CHAPTER 3
AFFECTED ENVIRONMENT

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Acronyms and Abbreviations

%	percent
CFR	Code of Federal Regulations
CJMT	Commonwealth of the Northern Mariana Islands Joint Military Training
CNMI	Commonwealth of the Northern Mariana Islands
DDT	dichlorodiphenyltrichloroethane
DoN	Department of the Navy
EIS	Environmental Impact Statement
MSL	mean sea level
NAVFAC	Naval Facilities Engineering Command
n.d.	not date
NEPA	National Environmental Policy Act
NMC-CREES	Northern Marianas College Cooperative Research, Extension and Education Service
OEIS	Overseas EIS
U.S.	United States

CHAPTER 3 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

According to the National Environmental Policy Act (NEPA) (40 Code of Federal Regulations [CFR] § 1502.15) "the Environmental Impact Statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration." Potential impacts cannot be determined without first understanding the existing conditions in the affected environment. For this reason, the impact analysis process involves two steps—identifying the affected environment and detailing the potential environmental consequences resulting from the alternatives. The geographic extent of the affected environment is determined by the potential for impacts to affect components of the human, natural, and cultural environment. From this point forward, these human, natural, and cultural components are referred to collectively as resource categories. Depending on the resource category, the extent of the affected environment/region of influence may differ. For instance, the proposed action may have impacts on soils within specific areas of the Military Lease Area; however, air pollutants generated by the proposed action would include areas downwind of the proposed action and could possibly influence the regional air quality. Following the affected environment discussion, Chapter 4 details the magnitude of potential impacts or "environmental consequences" of the proposed action on the resource categories.

3.2 GEOLOGY AND SOILS

Section 3.2 describes the geology and soils in the region of influence for the proposed action. The geology and soils of the islands of Tinian and Pagan including the adjacent marine geology and sediments (out to a distance of 1,000 feet [300 meters]) comprise the region of influence for this resource. This distance from shore for marine geology and sediments is based on the footprint of amphibious training under the proposed action. Geology and soils include the natural physical characteristics of the land forms (topography), the underlying soils and rocks (structural geology), and any associated geologic hazards.

3.2.1 Definition

The discussion of this resource includes an overall description of the regional geological setting as well as a description of the topography, geology (geologic units and hazards), and soils associated with the region of influence (i.e., Tinian and Pagan). These terms are defined below.

- ***Topography*** - the natural and man-made features of a place or region that show relative positions and elevations at the earth's surface.
- ***Geology*** - the bedrock materials, mineral deposits, and fossil remains of an area.
- ***Geologic Unit*** - a volume of rock of identifiable origin or age that is defined by the distinctive, dominant, easily mapped, and recognizable physical characteristics and features that characterize it.

- ***Geologic Hazards*** - one of several types of adverse geologic conditions capable of causing damage or loss of property and life. This includes adverse results of seismic activity (e.g., earthquakes or fault ruptures), liquefaction, volcanic activity, landslides, tsunamis, and sinkholes.
- ***Soils*** - unconsolidated earthen materials overlying rock.
- ***Erodibility*** - it is a measure of the susceptibility of soil particles to detachment and transport by rainfall and runoff.
- ***Runoff Rate*** - speed at which water that is not absorbed by the soil travels over and off the surface.
- ***Impervious Surfaces*** - surfaces covered or compacted to the point that water cannot be absorbed by the soil.
- ***Karst*** - landscape underlain by limestone that has been eroded by dissolution, producing ridges, towers, fissures, sinkholes, and other characteristic landforms.
- ***Sink Hole*** - a depression or hole in the ground caused by some form of collapse of the surface layer.

3.2.2 Regulatory Framework

The regulatory framework governing geologic and soil resources is listed below. A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations*. The United States (U.S.) Army Corps of Engineers and the U.S. Environmental Protection Agency are the primary federal agencies with jurisdiction over geological and soil resources. Within the Commonwealth of the Northern Mariana Islands (CNMI), the CNMI Bureau of Environmental and Coastal Quality is the administrative authority for the Clean Water Act. The U.S. Department of Agriculture is the regulatory entity with oversight of the Farmland Protection Policy Act. The Department of Defense adheres to Unified Facility Criteria 3-310-04 which provide planning, design, construction, sustainment, restoration, and modernization criteria. Federal and local regulations and codes that serve to protect, conserve, and manage geological and soil resources are listed below.

3.2.2.1 Federal Regulations and Codes

- Clean Water Act
- Farmland Protection Policy Act, 7 U.S. Code § 4201 regulated by the U. S. Department of Agriculture
- Unified Facility Criteria 3-310-04

3.2.2.2 CNMI Regulation

- CNMI Earthmoving and Erosion Control Regulations
- Water Quality Standards
- Drinking Water Regulations
- Well Drilling and Well Operation Regulations

3.2.3 Methodology

Reports, studies, and data sets prepared by or for the federal government, the CNMI government, and independent researchers which address natural resources (e.g., geology, soils, groundwater) and infrastructure (e.g., utilities) on Tinian and Pagan were reviewed for information related to the existing condition of geological and soil resources. All topography, geologic units, geologic hazards, and soils identified during literature review which could be potentially affected by the proposed action are described below. Federal and CNMI regulations were reviewed for regulations that serve to protect, conserve, and manage geological and soil resources.

3.2.4 Regional Geologic Setting

The islands of Tinian and Pagan are located on a volcanic arc adjacent to the Mariana Trench subduction boundary where tectonic plates converge. “Tectonic plates” are massive pieces of the earth’s crust and upper mantle that move and come in contact with each other on the Earth’s surface. A “subduction boundary” occurs where the edge of a denser plate moves under a less dense tectonic plate. The Mariana Trench and the Mariana Islands are part of an active subduction zone where the more dense Pacific Oceanic (tectonic) Plate, moving northwest, passes beneath the less dense Philippine Plate, moving west-northwest (Figure 3.2-1). These plates are constantly moving, resulting in many geologic phenomena (i.e., earthquakes, tsunamis, and volcanic activity) that originate where the moving plates encounter each other. During the past century, more than 40 earthquakes of magnitude 6.5 to 8.1 on the Richter Scale have occurred in the Mariana Trench region (Trusdell et al. 2006) and several of the islands feature active volcanoes.

The geology of individual islands in the Mariana Islands is largely dependent on the degree of volcanic activity present. The older, southern islands, including Tinian, generally consist of a volcanic core that was covered by coralline limestone in layers up to several hundred feet thick, which formed as the volcanic core was exposed above the ocean surface. Uplifting of the Philippine Plate resulted in the limestone caps being pushed several hundred feet above sea level. In some locations, the volcanic cores of these southern islands are exposed by the results of either volcanic activities or erosion of the limestone. The younger (northern) islands, including Pagan, generally consist of exposed volcanic cones (i.e., conical hill produced by volcanic eruptions) and calderas (i.e., large crater formed by volcanic explosion or collapse).

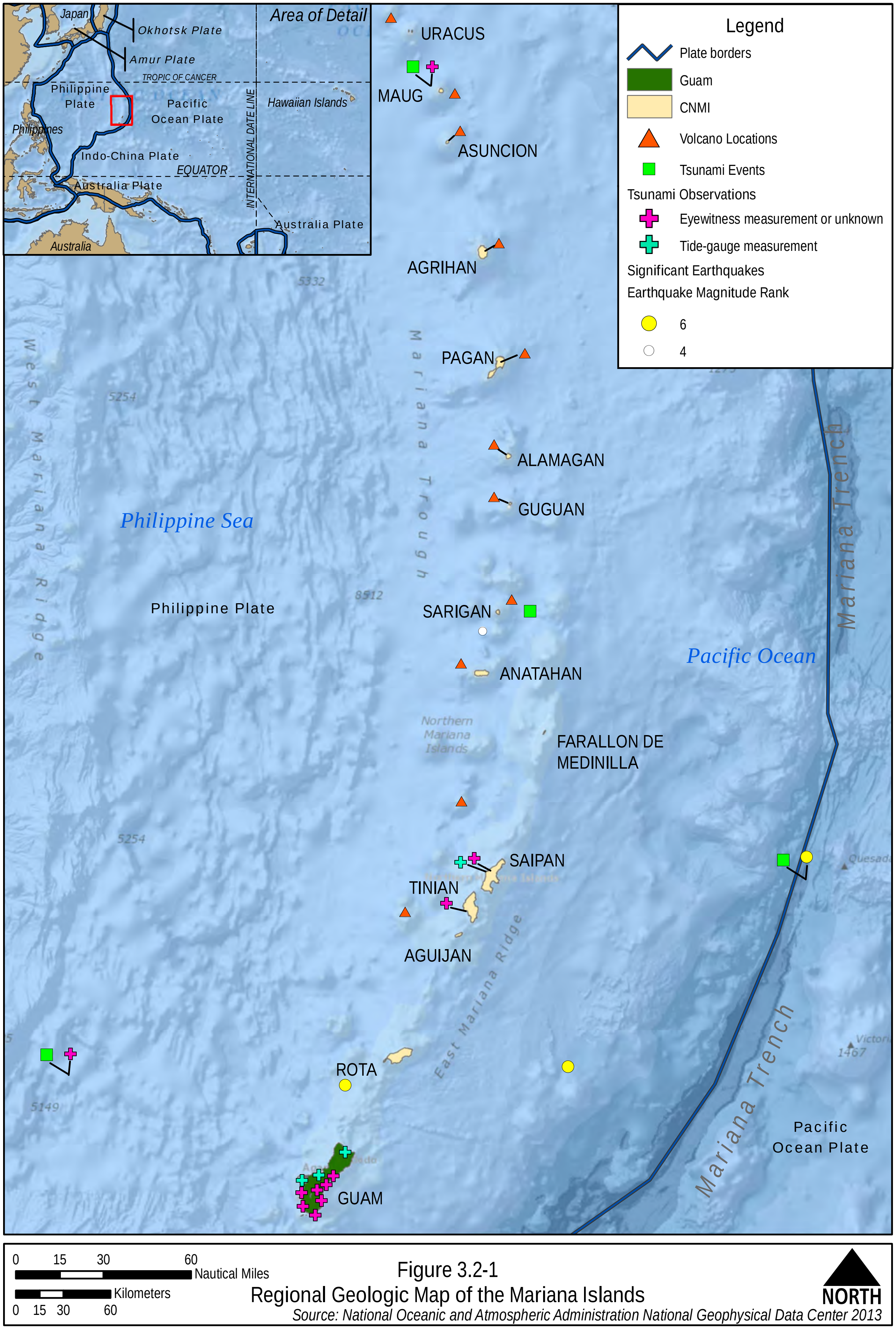


Figure 3.2-1
Regional Geologic Map of the Mariana Islands
Source: National Oceanic and Atmospheric Administration National Geophysical Data Center 2013

3.2.5 Tinian

3.2.5.1 Topography

Tinian is about 12 miles (19 kilometers) long and 6 miles (10 kilometers) wide. It is composed of a series of limestone plateaus separated by steep slopes and cliffs (Young 1989). The surface landforms can be divided into five major physiographic areas described below and shown on Figure 3.2-2 (Doan et al. 1960; Gingerich 2002).

- **Southeastern Ridge:** This land feature is the southernmost topographic feature on the island and includes Mount Kastiyu, the highest part of the island at 614 feet (187 meters). It has steep slopes and cliffs as high as 500 feet (150 meters).
- **Median (Marpo) Valley:** A low, broad depression located north of the Southeastern Ridge, this area has a maximum elevation of 150 feet (46 meters). This area includes San Jose Village.
- **Central Plateau:** This land area extends northward from Marpo Valley and includes all of central Tinian and portions of northern Tinian. The plateau is broad and gently sloping with the majority of the vertical relief at its southern and northern boundaries. This area includes the Tinian International Airport and portions of the Military Lease Area.
- **North-Central Highland:** This land area is located within the northern part of the Central Plateau and midway between the east and west coasts of the island. The maximum elevation is 545 feet (166 meters) at Mount Lasso.
- **North Lowland:** This land area is located at the very northern part of the island. It is generally flat with an average elevation of about 100 feet (30 meters), except for Lake Hagoi, where the elevation is approximately at sea level.

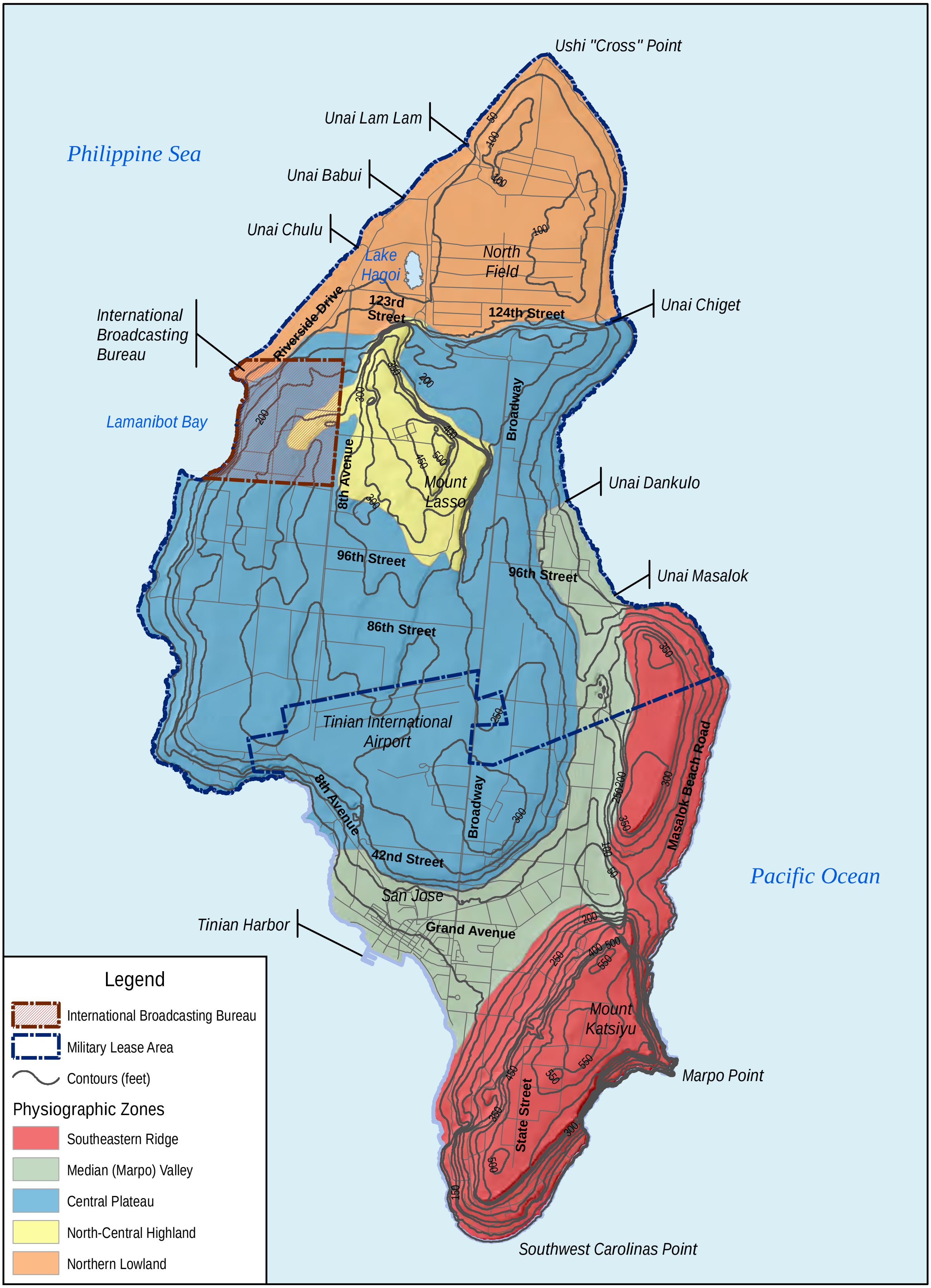


Figure 3.2-2
Tinian Physiographic and Topographic Map

Source: Gingerich 2002

3.2.5.2 Geology

3.2.5.2.1 Geologic Units

Tinian represents an extinct volcanic core (greater than 38 million years old) covered by younger limestone formations (5 to 23 million years old) and recent beach and reef deposits. The island is composed mainly of coralline and algal limestone overlying volcanic rock. The volcanic rock is only observable at ground surface in two localized areas in the vicinity of Mount Lasso (Figure 3.2-3) (Gingerich 2002). The limestone is highly porous, so water easily flows through it (Gingerich 2002). The raised limestone plateaus that characterize the island are evidence of uplifting caused by movement along high-angle normal faults. Figure 3.2-3 shows the four major geologic units that comprise Tinian. They are explained below.

- **Tinian Pyroclastic (volcanic) Rock:** These fine-grained to coarse-grained ash and angular fragments represent volcanic explosive materials ejected from an ancient (extinct) volcano that forms the core of the island. These rocks are exposed on the North-Central Highland and Southeastern Ridge and cover about 2 percent (%) of the surface of the island. These materials are generally highly weathered and are altered to clay in surface exposures. Because of its texture and density, this rock unit has low permeability (i.e., water does not flow easily through it).
- **Tagpochau Limestone:** These rocks are exposed on approximately 15% of the island's surface, generally in the North-Central Highland and the southern part of the Southeastern Ridge. This formation reaches thicknesses of up to 600 feet (180 meters). It is composed of fine to coarse-grained, partially recrystallized broken limestone fragments and approximately 5% reworked volcanic fragments and clays. This formation is very porous and water flows easily through it.
- **Mariana Limestone:** This formation covers approximately 80% of the island's surface, forming nearly all of the North Lowlands, the Central Plateau, and the Marpo Valley. This formation reaches thicknesses up to 450 feet (140 meters). It is composed of fine to coarse-grained fragmented limestone, with some fossil and algal remains, and small amounts of clay particles. Small voids and caverns are common in surface exposures. The Mariana Limestone has a higher coral content than the Tagpochau Limestone but is similarly porous, allowing water to readily flow through it.
- **Beach Deposits, Alluvium, Colluvium, and Marsh:** These deposits cover less than 1% of the island's surface and reach a thickness of up to 15 feet (5 meters). The deposits are made up of poorly consolidated sediments, mostly sand and gravel deposited by waves. However, they do contain clays and silt deposited inland at Lake Hagoi and Makpo Marsh, as well as loose soil and rock material found at the base of slopes.

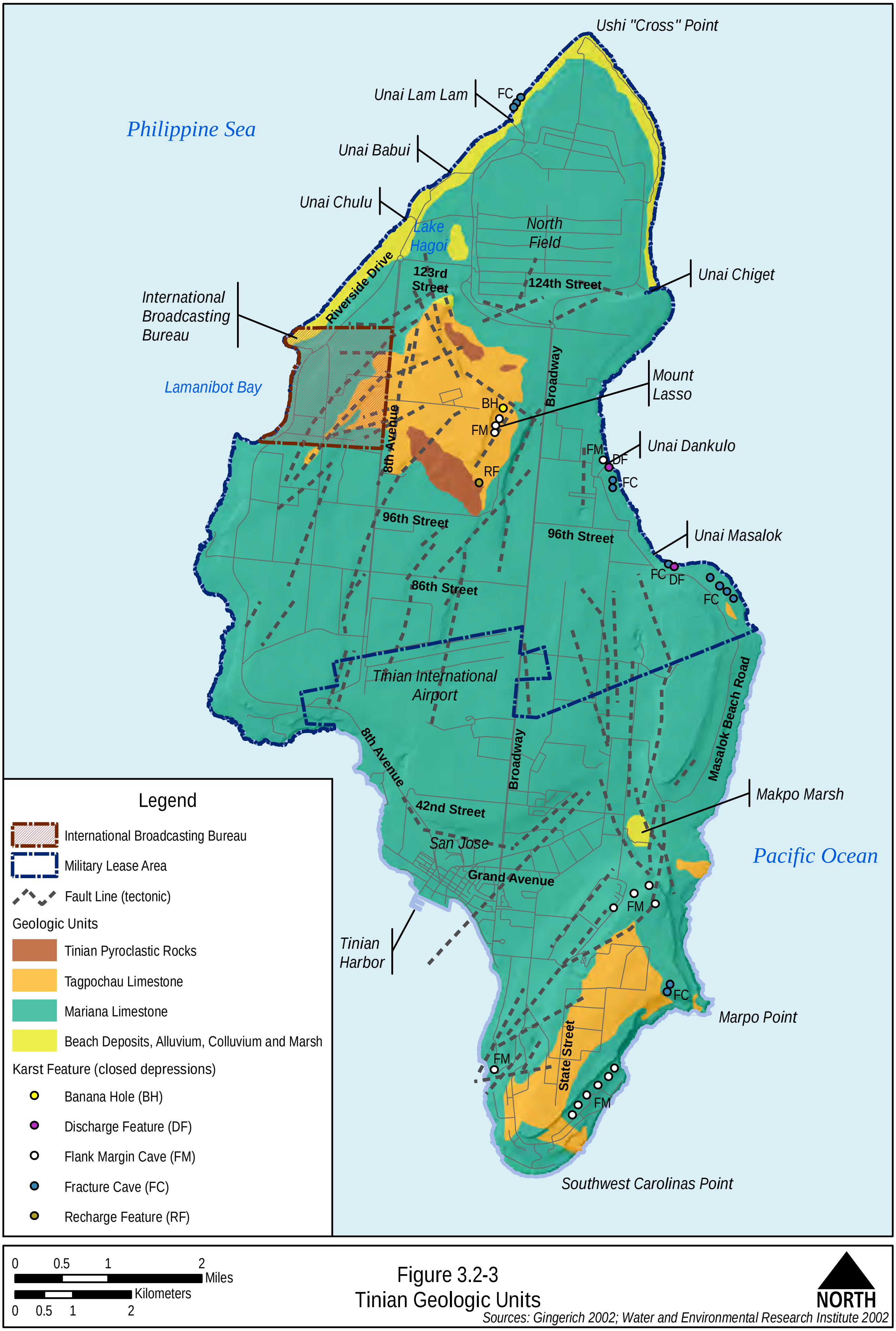


Figure 3.2-3
Tinian Geologic Units
Sources: Gingerich 2002; Water and Environmental Research Institute 2002

3.2.5.2.1.1 Coastal Geology

The majority of the Tinian coastline is characterized by limestone cliffs (Photo 3.2-1) with sea-level caverns, notches, cuts, and slumped materials (i.e., materials that have collapsed or fallen) commonly bordered by intertidal limestone benches (elevated flat areas). Beach deposits are mostly medium-to-coarse grain calcareous sands, gravels, and rubble interspersed over exposed limestone. Submarine topography is characterized by limestone with interspersed coral colonies and occasional submerged boulders. A more thorough discussion of the coral reef is presented in Section 3.10, *Marine Biology*.

Photo 3.2-1. View of typical Tinian coastline with limestone cliffs

There are four beaches proposed for different types of amphibious training (see Section 2.4.1.3.6), all of which are located within the Military Lease Area. They are described below, depicted on Figure 3.2-4, and further described in Section 3.10, *Marine Biology*.

- **Unai Babui:** Located on the leeward (western) side of the island, it is approximately 200 feet (60 meters) long with a land area of approximately 0.08 acre (0.03 hectare).
- **Unai Chulu**: Located on the leeward (western) side of the island, it is approximately 790 feet (240 meters) long with a land area of approximately 3 acres (1 hectare).
- **Unai Lam Lam:** Located on the leeward (western) side of the island, it is approximately 55 feet (17 meters) long with a land area of approximately 0.1 acre (0.04 hectare).
- **Unai Masalok:** Located on the windward (eastern) side of the island, it comprises three beaches covering a distance of 1,600 feet (370 meters) and 0.2 acre (0.1 hectare).

3.2.5.2.1.2 Karst Geology

Karst is a distinctive landscape formed when water dissolves rocks. This creates large voids, such as sinkholes and caves, as well as smaller features characterized by rough surfaces, little soil, and small cavities known as epikarst. The epikarst commonly acts as a conduit for surface water (such as rainfall) to the underlying groundwater aquifer by percolation or channelization through connected subsurface voids or cavities.

Figure 3.2-4
Proposed Amphibious Training Beaches on Tinian

Epikarst that is not ordinarily saturated by groundwater or surface water may provide a large amount of water storage in voids and cavities. The fast flow of water through the joints and channels of epikarst does not allow for adsorption (by soil), uptake (by plants), or microbial processes to occur that would ordinarily remove pollutants contained in surface waters before they reach groundwater (Islam 2005). Karst geology on Tinian includes epikarst, closed depressions (e.g., sinkholes), caves, and freshwater discharge features (Stafford et al. 2005). Epikarst is present in all of the limestone rock formations on Tinian and its characteristics vary based on proximity to the coast. Coastal epikarst is jagged as result of the effects of sea spray, while inland epikarst surface features become less extreme (Stafford et al. 2005). Sinkholes, a type of epikarst, can occur naturally or as a result of excavation, change in drainage patterns, or lowering of the groundwater table (Islam 2005); sinkholes can occur anywhere within the limestone formations on Tinian. Caves can form in limestone deposits in the mixing zone of the salty groundwater and fresh groundwater lens. These caves are present along portions of Tinian's coast.

There are three main types of closed depressions on Tinian: (1) dissolutional (when water dissolves rock); (2) constructional (caused by faulting or certain rock formations); and (3) man-made or modified (e.g., excavations such as quarries, borrow pits, or landfills). Twenty closed depressions were identified during the 2005 karst survey (Stafford et al. 2005), in both inland and nearshore locations on Tinian: 7 of them were identified as dissolutional, 8 constructional, and 5 man-made or modified. Figure 3.2-3 provides the locations of the closed depressions identified in the karst survey.

3.2.5.2.2 Geologic Hazards

Potential geologic hazards on Tinian include seismic activity (e.g., earthquakes along faults), liquefaction, landslides, tsunamis, and karst features (e.g., sinkholes). Additional information on these hazards is provided in the following sub-sections.

3.2.5.2.2.1 Seismic Activity

An earthquake is caused by 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 change in the earth's crust (U.S. Geological Survey 2013). Faults on Tinian are shown in Figure 3.2-3. In addition, there are several nearby faults along the ocean floor that could potentially cause significant earthquakes felt on Tinian. There have been 13 destructive earthquakes in the Mariana Islands during the past two centuries (Mueller et al. 2013) with the majority of the recorded impacts (i.e., property damage, injuries) felt on Guam (approximately 130 miles [225 kilometers] to the south).

3.2.5.2.2.2 Liquefaction

When loose sand and silt is saturated or partially saturated with water and shaken by an earthquake it can behave like a liquid; this is known as earthquake liquefaction. The soil can lose its ability to support structures, flow down gentle slopes, and erupt to the ground surface to form sand boils (i.e., upward movement of sand). This can cause damage to buildings, roads, and pipelines. Three factors are required for liquefaction to occur: (1) loose, granular sediment is present; (2) the sediment is saturated or partially saturated by groundwater (i.e., water fills the spaces between sand and silt grains); and (3) strong shaking occurs (i.e., from a strong earthquake). Typically, liquefaction occurs in areas where there are loose soils with poor drainage. On Tinian, these conditions could be present on fill land located near the coast (e.g., Port of Tinian).

3.2.5.2.2.3 Landslides

The term landslide includes a wide range of ground movement such as rock falls, deep failure of slopes, and shallow debris flows. Earthquakes of magnitude 4.0 and greater are known to trigger landslides (U.S. Geological Survey 2013). Tinian has numerous fault scarps depicted as "fault lines" on Figure 3.2-3. These are related to the uplift of the limestone formations as a result of tectonic activity in the region. In general, the consolidated nature of the limestone and volcanic units reduce the potential for slope failure; however, there is a potential for slope failure to occur due to wet tropical weather on Tinian combined with weathered rock and steep cliffs along the island's perimeter, and areas of land disturbance.

3.2.5.2.2.4 Tsunamis

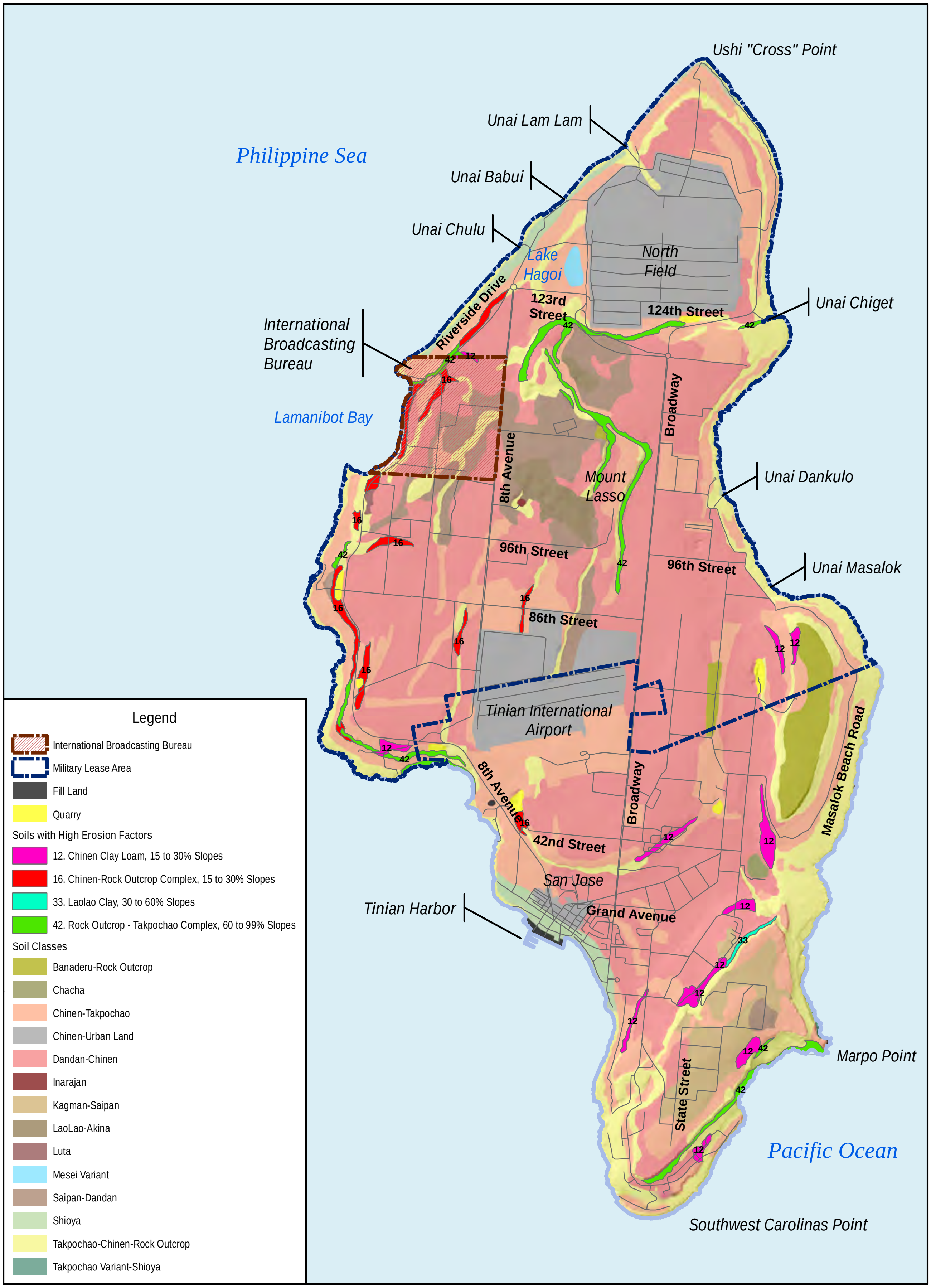
A tsunami is a sea wave that can result from large-scale seafloor displacements associated with large earthquakes, major submarine landslides, or volcanic eruptions. The Mariana Islands have had recorded tsunami events dating back to 1700 (Uslu et al. 2013). Doan et al. (1960) notes that Tinian is not likely to be vulnerable to tsunamis originating from distant earthquakes or landslides due to the geographic location and the close proximity to Saipan. However, Tinian may be vulnerable to those generated by disturbances along the volcanic axis (Mariana Islands) associated with the subduction zone at the Mariana Trench. Shocks emanating from this region have the potential to generate tsunamis capable of impacting the Tinian Harbor area and the low-lying Median Valley, or other areas not protected by coastal cliffs. On March 11, 2011, evacuations were ordered for low-lying areas in the CNMI in response to the earthquake and ensuing tsunami in Japan, no damage was reported.

3.2.5.2.2.5 Karst Features

Tinian exhibits several different types of karst features including naturally formed dissolution-type closed depressions or sinkholes, human modified depressions, and limestone caves. Figure 3.2-3 illustrates the location of karst features on Tinian mapped by Stafford et al. (2004). Due to the porous nature of the limestone formations that underlie much of the island, other unmapped karst features are likely to be present. These include sinkholes, caves, recharge features (i.e., voids in the rock that allow water to seep into the subsurface), and discharge features (i.e., voids in the rock where groundwater seeps out of the subsurface).

3.2.5.3 Soils

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Figure 3.2-5 shows the horizontal distribution of these soil classes and Table 3.2-1 describes the soil characteristics within the affected environment (i.e., Military Lease Area, Tinian International Airport, and Tinian Harbor). Appendix F, *Geology and Soils Technical Memo* provides a detailed table and map showing the soil units associated with the soil classifications.



0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

Figure 3.2-5
Tinian Soil Classes
Associated with the Affected Environment

NORTH

Source: Young 1989

Table 3.2-1. Soil Classifications Associated with the Affected Environment

Soil Class	*Soil Description*	*Location*
Banaderu-Rock Outcrop	Shallow, well drained, nearly level, to moderately steep soils, and rock outcrop.	Limestone Plateaus
Chacha	Shallow and deep, and poorly drained, and found on steep slopes, plateaus, and hills.	Limestone Uplands
Chinen-Takpochao	Very shallow and shallow, well drained, nearly level to strongly sloping soils; on plateaus and side slopes.	Limestone Plateaus
Chinen-Urban Land	Shallow, well-drained, nearly level soils and urban areas.	Limestone Plateaus
Dandan-Chinen	Shallow and moderately deep, well drained, nearly level to strongly sloping soils.	Limestone Plateaus
Inarajan	Very deep, poorly drained soils.	Valley Bottoms and Coastal Plains
Kagman-Saipan	Deep and very deep, well drained, nearly level to strongly sloping soils.	Limestone Plateaus
Laolao-Akina	Moderately deep, well drained, strongly sloping to steep soils; on volcanic uplands.	Uplands
Luta	Very shallow, well drained, nearly level to strongly sloping soils.	Limestone Plateaus
Mesei Variant	Moderately deep, very poorly drained, level soils.	Depressional Areas
Rock Outcrop-Takpochao-Luta	Shallow and very shallow, well drained, strongly sloping to extremely steep soils and rock outcrop; on limestone escarpments.	Uplands
Saipan-Dandan	Moderately deep and very deep, well drained, nearly level to gently sloping soils.	Limestone Plateaus
Shioya	Very deep, excessively drained, level to nearly level soils; on coastal strands.	Coastal Limestone Sands
Takpochao-Chinen-Rock Outcrop	Shallow, well drained, strongly sloping to extremely steep soils and rock outcrop; on limestone escarpments and plateaus.	Uplands
Takpochao variant-Shioya	Very shallow to very deep excessively drained, levels to gently sloping soils; on coastal stands and plateaus.	Lowlands

Source: Young 1989.

Soil types and characteristics affect the potential for soils to erode. The U.S. Department of Agriculture defines soil erosion as the "removal of material from the surface soil, which is the part of the soil having an abundance of nutrients and organic material vital to plant growth." Natural causes of soil erosion include wind and water. Human and wildlife activities can accelerate soil erosion (Muckel 2004). There are several soil units in the vicinity of the proposed action (i.e., Military Lease Area, Tinian International Airport, and Tinian Harbor) that are characterized as having the greatest susceptibility for soil erosion. These soil units are generally located in areas with steep slopes and include the following: (1) Chinen Clay Loam (15-30% slopes); (2) Chinen-Rock Outcrop Complex (15-30% slopes); (3) Laolao Clay (30-60% slopes); and (4) Rock Outcrop-Takpochao Complex (60-99% slopes). These soil units are shown in Figure 3.2-5 and are further described in Appendix F, *Geology and Soils Technical Memo*.

Most of the soil units located in the vicinity of the proposed action are characterized by slow water runoff or the potential for water to pond. These characteristics can cause issues with flooding or problems with construction if adequate grading and drainage are not provided for structures and roads. These soil types are largely located on relatively gentle slopes. Their locations and further description are provided in Appendix F, *Geology and Soils Technical Memo*.

Prime farmland soils are soils that are best suited to producing sustained high yields of crops (Young 1989). Two prime farmland soil units have been identified in the vicinity of the proposed action (Figure 3.2-6): (1) Dandan-Saipan clays, (0-5% slope) and (2) Saipan clay (0-5% slope). Appendix F, *Geology and Soils Technical Memo* provides a description of these soil units.

3.2.6 Pagan

3.2.6.1 Topography

Photo 3.2-2. View of Mount Pagan

Pagan is about 10 miles (16 kilometers) long and 4 miles (6 kilometers) wide. The island consists of two stratovolcanoes joined by an isthmus (narrow strip of land) with a width of 1,980 feet (660 meters). Pagan's main topographic features are Mount Pagan (or North Pagan Volcano), 1,870 feet (570 meters) above mean sea level (MSL) (Photo 3.2-2) and South Pagan Volcano, 1,771 feet (540 meters) above MSL (Figure 3.2-7) which are connected by the narrow isthmus. There are two lakes situated on the west side of Mount Pagan: Upper Lake or Laguna Sanhalom and Lower Lake or Laguna Sanhiyon. Figure 3.2-7 provides a topographic map of Pagan with four slope classes: (1) 0-5%; (2) 6-15%; (3) 16-30%; and (4) greater than 30%. The steepest slopes are located at Mount Pagan (sloping to the west towards the two lakes), along the isthmus leading to South Pagan Volcano, and around much of South Pagan Volcano. The gentlest slopes are located immediately south and southwest of Mount Pagan.

A well-defined valley system exists but there are no streams associated with these valleys. These valley systems were most likely developed during torrential downpours or soon after volcanic eruptions (Corwin et al. 1957). Most large valleys are directed down original volcanic slopes in a radial pattern. Terrain features described by Corwin et al. (1957) include plains and basin floors, lava fields, caldera backslopes, dissected ridges, cinder cones, volcanoes, rugged highlands, and major escarpments.

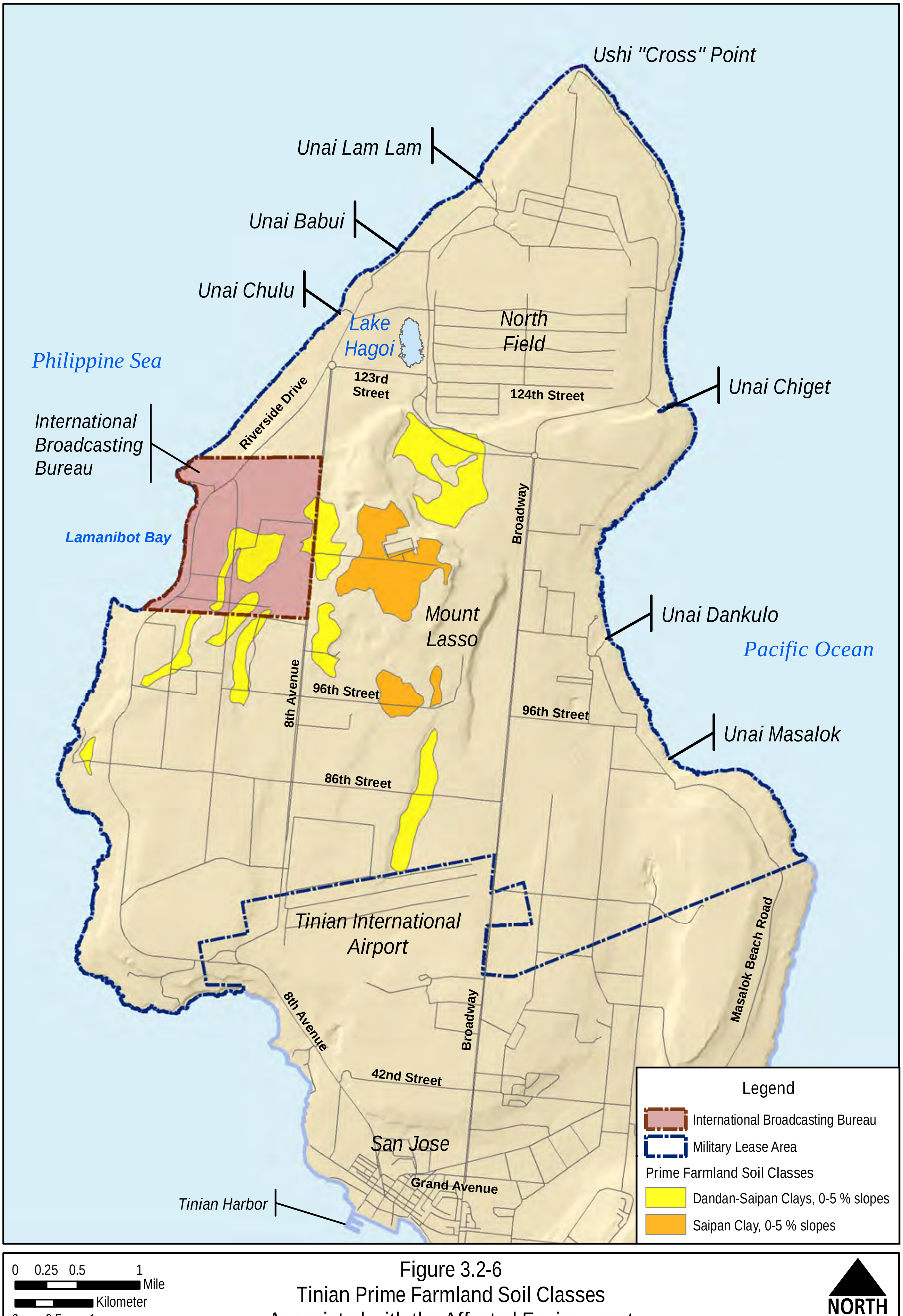


Figure 3.2-6
Tinian Prime Farmland Soil Classes
Associated with the Affected Environment

Source: Young 1989

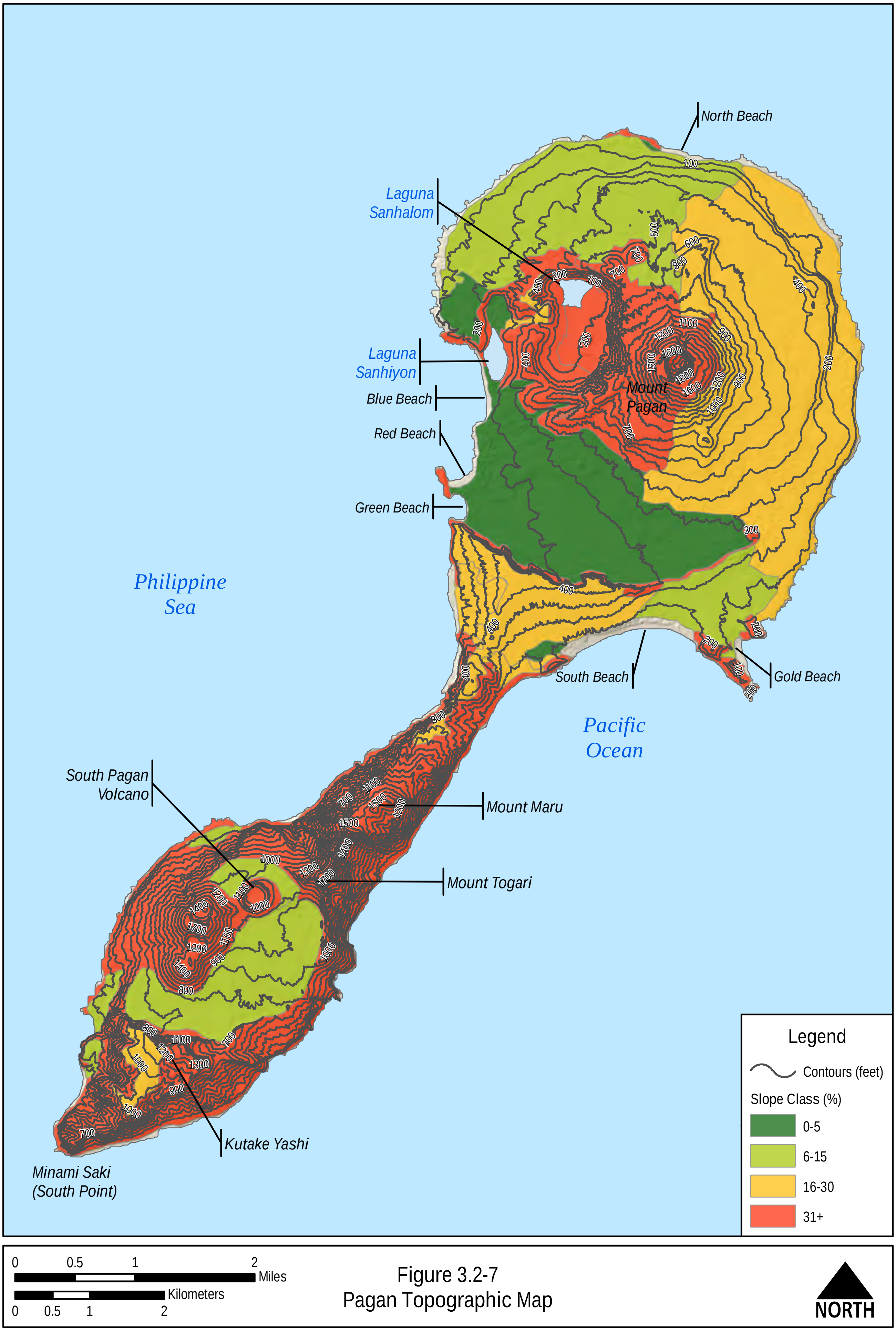


Figure 3.2-7
Pagan Topographic Map

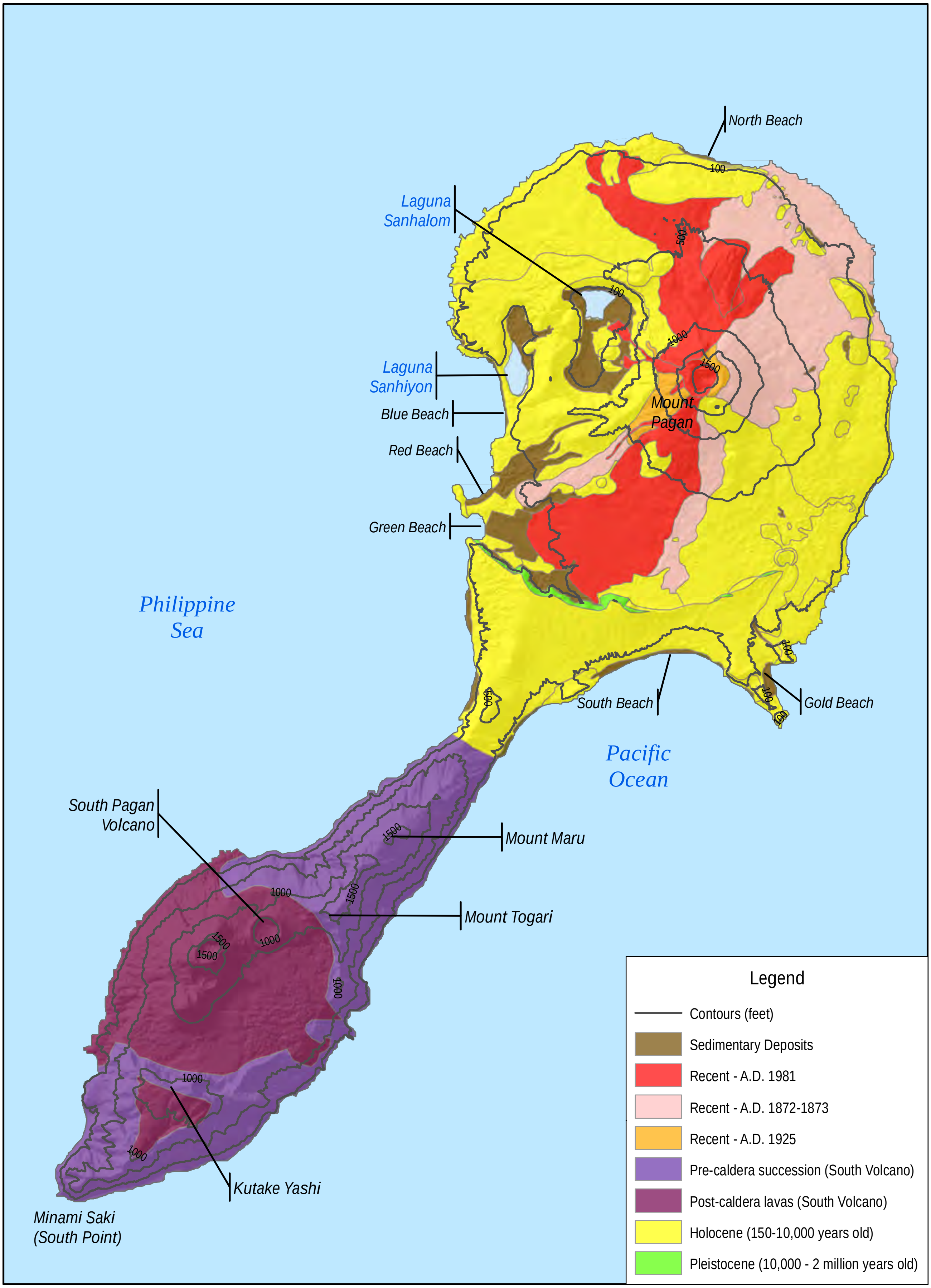
3.2.6.2 Geology

Mount Pagan and South Pagan Volcano are exposed volcanic cones formed within the calderas of two ancient stratovolcanoes (Banks et al. 1984) (Figure 3.2-8). A stratovolcano, also known as a composite volcano, is a conical volcano built up by many layers (strata) of hardened lava and pyroclastic materials such as volcanic ash. The structure of the two stratovolcanoes is located primarily beneath the ocean surface (i.e., submarine flanks). The northern portion of the island where Mount Pagan is located is a partially collapsed caldera. Mount Pagan is the larger and more active of the two exposed volcanoes (Banks et al. 1984). Few detailed studies of the geology and historic eruption activities of Pagan have been done. The oldest exposed lava flows on Pagan appear to be less than 700,000 years old (Banks et al. 1984). Trusdell et al. (2006) notes reports of eruptions in the 1600s, 1872-73, the 1920s, and on May 15, 1981. On May 15, 1981, a large eruption occurred from Mount Pagan that sent columns of gas and volcanic ash 8 miles (13 kilometers) into the stratosphere. As a result of this explosive eruption and continuing volcanic activity, Pagan residents were evacuated from the island and it has not been resettled. Since 1981, a number of eruptions, ash, and low-level gas and steam plumes have been confirmed from Mount Pagan in 1987, 1988, 1992, 1993, 1996, 2006, 2010, 2011, and 2012 (Smithsonian Institution National Museum of Natural History 2014).

3.2.6.2.1 Geologic Units

Photo 3.2-3. View of *a'a* lava just north of the Pagan airfield

A generalized geologic map was prepared by Corwin et al. (1957) (Figure 3.2-8) which shows geologic units on Pagan. Geologic units mapped included Quaternary-age lavas and ash deposits that pre-date and post-date the existing Mount Pagan and South Pagan Volcano. Limited portions of the shoreline included recent raised reef deposits (i.e., shown as sedimentary deposits in Figure 3.2-8). A more recent effort by the U.S. Geological Survey (Trusdell et al. 2006) mapped and conducted age-dating of various deposits on the northern portion of the island. All units and surface deposits of Mount Pagan are basalt, andesite, or a combination of the two. Rock outcrops include cinder or spatter cones, lava flows (*a'a* which is jagged or pahoehoe which is smooth) (Photo 3.2-3), or consolidated or unconsolidated pyroclastic (ash) deposits. In these deposits, pozzolan, a siliceous and aluminous material is found. Pozzolan, like that found on Pagan, is a material used in cement and concrete. The pozzolan deposits on Pagan were mapped by the U.S. Geological Survey in 2006 (Trusdell et al. 2006) and revised in 2007 (Ding and Wilson 2007). The pozzolan deposits found on Pagan are depicted by thickness contours on Figure 3.2-9 (Ding and Wilson 2007). The estimated volume of pozzolan is described in Section 3.15, *Socioeconomics and Environmental Justice*.



