range sites Marine Corps Orders (MCO) (i.e., MCO 3550.10 – Range Management, MCO 3550.12 – Operational Range Clearance Program, and MCO – 3570.1B – Range Safety) would be followed. The following Navy MRA sites on Guam have been identified to date (NAVFAC Pacific 2007):

- Naval Munitions Site Small Arms Range
- Spanish Steps Skeet and Trap Ranges
- Orote Point Rifle and Pistol Range
- Naval Computer and Telecommunications Main Station Finegayan Skeet Range
- Naval Computer and Telecommunications Main Station Small Arms Range

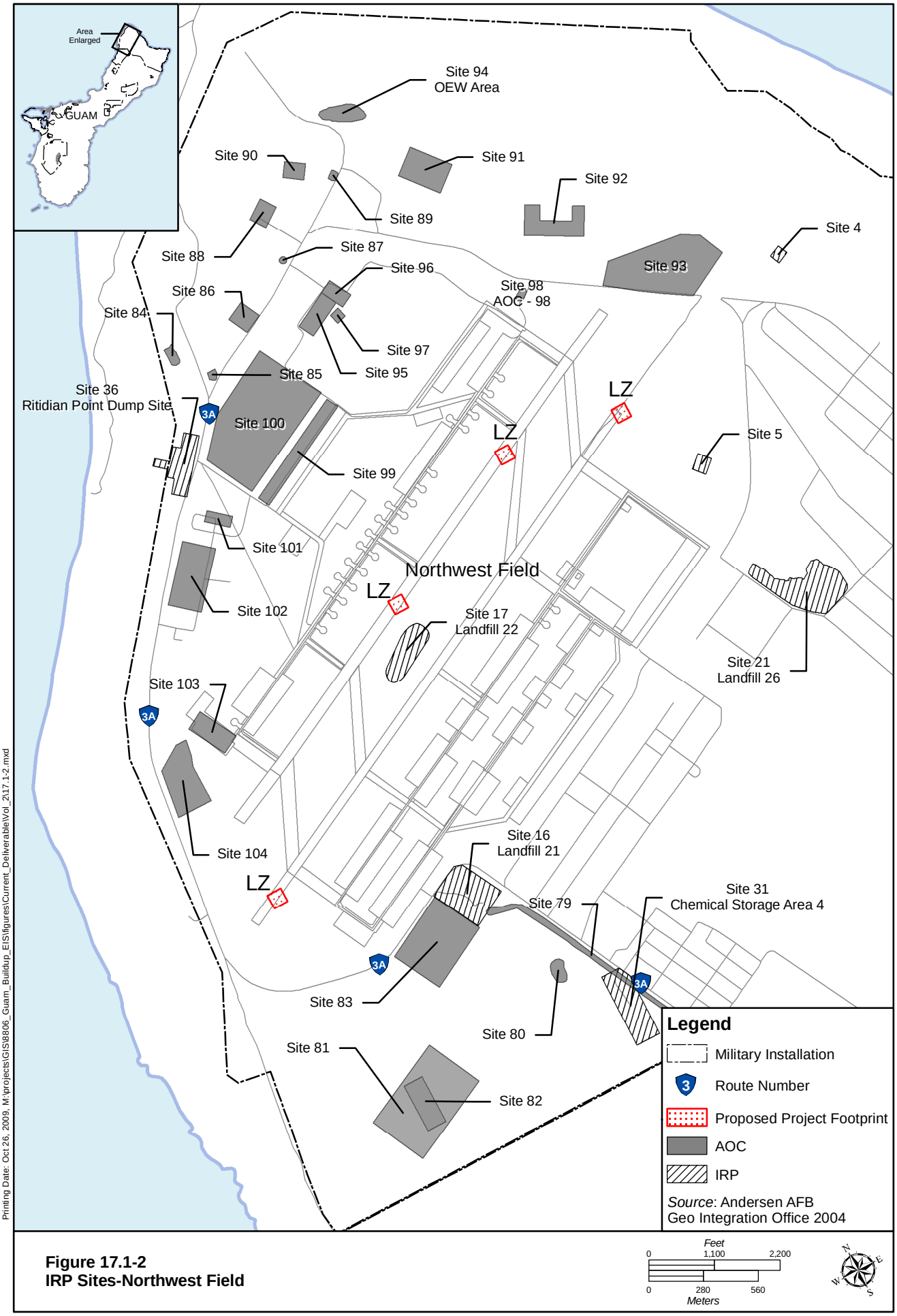

Figure 17.1-2
IRP Sites-Northwest Field

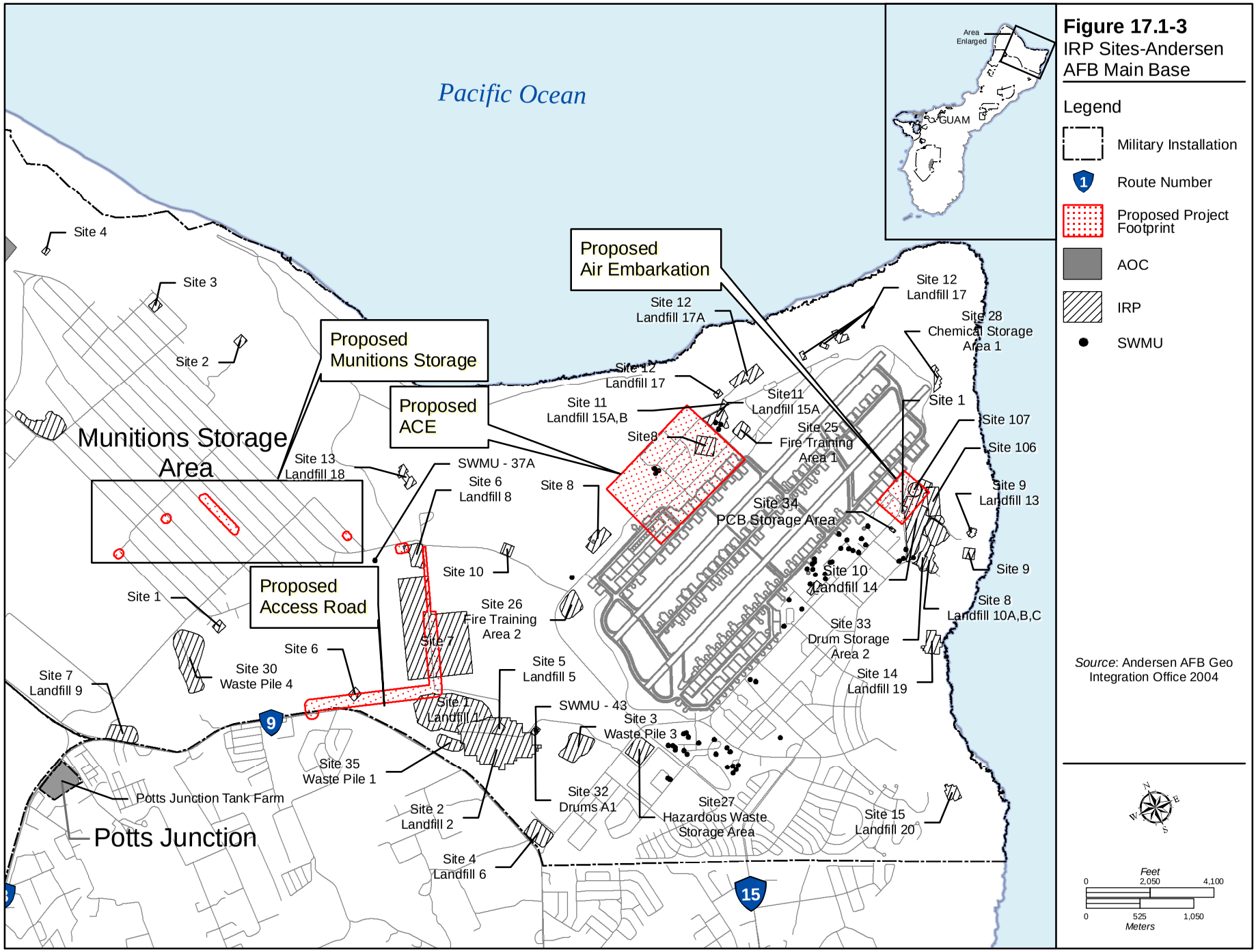

Figure 17.1-3
IRP Sites-Andersen AFB Main Base

Legend

- Military Installation
- Route Number
- Proposed Project Footprint
- AOC
- IRP
- SWMU

Source: Andersen AFB Geo Integration Office 2004

Feet
0 2,050 4,100
0 525 1,050
Meters

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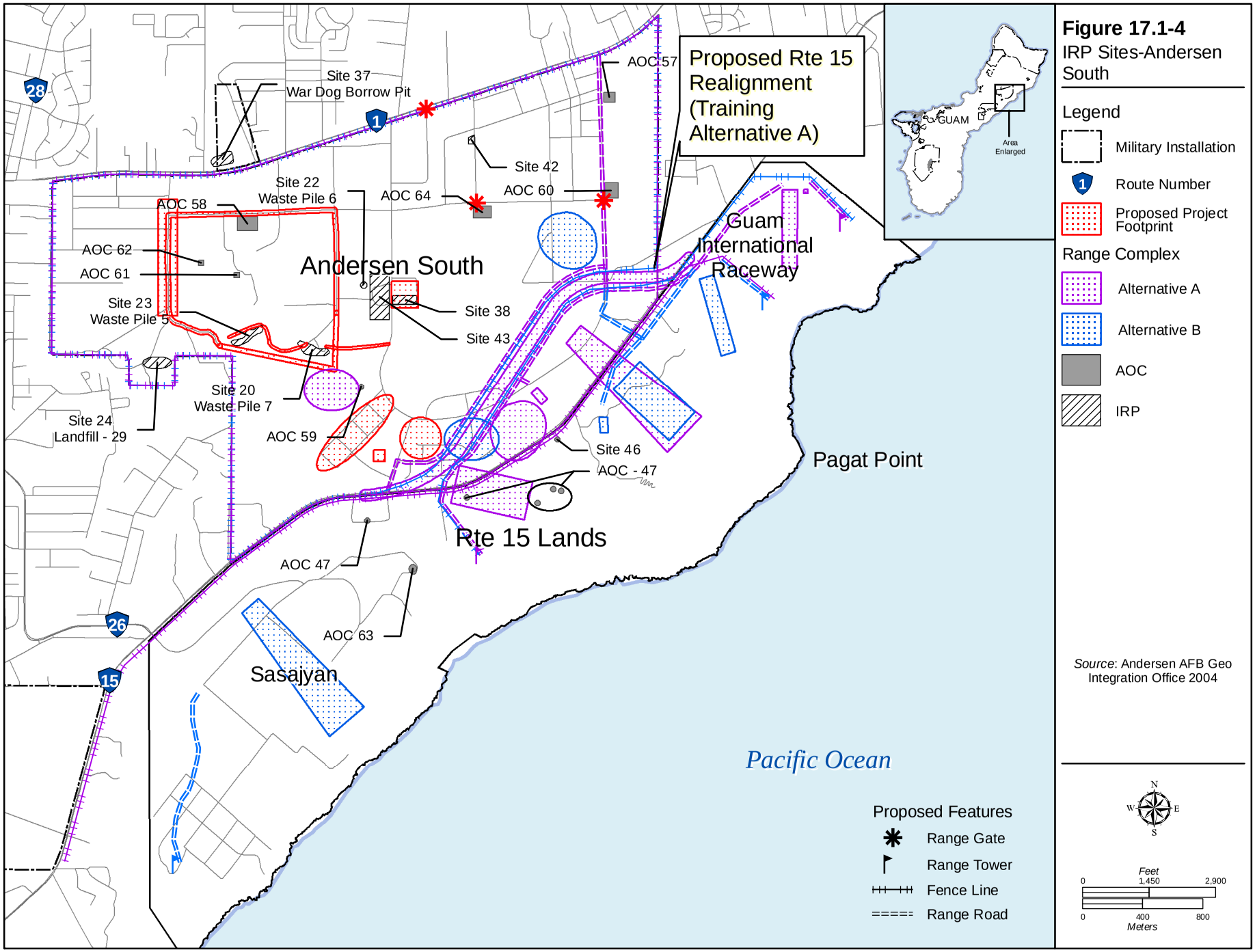
Proposed Rte 15 Realignment (Training Alternative A)
Site 37
War Dog Borrow Pit
AOC 57
Site 42
Site 22
Waste Pile 6
AOC 64
AOC 60
AOC 58
AOC 62
AOC 61
Andersen South
Site 23
Waste Pile 5
Site 38
Site 43
Guam International Raceway
Site 20
Waste Pile 7
Site 24
Landfill - 29
AOC 59
Site 46
AOC - 47
Pagat Point
Rte 15 Lands
AOC 47
AOC 63
Sasajyan
Pacific Ocean
GUAM
Area Enlarged
Figure 17.1-4
IRP Sites-Andersen South
Legend
Military Installation
Route Number
Proposed Project Footprint
Range Complex
Alternative A
Alternative B
AOC
IRP
Source: Andersen AFB Geo Integration Office 2004
Proposed Features
Range Gate
Range Tower
Fence Line
Range Road
N
W
E
S
Feet
0
1,450
2,900
0
400
800
Meters
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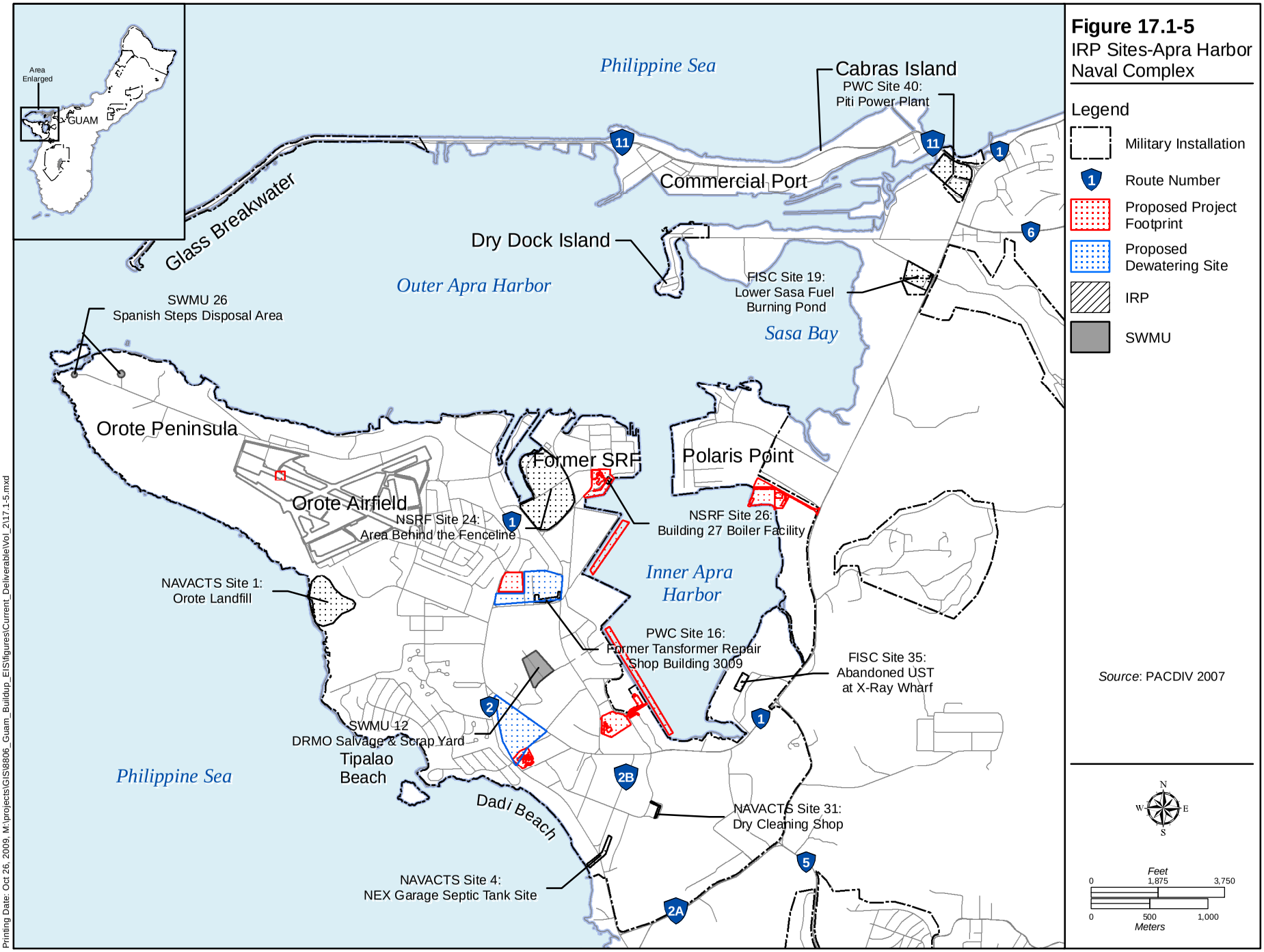


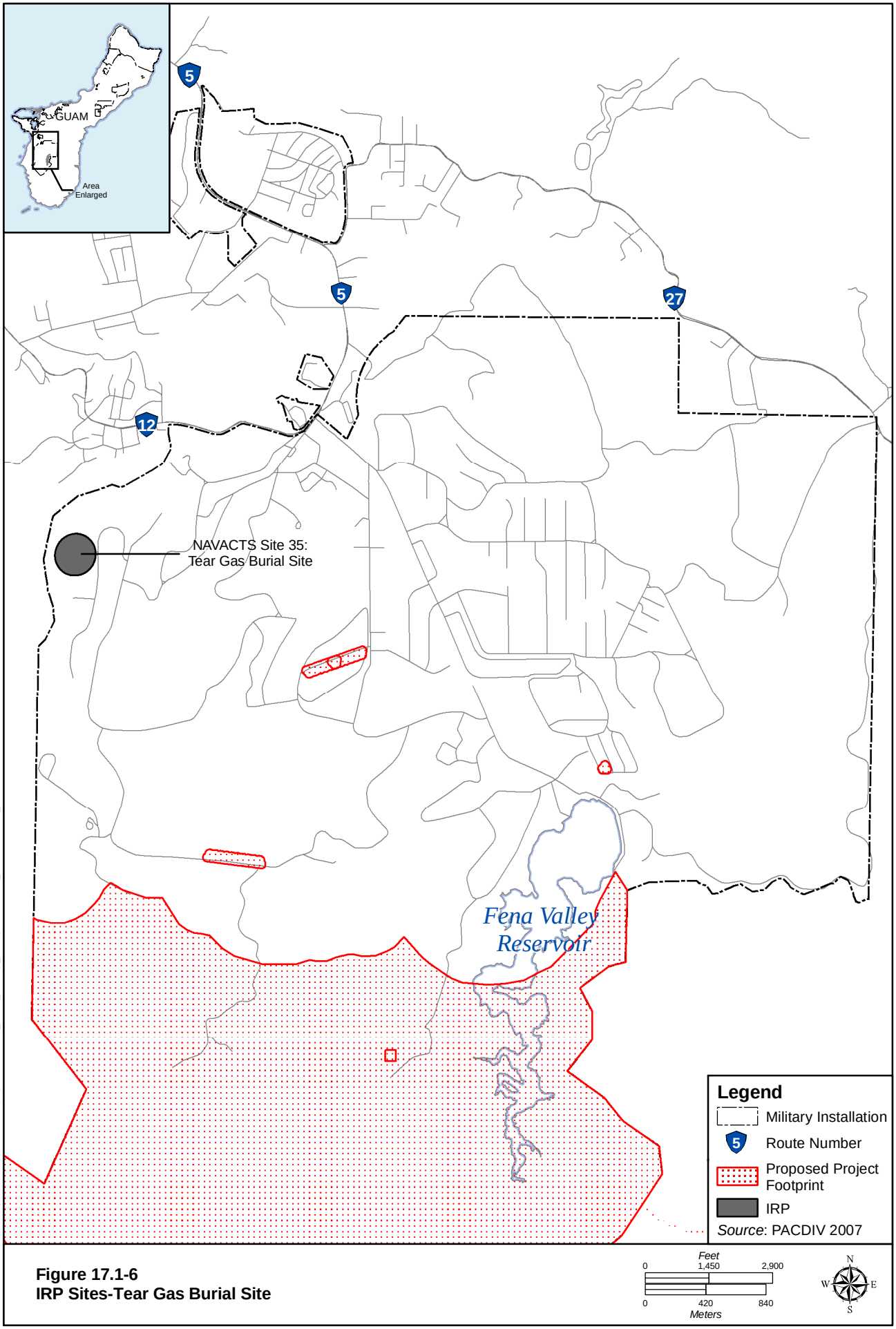
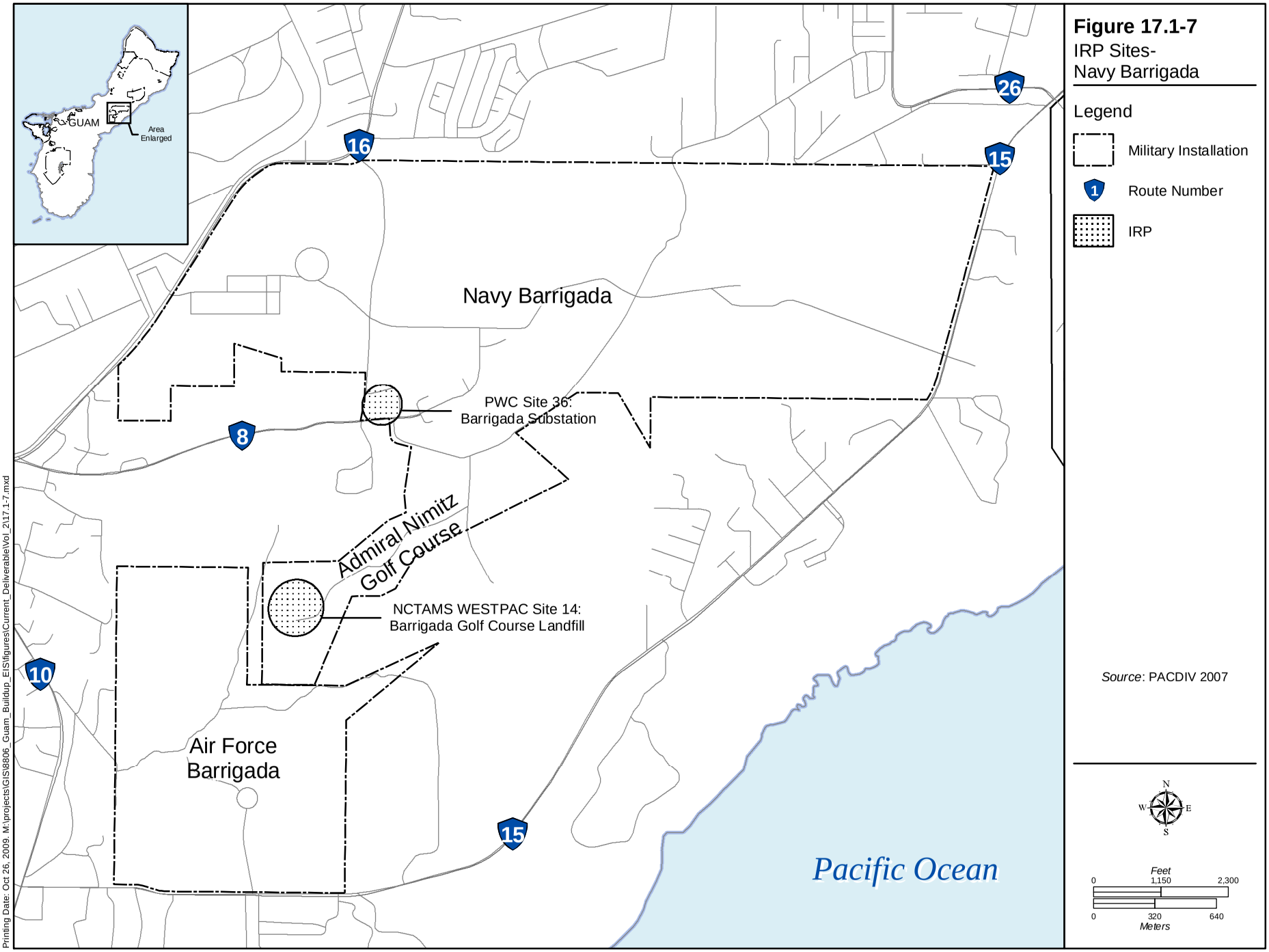