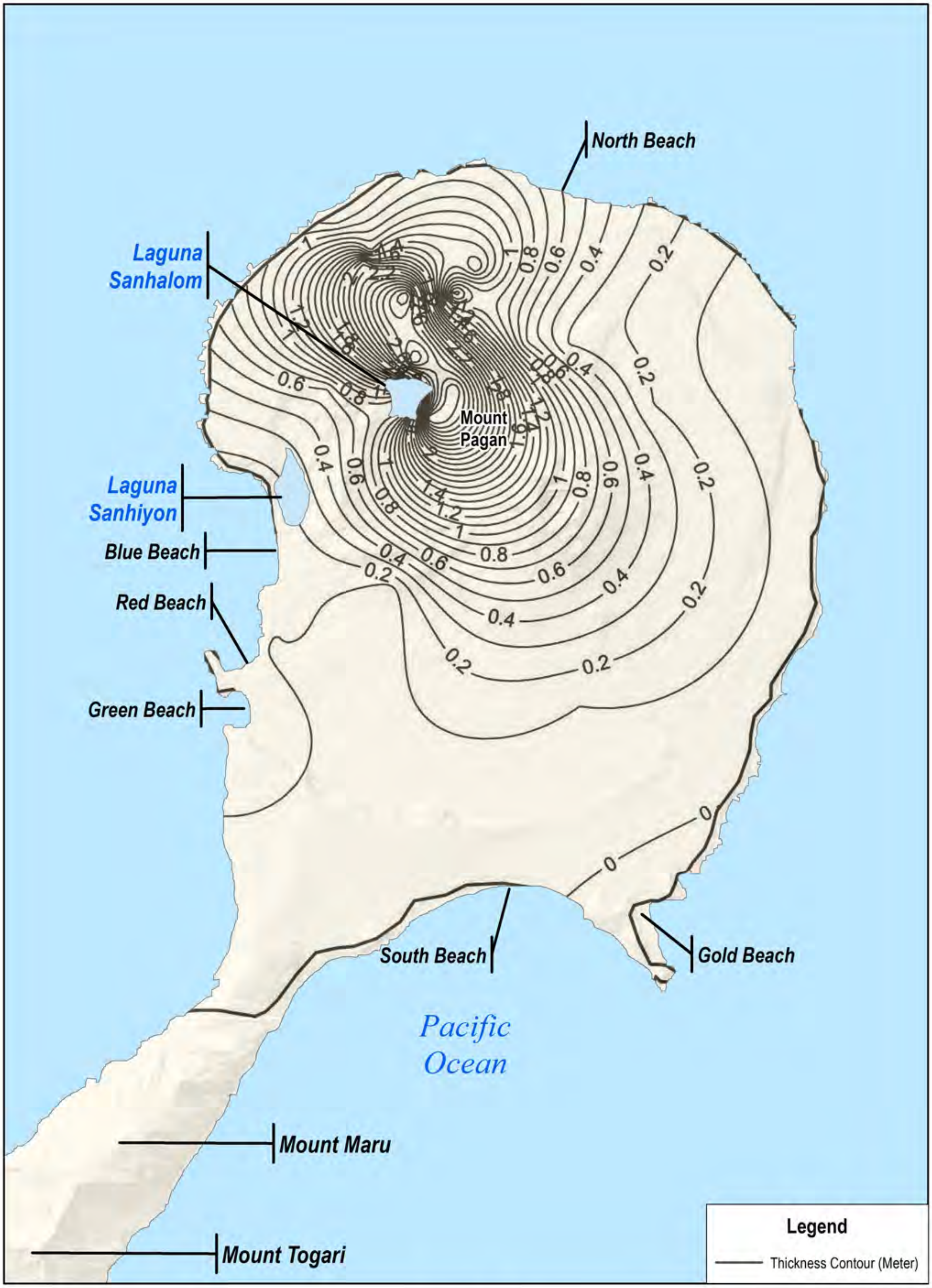
0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

Figure 3.2-8
Pagan Generalized Geologic Map

NORTH

Source: Corwin et al. 1957; Trusdell et al. 2006



0 0.5 1 Mile
0 0.5 1 Kilometer

Figure 3.2-9
Pagan Pozzolan Deposits

NORTH
Source: Wilson & Ding 2007

3.2.6.2.2 Geologic Hazards

Geologic hazards of concern for Pagan include the possibility of seismic activity (e.g., earthquakes), volcanic activity, landslides, and tsunamis. These concerns are addressed in the following sub-sections.

3.2.6.2.2.1 Seismic Activity

Seismic activity on Pagan can be attributed to its close proximity to the Mariana Trench subduction zone (see Section 3.2.4, *Regional Geologic Setting*), and the presence of two active volcanoes on the island. Seismic activity from low magnitude earthquake swarms has been documented and high magnitude earthquakes are possible. Months prior to the major explosive eruption of Mount Pagan in 1981, a number of locally felt earthquakes occurred, as described in the following section. On the day of the eruption, a swarm of small earthquakes occurred followed by a loud boom (Trusdell et al. 2006). These earthquakes are thought to have been the result of shifting underground magma (molten lava).

Other types of earthquake-generating activity in the region are the same as those described for Tinian. Pagan is not currently monitored with ground-based geophysical instrumentation to monitor seismic activity.

3.2.6.2.2.2 Volcanic Activity

Six of the northern Mariana Islands (i.e., Anatahan, Guguan, Pagan, Agrihan, Asuncion, and Uracus) have stratovolcanoes that have erupted in the past century (Trusdell et al. 2006). Lava flows erupted at stratovolcanoes are typically slow moving, thick, viscous flows (U.S. Geological Survey 2014); however, they can be fluid and fast-moving depending upon the energy of the eruption, topography, and the composition of the magma. It is possible for stratovolcanoes to have violent and prolonged eruptions. Eruptive materials associated with stratovolcanoes can include ash clouds; density currents of volcanic debris and hot gas (termed pyroclastic flows); falling rock blocks (termed volcanic bombs); and muddy debris floods (termed lahars). Other volcanic activity includes phreatic eruptions (water magma interactions) that can produce ash, steam, and gas. Agrihan, the highest of the Mariana arc volcanoes and located immediately north of Pagan, had a significant eruptive event in 1917 that sent large blocks of rock into the air and resulted in the deposition of approximately 10 feet (3 meters) of ash and lapilii (i.e., small stones ejected into the air from the volcano) on a former village on the southeast coast of Agrihan (U.S. Geological Survey 2014). Recent eruptions from Anatahan deposited in excess of 20 feet (6 meters) of volcanic ash on Anatahan, disrupted numerous flights, and closed Saipan International Airport (Quick n.d.). As previously described in Section 3.2.6.2, *Geology*, Pagan is home to two active stratovolcanoes with historic eruptions and continued volcanic activity through 2012.

As stated earlier, Pagan is not currently monitored with ground-based geophysical instrumentation. The only current source of information is satellite observation as noted in the *Volcano Hazards Program Report* (U.S. Geological Survey 2014). Land deformation may occur within the crater on Pagan such as swelling, shrinking, and topographical changes to the surface due to magma movement underneath the surface. Ground deformation may also be accompanied by temperature changes in the rock and water around it. Gases and particulates are released into the atmosphere as a result of volcanic activity of Mount Pagan. As magma moves up in the crust, pressure decreases and gases are released. Magma produces sulfur dioxide, carbon monoxide, carbon dioxide, hydrogen sulfide, hydrogen chloride, and hydrogen fluoride. These gases behave according to their properties and can accumulate, migrate, and be emitted in various areas depending on changing volcanic activity, subsurface conditions, and weather conditions. The hazard that these gases pose is that they are acids and can also cause asphyxia (a decrease in the concentration of oxygen and an increase in the concentration of carbon dioxide in the body which can lead to loss of consciousness and death). Particulates and solids can also become projectiles in sizes ranging from ash to objects more than 20 inches (50 centimeters) in diameter and present physical hazards. Gases may also be accompanied by temperature changes in the rock and water around it (The International Volcanic Health Hazard Network n.d.). Low level hazardous conditions continue to occur and minor gas and steam plumes continue to be observed at Mount Pagan in satellite data.

Volcanic activity can also produce noise ranging from soft hissing to deafening explosions accompanied by shockwaves. While the volcano is building up pressure prior to an eruption, sounds have been captured by acoustic recording devices and can sound like a rumble, roar, or sound coming from a jet engine. During blasts and explosions, impulsive, broad frequency band acoustic signals are created which are the highest amplitude or loudest sounds created by volcanoes. Consequentially, these loud booms and cracks travel the furthest and energy from these blasts can travel across ocean basins being recorded by pressure recorders thousands of kilometers away (Oregon State University n.d.; Hotovec et al. 2013).

3.2.6.2.2.3 Landslides

Rock falls, failure of slopes, and shallow debris flows (all forms of landslides) are possible due to the volcanic and seismic activity on Pagan. Evidence of collapse structures and debris flows have been reported on Pagan (Corwin et al. 1957; Trusdell et al. 2006).

3.2.6.2.2.4 Tsunamis

Tsunamis are generated when significant volumes of water are displaced by explosive eruptions or landslides of volcanic flanks. The National Oceanic and Atmospheric Administration does not have records of tsunamis occurring on Pagan. Tsunami inundation modelling has not been undertaken for Pagan (CNMI Coastal Resources Management Office, personal communication, 2013). However, the potential for tsunami generation resulting from movement of magma, submarine landslides, and seismic activity exists on Pagan and could result in significant, localized tsunamis with little warning. Modeling of 0.25 cubic mile (1.0 cubic kilometer) landslide from the south flank of Anatahan (an island in the northern Mariana Islands) volcano produces a calculated tsunami amplitude of 2 to 3 feet (0.6 to 0.9 meter) on Saipan; however, the presence of large calderas on Anatahan, Pagan, and Maug indicate that there is the potential for Mariana volcanoes to produce very large explosive eruptions, which could displace much greater volumes of water and thus generate a dangerous tsunami on Pagan (Quick n.d.).

3.2.6.3 Soils

Detailed soil survey data for Pagan is unavailable. As described earlier, surface soil and rock conditions range from alluvium (soil created from eroded rock), residuum (soil created from rock weathered in place), volcanic ash, raised coral reef deposits, volcanic cinder (Photo 3.2-4), and spatter deposits, as well as sharp (*a'a*) (see Photo 3.2-3) and smooth (pahoehoe) basalt, andesite, or basaltic andesite lava flows. Soils on the island are thin and largely confined to gentle slopes with a maximum depth seldom greater than 2 feet (0.6 meter). The best-developed soils are found in the inner basin, south of Lake Sanhalom, and the area north of the central plateau (Pangelinan and Kapileo 1970).

Photo 3.2-4. View of volcanic cinder sand along the west coast of Pagan (facing south) with South Pagan Volcano in the background

Anecdotal observations indicate that there are portions of soil (either alluvium or residuum) that are highly eroded. Surveys in 2000 and 2010 (Cruz et al. 2000; Kessler 2011) found the island's forests and grasslands "severely overgrazed" due to the abundance of feral cattle, goats, and pigs that have done considerable damage to island vegetation. This overgrazing has resulted in large open areas susceptible to soil erosion. Erosion has not been as prominent on Pagan as it has been on some other islands in the chain, perhaps due to the many lava flows and a lower abundance of loose pyroclastic materials. However, localized erosion has been prominent in large drainages that head on the western upper flank of Mount Pagan and flow southwestward into the central plateau (Trusdell et al. 2006).

3.3 WATER RESOURCES

Section 3.3 describes the existing conditions of the water resources on Tinian and Pagan. Water resources include surface waters, groundwater, and nearshore waters. The region of influence includes the surface waters, groundwater, and nearshore waters immediately adjacent to these islands.

3.3.1 Definition

Surface waters, groundwater, nearshore waters and other key terms are defined below:

- **Surface waters** include lakes, streams, rivers, springs, and wetlands; some of these features may be considered "Waters of the U.S." The discussion of surface waters also incorporates the analysis of watersheds and floodplains. A detailed discussion of stormwater runoff is provided in Sections 3.14 and 4.14, *Utilities*; however, potential impacts to water quality due to stormwater runoff are discussed under water resources.
  - **Waters of the U.S.** are defined under 40 CFR 230.3(s) and 33 CFR Part 328 as: "(1) all waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (2) all interstate waters including interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters: (i) which are or could be used by interstate or foreign travelers for recreational or other purposes; or (ii) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or (iii) which are used or could be used for industrial purposes by industries in interstate commerce…"
  - **Wetlands** are defined by Section 404 of the Clean Water Act as: "areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." The CNMI Water Quality Standards define wetlands as "waters of the Commonwealth," and state that all wetlands are subject to the provisions of the standards. Areas described and mapped as wetland communities may also contain small streams, shallow ponds, and lake edges.
  - **Watersheds** are typically defined by topographic ridges and their respective drainage areas contributing runoff to surface waters, including the sea, lakes, estuaries, or wetlands.
  - **Sub-watersheds** are smaller geographic units of a larger watershed.
  - **Floodplains** are low-lying areas subject to flooding as a result of excessive rains, stormwater runoff, or inundation from storm-induced waves.

- **Water Quality** describes the chemical and physical composition of water as affected by natural conditions and human activities.
- **Groundwater** is water beneath the ground surface in soil pore spaces and in the fractures of rock formations. An **aquifer** is an underground layer of water-bearing permeable rock or materials (gravel, sand, or silt) from which groundwater can be extracted using a well.
- **Nearshore waters** are all areas extending seaward from the coast out to a depth of 330 feet (100 meters).

3.3.2 Regulatory Framework

The U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, and the U.S. Maritime Administration are the primary federal agencies with jurisdiction over water resources. Within the CNMI, the CNMI Bureau of Environmental and Coastal Quality is the administrative authority for the Clean Water Act and some activities under Section 10 of the Rivers and Harbors Act. Federal and local regulations that serve to protect, conserve, and manage water resources are listed below.

3.3.2.1 Federal Regulation

- Clean Water Act
  - Section 401
  - Section 402
  - Section 404
- Water Pollution Control Act
- Fish and Wildlife Coordination Act
- Safe Drinking Water Act
- Coastal Zone Management Act
- Rivers and Harbor Act
  - Section 10
- Energy Independence and Security Act
- Executive Order 11990, Protection of Wetlands
- Executive Order 11988, Floodplain Management

3.3.2.2 CNMI Regulation

- CNMI Earthmoving and Erosion Control Regulations
- CNMI Wastewater Treatment and Disposal Rules and Regulations
- Water Quality Standards
- Groundwater Recharge Requirements
- Drinking Water Regulations
- Well Drilling and Well Operation Regulations
- Northern Mariana Islands Administrative Code Chapter 65-120: Wastewater Treatment and Disposal

A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations*.

3.3.3 Methodology

Reports and studies prepared by or for the federal government, the CNMI government, and independent researchers that address natural resources (e.g., water, geology, biology) and infrastructure (e.g., utilities) on Tinian and Pagan were reviewed for information related to the existing condition of water resources. Federal and CNMI regulations were reviewed for regulations that serve to protect, conserve, and manage water resources (see Section 3.3.2). In addition, an aquifer study is underway to evaluate potential well capacity and existing water quality in notional well fields; well setbacks and potential for saltwater intrusion (the movement of saline water into freshwater aquifers); and man-made contaminant migration into notional well fields on Tinian. This study will provide information needed to design and space wells in the notional well field. Information from this study will be added to the Final Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS).

Water resources identified during the literature review which could be potentially affected by the proposed action are described below. The CNMI government performs regular water quality monitoring of Tinian's coastal waters. The results of recent nearshore water quality monitoring are summarized in Section 3.3.4.3, *Nearshore Waters*. The CNMI government does not perform regular water quality monitoring of Pagan's coastal waters and does not perform water quality monitoring of surface waters or groundwater on either island. Information on nearshore water quality was summarized from the Mariana Archipelago Reef Assessment and Monitoring Program (Brainard 2012).

3.3.4 Tinian

3.3.4.1 Surface Water Resources

Rainfall on Tinian averages 83 inches (212 centimeters) per year (Water and Environmental Research Institute 2003), 58% of which typically occurs from July to November while only 14% typically occurs during the dry season from January to April (Department of the Navy [DoN] 2010a). Much of the precipitation on Tinian evaporates, transpirates, or percolates into openings in the limestone and volcanic rock beneath the thin soil surface (Gingerich 2002).

3.3.4.1.1 Surface Water Features

There are three known inland water features within the Military Lease Area (Table 3.3-1 and Figure 3.3-1): (1) Lake Hagoi; (2) Mahalang Complex; and (3) Bateha Isolated Wetlands. Because Tinian is formed almost entirely of permeable limestone karst, there are few springs and no perennial (permanently flowing) streams. Drainage throughout most of Tinian is underground where rainwater generally percolates downward into porous rock (Doan et al. 1960), with the exception of during heavy rain events that occasionally result in stormwater runoff entering the surface and nearshore waters via short-lived ephemeral streams. Surface water features occur on Tinian in areas of impermeable clay that prevent infiltration of surface water, or at perched water tables (temporary pockets of groundwater located above unsaturated soil or rock, not connected to the permanent groundwater table). These areas are entirely dependent on rainfall as a water source for sustaining productivity and habitat quality.

Because the entire shoreline is either limestone cliffs and rocky outcrops or sand beach, there are no mangroves or coastal wetlands present.

Table 3.3-1. Tinian Surface Water Features

Name	*Description**	*Area*
Lake Hagoi	Located on the northwest side of the Military Lease Area, Lake Hagoi is a permanent partially-open-water complex. It is situated on a limestone terrace over either an impervious layer or a perched water table. Lake Hagoi is dependent entirely on rainfall as a water source; in periods of drought the water level drops and the coverage of open water dramatically decreases (DoN 2010a). Since 2010, a rapid reduction of open surface water has been observed (Wenninger 2012). Due to sediment inflow, the open water area of Lake Hagoi is slowly transforming into a marsh, completely covering emergent vegetation (AECOS, Inc. and Wil Chee Planning, Inc. 2009).	34 acres (14 hectares)
Mahalang Complex	Located within the north central portion of the Military Lease Area, Mahalang comprises a cluster of craters and depressions, a subset of which pond water during the wet season. The complex is located on a plateau in an area of grasslands, tangantangan, and mixed secondary forest. Some of the features are characterized as likely bomb craters from World War II activities (DoN 2013a). Dominant vegetation within the craters consists of upland plant species, including introduced grass mixed with various weedy vines and herbaceous plants.	Approximately 24 individual sites; estimated the two largest features as approximately 1.2 acres (0.5 hectare) each
Bateha Isolated Wetlands	Located within the central portion of the Military Lease Area, these features consist of two shallow depressional areas that contain water during wet periods (U.S. Fish and Wildlife Service 1996; DoN 2013a). They are broad depressions or “moats” that have evolved as eroded clay and silt filled depressions in limestone bedrock (DoN 1997). Vegetation within and surrounding these features is dominated by introduced species.	1.5 acres (0.6 hectare) each

**Note:* Vegetation is described in Section 3.9, *Terrestrial Biology.*

3.3.4.1.1.1 Wetlands Communities

In support of the EIS/OEIS, all three surface water features were surveyed for wetland characteristics. Consistent with the definition of a wetland under the Clean Water Act, Lake Hagoi has hydric soils (soil which are permanently or seasonally saturated, resulting in anaerobic conditions), hydrophytic vegetation (plants adapted to life in water or waterlogged soils), and has surface water for most of the year (DoN 2013a). Vegetation within and surrounding the wetland is dominated by species native to Tinian. Based on the 2014 wetland surveys at the Mahalang Complex, one of the depressions (MD3) contains wetland vegetation and is a depressional isolated wetland (Figure 3.3-1). Other sites surveyed at the Mahalang Complex (MC1, M7, MC2, M10, and M11) in 2014 did not contain wetland vegetation and are ephemeral surface waters. The 2014 wetland survey documented wetland vegetation at both sites within the Bateha Isolated Wetlands. Table 3.3-2 provides a summary of the surface water areas determined to maintain wetland characteristics. The survey report is provided in Appendix L, Wetland Study Report.

Figure 3.3-1
Tinian Surface Waters and Flood Zones

Sources: Federal Emergency Management Agency 2006, DoN 2010a, DoN 2013

Table 3.3-2. Summary of Potential Wetlands of the Bateha and Mahalang Complexes

Site	*Presence of Obligate Wetland Vegetation*	*Presence of Hydrological Conditions*	*Test Pit and Presence of Hydric Soils*	*Site Connected to Stream System*	*Ponded Water Present*
Bateha BD1	Yes: *Ipomoea aquatic* (minor)	Yes; depressional	No. 1 – hydric soils No. 2 – hydric soils No. 3 – hydric soils No. 4 – hydric soils No. 5 – hydric soils	No	Yes
Bateha BD2	Yes: *Ipomoea aquatic* (minor)	Yes; depressional	No. 1 – no hydric soils No. 2 – no hydric soils No. 3 – no hydric soils No. 4 – hydric soils present	No	Yes
Mahalang MC1	No	Yes; crater	No. 1 – hydric soils No. 2 – hydric soils	No	Yes
Mahalang M7	No	Yes; crater	No. 1 – no hydric soils (*too far upslope due to high water levels?*) No. 2 – no hydric soils (*too far upslope due to high water levels?*)	No	Yes
Mahalang MC2	No	Yes; crater	No. 1 – no hydric soils (*too far upslope due to high water levels?*) No. 2 – hydric soils	No	Yes
Mahalang M10	No	Yes; crater	No. 1 – no hydric soils (*too far upslope due to high water levels?*) No. 2 – hydric soils	No	Yes
Mahalang M11	No	Yes; depressional	No. 1 – no hydric soils No. 2 – no hydric soils	No	No; *No saturated grounds*
Mahalang MD3	Yes: *Ipomoea aquatic* (dominant)	Yes; depressional	No. 1 – hydric soils No. 2 – no hydric soils (*too far upslope due to high water levels*)	No	Yes

Note: No. = number.

3.3.4.1.1.2 Sub-watersheds

The U.S. Department of Agriculture identified five sub-watershed areas on Tinian: Makpo Valley, Puntan Diaplo-Lamanibot, Carolinas, Masalok, and Puntan Tahgong. The designated sub-watershed areas are based on Island Resource Steering Committee concern areas, topography, and principal land uses. The Island Resource Steering Committee originated in 1991 and included government agencies and members of the Tinian community (U.S. Department of Agriculture 1994). Sub-watersheds areas are shown in Figure 3.3-1. Contamination due to human activity has the potential to impact surface water and groundwater in these sub-watersheds. Examples of existing or past human activities/land uses which have the potential to contaminate water resources include: agriculture/crop production and harvesting; auto mechanic shops; vehicle fuel stations; fuel storage; cattle ranching; pesticide storage and application; chemical storage; asphalt plant; landfill; grounds maintenance; and land disturbance/grading/construction. Details on historic and current sites of potential environmental concern are discussed in Section 3.16, *Hazardous Materials and Waste*.

Puntan Tahgong Sub-watershed. Located within the north end of the Military Lease Area, the Puntan Tahgong sub-watershed contains Lake Hagoi. It is the most disturbed of the Tinian sub-watersheds due to intensive sugar cane production prior to and during World War II; and due to nearly-complete vegetation clearing for runways and housing during World War II. The sub-watershed is underlain by porous limestone formations (primarily the Mariana Limestone) with small areas underlain by less permeable volcanic materials and more permeable beach deposits. Groundwater in Puntan Tahgong sub-watershed is vulnerable to surface contaminants due to the high permeability of the limestone substrate and the previous land use. Potential contaminants from World War II land uses and other historical land uses, as listed above, may still be present in Tinian's sub-watersheds (U.S. Department of Agriculture 1994).

Puntan Diaplo-Lamanibot Sub-watershed. The Puntan Diaplo-Lamanibot sub-watershed area includes the majority of the west side of the Military Lease Area, Tinian International Airport, and land south of Tinian International Airport. It supports secondary forest and portions of it are used for farming and ranching. The sub-watershed includes the location of the unlined Tinian municipal solid waste facility, and is therefore at risk for groundwater contamination due to that activity. The sub-watershed is underlain by porous limestone formations (primarily the Mariana Limestone) with small areas underlain by less permeable volcanic materials and more permeable beach deposits.

Masalok Sub-watershed. The Masalok sub-watershed is located largely within the east side of the Military Lease Area and is used mainly for livestock grazing. Residual contaminants from material storage during and following World War II and overgrazing are existing concerns for the Masalok sub-watershed (DoN 2010a). The sub-watershed is underlain by porous limestone formations (primarily the Mariana Limestone).

Makpo Valley Sub-watershed. The Makpo Valley sub-watershed currently supplies all of the municipal potable water supply and a portion of the agricultural water supply for the island. A small portion of the sub-watershed is situated within the south-central side of the Military Lease Area and Tinian International Airport. This sub-watershed is primarily underlain by porous limestone formations (primarily the Mariana Limestone).

Carolinas Sub-watershed. The Carolinas sub-watershed supports limestone forest cliffs along the southeastern shoreline including a small portion of the southeastern end of the Military Lease Area. The watershed is underlain by porous limestone formations (primarily the Mariana Limestone).

3.3.4.1.2 Flood Zones

The Federal Emergency Management Agency classifies areas that are likely to be inundated in a 100-year flood event as Flood Zone A. Areas along coasts subject to inundation by the 100-year flood event and with storm-induced wave hazards are classified as Flood Zone V. The Federal Emergency Management Agency has identified 19 isolated areas that are designated as Flood Zone A. These zones are located in areas including Hagoi, portions of North Field, Tinian International Airport, and Makpo Sub-watershed (Commander, U.S. Naval Forces Marianas 2004). The entire Tinian coastline extending from approximately 400 feet (120 meters) offshore to the shoreline cliff face or to the inland limit of primary flat sand beaches along open coastlines is designated as Flood Zone V and may be subject to storm-induced wave hazards. Tinian flood zones are shown in Figure 3.3-1.

3.3.4.1.3 Surface Water Quality

The CNMI Water Quality Standards establish criteria designed to protect the designated uses for each classification of waters (i.e., coastal waters, fresh waters, and wetlands). Coastal water quality is discussed in Section 3.3.4.3, *Nearshore Waters.* Designated uses of fresh surface waters include: aquatic life, fish consumption, recreation, aesthetic enjoyment, and potable water supply. The CNMI Bureau of Environmental and Coastal Quality maintains a monitoring program for water quality. However, this monitoring program on Tinian is limited to coastal waters. To date, surface water quality data has not been assessed for the three known surface water features on Tinian and the CNMI Bureau of Environmental and Coastal Quality performs no regular monitoring of surface water quality (Bearden et al. 2012).

3.3.4.2 Groundwater Resources

3.3.4.2.1 Groundwater Availability

Rainfall percolates rapidly downward into porous limestone rock and is the primary recharge source of fresh groundwater on Tinian (Doan et al. 1960). The average annual groundwater recharge for Tinian is estimated to be about 30 inches (76 centimeters) per year (Gingerich 2002). Groundwater is plentiful in Tinian's basal groundwater lens (lenses of fresh groundwater that floats on top of denser saltwater below) (Doan et al. 1960). This freshwater, Ghyben-Herzberg groundwater lens (fresh water that "floats" on top of saltwater forming a profile that has the appearance of a lens) is in both limestone and volcanic rocks, with the most important sources coming from limestone formations (Gingerich 2002). The interface between the freshwater and saltwater is a transition zone at a depth below sea level (Figure 3.3-2 and Figure 3.3-3). The portion of the lens that is used for potable water (i.e., with chloride concentrations less than 250 parts per million) is thickest in the North-Central Highland and Central Plateau and grows increasingly thinner approaching the coastline. See Appendix P, *Utilities Study*, for additional information about the Ghyben-Herzberg lens relationship. Tinian geologic units including Mariana and Tagpochau limestones are shown in Section 3.2, *Geology and Soils*, Figure 3.2-3. The freshwater lens extends from a maximum recorded 3.42 feet (1.04 meters) above MSL to about 140 feet (42 meters) below MSL at its deepest point (Gingerich 2002). Groundwater table elevation contours and the general direction of groundwater flow are shown in Figure 3.3-4.

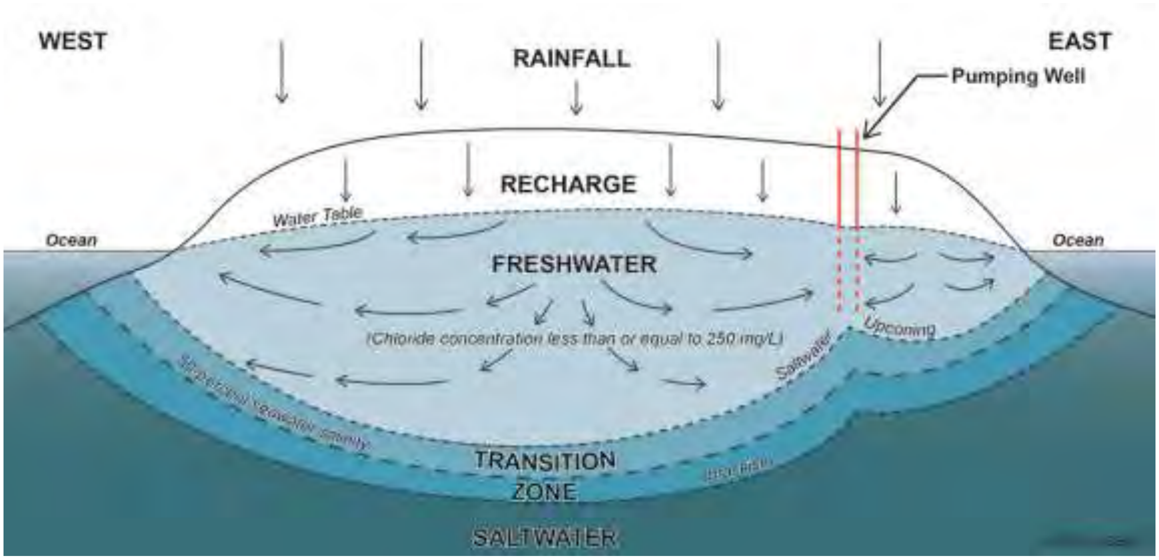


Figure 3.3-2 Graphic Depiction of a Freshwater Lens above a Saltwater Wedge – Standard, Vertical Pumping Well

Note: This figure is intended as a simple representation of interface between the freshwater and saltwater.

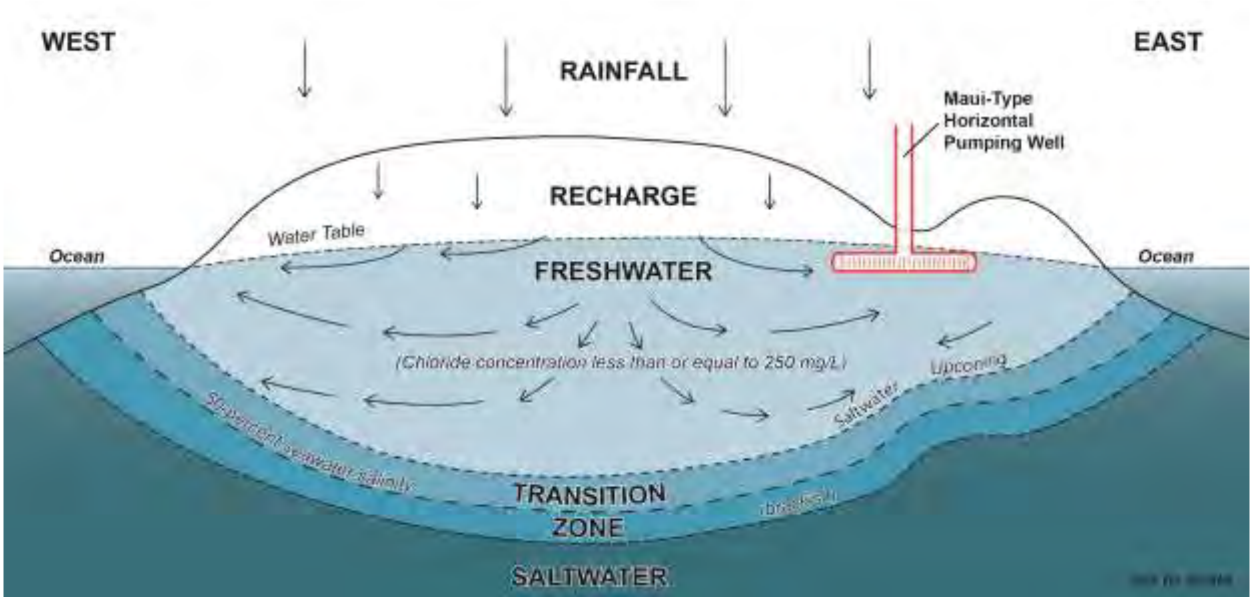


Figure 3.3-3 Graphic Depiction of a Freshwater Lens above Saltwater Wedge – Horizontal, Maui-Type Pumping Well

Note: This figure is intended as a simple representation of interface between the freshwater and saltwater.

Figure 3.3-4
Tinian Groundwater Wells, Elevation, and Flow Direction

The U.S. Environmental Protection Agency has not identified a sole-source aquifer (i.e., the principal source of drinking water) underlying Tinian. Per the CNMI *Wastewater Treatment and Disposal Rules and Regulations*, a Class I Aquifer Recharge Area is defined as an "area contributing surface infiltration to a geologic formation, or part of a formation, that is water bearing and which currently transmits, or is believed capable of transmitting water to supply pumping wells or springs." While not formally designated, based on this definition, the CNMI Bureau of Environmental and Coastal Quality considers all of Tinian a Class I Aquifer Recharge Area per the CNMI Rules and Regulations.

Figure 3.3-4 shows the locations of known groundwater wells. The Commonwealth Utilities Corporation public system extracts water from one horizontal Maui-type well (Maui Well #2) located in the Makpo sub-watershed (a Maui-type well has a horizontal collector trench constructed near the top of the water table). Before Maui Well #2 was put into service, the public system extracted water from Maui Well #1. Maui Well #1 is currently out of service due to old equipment and difficulty obtaining repair parts. See Appendix P, *Utilities Study*, for additional information on Tinian's public water system and discussion of the sustainable yield (the rate at which groundwater can be continuously withdrawn from an aquifer without impairing the quality or quantity of the pumped water or the environment) of Tinian's aquifers. In addition to pumping from Maui Well #2 for the public water system, water is currently pumped from two wells (rehabilitated by a private party) to fill containers for providing water to cattle, labeled M21 and M26 in Figure 3.3-4.

Historically, the Japanese may have dug more than 100 wells during occupation of Tinian; most of which were reportedly abandoned and filled. The U.S. military constructed approximately 44 groundwater wells between 1944 and 1945 on the island for water supply for the U.S. military, including Maui Well #1. All of these wells were abandoned shortly after World War II. It is not known if (or how) these wells were properly closed when abandoned. A total of 33 wells were used for groundwater monitoring between 1993 and 1997 by the U.S. Geological Survey. Of the 33 wells, 16 were rehabilitated and 17 were newly developed for groundwater monitoring on the island. Rehabilitation involved retrieving the original pump and pipe, redrilling if necessary, cleaning out the hole to near the original depth, and installing new surface casings/well head features, if necessary.

The CNMI government owns Maui Well #1 and Maui Well #2. There are other wells located on Tinian that are used for groundwater monitoring, agricultural use, or have been abandoned.

3.3.4.2.2 Groundwater Quality

While it is not currently a problem, Tinian has the potential for high chloride levels in groundwater due to seawater intrusion into the freshwater lens from excessive pumping (Gingerich 2002). The secondary drinking water standard for chloride is set at concentrations less than or equal to 250 parts per million. Chloride concentrations at the municipal water well (i.e., Maui Well #2) range from 160 to 220 parts per million, with an average of 180 parts per million; notably close to the secondary drinking water standard (i.e., non-mandatory drinking water quality standards for aesthetic considerations, such as taste, color, and odor) (U.S. Army Corps of Engineers 2003). Table 3.3-3 summarizes recent data.

Table 3.3-3. Tinian – Tinian Municipal Well Water Quality

Well #	*Year Tested*	*Chloride Concentrations Observed (ppm)*
Maui Well #2	2011	Mean 203, Range 195-210
	2012	Mean 196, Range 175-223
	2013	Mean 190, Range 172-217

Note: ppm= parts per million.

Surface activities (e.g., sewage spills, leachate from septic systems, and polluted stormwater runoff percolation) can also contaminate groundwater aquifers. As discussed in Section 3.14, *Utilities*, the Tinian existing solid waste facility consists of an unlined, open disposal site located about 0.5 mile (0.8 kilometer) north of San Jose on the west side of 8th Avenue (see Figure 3.3-1). The solid waste facility is believed to have been in use since 1944 and may contain World War II-era military waste, as well as municipal solid waste generated on Tinian. No trash pickup service is available on Tinian; therefore, residents take their municipal waste to the Tinian solid waste facility for disposal. The CNMI commercial entities (administrative offices, hotels, restaurants, etc.) including the Tinian Dynasty Hotel and Casino, transport their waste to the municipal solid waste facility as well. The facility does not comply with the Resource Conservation and Recovery Act Subtitle D regulations applicable to municipal solid waste landfills (40 CFR 258) and may be a source of groundwater contamination. It is not known if groundwater in the vicinity of the solid waste facility has been contaminated, but standard contaminants for municipal waste have not been detected in groundwater extracted for municipal water supply at Maui Well #1 and #2.

3.3.4.3 Nearshore Waters

Nearshore waters around Tinian are designated Class AA by the CNMI Bureau of Environmental and Coastal Quality, except for the nearshore waters of Tinian Harbor that are designated Class A. Class AA designation means these waters should remain in their natural pristine state with an absolute minimum of pollution or alteration of water quality from human related sources or actions. Class A designation waters under the jurisdiction of the CNMI Bureau of Environmental and Coastal Quality are protected for their recreational use and aesthetic enjoyment. Other uses of Class A waters are allowed as long as they are compatible with the protection and propagation of fish, shellfish, wildlife, and limited body contact recreation. Sewage outfalls, sewer collection overflows, sedimentation from unpaved roads and development, urban runoff, reverse osmosis brine discharges, and agriculture are the most significant stressors on the CNMI's marine water quality (Bearden et al. 2010). As discussed above, the Tinian municipal solid waste facility does not comply with the Resource Conservation and Recovery Act Subtitle D regulations and could be a source of nearshore water contamination. However, the solid waste facility was not identified as a source of contamination or a significant stressor to marine water quality (Bearden et al. 2012).

Beginning in 2004, the CNMI water quality for coastal waters has been assessed and reported once every 2 years in terms of water body segments based on established, named CNMI sub-watershed units (Bearden et al. 2012). As presented in Appendix I of the CNMI Bureau of Environmental and Coastal Quality's 2012 Water Quality Assessment Report (Bearden et al. 2012), the coastal waters of the Masalok, Makpo Valley, Puntan Diaplo-Lamanibot, and Puntan Tahgong sub-watersheds were listed as impaired by one or more pollutants during and the 2004, 2006, 2008, 2010, and 2012 reporting cycles. Masalok sub-watershed was reported as impaired by orthophosphate for the 2004 reporting cycle (20%

of the net reporting period). Makpo Valley sub-watershed was reported as impaired by enterococci bacteria, dissolved oxygen, biocriteria, and orthophosphate for the 2004, 2006, 2010 and 2012 reporting cycles (80% of the net reporting period). Puntan Diaplo-Lamanibot sub-watershed was reported as impaired by enterococci bacteria and orthophosphate for the 2004 and 2012 reporting cycles (40% of the net reporting period). Puntan Tahgong sub-watershed was reported as impaired by biocriteria and orthophosphate for the 2004 and 2006 reporting cycles (40% of the net reporting period). Only Makpo Valley and Puntan Diaplo-Lamanibot were listed as impaired during the 2012 assessment and reporting cycle. Table 3.3-4 provides a summary of the impaired Tinian coastal waters.

Table 3.3-4 Tinian Impaired Coastal Waters

Sub-watershed	***Pollutant(s)***	***Source***	***Year Listed***
Masalok	orthophosphate	unknown	2004
Makpo	enterococci, dissolved oxygen, biocriteria, orthophosphate	unknown, on-site treatment systems, urban runoff	2012 2010 2006 2004
Puntan Diaplo-Lamanibot	enterococci, orthophosphate	unknown	2012 2004
Puntan Tahgong	biocriteria, orthophosphate	unknown	2006 2004

Source: Bearden et al. 2012; APPENDIX II: Detailed 305b Listing of the CNMI Waters; Table II-5 Category 5: Coastal Waters Impaired by Pollutants (Total Maximum Daily Load Required).

The Makpo sub-watershed includes both Tinian's commercial harbor and its population center (San Jose). The absence of wastewater collection and treatment systems, stormwater quality treatment and erosion controls are existing concerns for the Makpo Valley sub-watershed. Makpo Valley sub-watershed coastal waters have been listed as impaired based on bacterial, nutrient, dissolved oxygen, and biological criteria. The sources of pollution include on-site treatment systems and urban runoff, as well as unidentified sources (B. Bearden, Consolidated Utilities Corporation, personal communication, December 4, 2012).

As part of the Mariana Archipelago Reef Assessment and Monitoring Program the National Oceanic and Atmospheric Administration, National Marine Fisheries Service conducted shallow-water conductivity, temperature, and depth casts in nearshore waters surrounding Tinian in August 2003, September 2005, and May 2007. Across all sample years and locations, at a depth of 33 feet (10 meters) water temperatures ranged from 82.71 to 85.86 degrees Fahrenheit (28.17 to 29.92 degrees Celsius) and salinity ranged from 34.22 to 34.60 practical salinity units. In 2003 cooler temperatures and higher salinity were recorded around the northeast end of Tinian relative to other areas of the island. In 2005 and 2007 spatial comparison suggest an east to west gradient in water properties, with warmer, more saline, and less turbid waters along the western half of the island compared to the eastern half (Brainard 2012).

In 2005 and 2007 water samples were collected to measure chlorophyll-*a*, total nitrogen, nitrate, nitrite, phosphate, and silicate levels. Measures of chlorophyll-*a*, nitrogen, nitrate, and nitrite concentration were lower in 2007 than in 2005. Phosphate and silicate concentration were higher in 2007 than in 2005. In 2005 all measured parameters showed higher concentrations in the southwest region of the island and total nitrogen was 4 times higher in the southwest as compared to other regions of the island.

Again in 2007 the highest concentration of nutrients was in the north regions of the island. However, in 2007 the highest chlorophyll-*a* values were in the southwest region (Brainard 2012).

3.3.5 Pagan

3.3.5.1 Surface Water Resources

3.3.5.1.1 Surface Water Features

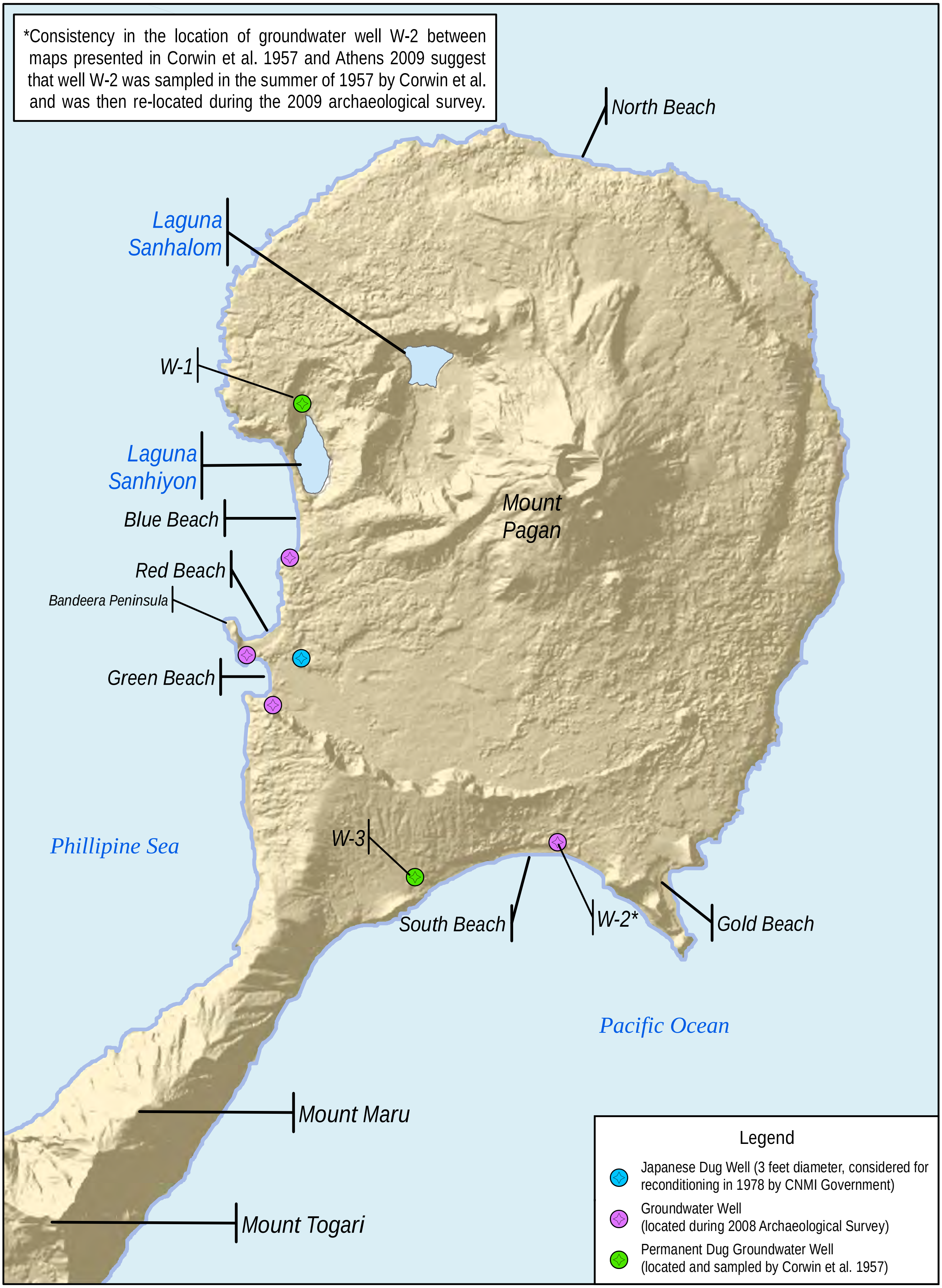
Average annual rainfall on Pagan is 70 to 80 inches (178 to 203 centimeters). Surface water features on Pagan include two lakes: Laguna Sanhiyon and Laguna Sanhalom, shown in Figure 3.3-5, and springs found across the island. There are no permanent rivers or streams on the island. Though surface water drainage has not been studied, it is thought that most of the infiltrating rainwater percolates rapidly to a large basal fresh groundwater body; however, no testing has been conducted to confirm this (CNMI Office of Transition Studies and Planning 1978).

Laguna Sanhiyon (commonly known as Lower Lake) is an approximately 40-acre (16-hectare) brackish water lake on the western shore. The lake has a maximum depth of approximately 65 feet (20 meters) (CNMI Office of Transition Studies and Planning 1978). A sand bar composed of marine tuffs and basaltic sand separates the lake from the ocean (Photo 3.3-1). During storms, waves occasionally over top the sand bar (CNMI Office of Transition Studies and Planning 1978). A small tidally mediated freshwater wetland area is located on the north end of Laguna Sanhiyon (Polhemus 2010).

Photo 3.3-1. Laguna Sanhiyon and Sand Bar Separating the Lake from the Ocean

Laguna Sanhalom (commonly known as Upper Lake or Inner Lake) is a 43-acre (17-hectare) brackish lake at the foot of Mount Pagan. The lake has a maximum depth of about 75 feet (23 meters), reaching a depth of 65 to 70 feet (20 to 21 meters) below sea level (CNMI Office of Transition Studies and Planning 1978).

Watershed areas on Pagan have not been designated. Due to the generally high permeability and infiltration rates of surficial volcanic materials on Pagan, the contribution of stormwater runoff to recharge Pagan's major surface water bodies (Laguna Sanhalom and Laguna Sanhiyon) is minimal as compared to the contribution from groundwater (Doan et al. 1960). During their 3-month long field investigation of the island, Doan et al. (1960) did not observe any stream formations, even during moderately heavy rain events. However, Doan et al. 1960 did mention that some surface runoff on steep slopes and cliffs was observed during and following the rain events, which suggests that stormwater runoff does enter the surface waters in some areas and during some storm events. This runoff is expected to form channelized flow from heavy rainfall. In addition sub-surface flow from higher elevations within and around the volcano is also believed to influence these surface waters.



0 0.25 0.5 1 Mile

0 0.25 0.5 1 Kilometer

Figure 3.3-5
Pagan Surface Waters and
Groundwater Well Locations

NORTH

Sources: Corwin et al. 1957; CNMI 1978; Athens 2009

3.3.5.1.2 Flood Zones

No flood zone data are available for Pagan.

3.3.5.1.3 Surface Water Quality

As described in Section 3.2, *Geology and Soils*, the island's forests and grasslands have been "severely overgrazed" due to the abundance of feral cattle, goats, and pigs that have done considerable damage to island vegetation (Cruz et al. 2000; Kessler 2011). This overgrazing has resulted in large open areas susceptible to soil erosion.

Water quality of both lakes has never been fully assessed and is not actively monitored by the Bureau of Environmental and Coastal Quality due to the remoteness of the island (Bearden et al. 2012). However, water quality samples from the lakes were collected by the U.S. Geological Survey in 1983 and 2001 (U.S. Geological Survey 2014). The data are presented in Table 3.3-5.

Table 3.3-5. Pagan Surface Water Quality Data Summary

Surface Water Body	*Sample Date*	*Dissolved Solids (mg/L)*	*Nitrate (mg/L)*	*Ammonia (mg/L as NH_4)*	*Phosphorus (mg/L as P)*	*Sodium (mg/L)*	*Chloride (mg/L)*
Laguna Sanhiyon	3/12/1983	12400	-	-	-	3500	7000
Laguna Sanhiyon	5/25/2001	13200	0.221	0.032	0.003	3890	7260
Laguna Sanhalom	3/12/1983	6380	-	-	-	1800	3500
Laguna Sanhalom	5/24/2001	4230	0.221	0.052	0.004	1040	1910

Notes: mg/L = milligrams per liter; P = phosphorous; NH_4 = Ammonia; - = not analyzed.

Laguna Sanhiyon has a salinity of about half that of the ocean. Although biological contamination (elevated fecal coliform) of surface waters caused by migration of bacteria from animal waste through the hydrologic system of the island has been documented (CNMI Office of Transition Studies and Planning 1978), surface water samples collected from the lakes and springs above the upper lake by the U.S. Geological Survey in 1983 (U.S. Geological Survey 2014) were below the U.S. Environmental Protection Agency's recommended fecal coliform criterion (U.S. Environmental Protection Agency 1976).

Surface water samples collected from Laguna Sanhalom by the U.S. Geological Survey in 1983 and 2001 (U.S. Geological Survey 2014) indicate that the water is brackish with a salinity about 4 to 6 times the potable drinking water standard (CNMI Office of Transition Studies and Planning 1978). The mixing of saltwater may occur through vents, faults, and the bedrock substrate. Nitrogen-based compounds in samples from the U.S. Geological Survey data were below detectable levels, as were phosphates. Sulfate and silica concentrations were elevated in the 2001 samples for the lakes. Elevated concentrations of rare dissolved metals and metalloids in the 2001 sample from the lower lake are likely the result of the weathering young volcanic deposits on the island (U.S. Geological Survey 2014). Water from both lakes is not considered a viable potable source. Table 3.3-6 summarizes the 1983 and 2001 surface water data.

Table 3.3-6. Pagan Surface Water Quality Sample Report

Site Name	***Laguna Sanhiyon***		***Laguna Sanhalom***	
Sample Date	**3/12/1983**	**5/25/2001**	**3/12/1983**	**5/24/2001**
Sample Time	**4:10 PM**	**11:30 AM**	**3:45 PM**	**12:55 PM**
Total nitrogen, water, filtered, mg/L	-	< 0.21	-	< 0.20
Organic nitrogen, water, filtered, mg/L	-	E 0.13	-	< 0.15
Ammonia, water, filtered, mg/L as nitrogen	-	E 0.03	-	< 0.04
Nitrite, water, filtered, mg/L as nitrogen	-	< 0.006	-	< 0.006
Nitrate, water, filtered, mg/L as nitrogen	-	< 0.050	-	< 0.050
Ammonia plus organic nitrogen, water, filtered, mg/L as nitrogen	-	0.16	-	0.15
Nitrate plus nitrite, water, filtered, mg/L as nitrogen	< 0.100	< 0.05	< 0.100	< 0.05
Orthophosphate, water, filtered, mg/L		< 0.061	-	< 0.061
Phosphorus, water, filtered, mg/L as phosphorus	-	E 0.003	-	E 0.004
Orthophosphate, water, filtered, mg/L as phosphorus	-	< 0.02	-	< 0.02
Chloride, water, filtered, mg/L	7000	7260	3500	1910
Sulfate, water, filtered, mg/L	940	1000	390	693
Silica, water, filtered, mg/L as silicon dioxide	4.1	8	80	53.4
Barium, water, filtered, ug/L	-	20.2	-	4.68
Barium, water, unfiltered, recoverable, ug/L	100	-	< 100	-
Boron, water, filtered, ug/L	-	2290	-	1540
Chromium, water, unfiltered, recoverable, ug/L	20	-	20	-
Iron, suspended sediment, recoverable, ug/L	90	-	0	-
Iron, water, unfiltered, recoverable, ug/L	130	-	40	-
Manganese, water, filtered, ug/L	20	19.2	20	14.3
Strontium, water, filtered, ug/L	-	2600	-	558
Vanadium, water, filtered, ug/L	-	131	-	8.8
Zinc, water, filtered, ug/L	-	9.6	-	5.4
Zinc, water, unfiltered, recoverable, ug/L	20	-	20	-
Antimony, water, filtered, ug/L	-	0.53	-	E 0.140
Aluminum, water, unfiltered, recoverable, ug/L	200	-	M	-
Aluminum, water, filtered, ug/L	-	9.1	-	3.4
Lithium, water, filtered, ug/L	-	31.5	-	31.1
Lithium, water, unfiltered, recoverable, ug/L	50	-	110	-
Selenium, water, filtered, ug/L	-	13.8	-	3.1
Selenium, water, unfiltered, ug/L	2	-	2	-
Uranium (natural), water, filtered, ug/L	-	0.35	-	0.08
Total coliform, water, colonies per 100 milliliters	150	-	15	-

Notes: M = presence verified but not quantified; E = estimated; - = not analyzed; mg/L = milligrams per liter; ug/L = micrograms per liter.

3.3.5.2 Groundwater Resources

Knowledge of the groundwater resources of Pagan is limited to a 1957 study of the geology and hydrogeology of the island (Corwin et al. 1957), a 1978 planning study by the CNMI Office of Transition Studies and Planning; and limited water sampling conducted by the U.S. Geological Survey in 1983 and 2001 (U.S. Geological Survey 2014). The hydrogeology (i.e., groundwater geology) of Pagan likely does not include any large bodies of fresh groundwater near sea level (i.e., basal groundwater lenses). This is evidenced by the very limited amount of groundwater seeping from soil or rock (i.e., perennial seeps, springs). One minor seep was located on a cliff face along the west coast approximately 0.5 mile (0.8 kilometer) south of Bandeera Peninsula (Corwin et al. 1957). A limited basal confined aquifer may exist beneath Mount Pagan caldera because of the density difference between freshwater (from rainfall) and saltwater (from the adjacent ocean). This lens is likely to have developed in the Mount Pagan caldera, because the less-dense freshwater, if undisturbed by other forces, will "float" on top of the more-dense saltwater. However, the 1981 eruption and subsequent temperature convection currents have likely mixed saltwater with portions of the freshwater lens to an extent that development of this lens as a freshwater resource is questionable.

No large high-level groundwater bodies have been identified although small bodies of perched water (isolated small bodies of water found above the regional water table) may occur at depth on the South Volcano, Mount Pagan, and within the several calderas associated with the ancestral volcanoes that form the island (Corwin et al. 1957; CNMI Office of Transition Studies and Planning 1978).

Other potential sources of potable water are within the volcanic rock of the plains surrounding Mount Pagan, because of the high rates of infiltration and rapid circulation through the rocks. Figure 3.3-5 shows the location of the known groundwater wells on Pagan: a former Japanese well located north of the Japanese runway, four wells identified during a 2008 archaeological survey (CNMI Office of Transition Studies and Planning 1978; Athens 2009), and two additional wells located and sampled by Corwin et al. (1957). The wells are subject to saltwater intrusion and their current status is unknown (DoN 2013b).

Six relatively broadly-distributed groundwater samples were collected from accessible wells on Pagan by the U.S. Geological Survey in 1983 and two were collected in 2001 (U.S. Geological Survey 2014). These data suggest groundwater for the Shomushon area (area just east of Green and Red Beach, north of the Pagan airfield) to be below the U.S. Environmental Protection Agency's regional screening levels for potable water for nutrients and dissolved metals (U.S. Environmental Protection Agency 2014). Three of the wells Corwin et al. (1957) tested (Wells 1, 2, and 3) had total dissolved solids below the secondary drinking water maximum contaminant level. Two of these wells (Wells 2 and 3) had nitrate concentrations below the primary drinking water (i.e., mandatory drinking water quality standards under the Safe Drinking Water Act) maximum contaminant level. Therefore these two wells might be considered potable; however both of these have water high in silica.

3.3.5.3 Nearshore Waters

Pagan has approximately 39 miles (63 kilometers) of undeveloped coastline that features diverse intertidal systems, with tide pools formed in basalt and limestone headlands exposed along the coast (Polhemus 2010). During coral surveys, visibility and apparent water quality was degraded in water along Green Beach (see Figure 3.3-5) relative to the other leeward beaches. Kitchen scraps found in shallow sediments of the bay at Green Beach during coral surveys suggests that use of the area by visitors to Pagan could also potentially influence nearshore water quality (DoN 2014).

Two sea water samples collected by the U.S. Geological Survey in 1983 and 2001 at the shoreline near the center of Red Beach were analyzed for standard water quality parameters (pH, conductance, temperature, turbidity) as well as nutrients and dissolved metals. Sodium and chloride levels were standard for the sea water samples, pH was basic (7.5-8.2) as would be expected for nearshore sea water, and was typical for bicarbonate concentrations. Dissolved nitrogen as nitrate and phosphorous concentrations were also standard for nearshore seawater (U.S. Geological Survey 2014).

As part of the Mariana Archipelago Reef Assessment and Monitoring Program the National Oceanic and Atmospheric Administration, National Marine Fisheries Service conducted shallow-water conductivity, temperature, and depth casts in nearshore waters surrounding Pagan in August and September 2003, September 2005, and June 2007. Across all sample years and locations, at a depth of 33 feet (10 meters) water temperatures ranged from 83.79 to 86.18 degrees Fahrenheit (28.77 to 30.10 degrees Celsius) and salinity ranged from 34.29 to 34.61 practical salinity units. Comparisons between surveys suggest a dynamic physical environment with few spatial similarities in water properties across sample years. In 2005 and 2007, temperature and salinity values were generally lower along the east side of the island as compared to the west (Brainard 2012).

In 2005 and 2007 water samples were collected to measure chlorophyll-a, total nitrogen, nitrate, nitrite, phosphate, and silicate levels. Water quality data suggests spatial and temporal variability in nutrient concentrations. Spatial pattern of measures nutrients varied between survey years, with the exception of phosphate, which was relatively consistent between survey years. Measured silicate values were higher in 2007 than in 2005. These differences may result from seasonal effects, with the 2005 survey occurring during a period of high precipitation and 2007 survey occurring in a period of low precipitation, or may be due to other processes unknown at this time (Brainard 2012).

3.4 AIR QUALITY

Section 3.4 describes the existing air quality in the region of influence for the proposed action. Air quality refers to pollutants in the air, and the health and safety aspect of those pollutants to humans and the environment, including plants and animals. Air pollution refers to chemical substances, particulates, biological materials, or other harmful materials that degrade the quality of the atmosphere. Air quality is affected by air pollutants from mobile sources such as vehicles, aircraft, ships, and construction equipment, as well as by stationary sources such as emergency generators, industrial stacks, exhaust vents, prescribed fires, and natural processes (e.g., wildfires and volcanic activity). The region of influence for air quality is Tinian’s and Pagan’s airsheds, which include the land areas and coastal waters within 3 nautical miles (5.5 kilometers) of the respective islands. Tinian’s and Pagan’s airsheds are under the same air quality jurisdiction.

3.4.1 Definition

Air quality is defined as a measurement of pollutants in the air. Regulatory definitions are based on the 1970 Clean Air Act (amended in 1977 and 1990), and are described in detail in Appendix G, *Air Quality Technical Memo*.

3.4.2 Regulatory Framework

The regulatory framework governing air quality is briefly summarized below and described in greater detail in Appendix G, *Air Quality Technical Memo*. A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations*.

- Clean Air Act 42 U.S. Code § 7401 *et seq.*
- CNMI Air Pollution Control Regulations
- Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management
- Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance

The U.S. Environmental Protection Agency, under the requirements of the Clean Air Act, established National Ambient Air Quality Standards for six contaminants. These contaminants, referred to as criteria pollutants, are:

- Carbon monoxide
- Nitrogen dioxide
- Ozone
- Particulate matter
- Lead
- Sulfur dioxide

The National Ambient Air Quality Standards include primary and secondary standards. The primary standards were established to protect human health, particularly the health of sensitive populations such as asthmatics, children, and the elderly. Sensitive land uses protected by the primary air quality standards are publicly accessible areas used by these sensitive populations; including residences, hospitals, libraries, churches, parks, playgrounds, and schools. The secondary air quality standards set limits to protect the environment, including plants and animals, from adverse effects associated with pollutants in the air. In addition to the criteria pollutants that have been established by the National Ambient Air Quality Standards, greenhouse gas emissions that trap heat in the atmosphere also occur from both natural processes and human activities. Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years (U.S. Environmental Protection Agency 2013). The primary long-lived greenhouse gases directly emitted by human activities are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

3.4.3 Methodology

Areas where concentration levels of a criteria pollutant are below standards are designated as being "in attainment," per the Clean Air Act. Areas where a criteria pollutant level equals or exceeds standards are designated as being in "nonattainment." A "maintenance area" is one that has been redesignated from nonattainment status to attainment status, and has an approved maintenance plan under § 175 of the Clean Air Act. Where insufficient data exist to determine an area's attainment status, it is designated as unclassifiable.

The CNMI local government has not collected ambient air quality data. Therefore, no existing ambient air quality data are available to represent current air quality conditions with respect to criteria pollutants. Because of the lack of ambient air quality monitoring data, the existing air quality conditions on Tinian and Pagan cannot be evaluated against National Ambient Air Quality Standards. Therefore, both islands are considered unclassifiable. However, given limited emission sources on these islands, it is anticipated that they would presumably be in an attainment area if the ambient data were monitored as other states. The discussion of existing air quality conditions on, and surrounding, the islands of Tinian and Pagan is based on a brief discussion of major emission sources and where they exist on the two islands. The localized air quality condition can be correlated with the close proximity of major emission sources. In general, the sensitive receptors (e.g., individuals with respiratory conditions) that are close to major emission sources tend to have more air quality concerns than those located far from these sources.

Stationary source permits regulate emissions from a facility but cannot be utilized to calculate ambient air quality conditions in terms of the National Ambient Air Quality Standards.

3.4.4 Tinian

Tinian has a tropical climate. Over the course of the year, the temperature varies from 76 to 88 degrees Fahrenheit (24 to 31 degrees Celsius) and is rarely below 73 degrees Fahrenheit (22 degrees Celsius) or above 90 degrees Fahrenheit (32 degrees Celsius). The probability of precipitation varies throughout the year but occurs most often around October. Wind speeds typically vary from 2 to 22 miles per hour with dominant winds originating from the east. It is anticipated that air pollutants from the island would be quickly dispersed under normal weather conditions.

The major stationary sources on Tinian include power generation units and distribution facilities that comprise the existing island-wide power system owned by the Commonwealth Utilities Corporation. The power generation facility consists of four 2.5-megawatt diesel generators and two 5-megawatt diesel generators. These generators are the largest stationary sources of air emissions on Tinian. Given the limited human activities on the island, Tinian is considered an unclassified area and presumed to be in attainment for all criteria pollutants. In addition to the major stationary sources, facilities may have back-up generators in case of grid power failure; however, these sources are intermittent and considered minor stationary sources.

Traffic along major travel routes, such as Broadway and 8th Avenue within the San Jose area, are the dominant source of mobile source emissions. Operation of aircraft and vessels also generate emissions. The airport and seaport are located relatively far from sensitive neighborhoods, approximately 1 mile and 0.2 mile, respectively. Effects from these emission sources are negligible when compared to those from immediately adjacent roadway traffic.

3.4.5 Pagan

Because only sparsely distributed intermittent encampments currently occur on Pagan, and no electrical utility facilities exist, air pollution as a result of human activities is essentially nonexistent. Pagan is considered an unclassified area and presumed to be in attainment for all criteria pollutants. Active volcanoes on Pagan are the main sources of air emissions. Pagan contains two active volcanoes (Mount Pagan and South Pagan volcanoes). Almost all of the historical eruptions have originated from the Mount Pagan volcano (or North Pagan volcano). The largest recorded eruption took place in 1981.

According to satellite images received by the U.S. Geological Survey (2013), the Pagan volcanoes generate persistent gas and steam plumes with occasional robust plumes. Ambient sulfur dioxide conditions are not monitored on Pagan. The only sources of air quality information are satellite observations and occasional reports from observers who pass by or visit the island. However, volcanic emissions released from active volcanoes, such as sulfur dioxide (a criteria pollutant), are of concern with respect to human health.

Sulfur dioxide, a colorless gas with a characteristic and irritating smell, is one of the most common gases released in volcanic eruptions. On the local scale, sulfur dioxide is a hazard to humans in its gaseous form. This odorous pollutant is perceptible at different levels, depending on the individual's sensitivity, but is generally perceived between 0.3 to 1.4 parts per million and is easily noticeable at 3.0 parts per million. Gas concentrations would reduce in half over a period of 6 to 24 hours. Therefore, only about 5% (i.e., 0.5 parts per million approximately) of the emitted gas is present in the lower atmosphere after 1 to 4 days, which is close to the odor level that is barely perceivable.

3.5 NOISE

Section 3.5 describes noise as perceived from a human perspective. The region of influence for noise is the islands of Tinian, Pagan, and surrounding areas including the southern portion of Saipan that could potentially be affected by the proposed action. Noise can also affect other resources such as biological (e.g., wildlife response), cultural (e.g., historic structures), recreational (e.g., noise intrusion on experience), and land use (e.g., incompatibility with existing land uses). This section presents baseline noise levels within the study area and focuses on the human response to those levels. Other sections in this EIS/OEIS use this information but in the context of their respective resource baseline and potential impact analyses. For example, the noise environment as it relates to terrestrial biological resources is presented in Sections 3.9 and 4.9, *Terrestrial Biology* of this EIS/OEIS.

3.5.1 Definition

Noise is generally described as unwanted sound. Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Unwanted sound can be based on objective effects (such as hearing loss and speech interruptions) or subjective judgments (such as noise complaints and annoyance).

There are two main concepts to understand how noise is generated—sound level and frequency.

- **Sound Level.** Sound level or intensity is a measure of the loudness of a sound expressed in decibels. A human ear can only detect sounds that are above a certain decibel level. The other end of the spectrum is sound so loud (high decibel level) that it can cause pain, discomfort, and hearing loss.
- **Frequency.** Frequency is a measure of sound-wave cycles per unit of time, with higher frequency sounds dispersing more quickly than those at lower frequencies. The standard unit of measurement for sound wave frequency is cycles per second, expressed as hertz.

Sound waves move outward in all directions from the source and weaken as the distance from the source increases. Sound waves (i.e., noise) can also be diminished or enhanced by wind movement, terrain, ground cover, and temperature. Human hearing can generally perceive frequencies between 20 and 20,000 hertz. The human ear cannot hear sounds above and below these frequencies.

Detailed definitions and explanations of noise modeling and methodology are provided in Appendix H, *Noise Study*.

3.5.1.1 Sound Level

Sound level is a measurement for the loudness of a sound, and loudness is a function of the amount of energy (or pressure) in a sound wave. A sound wave consists of a moving front of pressure that exceeds surrounding atmospheric pressure, followed by a trough that is below surrounding atmospheric pressure. The more this pressure front varies from the surrounding pressure, the louder, or more intense, the sound. Sound intensity is measured in units called decibels. The decibel system of measuring sound provides us with a simplified relationship between the physical intensity of sound and its perceived loudness to the human ear. The decibel scale is logarithmic, therefore, sound intensity increases or decreases exponentially with each decibel of change.

Not all people are affected the same way by the same sounds. In varying situations, common sounds can interfere with our speech, disturb our sleep, or interrupt a routine task. When this occurs, these sounds become noise (Army Center for Health Promotion and Preventative Medicine 2006). Just as some people find hard rock music annoying, others find it soothing and relaxing.

The decibel levels of multiple sources of sound are not additive. In fact, doubling a noise source would only generate a 3-decibel increase. For example, a receptor under a flight path of one jet airliner 500 feet (152 meters) overhead would experience 115 decibels; if two jetliners passed side-by-side, the receptor would experience 118 decibels not 230 decibels. In addition, the decibel 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 decibels for each doubling of distance from the source. Common sound levels include a garbage disposal, which measures at about 77 decibels, and a car at 100 feet (314 meters), which measures at about 60 decibels.

3.5.1.2 Frequency Weighting (A and C Weighting)

The human ear cannot perceive all pitches or frequencies of sound equally. Therefore, sound measurement can be adjusted or weighted to compensate for the human lack of sensitivity to low-pitched and high-pitched sounds. The weighted scales used in this analysis are defined below. Please note that noise levels from one scale cannot be added or converted mathematically to levels in another weighting scale.

- **A-weighted Scale**. This scale accounts for higher-pitched sounds and used for evaluating noise sources such as aircraft, vehicles, and small arms firing (up to .50-caliber).
- **C-weighted Scale.** This scale accounts for the lower-pitched sounds and used for evaluating explosions and large-caliber weapons such as artillery and mortars (20 millimeter and greater).

3.5.1.3 Noise Metrics

Noise is measured using several metrics that reflect different noise characteristics. There are differences in continuous (e.g., aircraft flying) versus impulsive (e.g., weapons firing) types of noise, variations in frequency, duration of noise exposure. Duration of noise exposure also dictates how a person perceives noise; a relatively long steady noise, like a train, aircraft passing or traffic, “feels” different than a rapid loud gunshot type noise. Noise metrics used for the affected environment are as follows:

- Day-Night Average Sound Level is used to measure average annual noise levels around airfields and ranges. Day-night average sound levels can be either A-weighted or C-weighted depending upon the activity measured. Because noise is considered more intrusive at night, a 10-decibel penalty is applied for operations occurring during nighttime hours, between 10:00 p.m. and 7:00 a.m.
- Peak 15 Sound Level (hereafter referred to as Peak) is the instantaneous, unweighted maximum value reached by the sound pressure produced by small- and large caliber weapons. Peak measures the impulsive sounds generated by small and large munitions, explosions, and sonic

booms. It represents a single event where the maximum noise level is likely to be exceeded 15% of the time.

3.5.1.4 Noise Modeling

To derive the noise contour bands, the following software models were used for evaluating existing noise conditions. Refer to Appendix H, *Noise Study* for more detailed information.

- The Small Arms Range Noise Assessment Model calculates and displays noise contour bands for firing operations at small arms ranges (Army 2003). It considers the type of weapon and ammunition, number of rounds fired, range attributes such as size and barriers, time of day fired, and direction of both muzzle and projectile.
- The model NOISEMAP is used to generate noise contour bands around airfields and landing zones (Czech and Plotkin 1998). The model incorporates the aircraft type and number; takeoffs, landings, touch and goes (i.e., aircraft simulates landing on the runway and then taking off), as well as closed patterns (e.g., going around the airfield to land or take off because of noise abatement procedures), and time of operation to depict noise levels.
- The BNOISE2 model calculates and portrays noise contour bands for large caliber weapons (Army 2009). It considers the weapon, ammunition, rounds fired, time of day fired, range size, and direction of both the muzzle and projectile.

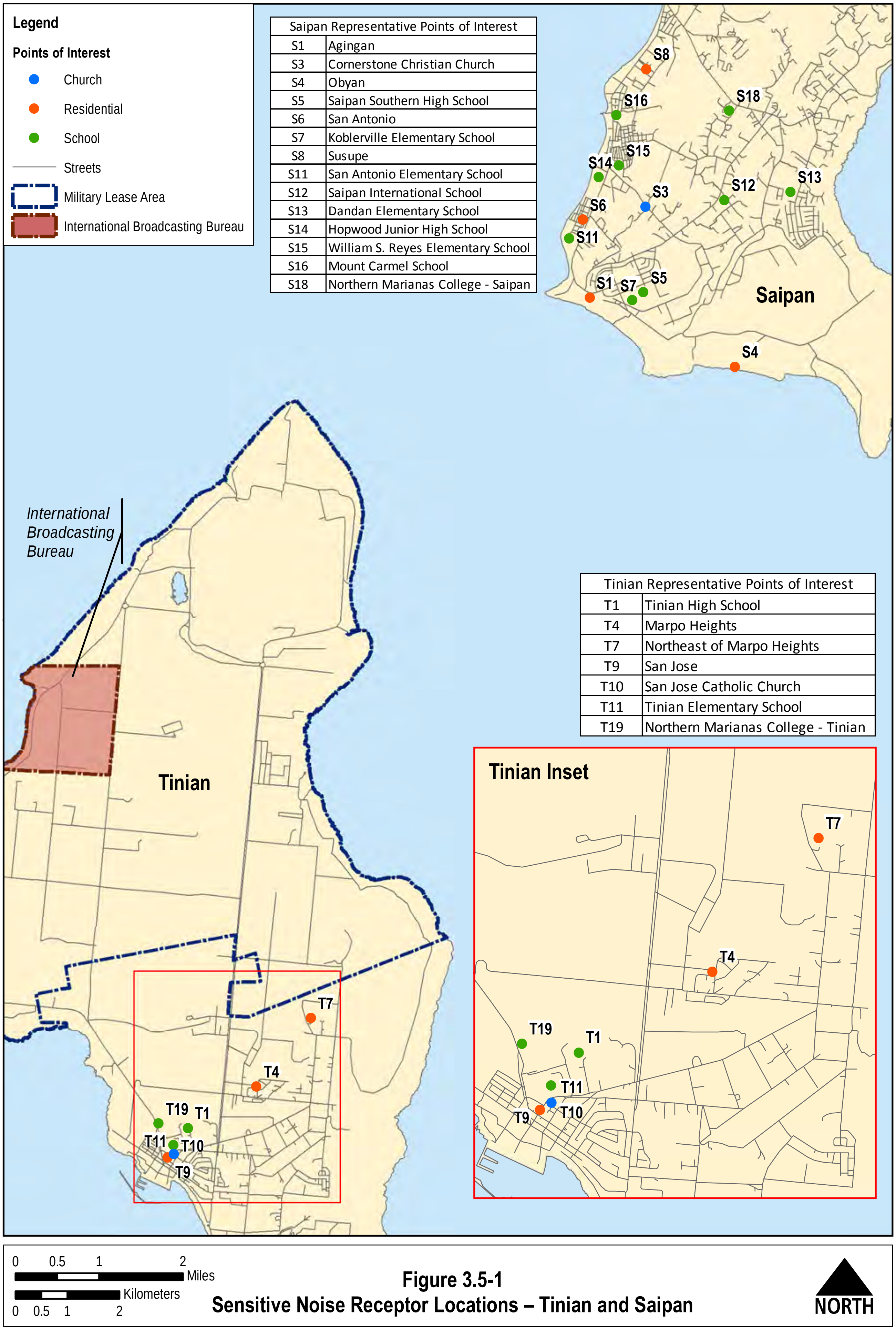
3.5.1.5 Noise Zones

Typically, noise contour bands are depicted on maps in 5-decibel bands, from 65 decibels to 85 decibels from the noise source. These bands are then grouped into noise zones that are used to identify whether land uses exposed to these noise zones are compatible or incompatible with the level of noise exposure. Some land uses such as residential areas, schools and hospitals are considered more sensitive than others, such as commercial endeavors. People living in residential areas, students in schools, and patients in hospitals are considered sensitive receptors. Figure 3.5-1 shows potential sensitive noise receptors on Tinian and Saipan.

3.5.2 Regulatory Framework

The Noise Control Act of 1972 and U.S. Environmental Protection Agency Guidance provide the regulatory framework used for this noise evaluation. Two programs are used by the U.S. military to address this guidance: (1) the Range Air Installation Compatible Use Zone (Office of the Chief of Naval Operations Instructions 3550.1A) for ground-based and air-to-ground operations within ranges and training areas, and (2) the Air Installation Compatible Use Zone (Office of the Chief of Naval Operations Instructions 11010.36C) for airfield operations (DoN 2008a, 2008b).

These compatible use zone programs help military installations determine noise generated by military training and operations; evaluate how the noise from these operations may impact adjacent communities, sensitive noise receptors, and activities; and assist military planners with assessing existing and proposed land uses on an installation. The U.S. military also provides this information to adjacent communities so if they wish to, they can use it in their planning and zoning decisions.



Saipan Representative Points of Interest	
S1	Agingan
S3	Cornerstone Christian Church
S4	Obyan
S5	Saipan Southern High School
S6	San Antonio
S7	Koblerville Elementary School
S8	Susupe
S11	San Antonio Elementary School
S12	Saipan International School
S13	Dandan Elementary School
S14	Hopwood Junior High School
S15	William S. Reyes Elementary School
S16	Mount Carmel School
S18	Northern Marianas College - Saipan

Tinian Representative Points of Interest	
T1	Tinian High School
T4	Marpo Heights
T7	Northeast of Marpo Heights
T9	San Jose
T10	San Jose Catholic Church
T11	Tinian Elementary School
T19	Northern Marianas College - Tinian

Figure 3.5-1
Sensitive Noise Receptor Locations – Tinian and Saipan

The results of the two programs are that noise contour bands based on the military activities can be modeled. These bands are then overlaid on land use planning maps to determine land use compatibility within the noise contour bands. Land use compatibility is then determined regarding the noise zone in which the land use is found.

Noise zones are defined as follows:

- **Zone I** (<65A-weighted/<62 C-weighted/<87 decibels Peak). This noise zone includes all areas in which day-night average sound levels are less than 65 decibels A-weighted, or 62 decibels C-weighted, or the Peak sound level is below 87 decibels. This noise zone is usually compatible with all types of land use activities (e.g., residential, schools, hospitals, places of worship, commercial). A subset of Zone I is the Land Use Planning Zone contours with noise levels between 57 and 62 decibels C-weighted. These noise levels are compatible with any land use, but land use planners often use this area as a buffer around military ranges. For example, although residential areas would be compatible in these areas, permitting or zoning a high-density apartment complex could invite noise complaints on days of higher than normal range activities.

- **Zone II** (65 to 75 A-weighted / 62 to 70 C-weighted / 87 to 104 Peak). Exposure to noise within this zone is normally considered incompatible with noise-sensitive land uses such as residences, hospitals, schools, and places of worship. Activities such as industrial, transportation, and resource production (e.g., farming, ranching, and mining) are considered compatible within this zone.

- **Zone III** (>75 A-weighted / >70 C-weighted / >104 Peak). Exposure to noise within this zone is considered incompatible with noise-sensitive land uses such as residences, schools, hospitals, places of worship, parks, and playgrounds but compatible with industrial, transportation, and resource production.

Table 3.5-1 lists the noise zones in tabular format, presents the noise levels encompassed within the particular noise zone, and identifies whether sensitive land uses such as homes, schools, hospitals, places of worship are compatible with that zone (Army 2007). Table 3.5-2 provides general land uses and identifies which are typically compatible with particular noise zones.

Table 3.5-1. Noise Zones and Sensitive Land Use Compatibility

Zone	*Decibel A-weighted / C-weighted / Peak*	*Land Use Compatibility Level*
I	<65 / <62 / <87	Compatible
II	65 to 75 / 62 to 70 / 87 to 104	Normally Incompatible
III	>75 / >70 / >104	Incompatible

Note: *Compatibility refers to sensitive land uses such as homes, schools, hospitals, and places of worship.
Sources: Army 2007; Army Center for Health Promotion and Preventative Medicine 2009.

Table 3.5-2. General Land Use Compatibility by Noise Zone

Noise Zones		*I*	*II*		*III*	
Aircraft/Small Caliber (A-weighted)		*<65*	*65-70*	*70-75*	*75-80*	*>80*
Large Caliber/Explosives (C-weighted)		*<62*	*62-70*		*>70*	
Percussive Munitions (Peak)		*<87*	*87-104*		*>104*	
Land Use	Commercial	Yes	Yes	Yes[2]	Yes[2]	No
	Industrial	Yes	Yes	Yes	Yes[2]	Yes[2]
	Open/Agricultural	Yes	Yes	Yes	Yes[1]	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.
Sources: Army 2007; Army Center for Health Promotion and Preventative Medicine 2009.

Another guideline used by the military for assessing noise generated by large-caliber and explosive munitions is risk of complaints. This approach uses Peak sound levels within low, moderate, and high ranges for risk of complaints. Table 3.5-3 provides the decibel levels associated with each level for risk of complaint.

Table 3.5-3. Large-caliber Weapons and Explosives Risk of Complaints Levels

Risk of Complaints	*Peak Decibel*
Low	< 115
Moderate	115 – 130
High	> 130

3.5.3 Methodology

Reports, studies, data sets, and regulations of the federal government and the CNMI government were reviewed and NEPA documents evaluated to define the existing noise environment for Tinian and Pagan. Site visits to Tinian and review of aerial photography of Saipan and Pagan were used to identify points of interest, such as residential areas, schools, and places of natural and cultural importance, for specific noise evaluation. Personal interviews with air traffic control and airspace managers, as well as review of regional flight records yielded information about current operations at Tinian and Saipan International Airports and within the regional CNMI airspace.

3.5.4 Tinian

The current noise environment on Tinian is typical of a rural town or small suburban area. Over half of Tinian's population resides in San Jose. Other residential areas include Marpo Heights, Marpo Valley, Carolinas Heights, and Carolinas village. All of Tinian's population resides outside of the Military Lease Area. As of the 2010 U.S. Census, total population was 3,136 people. Schools on Tinian include Tinian Elementary School, Tinian High School, and Northern Marianas College.

Although infrequent, most noise-generating activities stem from existing military aviation, marine, and ground-based training activities primarily occurring in the Military Lease Area once or twice per year. Other noise contributors include civil and commercial aircraft operations at Tinian International Airport, cargo vessel operations at the Port of Tinian, and aircraft activities in regional airspace.

3.5.4.1 Ground-based Military Training Activities

Existing military training consists mostly of infrequent ground-based non-live-fire training and occurs primarily in the Military Lease Area. A limited amount of small arms are employed during training using either simulated munitions or firing live ammunition into steel bullet traps. The small arms firing produces Peak sound levels of 90 to 100 decibels at 500 feet (152 meters) and 80 to 90 decibels at 1,000 feet (305 meters) for the most common types of small arms (5.56 and 7.62 millimeter, and .50 caliber). These activities occur well within the Military Lease Area and noise is imperceptible (undetectable) to populations outside Military Lease Area boundaries. Sound dissipates at the rate of 6 decibels per doubling of the distance from the source. The distance from where the small arms are employed, to the closest population in the village of Marpo Heights, is approximately 4 miles (6 kilometers). At this distance, the noise level reduces to a Peak sound level of 65 decibels (or Noise Zone I), well within the compatibility limits presented in Table 3.5-1.

Small unit field exercises and expeditionary warfare training occurs primarily on the northern portion of the Military Lease Area, including within an expeditionary airfield at North Field. On the southern portion of the Military Lease Area, limited military training primarily consists of reconnaissance exercises. With the maximum noise levels at about 65 decibels, none of these activities generate noise levels exceeding Noise Zone I outside of military boundaries, therefore adjacent land uses are considered compatible. Under current conditions, all of Tinian is considered to be in Noise Zone I, except in the immediate vicinity of the airport.

3.5.4.2 Aircraft and Airspace Activities

3.5.4.2.1 Military Lease Area

North Field (Photo 3.5-1) is an unimproved World War II-era airfield currently used for military vertical and short-field landings as part of existing military training. North Field is occasionally used for other military operations, such as helicopter insertion and extraction of personnel. Pyrotechnics (e.g., flares) are also used during existing training operations occurring throughout the main North Field area. These activities all create noise, as do the small arms and the limited amount of aircraft operations. These activities are infrequent and do not generate perceptible noise levels for populated areas to the south in San Jose or to the north in Saipan. Operations at North Field were evaluated but there are so few operations that the noise contour plotting software (which cannot plot noise levels below 55 decibels) could not be applied. Using the NOISEMAP software model, noise levels fall well below 65 decibels day-night average sound level (or Noise Zone I) and, therefore are considered compatible with all land uses.

Photo 3.5-1. Aerial View of North Field

3.5.4.2.2 Tinian International Airport

Tinian International Airport, located just south of the Military Lease Area boundary, is a commercial airport that had 49,116 annual flight operations during 2012 (Federal Aviation Administration 2013). Based on the 2014 to 2040 year-over-year growth rate estimated by the Federal Aviation Administration Terminal Area Forecast (Federal Aviation Administration 2013), air traffic operations for Tinian International Airport would not be expected to change (see also Appendix O, *Transportation Study*). At that time there were four single-engine aircraft and two multi-engine aircraft based at the airport and it has limited airfield services. Single engine air taxi operations by Star Marianas Airlines make up the majority of the operations at Tinian International Airport. Although rare, chartered jets such as Boeing 747 or 767 occasionally fly into and out of the airport.

Although military operations comprise a small proportion of the total annual operations, military jets, such as the FA-18 are about 30 decibels louder than the civilian aircraft operating at Tinian. As such, the noise environment at Tinian International Airport is dominated by the occasional military aircraft when they are operating at the airfield. Figure 3.5-2 shows the baseline noise contours for Tinian International Airport.

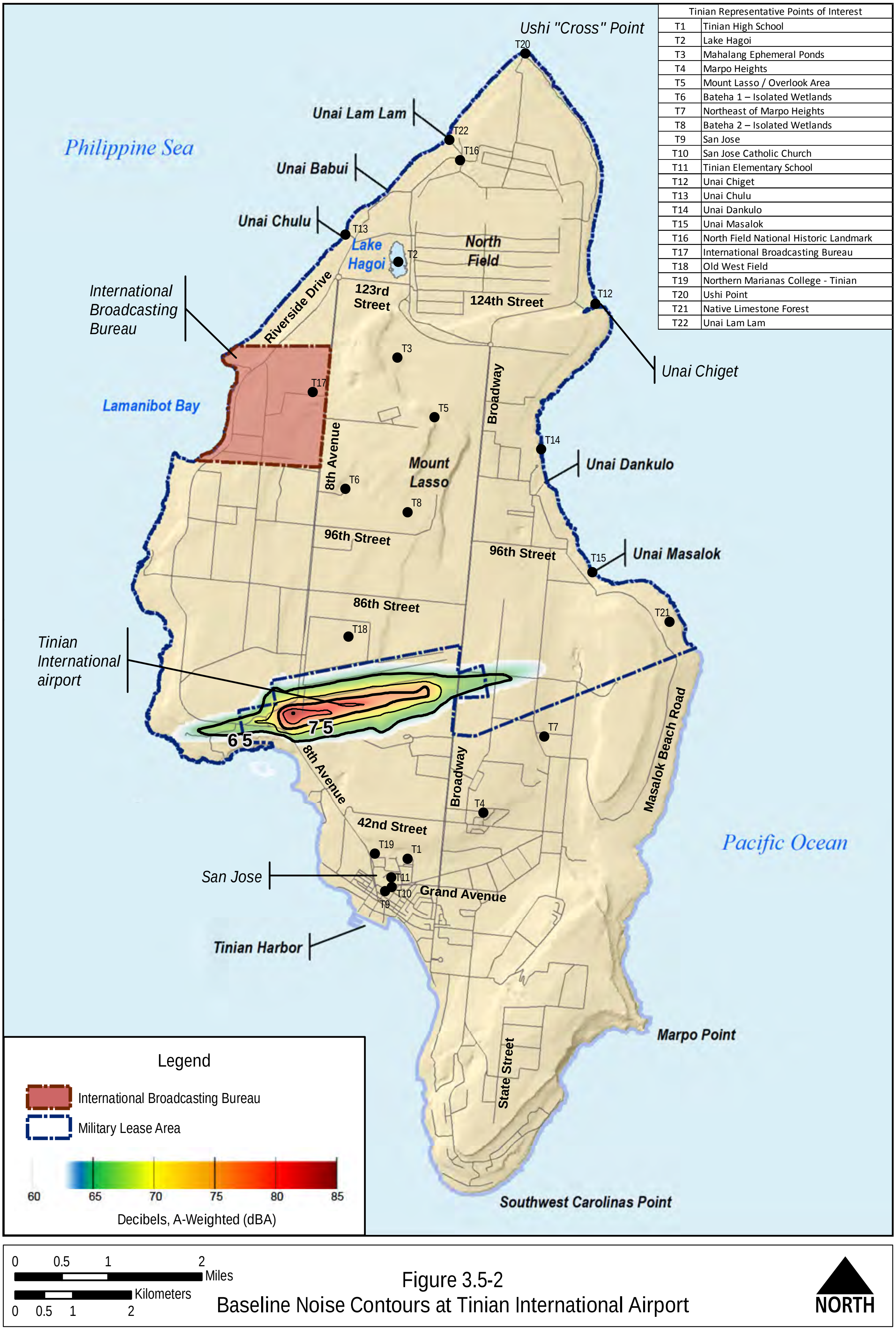
Points of interest were identified for a variety of reasons; some are sensitive land uses such as residential areas or schools, others were chosen to portray the general noise environment at that location and represent areas that have a combination of biological, cultural, recreational, or other resource implications. Section 4(f) discussions are presented in Section 4.19, *Section 4(f) Evaluation*. All sensitive receptors (i.e., homes and schools) are located well away from areas affected by 65 decibel levels or louder. Table 3.5-4 shows the noise levels at representative points of interest under current noise conditions generated by typical civilian aircraft and occasional military operations at Tinian International Airport.

3.5.4.2.3 Saipan International Airport

Saipan International Airport, due to its close proximity to Tinian International Airport is included in the following discussion as it could potentially be impacted by the proposed action. In addition, during scoping the public expressed concern if noise generated in the Military Lease Area would affect southern Saipan. There are 22 aircraft based at Saipan International Airport. Daily aircraft operations average 175, consisting of air taxi/inter-island commercial flights to and from Tinian, Rota, and Guam as well as international commercial airline flights to and from countries such as Japan and China (Air Force 2012). Although there are aircraft operating over the Military Lease Area, these operations are infrequent and are done at approximately 2,100 feet (640 meters) in altitude where noise levels would not exceed 65 decibels day-night average sound level (or Noise Zone I) and are considered compatible with all land uses. Saipan International Airport is unlikely to contribute to the noise environment in residential areas of Tinian, south of the Military Lease Area.

3.5.4.2.4 Airspace

Under baseline conditions, one Special Use Airspace unit (Air Traffic Controlled Assigned Airspace 6) and several airport departure and arrival routes produce aircraft-generated noise around Tinian and Saipan. These levels are negligible and do not perceptibly contribute to the baseline noise environment. These activities do not generate noise levels exceeding 65 decibels day-night average sound level.



Tinian Representative Points of Interest	
T1	Tinian High School
T2	Lake Hagoi
T3	Mahalang Ephemeral Ponds
T4	Marpo Heights
T5	Mount Lasso / Overlook Area
T6	Bateha 1 – Isolated Wetlands
T7	Northeast of Marpo Heights
T8	Bateha 2 – Isolated Wetlands
T9	San Jose
T10	San Jose Catholic Church
T11	Tinian Elementary School
T12	Unai Chiget
T13	Unai Chulu
T14	Unai Dankulo
T15	Unai Masalok
T16	North Field National Historic Landmark
T17	International Broadcasting Bureau
T18	Old West Field
T19	Northern Marianas College - Tinian
T20	Ushi Point
T21	Native Limestone Forest
T22	Unai Lam Lam

Figure 3.5-2
Baseline Noise Contours at Tinian International Airport

Table 3.5-4. Baseline Noise Levels at Representative Points of Interest

Tinian Representative Points of Interest			*Noise Level – A-weighted Day-Night Average Sound Level (decibels)*
Identification Number	***Description***	***Type***	
T1	Tinian High School	School	36.7
T2	Lake Hagoi	Other	44.1
T3	Mahalang Ephemeral Ponds	Other	39.5
T4	Marpo Heights	Residential	45.4
T5	Mount Lasso Overlook Area	Other	40.7
T6	Bateha 1 - Isolated Wetlands	Other	38.8
T7	Northeast of Marpo Heights	Residential	48.5
T8	Bateha 2 - Isolated Wetlands	Other	45.6
T9	San Jose	Residential	37.3
T10	San Jose Catholic Church	Church	37.1
T11	Tinian Elementary School	School	36.9
T12	Unai Chiget	Other	35.4
T13	Unai Chulu	Other	44.0
T14	Unai Dankulo/Long Beach	Other	47.0
T15	Unai Masalok	Other	48.8
T16	North Field National Historic Landmark	Other	41.2
T17	International Broadcasting Bureau	Administrative	41.8
T18	Old West Field	Other	54.6
T19	Northern Marianas College - Tinian	School	37.2
T20	Ushi Point	Other	36.3
T21	Native Limestone Forest	Other	50.0
T22	Unai Lam Lam	Other	39.0

Note: Shading indicates that points of interest are within the Military Lease Area.

3.5.4.3 Waterborne Activities

Currently, there are occasional Amphibious Assault Vehicle landings at the Port of Tinian. While these operations are rare, their noise levels are temporarily noise levels of 88 A-weighted decibels at 100 feet (30 meters). These noise levels are single events and not an average noise level used for compatibility. While average noise levels exceeding 65 decibels are considered incompatible with sensitive land uses, these areas are at least 1,000 feet (305 meters) from the port. To put it into perspective, at this distance noise levels from an Amphibious Assault Vehicle would be about as loud as two dump trucks operating in the harbor area. Therefore, sensitive land uses are not exposed to incompatible noise levels under baseline conditions. In the waters around Tinian, small fishing and dive boats operate and a cargo vessel makes regular trips between the Saipan and Tinian ports (in 2010, ferryboat operations between Tinian and Saipan ceased operations). Fishing and dive boats, as well as the cargo vessel operations generate noise levels that are low enough to be considered compatible with adjacent land uses.

3.5.4.4 Traffic

Roads on Tinian currently experience very light traffic volumes. According to the 2008 CNMI Comprehensive Highway Master Plan, the largest traffic volumes were on Broadway, Canal, and Grand Streets in San Jose with annual daily trips of 1,470, 1,520, and 2,240, respectively (Commonwealth

Department of Public Works 2008). Traffic volume on all other roads, including those in the Military Lease Area and Port of Tinian, is well below 500 daily trips. Traffic volumes this low contribute very little to the noise environment and do not exceed 65 decibels day-night average sound level. Again, all land uses within Noise Zone I are considered compatible.

3.5.4.5 Pagan

Currently the noise environment on Pagan is limited to visitors on the northern portion of the island. Man-made noise-generating activities (all-terrain vehicles, generators, and occasional aircraft) are rare and temporary. The only constant noise sources are naturally occurring and include wind, surf, and wildlife. Acoustically, this area would be typical of a rural or wilderness setting with ambient noise levels between 35 and 45 decibels A-weighted (U.S. Environmental Protection Agency 1978). Noise levels of this level cannot be modeled; therefore, no noise contour bands are presented.

3.6 AIRSPACE

Section 3.6 describes the current condition of the airspace surrounding the islands of Tinian and Pagan as well as the airspace approaches to Saipan International Airport on the island of Saipan. This information is derived from Appendix I, *Airspace Technical Memo,* which can be referred to for more details on this resource. In the U.S. and its territories, domestic airspace includes airspace overland to 12 nautical miles (22 kilometers) miles from the shoreline. The proposed Special Use Airspace associated with this action would lie entirely within the Oakland Flight Information Region. International airspace begins 12 nautical miles (22 kilometers) from the shoreline and is controlled based on International Civil Aviation Organization regulations. The International Civil Aviation Organization codifies the principles and techniques of international air navigation and fosters the planning and development of international air transportation to ensure safe and orderly growth. The U.S. is one of 191 member states belonging to the International Civil Aviation Organization. They have been delegated as the Air Navigation Service Provider for the airspace associated with the CNMI (Federal Aviation Administration 2014a, *Oakland Oceanic Controlled Airspace/Flight Information Region*). The Range and Training Areas under the proposed action includes both domestic and international airspace. Therefore, the Federal Aviation Administration has both special expertise and jurisdiction by law for both the domestic and international airspace associated with this proposed action.

In accordance with the *Memorandum of Understanding between the Federal Aviation Administration and the Department of Defense Concerning Environmental Review of Special Use Airspace Actions* (Federal Aviation Administration and the Department of Defense 2005), the Federal Aviation Administration is a cooperating agency for this EIS/OEIS to ensure that planning and decision making are conducted efficiently and effectively and without duplication of effort. The Federal Aviation Administration is responsible for evaluating, processing and charting airspace changes. They are represented by the Federal Aviation Administration Western Service Area (Renton, Washington) which provides guidance and control of U.S. territory airspace in the Pacific that includes the CNMI.

The region of influence for the proposed action is the airspace where the U.S. military proposes to operate aircraft and conduct live-fire training, and the airspace associated with the airports in the vicinity of the proposed airspace, to include Saipan. The region of influence includes the airspace associated with the proposed flight and live-fire training, including air-to-ground, sea-to-surface, and ground-based weapons training. The region of influence encompasses:

- The airspace supporting flights to and from Tinian International Airport, Saipan International Airport, and the Pagan airfield.
- Airspace within a 12-nautical mile (22-kilometer) boundary of Tinian's shore (see Chapter 2, *Proposed Action and Alternatives*).
- Airspace (domestic and international) within a 60-nautical mile (111-kilometer) by 80-nautical mile (148-kilometer) area surrounding Pagan (see Chapter 2, *Proposed Action and Alternatives*).
- The portions of the airspace associated with published aviation routes and other organized track system routes.

Other Special Use Airspace in the region would not be expected to have cumulative impacts with the proposed action. Therefore, the analysis does not include the following:

- Air Traffic Control Assigned Airspaces 1, 2 and 5 and Warning Area 517 would not be expected to have a cumulative effect with the proposed action as civilian aircraft needing access to this airspace are en route to and from Guam International Airport from locations south and east of the island. Therefore, Air Traffic Control Assigned Airspaces 1, 2 and 5 and Warning Area 517 are not included in the region of influence.
- Military Training Route Instrument Route 983 is aligned west of Tinian. It begins at a point northwest of Saipan and extends to an end point southwest of Guam. With two exceptions, the route is 8-nautical miles (15-kilometers) wide and extends from the surface to below 10,000 feet (3,048 meters) MSL. A portion of Instrument Route 983 is located approximately 8 nautical miles (15 kilometers) from Tinian. Instrument Route-983 is seldom used and was only scheduled for use four to six times in the past 3 to 4 years (Lt. Burkland W., Navy, June 2014). Due to the low usage, cumulative impacts resulting from use of Instrument Route 983 are dismissed from detailed analysis.

3.6.1 Definition

Airspace is a three-dimensional (i.e., latitude, longitude, and altitude) resource that is managed and controlled in the U.S. and its territories by the Federal Aviation Administration. The management of airspace and air traffic control consists of the direction, control, and coordination of flight operations in the "navigable airspace." Navigable airspace consists of airspace above the minimum altitudes of flight prescribed by regulations under U.S. Code Title 49, Subtitle VII, Part A. It includes the airspace needed to ensure safety of flight, including airspace needed for aircraft departures and arrivals (49 U.S. Code § 40102), the airspace needed for military training, and other special uses. The Federal Aviation Administration considers how navigable airspace is designated, used, and administered to best accommodate the individual and common needs of military, commercial, and general aviation. The management and use of airspace is important for many reasons including economic, transportation, recreation, and national defense.

The terminology and classification system used to characterize airspace is complex, but the following are key concepts required to understand the resource because they contain the basic set of rules used by aircraft operators flying in the region of influence (Federal Aviation Administration 2014b).

- **Above Ground Level:** Altitude expressed in feet measured above the ground surface.
- **Mean Sea Level:** Altitude expressed in feet measured above average (mean) sea level.
- **Visual Flight Rules:** A standard set of rules that all pilots, both civilian and military, must follow when not operating under instrument flight rules and in visual meteorological (weather) conditions. These rules require that pilots remain clear of clouds and avoid other aircraft.
- **Instrument Flight Rules:** A standard set of rules that all pilots, civilian and military, must follow when operating under flight conditions that are more stringent than visual flight rules. These conditions include operating an aircraft in clouds, operating above certain altitudes prescribed by Federal Aviation Administration regulations, and operating in some locations such as major civilian airports. Air traffic control agencies ensure separation of all aircraft operating under instrument flight rules.

There are two categories of airspace: regulatory (rulemaking) and other than regulatory (non-rulemaking). Regulatory airspace includes six airspace classifications, namely A, B, C, D, E, [no F], and G, and two types of Special Use Airspace: prohibited areas and restricted areas. Instances where the Federal Aviation Administration would establish new restricted areas are rulemaking actions because they require change to an existing Federal Aviation Administration regulation. Title 14 of the Code of Federal Regulations (14 CFR), Aeronautics and Space, contains rules issued by the FAA governing all civil aviation in the United States.