Figure 17.1-6
IRP Sites-Tear Gas Burial Site


GUAM
Area Enlarged
Navy Barrigada
PWC Site 36:
Barrigada Substation
Admiral Nimitz
Golf Course
NCTAMS WESTPAC Site 14:
Barrigada Golf Course Landfill
Air Force
Barrigada
Pacific Ocean
16
26
15
8
10
15
Figure 17.1-7
IRP Sites-
Navy Barrigada
Legend
Military Installation
Route Number
IRP
Source: PACDIV 2007
N
W
E
S
Feet
0
1,150
2,300
0
320
640
Meters
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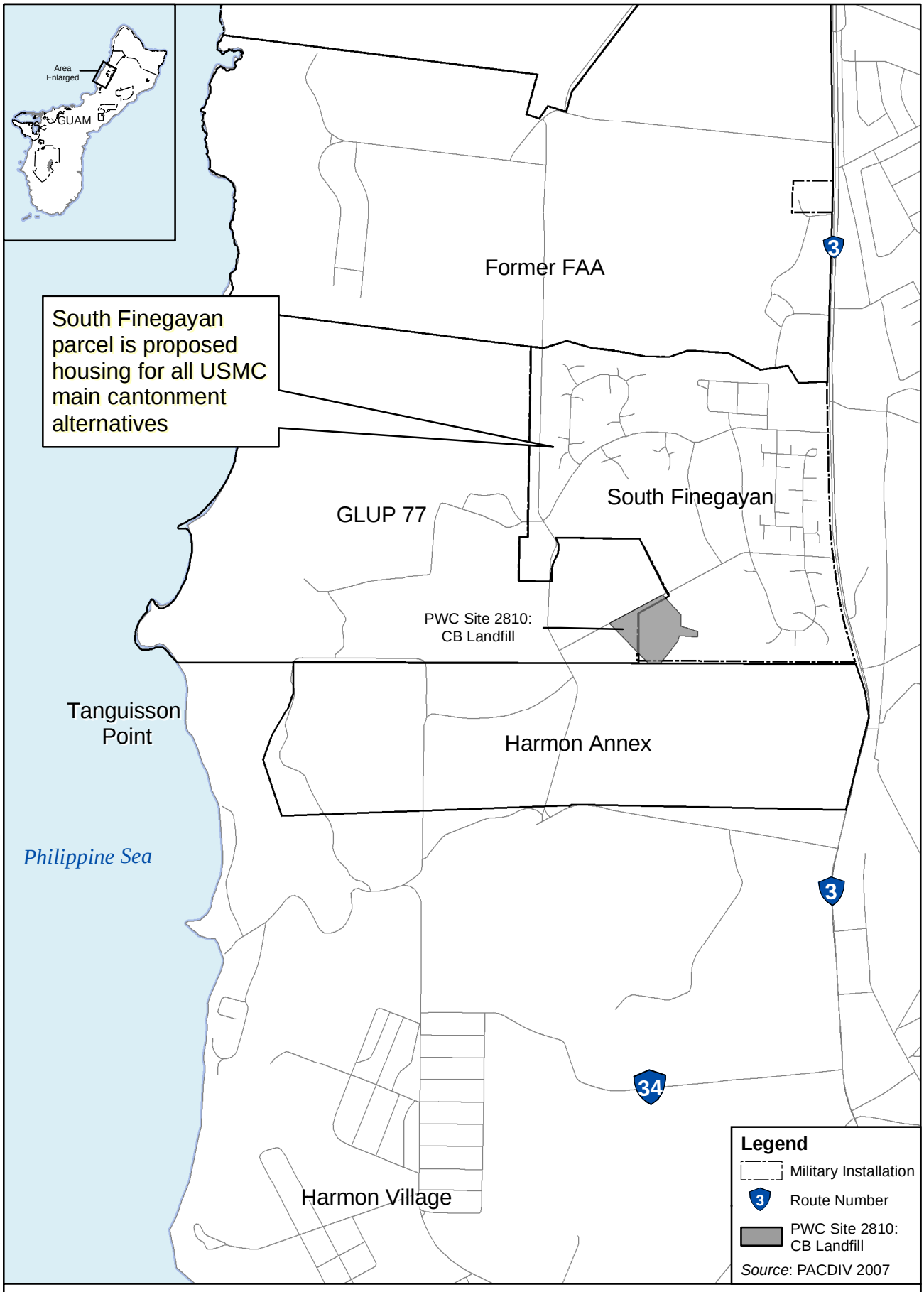

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Figure 17.1-8
PWC Site 2810: CB Landfill

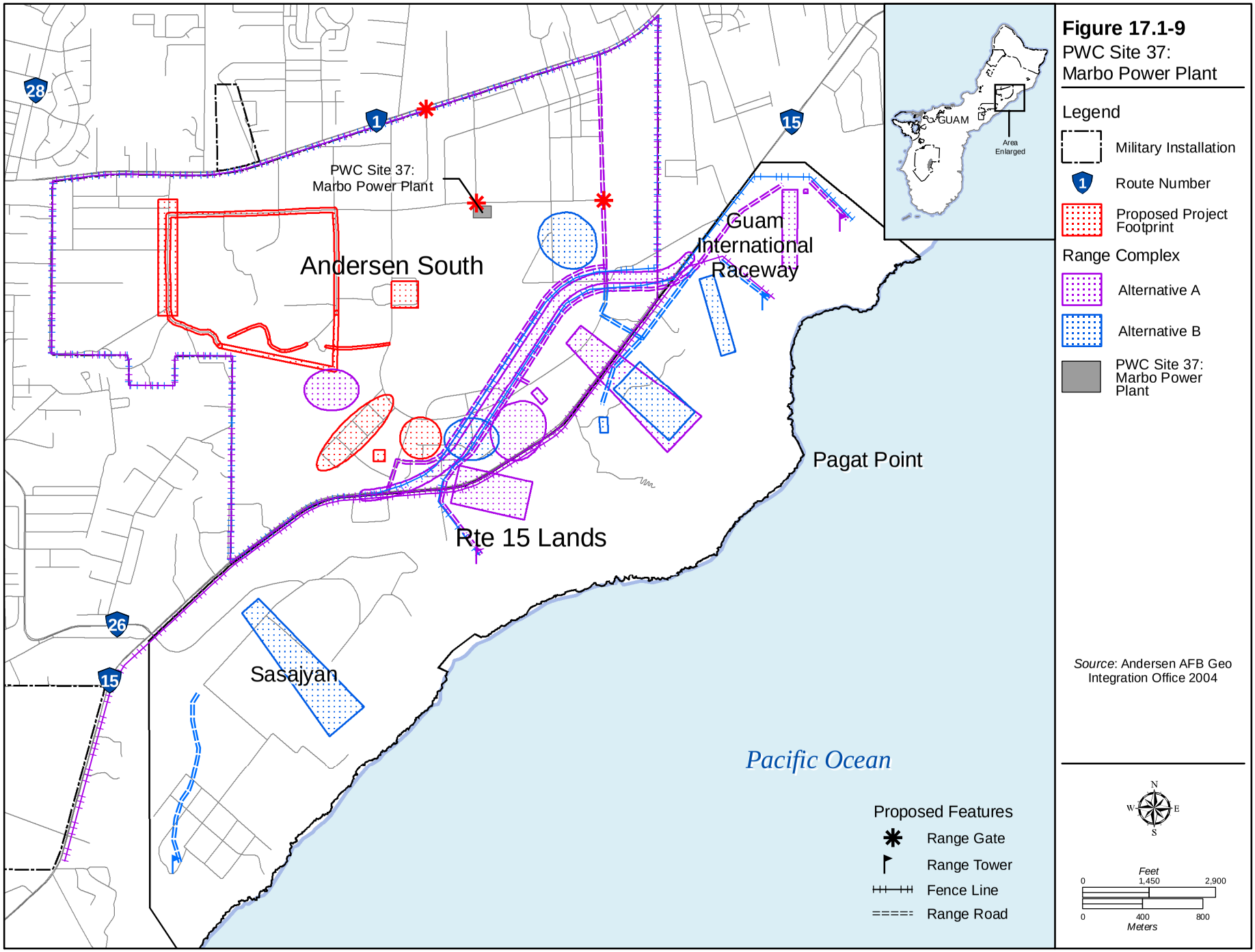

Figure 17.1-9
PWC Site 37:
Marbo Power Plant

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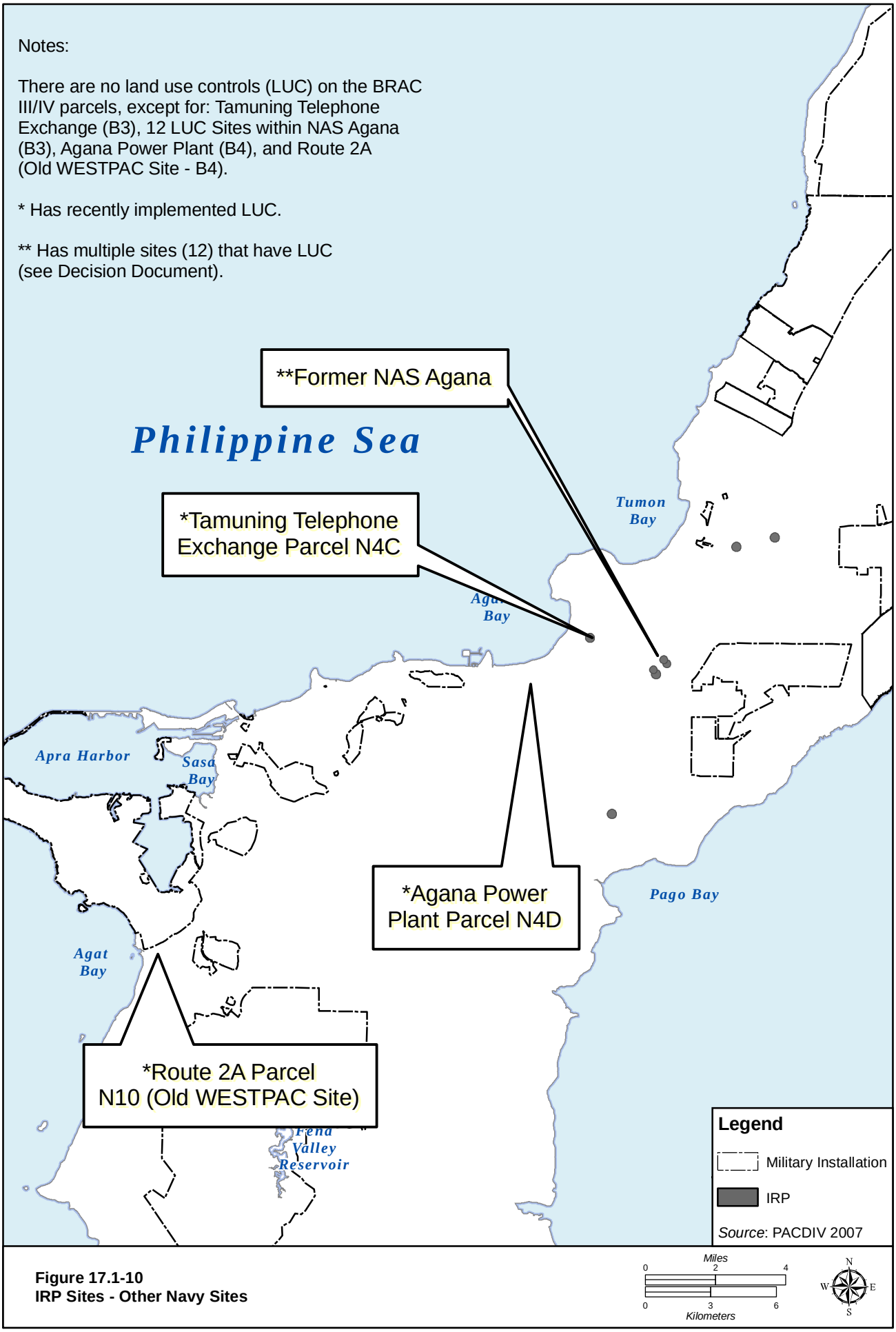


Figure 17.1-10
IRP Sites - Other Navy Sites

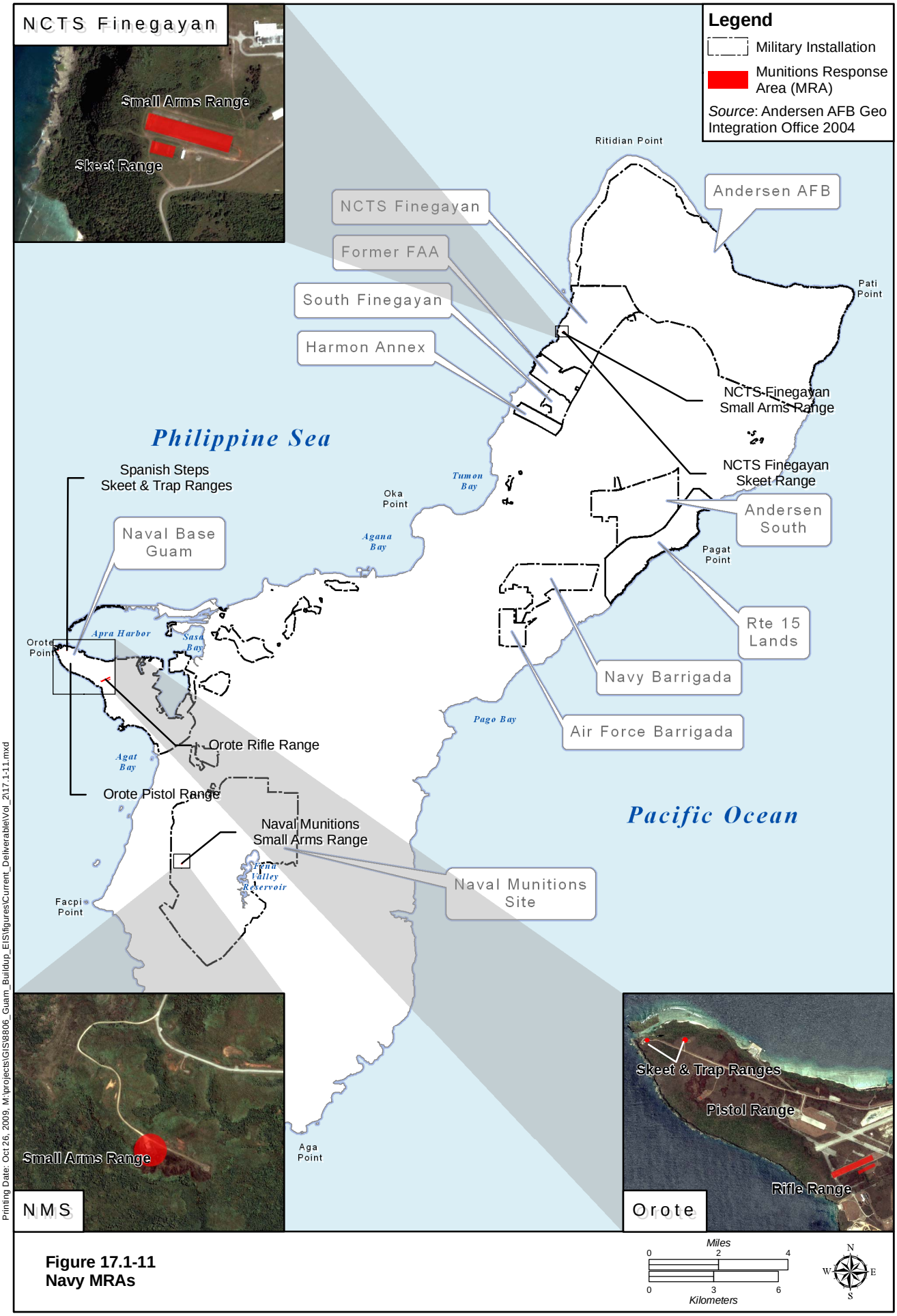


Figure 17.1-11
Navy MRAs

Air Force Hazardous Waste Management

Andersen AFB is a Large Quantity Generator (40 CFR 262.34 [d], [e], and [f]) of hazardous wastes with USEPA identification handler number GU6571999519. DRMO 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 (Andersen AFB 2007).

The management of hazardous waste at Andersen AFB is established primarily by AFI 32-7086, *Hazardous Materials Management.* Specifically, this AFI incorporates the requirements of federal regulations, other AFIs, and DoD directives. Additionally, Andersen AFB has a HWMP pursuant to the AFI. The HWMP provides guidance for personnel regarding the proper handling, storage, and disposal of hazardous waste. Furthermore, the HWMP implements the USEPA and DOT "cradle-to-grave" requirements regarding hazardous waste generated as a result of base operations (Andersen AFB 2007). The Air Force has various waste accumulation points as depicted in Figure 17.1-12. Andersen AFB holds a Guam RCRA Operating Permit for a hazardous waste management treatment facility located within the boundaries of Andersen AFB at the extreme reach of Tarague Beach. The hazardous waste management facility is permitted to conduct open burning and open detonation to treat MEC that is either reactive (D003) or toxic characteristic leaching procedure hazardous waste. The facility is known as the Explosive Ordnance Disposal (EOD) Range. The Facility Identification Number is GU6571999519 and the Permit Number is GUS002.

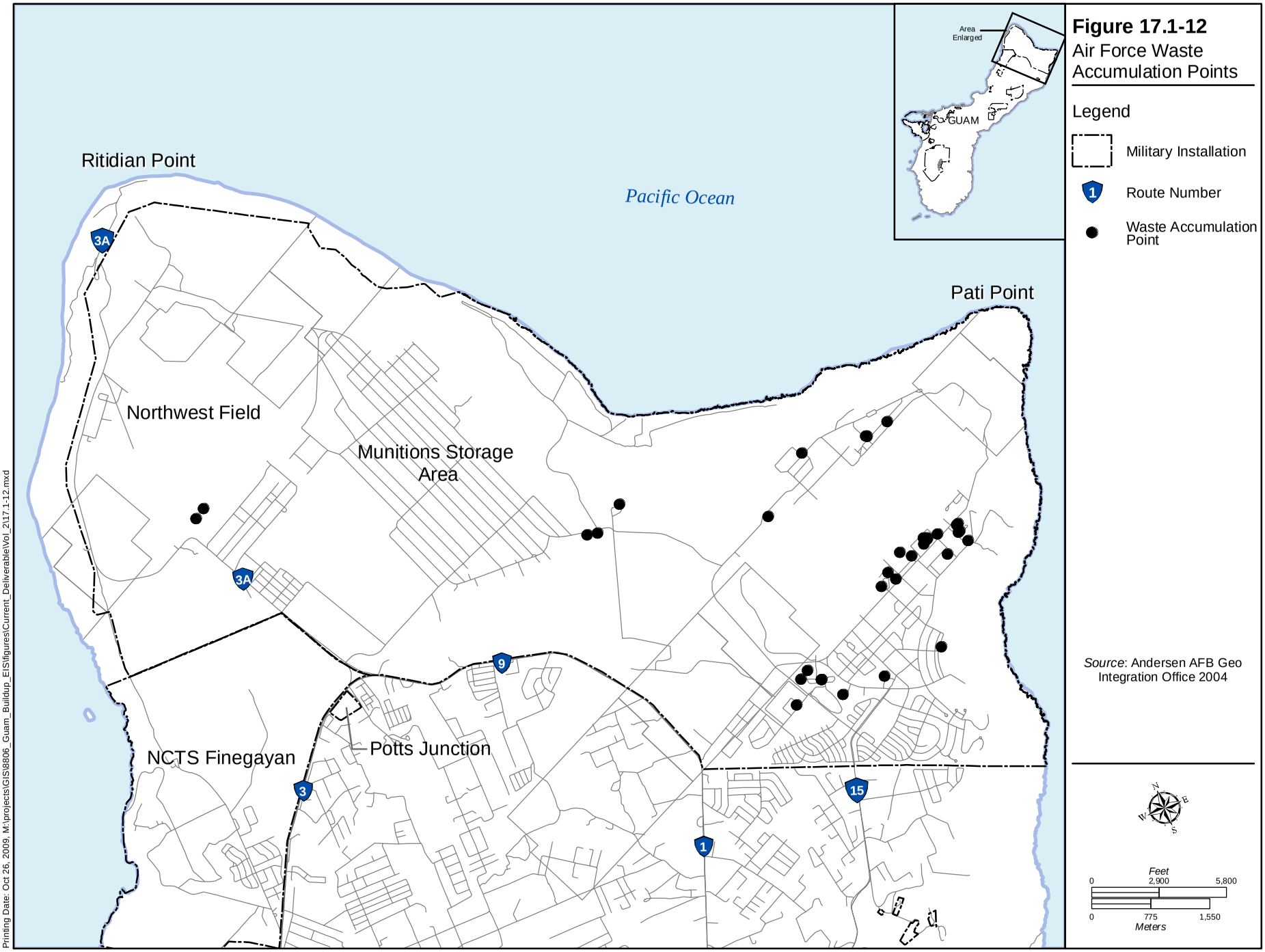
Navy Hazardous Waste Management

The Navy on Guam is a Large Quantity Generator (40 CFR 262.34 [d], [e], and [f]) of hazardous wastes with USEPA identification handler number GU5170022680. Disposal of Navy hazardous waste is arranged through DRMO and performed by its' licensed contractors. DRMO maintains all required hazardous waste documentation and contracts with licensed contractors for proper off-island disposal of the waste at permitted facilities (Navy 2007).

OPNAVINST 5090.1C requires all Navy facilities that generate hazardous waste to have a HWMP. The HWMP provides guidance for personnel on the proper handling, storage, and disposal of hazardous waste. Furthermore, the HWMP ensures the proper implementation the USEPA and DOT "cradle-to-grave" management requirements for hazardous waste.

Navy ships are not considered hazardous waste generators, but rather generate what is termed as "used hazardous material". This material is not considered hazardous waste until the receiving shore entity declares it "waste" and subjects it to applicable regulations. This policy applies only for material generated aboard ships. When "used hazardous material" is offloaded and determined to have "no further use" it then becomes regulated waste and is subject to all applicable regulations.

The Navy has various waste accumulation points as designated in its approved HWMP. The locations of these waste accumulation points are depicted in Figure 17.1-13.


Ritidian Point
Pacific Ocean
Pati Point
Northwest Field
Munitions Storage Area
NCTS Finegayan
Potts Junction
3A
3A
9
3
15
1
Area Enlarged
GUAM
Figure 17.1-12
Air Force Waste Accumulation Points
Legend
Military Installation
Route Number
Waste Accumulation Point
Source: Andersen AFB Geo Integration Office 2004
Feet
0
2,900
5,800
0
775
1,550
Meters
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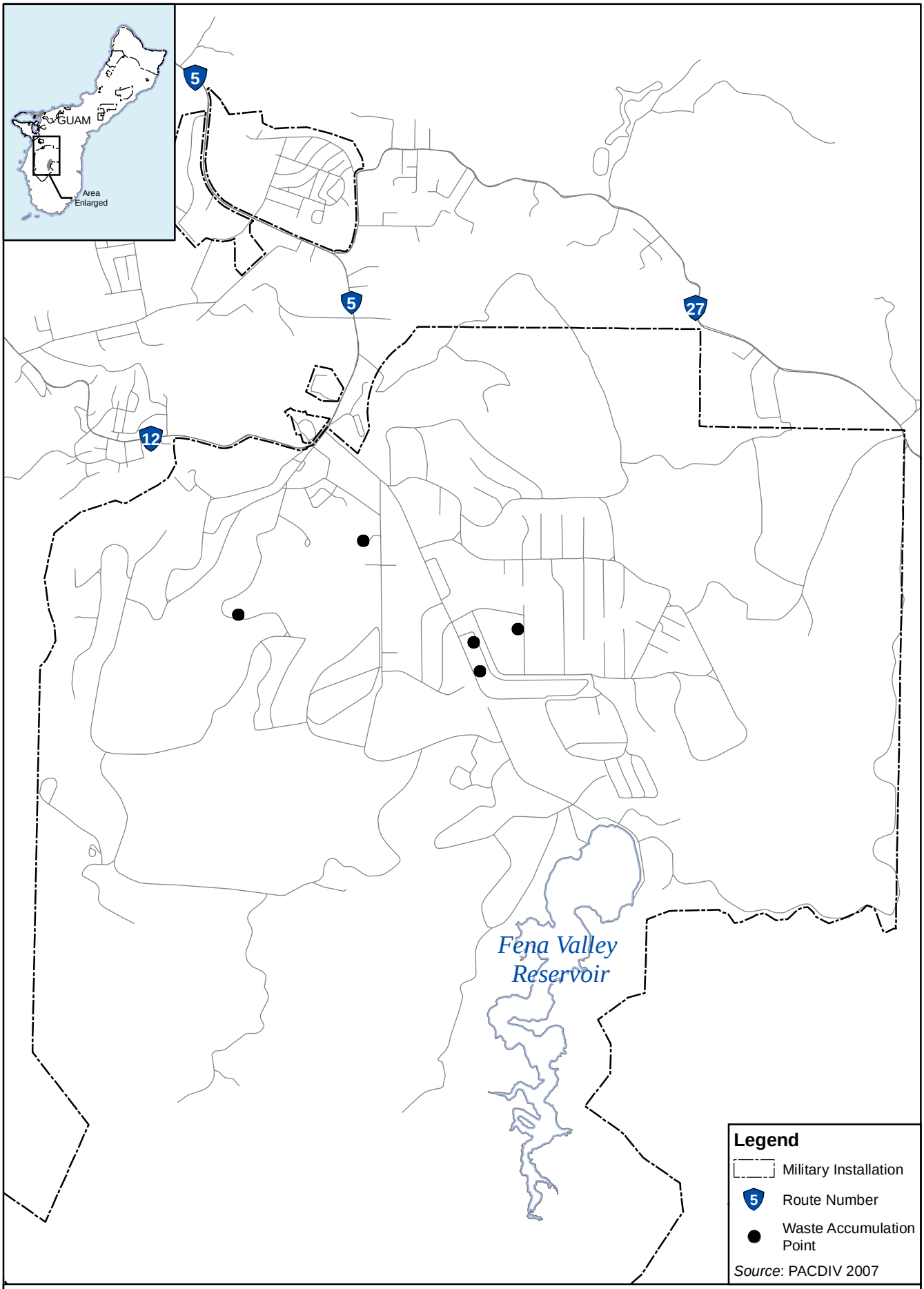

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Figure 17.1-13
Navy Waste Accumulation Points

GovGuam Hazardous Waste Management

GovGuam accumulates hazardous wastes from a multitude of waste streams. GEPA imposes regulations to control the generation and disposal of hazardous waste (GEPA 2008). The GEPA Permit Guidebook Chapter 2 - *Hazardous Waste Permits and Notification* and the Guam Hazardous Waste Management Regulations were developed as guidance for:

> "…individuals and organizations in the proper methods and procedures for handling, transporting, storing, disposing, and treating hazardous wastes". It is also the objective of the regulation to establish a program that identifies hazardous wastes and provides for the regulation of the above mentioned activities to include the transport or transfer of wastes through program capabilities for inspection, permit review, and enforcement. The primary goal of the regulations is to protect human health and carry out management activities in an environmentally sensitive and sound manner. Certain sections of the CFRs dealing with hazardous wastes have been adopted under Guam's regulations by reference to provide for comprehensive coverage. The Administrator of Guam EPA serves as the primary certification and regulatory authority for hazardous waste management in Guam."

The GEPA Guidebook includes information concerning:

- Storage of hazardous waste
- Treatment of hazardous waste
- Disposal of hazardous waste
- Notification of hazardous waste activity
- USTs
- Hazardous waste importers
- *Hasso Guam!* – Guam's household hazardous waste cleanup program

The transportation of hazardous wastes in Guam is regulated consistent with DOT requirements through the Guam Department of Public Works, Highway Division.

17.1.3.3 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highways Administration (FHWA).

North

Four potential contamination sites are located adjacent or proximal to the proposed road improvement projects in the North Region (Figure 17.1-14). Table 17.1-3 provides a key to locations of potentially contaminated sites near the specific Guam Road Network (GRN) project locations. Each of the potentially contaminated sites is described herein.