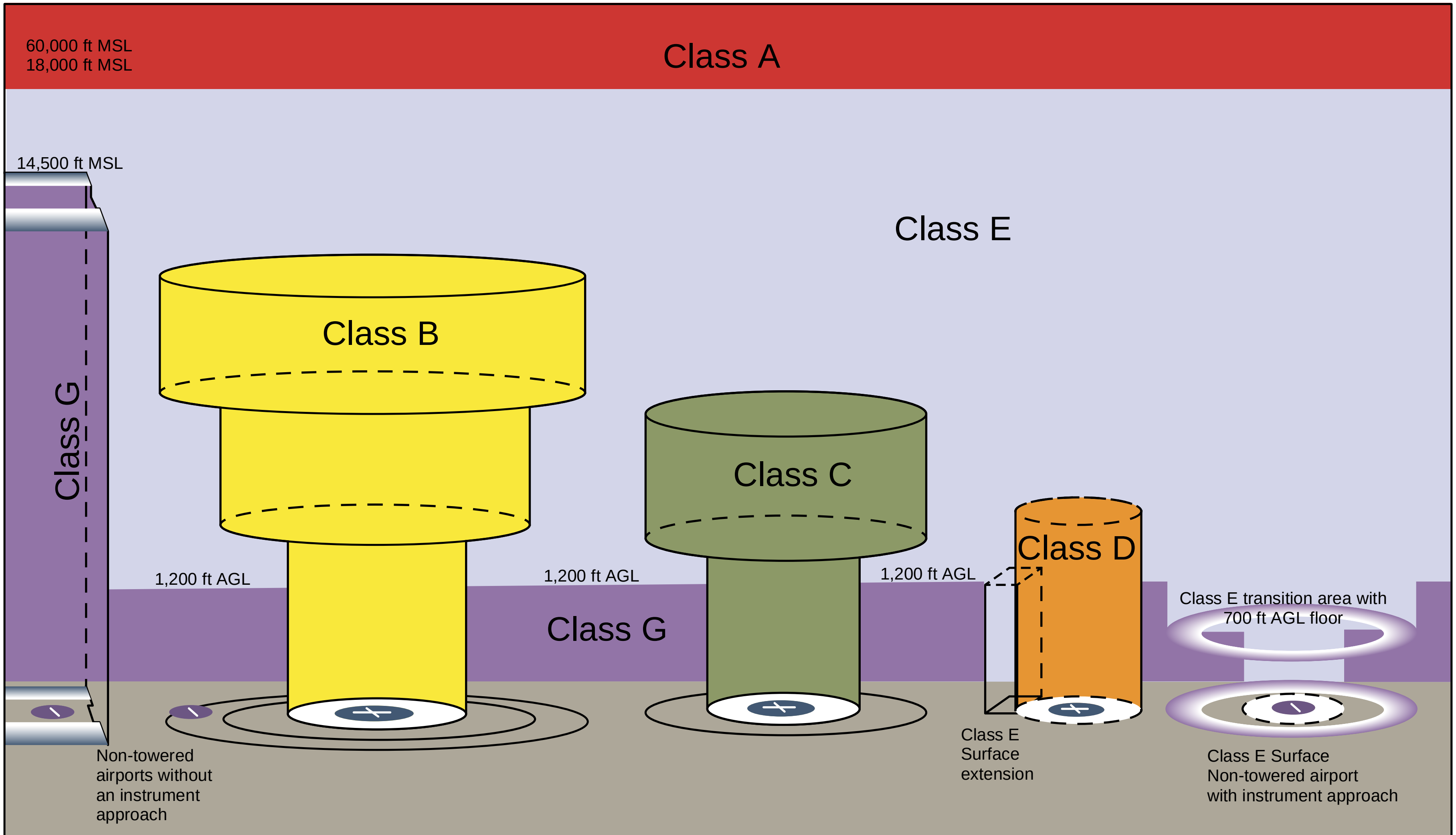
Classes A, B, C, D and E are controlled airspace, within which all aircraft operators are subject to certain pilot qualifications, operating rules and equipment requirements identified in 14 CFR Part 91, *General Operating and Flight Rules.* Figure 3.6-1 is a conceptual representation of the controlled classes relative to each other. It shows the maximum altitude of the various classes. Each class has specific navigational requirements that must be met for a pilot to enter safely. See Appendix I, *Airspace Technical Memo*, for a summary of these requirements by class. Class G is airspace that is not A, B, C, D, or E and is described as uncontrolled airspace.

Non-regulatory airspace includes five types of Special Use Airspace: (1) military operations areas, (2) warning areas, (3) alert areas, (4) controlled firing areas, and (5) national security areas. Military operations areas and warning areas are established through the Federal Aviation Administration as non-rule making actions.

Special use airspace is airspace with defined dimensions where activities must be confined because of their nature, or where limitations may be imposed on aircraft operations that are not a part of those activities (Figure 3.6-2).

Types of Special Use Airspace needed for military training activities and relevant to this EIS/OEIS are described below. (See Appendix I, *Airspace Technical Memo,* for the legal definition for each airspace type as contained in Federal Aviation Order 7400.2J).

- **Restricted areas are** airspace established under 14 CFR part 73 provisions, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Airspace designated as a restricted area denotes the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Entering a restricted area without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73.
- **Military operations area** is airspace below 18,000 feet (5,486 meters) MSL that separates military activities from instrument flight rule traffic. It also informs pilots flying under visual flight rules of where these activities are conducted.
- **Warning areas** are areas of defined dimensions extending from 3 nautical miles (6 kilometers) outward from the coast of the U.S. and extend outward over international waters. Warning areas are designated to contain activity that may be hazardous to nonparticipating aircraft. These areas may be considered for joint use with commercial aircraft if: (1) control can be shifted to the Federal Aviation Administration during times when it is not required for military use, and (2) they are located in airspace under civilian air traffic control authority.



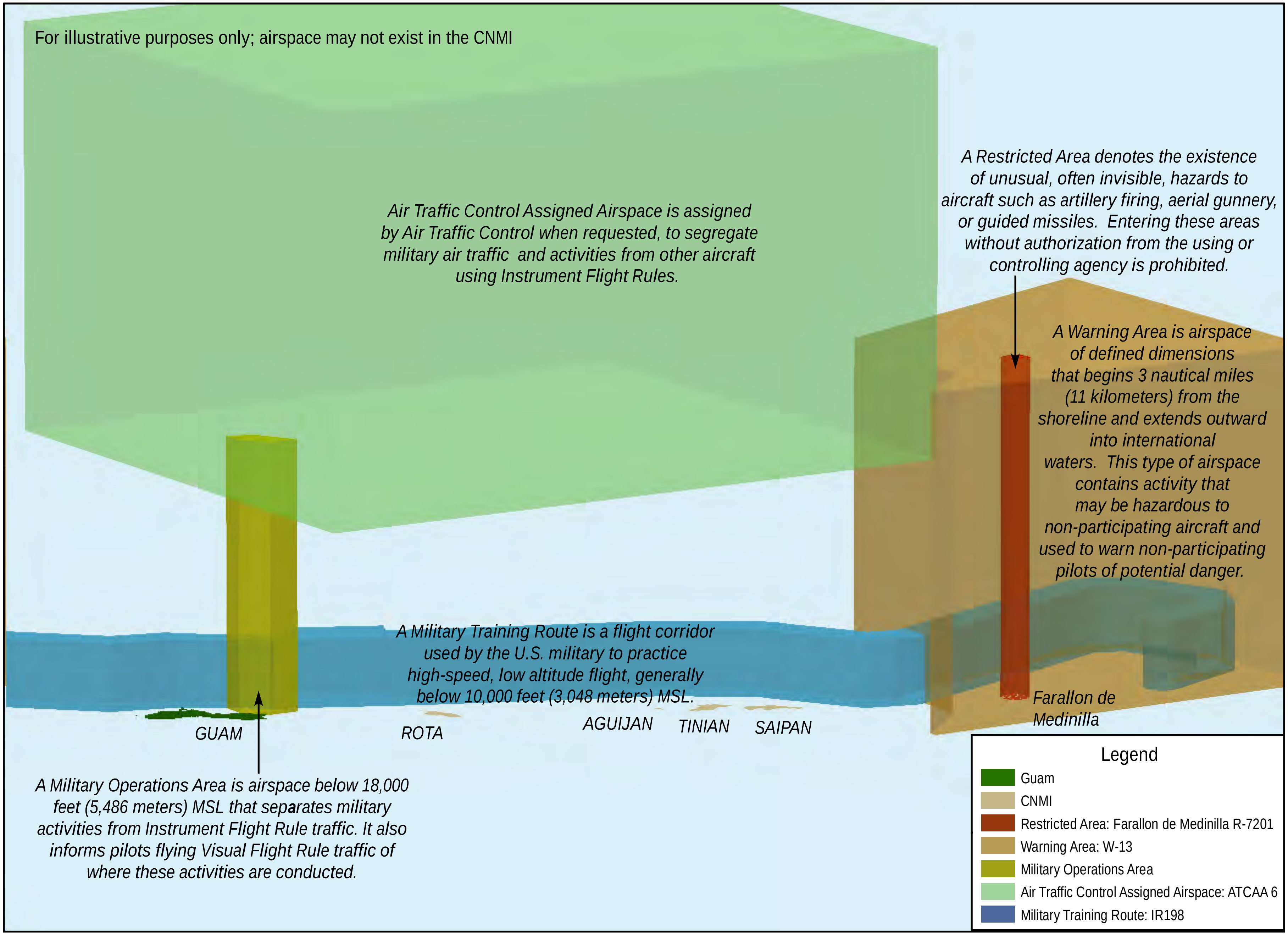
Notes: MSL - Mean Sea Level
AGL - Above Ground Level
ft - feet

Saipan International Airport is located within Class D airspace and extended by Class E airspace.

Tinian International Airport is located within Class G airspace with a restricted area floor that extends into their Class E airspace.

Pagan Airfield is located within Class G airspace.

Figure 3.6-1
Cross Section of Airspace Classes and Relationships



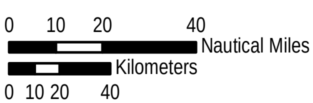


Figure 3.6-2
Special Use and Other Airspace Designated for Military Use

NORTH

Air Traffic Control Assigned Airspace is not considered Special Use Airspace but is used to extend the vertical limits of Special Use Airspace. Air Traffic Control Assigned Airspace has defined vertical and lateral limits, and is assigned by the Air Traffic Control facility responsible for the airspace to provide air traffic separation between the specified activities being conducted within the assigned airspace and other air traffic flying under instrument flight rules. Air Traffic Control Assigned Airspace is established through Letters of Agreement between the Department of Defense and Federal Aviation Administration.

Other airspace such as Classes A, B, C, D, E and Air Traffic Control Assigned Airspace are also needed to support Department of Defense military operations. Definitions for each of these classes of airspace can be found in Appendix I, *Airspace Technical Memo*.

Aeronautical charts also show aviation routes used by aircraft transiting between destinations. Airways are scheduled for use during flight planning and managed by an Air Route Traffic Control Center to ensure aircraft are safely separated from each other while en route to and from their destinations. The federal airway system allows the Federal Aviation Administration to effectively manage the airspace and ensure the safety of all users of the airspace. Additionally, aeronautical charts show airspace obstructions (e.g., communication towers and antennae). The obstructions often require lighting to ensure flight safety of aircraft operating at lower altitudes. In addition to aeronautical charts, there are published standardized procedures used to control aircraft arrivals and departures for many public airports. Air traffic controllers use the standardized procedures to ensure the flight safety of arrivals and departures to the runways. For example, during inclement weather conditions, pilots rely on instruments within their aircraft and navigational aids to land their aircraft safely based on instructions provided by the local air traffic control facility. These approach and departure procedures prescribe the correct altitudes and headings to be flown and procedures for missed approach, as well as obstacles, terrain, and potentially conflicting airspace. Appendix I, *Airspace Technical Memo,* contains detailed information regarding the published approaches for Tinian and Saipan International Airports.

3.6.2 Regulatory Framework

The International Civil Aviation Organization is responsible for codifying the principles and techniques of international air navigation and fostering the planning and development of international air transportation to ensure safe and orderly growth. In accordance with Executive Order 10854, Extension of the Application of the Federal Aviation Act of 1958*,* both rulemaking and non-rulemaking actions that encompass airspace outside of the U.S. sovereign airspace (e.g., beyond 12 nautical miles [22 kilometers] from the U.S. coast line) require coordination with the Department of Defense and Department of State. All Executive Order 10854 coordination must be conducted at the Federal Aviation Administration headquarters level by the Airspace Regulations and Air Traffic Control Procedures Group (Federal Aviation Administration 2014c, Section 2). The Federal Aviation Administration's Western Service Area has jurisdiction for international airspace associated with this proposed action and is responsible for obtaining airspace coordination with the International Civil Aviation Organization for this proposed action.

The Federal Aviation Administration has the overall responsibility for matters involving the use of navigable airspace and handles airspace matters in accordance with Federal Aviation Administration Order JO 7400.2K, *Procedures for Handling Airspace Matters* (Federal Aviation Administration 2014c). The Federal Aviation Administration has the same requirements under NEPA as the U.S. military (Federal

Aviation Administration Order 1050.1E, *Environmental Impacts: Policies and Procedures)* (Federal Aviation Administration 2006a) and Federal Aviation Administration Order 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions* (Federal Aviation Administration 2006b). To meet their NEPA requirements, the Federal Aviation Administration may adopt the EIS/OEIS prepared by the Department of Defense provided they independently evaluate the information in the document and take full responsibility for the scope and content that addresses Federal Aviation Administration actions. Federal Aviation Administration headquarters has the final approval authority for all permanent and temporary Special Use Airspace except controlled firing areas and must issue its own Record of Decision (Federal Aviation Administration Order 1050.1E, paragraphs 404d and 518h).

The Federal Aviation Administration controls airspace through policies and procedures designed to ensure safe and efficient use of the airspace by all users. Like the highway system and traffic laws, Federal Aviation Administration and International Civil Aviation Organization rules govern the Airspace System and regulations to establish how and where aircraft may fly. Collectively, the Federal Aviation Administration uses these rules and regulations to make airspace use as safe, effective, and compatible as possible for all types of aircraft, from private propeller-driven planes to large, high-speed commercial and military jets.

The U.S. military requests airspace from the Federal Aviation Administration and schedules and uses airspace in accordance with the processes and procedures detailed in Department of Defense Directive 5030.19, *DoD Responsibilities on Federal Aviation,* and Federal Aviation Administration regulations (DoN 2013a). When new airspace is needed to support military training, the U.S. military works closely with the Federal Aviation Administration to ensure the needs of all users of the airspace are met.

3.6.3 Methodology

Information used to characterize the existing environment was obtained from current and in-progress environmental analyses, data from the Federal Aviation Administration, commercial and other civilian aircraft traffic data, local airport reported data, existing military usage, and responsibilities and procedures for utilization of existing Special Use Airspace and Air Traffic Control Assigned Airspace. Additional detailed information is included in Appendix I, *Airspace Technical Memo*. Information regarding obstructions with the potential of interfering with flight safety during military training activity was also identified.

3.6.4 Tinian

The airspace surrounding Tinian is within the Federal Aviation Administration's Guam Combined Center/Radar Approach Control Flight Information Region. Radar services are provided to high altitude aircraft operating on instrument flight rule plans en route to, transiting through, and arriving at or departing from the airports within its service area. For Tinian, air traffic control services are provided at altitudes above 3,500 feet (1,100 meters) MSL by Guam Combined Radar/Approach Control. Air traffic services for aircraft en route to and from Saipan International Airport and below 3,500 feet (1,100 meters) are provided by Saipan Air Traffic Control. Air traffic control services are not available below 2,000 feet MSL (610 meters) for aircraft arriving and departing Tinian International Airport. All three airfields (Tinian International Airport, North Field, and Saipan International Airport) require access to the airspace within 12 nautical miles (22 kilometers) of Tinian for approaches and departures. Tinian International Airport and Saipan International Airport are used by commercial, private and military aircraft. North Field is used exclusively by the military (see Figure 3.6-2). There are no published approaches to North Field.

3.6.4.1 Tinian International Airport

Tinian International Airport has one runway that supports departures and arrivals in two directions; east (Runway 08) and west (Runway 26). Approximately 85% of arrivals and departures to Tinian International Airport come from the west and head to the east while only 15% comes from the east and heads to the west (Natasha Morgan, Tinian International Airport, personal communication, January 2014).

Tinian International Airport is equipped with a navigational light system that includes runway edge lights and runway end identifier lights. Additionally the airport has a Precision Approach Path Indicator with lights visible from about 5 nautical miles (9.26 kilometers) during the day and up to 20 nautical miles (37.04 kilometers) at night. There are no additional navigational aids, air traffic control towers, or air traffic control services. Aircraft arrivals and departures use visual flight rules and occur on a first come, first serve basis with pilots notifying each other of their intentions via the common traffic advisory frequency. The Guam Combined Center/Radar Approach Control provides air traffic control services for military flights en route to and from the Tinian International Airport beginning and ending at 3,500 feet (1,066 meters) MSL above Tinian. There are three published approaches to Tinian International Airport (Skyvector 2013): Tinian Area Navigation Global Position System, Tinian Area Navigation, and Tinian Non-Directional Beacon. For a detailed description of these approaches refer to Appendix I, *Airspace Technical Memo.*

Flights between Saipan and Tinian take place within the Saipan/Tinian Class E airspace and generally remain under 3,000 feet (914 meters) MSL. Charter flights which comprise 99% of Tinian International Airport operations fly using visual flight rules on a route similar to the commuter route depicted in Figure 3.6-3. It is the primary flight path for aircraft transiting between Saipan and Tinian (also see Section 3.6.4.5, *Commercial Aviation Routes*).

There are currently no scheduled flights into or out of the Tinian International Airport, and no commercial airlines offer international flights directly to Tinian. Flight operations generally consist of private aircraft, unscheduled charter flights available through Star Marianas, and military aircraft. The use of the Tinian International Airport by military aircraft requires prior coordination and approval with the CNMI Commonwealth Ports Authority and the Federal Aviation Administration (DoN 2013b).

As shown in Figure 3.6-4, there were 49,116 operations reported by Tinian International Airport in 2013. An operation is counted each time an aircraft lands or departs a runway. Operations are reported based on 365 flying days each year. This results in an approximately 134 operations on an average annual day (67 departures and 67 arrivals).

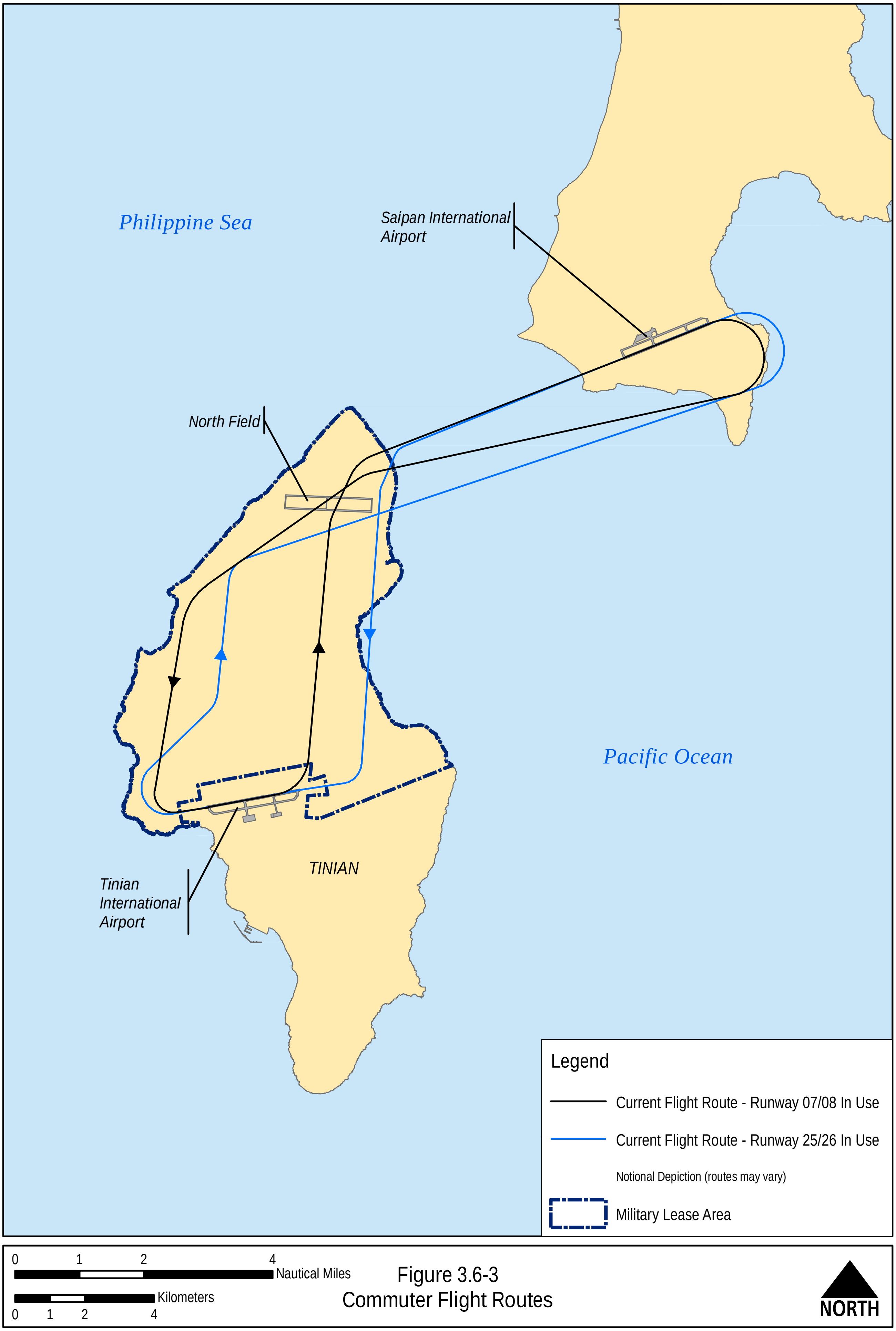
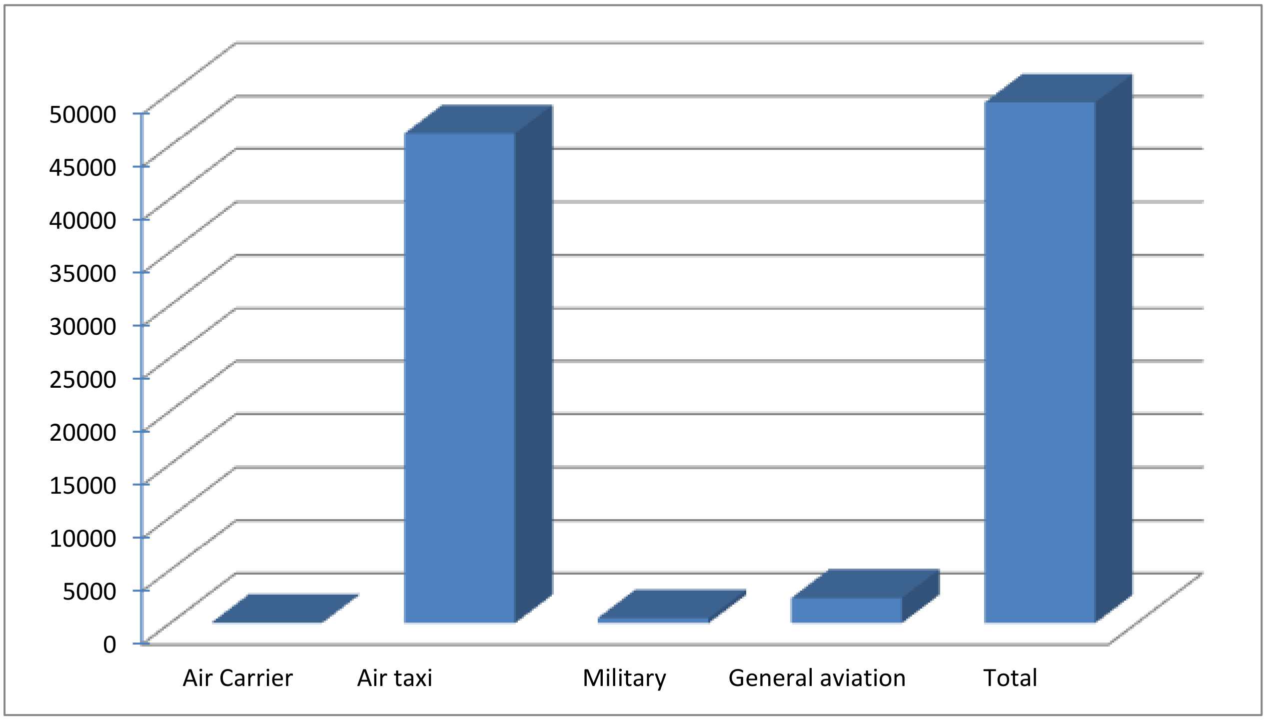


Figure 3.6-3
Commuter Flight Routes



Source: Federal Aviation Administration 2013.

Figure 3.6-4 Annual Airport Operations at Tinian International Airport

3.6.4.2 Tinian North Field

Tinian North Field lies within the northern portion of the Military Lease Area and beneath Saipan International Airport's Class E airspace and approach corridors to Runway 07.

Approaches, departures, and training operations at North Field are within Saipan International Airport's Class E airspace and managed by Saipan Air Traffic Control. Military aircraft operating at North Field are required to maintain radio communication with Saipan Air Traffic Control.

Military fixed wing and helicopter training activities include airlift of personnel and cargo drops into the Military Lease Area and North Field approximately 100 times per year (DoN 2013c). Helicopters operating over Lake Hagoi typically are required to maintain a minimum altitude of 1,000 feet (305 meters) above ground level during training exercises. Helicopter overflights are also restricted over the Mahalang ephemeral ponds and the Bateha sites (DoN 2013b).

3.6.4.3 Saipan International Airport

The Saipan International Airport has one runway that supports departures and arrivals in two directions, northeast (Runway 07) and southwest (Runway 25). A departure on Runway 07 would be heading northeast with a compass heading of 070 and a departure on Runway 25 would be heading southwest with a compass heading of 250. Arrivals to Runway 07 would be approaching from the southwest and arrivals to Runway 25 would be approaching from the northeast. Approximately 85% of arrivals and departures to Saipan International Airport come from the west and head east while only 15% comes from the east and heads to the west (Air Force 2012).

Saipan International Airport lies within the Guam Combined Center/Radar Approach Control. The Combined Center/Radar Approach Control is responsible for air traffic control of aircraft operations outside of the airport's Class D and E airspace. Saipan Air Traffic Control is responsible for the separation and movement of aircraft within their Class D and E airspace (Figure 3.6-5). The Class D airspace encompasses a 4.3-mile (6.9-kilometer) radius and stretches from the surface to 2,700 feet (823 meters) above ground level. Class E airspace extends the Class D to 7.4 miles (11.9 kilometers) west of Saipan and 6.5 miles (10.5 kilometers) east of Saipan. Prior to entering this Class D and E airspace, all pilots are required to establish and maintain radio communications with Saipan Air Traffic Control.

Saipan International Airport has two navigational aids, a non-directional beacon, and an instrument landing system. There are no obstructions identified for air traffic using Saipan International Airport. However, as a noise abatement procedure pilots are required to climb straight out until they reach an altitude of 1,600 feet (488 meters) before they are permitted to turn. Refer to Appendix I, *Airspace Technical Memo,* for a detailed description of the following procedures for Saipan International Airport:

- Saipan Instrument Landing System or Localizer /Distance Measuring Equipment Runway 07
- Saipan Non-directional Beacon /Distance Measuring Equipment Runway 07
- Saipan Non-directional Beacon/Distance Measuring Equipment Runway 25

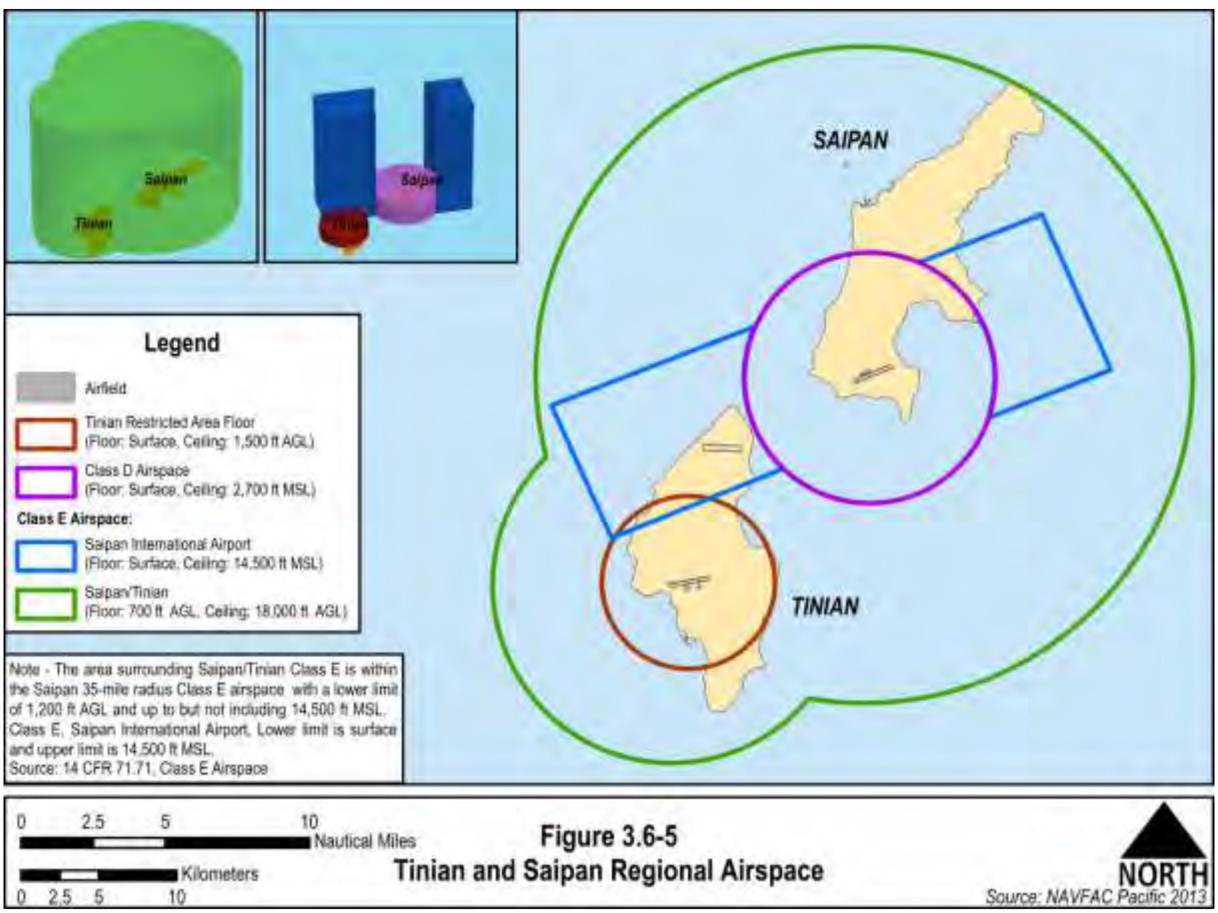
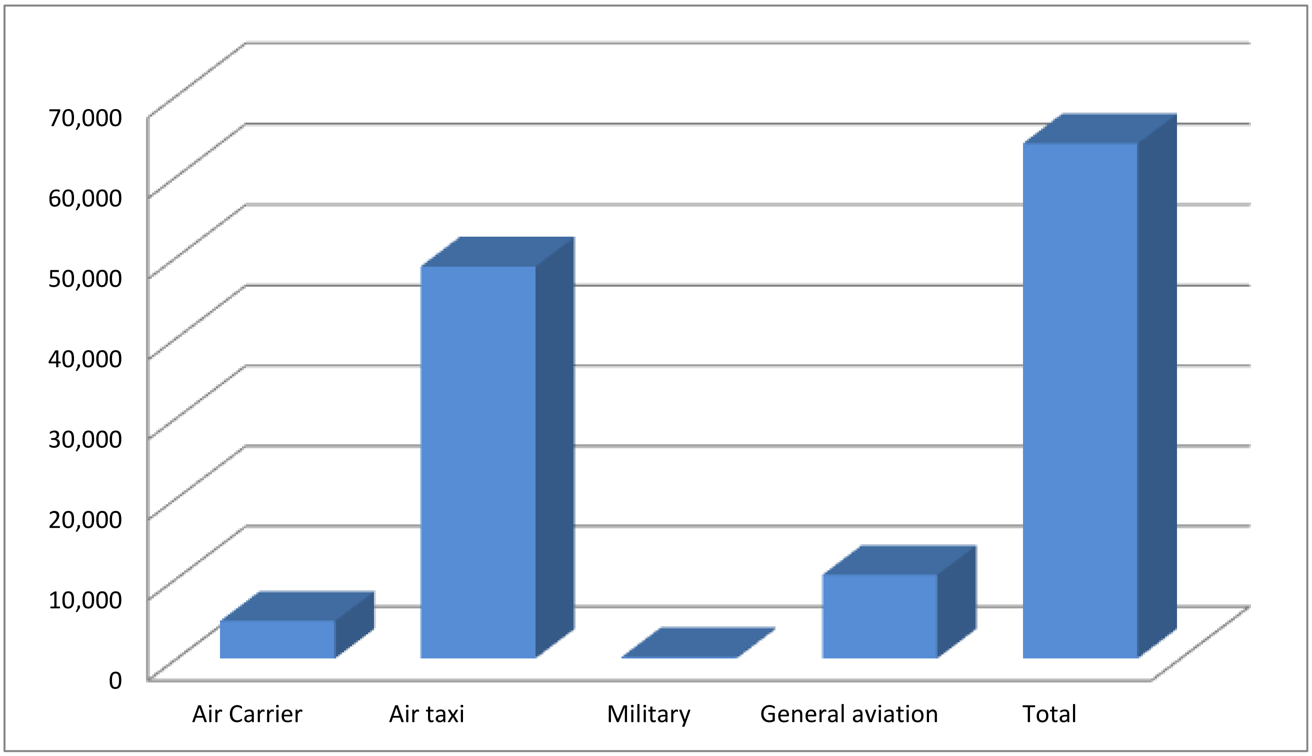


Figure 3.6-5
Tinian and Saipan Regional Airspace

Saipan International Airport provides services for seven major airlines (Asiana, China Eastern, Delta, Fly Guam, Shanghai, Sichuan, KLM, and United/Cape Air) and the Star Marianas charter/air taxi service. Major airlines have scheduled direct flights to Saipan from Guam, Korea, Japan, China, and Hong Kong. Star Marianas offers on-demand chartered air taxi service from Saipan to Tinian and Rota using single- and twin-engine aircraft. Between March 31, 2012 and March 31, 2013, there were 64,028 operations reported for Saipan International Airport (Figure 3.6-6). The airport is open 365 days per year generating approximately 176 operations (88 arrivals and 88 departures) on an average annual day. There are approximately nine scheduled daily international flights. Major airlines scheduled arrivals occur between the hours of 1:00 a.m. and 9:00 a.m. local time with the majority arriving before 5:00 a.m. Departures occur between the hours of 2:00 a.m. and 6:00 p.m. with approximately half occurring before 6:00 a.m. (FlightStats 2014). Saipan International Airport is designated as the commercial aviation divert airfield location for eastbound flights originating in western Asia and for all flights in-bound to Guam in the event that they cannot land at their original scheduled destination.

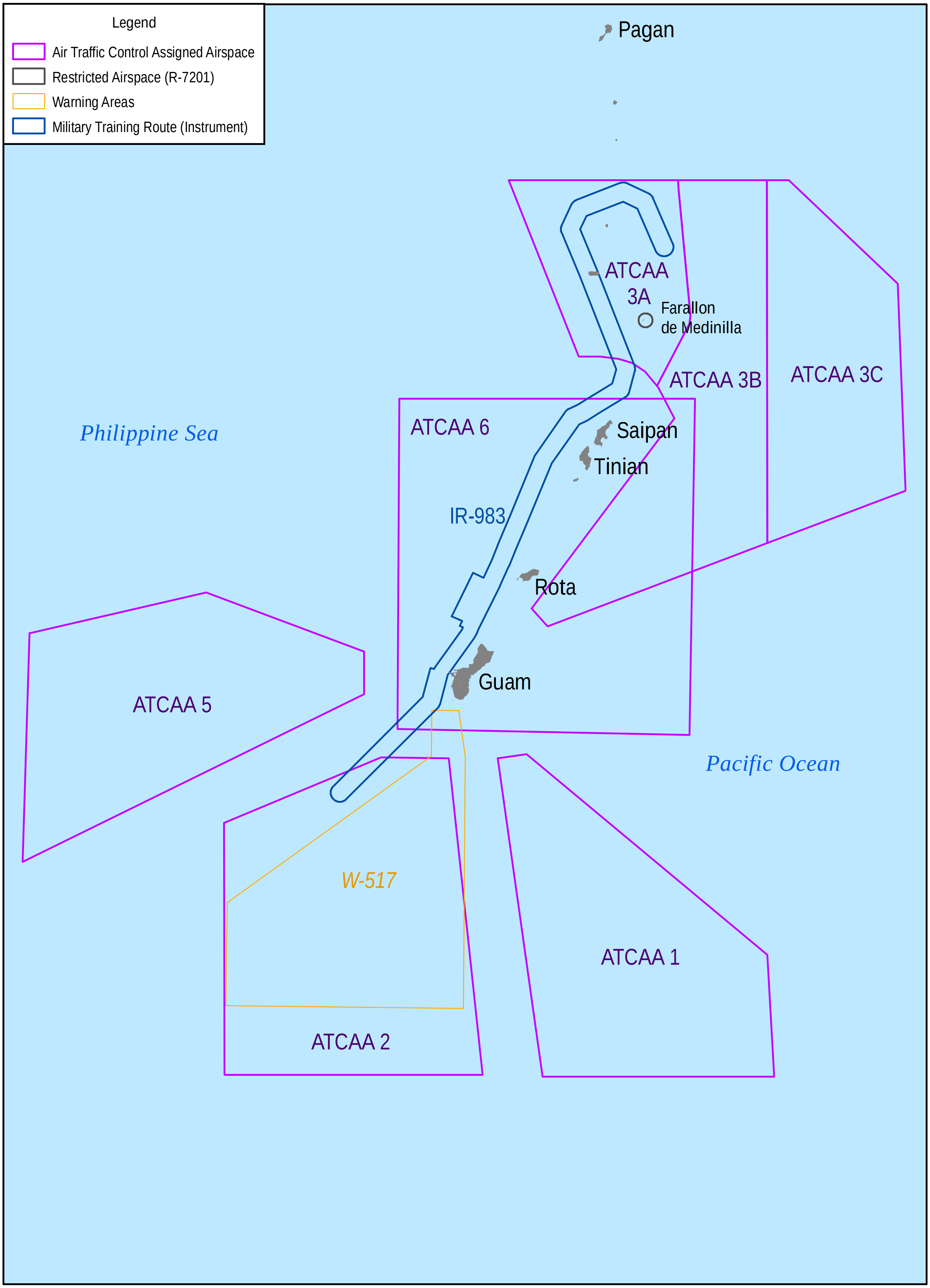


Source: Federal Aviation Administration 2013.

Figure 3.6-6 Annual Operations at Saipan International Airport

3.6.4.4 Airspace Designated for Military Use

Figure 3.6-7 illustrates the regional airspace currently available for military training.



0 12.5 25 50 Nautical Miles
0 25 50 100 Kilometers

Figure 3.6-7
Existing Mariana Islands Airspace
Designated for Military Use

NORTH
Source: DoN 2013b

Joint Region Marianas is designated as the scheduling and using agency for Restricted Area 7201 (Farallon de Medinilla). They are also responsible for coordinating use of Air Traffic Control Assigned Airspaces 3A, 3B, 3C, and 6 with the Federal Aviation Administration. The Guam Combined Center/Radar Approach Control is designated the controlling agency (DoN 2013b).

Air Traffic Control Assigned Airspace 6 lies directly over Tinian and Saipan and has a floor of 39,000 feet (11,877 meters) MSL and a ceiling of 41,000 feet (12,497 meters) MSL. Air Traffic Control Assigned Airspace 3A/B/C lies within 30 nautical miles (56 kilometers) of Tinian with a floor at the surface and a ceiling of 30,000 feet (9,144 meters) MSL. Use of Air Traffic Control Assigned Airspace requires at least one aircraft to continuously monitor the appropriate Guam Combined Center/Radar Approach Control frequency for immediate recall of the altitude/airspace as needed (DoN 2013c). Joint Region Marianas is the DoN-led command that provides scheduling and control of activities within the Air Traffic Control Assigned Airspace. The Federal Aviation Administration issues a Notice to Airmen at least 72 hours prior to military activity in the Air Traffic Control Assigned Airspace 3 A/B/C. Table 3.6-1 presents current use of Air Traffic Control Assigned Airspace in the region of influence.

Table 3.6-1. Current Use of Air Traffic Control Assigned Airspace

Airspace	*Annual # of Days*	*Annual Hours Used*
ATCAA 3A	160	1,440
ATCAA 3B	157	1,417
ATCAA 3C	111	1,109
ATCAA 6	61	381

Source: DoN 2011, Table 3-2. ATCAA = Air Traffic Control Assigned Airspace.

Restricted Area 7201 is located within 50 nautical miles (93 kilometers) of Tinian and is activated by a Notice to Airmen. Altitude limits span from the surface to infinity. This restricted area (7201) is located within Air Traffic Control Assigned Airspace 3A and would not directly interact with the proposed airspace. Additionally, the Federal Aviation Administration completed a feasibility assessment in 2011 and found that activation of Restricted Area 7201 would not conflict with any air traffic service routes (DoN 2013c). Therefore, Restricted Area 7201 is dismissed from further analysis in Chapter 4. Detailed information on Restricted Area 7201 is located in the *Mariana Islands Range Complex Airspace EA/OEA* (DoN 2013c), which is hereby incorporated by reference.

3.6.4.5 Commercial Aviation Routes

There is no published commercial route for aircraft transitioning between Tinian and Saipan International Airports. As shown in Figure 3.6-3, commuter and private flights to and from Saipan and Tinian International Airports fly the shortest route possible and limit time over water to the extent practicable. The current route takes those flights directly over the Military Lease Area. Although not published, it is the primary flight route for aircraft transiting between Saipan and Tinian. Figure 3.6-4 presents the annual air taxi and general aviation operations that would be expected to use this flight route.

As shown in Figure 3.6-8 several commercial routes lie within close proximity of Tinian. Additional routes that traverse the Pacific are not charted but are based on the Federal Aviation Administration's Pacific Organized Track System to provide fuel-efficient routes for long-distance, transpacific flights. These routes are currently adjusted every 12 hours in response to upper-level wind conditions and adjustments necessary to route around active airspace would not be expected to impact these commercial routes.

The Federal Aviation Administration completed an air traffic analysis over a 7-day period from September 16 to 22, 2012, for instrument flight rules traffic within the Guam Combined Center/Radar Approach Control airspace that included operations within the vicinity of Air Traffic Control Assigned Airspace 3A, 3B, and 3C. The study identified a total of 62 commercial tracks that occurred on or parallel to aviation route G205 along the far western edge or northwest corner of Air Traffic Control Assigned Airspace 3A, and a total of 28 tracks that occurred within Air Traffic Control Assigned Areas 3B and 3C, eight of which occurred between 10:00 p.m. and 2:00 a.m. local time (DoN 2013c).

3.6.4.6 Airspace Obstructions

The International Broadcasting Bureau facility (Photo 3.6-1) is located on Tinian, on the western side of the Military Lease Area. The facility has an antenna array that includes five high/low band pairs of antennas, one mid band antenna, and two low ban antennas for a total of 13 curtain antennae. Each antenna comprises two vertical steel towers between 150 and 400 feet (46 to 122 meters) tall with a curtain of horizontal and vertical cables hung between the towers of the same height (DoN 2010). All aircraft need to avoid these obstacles to prevent collision. Additionally, aircraft equipped with flight control or mission-critical electronic systems are vulnerable to the electromagnetic emissions from the relay station and are advised to avoid potential interference with aircraft control.

Photo 3.6-1. International Broadcasting Bureau Antenna Array

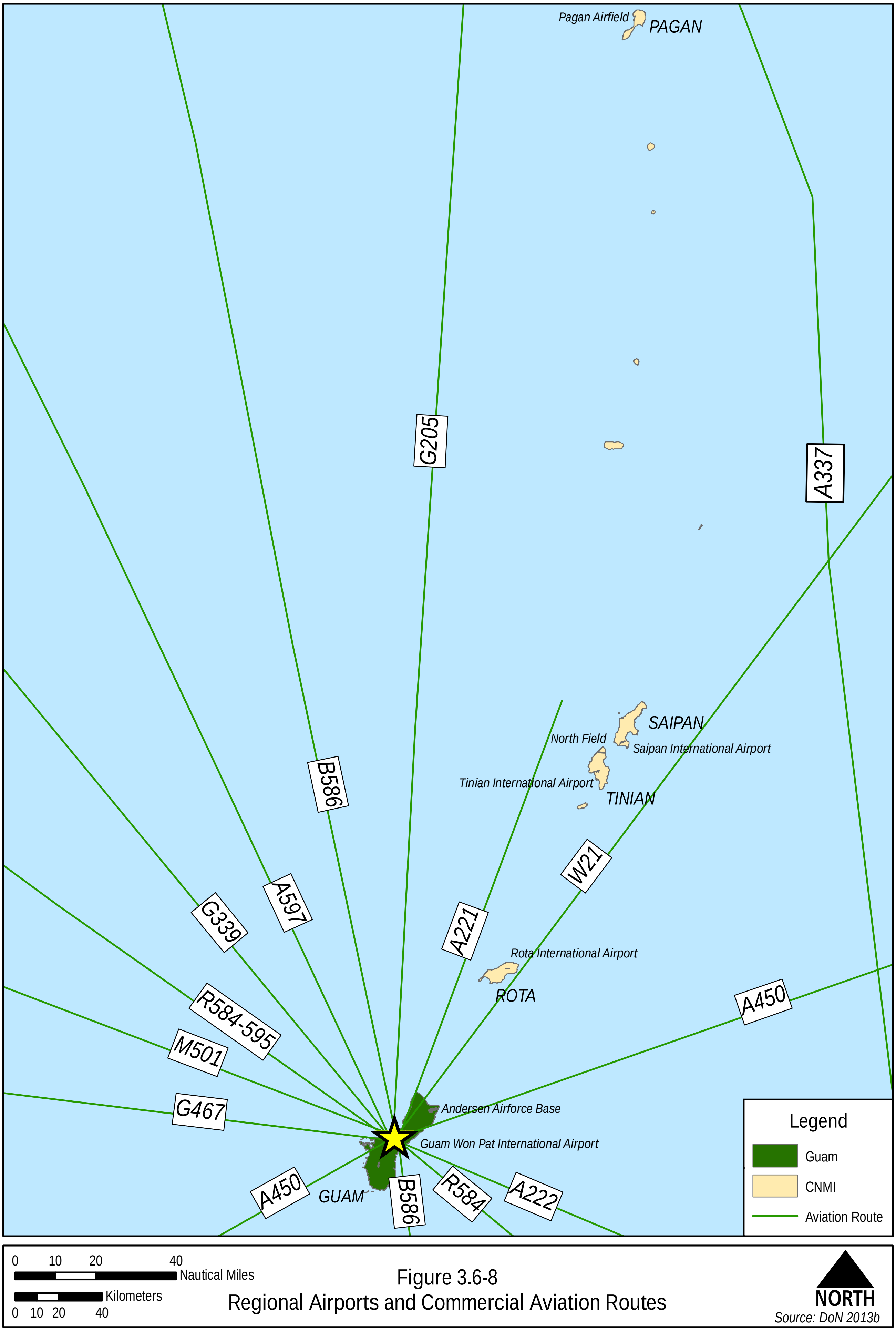


Figure 3.6-8
Regional Airports and Commercial Aviation Routes

Source: DoN 2013b

3.6.5 Pagan

Several elements within the Pagan region of influence are discussed to describe the current use of the airspace being proposed for military use.

The Pagan airfield is a 1,500 foot (300 meter) grass runway (Runway 11/29) considered closed indefinitely by Federal Aviation Administration as a result of volcanic activity in 1981. See Section 3.13.5.1, *Air Transportation*, for additional discussion of the Pagan airfield. The Pagan airfield is located within Class G airspace with no air traffic control services available for aircraft using the Pagan airfield. All aircraft must fly using visual flight rules. The closest airport with instrument approaches is the Saipan International Airport, about 180 nautical miles (333 kilometers) to the south. Pagan airfield is considered the lifeline for homesteaders on other northern islands of the CNMI and limited charter and general aviation operations occur for visitors to the island. Recently, passengers traveling to Pagan have been primarily federal and local government officials, including personnel from the U.S. Fish and Wildlife Service, the U.S. Geological Survey, the U.S. military, the Northern Islands Mayor's Office, and other local government agencies. The most current record of operations was found in the 2008 Pagan Airstrip Master Plan (Commonwealth Ports Authority 2008). It reported 10 to 24 annual operations from 2004 to 2007 by chartered helicopter (Bell 206) and fixed-wing aircraft (Cessna) (see also Appendix O, *Transportation Study)*. Most of the flights, whether by helicopter or fixed-wing aircraft, have carried the maximum load of four passengers and the pilot (Commonwealth Ports Authority 2008).

The airspace surrounding Pagan is within the Federal Aviation Administration's Seattle Flight Information Region. The Oakland Air Route Traffic Control Center provides radar services to high-altitude aircraft operating on instrument flight rules flight plans and is responsible for controlling aircraft en route to, transiting within, and arriving at or departing from the airports within its service area.

3.6.5.1 Airspace Designated for Military Use

The closest military use airspace to Pagan is Air Traffic Control Assigned Airspace 3A. Its northern border lies approximately 60 nautical miles (111 kilometers) south of Pagan (see Appendix I, *Airspace Technical Memo*).

3.6.5.2 Aviation Routes

There are two published transpacific aviation routes located within 60 nautical miles (111 kilometers) of Pagan (see Figure 3.6-8) that are scheduled for use during flight planning. Their use is controlled by the Federal Aviation Administration to ensure aircraft are safely separated from each other while en route to and from their destinations. Aircraft typically fly at altitudes at or above 30,000 feet (9,144 meters). A337 lies about 23 nautical miles (43 kilometers) to the east and G205 is located approximately 40 nautical miles (74 kilometers) to the west. Operations on these aviation routes and in the vicinity of Pagan are within the Federal Aviation Administration's Western Service Area's Oakland Flight Information Region and controlled by the Seattle Air Route Traffic Control Center. Aircraft originating from the south and using these routes would transition from the Guam Combined Center/Radar Approach Control area to the Oakland Oceanic Control Area and then to the Fukuoka Oceanic Control area at a point north of the proposed Warning Area 14. Aircraft originating from the north transition in the opposite direction. The Federal Aviation Administration-completed air traffic analysis included operations along aviation routes G205 and A337 for a 7-day period in September 2012. The analysis found a total of 62 commercial tracks occurred on or parallel to aviation route G205 and 10 civilian/commercial tracks on or parallel to route A337 (DoN 2013c).

3.6.5.3 Airspace Obstructions

There are no published obstructions to airspace on Pagan; however, the Federal Aviation Administration could publish temporary flight restrictions as a result of volcanic activity on the island. Temporary flight restrictions are published through the Notices to Airmen process.

3.7 LAND AND SUBMERGED LAND USE

Section 3.7 provides a summary of existing and planned land use, including submerged lands, on and adjacent to Tinian and Pagan. The region of influence includes the land of Tinian and Pagan, and their associated submerged lands, which are defined as areas within 3 nautical miles (5 kilometers) of the mean high tide line. The southern portion of Saipan is also included because of its proximity to Tinian, and potential for impacts (i.e., noise) from the proposed action. The region of influence is shown on Figure 3.7-1. The following discussion includes civilian and military land uses, as well as planning guidance that directs future development.

3.7.1 Definition

Land use includes natural and man-made activities occurring or planned on land and submerged land (within 3 nautical miles [5 kilometers] from shore). There are four key components to this land use discussion:

1. **Jurisdictional Control of Land.** There are a broad variety of contract types for control of land ownership. Real estate contracts include unencumbered deeds, long-term lease agreements, temporary easements, rights-of-way, assignments of custody and control, and a host of other types of contracts. In an effort to simplify the nomenclature for this section, all the various types of land controls are referred to as ownership and/or management, and include "jurisdictional control." For example, the Military Lease Area is owned by the CNMI government, but leased to the Department of Defense, giving them jurisdictional control over the Military Lease Area (within the confines and stipulations of the lease agreement).
2. **Jurisdictional Control of Submerged Land.** Submerged land(s) refers to a special condition of jurisdictional control that is related to the "land beneath navigable waters." Generally, this is considered those lands between the low and high-tide line and out to 3 nautical miles (5 kilometers) from the jurisdictional (mean high tide) line of the state, as outlined in the Conveyance of Submerged Lands to Territories (48 U.S. Code Chapter 15). This Act establishes the federal law that recognizes the rights of coastal states to jurisdictional authority over their coastlines and territorial waters. This authority is often referred to as the "jurisdictional waters." While this Act provides jurisdictional authority for submerged lands to the states, the U.S. Federal Branch (i.e. Department of Defense) still reserves executive privilege to supersede the state's authority, particularly when it concerns issues of national security or public safety. Jurisdictional authority of submerged lands for CNMI falls under the purview of the CNMI Bureau of Environmental and Coastal Quality. However, this is not applicable to those submerged lands adjacent to the Military Lease Area on Tinian as they are under the jurisdictional control of the U.S. government. The submerged lands around Pagan are within the jurisdictional control of the CNMI government (i.e., the CNMI Bureau of Environmental and Coastal Quality).

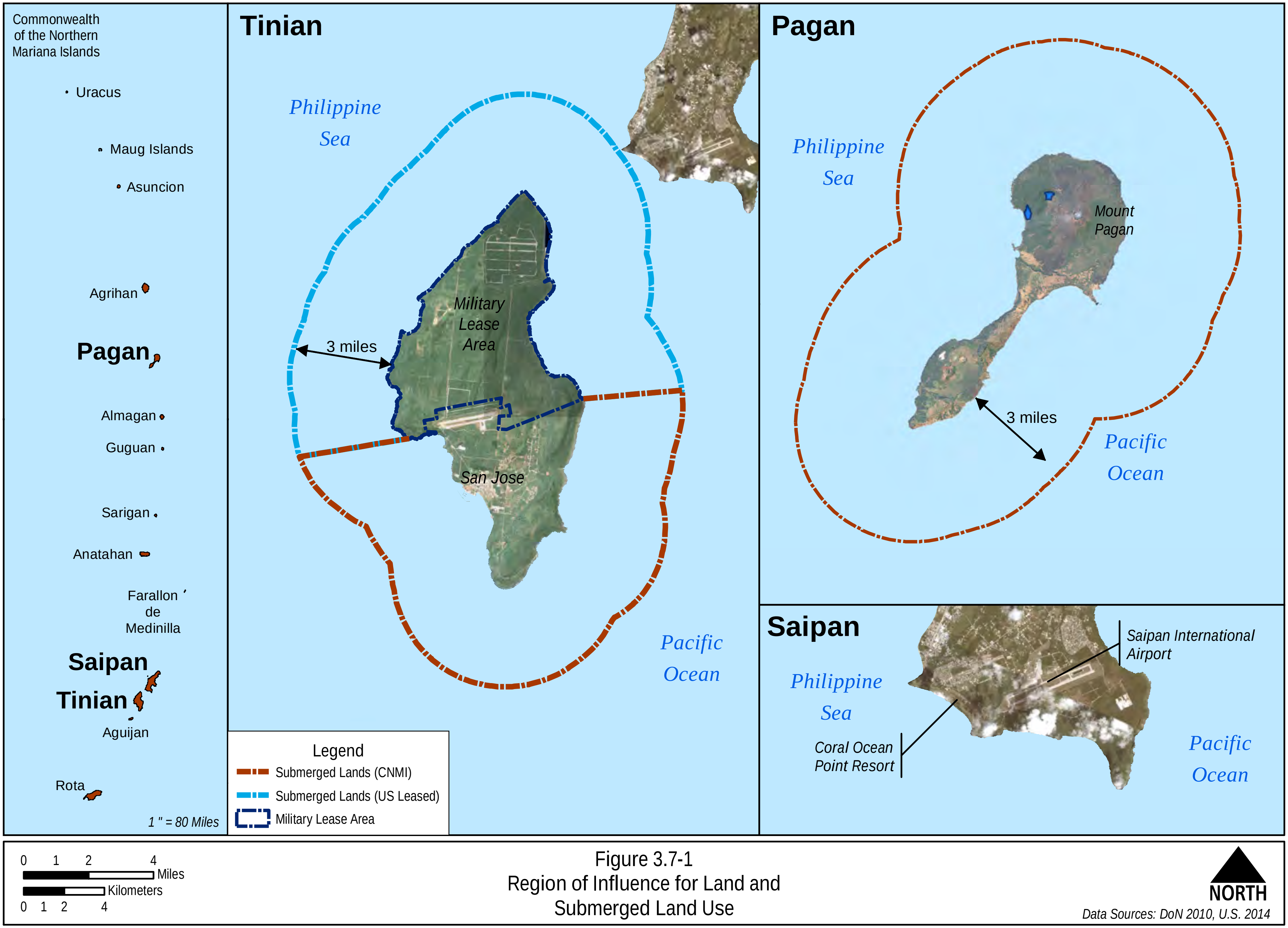


Figure 3.7-1
Region of Influence for Land and Submerged Land Use

Data Sources: DoN 2010, U.S. 2014

3. **Current and Planned Uses of Land.** Existing and planned land uses are typically documented in community or government land use plans, which are intended to represent the community's vision for land use development. The plans acknowledge that there are competing land uses and that these land uses are not necessarily compatible. Areas or zones are designated for a specific land use to provide adequate physical distance between incompatible land uses. There are also lands that are regulated or reserved for a specific use, such as cultural resource preservation or natural resource protection. These land use areas are often identified on government land use plans and maps. The CNMI Department of Public Lands is the primary land use planning agency for Tinian and Pagan as there are no local government island-specific zoning boards. Saipan has a Zoning Board at the local government level.
4. **Current and Planned Uses of Submerged Land.** Submerged lands in the CNMI are regulated by the CNMI Bureau of Environmental and Coastal Quality. This agency is responsible for meeting the requirements the Coastal Zone Management Act. The coastal zone includes all non-federal lands and submerged lands out to a distance of 3 nautical miles (5 kilometers) of the mean high tide line. The CNMI Coastal Resources Management Program defines the area subject to its provisions as the entire land area comprising the 14-island archipelago and the adjoining waters contiguous to each island seaward the extent of 3 geographic miles (5 kilometers), with the exception of the island of Farallon de Medinilla, which is used by the U.S. Department of Defense as a target area (National Oceanic and Atmospheric Administration 1980). For the purposes of the Coastal Zone Management Act, long-term leases are considered to be federal lands. The U.S. has jurisdiction of the submerged lands off of U.S.-leased land areas, including Tinian Military Lease Area. The Coastal Resources Management Program also identifies Areas of Particular Concern, which require that any work done within these areas would require a valid coastal permit (CNMI Coastal Resources Management Office 2014).

3.7.2 Regulatory Framework

The regulations governing land use and submerged land use are briefly summarized below. A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations.*

3.7.2.1 Federal Regulations

- Coastal Zone Management Act
- Territorial Submerged Lands Act as amended (Senate Bill 256 and Presidential Proclamation)

3.7.2.2 CNMI Regulations

- **CNMI Constitution – Article XI: Public Lands.** Article XI of the CNMI Constitution states that public lands collectively belong to the people of the CNMI who are of Northern Marianas decent. A person of Northern Marianas descent is someone who is a citizen or national of the U.S. and who is at least one-quarter Northern Marianas Chamorro or Northern Marianas Carolinian, or a combination thereof. The CNMI Department of Public Lands is the official government agency responsible for the administration and disposition of public lands. These public lands are available for commercial lease.
- **Public Law 16-50 Homestead Law**. See Section 3.7.3.3, *The CNMI Homestead Program.*

3.7.2.3 U.S.-CNMI Covenant and Lease Agreements

As summarized in Section 1.4, *The Mariana Islands*, the CNMI was integrated into the U.S. as a result of *The Covenant to Establish a Commonwealth of the Northern Mariana Islands in Political Union with the United States of America*, (The 1976 Covenant) which was signed by U.S. and CNMI representatives on February 15, 1975. Certain land areas on Tinian were "made available to the U.S. by lease to enable it to carry out its defense responsibilities" (Northern Mariana Islands 1975a; see Section 1.4.2, *Commonwealth of the Northern Mariana Islands Military Lease Area*).

The 1976 Covenant directed that a separate *Technical Agreement Regarding Use of Land to Be Leased by the United States in the Northern Mariana Islands* (Technical Agreement) (Northern Mariana Islands 1975b; see Section 1.4.2, *Commonwealth of the Northern Mariana Islands Military Lease Area*) be drafted to describe terms of lease back property and joint use of certain areas. The Technical Agreement was simultaneously executed with the 1976 Covenant. The Technical Agreement provided for the lease back of U.S. Military leased property to the CNMI government to provide agricultural permits to residents of Tinian and other joint use arrangements, between the U.S. Military and the CNMI government which are summarized in Appendix K, *Summary of Historical Land Use Agreements between the U.S. and the CNMI*. The original 17,799 acres (7,203 hectares) leased by the U.S. to the current lease area of approximately 15,148 acres (6,130 hectares).

Below are selected provisions within the Technical Agreement as they pertain to leases on Tinian:

- The lease back, though expired, is being administered on a month-to-month tenancy and is subject to cancellation with 1 year's notice or sooner in the event of urgent military requirement or national emergency.
- All uses of land in the Military Lease Area must be compatible with planned military activities.
- No construction of permanent facilities on lease back areas.
- Federal Aviation Administration airfield requirements and related safety zones apply to any facilities or activities in the Military Lease Area.
- All shoreline areas in and around the northern two-thirds of Tinian will remain open to fishermen at all possible times, except for those areas that must be closed to comply with safety, security, or hazardous risk requirements under the proposed action.
- Marianas citizens will have the same access to beach and recreation areas in the Military Lease Area of Tinian as military personnel (and their dependents) have for recreation.
- Closure for military maneuvers will be kept to a minimum, consistent with military requirements for safety and security.

Since the establishment of the Technical Agreement, numerous lease agreements have been executed that have reduced the acreage of the original agreement. Some of the amendments are described below as they pertain to Tinian (see Appendix K, *Summary of Historical Land Use Agreements between the U.S. and the CNMI)*.

- **1983 Lease Agreement made pursuant to the Covenant to Establish a CNMI in Political Union with the U.S.** The lease for the lands specified in the 1976 Covenant and Technical Agreement was issued on January 6, 1983 for an initial term of 50 years with an option for the U.S. to renew for a succeeding additional 50-year term. Terms of the lease mandated that any non-military uses within the leased areas must be approved by the DoN (DoN 2008).

- **1988 Leaseback Agreement between the CNMI and U.S.** The U.S. leases back to the CNMI 709 acres (287 hectares) on Tinian, including West Field.
- **1994 Leaseback and Disposal Agreement between the CNMI and U.S.** In 1994, the U.S. inventoried lands leased from the CNMI to determine land no longer needed for defense purposes and thus deemed surplus. The U.S. leased land deemed surplus included 1,245 acres (504 acres) on Tinian, south of West Field, and also designated the “Exclusive Military Use Area.”
- **1996 Partial Termination Agreement between the CNMI and U.S.** The U.S. released claims to 39 acres (16 hectares) at Tanapag Harbor on Saipan.
- **1999 Partial Release of Leasehold Interest between the CNMI and U.S.** The U.S. released leasehold interest in areas in the southern portions of Tinian and West Field. The U.S. identified West Field as a civilian aviation airfield and authorized the use of the 996 acres (403 hectares) of the Military Lease Area as the Tinian Military Retention Land for Wildlife Conservation for the Tinian Monarch (*Monarcha takatsukasae*). This area was designated per mitigation agreement number 1-2-98-F-07 between the Federal Aviation Administration and the U.S. Fish and Wildlife Service, dated January 4, 1999. The U.S. released leasehold interests of 10 acres (4 hectares) at Masalok Beach for CNMI to establish as a “Youth Site.” The U.S. also released interest in public rights of way within the Lease Back Area.

3.7.3 Methodology

A site visit to Tinian, document searches and reviews of publicly available information, and interviews at various agencies were conducted to obtain current and accurate land and submerged land use information. Meetings with CNMI agencies included the Department of Public Lands, Bureau of Environmental and Coastal Quality, Division of Fish and Wildlife (within the Department of Lands and Natural Resources), Mariana Visitors Authority, among others. The land use plans discussed in this section are those that are officially adopted by the CNMI government and those that are in-progress. The planned or proposed projects that have permits or are funded and moving towards being developed are discussed in this section. For a discussion of reasonably foreseeable land uses and projects, see Chapter 5, *Cumulative Impacts*.

3.7.3.1 The CNMI Coastal Resources Management Plan

The Bureau of Environmental and Coastal Quality is responsible for the implementation of the Coastal Resources Management permit process. While the permit process is not applicable to federally leased or owned submerged lands, the Coastal Zone Management Act consistency determination is, and must address potential impacts to these CNMI Areas of Particular Concern. The Bureau of Environmental and Coastal Quality has identified geographic areas with special management requirements: CNMI Areas of Particular Concern. There are five CNMI Areas of Particular Concern delineated:

1. **Shoreline:** The area between the mean high water mark and 150 feet (46 meters) inland.
2. **Lagoon and Reef:** The area extending seaward from the mean high water mark to the outer slope of the reef.

3. **Wetlands and Mangrove:** Areas that are covered either permanently or periodically with water and where species of wetland or mangrove vegetation can be found.
4. **Port and Industrial:** Includes land and water areas surrounding the ports of Saipan and Tinian.
5. **Coastal Hazards:** Those areas identified as coastal flood hazard zones (V and VE) on the Federal Emergency Management Agency Flood Insurance Rate Maps.

Any project wholly or partially within a CNMI Area of Particular Concern requires a Coastal Resources Management permit.

3.7.3.2 The CNMI Land Use Plans

The most recent official land use plan for all of the CNMI is the CNMI Public Land Use Plan (Marianas Public Land Corporation 1989). This plan superseded the Physical Development Master Plan for the Commonwealth of the Northern Mariana Islands (CNMI Office of Transition Studies and Planning 1978), hereafter referred to as the CNMI Physical Development Master Plan. The CNMI Public Land Use Plan outlines goals, objectives, and polices for the CNMI through a planning period of 1989 to 2015. The plan encompasses public land of the CNMI, with the focus on Saipan's projected growth.

More recent planning efforts for Tinian and Pagan are in progress (CNMI Department of Public Lands 2013a). The preliminary land use plans are included because they provide the best available current information on land use planning objectives.

The Commonwealth Zoning Board is charged with zoning for Saipan. Zoning and land use information for Saipan is provided in the 2013 Saipan Zoning Law and associated 2013 Saipan Zoning Map (Commonwealth Zoning Board 2013). There are no zoning laws or maps for Tinian and Pagan.

3.7.3.3 The CNMI Homestead Program

The CNMI Department of Public Lands is mandated to designate public land, including land on Tinian and Pagan, for potential homesteads. In an effort to fulfill this mandate, the CNMI Department of Public Lands designates available and suitable land on their land use planning maps for potential village and agricultural homesteading. A person is not eligible for more than one agricultural and one village homestead. A freehold interest in the homestead is granted once the person meets specified criteria and cannot be transferred for 10 years after receipt (Fifteenth (15th) Northern Marianas Commonwealth Legislature 2007).

In 2010, the CNMI enacted Public Law 16-50, a homesteading law to establish the Northern Islands Village and Agricultural Homesteading program for current or former residents of the Northern Islands or any qualified person interested in residing on the Northern Islands. The law, however, requires extensive municipal planning and infrastructure development prior to homesteading deeds being issued and, to date; the CNMI has not deeded any land on Pagan (DoN 2014a). Additional discussion on CNMI homesteading programs are discussed in Section 3.15, *Socioeconomics and Environmental Justice*, and Appendix Q, *Socioeconomic Impact Assessment Study*.

3.7.4 Tinian

3.7.4.1 Jurisdictional Control and Management

3.7.4.1.1 Land Area and CNMI Real Estate Designations

Tinian land area is approximately 25,148 acres (10,177 hectares) in size with approximately 68 miles (109 kilometers) of roads administered by the CNMI's Department of Public Works. A total of 10% (approximately 2,422 acres [980 hectares]) of Tinian's land is privately owned, and the remaining 90% (or 22,726 acres [9,197 hectares]) are public lands (DoN 2010). Figure 3.7-2 illustrates the percentages of both private and public Tinian land ownership, including the five public land sub-classifications, which are shown on Figure 3.7-3.

Public land is further classified as one of five sub-classifications described below:

1. **Grant of Public Domain:** Public lands given in fee simple (i.e., absolute title to land), with no use specified.
2. **Designated Public Lands:** Public lands actively managed for a particular use, such as a forest or park.
3. **Leased:** Public lands that require government approval (i.e., permits). If the proposed lease encompasses greater than 12.4 acres (5 hectares) it must be approved by the CNMI legislature. Areas less than 12.4 acres (5 hectares) require the CNMI Department of Public Lands approval. Permits tend to be for commercial operations, such as hotels, golf courses, and cattle grazing.
4. **Technical Agreement Leased:** Public lands that are leased to the military and collectively referred to as the Military Lease Area (15,148 acres [6,130 hectares]). This area encompasses the northern portion of Tinian. International Broadcasting Bureau occupies 840 acres (340 hectares) of land in the Military Lease Area (Figure 3.7-3). The Military Lease Area is largely undeveloped.
5. **Undesignated:** Undeveloped Tinian public lands without a specified use are classified as undesignated public lands.

The U.S. presently leases 15,148 acres (6,130 hectares) on Tinian (approximately the northern two-thirds of Tinian) from the CNMI. The U.S. Leaseback Agreement with the CNMI for the 7,779 acres (3,148 hectares) located in the middle third of Tinian is referred to as the Lease Back Area. The U.S. Leaseback Agreement expired in 2014, and ranchers have maintained cattle grazing in the Lease Back Area on a month-to-month basis. However, the CNMI and the Department of Defense are executing a renewal of the lease until the summer of 2016 (Zotomayor 2015).

The majority of these leased lands are used for training purposes. While training may occur all year long, it typically occurs only a few times per year for limited durations. When areas are not closed for training, the land is accessible to the public. Tinian jurisdictional control of land is shown in Figure 3.7-2 and Figure 3.7-3. As shown, all private land and non-Technical Agreement leased lands are located south of the Military Lease Area. Fee interest ownership is the primary means of private land ownership (DoN 2010). Leases or easements are used for land transfer and/or management purposes.

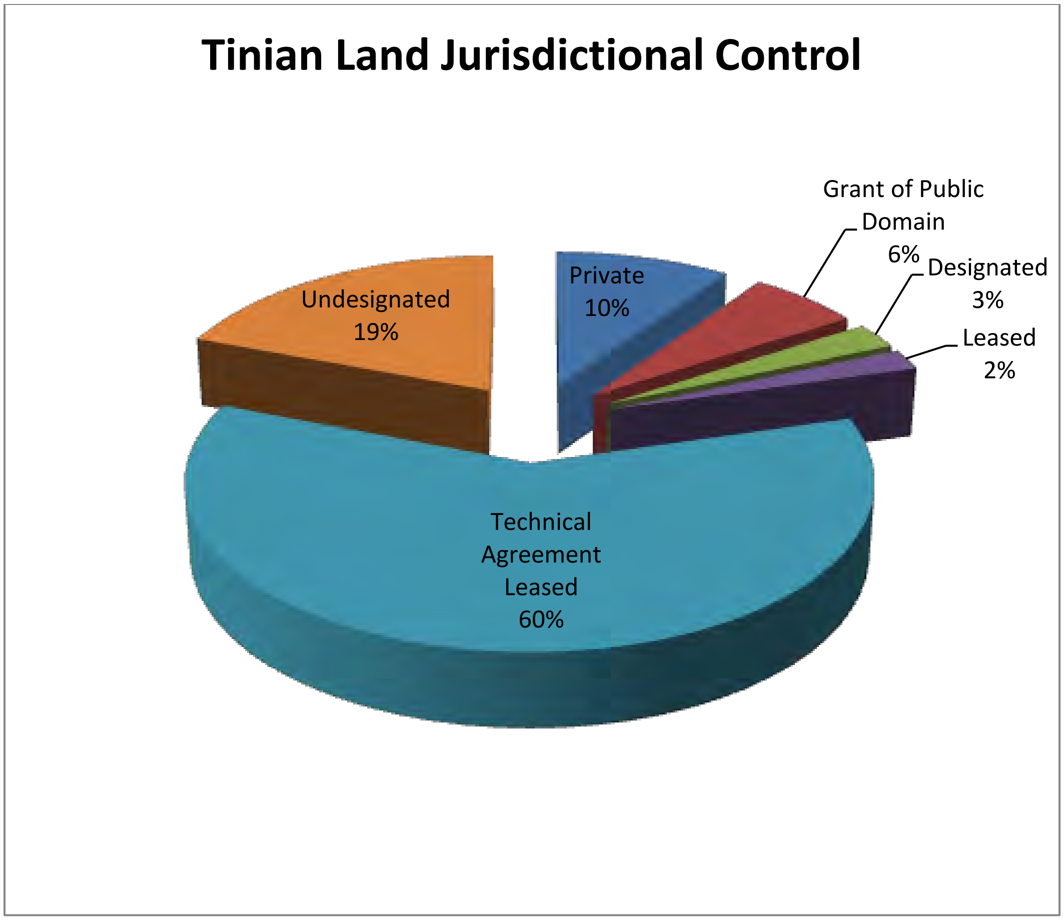


Figure 3.7-2 Tinian Land Jurisdictional Control

3.7.4.1.2 Homestead Developments on Tinian

There are at least two areas with fully implemented homestead programs on Tinian, Marpo Heights and the Carolinas Plateau. In 2014, the CNMI governor announced that a contract was awarded to a construction company to start site development work for the West San Jose Homestead. The West San Jose Homestead does not currently contain any homes but will be subdivided into 189 residential lots. Basic infrastructure such as roads and utility rights-of-way, have been developed. Other homestead village areas have been noted on the Department of Public Lands' Tinian land classification map (CNMI Department of Public Lands 2013b), some funding has been provided and the design and clearing of roads and rights-of-way has begun. For further discussion on these and other homestead village sites please see Chapter 5, *Cumulative Impacts*. For information and discussion on the CNMI homestead program and current status, please see Appendix Q, *Socioeconomic Impact Assessment Study*.

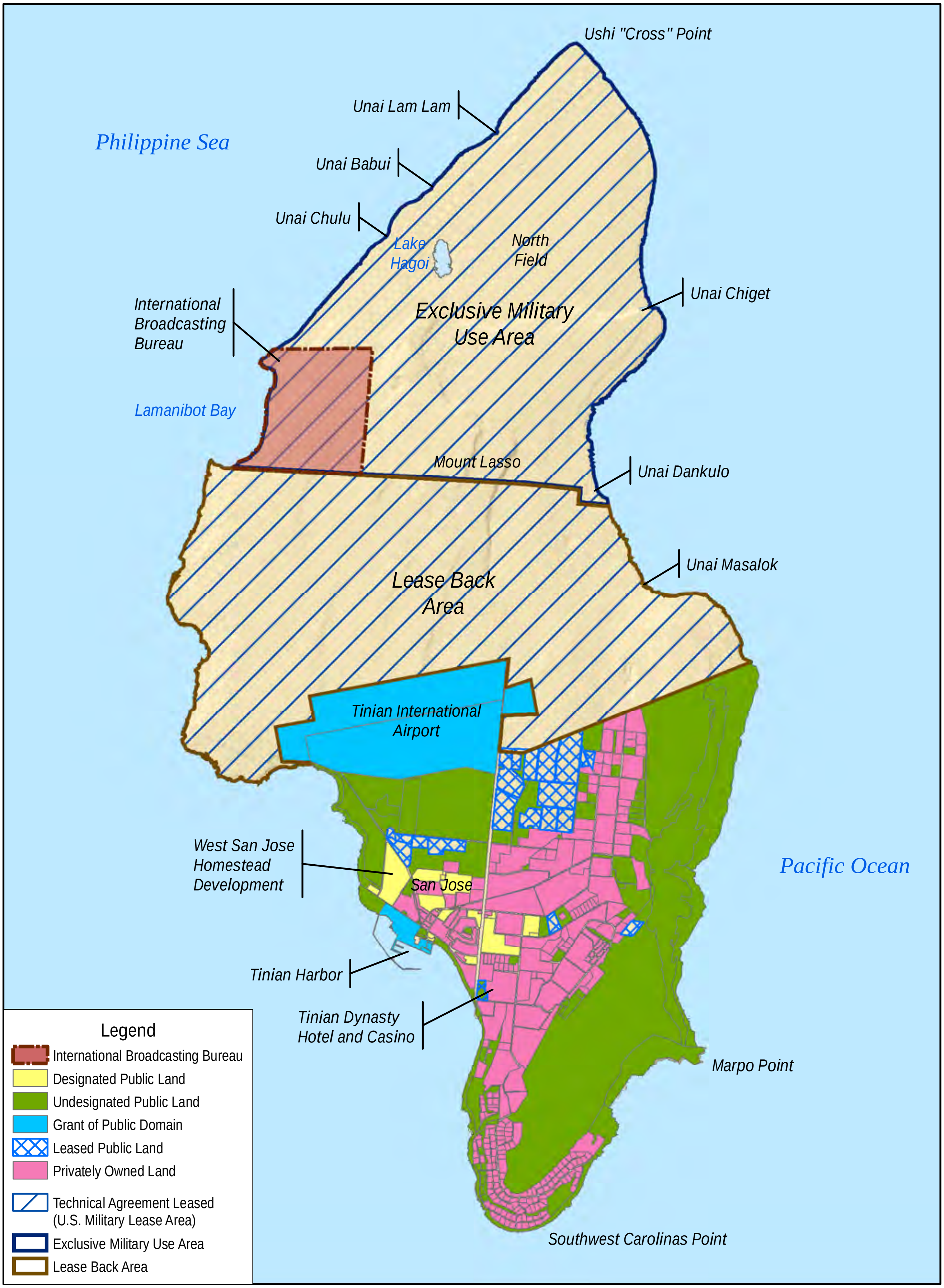


Figure 3.7-3
Tinian Land Jurisdictional Control and Management

Sources: DoN 2010; CNMI Department of Public Lands 2013a

3.7.4.1.3 CNMI Areas of Particular Concern Designations on and around Tinian

As shown on Figure 3.7-4, all five CNMI Areas of Particular Concern are found on Tinian: Shoreline, Lagoon and Reef, Wetlands and Mangroves, Port and Industrial, and Coastal Hazards (National Oceanic and Atmospheric Administration 1980; CNMI Coastal Resources Management Office 2014). Designated "Shoreline", "Lagoon and Reef" and "Coastal Hazard" CNMI Areas of Particular Concern surround the entire island. For more discussion on "Lagoon and Reef" areas see Section 3.10, *Marine Biology*. There are four "Wetland and Mangrove" CNMI Areas of Particular Concern on Tinian: Lake Hagoi, Bateha, Mahalang, and Makpo. For more discussion on "Wetland and Mangrove" areas see Section 3.3, *Water Resources* and Section 3.9, *Terrestrial Biology*. Tinian's port and harbor is designated as a "Port and Industrial" CNMI Area of Particular Concern.

3.7.4.1.4 Submerged Land Control around Tinian

The Territorial Submerged Lands Act (Public Law 113-34, 27 Stat. 518) was amended to provide for the transfer of certain submerged lands around the CNMI to the CNMI government to assure parity with other insular areas. Prior to the transfer, the U.S. government had control (fee simple ownership) over submerged lands on the CNMI. The U.S. retained control over submerged lands extending to 3 nautical miles (5 kilometers) from the coast of Tinian where the U.S. government has land leases. The U.S. government has rights in, and powers over, the waters and submerged lands extending seaward of the mean high tide line (see Figure 3.7-1). Per the 1980 CNMI Coastal Management EIS, "The commonwealth has excluded from its coastal management area all lands which are under the sole jurisdiction of or are held in trust by the federal government, its officers, or agents;" however, these submerged lands must comply with the federal Coastal Zone Management Act (National Oceanic and Atmospheric Administration 1980). To ensure the protection of military training in the area, a January 2014 Presidential Proclamation did not include the transfer of submerged lands adjacent to the leased lands of Tinian to the government of the CNMI (Obama 2014). Therefore, the U.S. retains control over submerged lands extending to 3 nautical miles (5 kilometers) from the coast of Tinian where the U.S. government has land leases.

Figure 3.7-5 shows the CNMI Department of Public Lands classifications of land use. This section covers the specific land uses, including lands outside of the Military Lease Area in the region of influence. Historical developments and land use are described in Section 4.11, *Cultural Resources*.

3.7.4.1.5 Exclusive Military Use Area

The Exclusive Military Use Area is used for military training. The area covers approximately the northern third of Tinian and comprises 7,574 acres (3,065 hectares) of land (DoN 2008). It is mostly forested, providing a realistic combat environment for maneuvers and amphibious training (DoN 2010). In the Exclusive Military Use Area some simulated munitions and live-fire small arms are employed.

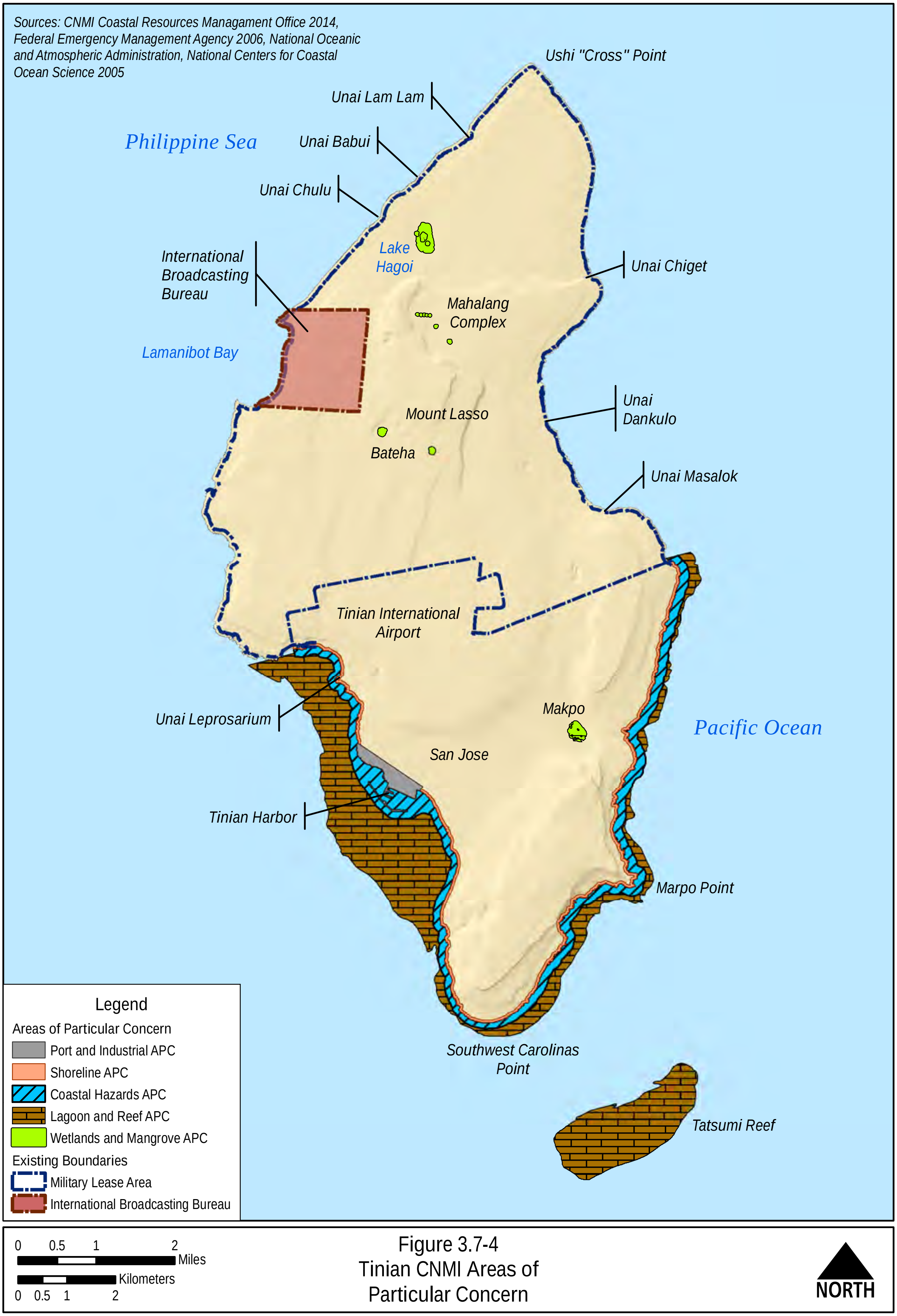


Figure 3.7-4
Tinian CNMI Areas of Particular Concern

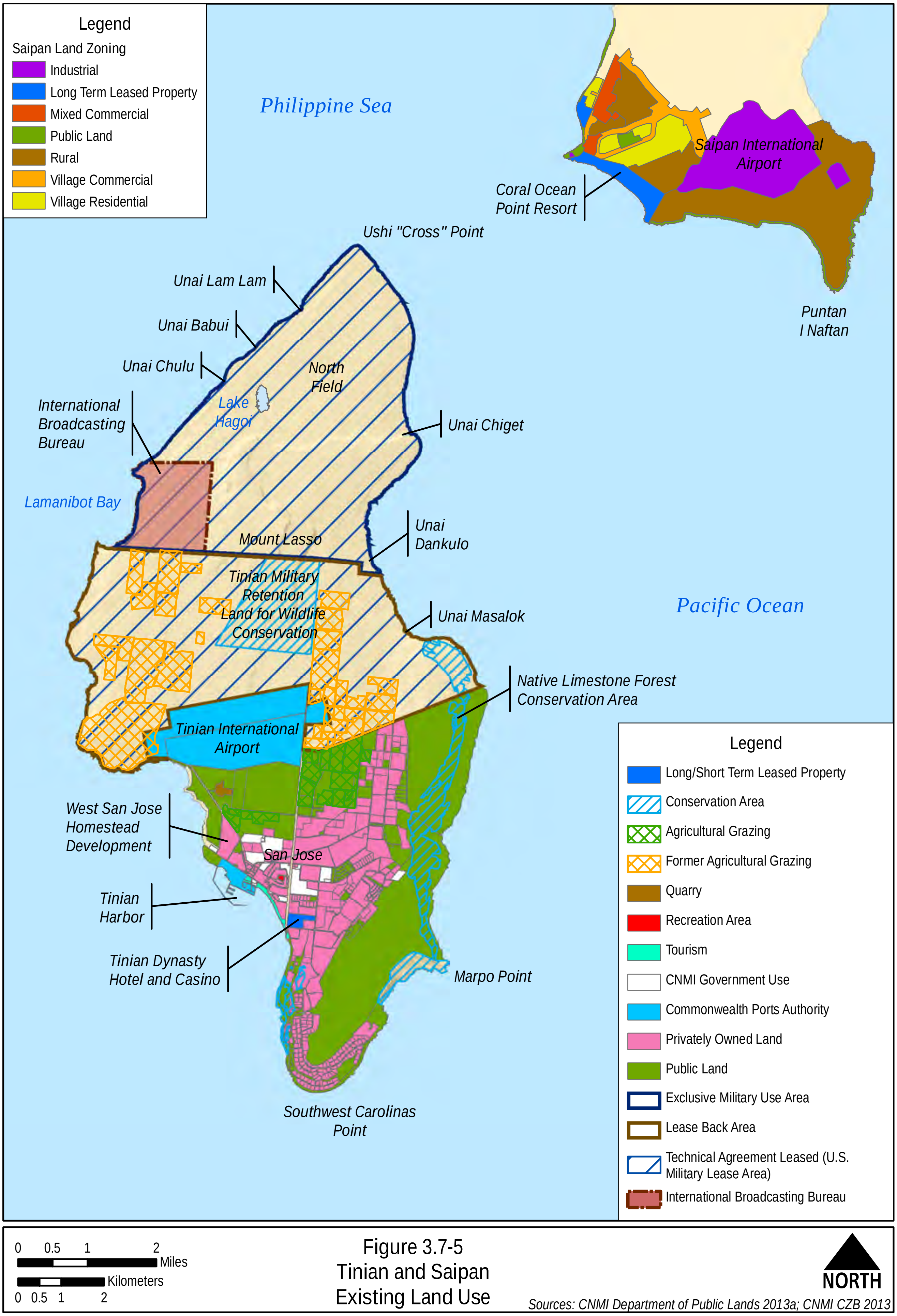


Figure 3.7-5
Tinian and Saipan
Existing Land Use

Sources: CNMI Department of Public Lands 2013a; CNMI CZB 2013

3.7.4.2 Existing Land Use

Figure 3.7-6 depicts the military uses on Tinian. The U.S. military uses the Exclusive Military Use Area for military training events that include Military Operations in Urban Terrain training, command and control, logistics, bivouac, vehicle land navigation, convoy training, and other ground element field activities. A key feature of the Exclusive Military Use Area is North Field, an unimproved expeditionary World War II-era airfield. North Field supports vertical and short-field landings, force-on-force airfield defense and offensive training, expeditionary airfield command and control, air traffic control, logistics, armament, fuels, rapid runway repair, and other airfield-related requirements.

Pyrotechnics and fires are allowed during training exercises on North Field (Commander, U.S. Naval Forces Marianas 2004). There have also been clandestine reconnaissance and hostage rescue exercises at the former Japanese Air Command Post at North Field where controlled live-fire was used.

Non-combatant evacuation operations occur at Unai Dankulo, Unai Chulu, Tinian Harbor, and North Field (DoN 2010). Hydrographic surveys are conducted from small boats around Tinian.

The Tinian Mortar Range (also called Chiget Mortar Range) on the east side of the island, between North Field and the eastern coast contains unexploded ordnance (60 millimeter and 40 millimeter) and is restricted to all but trained unexploded ordnance personnel. The area is fenced and warning signs prohibiting entrance are posted. See Section 3.16, *Hazardous Materials and Waste*, for more discussion on unexploded ordnance.

At Lake Hagoi, Unai Lam Lam, Unai Chulu, and Unai Dankulo (Long Beach), current training is restricted to designated areas because of cultural or natural resources.

No parks or recreation areas are designated in the Exclusive Military Use Area. However, there is public access to beaches, and there are 13 points of interest that are on the self-guided Tinian Historic Interpretive Trail (see Section 3.8, *Recreational Resources*). No agricultural uses are allowed within the Exclusive Military Use Area; however, historically there have been reports of animals grazing (Commander, U.S. Naval Forces Marianas 2004).

3.7.4.2.1 International Broadcasting Bureau

The International Broadcasting Bureau facility is located within the Exclusive Military Use Area on the northwestern side of Tinian (see Figure 3.7-2). It is distinct and fenced off from the remainder of the Exclusive Military Use Area and no training takes place within its boundaries. The International Broadcasting Bureau facility, which occupies approximately 800 acres (324 hectares), was developed in 1998 and includes access roads, an antenna field, and an operations facility. It is considered semi-improved, as it requires minimal landscaping and maintenance. About 25 employees work there, none of whom reside onsite (DoN 2013). Perimeter fencing and a security gate restrict public access to the International Broadcasting Bureau property, but the public has access to the coastal areas for recreation.

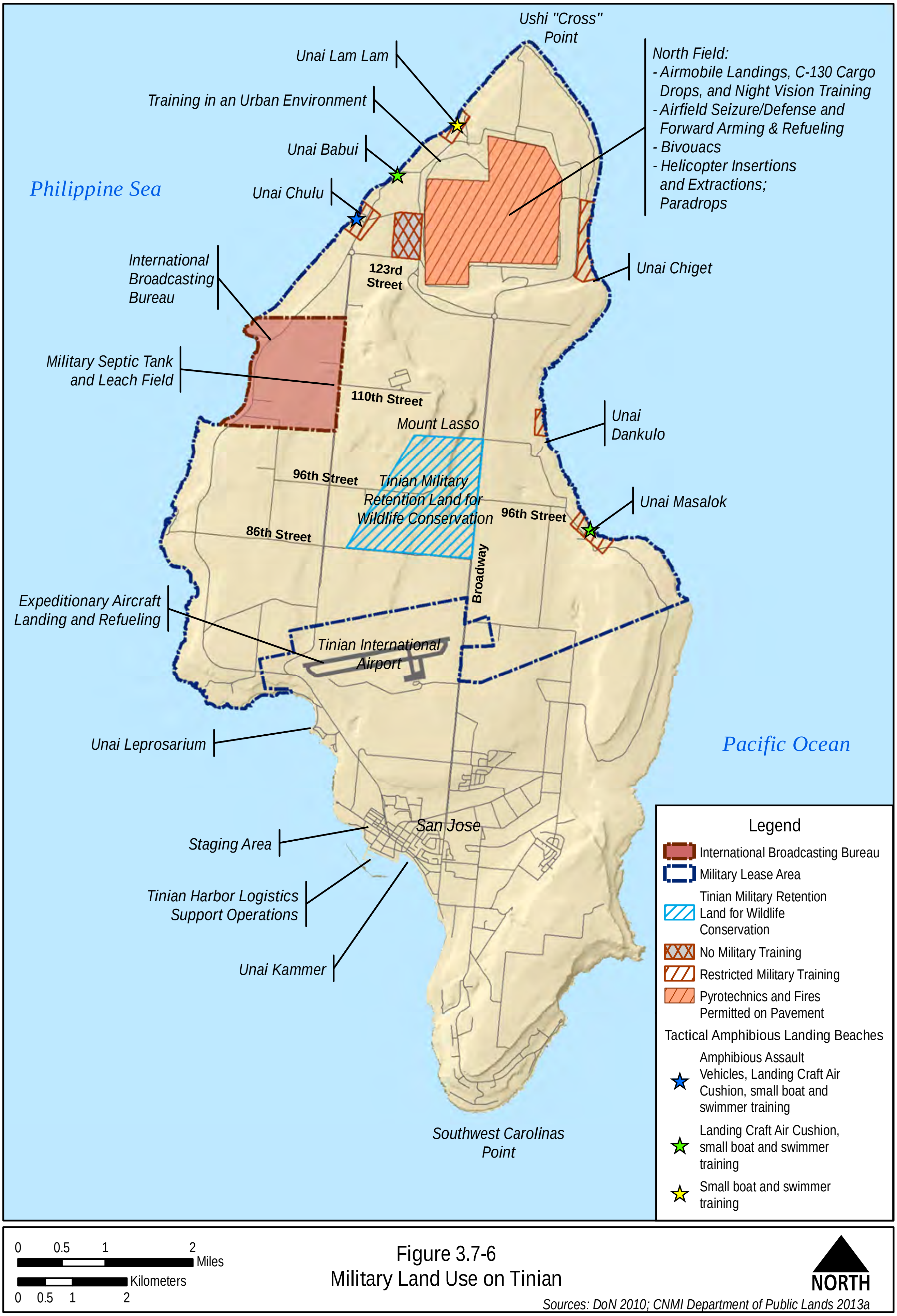


Figure 3.7-6
Military Land Use on Tinian

Sources: DoN 2010; CNMI Department of Public Lands 2013a

3.7.4.2.2 Lease Back Area

The Lease Back Area is composed of approximately 7,779 acres (3,148 hectares) and is located on the middle third of the island. As discussed in Section 3.7.2.3, *U.S.-CNMI Covenant and Lease Agreements*, the Tinian Leaseback Agreement has expired; however, the land is still used for cattle grazing. The Lease Back Area contains the following land uses:

- **Agricultural/Grazing in the Military Lease Area.** The total agriculture/grazing area is estimated at 2,552 acres (1,032 hectares) (see Figure 3.7-5). Most grazing and agricultural permits issued by the Department of Public Lands have expired.
- **Tinian Military Retention Land for Wildlife Conservation.** A 936-acre (379-hectare) conservation area is located within the Lease Back Area and is commonly referred to as the Tinian Military Retention Land for Wildlife Conservation and was designated for the Tinian monarch when it was on the federal endangered species list. See Section 3.9, *Terrestrial Biology*, for further discussion on this conservation area. The terms of the mitigation agreement allow the U.S. military to use the area for low-impact, non-habitat destructive training.
- **Points of Interest.** There are seven points of interest within the Lease Back Area that are on the Tinian self-guided tour; however, public access may be restricted during training. Refer to Section 3.8, *Recreation*, for other land and submerged land uses in the Lease Back Area.

3.7.4.2.3 Land Use Outside of the Military Lease Area

As shown on Figure 3.7-5, land use to the south of the Military Lease Area includes transportation (Tinian International Airport), agricultural, residential, resort, public services (e.g., power plant), open space, and conservation land. Most of Tinian’s population and commercial activity are in San Jose near the Port of Tinian.

The Technical Agreement (Northern Mariana Islands 1975b) between the U.S. and the CNMI governments provided for the lease back of property and joint use arrangements for the harbor and port area on Tinian; however the lease on the harbor was terminated in the 1994 amendment. Though the harbor lease was terminated in 1994, the U.S. retains the following rights:

- Handle cargo, stage equipment, and other port related activities.
- Use the harbor as ports of entry for troops, vehicles, and equipment. There is a staging area near San Jose used for logistical support associated with major training events.
- Install, operate and maintain fuel and utility lines to support above activities.

Military land uses on Tinian are shown on Figure 3.7-6. The Tinian government previously allowed (in the 1990s) special operations teams using combat rubber craft at Unai Leprosarium and Unai Kammer to conduct nighttime training landings (U.S. Commander Pacific Fleet 1999). This type of training could occur again with permission of the local government and the National Marine Fisheries Service. Unai Kammer is near the Tinian Dynasty Hotel and residential areas. Only the beach and nearby abandoned structures at Unai Kammer were used (DoN 2013). Unai Leprosarium is near the point south of Turtle Cove, near the airport.

3.7.4.3 Existing Submerged Land Use

3.7.4.3.1 Submerged Land Use Outside of the Military Lease Area

As discussed in Section 3.7.4.2, *Existing Land Use*, the Technical Agreement (Northern Mariana Islands 1975b) between the U.S. and the CNMI governments provided for the lease back of property and joint use arrangements for Tinian Harbor and port area, including submerged land associated with the harbor and port. Though the harbor lease was terminated in 1994, the U.S. retains the following rights, within submerged land:

- Moor vessels, handle cargo, stage equipment, and other port related activities
- Use the harbor as ports of entry for troops, vehicles, and equipment

Under the current military training program for Tinian, Amphibious Assault Vehicles have used an unutilized (by the public) boat ramp at the Tinian Marina, to land and launch Amphibious Assault Vehicles.

3.7.4.3.2 Public Use of Submerged Lands around Tinian

The public use of submerged lands and the waters above include recreation, fishing, and marine transportation. See Section 3.8, *Recreation*, Section 3.13, *Transportation*, and Section 3.15, *Socioeconomics and Environmental Justice*, for more discussion of use of the waters around Tinian.

3.7.4.4 Tinian Land Use Plans

Per the CNMI Public Land Use Plan (Marianas Public Land Corporation 1989), planned land use on Tinian involves accommodating growth in the available land outside of the Military Lease Area, with the majority of development expected to be concentrated in the San Jose area. This may include new urban land uses and hotel-style development (i.e., a compact footprint for transient accommodations, such as guest rooms with a bed and a bath) instead of a resort-style (i.e., a sprawling land-intensive complex that often includes a hotel plus outdoor amenities, such as gardens, golf courses, etc.) to accommodate the expected increase in visitors as a result of tourism.

Figure 3.7-5 shows the current land use information from the Department of Public Lands Land Classification Map for fiscal year 2013 (CNMI Department of Public Lands 2013b).

3.7.4.5 Saipan Existing Land and Submerged Land Use

Land use along the southern coast of Saipan may be affected by the proposed large-caliber weapons training noise that would occur on Tinian as part of the proposed action. As such, it is discussed briefly in the land use section, but is primarily addressed in Section 3.5, *Noise*. For a description of the affected environment for Saipan in regards to noise, see Section 3.5, *Noise*, and the *Commonwealth of the Northern Mariana Islands Joint Military Training Noise Study* in Appendix H, *Noise Study* (DoN 2014b).

The land use on the southern coastal area of Saipan includes a resort, golf course, beaches, residential neighborhoods, schools, commercial, and agriculture. The Commonwealth Zoning Board's zoning for the southern portion of Saipan is shown on Figure 3.7-5. The beaches and marine waters are used by tourists and residents for recreation.

3.7.5 Pagan

3.7.5.1 Land Jurisdictional Control and Management

3.7.5.1.1 Land Area

Although some families claim ancestral rights to the lands on Pagan, the CNMI government has title to all the land on Pagan. The establishment of homesteads in accordance with the CNMI Constitution and implementing statutes has been approved, but due to lack of funding, no deeds have been conveyed for the property. No land on Pagan is controlled by the U.S. government. The CNMI Department of Public Lands is mandated to manage the land for economic development and the benefit of the indigenous population (Coastal Resources Management Office 2008). In 1981, the residents of Pagan were evacuated due to volcanic eruptions and were relocated to Saipan; therefore, Pagan is considered uninhabited per the U.S. Census. There are people who visit Pagan and some may stay in temporary encampments. Access to Pagan is controlled by the CNMI government and permits are needed in order to visit. Resettlement of Pagan has not been approved by the CNMI government since the 1981 evacuation.

3.7.5.1.2 CNMI Areas of Particular Concern Designations on and around Pagan

Pagan includes two of CNMI's five Areas of Particular Concern (Figure 3.7-7): (1) Shoreline and (2) Lagoon and Reef. The "Shoreline" and "Lagoon and Reef" CNMI Areas of Particular Concern surround Pagan and are discussed in Section 3.10, *Marine Biology*.

3.7.5.1.3 Submerged Land Control around Pagan

The U.S. Senate Bill 256 amends the Territorial Submerged Lands Act to provide for the transfer of submerged lands around the CNMI to the CNMI government to assure parity with other insular areas. Prior to this, the U.S. government had control (fee simple ownership) over submerged lands in all of the CNMI. Submerged lands extend 3 nautical miles (5 kilometers) from the coast of Pagan. Under Public Law 113-34, 27 Stat. 518, the CNMI now has rights in, and powers over, Pagan's submerged lands extending seaward of the mean high tide line.

3.7.5.2 Existing Land Use

Pagan is a remote, difficult-to-reach island. There is no infrastructure or usable docking facilities. Helicopters or small planes can land on a World War II-era remnant airfield built by the Japanese; however, lava flows have damaged and shortened the airfield. Historical developments and use are described in Section 3.11, *Cultural Resources*. Pagan is mostly unmanaged, and feral ungulates (i.e., cattle, goats, and pigs) roam the island. There is no CNMI land use designation for Pagan, so it is therefore assumed to be conservation (see Section 3.7.5.4, *Pagan Land Use Plans*). However, Pagan visitors also conduct subsistence activities such as hunting, fishing, gathering of fruits, and such while staying on the island.

In recent years, limited military training has occurred as part of the Forager Fury and Forager Fury II exercises. The training consisted of a 1-day, non-live-fire combat search and rescue training mission. A rotary-wing aircraft (MV-22 Osprey) was utilized to extract personnel from a simulated downed aircraft on Pagan.

Figure 3.7-7
Pagan CNMI Areas of
Particular Concern

3.7.5.3 Existing Submerged Land Use

Uses of Pagan submerged land and associated waters are primarily recreational, fishing, and marine transportation. See Section 3.8, *Recreation*, Section 3.13, *Transportation*, and Section 3.15, *Socioeconomics and Environmental Justice*, for a discussion of uses of the waters around Pagan.

3.7.5.4 Pagan Land Use Plans

3.7.5.4.1 CNMI Physical Development Master Plan

The CNMI Physical Development Master Plan (CNMI Office of Transition Studies and Planning 1978) included a plan for Pagan as the island had a small permanent population at that time. Pagan was inhabited by about 40 residents in 1978. The CNMI Physical Development Master Plan expected that Pagan's population would not exceed 200 during the plan period (1978-1985). The CNMI Physical Development Master Plan projected that development would remain in the Bandera-Shomushon area (near the airfield and former dock). Some proposed infrastructure improvements to support homestead developments were included in the 1978 Physical Development Master Plan.

3.7.5.4.2 CNMI Public Land Use Plan

The CNMI Public Land Use Plan (Marianas Public Land Corporation 1989) was prepared after the evacuation of Pagan when there was no permanent population present. The 1989 plan did not mention Pagan specifically and referred to all islands north of Saipan collectively as the "Northern Islands." The 1989 plan stated that "public lands in the Northern Islands will remain in their current designation as conservation areas."