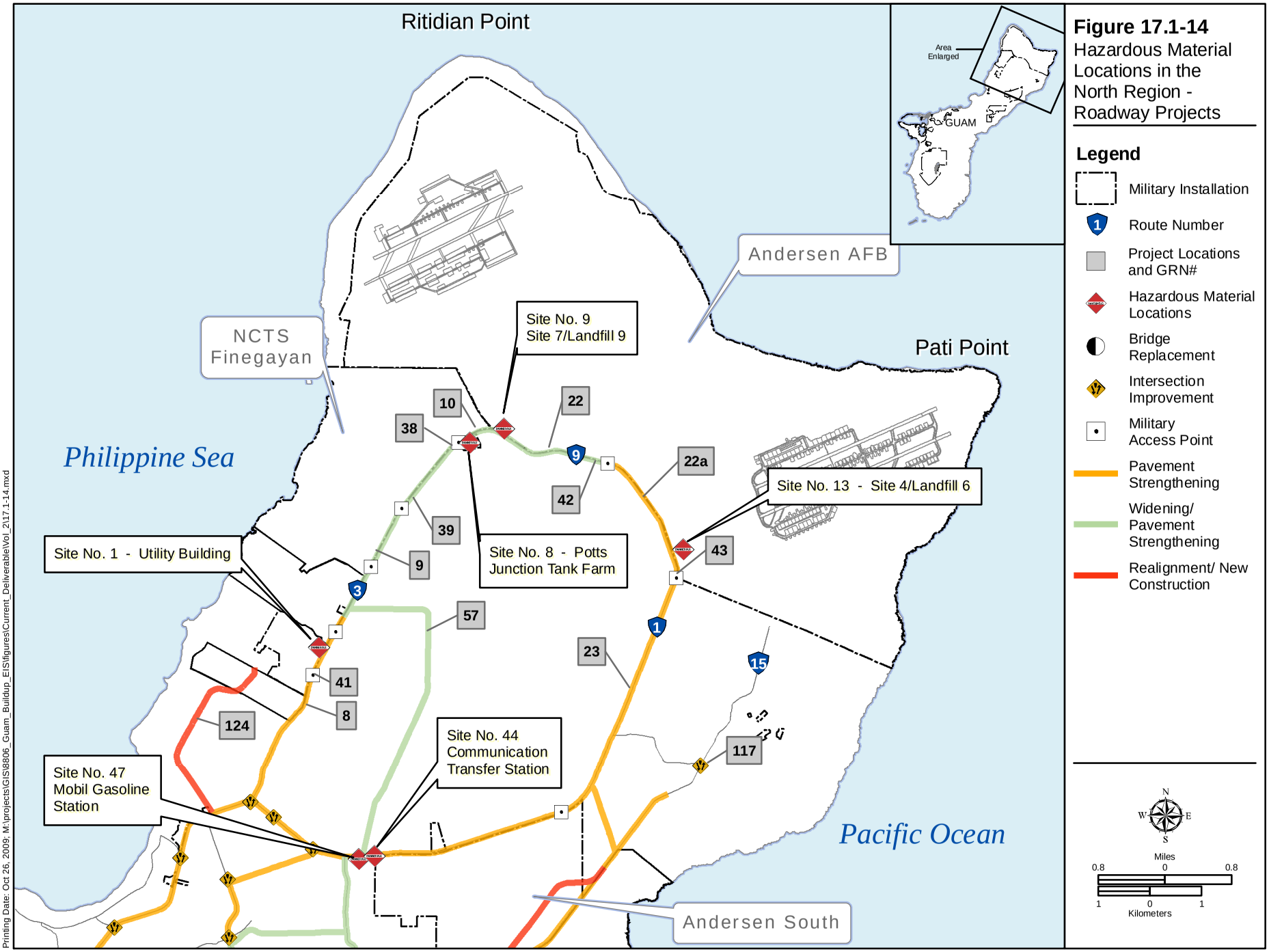

Figure 17.1-14
Hazardous Material Locations in the North Region - Roadway Projects

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Table 17.1-3. Potentially Contaminated Sites near GRN Roadway Project Sites in the North Region

GRN #	*Route and Segment*	*Site Number*	*Description*	*Environmental Concern*
8	Route 28 to Route 1	1	Utility Building	Site conditions suggest likely soil and/or groundwater contamination. Adjacent Comprehensive Environmental Response, Compensation, and Liability Act Information Systems (CERCLIS), RCRA Subtitle C site planned for reassessment. The March 2009 site visit identified one aboveground storage tank (AST) in service and posted "chlorine gas" sign.
10	NCTS Finegayan to Route 9	8	Potts Junction Tank Farm	Adjacent tank farm included in the Andersen Air AFB Installation Restoration Program (IRP). Access was not available during the March 2009 site visit. No current environmental disposition. On- or off-site contamination is unknown; however, historical site use and its inclusion in the Andersen AFB IRP suggest likely soil and/or groundwater contamination.
22A	Andersen AFB North Gate to Route 1 (Andersen AFB Main Gate)	9	Site 7/Landfill 9	Adjacent landfill included in the Andersen AFB IRP. Access was not available during the March 2009 site visit. No current environmental disposition. On- or off-site contamination is unknown; however, historical site use and its inclusion in the Andersen AFB IRP suggest likely soil and/or groundwater contamination
		13	Site 4/Landfill 6	Adjacent landfill included in the Andersen AFB IRP. Access was not available during the March 2009 site visit. No current environmental disposition. On- or off-site contamination is unknown; however, historical site use and its inclusion in the Andersen AFB IRP suggest likely soil and/or groundwater contamination.

Source: Parsons Brinckerhoff 2009.

PCB Contamination

A cursory field review of power pole and pad-mounted transformers in the North Region was conducted during inspections of substations and Guam Power Authority (GPA) utility buildings. Non-PCB-containing transformers or capacitors would be clearly labeled and are typically painted blue by the manufacturer. Clear white labeling typically indicates the use of non-PCB fluids for the breakers. Labeling for non-PCB-containing transformers was not identified during the limited field review. While any wooden pole with mounted transformers is likely to contain PCBs, individual pole-mounted or pad-mounted transformers in the region were not checked. The GPA has a PCB management program, and recent upgrades may have replaced some of the PCB-containing transformers. Most of the power poles on the island of Guam appear to have been upgraded, but replacement of PCB-containing capacitors and transformers may not have been completed at all locations. For this reason, existing pole- and pad-mounted transformers in the North Region may contain PCBs.

Solid Waste Management Units (SWMU)

The Andersen AFB SWMUs are located more than 0.25-mi (0.40-kilometer [km]) from the proposed roadway improvements in the north and central regions (i.e., roadway improvements proximal to the

mentioned military installations) and are not close enough the proposed improvements to warrant further discussion.

Central

Eight potential contamination sites are located adjacent or proximal to the proposed road improvement projects in the Central Region Figure 17.1-15. Table 17.1-4 provides a key to locations of potentially contaminated sites near the specific GRN project locations. Each of the potentially contaminated sites is described herein.

Table 17.1-4. Potentially Contaminated Sites Near GRN Roadway Project Sites in the Central Region

GRN #	*Route and Segment*	*Site Number*	*Description*	*Environmental Concern*
13	Route 11 to Asan River	14	Former Mobil Gasoline Station	No documented record of contamination; however an UST pad and associated monitoring wells suggest likely soil and/or groundwater contamination.
15	Route 6 (Adelup) to Route 4	25	Mobil Gasoline Station	Reworked pavement and monitoring wells identified during March 2009 site visit suggest undocumented UST removal and possible soil and/or groundwater contamination.
33	Route 8 to Route 3	33	Mobil Gasoline Station, Building #101	Three monitoring wells associated with USTs located as near as 35 feet (ft) (11 meters [m]) from project improvements suggest undocumented soil and/or groundwater contamination.
6	Route 27 to Chalan Lujuna	44	Communication Transfer Station	An AST and five monitoring wells identified during March 2009 site visit. Undocumented soil and/or groundwater contamination is likely as no evidence of remediation activities were observed.
		47	Mobil Gasoline Station	Three monitoring wells, two test wells, and drums labeled "hazardous waste" were identified during March 2009 site visit suggest undocumented soil and/or groundwater contamination.
17	Route 10 to Tiyan Parkway/Route 33 (east) Tiyan Parkway/ Route 33 (east) to Route 1	57	Mobil Mart	Six fuel islands and a tank farm located within 40 ft (12 m) of project improvements with eight groundwater monitoring wells located on site. No indication of remediation identified during March 2009 site visit. Site conditions suggest likely soil and/or groundwater contamination.
		58	Shell Gasoline Station	Site conditions in March 2009 included one AST without secondary containment; a fuel island and tank pad located within 30 ft (9 m) of project improvements; and active remediation equipment in use. Site conditions suggest likely soil and/or groundwater contamination.
		62	Shell Gasoline Station	Site conditions in March 2009 included one AST; a fuel island located within 25 ft (8 m) of project improvements; and active remediation equipment on site. Site conditions suggest likely soil and/or groundwater contamination.

Source: Parsons Brinckerhoff 2009.

PCB Contamination

A cursory field review of power pole and pad-mounted transformers in the central region was conducted during inspections of substations and GPA utility buildings. As discussed for the north region, existing pole- and pad-mounted transformers in the central region may contain PCBs.

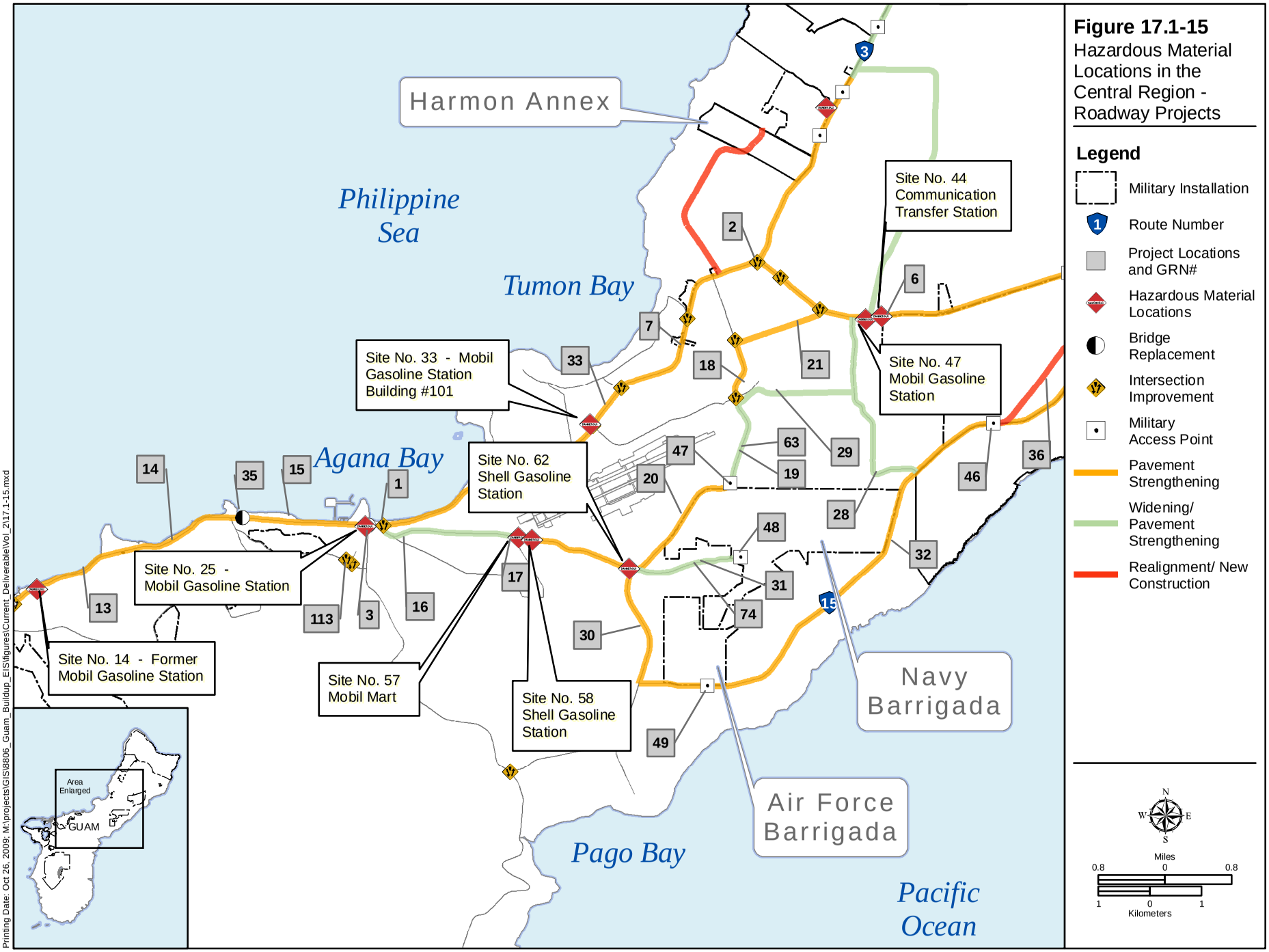

Figure 17.1-15
Hazardous Material Locations in the Central Region - Roadway Projects

Apra Harbor

Five potential contamination sites are located adjacent or proximal to the proposed road improvement projects in the Apra Harbor Region (Figure 17.1-16). Table 17.1-5 provides a key to locations of potentially contaminated sites near the specific GRN project locations in the Apra Harbor Region. Each of the potentially contaminated sites is described herein.

Table 17.1-5. Potentially Contaminated Sites near GRN Roadway Project Sites in the Apra Harbor Region

GRN #	*Route and Segment*	*Site Number*	*Description*	*Environmental Concern*
26	Route 1 to Route 5	111	Stell Newman Master Center/ Navy Housing – Navy Federal Credit Union	Included in the Apra-Harbor Naval Complex IRP as location of abandoned UST with petroleum contaminants on site. No current environmental disposition; however, the documented site history suggests likely soil and/or groundwater contamination.
		113	Old NSD Drum Storage Lot	Included in the Apra-Harbor Naval Complex IRP and designated as a Solid Waste Management Unit. The March 2009 site visit identified a possible disposal site at or near this site. Documentation suggests likely soil and/or groundwater contamination.
		114	Lower Sasa Fuel Burning Pond	Included in the Apra-Harbor Naval Complex IRP and formerly managed wastewater and fuels on site. Current environmental disposition is land use control. Site history suggests likely soil and/or groundwater contamination.
4	Port to Intersection with Route 1	117	GPA (Cabras Power Plant)	Currently considered to be in significant non-compliance in connection with former PCB disposal. Several ASTs were observed on site during March 2009 site visit. Documented site history and site conditions suggest likely soil and/or groundwater contamination.
		118	Piti Power Plant	Included in the Apra-Harbor Naval Complex IRP as location of abandoned UST with petroleum contaminants on site. No current environmental disposition; however, the documented site history suggests likely soil and/or groundwater contamination.

Source: Parsons Brinckerhoff 2009.

PCB Contamination

A cursory field review of power pole and pad-mounted transformers in the Apra Harbor Region was conducted during inspections of substations and GPA utility buildings. As discussed for the north region, existing pole- and pad-mounted transformers in the Apra Harbor Region may contain PCBs.

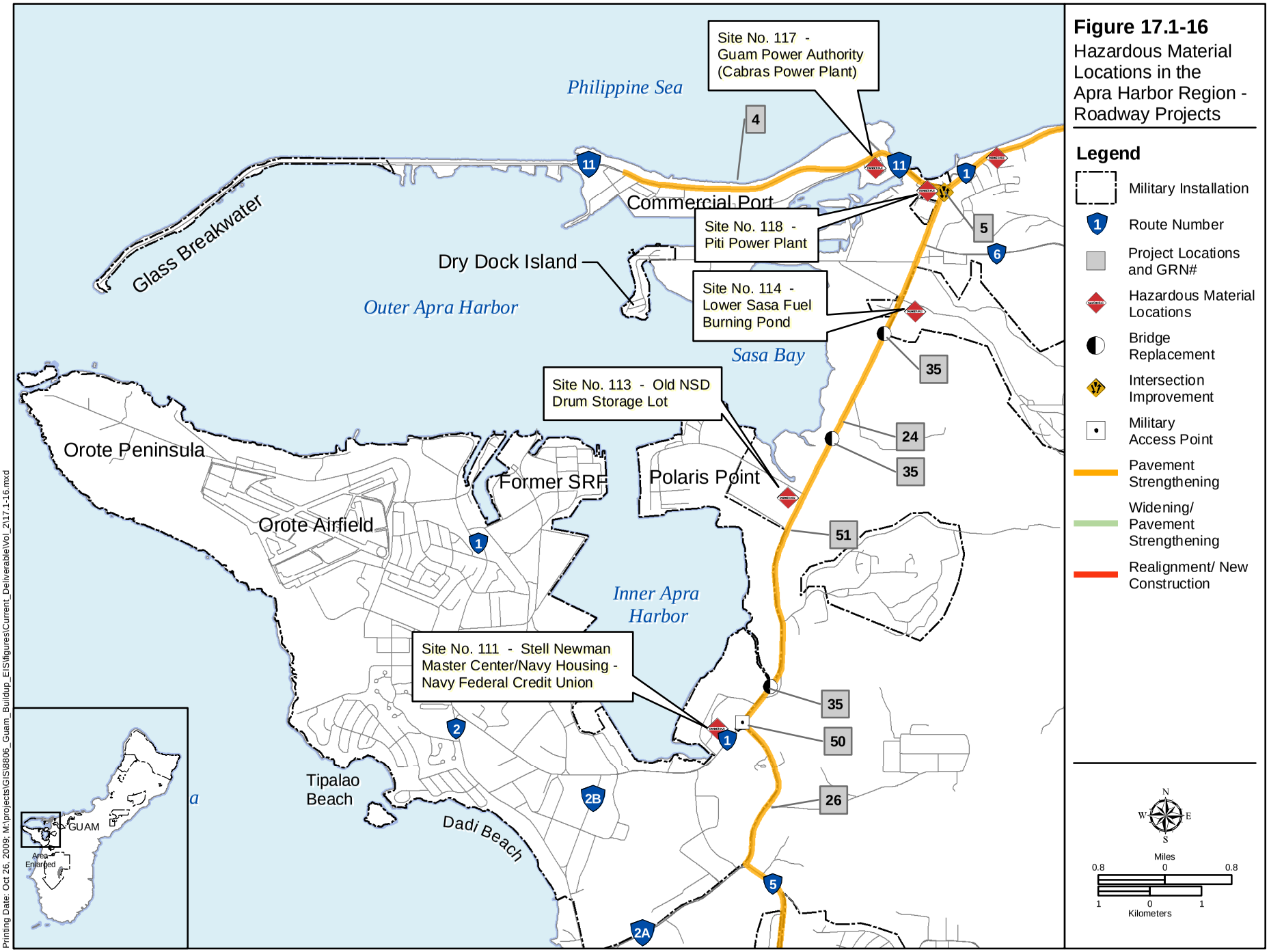

Figure 17.1-16
Hazardous Material Locations in the Apra Harbor Region - Roadway Projects

Legend

- Military Installation
- Route Number
- Project Locations and GRN#
- Hazardous Material Locations
- Bridge Replacement
- Intersection Improvement
- Military Access Point
- Pavement Strengthening
- Widening/ Pavement Strengthening
- Realignment/ New Construction

N
W
E
S

Miles
0.8 0 0.8

1 0 1
Kilometers

South

There are no potential contamination sites adjacent or proximal to the proposed road improvement projects in the South Region.

PCB Contamination

A cursory field review of power pole and pad-mounted transformers in the south region was conducted during inspections of substations and GPA utility buildings. As discussed for the north region, existing pole- and pad-mounted transformers in the south region may contain PCBs.

17.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

17.2.1 Approach to Analysis

17.2.1.1 Methodology

The evaluation of potential environmental consequences related to the proposed military expansion on Guam is discussed in this section. These impacts were assessed for the general public as well as various media (i.e., soils, surface water, groundwater, air, and biota).

Phases of the proposed military buildup assessed for each alternative are: 1) transportation to and within Guam; 2) the construction phase; and 3) the operational phase. The operational phase has been subdivided into Main Cantonment, aviation operations, waterfront operations, and range operations. The proposed action and alternatives require that infrastructure be developed to safely and responsibly store, dispense, handle, and dispose of additional hazardous materials, toxic substances, and/or hazardous wastes.

17.2.1.2 Determination of Significance

The determination of significance is based upon existing hazardous substance management practices, expected or potential impacts and environmental consequences of the proposed action and alternatives.. and potential mitigation measures to reduce the severity of impacts This determination evaluated the overall ability to mitigate or control hazardous materials and waste impacts and consequences to soils, surface water, groundwater, air, and biota. This determination considers current conditions and potential consequences relative to the anticipated ability of the hazardous substance management infrastructure system to accommodate added hazardous substance demand on the overall system. Specifically, for hazardous substances to be considered a significant impact, the following would have to occur:

- Leaks, spills, or releases of hazardous substances to environmental media (i.e., soils, surface water, groundwater, air, and/or biota) resulting in unacceptable risks to the environment
- Violation of applicable federal, state, or local laws or regulations regarding the transportation, storage, handling, use, or disposal of hazardous substances

17.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to Hazardous Materials that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed.

These include:

- Address management practices for hazardous substances including hazardous wastes, toxic substances, hazardous materials, and ordnance
- Describe the potential overall impacts of hazardous substances from construction and operation of proposed projects
- Identify the projected hazardous waste types and volumes
- Identify expected hazardous substance storage, disposal, and management plans
- Evaluate measures to mitigate generation of hazardous waste including pollution prevention
- Discuss how hazardous substances on land and from ships would be managed
- Discuss the potential for impacts to environmental media from spills, accidents, and/or releases of hazardous substances
- Identify existing installation restoration sites

17.2.2 Alternative 1

17.2.2.1 Transportation to and within Guam

This subsection describes potential environmental consequences and potential mitigation related to the relocation of approximately 8,600 Marines and 9,000 dependents from Okinawa to Guam. This personnel transfer includes the transport of all necessary supplies, materials, equipment, expendable, and non-expendable resources needed to perform the expanded mission. In addition, this analysis considers the routine transfer and use of hazardous substances within various DoD on-island installations.

Hazardous Materials

The proposed influx of DoD personnel and dependents to Guam would result in the transport/transfer of hazardous materials. It is expected that the largest increases of hazardous materials on Guam would occur from the use of POL which includes gasoline, aviation fuels, diesel, oil, grease, kerosene, and other related products. Table 17.2-1 summarizes potential effects, impacts, and mitigation measures associated with hazardous materials transport to Guam and transfer within Guam. Table 17.2-2 provides the quantities of hazardous materials used by the Marines on Okinawa.

Table 17.2-1. Hazardous Materials Transport Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials transport to Guam and transfer within Guam	• Increased transport of hazardous materials to Guam • Increased hazardous materials transfer and use within Guam	• Spill or release impacts during transport/transfer between DoD locations • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity • Increased risk of environmental media contamination	• No potential mitigation measures are identified

Table 17.2-2. Annual Marine DRMO Okinawa Waste Disposal Quantities

Waste Category	*Total Waste Volume (in lbs)*	*Waste Codes*
Hazardous Materials	32,389	POL/Fuels and contaminated wastes
Toxic Substances	27,585	PCBs and PCB contaminated wastes
Hazardous Waste	628	D001 and D0018
Hazardous Waste	250	D001, D002, D003, and D035
Hazardous Waste	250	D001, D002, and D026
Hazardous Waste	1,661	D001 and D002
Hazardous Waste	41	D001, D006, and D018
Hazardous Waste	973	D001, D006, D007, and D008
Hazardous Waste	50,313	D001 and D007
Hazardous Waste	2,910	D001, D007, and D008
Hazardous Waste	205,011	D001, D007, D008, and D018
Hazardous Waste	830	D001 and D018
Hazardous Waste	376	D001 and D022
Hazardous Waste	728	D001, D035, and D043
Hazardous Waste	2,633	D001 and D035
Hazardous Waste	13,189	D001
Hazardous Waste	436	D001, D005, and D018
Hazardous Waste	171,473	D006 and D008
Hazardous Waste	3,853	D007
Hazardous Waste	11,180	D008
Hazardous Waste	842	J005
Hazardous Waste	20,344	D001 and D003
Hazardous Waste	145	D001 and D009
Hazardous Waste	1,840	D002 and D004
Hazardous Waste	5,463	D002 and D005
Hazardous Waste	2,889	D002 and D006
Hazardous Waste	5,522	D002 and D007
Hazardous Waste	16,043	D002 and D008
Hazardous Waste	249	D002 and D009
Hazardous Waste	37,759	D002
Hazardous Waste	996	D003
Hazardous Waste	1,609	D004 and D005
Hazardous Waste	97	D004, D005, D006, and D007
Hazardous Waste	635	D004 and D006
Hazardous Waste	821	D004 and D008
Hazardous Waste	1,429	D005 and D007
Hazardous Waste	598	D005
Hazardous Waste	10,524	D006 and D007
Hazardous Waste	1,398	D006, D007, and D008
Hazardous Waste	90	D006, D007, and D009
Hazardous Waste	24,590	D006 and D007
Hazardous Waste	2,968	D006, D008, and D009
Hazardous Waste	2,984	D006 and D008
Hazardous Waste	4,293	D006
Hazardous Waste	1,047	D007 and D008
Hazardous Waste	170	D007 and D010
Hazardous Waste	140	D007 and D011
Hazardous Waste	232	D007 and D019
Hazardous Waste	324	D007 and D035
Hazardous Waste	174	D007 and D039

Waste Category	*Total Waste Volume (in pounds)*	*Waste Codes*
Hazardous Waste	11,679	D007
Hazardous Waste	23	D007, J003, and F005
Hazardous Waste	10	D008 and D009
Hazardous Waste	8,824	D008
Hazardous Waste	11	D009 and D011
Hazardous Waste	3,783	D009
Hazardous Waste	3,664	D011
Hazardous Waste	83	D018
Hazardous Waste	116	D026
Hazardous Waste	624	D035
Hazardous Waste	218	D040
Hazardous Waste	37	J002
Hazardous Waste	813	J003
Hazardous Waste	408	J011
Hazardous Waste	402	U080
Hazardous Waste	147	U080 and J003
Hazardous Waste	151	U151
Hazardous Waste	126	U188
Hazardous Waste	148	W001
Total Hazardous Waste	**644,217**	**All Hazardous Waste Codes**

Notes: Ignitability (D001): If the waste flashpoint is less than 140°F, the waste is "ignitable" and thus a hazardous waste. Corrosivity (D002): If the waste pH less than or equal to 2 or greater than or equal to 12.5, the waste is "corrosive" and thus a hazardous waste. Reactivity (D003): If a waste exhibits any of the criteria associated with the characteristic of "reactivity," it is a hazardous waste by virtue of its "reactivity". Toxicity (D004 through D043): Compare individual analytical results to corresponding regulatory limits. If the reported value is equal or greater than specified regulatory limits for particular compounds, then the waste exhibits the characteristic of "toxicity" and is therefore a hazardous waste. F-listed hazardous waste is generated from non-specific sources such as solvents, plating solutions, and chemical manufacturing processes and can be found in 40 CFR § 261.31. U-listed wastes include discarded commercial chemical products and/or residues in which the generic name of the product matches any chemical listed in 40 CFR §261.33 with an USEPA Waste Number beginning with the letter "U" (DRMO Okinawa 2009).