3.7.5.4.3 Five-year Land Use Plan Update for Pagan

Pagan is still considered as conservation land per the 1989 CNMI Public Land Use Plan. There is no land use plan specifically for Pagan. The 2013 CNMI Department of Public Lands' Five-year Land Use Plan for Pagan, CNMI is a land use planning effort that generated three potential land use plan options for consideration. The CNMI Department of Public Lands has not selected any of these options or officially adopted any land use plans for Pagan (CNMI Department of Public Lands 2013a). The developable use options all utilize roughly the same footprint and designate areas for community development, community farming, and general use. Only one of the options includes military land use. In 2010, the CNMI enacted Public Law 16-50, a homesteading law to establish the Northern Islands Village and Agricultural Homesteading program for current or former residents of the Northern Islands or any qualified person interested in residing on the Northern Islands. The law, however, requires extensive municipal planning and infrastructure development prior to homesteading deeds being issued and, to date; the CNMI has not deeded any land on Pagan (DoN 2014a). For a discussion on the CNMI homesteading programs and status, please see Section 3.15, *Socioeconomics and Environmental Justice.*

3.8 RECREATION

3.8.1 Definition

Section 3.8 describes the existing recreational resources on Tinian and Pagan. Recreation is defined as any type of activity in which area residents or visitors, including military personnel on liberty, may participate in for enjoyment during leisure time. Recreational resources are primarily assets of the physical geography of each island; from the mountains to the ocean, and the terrain in between. There are also man-made recreational resources, including parks, monuments, points of interest, National Historic Landmarks, sports fields, and events (e.g., competitions, cultural festivals, food fairs). National Historic Landmarks are places that possess exceptional value or quality in illustrating and interpreting the heritage of the U.S.

The region of influence for recreation includes the islands of Tinian and Pagan, and their surrounding waters. Recreational resources for this EIS/OEIS are organized into the following five categories: (1) historic and cultural sites, (2) beaches and parks, (3) ocean-based resources, (4) scenic points, and (5) annual events. The description of resources in this chapter follows these categories. Although each resource is organized under one category, there may be multiple recreational opportunities from a single resource. For example, a resource described under historic sites may offer scenic views. Therefore, a description of each resource is provided to supplement its categorization.

3.8.2 Regulatory Framework

The following entities are responsible for the management and maintenance of tourist sites and recreational areas on Tinian and Pagan:

- **National Park Service** – The National Park Service is a federal agency that has one office on Guam, one office on Saipan, but does not currently have an office presence on Tinian. Although managed by the National Park Service, the North Field National Historic Landmark on Tinian (National Historic Preservation Act Site #85003268 designated on December 30, 1985, discussed in Section 3.11, *Cultural Resources*) is not maintained by the National Park Service. The Superintendent for the National Historic Landmark is based out of Saipan.
- **Tinian and the CNMI Mayor's Offices** – The Tinian Mayor's Office maintains visitor areas on Tinian, including the historic and cultural sites in and outside of the National Historic Landmark. The CNMI Mayor's office is responsible for maintaining areas on Pagan for permitted ecotours.
- **CNMI Department of Land and Natural Resources – Division of Parks and Recreation** – This agency has a small presence on Tinian. The Division of Parks and Recreation is responsible for the administration of parks and recreational sports facilities in populated areas. However, this agency has no specific park management plans for Tinian or Pagan.
- **CNMI Bureau of Environmental and Coastal Quality – Division of Coastal Resources Management** – This agency ensures consistency with the Coastal Zone Management Program, and manages Areas of Particular Concern (see Section 3.7, *Land and Submerged Land Use*), which include areas extending 150 feet (45 meters) inland from shorelines, and extending

seaward to the outslope of lagoons and reefs. The Division of Coastal Resources Management requires commercial recreation and tourism operators to secure a permit to operate in the shoreline jurisdiction.

- **CNMI Department of Land and Natural Resources – Division of Fish and Wildlife** – This agency is responsible for the protection and enhancement of natural resources, both terrestrial and ocean-based. This agency issues fishing, harvesting, and hunting permits. In addition, this agency has law enforcement responsibilities and can issue citations for violations.
- **CNMI Department of Community and Cultural Affairs – Division of Sports and Recreation** – This agency oversees two facilities on Tinian, both located in the village of San Jose - the gymnasium and pool/ball field complex. The division is responsible for administration of the sports complexes and associated recreation programs.

3.8.3 Methodology

Information regarding the use of recreational resources was obtained through a series of agency interviews, phone calls, site visits, and focused internet searches.

3.8.4 Tinian

As discussed in Section 3.15, *Socioeconomics and Environmental Justice*, the tourism industry is the largest industry on Tinian, with over 54,000 visitors in 2013. According to the Tinian Dynasty, the average length of stay on Tinian is 2.5 nights, and the majority of the visitors to Tinian are there for the historic and cultural sites and to enjoy the warmth and the beaches (DoN 2014). Recreational resources enhance the visitor experience and help drive the local economy (DoN 2010). Most recreational facilities on Tinian are geared to visitors, and most commercial establishments catering to recreation activities are located in the village of San Jose. The most popular activities for visitors include historical island tours, snorkeling, and water sports at the beaches outside the Military Lease Area, as described below (Mariana Visitors Authority 2012). Figure 3.8-1 shows locations of various recreational resources on Tinian.

3.8.4.1 Historic and Cultural Sites

Tour agencies provide packaged tours of historic and cultural sites on and around Tinian. These tours are generally windshield tours with brief stops at the sites for the tourists to take photographs (DoN 2014). There are two tours sponsored by the Tinian Dynasty: South Side and North Side. The South Side tour makes stops at the following historic and cultural sites: Suicide Cliff and the House of Taga. The North Side tour stops at the North Field National Historic Landmark (DoN 2014). When the Tinian Dynasty is full, the bus tours will run all day with each tour accommodating up to 80 people and lasting 2 to 3 hours (DoN 2014).

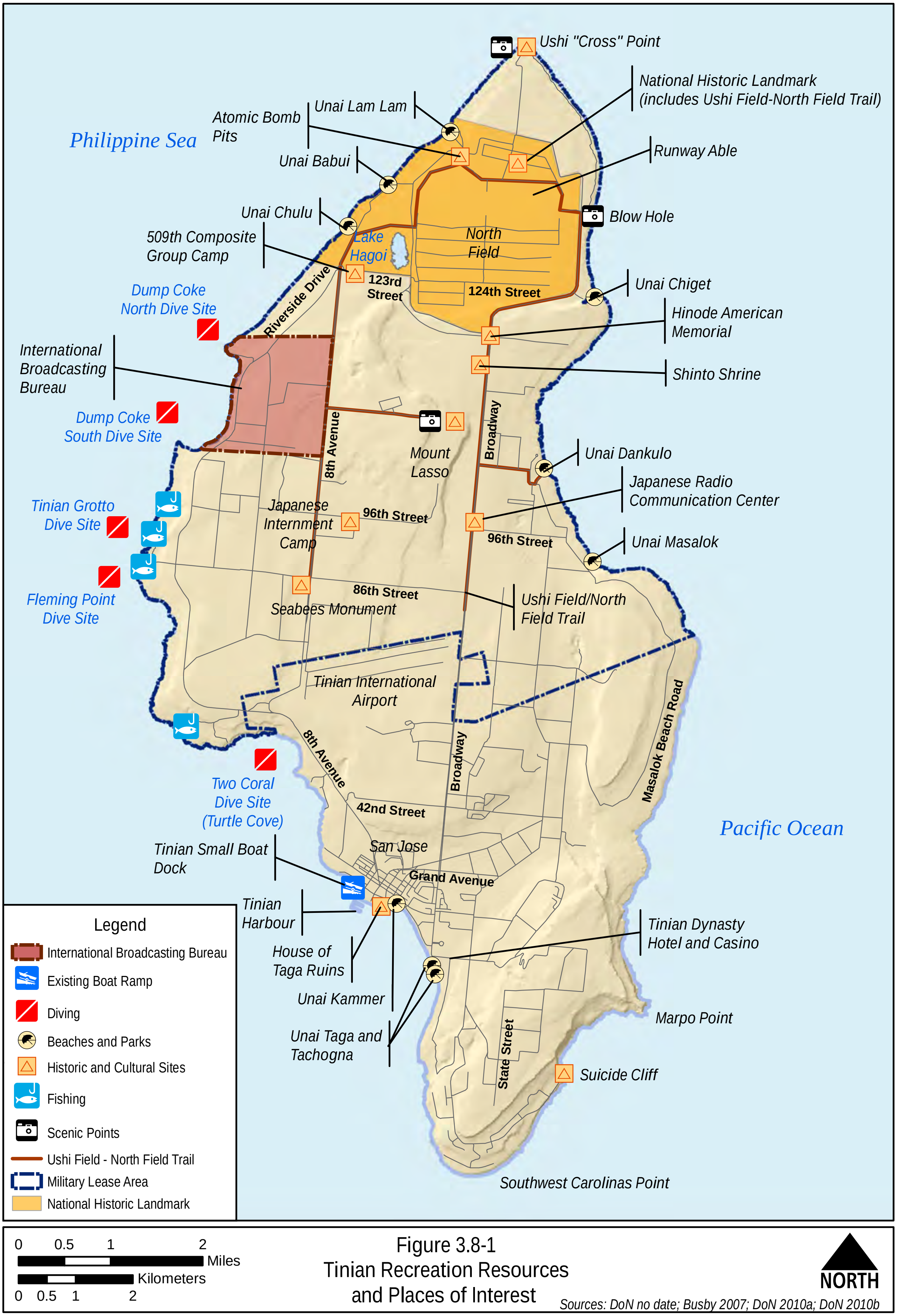


Figure 3.8-1
Tinian Recreation Resources and Places of Interest

3.8.4.1.1 Historic and Cultural Sites within the Military Lease Area

3.8.4.1.1.1 North Field National Historic Landmark

The North Field National Historic Landmark is located on the north end of the Military Lease Area (see Section 3.11, *Cultural Resources,* Figure 3.11-2) and is managed by the National Park Service. It includes World War II landing beaches at Unai Babui and Unai Chulu; World War II buildings, structures, and structural remains; and North Field runways (see below Photos 3.8-1 to 3.8-6). According to the Tinian Mayor's Office, the atomic bomb pits at North Field have approximately 100 visitors per day (DoN 2014).

The DoN retains control of lands encompassing the North Field National Historic Landmark based on a 50-year lease agreement with the CNMI (the landowner) that has been in place since 1983 (National Park Service 2001). The sites are accessible to the public, except during certain periods of military training. The DoN provides a 45-day advance notice to the CNMI agencies when military training is scheduled on Tinian (National Park Service 2001). The North Field National Historic Landmark is also the site of anniversary tours sponsored by private tour operators, such as Stephen Ambrose Historical Tours. The North Field National Historic Landmark is also a destination of the Tinian Dynasty North Side tour.

3.8.4.1.1.2 Ushi Field-North Field Trail

The Ushi Field-North Field Trail is an interpretive trail developed by the Department of Defense in 1999 that identifies 14 points of World War II historic interest. Ushi Field-North Field Trail is part of the National Historic Landmark and is managed by the National Park Service. During World War II, the Seabees (members of the U.S. Naval Mobile Construction Battalion) and Marine Corps constructed six large airstrips on Tinian. Four of the six airstrips (Runways Able, Baker, Charlie, and Dog) were located at North Field and constructed over the former Japanese Ushi Point airfield, formerly the Japanese Imperial Naval Air Forces headquarters. On August 6, 1945, the *Enola Gay* (B-29 bomber) took off from the northernmost runway (Runway Able) to drop an atomic bomb on Hiroshima, Japan. Three days later another B-29, *Bock's Car,* took off from the same runway to drop an atomic bomb on Nagasaki, Japan, on August 9, 1945. Also located along the trail are World War II Japanese fortification features (e.g., bunkers, naval batteries, a command post), a Radio Communications Center, and the Bomb Assembly Building.

To enhance the trail experience for visitors, the DoN, through funding from the Department of Defense Legacy Resource Management Program, cleared roads and trails, and installed interpretive signs. In 2001, a brochure was printed for a Self-Guided Tour of Historic North Tinian, including the North Field National Historic Landmark, which describes its historic resources. This brochure may be obtained through the National Park Service.

Photo 3.8-1. Historic Runway Able from which Numerous Aircraft Left for Bombing Raids over Japan

Photo 3.8-2. One of Two Loading Bays from which Atomic Bombs were Loaded into Aircraft for Bombing of Japan

Photo 3.8-3. Japanese Air Operations Building

Photo 3.8-4. Japanese Air Administration Building

Photo 3.8-5. Japanese Air Raid Shelter

Photo 3.8-6. Remains of Japanese Bomb Storage and Fuel Drum Storage

3.8.4.1.1.3 Ushi "Cross" Point

Ushi "Cross" Point is the northern-most point of the island. In addition to the various memorials at the point, the site and surrounding area are used by local fishermen. See Section 3.12, *Visual Resources* for photos of Ushi "Cross" Point.

3.8.4.1.1.4 Mount Lasso Scenic Lookout

Mount Lasso, located in the central portion of the Military Lease Area, is accessed from an unimproved road extending up the west side of the mountain off of 8th Avenue. The approach to the lookout involves passing the foundation of a former World War II Army Air Corps hospital and the remnants of a 1920s/1930s-era Japanese Shinto shrine near the lookout area.

3.8.4.1.1.5 Japanese Radio Communications Building

Located within the southern portion of the Military Lease Area along Broadway Avenue, the Japanese Radio Communications Building (Photo 3.8-7) is a World War II-era reinforced concrete shell of a two-story building. It is surrounded by smaller accessory facilities. The Tinian Mayor's Office is responsible for maintaining vegetation at the Japanese Radio Communications Building. Just north of the Radio Communications Building is a staging area used for off-road vehicle tours.

Photo 3.8-7. Japanese Radio Communications Building along Broadway Avenue

Photo 3.8-8. Nan'yo Kohatsu Kaisha Shinto Shrine off Broadway Avenue

3.8.4.1.1.6 Nan'yo Kohatsu Kaisha Shinto Shrine

The Nan'yo Kohatsu Kaisha Shinto Shrine is in the North Field area off Broadway Avenue (Photo 3.8-8). It was constructed after World War II by Nan'yo Kohatsu Kaisha, a Japanese firm that harvested sugar cane on Tinian prior to World War II. The remains of a railroad track once used for hauling sugar cane are located between Broadway Avenue and the shrine. The Tinian Mayor's Office is responsible for maintaining vegetation at the Nan'yo Kohatsu Kaisha Shinto Shrine.

3.8.4.1.1.7 Hinode American Memorial

North of the Shinto Shrine is a large traffic circle on Broadway Avenue. Traveling north, the road turns sharply to the east and begins its descent down to North Field plateau. The grass-covered center median of the traffic circle contains the American Memorial consisting of various Japanese-style small concrete monuments (Photo 3.8-9) that were built by Americans after World War II to honor those who were killed in the battle for Tinian. The Tinian Mayor's Office is responsible for maintaining vegetation at the Hinode American Memorial.

Photo 3.8-9. Hinode American Memorial

Photo 3.8-10. Remains of the Japanese Village – Last Used as an Internment Camp for Japanese during World War II

3.8.4.1.1.8 Japanese Village Internment Camp

This historic site, located just east of 8th Avenue, is reached via a forested narrow trail. It was formerly the site of the Japanese civilian internment camp after the capture of Tinian by American troops during World War II. The site is overgrown with a thick forested canopy. The most prominent feature is an entrance archway and concrete foundation structures (Photo 3.8-10). The Tinian Mayor's Office is responsible for maintaining vegetation at the Japanese Radio Communications Building.

3.8.4.1.1.9 Seabees Monument

Not far from the Japanese internment camp on the west side of the intersection of 86th Street and 8th Avenue is a small concrete and bronze monument to the Navy Seabees who constructed the facilities on island following the Battle of Tinian (Photo 3.8-11). The Tinian Mayor's Office is responsible for maintaining vegetation at the Seabees Monument.

Photo 3.8-11. Seabees Monument along 8th Avenue

3.8.4.1.1.10 509th Composite Group Camp Area

Photo 3.8-12. Entrance to the 509th Composite Group Camp Area

The 509th Composite Group was the U.S. Army Air Corps unit responsible for the delivery of the atomic bombs that were dropped on the Japanese cities of Hiroshima and Nagasaki at the end of World War II. The group's camp area was southeast of the 8th Avenue traffic circle, just south of the North Field National Historic Landmark. The camp location is marked by a sign, and the ruins of building foundations can be found along trails that have been cleared in the thick jungle vegetation (Photo 3.8-12). The Tinian Mayor's Office is responsible for maintaining vegetation at the 509th Composite Group Camp Area.

3.8.4.1.2 Historic and Cultural Sites Outside of the Military Lease Area

3.8.4.1.2.1 Ruins of House of Taga

The remnants of a house belonging to the ancient Chamorro chief, Taga, are in the village of San Jose. This site contains the tallest set of *latte* stones used by the ancient Chamorros throughout the CNMI. *Latte* stones are pillars capped by a hemispherical stone capital with the flat side facing up that were used as building supports by the ancient Chamorro people. The stones are quarried limestone, each approximately 19 feet (6 meters) in length. Of the 12 large *latte* structures, only one remains standing (Photo 3.8-13). The Ruins of the House of Taga are listed on the National Register of Historic Places and is a stop on the Tinian Dynasty's South Side tour. The Tinian Mayor's Office is responsible for maintaining vegetation at the Ruins of the House of Taga.

Photo 3.8-13. Ruins of House of Taga in the Village of San Jose

3.8.4.1.2.2 Suicide Cliff

Suicide Cliff gets its name from the many Japanese civilians and military personnel that took their lives during the Battle of Tinian (DoN 2014). The cliff area contains a large paved parking area for cars and tour buses, as well as a comfort station. The center of the area contains bleachers facing a ceremonial area. Suicide Cliff is a stop on the Tinian Dynasty's South Side tour. The Tinian Mayor's Office manages the Suicide Cliff area.

3.8.4.2 Beaches and Parks

Although beaches and parks are frequented by both visitors and Tinian residents, social activities of Tinian residents center on the beaches outside the Military Lease Area. On the weekends, residents go to the beach to barbeque and spend time with friends and family (DoN 2014). Tourists also visit the beaches, but their visits are often short as they are part of a tour group. The following sections describe the use of the beaches located within and outside of the Military Lease Area.

3.8.4.2.1 Beaches and Parks within the Military Lease Area

Beaches and parks accessible to the public within the Military Lease Area include (from northwest to southeast) Unai Lam Lam, Unai Babui, Unai Chulu, Unai Chiget, Unai Dankulo, and Unai Masalok, as described below. The remote locations of these beaches, lack of facilities (e.g., restrooms, showers, picnic tables), and difficult access to some of these beaches, as discussed in the description for each beach, make these beaches less frequented than the beaches located outside of the Military Lease Area. All beaches within the Military Lease Area are on public lands that are leased to the military. Beaches within the Military Lease Area are not managed or maintained.

3.8.4.2.1.1 Unai Lam Lam

Unai Lam Lam is located on the northwest coast, a short distance from the atomic bomb pits. This small beach is accessed by a thickly vegetated foot trail off a narrow dirt road. The beach is approximately 52 feet (16 meters) wide and is protected by a coral reef. This location is remote and access is difficult, as the only access is a steeply graded, rocky trail.

3.8.4.2.1.2 Unai Babui

Unai Babui is located on the northwest coast between Unai Lam Lam and Unai Chulu. Unai Babui was designated “White Beach One” by the Allies during the World War II amphibious assault landings and is part of the North Field National Historic Landmark. The beach is approximately 177 feet (54 meters) in length. Unai Babui is accessible via a single-lane unimproved road.

3.8.4.2.1.3 Unai Chulu

Unai Chulu is located south of Unai Babui. Unai Chulu was designated “White Beach Two” by the Allies during the World War II invasion and is also part of the North Field National Historic Landmark. Unai Chulu is the most accessible beach in the Military Lease Area. Access to the beach is well marked along an improved road. This beach is approximately 479 feet (146 meters) long, with a World War II Japanese bunker located at the north end adjacent to the parking area (Photo 3.8-14).

Photo 3.8-14. Japanese Bunker at Unai Chulu

Like Unai Lam Lam and Unai Babui, Unai Chulu is on the leeward (western) side of the island and is less windswept with thicker and taller vegetation than east coast beaches. The beach consists of white sand and a rocky shoreline that offer an overlook of the

Philippine Sea. Because of the size and accessibility of the beach, it attracts visitor groups for entertainment and picnics. Additionally, Unai Chulu is the only beach within the Military Lease Area that is recommended by the Tinian Dynasty to visitors (DoN 2014).

3.8.4.2.1.4 Unai Chiget

Unai Chiget is remotely located on the east windward coast of Tinian. The beach is comprised of coarse grand sand and is accessible via a small turnoff just north of the former Japanese Radio Communications Building.

3.8.4.2.1.5 Unai Dankulo

Situated on the east windward coast, Unai Dankulo, or Long Beach, is the largest beach on Tinian and has a continuous sandy crest across the entire run of the beach. Unai Dankulo comprises at least 10 beaches over a distance of 4,900 feet (1,494 meters), and is frequented by shore-based spear fishermen (Mariana Visitors Authority 2014). Access to Unai Dankulo is via a single-lane, unimproved road that runs from Broadway to the beach (Photo 3.8-15) and is accessed by local tour companies (Mariana Visitors Authority 2014). Additionally, all-terrain vehicle rides start at Unai Dankulo (DoN 2014).

Photo 3.8-15. Unai Dankulo from the Terminus of the Access Road

3.8.4.2.1.6 Unai Masalok

Unai Masalok, located on Tinian's east (windward) coast, is protected by an offshore reef and is approximately 154 feet (47 meters) in length. The 1999 Partial Release of Leasehold Interest between the CNMI and the U.S., as discussed in Section 3.7, *Land and Submerged Land Use*, established a 10-acre (4-hectare) area for a CNMI youth site at Unai Masalok. To date, this agreement has not resulted in any development in the beach area.

3.8.4.2.2 Beaches and Parks Outside the Military Lease Area

Beaches and parks located outside the Military Lease Area include (from north to south) Unai Kammer, Unai Taga, and Unai Tachogna, as described below. These beaches are the most frequented by tourists since they are located near the Tinian Dynasty. Additionally, the local population frequents these beaches because they are closer to the populated areas and have support facilities (e.g., areas for picnics, parking). Beaches outside the Military Lease Area are managed by the Bureau of Environmental and Coastal Quality. The Division of Parks and Recreation is responsible for the administration and maintenance of these beach parks.

3.8.4.2.2.1 Unai Kammer

Unai Kammer is located on the southwestern side of Tinian facing the Philippine Sea near the village of San Jose. This white sand beach is surrounded by mature vegetation. Unai Kammer contains approximately six well-maintained covered picnic pavilions and a large paved parking lot (Photo 3.8-16). Unai Kammer is utilized by residents as well as tourists, and is one of four beaches recommended by the Tinian Dynasty to visitors (DoN 2014).

Photo 3.8-16. Unai Kammer

3.8.4.2.2.2 Unai Taga

Unai Taga is located directly across from the Tinian Dynasty Hotel and Casino front entrance. The Unai Taga area is small and is accessed by a stairway system that extends to the beach and a concrete lookout area extending over the ocean where many local children enjoy diving and swimming (Photo 3.8-17). While the beach itself is quite small and generally frequented by residents, the site offers outstanding views to Aguijan Island and turquoise blue waters. It is a sightseeing stop for tourists. Unai Taga is one of four beaches recommended by the Tinian Dynasty to visitors (DoN 2014).

Photo 3.8-17. Unai Taga Stairway to the Beach and Overlook Platform with Aguijan Island in the Distance

3.8.4.2.2.3 Unai Tachogna

Unai Tachogna is another one of four beaches recommended by the Tinian Dynasty to visitors. Unai Tachogna is located just south of Unai Taga and connected to it by a shoreline pathway (Photo 3.8-18). On weekends, local families and groups gather here to barbecue and picnic. It is also a popular place for snorkeling, personal watercraft, and banana boats, most of which can be rented from the beach operators (Photo 3.8-19) (Tinian Dynasty 2013). Like Unai Kammer, there are numerous covered pavilions for picnicking and socializing. The rental kiosk and covered pavilions make Unai Tachogna a popular destination for tourists.

Photo 3.8-18. Walkway Connecting Unai Taga to Unai Tachogna

Photo 3.8-19. Unai Tachogna Rental Kiosk

3.8.4.3 Ocean-based Resources

Coastal recreational activities on Tinian take place in the coastal zone and surf zone waters. Ocean-based recreational activities on Tinian include snorkeling, diving, recreational fishing, and boating.

3.8.4.3.1 Snorkeling and Driving

Tinian waters contain many World War II wrecks, coral structures, and abundant sea life. Below are descriptions of the most popular snorkel and dive spots around Tinian (from north to south). All are located on the western (leeward) side of the island and require boats to get to them. There are approximately six charter boats on Tinian (National Oceanic and Atmospheric Administration 2012), as well as boats on Saipan, that offer charters to Tinian dive spots (DoN 2014).

- **Dump Coke (Cove) North/South –** Often mislabeled as Dump Cove, Dump Coke is located in Lamanibot Bay and gets its name from the many Coca-Cola bottles thrown from the cliffs during World War II. Dump Coke contains many World War II artifacts, such as airplanes, tanks, ammunition, and jeeps.
- **Tinian Grotto** –Tinian Grotto is a popular cavern dive in Tinian and is only reachable by boat. There are three main entry points. Most divers enter from the top to descend into the chamber below. Lionfish (*Pterois* sp.) can be observed in the cavern.
- **Fleming Point** – Fleming Point contains coral formations, small marine animals and fishes. The wall drops off to depths of more than 2,000 feet (609 meters) and has some of the best visibility of the waters surrounding Tinian.
- **Two Corals** – Two Corals consists of two adjacent coral formations. The fish life here includes varieties of parrot fish, grouper, damsel fish, and more. Two Corals is a short boat ride from Tinian Harbor.

3.8.4.3.2 Recreational Fishing

Most fishing activities on Tinian are of a subsistence or artisan (i.e., sell fish to cover cost of fishing excursion) variety (DoN 2014). However, recreational fishing is popular with the tourists. There are approximately six charter boats on Tinian available for recreational fishing charters. Subsistence, artisan, and recreational fishing activities include bottom fishing and trolling for barracuda, mahi-mahi, marlin, skipjack, red sea bass, and tuna. There are also shoreline fishing areas used for recreational fishing, which are primarily located south of Dump Coke South and north of the Two Coral (Turtle Cove) diving sites on the west side of Tinian (see Figure 3.8-1).

There are several fishing events held throughout the year within the CNMI. The most recent fishing events on Tinian include the Tinian Cliff Fishing Derby and the Tinian Bottom Fishing Derby. The Tinian Cliff Fishing Derby was held in April 2012. A total of 14 Tinian residents and five tourists participated in the competition sponsored by the Tinian Municipal Council and the Tinian Mayor's Office. In December 2013, the Tinian Mayor's Office hosted a bottom fishing derby. Anglers competed for prizes in seven categories: overall biggest, biggest deep water, biggest shallow water, most variety deep bottom, most variety shallow bottom, total weight deep bottom, and total weight shallow bottom (Saipan Tribune 2013).

3.8.4.3.3 Boating

Tinian Harbor's small boat dock is north of the main wharf and finger piers (Photo 3.8-20). The marina contains approximately 18 small craft mooring slips. The dock and finger piers support a variety of small craft used for fishing, diving, sight-seeing, and pleasure boating. The Tinian small boat dock is operated and maintained by the Boating Access program of the CNMI Division of Fisheries and Wildlife, which is 100% federally funded by the U.S. Fish and Wildlife Service. Vehicle access to the dock is via a paved road that services the port piers. North of the boat dock is a concrete boat ramp for launching and recovering small craft (Photo 3.8-21).

Photo 3.8-20. Mooring Slips at Tinian Small Boat Dock

Photo 3.8-21. Tinian Small Boat Ramp

As mentioned above, there are approximately six charter boats that serve tourist clientele. These charter boats are reportedly owned by non-local residents for tourists from their country of origin: Japan, China, and Korea. There is also one boat that is owned by the Tinian Dynasty's investors (DoN 2014). Although booked as charter fishing trips, these trips serve primarily as photographic opportunities for clients (National Oceanic and Atmospheric Administration 2012). Additionally, there is at least one charter boat from Saipan that conducts a Tinian boat tour (DoN 2014).

3.8.4.4 Scenic Points

As discussed in Section 3.12, *Visual Resources,* there are several scenic points on Tinian. Many of the scenic points also include a historic or cultural component and have been discussed in Section 3.8.4.1, *Historic and Cultural Sites.* However, the Blow Hole is a scenic point on Tinian, frequented by tourists, that was not discussed in Section 3.8.4.1.

The Blow Hole is located on the rocky coast of northeast Tinian within the Military Lease Area and is a stop on the Tinian Dynasty's North Side tour. Access to the site is off a gravel road, with the remaining 100 yards (91 meters) approachable by foot.

3.8.4.5 Annual Events

3.8.4.5.1 Tinian Hot Pepper Festival

In February, the Tinian Mayor's Office sponsors its annual 2-day Pika, or Hot Pepper, Festival to honor the Tinian hot pepper *(Donni Sali)*, a small but hot native pepper. The festival is an island-style show that features different kinds of locally prepared dishes, as well as arts and crafts. One of the highlights is the hot pepper eating contest. The festival location on Tinian varies from year to year, but the festival is always held in February over President's Day weekend. The 2014 festival was held at Unai Kammer, with ferry service from Saipan offered by the Mariana Visitors Authority (Saipan Tribune 2014a).

3.8.4.5.2 San Jose Fiesta

The San Jose Fiesta is an annual celebration of Tinian's patron saint, hosted in May by the Mayor's office at the Fiesta Grounds at Unai Kammer. The fiesta includes all night live entertainment, food and game concessions, carnival rides, cockfighting, big fish trolling competition, and a canoe race. The highlight of the fiesta is a free-for-all dinner banquet on Saturday following the Queen's coronation. Sunday starts with the San Jose Mass followed by a continuation of the games at the fiesta grounds. Camp grounds are also provided for those that wish to tent camp (Saipan Tribune 2014b).

3.8.1.1.1 Tinian Turquoise Blue Triathlon and Reef Swim

The Tinian Turquoise Blue Triathlon and Reef Swim is co-sponsored by the Mariana Visitors Authority, KFC Triathlon Club of Japan, Tinian Mayor's Office, and the Tinian Dynasty Hotel & Casino. The 2014 triathlon hosted 34 competitors from the CNMI and Japan (Mariana Visitors Authority 2014). The triathlon course starts at Unai Taga with a 1.5 kilometer swim, transitions to a 40 kilometer bike ride in southern Tinian between the airport and Suicide Cliff, and finishes with a 10 kilometer run from Unai Taga to Suicide Cliff and back. There is also a 1.5, 3.0, and 4.5 kilometer reef swim at Unai Taga. In 2014, the triathlon was held the same weekend as the Tinian Hot Pepper Festival. The 15th Annual Tinian Turquoise Blue Triathlon and Reef Swim is scheduled for February 14, 2015.

3.8.1.1.2 Tour de Tinian

The annual Tour de Tinian is a 100 kilometer mountain bike through the jungles of Tinian race hosted by the Bikers Association of Tinian. The race starts and ends in San Jose Village, and the race route includes interior and coastal areas in both north and south Tinian (i.e., within and outside of the Military Lease Area). In 2014, the Tour de Tinian was held May 3, 2014 in conjunction with the San Jose Fiesta and had more than 50 participants (DoN 2014). The 2015 Tour de Tinian will be held Memorial Day weekend (Mariana Visitors Authority, personal communication, September 4, 2014).

3.8.1.1.3 World War II Anniversaries

There are three tour seasons that correspond to specific World War II anniversaries: (1) March for the Iwo Jima anniversary, (2) June for the anniversary of the Battles of Saipan and Tinian, and (3) August for the anniversary of the Atomic Bomb. Star Marianas, the Tinian Dynasty, and private tour operators provide tours of the World War II historic sites, including the North Field National Historic Landmark, for these anniversaries. These tours are generally frequented by war veterans and their families and last a few days (DoN 2014). On every fifth anniversary of the End of the War in the Pacific, there is a larger event held at the North Field National Historic Landmark with guest speakers. There are also annual Memorial Day and Veteran's Day ceremonies (DoN 2014).

3.8.5 Pagan

Pagan is officially uninhabited because after the last major volcanic eruption in 1981, residents were evacuated from the island. There are currently no formally identified recreational facilities or activities on Pagan. Although there have been discussions about developing Pagan as an ecotourism destination and a staging area for visitors to the Marianas Trench Marine National Monument, these discussions have not resulted in establishment of Pagan as an official tourism destination. Nevertheless, Pagan offers a unique destination for backpackers, nature lovers, and hunters. Those who wish to visit Pagan must obtain a permit from the CNMI Homeland Security and Emergency Management Office. There are no scheduled flights or cruises to the island. Therefore, visitors generally come by private or chartered boats or aircraft (i.e., helicopters). Once on Pagan, visitors may visit the following historic resources (see Section 3.12, *Visual Resources*, Figure 3.12-2):

- Japanese-era concrete monument, which is a memorial to those that died in the Marianas during World War II
- World War II bomb shelter
- World War II Japanese Zero

Photo 3.8-22. Black Sand Beach on Pagan

Additionally, the black sand beaches on Pagan are undeveloped and generally untouched due to the lack of regular visitors, although there is feral livestock including goats, cows, pigs, and chickens (Photo 3.8-22). Since the beaches are not maintained, there is ocean-borne debris in the form of trash, fishing floats, and an occasional glass ball (a type of fishing float). Banadeera Bay is known as a good snorkel spot (Ogumoro and Torres 2014).

There are currently two tour options being offered for Pagan: Pagan ecotour adventure and the Silver Explorer cruise ship. There is a 10-person minimum for the Pagan ecotour adventure via boat with a maximum person count of 18, which includes the tour guide and boat operator. The maximum person count for the Pagan ecotour adventure via plane is eight to ten (Goodridge, W.F.J., personal communication, August 28, 2014). The first Pagan ecotour adventure encompassed 5 days with 3 full days on Pagan in April 2014 (DoN 2014). The ecotour included camping, visiting historic sites, hiking, and enjoying the black sand beaches. The next tour is a plane charter scheduled in January 2015 (Goodridge, W.F.J., personal communication, August 28, 2014).

According to the Mariana Visitors Authority (DoN 2014), Pagan will be a regular cruise ship stop. The first cruise ship visit occurred in September 2014. The Silver Explorer cruise ship anchored and shuttled people between the ship and Pagan for a day trip nature excursion before sailing on to Saipan and Tinian. The day trip included observation of one of the most recent lava flows by trekking down the old Japanese runway, a walk to several bunkers and planes, and a hike to a scenic overlook of the two lakes. The Silver Explorer cruise ship accommodates 132 guests and 117 crew (Silversea Expeditions 2012).

3.9 TERRESTRIAL BIOLOGY

This section describes the existing conditions of the terrestrial biological resources on Tinian and Pagan. The analysis of terrestrial biological resources 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. When species are mentioned for the first time in this section they are listed using the common name followed by the scientific name in parentheses; thereafter, only the common name is used. If there is no accepted English common name, then only the scientific name is used. Appendix L, *Biological Resources Supporting Documentation* identifies the Chamorro and Carolinian names where applicable and provides more detailed information on selected species of interest found on Tinian and Pagan.

The region of influence for terrestrial biology includes the northern portion of the Tinian International Airport, the Military Lease Area on Tinian, and the entirety of Pagan.

3.9.1 Definition

For the purposes of this document, terrestrial biology is divided into three categories: vegetation communities, wildlife, and special-status species.

3.9.1.1 Vegetation Communities

Vegetation communities include dominant plant species that occur within the project areas. Unvegetated, disturbed, and/or developed habitats are also discussed in this section. Vegetation communities were mapped and described in vegetation assessments or survey reports and delineated by either analysis of imagery, field observations, or a combination of these two methods. For Tinian, the vegetation community categories generally follow those defined by the U.S. Forest Service in their CNMI vegetation mapping project using high resolution aerial imagery (U.S. Forest Service 2006). For Pagan, the vegetation community categories generally follow those defined by Rogers (2010) during island-wide landcover mapping using aerial imagery, followed by ground-truthing at points within some of the delineated vegetation communities. Some category names were modified to make vegetation community names consistent for both Tinian and Pagan.

3.9.1.2 Wildlife

The wildlife section includes all common animal species: birds, mammals, reptiles, amphibians, and invertebrates. The discussion is subdivided into native and non-native species. Brief descriptions and life history information for wildlife species of special interest are detailed in Appendix L, *Biological Resources Supporting Documentation*.

3.9.1.3 Special-status Species

Special-status species include: (1) those listed as threatened or endangered under the federal Endangered Species Act that currently occur in the wild on Tinian or Pagan, (2) species proposed for listing under the federal Endangered Species Act, (3) species protected under the Migratory Bird Treaty Act, (4) those designated by legislative authority in the CNMI as threatened and endangered, and (5)

Species of Special Conservation Need as identified in the CNMI's Comprehensive Wildlife Conservation Strategy. Brief descriptions and life history information for Endangered Species Act-listed and proposed species and CNMI-listed species are detailed in Appendix L, *Biological Resources Supporting Documentation*.

3.9.2 Regulatory Framework

A variety of laws, regulations, executive orders, plans, and policies, such as the Endangered Species Act and the Migratory Bird Treaty Act, are applicable to the proposed action and alternatives for terrestrial biology.

- Federal Endangered Species Act (16 U.S. Code §§ 1531–1544)
- Migratory Bird Treaty Act (16 U.S. Code §§ 703–712)
- Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- Executive Order 13112, Invasive Species

These are described in detail in Appendix E, *Applicable Federal and Local Regulations*.

3.9.3 Methodology

3.9.3.1 Study Areas

Project-specific biological surveys for the following species or groups were conducted within study areas on Tinian that lacked sufficient or current data to evaluate potential impacts from proposed activities described in this EIS/OEIS: federally endangered Mariana common moorhen (*Gallinula chloropus guami*) and Micronesian megapode (*Megapodius laperouse laperouse*); native birds, including those protected under the Migratory Bird Treaty Act; and species proposed for listing under the Endangered Species Act (e.g., tree snails) (DoN 2014a). Surveys were conducted at representative locations (i.e., study areas) within the region of influence, and findings from these locations are assumed to be representative of other areas not surveyed that possess similar habitat attributes. The survey report is presented in Appendix L, *Biological Resources Supporting Documentation*, and provides figures depicting the individual study areas for each species surveyed. Previous survey reports by the DoN and U.S. Fish and Wildlife Service were also used to assess the status and presence of additional biological resources on Tinian and Pagan (e.g., Mariana fruit bat [*Pteropus mariannus mariannus*] and nesting sea turtles; see Table 3.9-1 and Section 3.9.3.2, *Data Sources and Surveys*).

3.9.3.2 Data Sources and Surveys

Various biological surveys, which have been conducted in the study areas within the region of influence, were used as key sources of information for this section. These sources include the *Terrestrial Resource Surveys of Tinian and Aguiguan, Mariana Islands, 2008* (U.S. Fish and Wildlife Service 2009); *Marianas Expedition Wildlife Surveys 2010* (U.S. Fish and Wildlife Service 2010); *Update of Integrated Natural Resources Management Plan for Navy Leased Lands on Tinian and Farallon de Medinilla* (DoN 2010a); *Final Joint Region Marianas Integrated Natural Resources Management Plan* (DoN 2013a); *Survey Report: Terrestrial Biological Surveys on Tinian in Support of the Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement/Overseas Environmental Impact Statement* (DoN 2014a); EISs, Environmental Assessments, Biological Assessments, and resulting U.S.

Fish and Wildlife Service Biological Opinions for previous actions on military lands on Tinian; and internal DoN field survey reports. In addition to the numerous DoN surveys, site-specific natural resources Geographic Information System data for the region of influence were obtained from the U.S. Fish and Wildlife Service as of August 2013. A summary of terrestrial biological field studies conducted on Tinian and Pagan is provided in Table 3.9-1.

Table 3.9-1. Terrestrial Biology Field Studies on Tinian and Pagan

Resource	***Location***	
	Tinian	***Pagan***
Vegetation	✓	✓
Wetlands	#	✓
Birds	✓, #	✓
Land mammals	✓	✓
Reptiles and amphibians	✓	✓
Federal Endangered Species Act-Listed Species		
Mariana common moorhen	✓, #	✓
Micronesian megapode	✓, #	✓
Mariana fruit bat	✓	✓
Sea turtles (nesting beaches)	✓	✓
Species Proposed for listing under the Federal Endangered Species Act		
Tree snails	✓, #	✓
Butterflies	✓	✓

Legend: ✓ = previous surveys and other data sources.
= surveys conducted for this EIS/OEIS (DoN 2014a); see Appendix L, *Biological Resources Supporting Documentation*.

3.9.4 Tinian

3.9.4.1 Vegetation Communities

Early reports of Tinian dating from the 1700s describe the island as having predominately limestone forest supporting trees such as *Pisonia grandis*, *Cerbera dilatata*, and *Guamia mariannae*. Tinian's native vegetation composition was largely impacted by agricultural and military use of the island, which began in the early 1800s and continued through World War II. In the 1920s, large sections of land were cleared by the Japanese to support sugarcane (*Saccharum* spp.) production. These fields were abandoned in the 1940s during World War II (Mueller-Dombois and Fosberg 1998). Aerial photographs reveal that World War II bombing, fires, and military reconstruction during and after the war significantly reduced the amount of native limestone forest on Tinian, and once-forested areas not under cultivation were susceptible to encroachment of the introduced non-native tangantangan (*Leucaena leucocephala*). Native limestone forests that once dominated the island were reduced to approximately 5% of the total vegetation cover (Camp et al. 2012; DoN 2013b).

Island-wide vegetation mapping was conducted in 2006 by the U.S. Forest Service (2006), and was updated in 2009 by the U.S. Fish and Wildlife Service (Amidon 2009) (Table 3.9-2 and Figure 3.9-1). The 2009 vegetation assessment of Tinian noted that since the 1980s, the coverage of open fields decreased 11.6% while secondary forest coverage increased 10.3%, likely a result of succession as open areas became reforested over the previous two decades. Smaller changes included a decrease in tangantangan and an increase in urban land cover (Amidon 2009).

Table 3.9-2. Tinian Vegetation Communities (acres)

Vegetation Community	*Military Lease Area*	*Non-Military Lease Area*	*Total*
Native Limestone Forest	391.3	964.4	**1,355.7**
Mixed Introduced Forest	4,647.5	2,176.4	**6,823.9**
Tangantangan	5,988.1	2,446.1	**8,434.2**
Herbaceous-Scrub	2,921.8	1,885.1	**4,806.9**
Casuarina Forest	296.4	54.7	**351.1**
Coconut Forest	32.1	65.8	**97.9**
Beach Strand	394.7	156.3	**551.0**
Wetlands*	33.7	31.2	**64.9**
Agriculture	2.5	329.2	**331.7**
Barren (soil, sand, or rock)	65.1	134.8	**199.9**
Developed Land	536.1	1,433.1	**1,969.2**
Total	**15,309.3**	**9,677.1**	**24,986.4**

Note: *The term wetlands refers to the habitat type and is not meant to infer a jurisdictional determination of wetlands as defined under the Clean Water Act.
Source: Amidon 2009.

The following vegetation community descriptions are summarized from Falanruw et al. (1989) to provide a systematic and consistent vegetation classification for discussing vegetation communities on Tinian.

3.9.4.1.1 Native Limestone Forest

Native limestone forest has been significantly reduced on Tinian due to past activities, including widespread cultivation of non-native species (e.g., sugar cane), activities during World War II, intentional and accidental introduction of non-native plants and animals, and grazing by non-native ungulates. Limestone forests on Tinian are important because they retain the functional ecological components of native forest that provide habitat for the majority of Tinian's native species, including Endangered Species Act-listed and proposed species, and CNMI-listed species, as well as bird species protected under the Migratory Bird Treaty Act. These forests also help maintain water quality and reduce fire risk. Non-native plant species (e.g., tangantangan) significantly alter the native forest structure, composition, and resilience of the forest to other disturbances and also provide less suitable conditions for native flora and fauna species than a native forest (Morton et al. 2000; Tang et al. 2011; DoN 2013b).

The few areas of native limestone forest remaining on Tinian within the Military Lease Area occur along cliff lines near Mount Lasso, around the northern escarpment of Maga, above and to the south-southeast of Unai Masalok, and in the southwestern section of the International Broadcasting Bureau site (Figure 3.9-1). This vegetation community harbors native trees such as *Cynometra ramiflora, Neisosperma oppositifolia, Cerbera dilatata*, *Psychotria* spp., *Eugenia* spp., *Guamia mariannae,* Pandanus (*Pandanus* spp.), coral tree (*Erythrina variegata* var. *orientalis*), banyan tree (*Ficus prolixa*), *Pisonia grandis*, and tropical almond (*Terminalia catappa*).

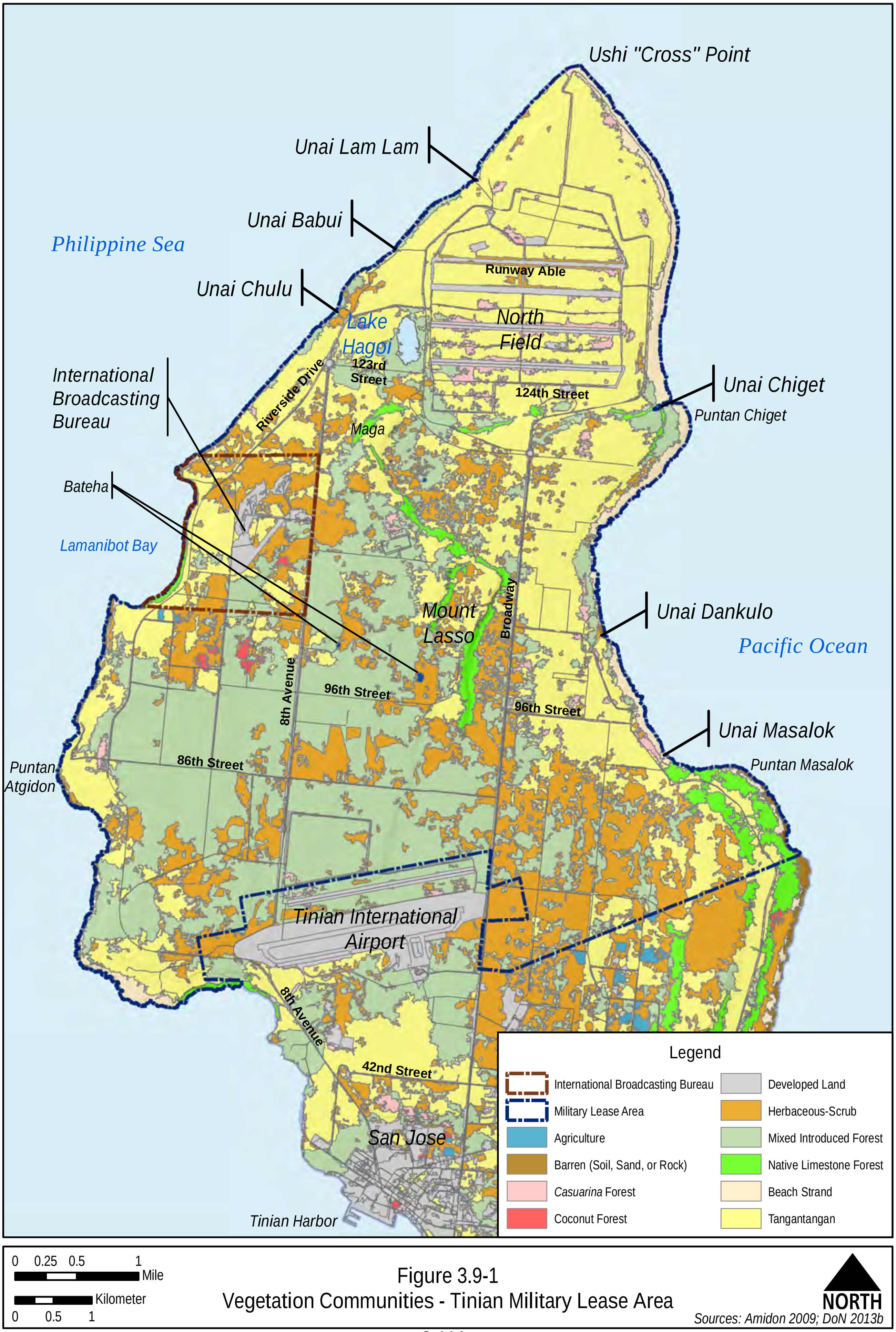


Figure 3.9-1
Vegetation Communities - Tinian Military Lease Area

Sources: Amidon 2009; DoN 2013b

3.9.4.1.2 Mixed Introduced Forest

Mixed introduced forest, also referred to as secondary forest, contains a mixture of introduced trees, shrubs, and dense herbaceous plants. Dominant trees common in this vegetation community include tangantangan, ironwood (*Casuarina equisetifolia*), siris tree (*Albizia lebbeck*), Formosan koa (*Acacia confusa*), flame tree (*Delonix regia*), and Madras thorn (*Pithecellobium dulce*). While not considered a native vegetation community on Tinian, the mixed introduced forest community provides habitat for the federal Endangered Species Act-listed and proposed species and CNMI-listed species as well as for other native bird species, including those protected under the Migratory Bird Treaty Act.

3.9.4.1.3 Tangantangan

This vegetation community typically occurs on limestone and is dominated by the non-native tangantangan tree. Tangantangan forests dominate much of the level and moderately sloping lowland habitat areas on Tinian, especially in the northern portions of the island. While not considered a native vegetation community on Tinian, tangantangan forest provides habitat for native bird species, including those protected under the Migratory Bird Treaty Act.

3.9.4.1.4 Herbaceous-Scrub

This vegetation community occurs on both limestone and volcanic soils, primarily within open fields, and is dominated by grassy and low herbaceous vegetation with small thickets of native and introduced shrubs. Introduced species such as lantana (*Lantana camara*), paper rose (*Operculina ventricosa*), climbing hempweed (*Mikania scandens*), blue buffle grass (*Pennisetum polystachion*), and giant sensitive plant (*Mimosa invisa*) are common, as are small groves of trees including African tulip tree (*Spathodea campanulata*).

3.9.4.1.5 Casuarina Forest

This vegetation community consists of forests of pure ironwood or dominated by ironwood and is referred to as *Casuarina* forest throughout this EIS/OEIS. Commonly called ironwood or Australian pine, this tree species tolerates dry and salty conditions. It often grows in shrub and grass habitat, and in some locations forms sparse woodland with little understory. Ironwood also occurs in exposed areas and in narrow bands along the coast. This species is generally accepted as native to the Mariana Islands and seems to be an early successional species that deters the growth of other species by producing a dense layer of fallen needle-like branches that have compounds inhibiting the growth, survival, and reproduction of other plant species within the immediate vicinity (Pratt 2010).

3.9.4.1.6 Coconut Forest

Coconut forest describes a vegetation community dominated by coconut palms (*Cocos nucifera*). Approximately one third of the island's coconut forests are located in five stands within the Military Lease Area. These stands are found adjacent to and south of the International Broadcasting Bureau (see Figure 3.9-1).

3.9.4.1.7 Beach Strand

Beach strand vegetation communities are limited to narrow strips in coastal areas and have adapted to excessively drained soils and salt spray from the adjacent coastal waters. Many beach areas are occasionally inundated with salt water during storm events, which is a controlling influence on all organisms. Strand vegetation includes beach heliotrope (*Tournefortia argentea*), bur-marigold (*Bidens pilosa*), portia tree (*Thespesia populnea*), false verbena (*Stachytarpheta* spp.), morning glory (*Ipomoea triloba*), lantana, and beach naupaka (*Scaevola taccada*). It also includes *Pemphis acidula* in rocky areas.