It is estimated that the proposed transfer of Marines to Guam would result in an increase to the Guam hazardous materials disposal volume of 50% of the known Okinawa DRMO disposal rate, or approximately 16,000 lbs (7,257 kg) annually (DRMO Okinawa 2009).

Although this is a substantial increase, proven and effective best management practices (BMPs) and standard operating procedures (SOPs) would be used to:

- Prevent, contain, and/or clean up spills and leaks to protect the human health and environment
- Provide personnel training and operational protocol and procedures to protect human health and environment
- Ensure DMRO's ability to properly arrange for and coordinate the disposal of anticipated hazardous materials
- Protect overall human health, welfare, and the environment

Increases in hazardous materials may require DRMO on Guam to expand its hazardous materials handling, storage, and disposal capacity. Due to the projected increase in hazardous materials, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous materials would be handled and

disposed per applicable BMPs and SOPs and therefore, the increase in volume would not result in significant impacts (Table 17.2-3).

Table 17.2-3. Summary of BMPs and SOPs

Alternatives 1, 2, 3, and 8
For Soils, Water, Air, and Biota Relative to Transportation, Construction, and Operations Functions
• Update/implement HMMPs and HWMPs. • Update/implement Facility Response Plans • Update/implement SPCC plans (training, spill containment and control procedures, clean up, notifications, etc.). • Ensure DoD personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, ensure they are trained in accordance with spill prevention, control, and clean up methods. • Perform all vehicle maintenance activities off-range at existing DoD maintenance shops. • Implement aggressive hazardous waste minimization plans that substitute hazardous waste for non-hazardous or less toxic waste as applicable and use LEEDS criteria. • Ensure that DRMO has sufficient hazardous substance storage, transportation, and disposal capacity prior to any expected increases. • Verify through surveillances and inspections that federal, local, and DoD laws and regulations are being observed and implement corrective actions as necessary. • Minimize the risk of uncontrolled spills and releases through industry accepted methods for spill prevention, containment, control, and abatement. • Implement routine firing range clearance operations (e.g., annually or as needed) to mitigate MEC depositions. • Implement land use controls, fencing, signage, and other means to ensure no unauthorized access to the firing ranges. • Implement public awareness education seminars and workshops regarding the dangers of MEC, the importance of staying off firing ranges, and what to do if you observe what may be MEC. • Minimize the use of contaminated sites for new construction. When new construction occurs on sites where contamination has been identified, ensure that the risk of human exposure to contaminated media is minimized via the use of a site-specific health and safety plan, engineering and administrative controls, and PPE.

Toxic Substances

Toxic substances being addressed on Guam regardless of any DoD expansion include: ACM, LBP, PCBs, and radon. LBP and PCBs originating in Guam are transported by licensed transporters and disposed in permitted facilities in accordance with applicable federal, state, and local laws and regulations. ACM is disposed of at federal facilities in Guam.

The collection, transportation, and disposal of toxic substances from all DoD operations is arranged by DRMO and performed by licensed contractors. ACM, LBP, PCBs, and radon are discussed as part of the affected environment section because existing DoD facilities and infrastructure on Guam contain these toxic substances.

When assessing the transport, transfer, and future use of these toxic substances associated with the proposed DoD expansion, there are not expected to be any significant environmental consequences from ACM, LBP, and PCBs. This is because LBPs were banned by the USEPA in 1978 and most uses of PCBs USEPA-banned in 1979. In addition, ACM and radon gas not already present would not be transported/transferred as a result of these activities. Therefore, as existing protocols would be followed, toxic substances impacts would be less than significant, and no mitigation measures are required.

Hazardous Waste

Expanded DoD missions on Guam would result in an increase in the off-island transport and inter-island transfer of hazardous waste. Increases in the transport/transfer and use of pesticides, herbicides, solvents, adhesives, lubricants, corrosive liquids, aerosols, and other hazardous wastes are expected. Table 17.2-4 provides quantities of hazardous waste known to be used by the Marine Corps on Okinawa. It is estimated that this activity would result in an increase to the Guam hazardous waste disposal rate of 50% of the known Okinawa rate, or approximately 322,000 lbs (146,057 kg) annually (DRMO Okinawa 2007).

Due to the projected increase in hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts.

Table 17.2-4 summarizes potential hazardous waste transport/transfer effects, impacts, and mitigation.

Table 17.2-4. Hazardous Waste Transport Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste transport to Guam and transfer within Guam	• Increased transport of hazardous waste to Guam • Increased hazardous waste transfer and use within Guam	• Spill or release impacts during transport/transfer between DoD locations • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacit • Increased risk of environmental media contamination	• No potential mitigation measures are identified

17.2.2.2 Construction Activities

Construction activities (e.g., demolition, new buildings, structures, and infrastructure improvements) would be required to expand existing DoD operations. This subsection analyzes possible construction-related impacts of this expansion.

Anticipated construction activities under Alternative 1 include demolition, site preparation, site grading, trenching and excavation, utilities improvements, installation of foundations and building structures, landscaping, installation or improvement of roads, and other related infrastructure actions. There is a possibility that some of these planned construction project footprints could encounter sites contaminated with hazardous substances and/or MEC. If relocation of various construction projects that may encounter hazardous substances and/or MEC is not possible, several BMPs and SOPs would be used including, but are not limited to: development of site-specific health and safety plans, the use of engineering controls (e.g., dust suppression, etc.) and administrative controls, and the use of personnel protective equipment (PPE).

Hazardous Materials

Proposed construction activities would result in the use and disposal of more hazardous materials. It is expected that the most notable increases of hazardous materials would occur for the use of POLs for heavy construction equipment, construction vehicles, generators, and other construction activities. It is estimated that this construction activity would result in an increase to the Guam hazardous material disposal rate of 10% of the known Okinawa rate, or approximately 3,200 lbs (1,451 kg) annually (DRMO Okinawa).

Due to the projected increase in the volume of hazardous material, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous materials would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts (see Table 17.2-2).

Table 17.2-5 summarizes potential hazardous materials effects, impacts, and mitigation of expected construction activities.

Table 17.2-5. Hazardous Material Construction Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials used during construction activities	• Increased hazardous materials storage, use, handling, generation, and disposal • Increased fueling and POL operations • Possible use of contaminated site footprint(s) for new construction projects	• Spill or release impacts during construction activities • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD laws and regulations during construction and demolition operations • Increased risk of environmental media contamination • Increased construction site erosion runoff	• No potential mitigation measures are identified

Legend: PPE= personnel protective equipment.

Toxic Substances

There are not expected to be significant environmental consequences from ACM, LBP, and PCBs. This is because LBPs were banned by USEPA in 1978 and most uses of PCBs were banned by USEPA in 1979. In addition, ACM would not be used to construct proposed new facilities on Guam. Planned building and/or utilities demolition may result in encountering ACM and LBP. If ACM and/or LBP is encountered during demolition, licensed asbestos and LBP contractors would be used for these projects to ensure that all DoD, federal, state, and local ACM and LBP handling and disposal protocol, procedures, and requirements are followed. As there are known radon zones within Guam, it is possible that new buildings, facilities, and/or structures could be constructed in these areas. Radon resistant construction techniques would be used. In addition, DoD would periodically test facilities constructed in known radon

zones to verify that no unacceptable radon gas buildup occurs and install radon mitigation systems as appropriate.

Hazardous Waste

Proposed construction activities would result in an increase in the use of hazardous waste. Construction activities are anticipated to increase the use of adhesives, lubricants, corrosive liquids, and aerosols. It is estimated that this construction activity would result in an increase to the Guam hazardous waste disposal rate of 10% of the known Okinawa rate, or approximately 64,400 lbs (29,211 kg) annually (DRMO Okinawa 2009).

Due to the projected increase in the volume of hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs; therefore, the increase in volume would not result in significant impacts (see Table 17.2-2).

Table 17.2-6 summarizes hazardous waste potential impacts associated with construction activities.

Table 17.2-6. Hazardous Waste Construction Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste generated during construction activities	• Increased hazardous waste storage, use, handling, generation, and disposal. • Possible use of contaminated site footprint(s) for new construction projects	• Spill or release impacts during construction activities • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity. • Violations of applicable federal, state, local, or DoD regulations during construction and demolition operations • Changes in hazardous waste generator status • Increased risk of environmental media contamination	• No potential mitigation measures are identified

17.2.2.3 Operations

There are various DoD-related operations as a result of the proposed military expansion. For the purpose of this analysis, expected DoD operations have been divided to the following categories:

- Main Cantonment – administrative and support functions associated with the DoD expansion including activities that occur in office facilities, bachelor and family housing, supply warehouses, community support facilities (e.g., retail, education, medical, recreation, day care, etc.)
- Aviation Operations – fueling, hanger maintenance activities, and other related functions
- Waterfront Operations – high speed vessels, on-island amphibious assault vehicles, and the continued use of transient vessels in support DoD training exercises

- Range Operations – Firing range activities, non-fire range maneuver exercises, aviation training operations (e.g., landing/takeoff training, loading/unloading cargo and personnel, etc.)

Main Cantonment

This subsection discusses the potential impacts related to general support, living, and recreational activities associated with the proposed expansion.

Hazardous Materials

Increases in the use of hazardous materials are judged to be minimal as a result of these general activities. It is estimated that these general activities would result in an increase to the Guam hazardous material disposal rate of 1% of the known Okinawa rate, or approximately 320 lbs (145 kg) annually (DRMO Okinawa 2009). Consequently, there are negligible impacts and no potential mitigation would required.

Due to the projected increase in the volume of hazardous materials, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous materials would be handled and disposed per applicable BMPs and SOPs; therefore, the increase in volume would not result in significant impacts (see Table 17.2-2).

Table 17.2-7 presents a summary of hazardous materials anticipated consequences and mitigation measures.

Table 17.2-7. Hazardous Materials General Activities Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with general operations activities	• Negligible increases of hazardous materials usage	• Minor spill or release impacts • Slight adverse impacts and increased risks to human health and/or the environment • Minimal adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No potential mitigation measures are identified

Toxic Substances

ACM, LBP, and PCBs are not expected to result in additional impacts. This is because LBPs were banned by USEPA in 1978 and most uses of PCBs banned by USEPA in 1979. In addition, ACM would not be used in new facilities on Guam. It is possible that new buildings, facilities, and/or structures could encounter radon intrusion. Radon resistant construction techniques would be used. In addition, DoD would periodically test facilities constructed in known radon zones to verify that no unacceptable radon gas buildup occurs and install radon mitigation systems as appropriate. Toxic substances impacts would be less than significant.

Hazardous Waste

Expected increases in the use of hazardous wastes are judged to be negligible as a result of these general activities. It is estimated that these general activities would result in an increase to the Guam hazardous waste disposal rate of 1% of the known Okinawa rate, or approximately 6,440 lbs (2,921 kg) annually (DRMO Okinawa). Consequently, no appreciable impacts would occur and no potential mitigation

measures would be required. Instead, routine hazardous waste BMPs and SOPs would be implemented (see Volume 7).

Aviation Operations

This subsection discusses the potential impacts related to proposed aviation operations. These activities include fueling, hanger maintenance activities, and other related functions.

Hazardous Materials

Proposed aviation operations would result in the use of more hazardous materials. It is expected that the largest increases would occur for the use of POL/fuels. Specifically, additional POL/fuels would be transported, stored, and dispensed in support of these operations. Expanded aviation maintenance activities would also generate more POL/fuels requiring handling and disposal. It is estimated that aviation operations would result in an increase to the Guam hazardous material disposal rate of 25% of the known Okinawa rate, or approximately 8,000 lbs (3,629 kg) annually (DMRO Okinawa 2009).

Due to the projected increase in the volume of hazardous materials, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous materials would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts.

Table 17.2-8 summarizes associated potential impacts and mitigation measures.

Table 17.2-8. Hazardous Materials Aviation Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with expanded aviation operations	• Increased use of hazardous materials	• Spill or release impacts. • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No potential mitigation measures are identified

Toxic Substances

ACM, LBP, and PCBs are not expected to result in additional impacts. This is because LBPs were banned by USEPA in 1978 and most uses of PCBs banned by USEPA in 1979. In addition, ACM would not be used as part of expanded aviation operations. Radon resistant construction techniques would be used for new facilities. In addition, DoD would periodically test facilities constructed in known radon zones to verify that no unacceptable radon gas buildup occurs and install radon mitigation systems as appropriate. Toxic substances impacts would be less than significant.

Hazardous Waste

Expected increases in the use of hazardous waste are anticipated to be at a moderate level from expanded aviation operations. Specific increased hazardous waste used and generated would most probably include solvents, corrosive or toxic liquids, and aerosols for maintenance purposes. It is estimated that aviation

operations would result in an increase to the Guam hazardous waste disposal rate of 25% of the known Okinawa rate, or approximately 161,000 lbs (73,028 kg) annually (DRMO Okinawa 2009).

Due to the projected increase in the volume of hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts.

Table 17.2-9 discusses these expected impacts.

Table 17.2-9. Hazardous Waste Aviation Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste use during aviation operations	• Increased hazardous waste storage, use, handling, generation, and disposal	• Spill or release impacts during aviation operations • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD laws and regulations • Changes in hazardous waste generator status • Increased risk of environmental media contamination	• No potential mitigation measures are identified

Waterfront Operations

This subsection discusses anticipated impacts related to proposed waterfront operations. These operations would use high speed vessels, on-island amphibious assault vehicles, and continue the use of transient vessels to support waterfront training exercises.

Hazardous Materials

Proposed waterfront activities would result in the use and subsequent disposal of more hazardous materials. It is expected that the most notable increases of hazardous materials would occur with POL/fuels used for various vessels and vehicles. However, the expected increased use of POL/fuels is estimated to be minimal. Specifically, it is estimated that waterfront operations would result in an increase to the Guam hazardous material disposal rate of 5% of the known Okinawa rate, or approximately 1,600 lbs (726 kg) annually (DRMO Okinawa 2009). Consequently, there would be negligible impacts and no potential mitigation measures required. Instead, routine hazardous materials management protocol, BMPs, and SOPs would be implemented**.**

Table 17.2-10 presents a summary of these potential impacts.

Table 17.2-10. Hazardous Materials Waterfront Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with waterfront operations	• Slight increases of hazardous materials usage	• Minor spill or release impacts • Slight adverse impacts and increased risks to human health and/or the environment • Slight adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No potential mitigation measures are identified

Toxic Substances

ACM, LBP, and PCBs are not expected to result in additional impacts. This is because LBPs were banned by USEPA in 1978 and most uses of PCBs banned by USEPA in 1979. ACM, if present in small amounts in vessel construction, would not pose any measurable adverse consequences. In addition, radon gas buildup is also not a viable concern. Therefore, no significant impacts are expected and no mitigation measures would be required for the proposed waterfront operations.

Hazardous Waste

Expected increases in the use of hazardous waste are anticipated to be minimal. Specific increased hazardous waste generated would likely include: solvents for degreasing and corrosive or toxic liquids and aerosols for maintenance purposes. It is estimated that waterfront operations would result in an increase to the Guam hazardous waste disposal rate of 5% of the known Okinawa rate, or approximately 32,200 lbs (14,606 kg) annually (DMRO Okinawa 2009).

Due to the projected increase in the volume of hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts.

Table 17.2-11 discusses these potential impacts and mitigation measures.

Table 17.2-11. Hazardous Waste Waterfront Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste use during waterfront activities	• Increased hazardous waste storage, use, handling, generation, and disposal	• Spill or release impacts during waterfront activities. • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD laws and regulations • Changes in hazardous waste generator status • Increased risk of environmental media contamination	• No potential mitigation measures are identified

Training Operations

This subsection discusses possible impacts from proposed range operations. These operations include:

- Firing range operations
- Non-fire range operations
- Aviation training operations (e.g., landing/takeoff training, loading/unloading cargo and personnel, etc.)

Firing Range Operations

DoD has historically conducted live-firing, ordnance testing, and training exercises to ensure military readiness. These munitions-related activities have resulted in the presence of UXO, DMM, and MC. UXO, DMM, MC, and other material potentially presenting an explosive hazard are all collectively referred to as MEC. Volume 2, Chapter 2 of this EIS/OEIS describes these potential firing range operations, including types and quantities of MEC expected to be stored and used.

Hazardous Material. Activities associated with firing range operations would result in hazardous materials in the form of MEC. This is because UXO, DMM, MC, and material potentially presenting an explosive hazard all have the potential to contain high explosives and explosives constituents. Furthermore, these firing range activities would result in the use of military transport vehicles and hence an increase in the usage of fuels and POL. It is estimated that firing range operations would result in an increase to the Guam hazardous material disposal rate of 2% of the known Okinawa rate, or approximately 640 lbs (290 kg) annually (DRMO Okinawa 2009). Consequently, there would be negligible impacts and no potential mitigation measures required. Routine hazardous materials management protocol, BMPs, and SOPs would be implemented as needed.

Table 17.2-12 presents potential impacts and mitigation measures for these hazardous materials.

Table 17.2-12. Hazardous Materials Firing Range Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with firing range operations	• Increases of hazardous materials usage • Increased MEC disposition within firing ranges	• Minor spill or release impacts • Adverse impacts and increased risks to human health and/or the environment from MEC, fuels, and POLs • Slight adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No potential mitigation measures are identified

Toxic Substances. Activities associated with firing range operations would not be expected to result in any significant environmental consequences from toxic substances (i.e., ACM, LBP, PCBs, or radon); therefore, no mitigation measures are required. BMPs and SOPs would be implemented as appropriate (see Volume 7).

Hazardous Waste. Andersen AFB holds a Guam RCRA Operating Permit for a hazardous waste management treatment facility located within the boundaries of Andersen AFB at the extreme reach of Tarague Beach. The hazardous waste management facility is permitted to conduct open burning and open detonation to treat MEC that is either reactive (D003) or toxic characteristic leaching procedure hazardous waste. The facility is known as the EOD Range. The Facility Identification Number is GU6571999519 and the Permit Number is GUS002.

Military munitions that are used for their "intended purposes" are not considered waste per the MMR (40 CFR 266.202)]. In general, military munitions become subject to RCRA transportation, storage, and disposal requirements (i.e., judged not to have been used for their "intended purposes") when:

- Transported off-range for storage
- Reclaimed and/or treated for disposal
- Buried or land filled on- or off-range
- Munitions land off-range and are not immediately rendered safe or retrieved

MEC at closed ranges are classified as solid waste and would likely be subject to RCRA Subtitle C hazardous waste disposal requirements as well. As long as the proposed firing ranges on Guam remain on "active" or "inactive" status, then the MEC on those ranges would be considered as used for their "intended purposes" and subject to the MMR exception to Subtitle C of RCRA (i.e., likely not classified as a hazardous waste). Therefore, as long as this range remains "active" or "inactive" the disposal of MEC would likely not contribute to increased hazardous waste volumes.

In addition to increased MEC, there may be slightly increased usage of hazardous wastes as a result of expanded firing range operations. Specific increased hazardous waste used and generated could include: solvents, corrosive or toxic liquids, and aerosols primarily used for firing range vehicle maintenance. It is estimated that firing range operations would result in an increase to the Guam hazardous waste disposal rate of 2% of the known Okinawa rate, or approximately 12,880 lbs (5,842 kg) annually (DRMO Okinawa 2009).

Due to the projected increase in the volume of hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs and, therefore, the increase in volume would not result in significant impacts.

Table 17.2-13 presents possible impacts and mitigation measures for firing range operations.

Table 17.2-13. Hazardous Waste Firing Range Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste generated from firing range operations	• Increased hazardous waste storage, use, handling, generation, and disposal	• Minor spill or release impacts from firing range vehicular traffic • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD regulations during firing range operations. • Changes in hazardous waste generator status. • Increased risks of environmental media contamination • MEC being classified as hazardous waste as a result of closing firing ranges	• No potential mitigation measures are identified

Non-Fire Range Operations

These range operations involve non-fire maneuvers and troop movement exercises and training. This subsection discusses potential impacts and mitigation measures associated with these activities.

Hazardous Materials. These range activities would result in the use of military transport vehicles and hence an increase in the usage of POL/fuels. It is estimated that non-fire range operations would result in an increase to the Guam hazardous material disposal rate of 2% of the known Okinawa rate, or approximately 640 lbs (290 kg) annually (DRMO Okinawa 2009). Consequently, there would be negligible impacts and no potential mitigation measures required. Routine hazardous materials management protocol, BMPs, and SOPs would be implemented as needed**.**

Table 17.2-14 presents anticipated impacts and mitigation measures for these hazardous materials.

Table 17.2-14. Hazardous Materials Non-Fire Range Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with non-fire range operations	• Increases of hazardous materials usage	• Minor spill or release impacts • Slight adverse impacts and increased risks to human health and/or the environment from fuels and POLs • Slight adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No mitigation measures are identified

Toxic Substances. Activities associated with firing range operations are not expected to result in any adverse impacts from toxic substances (i.e., ACM, LBP, PCBs, or radon) that would result in significant environmental consequences. Therefore, no mitigation measures are required. Instead, BMPs and SOPs would be implemented as appropriate.

Hazardous Waste. There may be minimal use of hazardous wastes as a result of non-fire range operations. Specific hazardous waste used and generated could include: solvents, corrosive or toxic liquids, and aerosols primarily used for firing range vehicle maintenance. It is estimated that non-fire range operations would result in an increase to the Guam hazardous waste disposal rate of 2% of the known Okinawa rate, or approximately 12,880 lbs (290 kg) annually (DRMO Okinawa 2009).

Due to the projected increase in the volume of hazardous waste, Alternative 1 could result in adverse impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous waste would be handled and disposed per applicable BMPs and SOPs therefore, the increase in volume would not result in significant impacts.

Table 17.2-15 summarizes possible impacts related to non-fire range operations.

Table 17.2-15. Hazardous Waste Non-Fire Range Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste generated from non-fire range operations	• Increased hazardous waste storage, use, handling, generation, and disposal	• Minor spill or release impacts from range vehicular traffic • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD regulations during range operations • Changes in hazardous waste generator status • Increased risks of environmental media contamination • New hazardous waste sites created as a result of vehicular usage and maintenance activities	• No potential mitigation measures are identified

Aviation Training Operations

Aviation training operations (e.g., landing/takeoff training, loading/unloading cargo and personnel, and other related exercises.) would not have measurable impacts or require mitigation measures.

Hazardous Materials. Aviation training activities would result in an increase in the usage of fuels and POL. It is estimated that aviation training operations would result in an increase to the Guam hazardous material disposal rate of 5% of the known Okinawa rate, or approximately 1,600 lbs (726 kg) annually (DRMO Okinawa 2009). Consequently, there would be negligible impacts and no potential mitigation measures required. Instead, routine hazardous materials management protocol, BMPs, and SOPs would be implemented**.**

Table 17.2-16 presents these anticipated impacts and mitigation measures for these hazardous materials.

Table 17.2-16. Hazardous Materials Aviation Training Operations Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous materials associated with aviation training operations	• Increases of hazardous materials usage. • Increases in hazardous materials transfer and use	• Minor spill or release impacts • Slight adverse impacts and increased risks to human health and/or the environment from fuels and POLs • Slight adverse impacts to DRMO's hazardous materials storage, handling, and disposal capacity	• No potential mitigation measures are identified

Toxic Substances. Activities associated with firing range operations are not expected to result in any toxic substance (i.e., ACM, LBP, PCBs, or radon) effects that would produce significant environmental consequences. Therefore, no mitigation measures are required. Instead, BMPs and SOPs would be implemented.

Hazardous Waste. There may be slight usage and generation of hazardous wastes as a result of aviation training operations. Specific increased hazardous waste generated could include: solvents, corrosive or toxic liquids, and aerosols primarily used for maintenance. It is estimated that aviation training operations would result in an increase to the Guam hazardous waste disposal rate of 5% of the known Okinawa rate, or approximately 32,200 lbs (14,606 kg) annually (DRMO Okinawa 2009). Consequently, there would be negligible impacts and no potential mitigation measures required. Instead, routine hazardous materials management protocol, BMPs, and SOPs would be implemented**.**

Table 17.2-17 summarizes these potential impacts related to aviation training operations.

Table 17.2-17. Hazardous Waste Aviation Training Consequences and Mitigation

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*Potential Mitigation Measures*
Hazardous waste generated from aviation training operations	• Increased hazardous waste storage, use, handling, generation, and disposal	• Minor spill or release impacts from range vehicular traffic • Increased requirement for off-island hazardous waste disposal • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems • Adverse impacts to DRMO's hazardous waste storage, handling, and disposal capacity • Violations of applicable federal, state, local, or DoD regulations during range operations • Changes in hazardous waste generator status • Increased risks of environmental media contamination • New hazardous waste sites created as a result of vehicle use and maintenance activities	• No potential mitigation measures are identified

17.2.3 Alternative 2 (Preferred Alternative)

The various proposed alternatives involve conducting DoD operations at varying geographic areas on Guam. The usage/generation of hazardous materials, toxic substances, and hazardous waste is primarily a function of the magnitude of DoD activities, not the geographic areas where potential expanded operations would be based. Therefore, this chapter's potential environmental consequences and related mitigation measures do not vary from alternative to alternative.

Please refer to Alternative 1 above for a detailed assessment of the potential environmental consequences and mitigation measures applicable to Alternatives 2.

17.2.4 Alternative 3

The various proposed alternatives involve conducting DoD operations at varying geographic areas on Guam. The usage/generation of hazardous materials, toxic substances, and hazardous waste is primarily a function of the magnitude of DoD activities, not the geographic areas where potential expanded operations would be based. Therefore, this chapter's potential environmental consequences and related mitigation measures do not vary from alternative to alternative.

Please refer to Alternative 1 above for a detailed assessment of the potential environmental consequences and mitigation measures applicable to Alternatives 3.

17.2.5 Alternative 8

The various proposed alternatives involve conducting DoD operations at varying geographic areas on Guam. The usage/generation of hazardous materials, toxic substances, and hazardous waste is primarily a function of the magnitude of DoD activities, not the geographic areas where potential expanded operations would be based. Therefore, this chapter's potential environmental consequences and related mitigation measures do not vary from alternative to alternative.

Please refer to Alternative 1 above for a detailed assessment of the potential environmental consequences and mitigation measures applicable to Alternatives 8.

17.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur and the Marine Corps would not meet readiness, mission and international treaty obligations. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would retain existing conditions, and there would be no impacts associated with the proposed action and alternatives. The no-action alternative means that none of the proposed DoD expansion activities would be implemented on Guam. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

17.2.7 Summary of Potential Impacts

Table 17.2-18, 17.2-19, 17.2-20, and 17.2-21 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 17.2-22 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 17.2-18. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternatives 1, 2, 3, and 8
Construction
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low
Operation
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low

Legend: LSI = Less than significant impact.

Table 17.2-19. Summary of Training Impacts – Training Range Complex Alternatives

Training Range Alternatives A and B
Construction
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low
Operation
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low

Legend: LSI = Less than significant impact.

Table 17.2-20. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternatives A and B
Construction
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low
Operation
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low

Legend: LSI = Less than significant impact.

Table 17.2-21. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternatives A and B
Construction
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low
Operation
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low

Legend: LSI = Less than significant impact.

Table 17.2-22. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low	LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low	LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low
Operation		
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low	LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low	LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release • BMPs and SOPs would keep the frequency and magnitude of the potential leaks, spills, and releases low

Legend: LSI = Less than significant impact.

The potential environmental impacts related to the relocation of approximately 8,600 Marines and 9,000 dependents from Okinawa to Guam include increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. It is expected that the largest increases of hazardous materials would occur from the use of POL/fuels. Expected increases in hazardous waste include solvents, corrosive or toxic liquids, and aerosols. Due to the projected increase in the volume of the hazardous material and hazardous waste, both estimated to be about 50%, the potential DoD expansion could result in significant impacts to human health and the environment (i.e., soils, surface water, groundwater, air, and biota). However, the increase in hazardous material and hazardous waste would be handled and disposed per applicable regulations, BMPs, and SOPs as discussed in this Chapter (see Table 17.3-3) and

in Volume 7. Therefore, despite the potential increases in hazardous materials and hazardous wastes, no significant impacts are anticipated as long as the controls discussed above are properly implemented and related plans, procedures, and permits are updated and modified as appropriate to meet the increased demand upon DRMO regarding hazardous substance transportation, handling, storage, use, and disposal.

17.2.8 Potential Mitigation Measures

No potential mitigation measures are required.

CHAPTER 18. PUBLIC HEALTH AND SAFETY

18.1 AFFECTED ENVIRONMENT

18.1.1 Definition of Resource

This section discusses the potential public health and safety issues related to implementation of the proposed action and alternatives on Guam. The region of influence (ROI) for public health and safety concerns includes the entire island. The various divisions (i.e., Environmental Health, Public Health, and Public Welfare) of the Guam Department of Public Health and Social Services (Department) is responsible for ensuring the safety and health of individuals and workers on Guam. The Department ensures construction and daily activities on Guam are conducted in accordance with applicable federal and Guam laws and regulations to ensure a safe environment for Guam residents to live and work.

The Marine Corps practices Operational Risk Management as outlined in Operational Navy 3500.39A and Marine Corps Order 3500.27A. Requirements outlined in these documents provide for a process to maintain readiness in peacetime and achieving success in combat while safeguarding people and resources. The health and safety analysis presented in the following sections addresses issues related to the health and well being of both military personnel and civilians living on Guam in the vicinity of proposed military operations and training areas.

The health and safety issues discussed in this section include operational and construction safety, environmental health effects, notifiable diseases, mental illness, traffic accidents, unexploded ordnance (UXO), and reduction in access to public services. Notifiable diseases are diseases that are required by law to be reported to government authorities. This collation of information allows the authorities to monitor the disease and provides early warning of possible outbreaks. Mental illness includes various psychiatric conditions that cause impairment of an individual's behavior. A traffic accident is a road traffic incident that usually involves one automobile (e.g., car, truck, motorcycle) colliding with either another vehicle or a stationary roadside object. UXO includes ordnance items that were fired from a weapon and failed to function properly or munitions that were not fired but abandoned and were not properly disposed.

These concerns are addressed in relation to the current population of Guam and the per capita rates of occurrence for each of these public health and safety factors. Additional information pertinent to public health and safety issues is provided in Volume 2, Chapter 16, Socioeconomic and General Services).

18.1.2 Operational Safety

18.1.2.1 Aircraft Mishaps

Areas around airports are exposed to the possibility of aircraft accidents, even with well-maintained aircraft and highly-trained aircrews. Despite stringent maintenance requirements and countless hours of training, past history indicated that accidents may occur. The risk of people on the ground being killed or injured by aircraft accidents is small. However, an aircraft accident is a high-consequence event and, when a crash does occur, the result is often catastrophic. To address the potential for aircraft mishaps, the military approaches safety from a land-use planning perspective through its Air Installation Compatible Use Zone (AICUZ) program. Designation of safety zones around airfields and restriction of incompatible land uses reduces the public's exposure to safety hazards.

Accident Potential Zones (APZs) are established to delineate recommended surrounding land uses for the protection of people and property on the ground. APZs define the areas in the vicinity of an airfield that would have the highest potential to be affected if an aircraft mishap were to occur. AICUZ guidelines identify three types of APZs for airfields based on aircraft mishap patterns: the Clear Zone, APZ I, and APZ II. The standard Clear Zone is a 3,000 feet (ft) (915 meter [m]) by 3,000 ft (915 m) square area that extends from the end of a runway and has the highest probability of being impacted by a mishap. APZ I, which typically extends 5,000 ft (1,524 m) from the end of the Clear Zone, has a lower mishap probability. APZ II, which typically extends 7,000 ft (2,134 m) from the end of APZ I, has the lowest mishap probability of the three zones. APZs have been established for the airfield to minimize the results of a potential accident involving military aircraft operating on Guam.

The Federal Aviation Administration (FAA) is responsible for ensuring safe and efficient use of United States (U.S.) airspace by military and civilian aircraft and for supporting national defense requirements. In order to fulfill these requirements, the FAA has established safety regulations, airspace management guidelines, a civil-military common system, and cooperative activities with the Department of Defense (DoD). The primary concern with regard to military training flights is the potential for aircraft mishaps (i.e., crashes) to occur, which could be caused by mid-air collisions with other aircraft or objects, weather difficulties, mechanical failures, pilot error, or bird aircraft strikes.

Aircraft mishaps are classified as A, B, or C. Class A mishaps are the most severe with total property damage of $1 million or more and a fatality and/or permanent total disability and is used for comparing mishap rates for various aircraft types. Class A mishap rates for aircraft associated with proposed Marine Corps operations on Guam are presented in Table 18.1-1.

Table 18.1-1. Class A Flight Mishaps

Aircraft Type	*Mishap Rate*
CH-53	1.76
MV-22	11.43
AH-1	4.04
UH-1	3.71

Notes: — The mishap rate is an average based on the total mishaps and 100,000 flying hours.
Sources: Congress Research Service 2002, Navy 2008.

The 2002-2008 annual average Navy flight mishap rate was 1.54 (Navy 2009). The mishap rate is an average based on the total mishaps and 100,000 flying hours.

18.1.2.2 Bird Aircraft Strike Hazards

Bird strikes constitute a safety concern because of the potential for damage to aircraft, injury to aircrews, or impacts to local populations if an aircraft strike and subsequent aircraft accident should occur in a populated area. Aircraft may encounter birds at altitudes of 30,000 ft (9,144 m) above mean sea level or higher; however, most birds fly close to the ground. Over 95% of reported bird strikes occur below 3,000 ft (915 m) above ground level. Approximately 49% of bird strikes occur in the airport environment and 15% during low-level cruise. Navy and Marine Corps commands are required to develop a Bird Aircraft Strike Hazards (BASH) plan to reduce hazardous bird activity relative to airport flight operations.

A BASH program is an ongoing process including both information dissemination and active/passive bird control techniques. Of these processes, the most critical is the aircrew notification and warning system. This system establishes procedures for the immediate exchange of information between ground agencies and aircrews concerning the existence and location of birds that pose a hazard to flight safety.

The standardized Bird Hazard Condition (BHC) warning system is used to warn aircrew and support personnel of the current bird threat to operations. These codes are identical for both the Navy and the Air Force as presented in section B of the DoD Flight Information Handbook. Bird locations are provided with the appropriate condition code.

BHC Red (Severe) is generally defined as heavy concentrations of birds (more than 15 large or 30 small) on or immediately adjacent to the active runway or other specific locations that present an immediate hazard to flight operations. Active dispersal is initiated and BASH Detection and Dispersal Team (BDDT) personnel are to remain on the airfield actively involved in dispersal techniques until this BHC is downgraded. Aircrews should apply applicable Go/No-Go criteria. BHC Red may also be declared when birds of any size or quantity present an immediate hazard.

BHC Yellow (Moderate) is generally defined as moderate concentrations of birds (5 to 15 large or 15 to 30 small) observable in locations that represent a probable hazard to flying operations. Actions may be taken to disperse the concentrations of birds that are causing the hazard.

BHC Green (Low) involves sparse bird activity on and above the airfield (less than described in Yellow) with a low probability of hazard.

With respect to bird dispersal procedures, the BDDT actively patrols the airfield. Prior to initiation of dispersal actions, the BDDT leader coordinates the location and dispersal methods with the control tower and ensures that BHC Red has been declared prior to dispersal activities on the airfield. Horns and bioacoustic distress calls are typically used before pyrotechnics are used. Pyrotechnics are typically used in conjunction with distress tapes. These consist of screamer, whistle banger, and cracker shells. Propane sound cannons may be placed around the airfield and moved periodically (once a day) to prevent habituation. If the dispersal methods above do not work or the birds become accustomed to the hazing, it may become necessary to remove birds via lethal methods to reinforce the dispersal methods. Lethal control methods would be conducted in accordance with appropriate depredation permit guidelines. Once the target flock or problem birds are dispersed, the control tower is notified so the BHC can be lowered.

The 8-year annual average for bird strikes at Andersen Air Force Base (AFB) on the northern portion of Guam is 3 per year (PACAF 2006).

18.1.2.3 Explosives Safety

Siting requirements for explosive materials storage (e.g., munitions) and handling facilities are based on safety and security criteria established by the DoD Explosive Safety Board. Explosive Safety Quantity Distance (ESQDs) arcs determine the distance between ordnance storage and handling facilities and inhabitable areas. Ammunition and bulk explosives are stored in magazines specifically designed, sited, and designated for this purpose. A magazine's ESQD arc is calculated by the type and amount of ordnance stored in that magazine. ESQD requirements and permissible storage capacities are established by Naval Sea Systems Command and approved by the DoD Explosives Safety Board.

18.1.2.4 Electromagnetic Emissions

Radar and other high-energy electromagnetic emissions can constitute a hazard to persons exposed to radiation above a threshold power density. Electromagnetic signals emanating from communication and other radar equipment can also interfere with and adversely affect stored ordnance and fuel. Electromagnetic radiation hazards occur when transmitting equipment generates sufficient field intensity to cause harmful or injurious effects to humans or wildlife; induce or couple currents and/or voltages of

magnitudes sufficient to initiate electro-explosive devices in ordnance; or create sparks or sufficient magnitude to ignite flammable materials.

Exposure to electromagnetic emissions is controlled in accordance with national exposure standards (e.g., federal and voluntary exposure standards), which are set by experts in biophysics, medicine, engineering, and epidemiology. The Institute of Electrical and Electronics Engineers International Committee for Electromagnetic Safety produces an electromagnetic emission standard that has been adopted by the American National Standards Institute as an Institute of Electrical and Electronics Engineers/American National Standards Institute standard. This voluntary standard is based on numerous sources of scientific information that are subject to rigorous review. After reviewing the biological effects database, scientific committees concluded that the threshold for potential adverse biological effects was 4 watts per kilogram of absorbed electromagnetic emission per unit mass of tissue. The standards-making organizations have adopted safety factors for electromagnetic emission exposures in occupational and general public settings. These safety factors are set at 10 for occupational exposures and 50 for general public exposures, thereby reducing the adverse biological effects threshold to 0.4 and 0.08 W/kg, respectively (Institute of Electrical and Electronics Engineers 1999).

18.1.3 Environmental Health Effects

18.1.3.1 Noise

Volume 2, Chapter 6 discusses the current noise environment associated with military activities on Guam. Currently, various activities occurring on Guam create noise; these activities include (depending on the location on Guam) aviation operations, range operations, traffic, construction, and general industrial activities. These activities are generally conducted in accordance with applicable regulations to protect the general population and workers from excessive noise exposure.

18.1.3.2 Water Quality

Volume 2, Chapter 4 discusses water quality issues that could potentially affect public health. The U.S. Environmental Protection Agency (USEPA) and Guam Environmental Protection Agency (GEPA) enforce Safe Drinking Water Act standards and related legislation to protect public health. Currently, Guam's water quality meets Safe Drinking Water Act standards.

18.1.3.3 Air Quality

Volume 2, Chapter 5 discusses the stationary and mobile source air emissions that can potentially affect public health. USEPA and GEPA set and enforce these standards to protect public health. Currently, ambient air quality standards are met for all areas excepting the area surrounding the Piti and Tanquisson power plants. At each of these sites, a 2.2 mile (3.5 km) radius surrounding each plant has been identified as non-attainment for sulfur dioxide. No other air quality issues have been identified that currently pose public health or safety risks from an air quality perspective.

18.1.3.4 Health Care Services

Volume 2, Chapter 16 discusses existing health care services conditions on Guam. The island is currently designated a Medically Underserved Area. Further, the island's remoteness exacerbates the ability to provide specialized health care services when needed and not available on island. As result, Guam falls below the national average in terms of health care provider to general population ratio. The service ratio for the number of physicians to the population of Guam is 1:2,821 (i.e., 1 doctor per 2,821 people). The service ratio for the number of nurses to the population of Guam is 1:453 (i.e., 1 nurse per 453 people).

18.1.4 Notifiable Diseases

18.1.4.1 AIDS

AIDS is an infectious disease caused by the human immunodeficiency virus (HIV). AIDS is the advanced form of infection with the HIV virus, which may not cause recognizable symptoms for a long period after the initial exposure. No vaccine is currently available to prevent HIV infection. At present, all forms of AIDS therapy are focused on improving the quality and length of life for AIDS patients by slowing or halting the replication of the virus and treating or preventing infections and cancers that take advantage of a person's weakened immune system. The average number of AIDS cases on Guam over the past 10 years is five cases per year. The average per capita occurrence of AIDS patients is 0.0000306. This equates to one case of AIDS for every 32,678 people on Guam (Table 18.1-2).

Table 18.1-2. AIDS Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	5	8	8	1	9	4	9	0	3	0	5	47
Rate	NA	NA	NA	NA	1/17,506	1/40,199	1/18,215	0	1/56,188	0	1/32,678	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.2 Cholera

Cholera is an acute infectious disease characterized by watery diarrhea that is caused by the bacterium *Vibrio cholerae*. Cholera is spread by eating food or drinking water contaminated with the bacterium. Modern sanitation and the treatment of drinking water have virtually eliminated the disease in developed countries. Cholera outbreaks still occur from time to time in less developed countries. Between 2001 and 2006 Guam had three cases of Cholera reported. This makes the average per capita incidence of Cholera 0.00000612, which means that, on Guam, there is one case of Cholera for every 163,389 people. The current population on Guam is estimated at 171,091, meaning that there is statistically less than one case of Cholera reported in any given year (Table 18.1-3).

Table 18.1-3. Cholera Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	0	2	0	4	0	0	0	0	3	0	1	9
Rate	NA	NA	NA	NA	0	0	0	0	1/56,188	0	1/163,389	—

Notes: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006

18.1.4.3 Dengue

Dengue is an infectious tropical disease caused by an arbovirus transmitted by mosquitoes and characterized by high fever, rash, headache, and severe muscle and joint pain. The average number of dengue cases on Guam over the past 10 years is one per year. The average per capita rate of dengue cases on Guam is 0.00000612. This translates into one case of dengue per 163,389 people (Table 18.1-4). It should be noted that all reported cases of dengue were contracted off-island.

Table 18.1-4. Dengue Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	1	2	1	2	0	0	1	1	0	3	1	11
Rate	NA	NA	NA	NA	0	0	1/163,940	1/166,090	0	1/57,019	1/163,389	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.4 Hepatitis C

Hepatitis C is a form of liver inflammation that primarily causes a long-lasting disease. The most common way of transmitting hepatitis C is by contact with infected blood. In 2006, there were no reported new cases of hepatitis C; however there have been over 30 cases in the past 10 years. The average per capita rate of hepatitis C cases on Guam is 0.0000190. This translates into one case of hepatitis C per 52,706 people (Table 18.1-5).

Table 18.1-5. Hepatitis C Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	3	1	2	3	0	0	5	9	8	0	3.1	31
Rate	NA	NA	NA	NA	0	0	1/32,788	1/18,454	1/21,071	0	1/52,706	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.5 Malaria

Malaria is a serious infectious disease spread by certain mosquitoes. A person gets malaria when bitten by a female mosquito and is infected with the malaria parasite. The parasites enter the blood stream and travel to the liver. When the parasites re-emerge into the blood, symptoms appear. It is most common in tropical climates and is characterized by recurrent symptoms of chills, fever, and an enlarged spleen. The disease can be treated with medication, but it often recurs. The average number of malaria cases on Guam over the past 10 years is one case per year (Department of Public Health and Social Services 2006). The average per capita rate of malaria cases on Guam is 0.00000612. This translates into one case of malaria per 163,389 people (Table 18.1-6). It should be noted that all reported cases of malaria were contracted off-island.

Table 18.1-6. Malaria Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	0	2	1	2	1	0	1	0	0	3	1	10
Rate	NA	NA	NA	NA	1/157,5570	0	1/163,940	0	0	1/57,019	1/163,389	—

Notes: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006

18.1.4.6 Measles

Measles is an infection caused by a virus (*paramyxovirus*) that causes an illness displaying a characteristic skin rash. It is an extremely contagious infection, spread through the tiny droplets that may spray into the air when an individual carrying the virus sneezes or coughs. Once someone is infected with the virus, it takes about 7-18 days before they actually become ill. In the last 10 years, the highest number of cases in a year was nine, in 2002, which accounts for half the total number of measles cases on Guam in that same time period. The average per capita of measles cases is 0.0000102, which means that there is one case of measles for every 90,772 people (Table 18.1-7).

Table 18.1-7. Measles Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	0	0	1	0	0	9	5	3	0	0	1.8	18
Rate	0	0	NA	0	0	1/17,866	1/32,788	1/55,363	0	0	1/90,772	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.7 Rubella

Rubella, or the German Measles, is similar to the common Measles in that it is transmitted through the tiny droplets that may spray into the air when an individual carrying the virus sneezes or coughs. Rubella is caused by the rubella virus (*Rubivirus*) and symptoms are generally mild. The first visible sign of rubella is a red rash that begins on the face and rapidly moves downward to cover the whole body within 24 hours. Unlike the common measles, rubella is not commonly found on Guam. In the past ten years, there have been two cases of Rubella, making the average per capita of Rubella occurrences 0.00000122. (Table 18.1-8).

Table 18.1-8. Rubella Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	0	0	0	0	0	0	1	1	0	0	0.2	2
Rate	0	0	0	0	0	0	1/163,940	1/166,090	0	0	1/2,768,033	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.8 Typhoid Fever

Typhoid fever is a severe infection caused by a bacterium, (*Salmonella typhi*). The most prominent symptom of Typhoid fever is persistent high fever. Typhoid fever is passed from person to person through poor hygiene, such as incomplete or no hand washing. In the past ten years on Guam there have been seven patients diagnosed with Typhoid fever. The average per capita occurrence for Typhoid fever cases is 0.00000428, making the incidence of Typhoid fever one case for every 233,412 people (Table 18.1-9).

Table 18.1-9. Typhoid Fever Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	2	0	0	0	3	0	0	1	1	0	0.7	7
Rate	NA	0	0	0	1/52,519	0	0	1/166,090	1/168,564	0	1/233,412	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.9 STDs other than AIDS

STDs include Chlamydia, Gonorrhea, and Syphilis, which are all transmitted by sexual contact. The 10 year average for STD cases is 671 per year. This average includes all three diseases. The average per capita STD occurrences on Guam is 0.0041, which means that, in any given year, there would be one new case of an STD for every 243 people (Table 18.1-10).

Table 18.1-10. Sexually Transmitted Disease Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	442	507	524	558	465	682	669	930	974	961	671.2	6,712
Rate	NA	NA	NA	NA	1/339	1/236	1/245	1/179	1/173	1/178	1/243	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.4.10 Tuberculosis

Tuberculosis (TB) is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or *Mycobacterium tuberculosis*. TB spreads when a TB patient exhales, coughs, or sneezes, tiny droplets of fluid containing tubercle bacilli are released into the air. TB is not, however, highly contagious compared to some other infectious diseases. Only about one in three close contacts of a TB patient, and fewer than

15% of more remote contacts, are likely to become infected. Unlike many other infections, TB is not passed on by contact with a patient's clothing, bed linens, or dishes and cooking utensils.

The 10-year average for TB cases is 67.5 per year. The average per capita TB occurrences on Guam is 0.0407, which means that, in any given year, there would be one new case of TB for every 2,416 people (Table 18.1-11).

Table 18.1-11. Tuberculosis Reports, Guam 1997-2006

	1997	*1998*	*1999*	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*Average*	*Total*
Cases	95	84	70	54	63	65	61	56	73	54	67.5	675
Rate	NA	NA	NA	NA	1/2,502	1/2,476	1/2,687	1/2,972	1/2,308	1/3,168	1/2,416	—

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.5 Mental Illness

Mental illness can be any various psychiatric condition, usually characterized by impairment of an individual's normal cognitive, emotional, or behavioral functioning, and caused by physiological or psychosocial factors. The 6-year average for mental illness cases per year is 177. The average per capita mental illness occurrences on Guam is 0.00108, which means that, in any given year, there would be one case of a mental illness for every 923 people (Table 18.1-12).

Table 18.1-12. Mental Illness Reports, Guam 2000-2005

	2000	*2001*	*2002*	*2003*	*2004*	*2005*	*Average*
Population	NA	157,557	160,796	163,941	160,090	168,564	163,389
Cases	212	204	177	159	155	153	177
	NA	1/722	1/908	1/1,031	1/1,071	1/1,101	1/923

Note: — not applicable; NA Population of Guam not available to calculate rate.
Source: Department of Public Health and Social Services 2006.

18.1.6 Hazardous Substances

Volume 2, Chapter 17 discusses practices associated with hazardous materials and waste management on Guam. Current management practices and contingency plans for the use, handling, storage, transportation, and disposition of hazardous substances ensures exposure to the environment and human contact are minimized.

18.1.7 UXO

Guam was an active battlefield during World War II. As a result of the occupation by Japanese forces and the assault by Allied/American forces to retake the island, unexploded military munitions may still remain. Unexploded military munitions have been discovered periodically since the end of the war and may still be present on Guam. Unexploded military munitions can be classified into two main categories: UXO, which are ordnance items that were fired from a weapon and failed to function properly (i.e., explode). These items are fused and are considered more sensitive than the second category of unexploded military munitions, Discarded Military Munitions (DMM). DMM consists of munitions that were not fired but abandoned and were not properly disposed. DMM items could include munitions that were left behind by military personnel and intentionally buried (i.e., weapons cache) or unintentionally buried as a result of combat on the island. Additionally, the retaking of Guam by Allied/American forces required amphibious landings; therefore, UXO and DMM may also be present in waters off the assault beaches.

UXO and DMM items include, but are not limited to: aerial bombs, Naval and field artillery projectiles, aerial and barrage rockets, mortar rounds, bazooka rounds, hand grenades, landmines, flares, and other pyrotechnic devices. The aforementioned munitions would vary in size (e.g., 105-millimeter or 5-inch projectiles) and explosive hazard (e.g., high explosive, incendiary filler).

Clearances for unexploded military munitions have been conducted in the past to remove this hazard, and unexploded military munitions have been found and reported periodically since the end of the war. Although over 60 years have passed since the battle for Guam and portions of the island have been developed, unexploded military munitions may still be present.

18.1.8 Off Base Roadways

The proposed action include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

18.1.8.1 North

Roadway projects in the north region of Guam include intersection improvements, pavement strengthening, road widening, and construction of a new road, as well as military access point construction for facilitating access to Finegayan and Andersen AFB. The roadway project action alternatives comprise nine projects proposed for the north region of Guam, as described in the Roadway Projects section of Volume 6.

The potentially affected public health and safety factors associated with road projects adopts the relevant resource definitions described in this Affected Environment section. The public health and safety aspects relevant to the proposed roadway improvements include (1) traffic incidents, as described in the Affected Environment section, Apra Harbor region, of this chapter; and (2) unexploded ordnance, as described in the Affected Environment section, south region, of this chapter. The subjects of notifiable diseases and mental illness have been evaluated in the Affected Environment section, North and Central regions, of this chapter.

The Guam Police Department has instituted traffic safety checkpoints and safety education programs across the island. Traffic accident data for the years 2001 through 2005 indicated that, despite the population increase over the 5-year period between 2001 and 2005, the number of traffic accidents has decreased. The number of traffic accident-related fatalities averages 18 per year.

Guam DPW is conducting a safety and hazard elimination study to identify the most hazardous traffic locations on Guam. Preliminary results identified intersections with the highest frequency of fatal, non-fatal, or non-injury traffic accidents. Traffic incident information was reported by classifying information into categories reflecting:

- Type of accident
- Location information
- Involvement by automobile(s), motorcycle(s), and/or pedestrian(s)
- Weather conditions
- Time of day, day of week, month
- Type of maneuver
- Road characteristics

- Road surface
- Traffic controls, and
- Driver characteristics and behavior

Accident reports for 2005 and 2006 were reviewed, resulting in a preliminary list of the 50 most hazardous intersections. Based on a preliminary statistical trend analysis of fatal accidents on Guam:

- 26% of fatalities resulted from cars that ran off a roadway
- 20% of fatalities involved a pedestrian
- The greatest number of fatal crashes occurs at 8:00 a.m. and 9:00 p.m.
- The greatest number of total crashes occurs between 8:00 a.m. and 6:00 p.m.
- The greatest number of crashes occurs between Friday and Sunday
- The greatest number of crashes occurs between January and April, and also in October
- The greatest number of crashes occurs during clear and dry weather

In the north region, the intersection of Routes 1 and 28 has the highest frequency of collisions based on an analysis of 2005 and 2006 accidents at intersections on Guam. The North Region also exhibits a relatively low crash frequency near existing schools. Over the period of 2005 to 2006, there were between zero and 49 accidents within 0.25-mile (0.40-kilometer) of a school.