3.9.4.1.8 Wetland

Wetland vegetation communities are areas of grasses, sedges, herbs, or woody species which are specialized for growing in standing water or soils that are saturated for most of the year. Wetlands are habitats that are subject to permanent or periodic inundation sufficient to support vegetation that is typically adapted for life in saturated soil conditions. These habitats include marshes, swamps, bogs, and similar areas.

Wetland habitats on Tinian are important because of their limited occurrence and the habitat they provide for the federally and CNMI-listed endangered Mariana common moorhen (see Section 3.9.4.4, *Special-status Species*) and migratory birds. Lake Hagoi is a 34-acre (14-hectare) area comprising open-water and wetland vegetation that is the only permanent wetland habitat within the Military Lease Area. A 1995 vegetation map of the area (U.S. Fish and Wildlife Service 1996) showed a band of tall reed (*Phragmites karka*) and large patches of bulrush (*Schoenoplectus litoralis*, formerly *Scirpus litoralis*) around the perimeter. There were also patches of giant swampfern (*Acrostichum aureum*) and the grass *Paspalum distichum*. All of these species are native to Tinian (Raulerson 2006). The DoN (2013b) noted that as of 2012, Lake Hagoi vegetation appears to have changed relative to that mapped in 1995, with the occurrence of additional species such as the indigenous hibiscus (*Hibiscus tiliaceus*), a type of tree. In addition, the range of existing plant species had expanded into previously open-water areas of the wetland. The DoN (2013a) report further noted that the lake's vegetation has been changing continually over the past 50 years, with the expansion of bulrush into the wetland, resulting in a reduction of open water. Particularly rapid changes in the range of bulrush have been documented at Lake Hagoi between 2001 and 2013.

Two additional areas within the Military Lease Area contain water during the wet season: Mahalang and Bateha. The Mahalang complex consists of a number of ephemeral ponds located on a plateau within the northern portion of the Military Lease Area, south of Lake Hagoi (see Figure 3.9-1). At least 24 individual sites form the complex and are located within a matrix of grasslands (herbaceous-scrub), tangantangan, and mixed secondary forest. A subset of these individual sites contains water during the wet season, and all sites are dry during the dry season. Although no specific sizes for these sites were given in previous reports, AECOS and Wil Chee Planning (2009) estimated the two largest features as approximately 1.2 acres (0.5 hectare) each. The majority of the sites are characterized as likely bomb craters from World War II activities (DoN 2013b). Blue buffle grass, an introduced grass, and various species of weedy vines dominate the interiors of the craters. Other sites in the complex consist of shallow depressions with various weedy vines and herbs. One site contains a dense covering of the introduced wetland species *Ipomoea aquatica* that grows in ponded water during the wet season (DoN 2013b). Results of wetland surveys conducted at a sample of the Mahalang sites in December 2014 indicate that only a single Mahalang site supports wetland vegetation (e.g., *Ipomoea aquatica*) and exhibits the characteristics of an isolated wetland. All other surveyed Mahalang sites do not contain wetland soils, suitable hydrology, or wetland vegetation. See Appendix L, *Tinian Wetland Survey Report*, for more details regarding the Mahalang sites.

The Bateha sites are located within the Military Lease Area (see Figure 3.9-1) and consist of two shallow depressions that contain water during the wet season. These areas are approximately 1-2 acres (0.4-0.8 hectare) each. Numerous other small areas, previously identified as potential wetlands, did not have the characteristics of seasonal wetlands as of December 2012 (DoN 2013b). The larger western site at Bateha is dominated by the introduced, sprawling scrub-shrub giant sensitive plant and also contains the introduced shrub *Cassia alata* along with other weedy species. Blue buffle grass occurs along the perimeter. The eastern site is a deeper depression surrounded by ridges dominated by an overstory of the introduced Formosan koa and blue buffle grass. Candle bush (*Cassia alata*) is dispersed throughout the northern and southern portions of the site (DoN 2013b). Wetland surveys conducted at these two Bateha sites in December 2014 indicate that both sites exhibit characteristics of isolated wetlands, including the presence of wetland soils and wetland vegetation. See Appendix L, *Tinian Wetland Survey Report*, for more details regarding the Bateha sites.

3.9.4.1.9 Agriculture

For the purposes of the terrestrial biological resources discussion, the agricultural community is defined as those areas used for the cultivation of food crops. Only 2.5 acres (1.0 hectare) were identified within the Military Lease Area by the U.S. Fish and Wildlife Service (Amidon 2009) (see Table 3.9-2). These occur near the southwest corner of the International Broadcasting Bureau site (see Figure 3.9-1). Portions of the herbaceous scrub vegetation community support cattle (*Bos primigenius*) grazing on Tinian. Refer to Section 3.7, *Land Use*, for further discussion of agriculture and cattle grazing.

3.9.4.1.10 Barren (Soil, Sand, or Rock)

Barren, unvegetated areas of soil, sand, or rock primarily occur along Tinian's coastline. Approximately one third of the island's barren areas are located within the Military Lease Area and can be found from Puntan Atgidon to Lamanibot Bay (known locally as Dump Coke) and south of Puntan Masalok (see Table 3.9-2 and Figure 3.9-1).

3.9.4.1.11 Developed Land

Developed land includes human-occupied or otherwise highly disturbed areas that include lawns, mowed grass fields, and other landscaped areas and impervious surfaces such as buildings, roads, and parking lots. This category includes areas mapped by U.S. Forest Service (2006) as "Urban and Built-up" and "Urban Vegetation."

3.9.4.2 Native Wildlife

3.9.4.2.1 Birds

There are 44 native bird species reported on Tinian, of which 39 are protected under the Migratory Bird Treaty Act. The Marianna common moorhen is a native bird species protected by the Migratory Bird Treaty Act and the federal Endangered Species Act. In addition, another native bird species, Micronesian megapode, is protected only under the federal Endangered Species Act. Section 3.9.4.4, *Special-status Species*, further addresses bird species protected under the Migratory Bird Treaty Act and the federal Endangered Species Act. The remaining five native bird species that do not have a special status include: (1) Micronesian honeyeater (*Myzomela rubratra*); (2) rufous fantail (*Rhipidura rufifrons uraniae*); (3)

Tinian monarch (*Monarcha takatsukasae*); (4) bridled white-eye (*Zosterops conspicillatus saypani*); and (5) Micronesian starling (*Aplonis opaca guami*) (DoN 2013a, 2013c; U.S. Fish and Wildlife Service 2013).

Of the 44 bird species native to Tinian, 20 have been regularly detected in surveys conducted on Tinian between 1982 and 2013, during monthly monitoring by the DoN, and from periodic observations by the CNMI Division of Fish and Wildlife (Camp et al. 2009, 2012; DoN 2013c, 2014b). Island-wide surveys for native birds were conducted in 1982, 1996, 2008, and 2013 along a set of transects established by the U.S. Fish and Wildlife Service in 1982 (U.S. Fish and Wildlife Service 2009). Surveying of these standardized transects over time has allowed for analyses of population trends for a subset of Tinian native bird species (Camp et al. 2012; DoN 2014a).

Native bird species commonly found in forest habitats on Tinian include bridled white-eye, rufous fantail, Tinian monarch, Mariana fruit dove, white-throated ground-dove (*Gallicolumba xanthonura*), collared kingfisher (*Todiramphus chloris*), Micronesian honeyeater, and Micronesian starling. The yellow bittern (*Ixobrychus sinensis*) is a native bird species that is commonly present in open areas (DoN 2014a). All native shorebirds (e.g., sandpipers, plovers) and waterbirds (e.g., ducks) are protected under the Migratory Bird Treaty Act and are discussed in Section 3.9.4.4, *Special-status Species*.

Analysis of the 2013 native bird survey data was conducted by the U.S. Geological Survey to allow direct comparison to the data collection and analyses conducted for the 2008 Tinian surveys (Camp et al. 2009), as well as those done for the 1982 and 1996 surveys (Camp et al. 2012; DoN 2014a). Based on the 2013 analysis, the most abundant native bird species on Tinian were bridled white-eye, rufous fantail, and Tinian monarch (DoN 2014a). The collared kingfisher, white-throated ground-dove, and Mariana fruit dove were the least abundant. Analyses of population trends from 1982 to 2013 indicate increases in population densities for the collared kingfisher, Micronesian starling, rufous fantail, Mariana fruit dove, and white-throated ground-dove. Population densities have decreased for the Micronesian honeyeater. Population densities have remained stable for the bridled white-eye and Tinian monarch (DoN 2014a). For more detailed information on the 2013 native forest bird surveys on Tinian, refer to the *Tinian Monarch* section below and to the *Tinian Wetland Survey Report* provided in Appendix L, *Biological Resources Supporting Documentation*.

3.9.4.2.1.1 Tinian Monarch

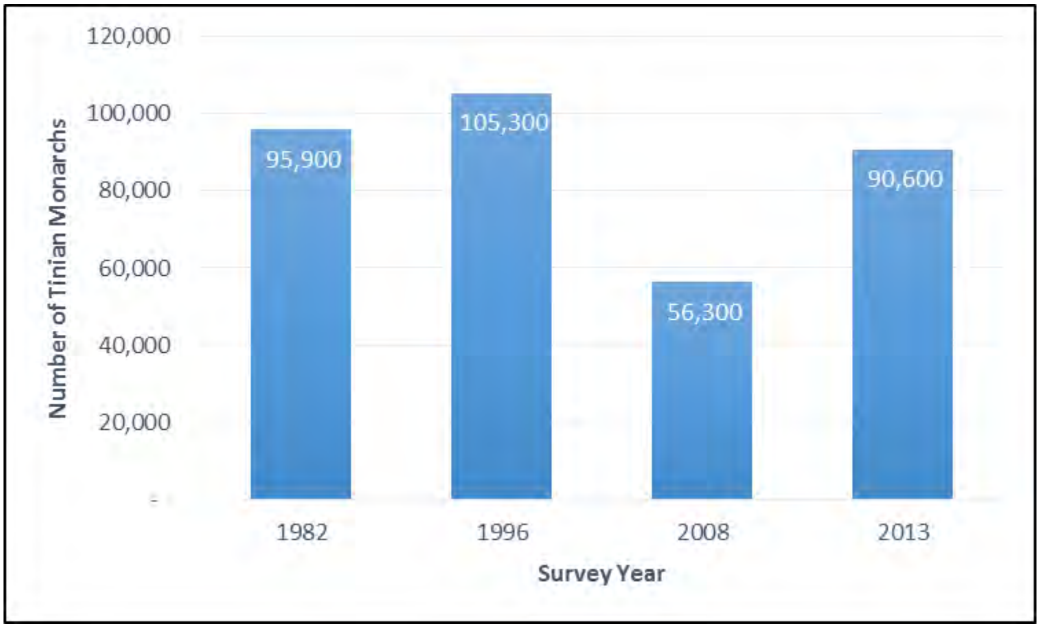
Although not protected under the Migratory Bird Treaty Act, the Tinian monarch (Photo 3.9-1) was previously listed under the federal Endangered Species Act and by the CNMI government, and is a native bird species found only on Tinian. The monarch nests in native limestone, mixed introduced, and tangantangan forest communities. Native tree species are preferred monarch nesting sites, and native limestone forest appears to provide higher-quality habitat, as evidenced by higher monarch densities, nesting rates, and reproductive success when compared to mixed introduced and tangantangan forest communities (DoN 1997; Camp et al. 2012).

Photo 3.9-1. Tinian Monarch
(Source: S. Vogt)

The Tinian monarch was federally listed as endangered in June 1970 because its population was thought to be critically low due to the destruction of native forests by pre-World War II agricultural practices, and by military activities during and after World War II. Based on forest bird surveys in 1982, which resulted in a population estimate of 39,338 individuals, the Tinian monarch was down-listed to threatened in April 1987. Further population studies in 1994 and 1995 resulted in a population estimate of approximately 52,904 birds. In 1996, surveys conducted along the same routes and using the same methods used in 1982 yielded a population estimate of 55,721 birds (Lusk et al. 2000). The 1996 survey also found a significant increase in forest vegetation density relative to 1982, indicating an improvement in monarch habitat. The U.S. Fish and Wildlife Service proposed delisting the Tinian monarch from the Federal List of Endangered and Threatened Wildlife in February 1999, and the species was federally delisted in 2004 (U.S. Fish and Wildlife Service 2004). The Tinian monarch was also delisted by the CNMI government in 2009 (Commonwealth Register Volume 31, page 29532). As described below, surveys and the associated data analysis conducted in 2008 indicated a significant decrease in the Tinian monarch population compared to the surveys conducted in 1996. Based on these results, the Center for Biological Diversity petitioned the U.S. Fish and Wildlife Service in December 2013 to relist the Tinian monarch as a threatened or endangered species under the Endangered Species Act (Center for Biological Diversity 2013). To date, the species has not been relisted.

The Military Lease Area comprises roughly 66% of the Tinian monarch habitat on the island and supports approximately 52% of the total monarch population (DoN 2014a). After delisting of the Tinian monarch in 2004, the species was monitored for 5 years under the *Post-Delisting Monitoring Plan for the Tinian Monarch* (U.S. Fish and Wildlife Service 2005). In 2008, monitoring resulted in a population estimate of approximately 33,310 Tinian monarchs, a decline of approximately 40% since 1996. In addition, monarch densities in high-quality habitats calculated from the 2008 surveys declined significantly from densities reported by U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2005). It was hypothesized that the overall population decline between 1982 and 2008 was associated with reduced bird density in quality habitats, particularly limestone forest (Camp et al. 2012).

In support of this EIS/OEIS, forest bird surveys, including surveys for the Tinian monarch, were conducted throughout Tinian in 2013. This island-wide survey using the original 10 transects established by the U.S. Fish and Wildlife Service in 1982 resulted in a Tinian monarch population estimate of approximately 90,600 birds. Because analytical methods have changed slightly over time, the 1982, 1996, and 2008 survey data were re-analyzed using the same methods used for the 2013 data. Results of these analyses provided population estimates of approximately 95,900 monarchs in 1982, 105,300 monarchs in 1996, and 56,300 monarchs in 2008 (Figure 3.9-2). Given these results, the overall population trend for Tinian monarchs from 1982 to 2013 was stable (DoN 2014a).



Source: DoN 2014a

Figure 3.9-2 Estimated Tinian Monarch Population (1982 – 2013)

The Tinian Military Retention Land for Wildlife Conservation was established in 1999 in an agreement between the CNMI Commonwealth Ports Authority, Federal Aviation Administration, and DoN. This conservation area was established for the protection of endangered or threatened wildlife, particularly the Tinian monarch, following Endangered Species Act consultation by the Federal Aviation Administration with the U.S. Fish and Wildlife Service on expansion of the Tinian Airport (U.S. Fish and Wildlife Service 1998). The 936-acre (379-hectare) conservation area is located in the Military Lease Area, northwest of the corner of Broadway and Cross Island Road (see Figure 3.9-3 in Section 3.9.4.4, *Special-status Species*).

3.9.4.2.2 Mammals

The only native mammal species on Tinian is the Mariana fruit bat. This bat is listed as threatened under the federal Endangered Species Act and as threatened and endangered by the CNMI government. It is discussed in detail in Section 3.9.4.4, *Special-status Species*.

3.9.4.2.3 Reptiles

There are eight native terrestrial reptile species reported on Tinian. Of these, the Micronesian gecko (*Perochirus ateles*) is a special-status species and is described separately in Section 3.9.4.4, *Special-status Species*. There are two native marine reptile species reported to nest on Tinian: the green turtle (*Chelonia mydas)* and hawksbill turtle (*Eretmochelys imbricata*). Both are protected under the federal the Endangered Species Act and the CNMI Endangered Species Act. These marine reptiles are addressed in Section 3.10, *Marine Biology,* but their beach nesting areas are discussed in Section 3.9.4.4, *Special-status Species*.

Several native terrestrial reptile species were found during the 2008 surveys on Tinian, including the mourning gecko (*Lepidodactylus lugubrus*), Micronesian gecko, Indo-Pacific house gecko (*Hemidactylus garnotii*), oceanic snake-eyed skink (*Cryptoblepharus poecilopleurus*), littoral skink (*Emoia atrocostata*), Pacific blue-tailed skink (*Emoia caeruleocauda*), and Brahminy blindsnake (*Ramphotyphlops braminus*). The mourning gecko was the most abundant lizard species in both mixed and limestone forest habitats, while the Indo-Pacific house gecko was the most abundant and conspicuous gecko in tangantangan forests. The oceanic and littoral skinks were found predominantly within the vicinity of coastal areas. The blue-tailed skink was observed only in native forest at Mount Lasso. The blindsnake was found in both mixed and limestone forest (Rodda et al. 2009).

3.9.4.2.4 Amphibians

There are no native amphibians on Tinian.

3.9.4.2.5 Invertebrates

There are four native invertebrate species reported on Tinian—three crab species and one snail species. The humped tree snail (*Partula gibba*), proposed for listing as endangered under the federal Endangered Species Act, is the only terrestrial invertebrate special-status species known to occur on Tinian. This species is discussed in Section 3.9.4.4, *Special-status Species.*

The coconut crab and two species of land crab (*Discoplax hirtipes* [previously *Cardisoma hirtipes*] and *Cardisoma carnifex*) are regulated as game species by the CNMI Division of Fish and Wildlife. A license is required for harvesting these crabs during regulated hunting seasons. The coconut crab is the largest land invertebrate in the world and can reach over 3 feet (1 meter) in length from leg to leg. In addition to being a highly valued game species in the CNMI, it serves important ecological functions including dispersing seeds and scavenging. Although coconut crabs occur in native forests, females regularly migrate to the ocean to spawn. Coconut crab densities on Tinian have been estimated at 2 crabs/acre (5 crabs/hectare) in native forest and 0.7 crab/acre (1.8 crabs/hectares) in tangantangan (Vogt 2009).

Land crabs are a common terrestrial burrowing crab found throughout the Indo-Pacific and are generally associated with wetland or coastal habitats, although juveniles can be found further inland. Their shells can measure 4-5 inches (10-13 centimeters) across. The two species on Tinian are primarily herbivorous, eating leaves and other vegetation (Carpenter and Niem 1998).

3.9.4.3 Non-native Wildlife

Non-native species are common on Tinian and can negatively impact native wildlife and vegetation. The non-native species on Tinian currently include at least 5 birds, 10 mammals, 6 reptiles, 1 amphibian, and 3 invertebrates (DoN 2010b, 2013a, 2013c).

3.9.4.3.1 Birds

Common non-native bird species include red junglefowl (or feral chicken [*Gallus gallus*]), rock dove (*Columba livia*), island collared-dove (*Streptopelia bitorquata*), Eurasian tree sparrow (*Passer montanus*), and orange-cheeked waxbill (*Estrilda melpoda*) (DoN 2013a, 2013c, 2014c). Red junglefowl are found throughout the island and are no longer exclusively associated with humans. Rock doves can be found in the Military Lease Area and San Jose. The island collared-dove was introduced to the southern Mariana Islands by the Spanish from the Philippines in the 1700s and is considered common to abundant on Tinian. The most abundant non-native bird is the Eurasian tree sparrow, primarily in the vicinity of San Jose. Flocks of 30 or more orange-cheeked waxbills are seen in grasslands and roadsides (Camp et al. 2009; DoN 2013a, 2013c).

3.9.4.3.2 Mammals

Introduced mammals include three rat species, the house mouse (*Mus musculus*), Asian house shrew (*Suncus murinus*), domestic cat (*Felis catus*), dog (*Canis lupus familiaris*), goat (*Capra hircus*), and cattle. High densities of roof rats (*Rattus rattus*) are found in all habitats of the Military Lease Area. Pacific rats (*Rattus exulans*) and brown rats (*Rattus norvegicus*) also occur on Tinian but in lower densities. Rat densities on Tinian are higher than on many other tropical Pacific islands and are likely detrimental to flora and fauna, including Tinian's bird species. Asian house or musk shrew densities are high in native and tangantangan forest. Rodents and shrews are predators of native birds, lizards, insects, and snails. The rat's diet also includes native plants, seeds, and fruit, and high rodent densities are associated with changes in forest composition (Wiewel et al. 2009).

Feral cats are extremely common on Tinian and have been observed hunting in native forest at night (DoN 2013a). Goats have been transported from Aguiguan to Tinian, and a coastal survey in October 2008 confirmed at least 20 goats at Puntan Kastiyu. There is some evidence that feral goats are creating trails, accelerating erosion, and impacting the native vegetation on Tinian (Kessler 2009).

3.9.4.3.3 Reptiles

Introduced reptiles include the oceanic gecko (*Gehyra oceanic*), mutilating gecko (*Gehyra mutilata*), curious skink (*Carlia fusca*), emerald skink (*Lamprolepis smaragdina*), mangrove monitor lizard (*Varanus indicus*), and green anole (*Anolis carolinensis*). Oceanic geckos were reported during the 2008 U.S. Fish and Wildlife surveys and constituted about half of the lizard biomass in limestone forest areas (Rodda et al. 2009). Mangrove monitor lizards were found throughout the island in all habitats (Rodda et al. 2009; DoN 2013a). It should be noted that recent studies indicate that mangrove monitor lizards may be native to some Mariana Islands (Pregill and Steadman 2009).

The brown treesnake (*Boiga irregularis*), while not present on Tinian, has the potential to impact the economy, human health, and island ecology in the CNMI. The brown treesnake's native range is coastal Australia, Papua New Guinea, and a large number of islands in northwestern Melanesia. This species was inadvertently introduced to Guam after World War II (Rodda and Savidge 2007). As a result of this introduction, 17 of 18 native bird species on Guam were severely impacted, and 12 of the 18 species were likely extirpated (i.e., no longer exist on Guam) (Wiles et al. 2003).

Efforts to control the brown treesnake include preventing the snakes from leaving Guam by cargo, ship, or air vessels. The U.S. military has collaborated with other partners and participated in the development of brown treesnake-specific trapping techniques, detection using sniffer dogs, exclusion fence design, development of toxicants, and toxicant delivery methods. While these efforts have had success, individual brown treesnakes originating from Guam have been found in Kwajalein, Pohnpei, Hawaii (Oahu), Diego Garcia, Spain, Alaska, Texas, Oklahoma, California, and neighboring CNMI islands (Rota, Tinian, and Saipan) (Brown Treesnake Technical Working Group 2009; U.S. Department of Agriculture 2014; Kerrigan 2014).

The potential establishment of the brown treesnake on Tinian is of great concern. As of 2008, there have been 76 alleged brown treesnake detections on Saipan considered credible based upon conditions and the observers' familiarity with snakes (N. Hawley, CNMI Division of Fish and Wildlife, unpublished data). Nine unconfirmed brown treesnake sightings have been reported on Tinian (Brown Treesnake Technical Working Group 2009).

3.9.4.3.4 Amphibians

The marine toad (*Bufo marinus*) is the only known amphibian on Tinian and was likely introduced in 1944, when approximately 4,000 individuals were observed in lily ponds and cisterns. By 1974, the toad was common throughout the island in mixed and limestone forest habitats (DoN 2013a). Marine toads currently occur in high densities at Lake Hagoi. The species possesses large parotid glands that excrete poison and kill potential predators. Marine toads are prolific breeders and can lay up to 70,000 eggs per year, and are possibly a threat to native reptiles on Tinian (DoN 2013a).

3.9.4.3.5 Invertebrates

The mangrove crab (*Scylla serrata*), introduced as a potential food source, is the only introduced terrestrial crustacean on Tinian (Commander, U.S. Naval Forces Marianas 2004; DoN 2010b). The predatory manokar flatworm (*Platydemus manokwari*) was introduced to Tinian to help control the introduced giant African snail (*Achatina fulica*). The flatworm poses a serious threat to native tree snails, including the humped tree snail that is proposed for listing under the federal Endangered Species Act (discussed below) (Hopper and Smith 1992; DoN 2014a).

3.9.4.4 Special-status Species

3.9.4.4.1 Federal Endangered Species Act-listed and Proposed Species

The status and occurrence of federal Endangered Species Act-listed and proposed species and CNMI-listed species on Tinian are presented below (Table 3.9-3). The observed locations of these special-status species within the Military Lease Area are presented in Figure 3.9-3. Further descriptions of these species are presented in the following subsections.

Table 3.9-3. Occurrence of Federally Endangered Species Act-Listed and Proposed Species and CNMI-Listed Species on Tinian

English Name	Status* ESA	Status* CNMI	Habitat	Occurrence
Birds				
Mariana common moorhen	E	E/T	Freshwater wetlands.	Population up to 75 birds at Lake Hagoi, the Mahalang ephemeral ponds, and Bateha sites.
Micronesian megapode	E	E/T	Limestone forest and coconut forest.	Eight reports of individual birds seen within last 28 years, but none were detected during taped-playback surveys in 2008, 2013, and 2014.
Mammals				
Mariana fruit bat	T	E/T	Limestone forest, coastal forest, and coconut forest.	Occasional sightings by residents. During three surveys conducted between 2000 and 2008, five fruit bats were observed in 2005.
Pacific sheath-tailed bat	PE	-	Roosts in caves during the day and forages for insects over forests at night.	The subspecies is currently known only from Aguiguan and does not occur on Tinian.
Reptiles				
Green sea turtle	T	E/T	Suitable beaches for basking and nesting.†	Regular nesting documented.
Hawksbill sea turtle	E	E/T	Suitable beaches for basking or nesting.†	One hawksbill nest observed during monthly surveys from 1999-2012.
Slevin's skink	PE	-	Leaf litter of native forest floors.	Not known to currently occur on Tinian.
Micronesian gecko	-	E/T	Forested areas.	Reported at Mount Lasso and Carolinas Plateau in 2008.
Invertebrates				
Humped tree snail	PE	-	Intact limestone forest.	Observed during 2013 surveys along Lamanibot Bay (Dump Coke) escarpment.
Plants				
*Cycas micronesica***	PT	-	Forest and savanna ecosystems.	*Cycas micronesica* is not known historically from Tinian. In 2008, the DoN cycad conservation project planted 1,000 cycad seedlings in native limestone forest on Tinian.
Heritiera longipetiolata	PE	-	Moist forest on limestone cliffs and in coastal sites with windy conditions.	Within the Military Lease Area at Unai Masalok on the east coast and along the Lamanibot Bay (Dump Coke) escarpment.
Dendrobium guamense	PE	-	Grows on tree trunks and branches in forest habitats.	Within the Military Lease Area near Unai Dankulo on the east coast.
Solanum guamense	PE	-	Native forest.	Not known to currently occur on Tinian; known from just a single individual on Guam.
Tuberolabium guamense	PE	-	Native forest.	Not known to currently occur on Tinian; known only from a single individual on Guam and two occurrences on Rota.

Legend: *ESA = Federal Endangered Species Act; E = endangered; E/T = the CNMI Administrative Code does not specify whether a species is threatened or endangered: all species are considered threatened and endangered; PE = proposed endangered; PT = proposed threatened; T = threatened; - = not listed.

†Occurrence of sea turtles in the marine environment is addressed in Section 3.10, *Marine Biology*.

**Population established by DoN on Tinian via translocations is not included in the species' range in U.S. Fish and Wildlife Service (2014).

Sources: Berger et al. 2005; Vogt 2008a, 2008b; Brooke 2009; Kessler and Amidon 2009; Marshall et al. 2009; DoN 2010a, 2010b, 2011, 2012, 2013a; U.S. Fish and Wildlife Service 2012a, 2014; Holland and Sischo 2013.

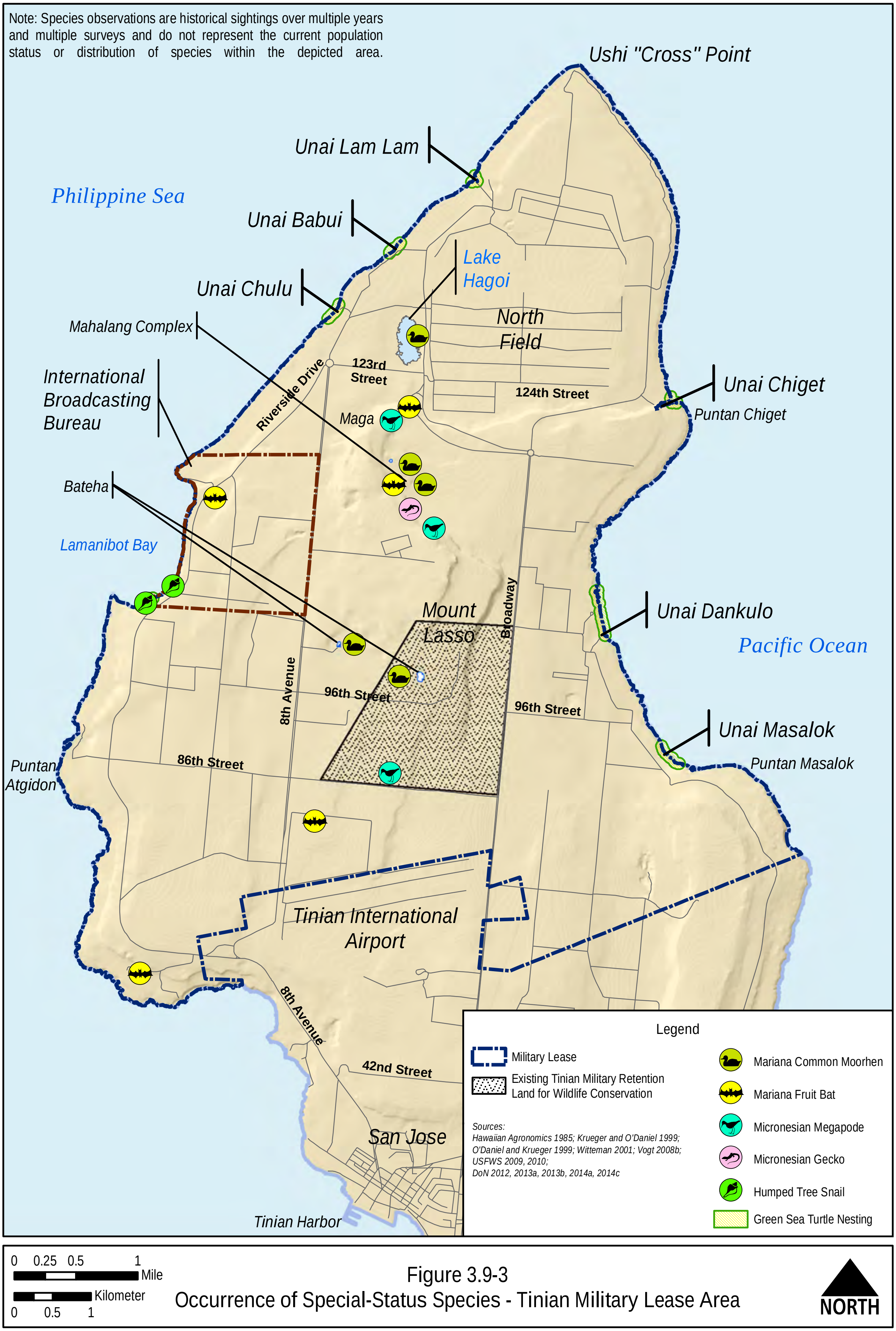


Figure 3.9-3
Occurrence of Special-Status Species - Tinian Military Lease Area

3.9.4.4.1.1 Mariana Common Moorhen

Photo 3.9-2. Mariana Common Moorhen
(Source: S. Vogt)

The Mariana common moorhen (Photo 3.9-2) is a bird species that relies on emergent vegetation of freshwater marshes, ponds, and placid rivers for breeding, foraging, and shelter (U.S. Fish and Wildlife Service 1991; DoN 2010b). In the Mariana Islands, its preferred habitat includes freshwater lakes, marshes, and swamps. The U.S. Fish and Wildlife Service recovery plan for the Mariana common moorhen identifies Lake Hagoi (estimated at that time at 44 acres [18 hectares] with 2.5 acres [1 hectare] of open water) within the northern portion of the Military Lease Area as primary habitat for the moorhen (U.S. Fish and Wildlife Service 1991) (see Figure 3.9-3).

The 1991 recovery plan estimated the moorhen population on Tinian to be between 20 and 125 birds (U.S. Fish and Wildlife Service 1991). Based on previous reports and surveys from 1989, 1994-1995, and 2001, the moorhen population was estimated to be between 41 and 75 birds (Takano and Haig 2004).

The DoN has conducted monthly or quarterly monitoring of moorhens at Lake Hagoi since 1998. Surveys conducted between November 1998 and September 2013 indicate that total moorhen detections have ranged from 0 to 46 birds per survey, with a mean of 15 individuals detected per survey (DoN 2014d). Yearly averages show that 2003 and 2007 were peak years for adult moorhen numbers at Lake Hagoi (16.9 and 17.1 detections, respectively), and that 2010 was an extremely low year (6.8 detections). These numbers are the means for the year and are index surveys, not absolute population estimates. The number of birds observed is negatively correlated with periodic dry conditions at Lake Hagoi, and the lake was completely dry for much of 2010. Survey results for fiscal years 2011, 2012, and 2013 show a rebound from the low of 2010, with an average of 16, 16, and 16.5, respectively, adult moorhens detected per monthly survey (DoN 2011, 2012, 2013a). The 2013 taped-playback surveys resulted in the detection of 20-23 individual moorhens at 3 survey points on Lake Hagoi (DoN 2014a). This is within U.S. Fish and Wildlife Service's range of 21-29 moorhens detected per survey during wet season surveys between July 1994 and August 1995 (DoN 2013b). Depredation by rats and mangrove monitor lizards may impact the moorhen population at Lake Hagoi, especially during peak nesting periods (U.S. Fish and Wildlife Service 1996; Vogt 2008a; DoN 2010b).

Prior to 2013, moorhen use of the Mahalang complex of ephemeral ponds and Bateha wetlands had not been regularly monitored. Based upon surveys at the Mahalang complex and Bateha sites in 1994 and 1995, the U.S. Fish and Wildlife Service estimated that Mahalang and Bateha may have supported a total of approximately 10 moorhens (U.S. Fish and Wildlife Service 1996) (Figure 3.9-4).

To obtain a more recent inventory of sites used or potentially used by moorhens, surveys were conducted at the Mahalang ephemeral ponds and the Bateha wetlands during the wet seasons of 2012-2014. As of January 2014, surveys conducted within the Mahalang ephemeral ponds resulted in the following individual moorhen detections: one in MC1 in November and December of 2012, one in M10 in November 2013, one in M07 from May through October 2013, and one in M11 from May through October 2013 (see Figure 3.9-3).

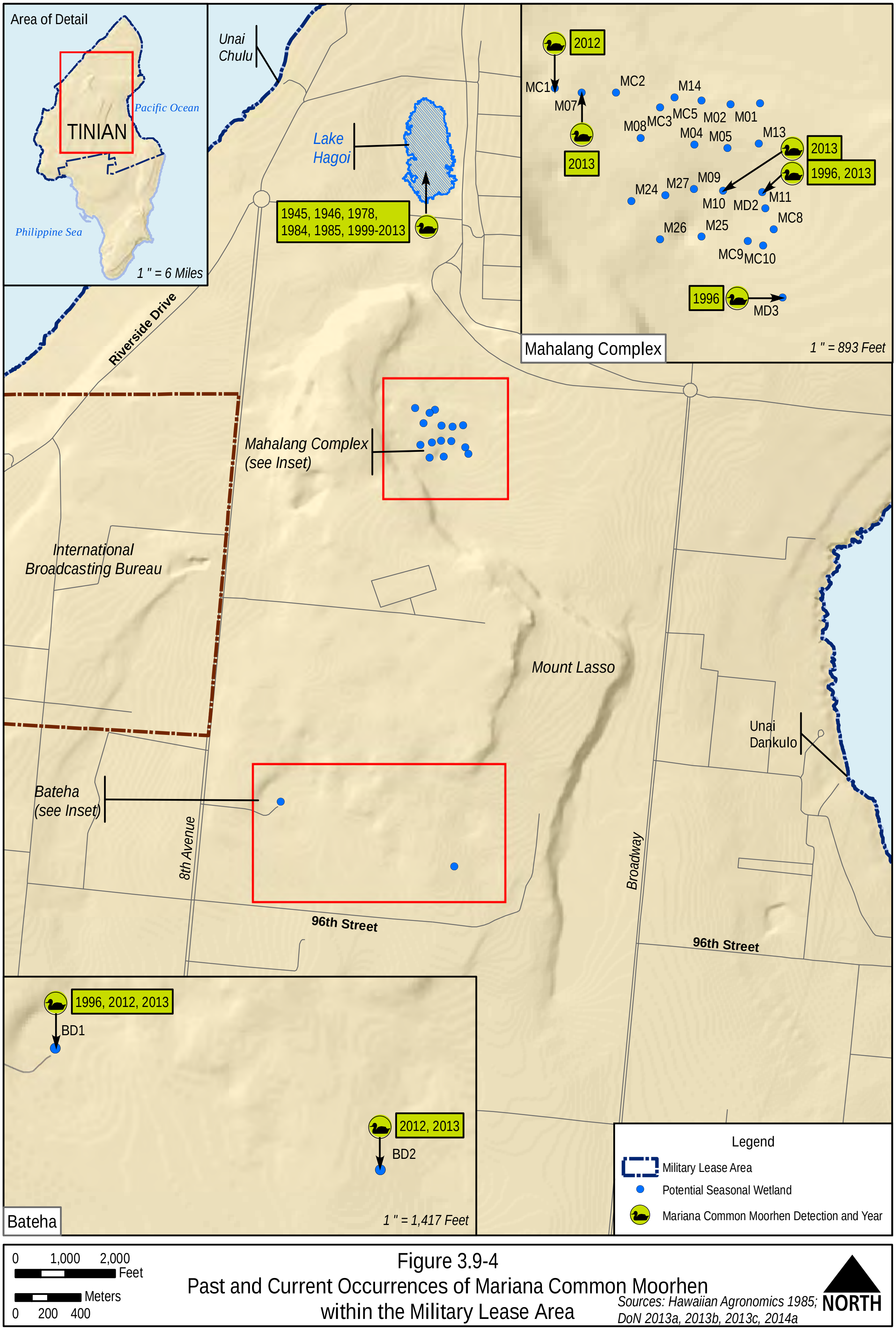


Figure 3.9-4
Past and Current Occurrences of Mariana Common Moorhen
within the Military Lease Area

Sources: Hawaiian Agronomics 1985; DoN 2013a, 2013b, 2013c, 2014a

Surveys have also detected moorhens within both Bateha sites BD1 and BD2. Seven surveys between October 2012 and January 2013 resulted in a total of 20 moorhen detections at BD1 (see Figure 3.9-4). This includes a maximum of three visual observations of adults and four visual observations of juveniles on both October 22 and November 25, 2012. An additional 4 detections, of 2 adult and 2 juvenile moorhens, were made in November 2013 (DoN 2014a). Eight surveys conducted between October 2012 and January 2013 at BD2 resulted in 50 moorhen detections, including 4 visual detections of adults and 3 visual detections of juveniles in November 2012 (DoN 2013b).

Overall, the 2012-2014 surveys indicated that approximately four moorhens used the Mahalang ephemeral ponds and approximately four adult and four juvenile moorhens used each of the Bateha wetlands each year during this period (DoN 2014b).

3.9.4.4.1.2 Micronesian Megapode

The Micronesian megapode (Photo 3.9-3) is a medium-sized, stocky, brownish-black, ground-dwelling bird. In 1902, the Micronesian megapode was noted as common on Tinian. However, by 1949 these birds were difficult to locate (DoN 1997). Surveys conducted prior to 1999, and monthly surveys since 1999, have confirmed that the megapode occurs within the Military Lease Area on Tinian at very low numbers: one to three megapodes were detected, always individually, in 1985, 1995, 2000, 2001, 2004, 2005, 2009, and 2013. No megapodes were detected during surveys in 1999, 2002, 2003, 2006-2008, and 2014 (Krueger and O'Daniel 1999; Witteman 2001; Vogt 2006; DoN 2010b, 2012, 2014b). All megapode detections have been from the Mount Lasso area, the Maga area (south of Lake Hagoi), and a small area of native forest adjacent to Cross Island Road in the southern portion of the Tinian Military Retention Land for Wildlife Conservation (see Figure 3.9-3). Occasional sightings of megapodes on Tinian may be a result of the movement of transient birds from Aguiguan or Saipan, as there is not a resident breeding population on Tinian at this time (DoN 2013c).

Photo 3.9-3. Micronesian Megapode
(Source: S. Vogt)

3.9.4.4.1.3 Mariana Fruit Bat

Tinian once supported a large number of Mariana fruit bats (Photo 3.9-4). After World War II, however, it was estimated that only 5% of the native forest cover remained on Tinian. Habitat loss and poaching are thought to be the primary reasons for the current near-absence of Mariana fruit bats on the island. No permanent fruit bat colony exists on Tinian. However, bats may fly between islands in the southern Marianas, including Aguiguan (DoN 2013c;

Photo 3.9-4. Mariana Fruit Bat
(*Source*: U.S. Fish and Wildlife Service)

Mildenstein and Mills 2013). Within the Military Lease Area, fruit bats have been observed associated with the native limestone forest in the cliff-line forest in the Maga region north of Mount Lasso, and at other locations in western Tinian (see Figure 3.9-3). There have been sightings of two (in 1979), and as many as four fruit bats (in 1983-1984) in the Kastiyu forest, south of the Military Lease Area. No fruit bats were observed during 1994 and 1995 surveys at five observation stations. However, there were two incidental observations during the 1994-1995 study period, one near San Jose village and one near the south end of the island. No fruit bats were observed during surveys in 2000, 2001, or 2008. The highest number of recent sightings from Tinian occurred in 2005 when approximately five individuals were sighted in cliff-line forest in the Maga region. In 2008, fruit bat surveys were conducted at eight separate count stations at seven locations on Tinian but no bats were observed (Brooke 2009; DoN 2010b, 2013c).

3.9.4.4.1.4 Pacific Sheath-tailed Bat

The Pacific sheath-tailed bat (*Emballonura semicaudata rotensis*) is endemic to the Mariana Islands, with populations historically occurring on Guam, Rota, Saipan, Tinian, Aguiguan, and possibly Anatahan and Maug. The subspecies is currently known only from Aguiguan and is proposed for listing as endangered under the Endangered Species Act (U.S. Fish and Wildlife Service 2014). Surveys conducted in 2008 by U.S. Geological Survey biologists, using echolocation stations in native limestone forest, resulted in no detections of sheath-tailed bats on Tinian (U.S. Fish and Wildlife Service 2009). The Pacific sheath-tailed bat is presumed to no longer exist on Tinian and is not discussed further in this EIS/OEIS. This species is being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.1.5 Sea Turtles

Both the green and the hawksbill sea turtles are known to nest on Tinian (DoN 2010a, 2011, 2012, 2013c). Beaches within the Military Lease Area are surveyed monthly for sea turtle activity (i.e., crawls, nests, potential nests, and body pits). The occurrence of sea turtle nesting activities on land is covered in this section, and occurrence in the nearshore waters is discussed in Section 3.10, *Marine Biology*.

Green sea turtle abundance and density is highest along the island's relatively uninhabited east coast (Kolinski 2001). For successful nesting, green sea turtles require deep sand beaches with open ocean exposure and minimal disturbance (DoN 2010b, 2012). Of the 13 distinct beaches or beach complexes on Tinian that could support nesting, 10 are within the Military Lease Area, and 6 of these have been surveyed monthly since 1998: Unai Chulu, Unai Lam Lam, Unai Chiget, Unai Dankulo, Unai Masalok, and Unai Babui (see Figure 3.9-3). Unai Dankulo consists of 13 pocket beaches, separated by rocky outcrops and fronted by a coral reef system (DoN 2014c).

Over 10 years (1998-2007) of monthly nesting beach surveys, data indicate that Unai Dankulo is the beach most used by sea turtles (DoN 2014c). Nearly 50% of all sea turtle activity on the 6 regularly surveyed Military Lease Area beaches was observed on 2 of the 13 pocket beaches at Unai Dankulo. These surveys also indicated that nesting activity is variable, with relatively high levels of activity in 1999 and 2005, and little to no activity in 1998, 2000-2004, 2006, and 2007 (DoN 2014c).

Based on the 1998-2007 surveys, it was believed that green sea turtle nesting activity would occur as early as late January and end in mid-July on most of Tinian's sandy beaches (DoN 1997). Surveys since October 2008, however, have indicated that nesting activity occurs during all months of the year. These more recent surveys also indicated a substantial increase in overall sea turtle nesting activity (DoN 2014c), with 2010 and 2012 having the greatest nesting activity. In addition, 2012 was the first year in which Unai Dankulo was not an active nesting beach. Conversely, in 2012, Unai Babui was among the most active beaches despite its complete lack of nesting activity during the previous 10 years of surveys (DoN 2014c). On Tinian, the green sea turtle is threatened by increased human presence, coastal construction, algae/seagrass/reef degradation, and illegal harvesting (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998).

Hawksbill sea turtles use both low- and high-wave energy nesting beaches on insular and mainland sites in tropical oceans of the world. Hawksbills will nest on small pocket beaches and, because of their small body size and great agility, can traverse fringing reefs that limit access to other sea turtle species (National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998b). Hawksbill sea turtles are rare on Tinian beaches, and no hawksbill sea turtles were recorded during a 13-month survey in 1994-95 (DoN 2010b). Only one hawksbill nest, found in 2010 at Unai Dankulo, has been observed during monthly surveys from 1999 through 2012 (DoN 2013c). On Tinian, the hawksbill sea turtle is primarily threatened by direct takes from humans. Historically, hawksbill sea turtles have been taken for trade (e.g., tortoiseshell crafts) and, to a lesser extent, for food. Although hawksbill sea turtle eggs are readily consumed, adults are not valued as highly as green sea turtles for food. This may be due to their poor taste and sporadic fatal poisonings from their occasional toxicity (National Oceanic and Atmospheric Administration 1998).

3.9.4.4.1.6 Slevin's Skink

Slevin's skink (*Emoia slevini*), a lizard species, is endemic to the Mariana Islands and is proposed for listing as endangered under the Endangered Species Act (U.S. Fish and Wildlife Service 2014). The species historically occurred on Guam, Rota, Tinian, and Aguiguan. Surveys over the past three decades have indicated Slevin's skink populations on Guam (Cocos Island), Sarigan, Guguan, Alamagan, Pagan, Asuncion, and Maug (U.S. Fish and Wildlife Service 2014). The species was last observed on Tinian in the 1940s (U.S. Fish and Wildlife Service 2009). Slevin's skink is presumed to no longer exist on Tinian and is not discussed further in this EIS/OEIS. This species is being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.1.7 Humped Tree Snail

The humped tree snail is a species proposed for listing as endangered under the federal Endangered Species Act (U.S. Fish and Wildlife Service 2014). It was historically present on Tinian but was thought to no longer occur on the island because of the presence of the predatory manokar flatworm and rosy wolf snail (*Euglandina rosea*), the severe loss of native limestone forest habitat, and because it had not been observed on Tinian since 1970 (Berger et al. 2005; DoN 2010b; U.S. Fish and Wildlife Service 2012b; Holland and Sischo 2013). However, surveys from June 22-27, 2013, performed in support of this EIS/OEIS, documented two discrete populations of the humped tree snail within native limestone forest along Lamanibot Bay, which is known locally as Dump Coke (see Figure 3.9-3). A total of 92 individuals were counted between the two sites, including adults, subadults, and juveniles (DoN 2014a). Aged humped tree snail shells were also observed on the ground in native limestone forests in the vicinity of Unai Chiget, south of Lake Hagoi in the Maga area, the Mount Lasso area, and Unai Masalok (DoN

2010b; Holland and Sischo 2013). For more detailed information on the 2013 tree snail surveys, refer to Appendix L, *Biological Resources Supporting Documentation*.

3.9.4.4.1.8 Cycas micronesica

Cycas micronesica is a tree currently known to occur in the forest and savanna ecosystems of Guam, Rota, Palau, and Yap (Raulerson 2006; U.S. Fish and Wildlife Service 2014), and was recently reported on Pagan (Pratt 2010). *C. micronesica* is not known historically from Tinian. On Guam *C. micronesica* is severely impacted by Asian cycad scale (*Aulacaspis yasumatsui*), the non-native cycad blue butterfly (*Chilades pandava*), and non-native ungulates (e.g., Philippine deer [*Rusa marianna*], water buffalo [*Bubalus bubalis*], and feral pigs [*Sus scrofa*]) (Marler and Lawrence 2012). As a result, DoN has been collaborating with others on a conservation project for *C. micronesica* on Tinian. Following the cycad scale outbreak on Guam in the mid-2000s, in 2005 Joint Region Marianas collected 3,000 cycad seeds from Guam, cleaned the seeds of scale insects, and germinated and raised seedlings in a nursery on Tinian. In 2008, 1,000 of the cycad seedlings were planted in native limestone forest on Tinian. The outplanted cycads on Tinian have since been monitored monthly. As of April 2012, there has been an 81% survivorship of these seedlings (Brooke 2012). Although a *C. micronesica* population thus now occurs on Tinian, it is considered to be an experimental population and was not included within the species' range in the proposed rule to list *C. micronesica* as a threatened species under the Endangered Species Act (U.S. Fish and Wildlife Service 2014).

3.9.4.4.1.9 Heritiera longipetiolata

Heritiera longipetiolata is a tree species reported from Guam, Saipan, and Tinian (Raulerson 2006) and is known outside the Marianas only from Pohnpei (Costion and Lorence 2012). The species has been proposed for listing as endangered under the federal Endangered Species Act (U.S. Fish and Wildlife Service 2014). Within the Military Lease Area it has been found in coastal forests near Unai Masalok on the east coast and along the Lamanibot Bay (Dump Coke) escarpment (Hawaiian Agronomics International, Inc. 1985). It has also been observed south of the Military Lease Area in native limestone forest along Tinian's southeastern coast, between Puntan Barangka and Puntan Kastiyu (DoN 2014a; U.S. Fish and Wildlife Service 2014).

3.9.4.4.1.10 Dendrobium guamense

Dendrobium guamense is an orchid species that grows on tree trunks and branches in forest habitats and has been proposed as endangered under the Endangered Species Act. *D*. *guamense* is known historically from Guam, Rota, Saipan, and Tinian. Currently, a single population of *D*. *guamense* is known within the Military Lease Area on Tinian, near Unai Dankulo on the east coast (U.S. Fish and Wildlife Service 2014; U.S. Fish and Wildlife Service, R. Rounds, personal communication, 2014).

3.9.4.4.1.11 Solanum guamense and Tuberolabium guamense

Solanum guamense, a shrub in the nightshade family, and *Tuberolabium guamense*, an orchid species, are proposed for listing as endangered under the Endangered Species Act. Although *Solanum guamense* is known historically from Guam, Rota, Saipan, Tinian, Asuncion, Guguan, and Maug, the species is currently known from just a single individual on Guam. *Tuberolabium guamense* is known historically from Guam, Rota, Tinian, and Aguiguan, but it is now known only from a single individual on Guam and two occurrences on Rota (U.S. Fish and Wildlife Service 2014). Both plant species are presumed to no longer exist on Tinian and are not discussed further in this EIS/OEIS. These species are being addressed in the Biological Assessment in support of Endangered Species Action section 7 conferencing with the U.S. Fish and Wildlife Service.

3.9.4.4.2 Species Protected under the Migratory Bird Treaty Act

A total of 39 bird species observed on Tinian, including the Mariana common moorhen discussed above, are protected under the Migratory Bird Treaty Act (Table 3.9-4).