The Guam Territorial Transportation Improvement Plan (TTIP) contains 14 hazard elimination projects, six of which are specific locations. While there were no hazard elimination projects identified or funded for the North Region of Guam, islandwide projects include school zone signs, village road safety and warning signs, seashore protection, pavement markers, anti-skid surfacing, and guardrails.

18.1.8.2 Central

The central region has the greatest number of existing traffic safety hazards due to the concentration of roadways and population. Nine high crash frequency locations on Guam are located in the Central Region: Route 1/Route 14; Route 1/Route 3; Route 1/Route 18; Route 1/Route 26; Route 1/Route 14A; Route 1/Route 10A; Route 10/Tun Jose Salas; Route 8/Route 10/Route 16 (Tri-Intersectional); and Route 1/Route 30. .

The highest frequency of vehicle crashes near schools on Guam occurs in the Central Region. Over the period of 2005 to 2006, seven school sites reported from 50 to 197 accidents within 0.25-mile (0.40-kilometers) of a school. The highest frequency of accidents occurred near John F. Kennedy High School and Santa Barbara School.

A TTIP hazard elimination project on Route 1 (Deadman's Curve) is the only specific location project that has been funded in the central region.

18.1.8.3 Apra Harbor

The Apra Harbor region is characterized by a low number of existing safety hazards. No high crash frequency locations on Guam are in this region. There are no school locations in the Apra Harbor region. There were no TTIP hazard elimination projects identified for this region.

18.1.8.4 South

The south region has a low number of existing safety hazards. No high crash frequency locations on Guam are located in the South Region.

The South Region exhibits a relatively low crash frequency near existing schools. Over the period of 2005 to 2006, schools in the South Region exhibited between zero and 49 accidents.

A TTIP hazard elimination project on Route 4 (Jeff's Pirate Cove) is the only specific location project in the south region of Guam that has been funded.

18.1.9 Public Services

Police Service

Volume 2, Chapter 16 discusses existing police services on Guam. The Guam Police Department (GPD) is responsible for law enforcement outside of federal property. Police stations are located in Hagatna, Dededo, Agat, and the Tumon Bay resort area. The island currently experiences both violent and property crime levels well below the U.S. national average. Total arrests in 2007 were 3,315 (Guam Police Department 2007). In 2007, the GPD employed 309 sworn personnel and 66 civilian employees. The service ratio for the number of police officers to the population of Guam is 1:561 (i.e., 1 officer per 561 people).

Fire Service

Volume 2, Chapter 16 discusses existing fire suppression services on Guam. The Guam Fire Department (GFD) is the primary agency responsible for fire suppression, search and rescue, and emergency medical response for the territory of Guam. GFD operates 12 fire stations (5 in the northern district and seven in the southern district), two rescue bases, and the 911 Integrated Emergency Communications Center. GFD currently employs approximately 200 full-time sworn firefighters. The service ratio for the number of firefighters to the population of Guam is 1:846 (i.e., 1 firefighter per 846 people).

18.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in more detail in Volume 6.

18.2.1 Approach to Analysis

18.2.1.1 Methodology

Public health and safety concerns were addressed based on anticipated changes in the population of Guam, both from natural increases and from population growth created by implementing the proposed action and alternatives. Average per capita incidents for notifiable diseases, mental illness, and traffic accidents were used to calculate the potential increase in these incidents as a result of the alternatives. Safety of construction workers would be conducted in accordance with Occupational Safety and Health Administration guidelines to ensure a safe work environment.

Data used for the analysis included information regarding the current and projected population of Guam as well as incident rates for notifiable diseases, mental illness, and traffic accidents. Population, notifiable disease, mental illness, and traffic accident data were obtained from various sources including the Guam

Bureau of Statistics and the Bureau of the Census. Information regarding the possible presence of UXO was obtained from various military and public sources. Information specific to the proposed movement of Marines to Guam was obtained from military sources (refer to Chapters 2.01 and 2.02 of this volume). Impacts due to environmental effects related to the proposed action were derived from appropriate chapters of this EIS/OEIS. These include air quality, water resources, noise, hazardous materials and waste, and socioeconomics.

18.2.1.2 Determination of Significance

Factors considered in determining whether an alternative would have a significant public safety impact include the extent or degree to which implementation of the alternative would subject the public to increased risk of contracting a disease or experiencing personal injury. For proposed military events conducted on or around Guam, there would be specific and documented procedures in place to ensure that the public is not endangered by military operations and training activities.

18.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to public health and safety that were mentioned by the public, including regulatory stakeholders, during public scoping meetings were addressed.

These include:

- Potential increases in diseases including:
  - AIDS
  - Cholera
  - Dengue
  - Hepatitis C
  - Malaria
  - Measles
  - Rubella
  - Tuberculosis
  - Typhoid Fever
  - STDs other than AIDS
- Potential increases in mental illness
- Potential increases in traffic incidents
- Potential contact with UXO

18.2.2 Alternative 1

18.2.2.1 Operational Safety

The safety of the public as well as personnel participating in military training events is a primary consideration for all training activities. The fundamental guidance adhered to during training is that the range must be able to safely contain the hazard footprints of the weapons and equipment employed. The Range Safety Officer ensures that these hazardous areas are clear of personnel during training activities. After a live-fire event, the participating unit ensures that all weapons are safe and clear of live rounds.

Standard Operating Procedures (SOPs) require that prior to conducting training activities, the public and non-participating personnel would be cleared from the area so that the only public health and safety issue would be if a training event exceeded the safety area boundaries. Risks to public health and safety are reduced by confirming that the training area is clear. The Navy would also notify the public of training activities through public notices.

Possible interactions between training activities within near shore areas would be minimized by ensuring the area is cleared. Recreational diving activities within near shore areas take place primarily at known diving sites and dive boats are typically well-marked with diver down flags. The Navy would also notify the public of training activities through Notices to Airmen and Notices to Mariners.

Public notification of training activities, use of established training areas, compliance with appropriate range safety procedures, and avoidance of non military vessels and personnel would reduce the potential for interaction between the public and personnel that are training. Specific and documented procedures would be in place to ensure the public is not endangered by training activities; therefore, Alternative 1 would result in no impacts to public health and safety (resulting from training activities).

Aircraft Mishaps

The Navy would maintain detailed emergency and mishap response plans to react to an aircraft accident, should one occur. These plans assign agency responsibilities and prescribe functional activities necessary to react to major mishaps. Response would normally occur in two phases. The initial response focuses on rescue, evacuation, fire suppression, safety, elimination of explosive devices, ensuring security of the area, and other actions immediately necessary to prevent loss of life or further property damage. The initial response element usually consists of the Fire Chief, who would normally be the first on-scene commander, fire-fighting and crash-rescue personnel, medical personnel, security police, and crash-recovery personnel. The second phase is the mishap investigation, which is comprised of an array of organizations whose participation would be governed by the circumstances associated with the mishap and actions required to be performed.

Under Alternative 1, annual airfield operations would increase by 31,204 operations from 68,139 to 99,343 operations (see Table 6.2-1), a 46% increase when compared to the no-action alternative. Most of the aircraft operations increase (74%) would be helicopter operations, which, on average, have a lower flight mishap rate. The increase in aircraft operations could result in a small increase in the mishap rate; however, the average mishap rate would still remain approximately 1.54 based on the total number of Navy aircraft operations.

In addition, proposed construction and infrastructure improvements related to the Guam buildup and existing land uses near airfields would be consistent with established APZs. The APZs have been established to restrict surrounding land uses for the protection of people and property on the ground near the runway.

The increase in aircraft operations is not anticipated to significantly increase the flight mishap rate and AICUZ land use restrictions would remain in place to limit public exposure to aircraft mishaps; therefore, no impact to public health and safety from aircraft mishaps are anticipated.

Bird Aircraft Strike Hazards

Aircrews operating on Guam would be required to follow applicable procedures outlined in the BASH plan. When risk increases, limits would be placed on low altitude flight and some types of training (e.g., multiple approaches, closed flight patterns). Special briefings would be provided to pilots whenever the potential exists for greater bird strike hazards occur.

The total annual aircraft operations are anticipated to increase by about 37% when compared to the no-action alternative. Thus, bird aircraft strikes associated with airfield operations at Andersen AFB (where most aircraft would originate) would be expected to increase commensurate with the increase in aircraft

operations. Based on the 8-year average of three bird aircraft strikes per year, the increase in aircraft operations is estimated to result in one additional incident for a total of four annual bird aircraft strikes.

The overall potential for bird aircraft strikes is not anticipated to be significantly greater than current levels. Therefore, no impact to public health and safety from BASH incidents are anticipated.

Explosive Safety

Proposed construction and infrastructure improvements related to the Guam buildup would be consistent with established ESQD arcs. Therefore, construction activity and subsequent operations would not result in any greater safety risk. Ordnance would be handled and stored in accordance with Marine Corps explosive safety directives (Marine Corps Order P8020.10A, *Marine Corps Ammunition Management and Explosives Safety Policy Manual*), and all munitions handling would be carried out by trained, qualified personnel. Therefore, no impact related to explosives safety are anticipated.

Electromagnetic Safety

Proposed construction and infrastructure improvements related to the Guam buildup would be consistent with established electromagnetic radiation hazard zones. Exposure to electromagnetic emissions would also be limited by restricting access to emitters through the use of security fencing, posting warning signs, or locking out unauthorized persons in areas, where practical. Because electromagnetic emission sources would be constructed and operated in accordance with applicable safety standards and the public would be excluded from entering areas where emission sources are located, potential impacts from electromagnetic emissions on public health and safety would not result in any greater safety risk. Therefore, no impact to public health and safety related to electromagnetic emissions would occur.

Construction Safety

During construction activities, a health and safety program would be implemented by the construction contractors, based on industry standards for accident prevention. At a minimum, the construction health and safety program would comply with federal and local health and safety regulations. Elements of the safety program would include:

- Responsibilities of construction workers and subcontractors
- Job site rules and regulations
- Emergency response procedures
- Safety inspections and audits
- Location of medical services and first aid
- Safety meetings, employee training, and hazard communications
- Personal protective equipment
- Standard construction procedures
- Accident investigation and reporting

Because a health and safety program would be implemented for construction activities and the public would be excluded from entering construction areas, potential construction impacts on public health and safety would not result in any greater safety risk. Therefore, no impact to public health and safety related to construction activities would occur.

18.2.2.2 Environmental Health Effects

Noise

Construction and operational noise emissions associated with this alternative is discussed in Volume 2, Chapter 6. Increases in noise emissions associated with implementation of the construction phase of this alternative with identified best management practices would be less than significant. Therefore it is anticipated that overall impacts associated with noise to human health and safety would be less than significant. Operations associated with this alternative would be conducted in accordance with applicable AICUZ and other land use guidelines as appropriate; therefore, no long term impacts from noise to human health are anticipated.

Potential impacts to human health and safety from increased noise can be indirect or direct, and short-or long-term, or permanent. These impacts are a function of intensity and duration of noise. Indirect impacts to humans from noise can include annoyance, speech interference, difficulty concentrating, reduced efficiency, low morale, and adverse social behavior (OSHA, 2009).

The primary direct impacts of excessive noise exposure to human health and safety may include:

- *Acoustic trauma*, a temporary or permanent hearing loss due to a sudden, intense acoustic or noise event (i.e,. an explosion).
- *Tinnitus,* a condition of "ringing in the ears." The predominant cause of tinnitus is long-term exposure to high sound levels, though it can also be caused by short-term exposure to very high sound levels, such as gunshots. Many people experience tinnitus during their lives. While the sensation is often only temporary, it can be both permanent and debilitating.
- *Noise-induced temporary threshold shift (NITTS)* is a temporary loss in hearing sensitivity. NITTS may be the result of the acoustic reflex of the stapedial muscle; short-term exposure to noise; or, fatigue of the inner ear. With NITTS, hearing sensitivity would return to the pre-exposed level in a matter of hours or days, assuming that there is not continued exposure to excessive noise.
- *Noise-induced permanent threshold shift (NIPTS)* is a permanent loss in hearing sensitivity due to the destruction of sensory cells in the inner ear. NIPTS can be caused by long-term exposure to noise, or acoustic trauma.

The noise analysis included estimation of Potential Hearing Loss (PHL). This analysis focuses on residents. The only residents exposed to 80 dB DNL or greater would be on-base at Andersen AFB, and only those associated with dormitory Buildings 25003 and 25017. The methodology for determining PHL employs the Leq_{24} metric (USEPA 1982). The estimated PHL for the no-action scenario would be approximately 3 dB. The estimated PHL for the proposed action would be identical to the no action (Czech 2009). Thus, this alternative would introduce no change to the no-action PHL and therefore considered less than significant. Based on the modeled noise for proposed activities, it is anticipated that overall impacts associated with noise to human health and safety would be less than significant.

Water Quality

Under the proposed action, there would be no reduction in the availability or accessibility of water resources. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use.

Construction and operational activities associated with this alternative would be implemented in accordance wit SOPs and BMPs, and in accordance with applicable regulations. Therefore, no impacts to water quality from construction and operational activities are anticipated and there would be no increased risk from environmental hazards to human health.

Air Quality

As discussed in Volume 2, Chapter 5, increased pollutants associated with construction and operational activities associated with this alternative would be less than significant. Air emissions associated with both construction and operational components of Alternative 1 would be well below the significance criteria of 250 TPY for all air pollutants except CO. However, a further CO dispersion modeling analysis described in Volume 6 shows that no exceedances of CO would occur from roadway traffic under the proposed action. The predicted SO_2 emissions would be below the 100 TPY *de minimis* level. Therefore, all project specific air quality impacts are considered less than significant for all areas for this action.

Although increased emissions would be less than significant, construction and operational activities would result in a measured increase in pollutant emissions, which could result in health impacts to some individuals on Guam.

Health Care Services

Volume 2, Chapter 16 discusses the impact of an increased patient to health care provider ratio as a result of population growth with implementation of this alternative. It is anticipated that short- and mid-term medical staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) 15 additional doctors (26% increase) and 91 additional nurses (26% increase) would be required to maintain the current service ratios; the number of additional doctors drops to 2 (4% increase) and nurses drops to 12 (3% increase) after construction activities are completed. These additional health care professionals would be hired in order to maintaining current service ratios. Without corresponding increases in health care providers, potential health and safety impacts could include:

- Longer wait/response times for patients
- Fewer or no available providers on island for chronic or acute issues
- Complications or death from delayed treatment, and/or
- Requirements for patients to travel off-island to receive adequate treatment

According to the impact analysis in Chapter 16, significant adverse impacts would occur to public service agencies influenced by population increases,. These impacts would be mitigated by assisting GovGuam in funding for health services personnel.

18.2.2.3 Notifiable Diseases

A potential increase in disease occurrences due to the addition of approximately 21,262 personnel and dependents and 18,374 construction employees (peak construction force in 2014) would be anticipated. A natural annual increase of 1.4% in the Guam population is also anticipated, resulting in a population of approximately 201,095 by the year 2019. With the increase in military and dependent personnel, the total Guam population would be approximately 222,357 in 2019 (see Chapter 16, Socioeconomics, in this volume for more detail on projected population growth patterns). Using the average per capita rates for notifiable diseases on Guam, the potential increase in disease occurrences was estimated based on the natural increase in population and the anticipated arrival of military personnel and their dependants. The construction workforce visiting Guam from other countries to support construction requirements (peak

construction force of 18,374 in 2014) would have the potential to contribute notifiable disease incidents during the construction period (2010 to 2016). A discussion of medical care and health screening for workers visiting Guam to support construction activities is provided in Section 16, Socioeconomics and General Services.

With construction activities, there is a potential for standing water and water based vectors such as mosquitoes and related diseases. Most mosquitoes require quiet, standing water or moist soil where flooding occurs to lay their eggs. Removal of standing water sources and/or promotion of drainage would eliminate potential breeding sites. To limit the amount of standing water at construction sites, stagnant water pools, puddles, and ditches would be drained or filled; containers that catch/trap water (e.g., buckets, old tires, cans) would be removed; and if necessary, pesticide application (e.g., *Bacillus thuringensis*) could be used to help control mosquitoes. Implementing these best management practices would reduce the opportunities for an outbreak of water-related diseases.

The potential increase in disease occurrences based on the estimated 2019 Guam population is presented in Table 18.2-1. Based on the anticipated 2019 population of Guam, the annual number of AIDS cases could increase by 1 to a total of 7 cases; the number of cholera, dengue, and malaria cases is not anticipated to increase and would remain at about one case annually; the number of cases of Hepatitis C is not anticipated to increase and would remain at about 4 cases annually; the number of cases of measles is not anticipated to increase and would remain at about 2 cases annually; the number of Rubella and Typhoid fever cases is not anticipated to increase and would remain at below one case annually; the number of STDs could increase by 77 to a total of 915 cases, and the number of TB cases could increase by 16 to a total of 79 cases.

Table 18.2-1. Potential Disease Occurrence Increase, Guam

Disease	*Average Rate*	*Annual Average 1997-2006*	*Alternative 1 Increase*	*Alternative 2 Increase*	*Alternative 3 Increase*	*Alternative 8 Increase*	*No-Action Alternative Increase[(b)]*	*Difference[(a)]*
AIDS	1/32,678	5	7	7	7	7	6	1
Cholera	1/163,389	1	1	1	1	1	1	0
Dengue	1/163,389	1	1	1	1	1	1	0
Hepatitis C	1/52,706	3.1	4	4	4	4	4	0
Malaria	1/163,389	1	1	1	1	1	1	0
Measles	1/90,772	1.8	2	2	2	2	2	0
Rubella	1/2,768,033	0.2	<1	<1	<1	<1	<1	0
Typhoid Fever	1/233,412	0.7	<1	<1	<1	<1	<1	0
STDs	1/243	671	915	915	915	915	838	77
TB	1/2,416	67.5	95	95	95	95	79	16

Notes: (a) Difference between Alternatives 1, 2, 3, and 8 increase in average number of diseases per year and the No-Action Alternative increase.
(b) Based on natural increase in population.

During the peak construction period (2014), the construction workforce visiting Guam from other countries would have the potential to contribute 76 cases of STDs and 7 cases of TB annually. The annual number of AIDS cholera, dengue, Hepatitis C, malaria, measles, rubella, and typhoid fever cases is not anticipated to increase and would remain at about one case annually. A discussion of medical care and health screening for construction workers visiting Guam is provided in Section 16, Socioeconomics and General Services.

As seen in Table 18.2-1, the largest potential increase in disease occurrences is that of STDs (8% increase/77 new cases annually). Young adults would be more likely to contract an STD. These increases; however, are not likely to impact the resources of the citizens of Guam. Military installations have hospitals and clinics that would treat military personnel; therefore, the presence of additional military personnel and their dependents is not expected to increase stress on the public hospital and other clinics on Guam. Additionally, military personnel are vaccinated against a myriad of diseases including measles, rubella, and Typhoid fever, which would preclude them from the potential increase in disease incidents. Vaccinations for AIDS or STDs are not available. Based on the small potential for increase in notifiable diseases (including construction workforce contribution) and the presence of a Navy hospital to treat military personnel, a less than significant impact on the health and safety of the citizens of Guam (from notifiable diseases) is anticipated.

18.2.2.4 Mental Illness

A potential increase in mental illness occurrences due to the addition of 21,262 personnel and dependents, construction workforce, as well as the natural population increase, would be anticipated. Based on the average per capita rates for mental illness on Guam, the potential increase in mental illness occurrences was estimated based on the natural increase in population as well as the anticipated military personnel moving to Guam. Based on the anticipated 2019 population of Guam, the annual number of mental illness cases could increase by 20 to a total of 247 cases. During the peak construction period, the construction workforce visiting Guam from other countries would have the potential to contribute 20 mental illness cases annually. Based on the small potential for increase in mental illness cases, no impact on the health and safety of the citizens of Guam (resulting from a potential increase in mental illness) is anticipated.

18.2.2.5 Hazardous Substances

Implementation of this alternative would result in an increase in the use, handling, storage, transportation and disposition of hazardous substances. These activities would be conducted in accordance with applicable hazardous material and waste regulations, and established BMPs and SOPs to ensure the health and safety of workers and the general public is maintained. BMPs and SOPs include:

- Implementing Hazardous Materials Management Plans
- Implementing Facility Response Plans
- Implementing Spill Prevention Control and Countermeasures plans (training, spill containment and control procedures, clean up, notifications, etc.). Also, ensure personnel are trained in accordance with spill prevention, control, and clean up methods
- Implementing hazardous materials minimization plans
- Ensuring DoD personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous materials
- Ensuring that DRMO has sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases.
- Verifying full compliance with federal, local, and DoD laws and regulations and implement corrective actions as necessary.

Because hazardous substance management activities would be conducted in accordance with applicable regulations and established BMPs and SOPs, no impacts to public health and safety are anticipated.

18.2.2.6 UXO

Excavation for building foundations, roads, underground utilities, and other infrastructure could encounter unexploded military munitions in the form of UXO, DMM and/or material potentially presenting an explosive hazard. Exposure to these Munitions and Explosives of Concern (MEC) could result in the death or injury to workers or to the public. The general public would be excluded from entering construction zones and training areas. To reduce the potential hazards related to the exposure to MEC, qualified UXO personnel would perform surveys to identify and remove potential MEC items prior to the initiation of ground disturbing activities. Additional safety precautions would include: UXO personnel supervision during earth-moving activities and providing MEC awareness training to construction personnel involved in grading and excavations prior to and during ground-disturbing activities. The identification and removal of MEC prior to initiating construction activities and training construction personnel as to the hazards associated with unexploded military munitions would ensure that potential impacts would be minimized and less than significant.

18.2.2.7 Traffic Incidents

As a result of the increase in military personnel and their dependents, there would potentially be more vehicles on the roadways resulting in more heavily congested roadways and, thus, more potential for accidents and traffic fatalities. Using the average per capita rates for traffic accidents and traffic fatalities on Guam, the potential increase in traffic accidents and traffic fatalities was estimated based on the natural increase in population as well as the anticipated military personnel and their dependents moving to Guam.

The potential increase in traffic accidents and traffic fatalities based on the estimated 2019 Guam population is presented in Table 18.2-2. It is estimated that the annual number of traffic accidents could increase by 743 to a total of 8,894 and the number of traffic fatalities could increase by 2 to a total of 24. Young adults that are of legal driving age would be more likely to experience a traffic incident. During the peak construction period, the construction workforce visiting Guam from other countries would have the potential to increase traffic incidents by 735. The annual number of traffic fatalities could increase by 2 due to the increase in construction population.

Table 18.2-2. Potential Traffic Accident Increase, Guam

	Average Rate	*Annual Average 2001-2005*	*Alternative 1 Increase*	*Alternative 2 Increase*	*Alternative 3 Increase*	*Alternative 8 Increase*	*No-Action Alternative Increase[(b)]*	*Difference[(a)]*
Accidents	1/26	6,651	8,894	8,894	8,894	8,894	8,044	743
Fatalities	1/9,717	18	24	24	24	24	22	2

Notes: (a) Difference between Alternatives 1, 2, 3, and 8 increase in average number of traffic accidents and fatalities per year and the no-action alternative increase; (b) Based on natural increase in population.

The Navy has used focus group sessions with personnel at several bases to strategize potential measures to reduce the number of liberty incidents, including traffic incidents. Several common factors appear to contribute to liberty incidents including; young personnel, late night, impaired driving, and alcohol/drugs. Some of the measures that would be implemented to reduce traffic incidents during liberty include:

- Increase awareness training regarding the consequences of drugs and alcohol use;
- Declare specific off-base bars/clubs off-limits;
- Increase Shore Patrol activity; and
- Provide free shuttle bus runs to/from town.

Although implementing the proposed action or alternatives could potentially mean many more military personnel on the roads, the actual potential for increased traffic incidents is small (17% increase/1,736 traffic incidents annually). The potential increase in the number of traffic accidents and fatalities as a result of the increase in personnel (as well as the construction workforce contribution) would be minimal; therefore, a less than significant impact on the health and safety of the citizens of Guam (from traffic incidents) is anticipated.

18.2.2.8 Public Services

Police Service

Volume 2, Chapter 16 discusses staffing requirements for GPD necessary to cope with population increases associated with this alternative. It is anticipated that short- and mid-term GPD staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) the GPD would require 117 (38% increase) additional officers to maintain the current service ratio; the number of additional officers drops to 55 (17% increase) after construction activities are completed. The GPD would hire these additional personnel in order to maintain current service ratios. Without increases in police services (i.e., more police officers) to compensate for population increases, it would be expected that crime rates and police response times would also increase. As a result, the severity of consequences associated with crimes may worsen (i.e., there may be increased injury and or death associated with delayed police responses).

Because corresponding increases in GPD personnel are anticipated to occur to maintain existing service conditions, no impacts to police service are anticipated.

Fire Service

Volume 2, Chapter 16 discusses staffing requirements for GFD necessary to cope with population increases associated with this alternative. It is anticipated that short- and mid-term GFD staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) the GFD would require 59 (31% increase) additional firefighters to maintain the current service ratio; the number of additional firefighters drops to 11 (6% increase) after construction activities are completed. The GFD would hire these additional personnel in order to maintain current service ratios. Without increases in fire protection services (i.e., more firemen, trucks and stations) to compensate for population increases, it is anticipated that response times to incidents would increase. As a result, increases in property damage and injuries/deaths could be expected.

Because corresponding increases in GFD personnel are anticipated to occur to maintain existing service conditions, no impact to fire service are anticipated.

18.2.2.9 Summary of Alternative 1 Impacts

Based on the addition of approximately 21,262 military personnel and dependents, 18,374 construction employees (during peak construction in 2014), as well as the natural population increase, no impact is anticipated from operational safety concerns (i.e., aircraft mishaps, BASH, explosive safety, electromagnetic safety, and construction safety). No impacts are anticipated from mental illnesss as well. However, less than significant impact are anticipated from notifiable diseases, UXO, and traffic incidents due to the increase in military personnel and dependents, construction employees, and natural population increase.

18.2.2.10 Potential Mitigation Measures

No mitigation measures would be required.

18.2.3 Alternative 2 (Preferred Alternative)

Potential impacts to public health and safety from implementation of Alternative 2 would be the same as those discussed under Alternative 1.

18.2.4 Alternative 3

Potential impacts to public health and safety from implementation of Alternative 3 would be the same as those discussed under Alternative 1.

18.2.5 Alternative 8

Potential impacts to public health and safety from implementation of Alternative 8 would be the same as those discussed under Alternative 1.

18.2.6 No-Action Alternative

18.2.6.1 Operational Safety

Under the no-action alternative, no operational or training activities would occur on Guam. As a result, there would no potential risk to the public from operations and training activities. Therefore, the no-action alternative would result in no impacts to public health and safety.

18.2.6.2 Noise

No new impacts to public health and safety associated with noise would result from construction or operational activities on Guam. Therefore no impacts to public safety from noise would be expected from the no-action alternative.

18.2.6.3 Water Quality

No new impacts to public health and safety associated with water quality would result from construction or operational activities on Guam. Therefore no impacts to public safety from water quality would be expected from the no-action alternative.

18.2.6.4 Air Quality

No new impacts to public health and safety associated with air quality would result from construction or operational activities on Guam. Therefore no impacts to public safety from air emissions would be expected from the no-action alternative.

18.2.6.5 Health Care Services

No increases in demand for health care services would occur as a result of additional military activities on Guam. However, the natural increase in population would result in a slight increase in demand for these services. As a result of natural population increase on Guam, approximately 1 additional doctor and 3 additional nurses would be required to maintain the current service ratios. These additional health care professionals would be hired in order to maintaining current service ratios. Without corresponding increases in health care providers potential health and safety impacts could include:

- Longer wait/response times for patients
- Fewer or no available providers on island for chronic or acute issues
- Complications or death from delayed treatment, and/or

- Requirements for patients to travel off-island to receive adequate treatment

However, because corresponding increases in doctors and nurses are anticipated to occur to maintain existing service conditions, no impact to health care services from the no-action alternative are anticipated.

18.2.6.6 Notifiable Diseases

A potential increase in disease occurrences due to the natural increase in population would be anticipated. Using the average per capita rates for notifiable diseases on Guam, the potential increase in disease occurrences was estimated based on the natural increase in population.

The potential increase in disease occurrences based on the estimated 2019 Guam population is presented in Table 18.2-1. Based on the anticipated 2019 population of Guam, without the implementation of the proposed action, the annual number of AIDS cases could increase by one to a total of six cases; cholera, dengue, malaria, measles, rubella, and Typhoid fever cases are not anticipated to increase, and the number of cases of hepatitis C could increase by one to a total of four cases. The number of cases of STDs could increase by 167 to a total of 838 cases. Young adults would be more likely to contract an STD. The number of cases of TB could increase by 12 to a total of 79 cases. No adverse impact on the health and safety of the citizens of Guam (from notifiable diseases) is anticipated.

18.2.6.7 Mental Illness

A potential increase in mental illness occurrences due to the natural increase in population could occur. Using the average per capita rates for mental illness on Guam, the potential increase in mental illness occurrences was estimated based on the natural increase in population. Based on the anticipated 2019 population of Guam, the annual number of mental illness cases could increase by 44 to a total of 221 cases. No adverse impact on the health and safety of the citizens of Guam (resulting from mental illness) is anticipated.

18.2.6.8 Hazardous Substances

No increase in the types or quantities of hazardous substances would be anticipated under the no-action alternative. Management of hazardous substances would continue to be conducted in accordance with applicable hazardous material and waste regulations, and established BMPs and SOPs to ensure the health and safety of workers and the general public is maintained. Therefore no impacts to management of hazardous substances would be expected from the no-action alternative.

18.2.6.9 UXO

The Island of Guam was an active battlefield during World War II. As a result of the invasion, occupation, and defense of the island by Japanese forces and the assault by Allied/American forces to retake the island, unexploded military munitions may still remain. Under the no-action alternative, no excavation for building foundations, roads, underground utilities, and other infrastructure would occur in support of proposed action. As a result, there would not be an increase in the likelihood of encountering unexploded military munitions. No adverse impact on the health and safety of the citizens of Guam (from UXO) is anticipated.

18.2.6.10 Traffic Incidents

A potential increase in traffic accidents and traffic fatalities due to the natural increase in population could occur. Using the average per capita rates for traffic accidents and traffic fatalities on Guam, the potential increase in traffic accidents and traffic fatalities was estimated based on the natural increase in population.

The potential increase in traffic accidents and traffic fatalities based on the estimated 2019 Guam population is presented in Table 18.2-2. Based on the anticipated 2019 population of Guam, the annual number of traffic accidents could increase by 1,500 to a total of 8,151 and the number of traffic fatalities could increase by four to a total of 22. Young adults that are of legal driving age would be more likely to experience a traffic incident. No adverse impact on the health and safety of the citizens of Guam (from traffic accidents) is anticipated.

18.2.6.11 Public Services

Under the no-action alternative, natural increases in population on Guam would result in an increased need for police and firefighting presence on the island. As a result of natural population increase on Guam, approximately 3 additional police officers and 5 additional firefighters would be required to maintain the current service ratios. The GPD and GFD would hire these additional personnel in order to maintain current service ratios. Without increases in police and fire services (i.e., more police officers and firefighters) to compensate for population increases, it would be expected that response times would increase. As a result, the severity of consequences associated with crimes and fire may worsen (i.e., there may be increased injury and or death associated with delayed responses). However, because corresponding increases in police and fire service are anticipated to occur to maintain existing service conditions, no impact to public services from the no-action alternative are anticipated.

18.2.7 Summary of Impacts

Tables 18.2-3, 18.2-4, 18.2-5, and 18.2-6 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 18.2-7 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 18.2-3. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternatives 1, 2, 3, and 8
Construction
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and to air quality during construction • Less than significant impacts to notifiable diseases NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to health care services, mental illness, water quality, and hazardous substances • No impacts to operational safety (aircraft mishaps, bird aircraft strike hazards, explosives safety, electromagnetic safety, and construction safety)
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise, and to air quality during operation • Less than significant impacts to Notifiable diseases
NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to health care services, mental illness, water quality, and hazardous substances

Legend: *SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.*

Table 18.2-4. Summary of Training Impacts – Training Range Complex Alternatives

Training Range Alternatives A and B
Construction
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise, and to air quality during construction
NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances
Operation
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality
NI • No impacts to water quality and hazardous substances • No impacts to operational safety (explosives safety)

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 18.2-5. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise, and to air quality during construction	
Operation	
NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances	

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 18.2-6. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during construction NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances	NI • No construction
Operation	
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during operation NI • No impacts to water quality and hazardous substances • No impacts to operational safety (explosives safety)	LSI • The impacts would be the same as for Alternative A NI • The impacts would be the same as for Alternative A

Legend: LSI = Less than significant impact, NI = No impact.

Table 18.2-7. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during construction	LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during construction	LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during construction
NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances	NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances	NI • No impacts to public, military personnel or worker safety due to construction hazards • No impacts to water quality and hazardous substances
Operation		
LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during operation	LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during operation	LSI • Less than significant impacts due to UXO and traffic incidents • Less than significant impacts to noise and air quality during operation
NI • No impacts to water quality and hazardous substances • No impacts to operational safety (aircraft mishaps, bird aircraft strike hazards, explosives safety, electromagnetic safety, and construction safety)	NI • No impacts to water quality and hazardous substances • No impacts to operational safety (aircraft mishaps, bird aircraft strike hazards, explosives safety, electromagnetic safety, and construction safety)	NI • No impacts to water quality and hazardous substances • No impacts to operational safety (explosives safety, electromagnetic safety, and construction safety)

Legend: LSI = Less than significant impact, NI = No impact.

The identification and removal of MEC prior to initiating construction activities, and training construction personnel regarding hazards associated with MEC, would ensure that potential impacts would be minimized and would be less than significant.

Prior to conducting training activities, training areas would be cleared of non-participating personnel and the public so that the only public health and safety issue would be if a training event exceeded the safety area boundaries. Public notification of training activities, use of established training areas, compliance with appropriate range safety procedures, and avoidance of non military vessels and personnel would reduce the potential for interaction between the public and personnel that are training. Therefore, no impacts to public health and safety from training activities are anticipated. Military operations on Guam would be conducted in accordance with applicable regulations and specific safety precautions would be in place to ensure the health and safety of the public and military personnel.

The potential increase in disease occurrences and mental illness as a result of the increase in personnel is considered low. The largest potential increase in disease occurrences is that of STDs (increase of 77 cases

annually); however, these increases are not likely to impact the resources of the citizens of Guam. Military installations have hospitals and clinics that would treat military personnel; therefore, the presence of additional military personnel and their dependents is not expected to increase stress on the public hospital and other clinics on Guam.

Although the increase in personnel could potentially result in more military personnel on the roads, the actual potential for increased traffic incidents is considered small (increase of 743 traffic incidents annually); therefore, no adverse impact on the health and safety of the citizens of Guam (from traffic incidents) is anticipated.

18.2.8 Summary of Potential Mitigation Measures

No mitigation measures would be required.

CHAPTER 19. ENVIRONMENTAL JUSTICE AND THE PROTECTION OF CHILDREN

This chapter focuses on the potential for racial and ethnic minorities, low income populations, or children to be disproportionately affected by project-related impacts. Normally an analysis of environmental justice is initiated by determining the presence and proximity of these segments of the population relative to the specific locations that would experience adverse impacts to the human environment. The situation on Guam is unique in this regard because racial or ethnic minority groups (as defined by the U.S.) comprise a majority of the Guam population, and the proportions of people living in poverty or who are under 18 years of age are also substantially higher than in the general U.S. population. The analysis is further complicated by the fact that Guam is a relatively small and isolated island, and certain types of impacts would be experienced island-wide. Accordingly, the analysis of environmental justice described in this chapter acknowledges the unique demographic characteristics of the island population and assumes that the project effects could disproportionately affect disadvantaged groups and children because they comprise relatively high proportions of the population. By the same logic, mitigation measures that would reduce the severity of any significant project impacts to a less than significant level would be expected to effectively mitigate the associated environmental justice impacts to a less than significant level. Consequently, a distinction is made between potential significant impacts that would be mitigated and those for which no mitigations have been identified. The focus of this analysis is on the latter type of impacts.

19.1 AFFECTED ENVIRONMENT

19.1.1 Definition of Resource

In 1994 President Clinton issued Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, in response to growing concern that minority and low-income populations bear adverse health and environmental effects disproportionately. EO 12898 requires federal agencies to assess the potential for their actions to have disproportionately high and adverse environmental and health impacts on minority and low-income populations. In 1997 EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, required a similar analysis for children.

EO 12898 authorized the creation of an Interagency Working Group on Environmental Justice, overseen by the United States (U.S.) Environmental Protection Agency (USEPA), to implement the EO's requirements. The Interagency Working Group and USEPA developed guidance for terms contained in the EO. USEPA (2009) defines environmental justice as, "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

USEPA (1995) defines "fair treatment" as follows: "No group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies." A "disproportionate share of the negative environmental consequences" is an adverse effect or impact that is predominately borne by any segment of the population, including a minority population or a low income population. It can also mean that the

suffering experienced by a minority population or low income population is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by a non-minority or non-low-income population (USEPA 2009).

USEPA defines "meaningful involvement" as follows:

1. Potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment and/or health.
2. The public's contribution can influence the regulatory agency's decision.
3. The concerns of all participants involved would be considered in the decision making process.
4. The decision makers seek out and facilitate the involvement of those potentially affected.

The Presidential Memorandum that accompanies EO 12898 cites the importance of the National Environmental Policy Act (NEPA) in identifying and addressing environmental justice concerns. The memorandum states that, "each federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on minority communities and low-income communities, when such analysis is required by NEPA" (Federal Register 1994). The memorandum emphasizes the importance of NEPA's public participation process, directing that "each federal agency shall provide opportunities for community input in the NEPA process." Agencies are directed to identify potential impacts and mitigations in consultation with affected communities and ensure the accessibility of meetings, crucial documents, and notices." The Presidential Memorandum includes four provisions that identify ways agencies should consider environmental justice under NEPA:

1. Each federal agency should analyze the environmental effects, including human health, economic, and social effects of federal actions, including effects on minority populations and low-income populations, and Indian tribes, when such analysis is required by NEPA.
2. Mitigation measures identified as part of an Environmental Assessment, a Finding of No Significant Impact, an Environmental Impact Statement (EIS), or a Record of Decision should, whenever feasible, address significant and adverse environmental effects of proposed federal actions on minority populations, low-income populations, and Indian tribes.
3. Each federal agency must provide opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices.
4. Review of NEPA compliance must ensure that the lead agency preparing NEPA analyses and documentation has appropriately analyzed environmental effects on minority populations, low-income populations, or Indian tribes, including human health, social, and economic effects.

Neither the EO nor the Council on Environmental Quality (CEQ) prescribe a specific format for environmental justice assessments in the context of NEPA documents. However, CEQ (1979) identifies the following six general principles intended to guide the integration of environmental justice assessment into NEPA compliance, and that are applicable to the proposed project:

1. Agencies should consider the composition of the affected area to determine whether minority populations, low-income populations, or Indian tribes are present in the area affected by the proposed action and, if so, whether there may be disproportionately high and adverse human health or environmental effects on minority populations, low-income populations, or Indian tribes.

2. Agencies should consider relevant public health data and industry data concerning the potential for multiple or cumulative exposure to human health or environmental hazards in the affected population and historical patterns of exposure to environmental hazards, to the extent such information is reasonably available. For example, data may suggest there are disproportionately high and adverse human health or environmental effects on a minority population, low income population, or Indian tribe from the agency action. Agencies should consider these multiple, or cumulative effects, even if certain effects are not within the control or subject to the discretion of the agency proposing the action.
3. Agencies should recognize the interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the agency's proposed action. These factors should include the physical sensitivity of the community or population to particular impacts; the effect of any disruption on the community structure associated with the proposed action; and the nature and degree of impact on the physical and social structure of the community.
4. Agencies should develop effective public participation strategies. Agencies should, as appropriate, acknowledge and seek to overcome linguistic, cultural, institutional, geographic, and other barriers to meaningful participation, and should incorporate active outreach to affected groups.
5. Agencies should assure meaningful community representation in the process. Agencies should be aware of the diverse constituencies within any particular community when they seek community representation and should endeavor to have complete representation of the community as a whole. Agencies also should be aware that community participation must occur as early as possible if it is to be meaningful.
6. Agencies should seek tribal representation in a manner that is consistent with current procedures and protocols between the U.S. and tribal governments, the federal government's trust responsibility to federally-recognized tribes, and any treaty rights.

CEQ (1979) states that the identification of a disproportionately high and adverse human health or environmental effect on a low-income or minority population does not preclude a proposed agency action from going forward, or compel a finding that a proposed project is environmentally unacceptable. Instead, the identification of such effects is expected to encourage agency consideration of alternatives, mitigation measures, and preferences expressed by the affected community or population.

The following definitions apply to this section and the Environmental Consequences section of this chapter:

- Consistent with CEQ guidance (1979), this chapter defines a racial minority according to the definition used in the 2000 U.S. Census (U.S. Census Bureau 2000a): a racial minority includes American Indian or Alaskan Native; Asian or Pacific Islander; Black; or Hispanic. The 2000 Census (U.S. Census Bureau 2000a) allowed individuals to choose more than one race. For this analysis, consistent with guidance from the CEQ as well as USEPA (CEQ 1979; USEPA 1998, 1999), "minority" refers to people who are Pacific Islander, as well as those who are non- Pacific Islander of a race other than White or European-American.
- Also consistent with CEQ guidance (1979), this chapter bases the definition of low-income on the official poverty line according to the U.S. Census (U.S. Census Bureau 2000b) ($17,603). However, because U.S. Census Bureau (2000b) data is collected in increments, the closest increment to the poverty line ($19,999) is used to determine low-income.

- Based on U.S. Census 2000 data categories, children are defined as people under the age of 18.

19.1.2 Guam Demographics Relevant to Environmental Justice

According to the U.S. Census 2000, "Native Hawaiian and Other Pacific Islander" refers to any of the original peoples of Guam, Hawaii, Samoa, or other Pacific Islands. This category includes people who indicated their race or races as Native Hawaiian, Chamorro, Samoan, Carolinian, Chuukese, Tahitian, Mariana Islander, Kosraean, Marshallese, Palauan, Pohnpeian, Yapese, or Other Pacific Islander (Grieco and Cassidy 2001; US Department of Commerce 2004). The island of Guam is divided into 19 villages called municipalities. Figure 19.1-1 identifies the villages located adjacent to each military installation on Guam, and Table 19.1-1 provides an overview of racial composition, percentage of households in poverty, and percentage of children for those villages that are adjacent to and would be potentially affected by elements of the proposed action or alternatives. In general, the various racial and ethnic minority populations are evenly distributed within each of the villages on the island, as are people with lower incomes and children under age 18.

19.1.2.1 North

Racial or Ethnic Minorities

With 15% or less of their populations being Caucasian, Dededo and Yigo have high percentages of racial and ethnic minorities based on U.S. averages (Table 19.1-1). Seventy-five percent (75%) of Dededo's population is Chamorro and Filipino (combined), while 58% of Yigo is Chamorro and Filipino (combined). Both Dededo and Yigo have a slightly higher percentage of Filipinos (31% and 45%, respectively) than Chamorro (27% and 30%, respectively) (U.S. Census Bureau 2000a). The CNMI and other villages of Guam have similar percentages of racial minorities to Dededo and Yigo.

Low-Income Populations

Table 19.1-1 compares the percent of households in poverty in Dededo and Yigo to that of other villages on Guam, the U.S. population as a whole, and the CNMI. As the data indicate, while poverty rates in Dededo and Yigo are similar to those of other villages on Guam, CNMI's poverty rate is almost double that of both Dededo and Yigo. Further, Dededo and Yigo's poverty rates are double that of the U.S.

Children

As Table 19.1-1 indicates, both Dededo and Yigo have percentages of children similar to those of other Guam villages. However, these percentages are higher than those of both CNMI and the U.S. average.

Figure 19.1-1
Villages of Guam

Table 19.1-1. Villages Affected by the Proposed Action Alternatives on Guam: Percentage Ethnic Minorities, in Poverty, and Under 18 Years of Age

Villages Affected	*Village Minority*[1]	*CNMI Minority*	*U.S. Average Minority*	*Village Poverty*[2]	*CNMI Poverty*	*U.S. Average Poverty*	*Village Children*[3]	*CNMI Children*	*U.S. Average Children*
North									
Dededo	97%	98%	25%	25%	48%	11%	36%	28%	21%
Yigo	85%			22%			38%		
Central									
Mangilao	96%	98%	25%	27%	48%	11%	34%	28%	21%
Barrigada	95%			19%			35%		
Piti	84%			25%			30%		
South									
Santa Rita	76%	98%	25%	13%	48%	11%	31%	28%	21%
Agat	97%			29%			39%		
Umatac	99%			31%			43%		
Talofofo	93%			21%			40%		
Yona	70%			20%			41%		

Notes: [1] All the Guam villages identified in this table have minority populations that are at least three times the percentages of the average minority population in the U.S. (25%), but less than the CNMI average minority populations (98%).
[2] All Guam villages identified in this table have high percentages of people living in poverty relative to the U.S. average (11.3%), but less than the average for CNMI (48%).
[3] All Guam villages identified in this table have higher percentages of children compared to the U.S. average (21.4%) and the CNMI average (28%).
Sources: U.S. Census Bureau 2000b, CNMI Department of Commerce 2005.

19.1.2.2 Central

Villages located in central Guam that would potentially be affected by the proposed action include Mangilao, Barrigada, and Piti (see Figure 19.1-1).

Racial or Ethnic Minorities

With only 4% of its population being Caucasian, Mangilao has a racial/ethnic majority compared to the U.S. average. However, this percentage is similar to the percentages of racial minorities in other villages on Guam and on CNMI. Mangilao has a higher percentage of Chamorros (47%) than Filipinos (22%) (U.S. Census Bureau 2000a).

With only 5% of its population being Caucasian, Barrigada has a high percentage of racial and ethnic minorities compared to the U.S. average (refer to Table 19.1-1). Like Mangilao, it has a higher percentage of Chamorros (56%) than Filipinos (19%) (U.S. Census Bureau 2000a).

While Piti has a higher percentage of Caucasians than the other Guam villages analyzed (16%), the majority of its population is a racial or ethnic minority compared to the U.S. average. Piti's percentage of racial minorities (84%) is lower than that of CNMI (98%) but still higher than the U.S. average (25%). Piti has a much higher percentage of Chamorros (60%) than Filipinos (7%) (U.S. Census Bureau 2000a).

Low-Income Populations

As indicated in Table 19.1-1, over one quarter (27%) of Mangilao's households live in poverty. While this percentage is similar to that of other villages on Guam and less than that of CNMI (48%), it is over two times greater than that of the U.S. (11%).

The percentage of households living in poverty in Barrigada in 2000 was 19%, which is relatively lower than other Guam villages. This is also substantially lower than the poverty rate on CNMI, which is close

to 50% (U.S. Census Bureau 2000b). However, while relatively low, Barrigada's poverty rate is still higher than the U.S. average.

According to the 2000 U.S. Census, 18% of households in Piti are living in poverty, which is similar to that of Barrigada but less than that of the other villages of Guam analyzed (refer to Table 19.1-1). Piti's poverty rate (18%) is substantially lower than that of CNMI (48%) is but still greater than the U.S. average (11%).

Children

Mangilao has a similar percentage of children to that of other Guam villages (34%); however, this percentages is higher than both CNMI (28%) and the U.S. average (21%).

Barrigada's percentage of children is similar to that of the other Guam villages analyzed. However, Barrigada's percentage of children exceeds that of both CNMI and the U.S. (refer to Table 19.1-1).

Piti's percentage of children (30%) is similar to that of the Guam villages analyzed but still higher than that of CNMI (28%) and the U.S. (21%).

19.1.2.3 South

Villages located in the south part of Guam that would potentially be affected by the proposed action include Santa Rita, Agat, northern Umatac, Tolofofo, and Yona (refer to Figure 19.1-1).

Racial or Ethnic Minorities

Santa Rita has one of the highest percentages of Caucasians on the island of Guam (24%) (refer to Table 19.1-1). CNMI has a higher percentage of racial minorities (98%) than Santa Rita (76%). However, Santa Rita has a higher percentage of racial minorities than the U.S. average (25%). The population in Santa Rita is 31% Chamorro and 20% Filipino (U.S. Census Bureau 2000a).

Agat, Talofofo, and Umatac have similarly high percentages of racial minorities compared to the other villages on Guam analyzed and to CNMI. The percentage of racial minorities in Yona (70%) is similar to that of Santa Rita (76%). Agat, Talofofo, Umatac, and Yona have higher percentages of racial minorities than the U.S. average (25%).

Agat, Talofofo, Umatac, and Yona have some of the highest percentages of Chamorros on Guam (67%, 79%, 95%, and 70%, respectively). While 23% of the population in Agat is Filipino, the percentage of Filipinos in Talofofo, Umatac, and Yona is 5% or less (U.S. Census Bureau 2000a).

Low-income Populations

Santa Rita has the lowest percentage of households in poverty on the island (refer to Table 19.1-1). Santa Rita's poverty rate (13.4%) is substantially lower than that of CNMI (48%) but is still not as low as the U.S. (11%) (U.S. Census Bureau 2000b).

While Umatac has the highest poverty rate of the other southern villages on Guam that were analyzed (31%), this is lower than the CNMI poverty rate (48%). All villages of southern Guam and CNMI have poverty rates higher than the U.S. average (11%).

Children

As indicated in Table 19.1-1, Santa Rita has a similar percentage of children to the other Guam villages examined. However, the percent of children in Santa Rita (31%) is slightly higher than that of CNMI (28%) and higher than that of the U.S. (21%).

The villages of southern Guam, especially Agat, Umatac, Talofofo, and Yona, have substantially higher percentages of children than villages in other regions of Guam. They also have substantially higher percentages of children than CNMI and the U.S.

19.2 ENVIRONMENTAL CONSEQUENCES

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, a full analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

19.2.1 Approach to Analysis

19.2.1.1 Methodology

Volume 2 of this EIS/OEIS examines and identifies the potential impacts that each alternative may have on various resources on Guam Based on the conclusions reached in each resource chapter, the analysis of environmental justice sought to identify the adverse impacts that would disproportionately affect racial minorities, children, and/or low-income populations, based on the following assumptions.

- Environmental justice policies are intended to analyze disproportionate impacts of potentially harmful environmental impacts on minority or other special status populations. However, the island of Guam is unique in that the majority of the population is a racial or ethnic minority, and low-income and child populations also comprise a relatively large proportion of the population (compared to the U.S.). Consequently, in this analysis it is assumed that any adverse impact that would affect the island as a whole, and any localized adverse impact that would affect a particular community on Guam, would have a disproportionate effect in terms of environmental justice.
- The region of influence (ROI) is defined as the area in which the principal effects arising from the implementation of the proposed action or alternatives are likely to occur. Those who may be affected by the consequences of the alternatives are often those who reside or otherwise occupy areas immediately adjacent to the alternative locations.
- Because impacts under the proposed action are related either to construction or operations, impacts to villages could result from either a "spill over" effect that extends beyond an installation's boundary line into the surrounding community (for instance, noise impacts from operations), or that directly affect minority populations in the ROI.

The analysis involved the application of three tiers of criteria to assess the environmental justice implications of each adverse effect identified in the relevant resource chapters:

- *Tier 1*: *Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?*
- *Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?*
- *Tier 3*: *Would the disproportionate adverse effects be significant?*

19.2.1.2 Determination of Significance

According to Section 1508.27 of the CEQ Regulations for Implementing NEPA (CEQ 1979), determining the level of significance of an environmental impact requires that both context and intensity be considered. These are defined in Section 1508.27 as follows:

- "Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant".
- "Intensity. This refers to the severity of the impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
  - Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
  - The degree to which the proposed action affects public health or safety.
  - Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
  - The degree to which the effects on the quality of the human environment are highly uncertain or involve unique or unknown risks.
  - The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
  - Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
  - The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
  - The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined critical under the Endangered Species Act of 1973.
  - Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment."

This chapter uses these criteria to determine significance for the proposed action in terms of Environmental Justice.

19.2.1.3 Issues Identified During Public Scoping Process

As part of the analysis, concerns relating to environmental justice or the protection of children that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These included:

- Concerns that disruption to family lives and cultural values would ultimately, "jeopardize the future of [indigenous] children."
- Concerns from the Micronesian Youth Services Network about ensuring that, "the transition of personnel on our islands will not disrupt our family lives and our cultural values..."

- Concerns that indigenous people of Guam are treated as second-class citizens. One commenter from Saipan indicated that, "these are their islands, and the locals' culture and related artifacts which still can be found...are also deserving of respect."
- Sanctuary, Incorporated, a non-profit organization focused on youth and their families, recommended using the *Social Impact Assessment Guide and Principles* as a basis for conducting the social impact study for this EIS/OEIS.
- The Chamorro Studies Association requested, "protect the people of Guam and their human rights."
- The CMTF Social and Cultural Subcommittee submitted a comprehensive paper on the subject of Chamorro interests (see Appendix G). That subcommittee recommends that the EIS identify issues and concerns that must be addressed to minimize negative social impacts and allow local and military communities to live in harmony.

19.2.1.4 Best Management Practices

Given the public concern expressed during the public scoping process and in keeping with CEQ guidance to "develop effective public participation strategies", the following Best Management Practices (BMPs) are recommended (Table 19.2-1) to ensure that minority populations on Guam have the ability to participate in the public review process of this EIS/OEIS:

Table 19.2-1 Environmental Justice Best Management Practices

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Public Involvement			
• Public meetings would be located in areas most accessible to public transportation • Public notices would be printed as well as online • Extra effort would be made to inform residents in southern Guam about public meetings • Written materials would be provided in the Chamorro language and an interpreter will be provided at meetings	• Public meetings would be located in areas most accessible to public transportation • Public notices would be printed as well as online • Extra effort would be made to inform residents in southern Guam about public meetings • Written materials would be provided in the Chamorro language and an interpreter will be provided at meetings	• Public meetings would be located in areas most accessible to public transportation • Public notices would be printed as well as online • Extra effort would be made to inform residents in southern Guam about public meetings • Written materials would be provided in the Chamorro language and an interpreter will be provided at meetings	• Public meetings would be located in areas most accessible to public transportation • Public notices would be printed as well as online • Extra effort would be made to inform residents in southern Guam about public meetings • Written materials would be provided in the Chamorro language and an interpreter will be provided at meetings

Note: In addition, for all alternatives, the Mitigation Measures proposed for Chapters 6, 8, 9, 10, and 12 of Volume 2 are recommended; refer to Tables 6.2-6, 8.2-7, 9.2-6, 10.2-15, and 12.2-6, respectively.

19.2.2 Alternative 1

19.2.2.1 North

<u>Recreation</u>

As described in Volume 2, Chapter 9 (Recreational Resources), there are numerous public recreational resources in Dededo and Yigo. Chapter 9 discusses that while the proposed action would occur on DoD land, indirect adverse impacts to public recreational resources are anticipated due to the large influx of

military, their dependents, and the H2B workers that are anticipated to provide much of the labor for the construction effort in the north. As Chapter 9 states, this increase in people would cause an increase in demand for the recreational services, which would likely result in crowding during peak use times (i.e. weekends, holidays, and evenings during summer), as well as increased wear and tear on the resources themselves. While the population is expected to taper off again in a few years, this would nonetheless alter the availability and condition of public recreational resources on northern Guam. Potentially affected resources include: Guam International Raceway, Marbo Cave, Pagat Trail and associated trails in the vicinity, cultural gathering activities (*suruhana*), and off-shore fishing near Marbo Cave. Implementation of Alternative 1, regardless of the Training Complex Alternatives A or B, would cause the cessation of the present activities at all the resources mentioned because the Known Distance (KD) Range Complex is proposed in that location.

The loss of Guam International Raceway land and use in particular would be a significant adverse impact. Guam's only automobile raceway is located on a 250-acre (100-ha) parcel of land leased from the Chamorro Land Trust and operated under a 21-year commercial license administered by the Guam Economic Development Authority. To date, the Government of Guam has spent approximately $7.3 million and volunteers have donated many hours developing the Raceway's facilities. The Raceway began holding events in 2002 and has since operated continuously. The Raceway offers a variety of race venues that provide a variety of activities for various user groups, including participation in soap box derbies and mini bike races for children; quarter mile drag racing, drifting, obstacle course maneuvering, four wheeling rock crawl and mud events, stock car racing, off-road racing for adults and young adults; and construction vehicle events for spectators of all ages. Motocross and drag races are the most frequently held events. International motorcycle and off-road races promote tourism and draw professional competitors from both the U.S. and Asia. In addition to races, the Raceway hosts a number of special events every year, including music concerts, car shows, and driving schools. Some special events are combined with races and draw crowds of over 5,000 people. The Raceway is a popular recreational venue for tourists and Guam's local and military population, and has over 100 races and events scheduled for 2009. Therefore, Alternative 1 would result in significant impacts to recreational resources.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The recreational resources are generally used by all people of Guam, which includes a high proportion of racial or ethnic minorities, low-income individuals, and children.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

As described above, racial or ethnic minority groups comprise the majority of the population of Guam and so the impacts would disproportionately affect this disadvantaged group. The low-income population and children would not be disproportionately affected.

Tier 3: Would the disproportionate adverse effect(s) be significant?

As described in Volume 2, Chapter 9 (Recreational Resources), Alternative 1 would result in significant impacts to recreational resources. Therefore, this impact would also be significant in terms of environmental justice.

Cultural Resources

Volume 2, Chapter 12 (Cultural Resources), has identified both archaeological and cultural resources at Andersen AFB and Finegayan that are anticipated to be impacted by the proposed action. With mitigation measures, Chapter 12 has determined that the impacts to the resources themselves would be less than significant. However, because these resources are of value to a racial/ethnic group on Guam, this section analyzes the action in terms of environmental justice.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The value of these resources is tied to the Chamorro history and culture, rather than to a specific geographic area.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The proposed action may affect resources of value to a particular racial/ethnic group on the island: the Chamorros. So there would be a disproportionate impact on a particular racial minority group. There would be no disproportionate impact to low-income populations or children specifically.

Tier 3: Would the disproportionate adverse effect(s) be significant?

While Section 106 would be adhered to and mitigation has been proposed to reduce the adverse effects, Section 1508.27 of the CEQ Regulations (2007) states that the following may be considered a significant impact: "unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wild and scenic rivers, or ecologically critical areas." The impacts may affect the unique historic and cultural resources of a racial minority group. However, with implementation of the mitigation measures in Chapter 12 of this volume, the impacts would be reduced to less than significant.

Off Base Transportation

The FHWA traffic study uses a volume to capacity ratio (v/c ratio) to determine the anticipated level of traffic congestion by 2014. If a v/c ratio is greater than 1, the increased traffic is anticipated to reach a level that would cause congestion. Due to the aforementioned and other construction activities in the north, the FHWA traffic study projects that by 2014 the following northern roadways and intersections will have a v/c ratio greater than 1:

- The portion of Route 3 south of the Residential Gate and between Route 28 and Main Gate in both the morning and afternoon
- The intersection of Routes 3, 3A, and 9 in the morning

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

Over 90% of the local population in Dededo and Yigo are racial minorities (Table 19.1-1). Relative to the U.S. both Dededo and Yigo have a high poverty rate, although some villages in Guam have higher poverty rates. Compared to both CNMI and the U.S., both Dededo and Yigo have a high percentage of children (see Section 19.1.2.1).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities and low-income populations that live in northern Dededo and northern Yigo near Routes 3 and 9 would be disproportionately impacted by increased traffic. There would be no disproportionate impact to children.

Tier 3: Would the disproportionate adverse effect(s) be significant?

Because the traffic increase is anticipated to reach the level of congestion, the impact would be significant. However, with implementation of the mitigation measures in the FHWA traffic study, as well as the mitigation measures proposed in Section 19.2.2.5 of this chapter, the impacts would be reduced to less than significant.

Access to Public Health and Social Services

According to Chapter 16 of this volume, health services of the Guam Department of Public Health and Social Services (GDPHSS) and the Guam Department of Mental Health and Substance Abuse (GDMHSA) target the most indigent populations for health care. Therefore, the majority of Guam residents accessing health services from the GDPHSS and the GDMHSA are low-income and uninsured. However, many people with health insurance also use GDPHSS and GDMHSA services because unaffordable co-payments or missing coverage for specific services and medications necessitate that they access the free services of these two public agencies. This section assesses if the proposed action would disproportionately reduce or limit access to GDPHSS and GDMHSA services to low-income populations on Guam.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The people who access GDPHSS and GDMHSA are predominantly low-income.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Because the GDPHSS and GDMHSA's programs are designed to primarily serve the poor and uninsured, low-income populations of Guam would be disproportionately impacted by factors that would affect these programs. According to Chapter 16 of this volume, the population growth associated with the proposed action would increase the number of uninsured and underinsured people attempting to access the free services of GDPHSS and GDMHSA, especially temporary workers entering Guam through the Compact of Free Association agreement that does not require individuals to have health coverage before arriving on Guam. Without an increase in staff and other resources, this increase in demand for GDPHSS and GDMHSA would strain existing services to low-income people on Guam.

Tier 3: Would the disproportionate adverse effect(s) be significant?

This would depend on how great the demand would be. Given that the GDPHSS and GDMHSA programs are already strained and insufficient to support the needs of the low-income population on Guam, it is likely that the substantial population increase anticipated as part of the proposed action would have significant adverse effects on the low-income and uninsured populations on Guam. However, with implementation of the mitigation measures in Section 19.2.2.5, the impacts would be reduced to less than significant.

Socioeconomic Impacts

According to Chapter 16 of this EIS/OEIS, the proposed action would have several adverse socioeconomic impacts. Implementation of the proposed action would result in a "boom then bust" effect where the population on Guam would increase rapidly through 2014 during the construction phase, and then decrease rapidly after 2014 before leveling off. This cycle would lead to a construction downturn and the creation of an economic environment that meets standard definitions of an economic recession (e.g. decrease in jobs and civilian labor force income). With implementation of the proposed action, the cost of goods and services would rise with the increase in population, but may not be matched by an increase in income. Further, high housing costs, crowding, and/or homelessness may occur if the construction phase housing demand is not met at the construction peak. This section assesses these impacts in terms of Environmental Justice.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

As Table 19.1-1 indicates, Guam villages have a high percentage of low-income people relative to the U.S. The villages have similar percentages of low-income populations when compared to each other and to CNMI (Table 19.1-1).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Generally, people with lower incomes have a more difficult time surviving under economic pressures. While all populations on Guam would experience the aforementioned socioeconomic impacts, lower-income people are more likely to slip into poverty under economic distress. Low-income people are more financially vulnerable because they have fewer resources to support them in difficult economic times. The possible combination of higher costs of goods and services with higher housing costs would likely affect low-income people more severely than those with additional resources. Stressful economic circumstances may push people on the verge of poverty into poverty.

Tier 3: Would the disproportionate adverse effect(s) be significant?

Chapter 16 proposes mitigation measures to reduce the potential socioeconomic impacts. If these mitigation measures are implemented, they would help reduce the impact of the proposed action on the low-income populations on Guam.

19.2.2.2 Central

Recreational and Cultural Resources

Due to the proposed action, Pagat Trail, both a recreational and a cultural resource near Andersen South, would be closed to the public because it would be located within the safety zone of a planned fire training area. Cultural resource mitigation in Volume 2, Chapter 12 suggests that the military would consider allowing limited access to this and other cultural sites to the Chamorros.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The value of these resources is tied to the Chamorro history and culture, rather than to a specific geographic area.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The proposed action may affect resources of value to a particular racial/ethnic group on the island: the Chamorros. So there would be a disproportionate impact on a particular racial minority group. There would be no disproportionate impact to low-income populations or children specifically.

Tier 3: Would the disproportionate adverse effect(s) be significant?

While Section 106 would be adhered to and mitigation has been proposed to reduce the adverse effects, Section 1508.27 states that the following may be considered significantly impacted: "unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wild and scenic rivers, or ecologically critical areas." The adverse impacts would affect unique historic and cultural resources of a racial minority group. Further, historic resources like Pagat Trail that are now fully accessible to the public would have limited and regulated access. However, with implementation of the mitigation measures in Chapter 12, the impacts would be reduced to less than significant.

Off Base Transportation

According to the FHWA Study, with the implementation of Alternative 1, traffic is projected to increase in the following areas by 2014: Route 3, Route 10 north of Route 32 to Route 8, Route 15 at its intersection with Route 10, Route 16, Route 25, Route 26, and Route 28.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The villages that would be impacted by actions proposed in the central region include Mangilao and Barrigada. These village populations all have a majority of racial minorities. Mangilao also has a high poverty rate compared to the U.S. average (refer to Table 19.1-1). These villages do not have high percentages of children relative to the other villages on Guam but they do have higher percentages of children than the U.S. (refer to Table 19.1-1).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities and low-income populations living near these roads would experience the traffic increase disproportionately relative to racial minorities and low-income populations that do not live near these roadways. Children would not be disproportionately impacted.

Tier 3: Would the disproportionate adverse effect(s) be significant?

The FHWA traffic study uses a v/c ratio to determine the anticipated level of traffic congestion. If a v/c ratio is greater than 1, the road is anticipated to be congested. According to the FHWA traffic study, by 2014 Alternative 1 is projected to result in a v/c ratio greater than 1 along the following roadways: Route 3, Route 10 north of Route 32 to Route 8, Route 15 at its intersection with Route 10, Route 16, Route 25, Route 26, and Route 28. Therefore, the impact would be significant. However, with implementation of proposed mitigation in the traffic study, as well as the mitigation proposed in Section 19.2.2.5, the impacts would be less than significant.

Land Acquisition of Proposed Range A and B Areas

As described in Chapter 2 of this volume, two ranges are proposed for the Route 15 lands near Andersen South. The Route 15 lands are owned by private owners as well as by the Government of Guam

(GovGuam), and the proposed action would include the federal government acquiring these lands through negotiation.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The site itself is sparsely developed; however, based on the data provided in Sections 19.1.2 – 19.1.4, the private land owners are likely to be racial minorities that live in areas with a higher poverty rate than the U.S.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Assuming that the lands are acquired through negotiations and compensation is paid to the landowners there would be no disproportionate adverse impact.

Access to Public Health and Social Services

Impacts would be the same as for the North.

Socioeconomic Impacts

Impacts would be the same as for the North.

19.2.2.3 Apra Harbor

As discussed in Chapter 2 of this volume, proposed Marine Corps actions at Navy Base Guam include the construction of a ship berthing and embarkation/staging area and the construction of an amphibious craft laydown area. Also included are the relocation of U.S. Coast Guard facilities, the military working dog kennel, and Apra Medical/Dental Clinic.

Off Base Transportation

The construction for the Marine Corps actions at Naval Base Guam would increase traffic along Route 1, but because only two facilities would be constructed, it is not a large enough action alone to increase traffic to significant levels. This is supported by the FHWA traffic study, which does not project that traffic would increase along the major roadways near Apra Harbor (Routes 1, 2A, and 11) to the level of congestion by 2014. So there would not be a significant adverse effect at Apra Harbor.

Access to Public Health and Social Services

Impacts would be the same as the North.

Socioeconomic Impacts

Impacts would be the same as the North.

19.2.2.4 South

Recreation

While there are fewer public recreational resources in the south, there are several resources along the coast as described in Volume 2, Chapter 9. An increase in the number of people using these resources is anticipated with implementation of the proposed action. This may have an adverse impact on the ability of others to use these resources.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

There are high percentages of racial minorities in the southern villages of Guam, and many of these villages have high levels of poverty and children.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Minority and low-income populations would be disproportionately affected as a function of the demographics of villages in the area. Children would not be disproportionately affected.

Tier 3: Would the disproportionate adverse effect(s) be significant?

Volume 2, Chapter 9 describes mitigation measures that would reduce the potential impacts to a less than significant level. Therefore, environmental justice impacts would also be mitigated to a less than significant level.

Off Base Transportation

The FHWA traffic study projections indicate that traffic on Route 5 would increase to the level of congestion by 2014 during the evening with the implementation of Alternative 1. This traffic increase will now be examined in terms of environmental justice.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

These roads run through the village of Santa Rita, which, while still having a high percentage of racial minorities, people in poverty, and children than the U.S., has one of the lowest poverty rates in Guam. Santa Rita has a relatively high proportion of children relative to other villages on Guam and the U.S. (refer to Table 19.1-1).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

The racial minorities and low-income populations living near Routes 5 would be disproportionately impacted. Children would not be disproportionately impacted.

Tier 3: Would the disproportionate adverse effect(s) be significant?

The FHWA traffic study projects that by 2014, the v/c ratio along Route 5 would be greater than 1, which indicates that traffic would increase to the level of congestion. Therefore, this impact would be significant. However, with implementation of the proposed mitigation measures in the FHWA traffic study, as well as those in Section 19.2.2.5, the impacts would be reduced to less than significant.

Access to Public Health Services

Impacts would be the same as the North.

Socioeconomic Impacts

Impacts would be the same as the North

19.2.2.5 Potential Mitigation Measures

To reduce potential impacts from the implementation of Alternative 1, it is recommended that the mitigation measures in Chapters 6, 8, 9, 10, 12 and 16 of Volume 2, as well as those in the transportation

chapter of this Volume 6, be implemented. This would reduce impacts related to noise, recreation, cultural resources, land ownership/use, and traffic on the surrounding community.

The following measures are recommended to address potential impacts to low-income people due to the proposed land acquisition or long term leasing of the Route 15 lands:

- The mitigation measures in Chapter 8, Land Use.

The following measures are recommended to reduce the strain on GDPHSS and GDMHSA health services for the poor and uninsured:

- DoD would consider assisting GovGuam in finding the resources needed to support the increase in demand for public services.

The following measures would likely reduce the socioeconomic impacts to low-income residents of Guam:

- The mitigation measures in Chapter 16, Socioeconomics.

19.2.3 Alternative 2 (Preferred Alternative)

19.2.3.1 North

The impacts for the actions proposed in Alternative 2 are the same as those discussed under Alternative 1.

19.2.3.2 Central

The impacts for the actions proposed in Alternative 2 are the same as those discussed under Alternative 1.

19.2.3.3 Apra Harbor

The impacts for the actions proposed in Alternative 2 are the same as those discussed under Alternative 1.

19.2.3.4 South

The impacts for the actions proposed in Alternative 2 are the same as those discussed under Alternative 1.

19.2.3.5 Potential Mitigation Measures

The mitigation measures proposed for Alternative 2 are the same as those proposed for Alternative 1.

19.2.4 Alternative 3

19.2.4.1 North

The impacts for the actions proposed in Alternative 3 are the same as those discussed under Alternatives 1 and 2.

19.2.4.2 Central

According to Volume 2, Chapter 10, Alternative 3 includes an adverse impact at Navy and Air Force Barrigada to vegetation due to the removal of 153 ac (62 ha) of previously uncleared limestone forest. The tree removal would generate traffic from construction laborers driving to and from the work site and the transport of material and debris. The villages adjacent to Navy and Air Force Barrigada are Mangilao and Barrigada. However, the proposed action would occur on base. This action will now be analyzed in terms of environmental justice.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

Both Mangilao and Barrigada have high percentages of racial minorities. Mangilao has a high percentage of poverty relative to the rest of Guam and the U.S., while Barrigada has a lower level of poverty relative to the rest of Guam but higher than the U.S. Both Mangilao and Barrigada have high percentages of children relative to CNMI and the U.S. (refer to Table 19.1-2).

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

This would affect the racial minorities and low-income populations who live in proximity to Routes 3 and 10 disproportionately. Children would not be disproportionately impacted.

Tier 3: Would the disproportionate adverse effect(s) be significant?

The FHWA traffic study projections indicate that the traffic along Routes 2 and 10 would increase to the level of congestion. However, with implementation of the proposed mitigation measures in the FHWA traffic study (Volume 6), the impacts would be reduced to less than significant.

19.2.4.3 Apra Harbor

The impacts for the actions proposed in Alternative 3 are the same as those discussed under Alternatives 1 and 2.

19.2.4.4 South

The impacts for the actions proposed in Alternative 3 are the same as those discussed under Alternatives 1 and 2.

19.2.4.5 Potential Mitigation Measures

The mitigation measures proposed for Alternative 3 are the same as those proposed for Alternatives 1 and 2.

19.2.5 Alternative 8

19.2.5.1 North

The impacts for the actions proposed in Alternative 8 are the same as those discussed under Alternatives 1 and 2.

19.2.5.2 Central

The impacts for the actions proposed in Alternative 8 are the same as those discussed under Alternatives 1 and 2.

19.2.5.3 Apra Harbor

The impacts for the actions proposed in Alternative 8 are the same as those discussed under Alternatives 1 and 2.

19.2.5.4 South

The impacts for the actions proposed in Alternative 8 are the same as those discussed under Alternatives 1 and 2.

19.2.5.5 Potential Mitigation Measures

The mitigation measure proposed under Alternative 8 are the same as those proposed under Alternatives 1 and 2.

19.2.6 No-Action Alternative

Under the no-action alternative, no construction or operations associated with the proposed action to Guam would occur. Existing operations at the proposed project areas would continue. Recreational and Cultural Resources like Pagat Trail in northern Guam would remain open to the public, so there would be no disproportionate impact to Chamorros. Traffic congestion along major roadways throughout Guam would not increase due to an influx of construction laborers and military.

The GDPHSS and GDMHSA services would be insufficient to meet the demand; however, their programs would not have the added strain of increased demand due to uninsured and underinsured migrant workers. The no-action alternative would not change the present impact and status of minority, low-income, or children populations.

Under the no-action alternative, the economy of Guam would not change as rapidly as under the proposed action. There would remain a high percentage of low-income people on Guam.

19.2.7 Summary of Potential Impacts

Tables 19.2-2, 19.2-3, 19.2-4, and 19.2-5 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 19.2-6 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. As these tables indicate, resources that may have effects in terms of Environmental Justice include cultural resources, traffic, access to public health services, and socioeconomics. With implementation of the mitigation measures in other chapters of this volume, these impacts would be reduced to less than significant.

Table 19.2-2. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
SI-M • Traffic along Routes 2, 28, 3, 3A, and 9 would increase to the level of congestion and disproportionately impact disadvantaged populations who live near them. With implementation of mitigation measures in Volume 6, would be reduced to less than significant.	SI-M • Traffic along Routes 2, 28, 3, 3A, and 9 would increase to the level of congestion and disproportionately impact disadvantaged populations who live near them. With implementation of mitigation measures in Volume 6, would be reduced to less than significant.	SI-M • Traffic along Route 3, Route 10 north of Route 32 to Route 8, Route 15 at its intersection with Route 10, and Routes 2, 16, 25, 26, and 28 would increase to the level of congestion and disproportionately impact disadvantaged populations living along these routes. With implementation of mitigation measures in Volume 6, would be reduced to less than significant.	SI-M • Traffic along Route 3, Route 10 north of Route 32 to Route 8, Route 15 at its intersection with Route 10, and Routes 2, 16, 25, 26, and 28 would increase to the level of congestion and disproportionately impact disadvantaged populations living along these routes. With implementation of mitigation measures in Volume 6, would be reduced to less than significant.

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
• Traffic is projected to increase to the level of congestion along Route 5 by 2014. This would disproportionately impact racial minorities and low-income people who live along or near Route 5. With implementation of mitigation in Volume 6, these impacts would be reduced to less than significant. • Cultural resources may be affected by construction, training, or vandalism, which would be a significant effect to resources valued by Chamorros. With implementation of mitigation measures in Chapter 12, this effect would be reduced to less than significant. • Access to public health and social services would be strained by an increase in uninsured and underinsured workers coming to Guam. Implementation of mitigation measures in Chapter 16 would reduce this effect. • The "boom and then bust" cycle of population growth and decline may stress the Guam economy. This would be felt more severely by low-income people, who often do not have resources to buffer hard economic times. Implementation of mitigation measures in Chapter 16 would reduce this effect.	• Cultural resources may be affected by construction, training, or vandalism, which would be a significant effect to resources valued by Chamorros. With implementation of mitigation measures in Chapter 12, this effect would be reduced to less than significant. • Access to public health services would be strained by an increase in uninsured and underinsured workers coming to Guam. Implementation of mitigation measures in Chapter 16 would reduce this effect. • The "boom and then bust" cycle of population growth and decline may stress the Guam economy. This would be felt more severely by low-income people, who often do not have resources to buffer hard economic times. Implementation of mitigation measures in Chapter 16 would reduce this effect.	• Impacts to cultural resources would be the same as for Alternative 1. • Access to public health services would be strained by an increase in uninsured and underinsured workers coming to Guam. Implementation of mitigation measures in Chapter 16 would reduce this effect. • The "boom and then bust" cycle of population growth and decline may stress the Guam economy. This would be felt more severely by low-income people, who often do not have resources to buffer hard economic times. Implementation of mitigation measures in Chapter 16 would reduce this effect.	• Impacts to cultural resources would be the same as for Alternative 1. • Access to public health services would be strained by an increase in uninsured and underinsured workers coming to Guam. Implementation of mitigation measures in Chapter 16 would reduce this effect. • The "boom and then bust" cycle of population growth and decline may stress the Guam economy. This would be felt more severely by low-income people, who often do not have resources to buffer hard economic times. Implementation of mitigation measures in Chapter 16 would reduce this effect.

Legend: SI-M = Significant impact mitigable to less than significant.

Table 19.2-3 Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
SI-M • Loss of access to and use of recreational resources (Guam International Raceway, Marbo Cave (spelunking and offshore fishing), Pagat Trail and associated trails, *suruhana* activities SI-M • Route 15 lands would be acquired for proposed Ranges A and B. Assuming that private lands would be acquired through negotiation and that landowners would be compensated, impacts would be less than significant	SI-M • Loss of access to and use of recreational resources (Guam International Raceway, Marbo Cave (spelunking and offshore fishing), Pagat Trail and associated trails, *suruhana* activities SI-M • Route 15 lands would be acquired for proposed Ranges A and B. Assuming that private lands would be acquired through negotiation and that landowners would be compensated, impacts would be less than significant

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant.

Table 19.2-4. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
NI • No impacts	NI • No impacts

Legend: NI = No impact.

Table 19.2-5. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
NI • No impacts	NI • No impacts

Table 19.2-6. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
NI • No impacts	NI • No impacts	NI • No impacts

Legend: NI = No impact.

19.2.8 Summary of Potential Mitigation Measures

The proposed action would likely have significant effects on racial minorities due to a risk of damage to, and a loss of access to, cultural and historic resources valued by Chamorros**.** These effects can be reduced to less than significant with implementation of Chapter 12 mitigation measures. Racial minorities and low-income populations that live near certain major roadways in northern, central, and southern Guam would likely experience increased traffic congestion related to construction; however, with implementation of mitigation measures in Volume 6, these impacts would be reduced to less than significant. Finally, potentially significant impacts to public services and socioeconomics would also be reduced to less than significant with implementation of mitigation measures in Chapter 16 of this EIS/OEIS.

CHAPTER 20. REFERENCES

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No references were cited.

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