Table 3.9-4. Bird Species Observed on Tinian and Protected under the Migratory Bird Treaty Act

Barn swallow (*Hirundo rustica*)	Mariana fruit dove (*Ptilinopus roseicapilla*)
Black kite (*Milvus migrans*)	Marsh sandpiper (*Tringa stagnatilis*)
Black noddy (*Anous minutus*)	Northern pintail (*Anas acuta*)
Black-crowned night heron (*Nycticorax nycticorax*)	Northern shoveler (*Anas clypeata*)
Black-winged stilt (*Himantopus himantopus*)	Pacific golden plover (*Pluvialis fulva*)
Brown booby (*Sula leucogaster*)	Pacific reef heron (*Egretta sacra*)
Brown noddy (*Anous stolidus*)	Ruddy turnstone (*Arenaria interpres*)
Collared kingfisher (*Todiramphus chloris*)	Sooty tern (*Onychoprion fuscatus*)
Common sandpiper (*Actitis hypoleucos*)	Spectacled tern (*Onychoprion lunatus*)
Common tern (*Sterna hirundo*)	Swinhoe's snipe (*Gallinago megala*)
Eastern cattle egret (*Bubulcus coromandus*)	Tufted duck (*Aythya fuligula*)
Eurasian coot (*Fulica atra*)	Wandering tattler (*Tringa incana*)
Eurasian wigeon (*Anas penelope*)	Whimbrel (*Numenius phaeopus*)
Gadwall (*Anas strepera*)	White-tailed tropicbird (*Phaethon lepturus*)
Garganey (*Anas querquedula*)	White tern (*Gygis alba*)
Grey-tailed tattler (*Tringa brevipes*)	White-throated ground-dove (*Gallicolumba xanthonura*)
Green-winged teal (*Anas carolinensis*)	White-winged tern (*Chlidonias leucopterus*)
Intermediate egret (*Egretta intermedia*)	Wood sandpiper (*Tringa glareola*)
Lesser sand plover (*Charadrius mongolus*)	Yellow bittern (*Ixobrychus sinensis*)
Mariana common moorhen (*Gallinula chloropus guami*)	

Sources: Reichel and Glass 1991; Vogt and Williams 2004; Camp et al. 2009, 2012; Kessler 2009; DoN 2013a; U.S. Fish and Wildlife Service 2013; Gill and Donsker 2014.

Numerous grey-tailed tattlers and wandering tattlers, Pacific reef herons, black noddies, and white terns (including one large colony of more than 30 birds), all protected under the Migratory Bird Treaty Act, were recorded during 2008 shoreline surveys of the Military Lease Area. More shorebirds and seabirds were observed along the western coastline that consists of flat coralline shelves along the water with large boulders in the bays and protection from the prevailing winds (Kessler 2009).

In support of this EIS/OEIS, forest bird surveys were conducted in June 2013 along transects previously surveyed by the U.S. Fish and Wildlife Service in 1982, 1996, and 2008 (Camp et al. 2012; DoN 2014a). Three species protected under the Migratory Bird Treaty Act were detected, including collared kingfisher, Mariana fruit dove, and white-throated ground-dove. Based on these surveys, estimates of species abundance and density on Tinian are available, and detailed discussion is provided below.

3.9.4.4.2.1 Collared Kingfisher

Abundance estimates for collared kingfishers across the four survey efforts (1982, 1996, 2008, and 2013) varied greatly, with a high of approximately 7,300 birds in 2008, and a low of 842 birds in 1982. While the 2013 estimates showed a decrease in kingfisher abundance and density compared to 2008, the 2013 estimates were similar to the 1996 estimates. In terms of abundance and density by habitat type, there were significant decreases in density from 2008 to 2013 in limestone forest, secondary forest, and tangantangan habitats. Although there was a decrease in abundance and density from 2008 to 2013, the overall trend for collared kingfisher abundance and density since 1982 is increasing (DoN 2014a).

3.9.4.4.2.2 Mariana Fruit Dove

Abundance estimates for Mariana fruit doves across the four survey efforts varied from a high of approximately 6,600 birds in 1982, to a low of 2,445 birds in 1996. In terms of abundance and density by habitat type, there were decreases in density from 2008 to 2013 in herbaceous-scrub and tangantangan habitats. The overall trend for Mariana fruit dove abundance and density since 1982, however, is increasing (DoN 2014a).

3.9.4.4.2.3 White-throated Ground-Dove

Abundance estimates for white-throated ground-doves across the four survey efforts varied greatly and showed an increase across all years, with a high of approximately 4,500 birds in 2013, and a low of 535 birds in 1982. In terms of abundance and density by habitat type, there were no significant changes in density from 2008 to 2013. Overall, the trend for white-throated ground-dove abundance and density since 1982 is increasing (DoN 2014a).

3.9.4.4.3 CNMI-Listed Species

The Mariana common moorhen, Micronesian megapode, Mariana fruit bat, and green and hawksbill sea turtles are all CNMI-listed threatened/endangered species. These species are discussed above within the *Federal Endangered Species Act-listed and Proposed Species* section. One other species, the Micronesian gecko, is a CNMI-listed species.

3.9.4.4.3.1 Micronesian Gecko

The Micronesian gecko is native to Micronesia and is the only CNMI-listed threatened/endangered terrestrial reptile in the CNMI. This gecko has never been abundant on Tinian. It was believed to no longer exist on the island after 1946 but was collected in southern Tinian in August 2003, was sighted in 2007 near Mount Lasso, and was collected in limestone forest on Mount Lasso in 2008 (see Figure 3.9-3) (Rodda et al. 2009; DoN 2010b).

3.9.5 Pagan

3.9.5.1 Vegetation Communities

Pagan consists of two high volcanic cones connected by a wide, low isthmus. A 2010 vegetation survey found that the vegetation communities have been shaped by three primary forces: (1) cultivation and alteration of land cover by humans; (2) grazing and browsing actions of feral domestic animals; and (3) volcanic eruptions that have produced vast quantities of lava and fragmented material (Pratt 2010).

A total of 215 vascular plant species were observed in the 2010 survey. An additional 84 vascular plant species not observed in the 2010 survey were observed in previous vegetation surveys for a total of 299 plant species recorded on Pagan (Pratt 2010).

Non-native plants make up a significant component of the flora of Pagan, with the number of non-native species increasing over the last 50 years. Fosberg (1958, 1960) compiled a list of plant species reported from Pagan based on collections from 1930-1950 and listed 59 non-native plant species and 8 intentional Chamorro introductions. The 2010 vegetation survey documented 102 non-native plant species, an increase of 35 species or 52% since 1950. New non-native plant species recorded in 2010 included ivy gourd (*Coccinia grandis*), which is a serious, rapidly growing pest. Because non-native plant introductions are occurring at a rapid pace and occur over large areas of the island, they are considered a substantial threat to ecosystem health on Pagan (Pratt 2010).

Surveys in 2000 and 2010 found the island's forests and grasslands "severely overgrazed" due to the abundance of feral cattle, goats, and pigs that have done considerable damage to island vegetation. Overgrazing has resulted in large open areas susceptible to soil erosion. There is a significant lack of native ground cover, deterioration of the forest cover, and a distinct browse line within the vegetation communities where grazing by non-native ungulates (e.g., cattle, goats, pigs) is seen (Cruz et al. 2000; Kessler 2011a).

Supplementing the vegetation survey by Pratt (2010), vegetation communities on Pagan were mapped by Rogers (2010) and are shown in Figure 3.9-5 with the acreages listed in Table 3.9-5.

Table 3.9-5. Vegetation Communities – Pagan

Vegetation Community	*Acres*	*Percent*
Casuarina Forest	3,197	27.8
Barren (lava or cinder)	2,531	22.0
Grassland	1,706	14.8
Herbaceous-Scrub	1,362	11.8
Barren (bare ground)	937	8.1
Coconut Forest	858	7.5
Native Forest	418	3.6
Mixed Native-Introduced Forest	398	3.5
Water (Lake)	67	<1
Sand	28	<1
Total	**11,502**	**100**

Source: Rogers 2010.

Current Pagan vegetation communities described below are based on Rogers (2010) and Pratt (2010).

3.9.5.1.1 Casuarina Forest

This vegetation community consists of forests of pure ironwood or dominated by ironwood. This species is generally accepted as native to the Mariana Islands and seems to be an early successional species that then deters the growth of other species due to a dense layer of fallen needle-like branches that have compounds inhibiting the growth, survival, and reproduction of other plant species within the immediate vicinity (Pratt 2010).

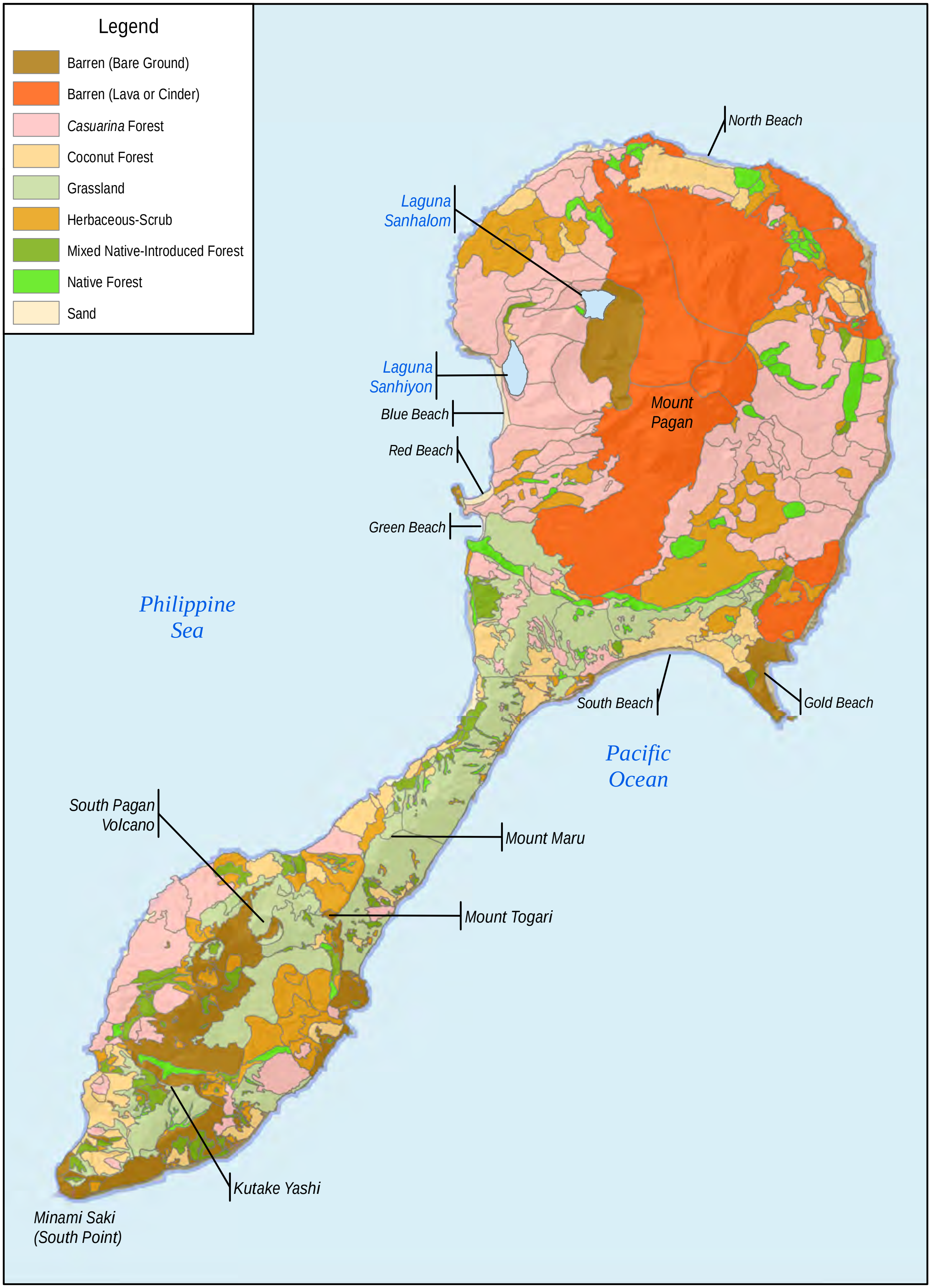


Figure 3.9-5
Vegetation Communities - Pagan

Source: Rogers 2010

3.9.5.1.2 Barren (Lava, Cinder, or Ground)

Barren areas of lava or cinder are found on the northern half of Pagan and consist of land completely covered by volcanic material. Areas of barren ground not covered by lava do not support any vegetation and are found island-wide.

3.9.5.1.3 Grassland

This vegetation community consists of either swordgrass (*Miscanthus floridulus*) or golden false beardgrass (*Chrysopogon aciculatus*), sometimes mixed with Siam weed (*Chromolaena odorata*) (Rogers 2010). Pratt (2010) noted that swordgrass appears to be the dominant grass in the isthmus connecting the northern and southern parts of the island, but other grass species are dominant in northern Pagan.

3.9.5.1.4 Herbaceous-scrub

This vegetation community is open or lava-covered land with a discontinuous canopy cover of grass, shrubs, and/or trees. Rogers (2010) mapped this community in northern Pagan as “lava scrub” or “scrub.” Scrublands on northern Pagan occur on relatively young substrates and primarily are composed of native species such as hopseed bush (*Dodonaea viscosa*).

3.9.5.1.5 Coconut Forest

Coconut forest vegetation communities are prominent on both northern and southern Pagan. Groves of coconut palm are generally in areas formerly used as coconut plantations, and some areas may have been developed during initial habitation by Chamorro people (Pratt 2010). Coconut forests, typically composed of three to eight native tree species in the canopy (Pratt 2010), were estimated to cover 19% of the island in 2000 (Cruz et al. 2000). Rogers (2010) identified a reduced cover of only 7.5%.

3.9.5.1.6 Native Forest

Native forest has been significantly reduced on Pagan by World War II, widespread planting of non-native species, non-native ungulate grazing, periodic development, deforestation, and volcanic eruptions. Native forests on Pagan are important as this habitat provides for the majority of Pagan’s native species, including special-status species, as well as maintaining water quality and reducing fire risk (Morton et al. 2000; Tang et al. 2011; DoN 2014a).

Native forests on northern Pagan, other than those dominated by ironwood, are observed at the base of the old caldera wall north of the isthmus, and growing on rocky substrates of the northeastern slopes. Species include *Aglaia mariannensis*, *Psychotria mariana*, *Neisosperma oppositifolia*, and *Ochrosia mariannensis* (Pratt 2010).

Prior to the 1981 eruption of Mount Pagan and the release and increase in feral animals, native broad-leaf forests were more widespread. Fosberg (1960) reported these forests in the vicinity of Sanhalom Lake (i.e., Upper Lake), and from the north and south slopes of Mount Pagan. In 2010, Sanhalom Lake was surrounded by ironwood forest, with only scattered individuals of other plant species. The release and increase in feral animals also impacted native forests in other areas on Pagan (Pratt 2010).

Common tree species of native forests on southern Pagan include ironwood and the small trees *Aglaia mariannensis* and *Psychotria mariana*. Several uncommon or rare species, some of which were new records for Pagan during the 2010 surveys, were noted in an area referred to as “cycad ravine” in southern Pagan. This includes *Cycas micronesica*, *Chamesyce serrulata*, *Cordia subcordata*, *Cynometra ramiflora*, *Pisonia grandis*, and *Melochia villosissima*. The rugged nature of the southern forests, the lack of grazing cattle, and the lack of recent cultivation of land have likely been the reason for the presence of a greater native woody plant diversity and abundance in the south versus the north (Pratt 2010).

3.9.5.1.7 Mixed Native-introduced Forest

The mixed native-introduced forest vegetation community is a general category for forests that do not fall within another category (Rogers 2010). These forests are often dominated by one or more of the native trees *Aglaia mariannensis*, *Psychotria mariana*, ironwood*, Neisosperma oppositifolia*, or *Ochrosia mariannensis,* and the introduced tangantangan or physic nut (*Jatropha curcas*).

3.9.5.1.8 Water (Lake)

This community consists of two lakes: Lagunas Sanhalom and Sanhiyon (Upper Lake and Lower Lake, respectively).

3.9.5.1.9 Sand

Sand occurs on the beach areas.

3.9.5.1.10 Rare Plants

Several species were noted as rare in the 2010 survey.

Chamaesyce serrulata, a small shrub, was present in southern Pagan. The description in Pratt (2010) noted that this species was previously known only from the southern Marianas (Fosberg et al. 1979). Synonym names for the species were listed as present on Pagan in Raulerson's (2006) checklist of the Mariana Islands. Based on this information, the taxonomy of this species is unclear. *Chamaesyce serrulata* is not on the Costion and Lorence (2012) Micronesia endemics list. No other definitive information about the species, including its current status on other Mariana Islands, is known.

Hedyotis scabridifolia, a shrub, was listed in Pratt (2010) but was not documented during the 2010 survey. This species is listed as present on Pagan and Saipan by Raulerson (2006), and is listed as being an endemic species to the Mariana Islands (Costion and Lorence 2012). Wagner et al. (2012) specifies two varieties, var. *stonei* (present on Guam and Rota) and var. *scabridifolia* (present on Saipan). The omission of Pagan as a location for the variety *scabridifolia* on the Wagner et al. (2012) list may be in error because its presence on Pagan was reported by Fosberg et al. (1975) and Raulerson (2006). The eruptions in 1981 and 1986 would have eliminated the species from Mount Pagan because lava flows destroyed the area where this species was formerly reported to have occurred.

Ischaemum longisetum var. *raulersoniae* is a grass reported by Pratt (2010) as rare but present near the peaks of southern Pagan. This species is reported as native to the Mariana Islands (Costion and Lorence 2012), with the variety found on Pagan reported on four other northern Mariana islands (Raulerson 2006).

Lagenophora lanata is a small herb in the composite family occurring widely on southwestern Pacific islands. Prior to its reported occurrence near the southern peaks on Pagan by Pratt (2010), this species had been previously reported only from the Mariana Islands on Alamagan (Raulerson 2006). The current status of the species on other Mariana Islands is unknown.

3.9.5.2 Native Wildlife

Based on previous island-wide wildlife surveys that were conducted between 2000 and 2010, the following native terrestrial wildlife species have been observed on Pagan: 15 birds, 1 mammal, 7 reptiles, and over 400 invertebrate species (Cruz et al. 2000; Commander, U.S. Naval Forces Marianas 2004; Berger et al. 2005; Marshall and Amidon 2010; Reed et al. 2010; Vogt 2010a, 2010b; Kessler 2011b). Special-status species are addressed separately under Section 3.9.5.4, *Special-status Species*.

3.9.5.2.1 Birds

Within the last decade, 15 landbird, seabird, and wetland bird species were observed during surveys on Pagan. All are protected under the Migratory Bird Treaty Act except for the Micronesian starling, Micronesian honeyeater, and Micronesian megapode (U.S. Fish and Wildlife Service 2013) (see Section 3.9.5.4, *Special-status Species* for a list of those protected under the Migratory Bird Treaty Act). The most commonly observed birds during the 2010 survey were the Micronesian starling, Micronesian honeyeater, white tern, and collared kingfisher (Marshall and Amidon 2010; Kessler 2011b). The Endangered Species Act-listed Micronesian megapode is discussed below in Section 3.9.5.4, *Special-status Species*.

3.9.5.2.2 Mammals

Only one native terrestrial mammal species is currently known to occur on Pagan, the endangered Mariana fruit bat. This species is discussed in Section 3.9.5.4, *Special-status Species*.

3.9.5.2.3 Reptiles

Native reptile species found during the 2010 surveys include mourning gecko, Indo-Pacific house gecko, Pacific slender-toed gecko (*Nactus pelagicus*), Pacific blue-tailed skink, oceanic snake-eyed skink, and Brahminy blindsnake. Slevin's skink is proposed for listing under the Endangered Species Act and is discussed in more detail in Section 3.9.5.4, *Special-status Species.*

The occurrence of the federal Endangered Species Act-listed green and hawksbill turtles in the marine environment is addressed in Section 3.10, *Marine Biology,* and potential beach nesting areas are discussed in Section 3.9.5.4, *Special-status Species*.

3.9.5.2.4 Amphibians

There are no native amphibians on Pagan.

3.9.5.2.5 Invertebrates

A terrestrial arthropod survey conducted in 2010 identified 288 species, bringing the total number of known arthropod species on Pagan to 416. Eight of these species are endemic to Pagan (Evenhuis et al. 2010). Coconut crab populations have declined on Pagan within the last few decades, and only one crab was captured on Pagan during a recent 2010 survey. However, coconut crabs were common in the past on the southeast side of the island, which was not sampled in this study. The decline in the coconut crab population may be a result of feral pig depredation as well as direct mortality and degradation of habitat from the 1981 volcanic eruption. In addition to being a highly valued game species in the CNMI, coconut crabs serve important ecological functions as scavengers and seed dispersers (Vogt 2010a).

The humped tree snail is proposed for listing under the federal Endangered Species Act and is discussed in Section 3.9.5.4, *Special-status Species*.

3.9.5.3 Non-native Wildlife

3.9.5.3.1 Birds

The only non-native bird species on Pagan is the red junglefowl (feral chicken).

3.9.5.3.2 Mammals

Non-native mammals found on Pagan include the Oriental house rat (*Rattus tanezumi*), dogs, cats, pigs, goats, and cattle. It is unknown when these domesticated animals were first brought to Pagan, but it is assumed that the pigs and goats were first introduced in the 1600s with the Spanish and after that during attempts to colonize Pagan in the 1800s. Cattle were brought to the island during the German and Japanese administration (early 1900s) when the island was developed for copra production. All livestock were abandoned in 1981 following the volcanic eruption. Surveys of feral ungulates in 2010 resulted in island-wide estimates of approximately 260 cattle, 1,180 pigs, and 3,160 goats. Cattle were found only in northern Pagan, while pigs and goats were observed throughout the island. As a result of the feral ungulate populations, the island vegetation has a long history of being severely overgrazed, particularly in the north (Adams et al. 2010; Amidon et al. 2011; Kessler 2011a).

3.9.5.3.3 Reptiles

Three non-native reptiles were observed during the 2010 survey: mutilating gecko, oceanic gecko, and mangrove monitor lizard. The mutilating gecko was the most common of the three, with densities of 202-364 per acre (500-900 per hectare). The oceanic gecko is currently rare on Pagan, with only two individuals found during the 2010 survey. These non-native geckos could pose a threat to native geckos. Only five observations of the mangrove monitor lizard were made during the 2010 survey. While the population size of the mangrove monitor lizard is unknown, there are thought to be scattered patches of higher densities, with it being more common on the southern peninsula. The mangrove monitor lizard may be a threat to megapodes as they are known to eat megapode eggs (Reed et al. 2010; Vogt 2010b).

3.9.5.3.4 Amphibians

There are no non-native amphibians on Pagan.

3.9.5.3.5 Invertebrates

The highly invasive, non-native crazy ant (*Anoplolepis gracilipes*) is abundant on Pagan. This species can form super colonies, and when they occur in high densities, can devastate plant and invertebrate organisms, thereby posing a potential threat to food resources of the Mariana fruit bat and Micronesian megapode. No super colonies were observed during 2010 surveys, and it is believed that they currently pose no direct threats to megapode or fruit bat populations (Evenhuis et al. 2010).

Evidence of three non-native snail species was found during the 2010 surveys. One single living giant African snail was found along with shells of the land snail *Subulina octona* and the predatory snail *Gonaxis kibweziensis*. These species were observed during surveys on Pagan in 1949 and 1994 and at that time were widely dispersed. The giant African snail was likely introduced for food, while *G.*

kibweziensis was introduced to control the giant African snail, and *S. octona* was most likely introduced by accident on food plants from human migrations (Hadfield 2010).

3.9.5.4 Special-status Species

3.9.5.4.1 Federal Endangered Species Act-listed and Proposed Species

Eight federal Endangered Species Act-listed threatened, endangered, or proposed species have been observed on Pagan (Table 3.9-6 and Figure 3.9-6). These species are discussed below. Two other federally listed species, the nightingale reed-warbler (*Acrocephalus luscinia*) and Mariana common moorhen, are presumed to no longer exist on Pagan (Marshall and Amidon 2010) and are not discussed further.

Table 3.9-6. Occurrence of Federally Endangered Species Act-Listed and Proposed Species and CNMI-Listed Species on Pagan

English Name	*Status** *ESA*	*CNMI*	*Habitat*	*Occurrence*
Birds				
Micronesian megapode	E	E/T	Limestone forest, mixed native-introduced forest, and coconut forest.	In 2010, approximately 147 birds were estimated to occur on Pagan.
Mammals				
Mariana fruit bat	T	E/T	Limestone forest, coastal forest, and coconut forest.	Two colonies in the southeast and one in the northeast portions of Pagan, consisting of an estimated 1,017 individuals.
Reptiles				
Green sea turtle	T	E/T	Suitable beaches for basking and nesting.†	No known nesting records.
Hawksbill sea turtle	E	E/T		
Slevin's skink	PE	-	Mid-elevation closed humid forest and montane forest ecosystems	Although Slevin's skink was not observed during the 2010 surveys on Pagan, it was collected during a survey in 1999 on the southern part of the island.
Invertebrates				
Humped tree snail	PE	-	Intact native forest.	Found within the ancient caldera rim of South Pagan volcano.
Plants				
Cycas micronesica	PT	-	Forest and savanna ecosystems.	Recently reported on Pagan in ravines of the southern part of the island.
Bulbophyllum guamense	PE	-	Forest ecosystems.	Historically this species occurred on Pagan, but has not been observed since 1984.

Legend: *E = endangered; ESA = federal Endangered Species Act; PE = proposed endangered; PT = proposed threatened; T = threatened; E/T = the CNMI Administrative Code does not specify whether a species is threatened or endangered: all species are considered threatened *and* endangered; - = not listed.
†Occurrence of sea turtles in the marine environment is addressed in Section 3.10, *Marine Biology*.
Sources: Hadfield 2010; Marshall and Amidon 2010; Valdez 2010; Amidon et al. 2011; U.S. Fish and Wildlife Service 2012a, 2014.

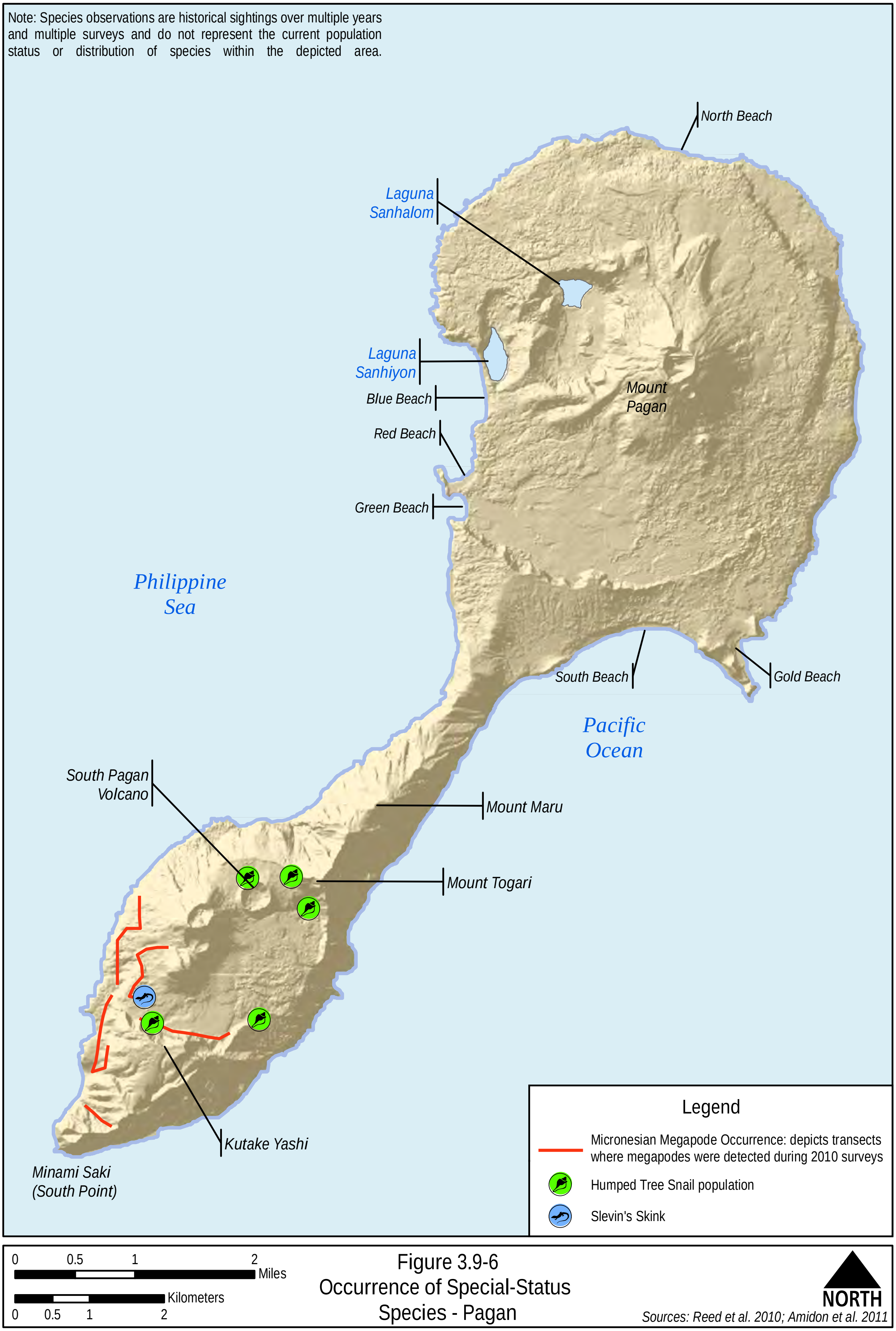


Figure 3.9-6
Occurrence of Special-Status Species - Pagan

Sources: Reed et al. 2010; Amidon et al. 2011

3.9.5.4.1.1 Micronesian Megapode

The Micronesian megapode has been extirpated (i.e., no longer exists) on Guam and Rota, two of the largest southern Mariana Islands, and large populations are only found on three uninhabited northern islands: Sarigan, Guguan, and Asuncion. Megapodes were reported common on Pagan in the 1950s and 1960s; however, populations have been reported low since Mount Pagan's 1981 eruption that buried at least one nesting area. During surveys in 2010, megapodes were observed only within the southern portion of Pagan within *Casuarina*, coconut, and mixed native-introduced forests (see Figure 3.9-6).

Based upon the 2010 surveys, it was estimated that there were approximately 147 Micronesian megapodes on Pagan. This estimate was slightly higher than the 1990s and 2000 surveys that estimated 50-100 and 134 birds, respectively. The main threats affecting this species are habitat loss and degradation mainly due to forest clearing and browsing by feral goats, pigs, and cattle, and depredation by introduced species, including mangrove monitor lizards, pigs, dogs, and cats. Heavy grazing by feral livestock also prevents megapode occurrence on the northern half of the island (Amidon et al. 2011).

3.9.5.4.1.2 Mariana Fruit Bat

During surveys in 2010, two fruit bat colonies were observed on southern Pagan (Valdez 2010). One colony was estimated to have 347 bats, while the other colony was estimated to have 670 bats. The survey team also attempted to find a colony of an estimated 200 bats on northern Pagan that was reported by a field technician assisting with other biological surveys on Pagan in June 2010. However, this colony was not found during the July 2010 fruit bat surveys. The survey team suspected that fruit bats from the colony on the northern end may have moved to one or both of the two colonies on the southern end of the island.

During a helicopter flight over Pagan, the survey team noticed that the majority of food sources for the fruit bat were isolated in small patches on the northern end of the island and scattered along the ravines of the southern end of the island. It is thought that the Mariana fruit bat population on Pagan continues to be impacted by habitat degradation or loss from feral animals, as well as from illegal hunting (Valdez 2010).

3.9.5.4.1.3 Sea Turtles

No sea turtle nesting crawls were observed on Pagan's eastern and western beaches during weekly beach surveys conducted by the CNMI Division of Fish and Wildlife sea turtle tagging team during the June 2010 surveys (Kessler 2011b). Sea turtle nesting on Pagan may be impacted by the high densities of feral pigs and cows using and degrading beach habitat. One juvenile green sea turtle was observed resting on Red Beach during the 2010 surveys (Kessler 2011b). In addition, seven beaches on Pagan were surveyed in July of 2013. No active or past nesting activity was observed on any of these beaches (DoN 2014c). The occurrence of sea turtles in the nearshore waters of Pagan is discussed in Section 3.10, *Marine Biology*.

3.9.5.4.1.4 Slevin's Skink

Slevin's skink is known to inhabit mid-elevation closed humid forest and montane forest ecosystems, with most individuals observed on the forest floor using leaf litter as cover. Occasionally, individuals have been observed in low hollows of tree trunks (U.S. Fish and Wildlife Service 2014). Surveys for terrestrial reptiles were conducted by U.S. Geological Survey biologists on Pagan in 2010 (Reed et al.

2010). Although Slevin's skink was not observed during these surveys, the species was collected in the southern part of Pagan during a CNMI Division of Fish and Wildlife survey in 1999 (see Figure 3.9-6). Slevin's skink may still be present on Pagan, but if so, it occurs in small numbers (Reed et al. 2010).

3.9.5.4.1.5 Humped Tree Snail

The distribution of the humped tree snail currently extends from Guam, north to Pagan and includes, or once included, populations on nine islands. During the 2010 surveys on Pagan, 345 humped tree snails were found within five survey transects located in the old caldera of the southern volcano (see Figure 3.9-6). The snails were found only in forests of mixed native vegetation with relatively dense understory and ground cover. The humped tree snail was not found in forests around Mount Pagan where the snail had been collected in 1949. Their absence in the north is most likely due to the impacts from the 1981 eruption and the intense grazing from feral cattle. Non-native snail species could also be a potential threat to the humped tree snail. Evidence of non-native predatory snail species *Gonaxis kibweziensis* was found on Pagan during the 2010 surveys (Hadfield 2010).

3.9.5.4.1.6 Cycas micronesica

Cycas micronesica is a tree currently known to occur in the forest and savanna ecosystems of Guam, Rota, Palau, and Yap (Raulerson 2006; U.S. Fish and Wildlife Service 2014), and was recently reported on Pagan in ravines of the southern part of the island (Pratt 2010).

3.9.5.4.1.7 Bulbophyllum guamense

Bulbophyllum guamense is an epiphytic orchid that occurs in mat-like formations on tree branches of forest ecosystems. Currently it is known from widely distributed occurrences on the southern Mariana Islands of Guam and Rota. Historically this species occurred on Pagan, but has not been observed since 1984 (U.S. Fish and Wildlife Service 2014).

3.9.5.4.2 Species Protected under the Migratory Bird Treaty Act

Twelve species that are protected under the Migratory Bird Treaty Act have been observed on Pagan (Table 3.9-7). The majority (nine species) are seabirds.

Table 3.9-7. Bird Species Occurring on Pagan and Protected under the Migratory Bird Treaty Act

Black noddy (*Anous minutus*)	Red-footed booby (*Sula sula*)
Brown booby (*Sula leucogaster*)	Red-tailed tropicbird (*Phaeton rubricauda*)
Brown noddy (*Anous stolidus*)	Sooty tern (*Onychoprion fuscatus*)
Collared kingfisher (*Todiramphus chloris*)	White-tailed tropicbird (*Phaeton lepturus*)
Masked booby (*Sula dactylatra*)	White tern (*Gygis alba*)
Pacific reef heron (*Egretta sacra*)	White-throated ground-dove (*Gallicolumba xanthonura*)

Sources: Reichel and Glass 1991; Vogt and Williams 2004; Camp et al. 2009; Kessler 2009; Camp et al. 2012; DoN 2013a; Gill and Donsker 2014.

3.9.5.4.3 CNMI-Listed Species

The federally listed Micronesian megapode, Mariana fruit bat, and green and hawksbill sea turtles are also listed as threatened/endangered by the CNMI. These species are discussed in detail above within the *Federal Endangered Species Act-listed and Candidate Species* section.

3.10 MARINE BIOLOGY

Section 3.10 describes the existing conditions of the marine biological resources in the waters surrounding Tinian and Pagan. The analysis of marine biology focuses on marine plants, animals, and habitats that are crucial to the functions of biological systems, of special public importance, or are protected under federal or local law or statute. When species are mentioned for the first time in this section they are introduced by common name, followed by the scientific name in parentheses; thereafter, only the common name is used. If there is no accepted English common name, then only the scientific name is used. Appendix L, *Biological Resources Supporting Documentation,* identifies the scientific and Chamorro and Carolinian names where applicable and provides more detailed information on special-status species found in the waters surrounding Tinian and Pagan. Appendix M, *Marine Biology Technical Memo and Survey Reports,* has additional information and details for information presented throughout this section.

The region of influence for marine biological resources generally includes the waters surrounding Tinian and Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. A larger region of influence of 7.3 nautical miles (13.6 kilometers) applies to the potential for behavioral effects to marine mammals from pile driving and extraction activities during construction.

3.10.1 Definition

The marine biology section is divided into five categories: marine habitat and essential fish habitat, marine flora, marine invertebrates, fish, and special-status species. Five species of sea turtles are potentially found within the CNMI waters, all of which are listed under the federal Endangered Species Act. Several marine mammals are listed under the Endangered Species Act and all are protected under the Marine Mammal Protection Act. Therefore, sea turtles and marine mammals are considered special-status species for the purposes of this EIS/OEIS.

3.10.1.1 Marine Habitat and Essential Fish Habitat

The U.S. military is preparing an Essential Fish Habitat Assessment for the proposed action in accordance with the Magnuson-Stevens Act. Appropriate consultations with regulatory entities will be completed as part of the EIS/OEIS process, and relevant information will be included in the EIS/OEIS as applicable. Various agency consultations are underway as part of this EIS/OEIS process and as applicable will be summarized in the Final EIS/OEIS. A summary of the in progress assessment is presented in this section.

Due to the overlap of content, the marine habitats and Essential Fish Habitat discussions are both presented in this subsection. For the purposes of this EIS/OEIS, the term “marine habitat” refers to nonliving marine substrate supporting marine organisms within the nearshore waters surrounding Tinian and Pagan. “Essential Fish Habitat” includes marine habitat as well as certain ecological functions. The Magnuson-Stevens Fishery Conservation and Management Act (hereafter referred to as the Magnuson-Stevens Act) defines “Essential Fish Habitat” as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. “Waters,” when used for the purpose of defining Essential Fish Habitat, include aquatic areas and associated physical, chemical, and biological properties used by fish; and may include historical areas of use, where appropriate. "Substrates" include sediment, hard bottom, underlying structures, and associated biological communities.

As a subset of Essential Fish Habitat, "Habitat Areas of Particular Concern" are specific areas that are essential to the life cycle of management unit species that meet one or more of the following criteria:

- The importance of the ecological function provided by the habitat
- The extent to which the habitat is sensitive to human-induced environmental degradation
- Whether, and to what extent, development activities are, or will be, stressing the habitat type
- The rarity of the habitat type

The marine habitat types within the region of influence were determined based on the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) which groups and defines the habitat types by shared substrate characteristics and ecological functions. They are as follows:

- Hard shores/Rocky Shores (rocky intertidal)
- Soft Shores/Unconsolidated Shore (beaches/tidal delta/mudflats/tidal riverine/estuarine streambeds)
- Hard bottoms/Rocky Bottom (reef/seamount/hydrothermal vents)
- Soft bottoms/Unconsolidated Bottom (lagoons/abyssal plain)
- Aquatic beds (seagrass/Sargassum)

Hard shores are the most prevalent marine habitat in the CNMI, and the dominant marine habitat surrounding Tinian and Pagan due to their volcanic origins. Hard shores include aquatic environments that have at least 75% cover of stones, boulders, or bedrock and less than 30% vegetative cover. A diverse array of organisms is supported by the relatively stable rocky substrate provided by hard shores. Environmental gradients between hard shorelines and subtidal habitats are determined by wave action, depth, frequency of tidal inundation, and stability of substrate. Only rock outcrops may persist in areas of extreme wave energy. A mixture of rock sizes will form the intertidal zone in areas of lower energy. Boulders scattered in the intertidal and subtidal areas provide substrate for attached macroalgae and sessile (immobile) invertebrates. Plants and animals usually attach themselves to the rocky surfaces, while some animals hide in rocky crevices, under rocks, or burrow into finer substrate between boulders.

Soft shores include beaches, tidal flats, deltas, tidal rivers and estuarine systems. Soft shore habitats consist of unconsolidated substrates with less than 75% cover of stones, boulders, or bedrock and less than 30% vegetative cover other than pioneering plants. Pioneering plants are species that are the first to colonize previously disrupted or damaged ecosystems that become established during brief periods when growing conditions are favorable. The particle size of the substrate and the water regime are important factors determining the types of plant and animal present in the area. Soft shores can be irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded. The distribution and composition of organisms within this habitat, particularly invertebrates, is determined by substrate particle size, the space between the substrate particles, wave action, currents, and salinity (Cowardin et al. 1979).

Hard bottom habitats in nearshore waters can include reefs and rocky bottoms colonized by dead and living sedentary invertebrates, such as coral reefs. Rocky bottoms in this habitat form as extensions of intertidal shores or isolated offshore outcrops (rock formations visible from the surface) (Cowardin et al.

1979). Colonization of this substrate can be determined by the size and shape of the rocks, but also by the depth, less than 650 feet (200 meters), where there may be enough exposure to sunlight for photosynthesis to occur. This determines whether it is encrusted by algae or marine fauna, such as sponges, sea cucumbers, corals, and sea whips (DoN 2013a). Refer to Section 3.10.1.3, *Marine Invertebrates*, for more information on coral reefs.

Soft bottoms include all wetland and deepwater habitats with at least 25% cover of small unconsolidated substrate particles, such as stones and sands and less than 30% vegetative cover. The distribution and composition of organisms within this habitat is determined by exposure to wave action, sunlight, and duration of being underwater, which results in variations in temperature, salinity, and pH (Cowardin et al. 1979). Soft bottom habitats include lagoons, which are semi-enclosed bays between the shoreline and a fringing or barrier reef, generally with sandy bottoms and scattered coral mounds, rubble, seagrass, and algae (DoN 2013a). Soft bottoms are inhabited by soft-sediment communities of mobile invertebrates fed by benthic algae production, chemosynthetic microorganisms, and decaying organic matter sinking through the water column.

Aquatic beds include mangroves, seagrass beds and mats of floating seaweed that are generally found in the intertidal or shallow subtidal zone of nearshore waters, where the vegetation grows mainly on or below the water surface (Cowardin et al. 1979). Aquatic bed habitats can be subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semi-permanently flooded intermittently exposed, semi-permanently flooded, or seasonally flooded. Seagrasses are living marine resources and biotic habitats where they dominate the intertidal or shallow subtidal zone, and are therefore not covered in this chapter. Section 3.10.1.2, *Marine Flora*, has more information on aquatic beds.

3.10.1.2 Marine Flora

Aquatic beds represent plant communities that require surface water for growth and reproduction. They are best developed in relatively permanent water or under conditions of repeated flooding. Plants are either attached to the substrate or float freely in the water above the bottom or on the surface. Aquatic beds include algae, aquatic moss, rooted vascular, and floating vascular species (Cowardin et al. 1979).

This *Marine Flora* section will focus on macroalgae and seagrasses as these communities are found within the region of influence. Algae are photosynthetic, nonvascular plants, commonly referred to as "seaweeds." Algae live on substrates characterized by a wide range of sediment depths and textures and occur in both the subtidal and intertidal zones up to depths of 98 feet (30 meters) (Cowardin et al. 1979). In tropical regions, such as the CNMI, green algae, brown algae, and red algae are common. Algae are a main food source for sea turtles in the CNMI and within the region of influence.

Seagrasses are flowering marine plants that grow entirely underwater. Seagrasses normally occur in water less than 85 feet (26 meters). The distribution of seagrass is influenced by the availability of suitable soft substrates, such as sand or mud, in low wave energy areas at depths that allow sufficient light exposure (Spalding et al. 2003). Distribution and abundance of marine flora depends on several factors including light availability, water quality/clarity, salinity, type of seafloor substrate, currents, tides/water movement, and temperature (Spalding et al. 2003).

Seagrasses also provide a food source for sea turtles and habitat for fishes within the region of influence (Spalding et al. 2003). In addition, seagrasses play a major role in fisheries production and have been shown to provide protection from coastal erosion (Spalding et al. 2003).

3.10.1.3 Marine Invertebrates

Invertebrates are animals without backbones. Marine invertebrates are a large and diverse group that includes sponges, corals, snails, octopus, clams, lobsters, crabs, starfish, sea urchins, sea cucumbers, and marine worms (Eldredge 1983; DoN 2005).

True corals are categorized in the phylum Cnidaria which also includes fire corals, anemones, Portuguese man-o-war, jellyfish, box jellyfish and a variety of other related animals. Cnidarians have two basic body forms: free-swimming or floating medusa and sessile polyps. However, because many Cnidaria are colonial, both body forms can be found on some floating colonies such as the Portuguese man-o-war. Additionally, a single coral colony can be comprised of thousands of individual polyps, making it difficult to determine between a coral individual and a coral colony.

Corals are marine invertebrates in the class Anthozoa of the phylum Cnidaria that live individually or in colonies. Fire corals are not technically corals since they are part of the class Hydrozoa; however, fire corals are colonial marine organisms that look like true corals and are included in this discussion (DoN 2013a). Major groups of corals in the region of influence include:

- Stony corals (*Scleractinia*)
- Black and wire corals (*Antipatharia*)
- Soft corals (*Alcyonacea*, synonymous with horny corals and sea fans [*Gorgonacea*] and blue corals [*Helioporacea*])

The term "coral reef" refers to any reef, bank, or shoal comprised mostly of corals. "Reef ecosystem" includes coral and other species of reef plants and animals associated with coral reefs, and the physical environmental factors that directly affect coral reefs (Riegl and Dodge 2008; Brainard et al. 2011). Reefs are usually divided into four broad categories: barrier, bank, fringing, and patch reefs. The Mariana Islands are dominated by fringing reefs, with limited examples of barrier, bank, and patch reefs (Riegl and Dodge 2008; Brainard et al. 2011). Among the four reef types, fringing reefs are along a shoreline. Barrier, bank, and patch reefs do not require a shoreline (Riegl and Dodge 2008). Common reef morphology terms are tied to distinctive zones, which are created by differences in depth, wave action, current movement, light, temperature, and sediments along different parts of the reef. Zones are principally composed of the fore reef (adjacent to the reef crest and closer to the shore than the deep reef), reef crest (peak of the reef slope closest to the water surface and closer to the shore than the deep reef) and back reef (reef shoreward of the reef crest) (Riegl and Dodge 2008; DoN 2014a) (Figure 3.10-1). Reef flats (shallow zone located closest to shore), lagoons, and benches may be found shoreward of the reef crest. The fore reef, is often subdivided by depth (e.g., shallow and deep fore reef) or by geomorphology (e.g., spur-and-groove, apron, and sand channel). The fringing reefs of the Mariana Islands are predominately shore-attached with poorly-developed reef crests (Riegl and Dodge 2008; Brainard 2012), meaning the fore reef runs up to mean low water with little or no development of a reef crest between the fore reef and the shoreline. Typical reef crests and reef flats are less than 2 feet (0.6 meter) deep, with some grooves that are as much as 20 feet (6 meters) deep, but less than 3 feet (1 meter) wide (Smith 2012). In order of relative areal extent, fore reef is the most abundant habitat type in the Mariana Islands, followed by reef crest, and very small extents of reef flats (Analytical Laboratories of Hawaii 2004; National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science 2005; Bearden et al. 2008; Riegl and Dodge 2008; Brainard et al. 2011).

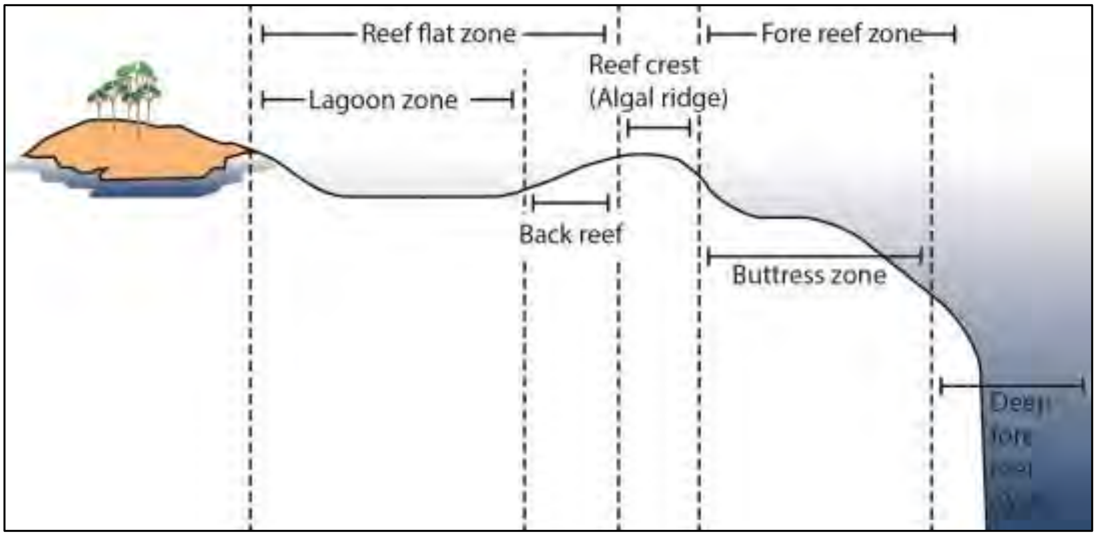


Figure 3.10-1 Typical Reef Zonation

Note: This figure is intended as a simple representation of reef zonation. Actual zonation will vary reef to reef.

3.10.1.4 Fish

Fish include aquatic animals with a hard bone or cartilage skull and gills, and that lack limbs or digits. Fish are not distributed uniformly throughout the region of influence; fish are closely associated with specific habitats. Fish species, such as large sharks, tuna, and billfishes, range across thousands of square miles; others, such as reef fishes, have small home ranges and restricted distributions (Helfman et al. 2009). The distribution and specific habitats of individual fish are influenced by a number of factors including its developmental stage, size, sex, and reproductive condition. This EIS/OEIS will focus mainly on reef fish.

Fisheries, in terms of habitat requirements, are discussed under *Essential Fish Habitat*. Recreation and commercial fishing are addressed in Section 3.8, *Recreation* and Section 3.15, *Socioeconomics and Environmental Justice*.

3.10.1.5 Special-status Species

Special-status species include: (1) those species that currently occur in the wild within the CNMI and are listed as threatened or endangered under the federal Endangered Species Act, (2) candidates or species proposed for listing under the federal Endangered Species Act, (3) those designated by legislative authority in the CNMI as threatened or endangered, (4) Species of Special Conservation Need as identified in the CNMI's Comprehensive Wildlife Conservation Strategy, and (5) those species protected under the Marine Mammal Protection Act. Brief descriptions and life history information for special-status species, are detailed in Appendix L, *Biological Resources Supporting Documentation*. Special-status species within the region of influence of the proposed action include marine invertebrates, fish, sea turtles, and marine mammals. Marine invertebrates and fish are defined above.

Sea turtles, also referred to as marine turtles, are air-breathing reptiles that are found throughout the world's tropical and subtropical ocean waters. Habitat use varies among species and within the life stages of individual species, correlating primarily with the distribution of preferred food sources, as well as the locations of nesting beaches. Sea turtle behaviors such as foraging, migrating, and resting take place in the marine environment, where they spend most of their lives. Generally, after hatching, young sea turtles spend time in the open ocean habitat before returning to nearshore foraging grounds. Green turtles have a mainly herbivore diet and feed on seagrasses and algae. Other sea turtle species are omnivores and eat a variety of plants and animals including jellyfish and sponges (Bjorndal 1997). This section addresses sea turtles in the marine environment, which fall under the jurisdiction of the National Marine Fisheries Service. Nesting sea turtles are addressed in detail in Section 3.9, *Terrestrial Biology* since they are terrestrial at the nesting stage and fall under the jurisdiction of the U.S. Fish and Wildlife Service.

Marine mammals are cited in the Marine Mammal Protection Act as mammals "morphologically adapted to the marine environment," which include members of the orders Sirenia (i.e., manatees and dugongs), Pinnipedia (i.e., seals and sea lions), and Cetacea (i.e., whales, dolphins, and porpoises), as well as mammals that primarily inhabit the marine environment, such as sea otters (*Enhydra lutris*) and polar bears (*Ursus maritimus*). This EIS/OEIS discusses Cetacea as these are the only marine mammals species located within the region of influence. Sirenia and Pinnipedia will not be discussed in this document. In general, cetaceans are large animals with streamlined bodies that glide through the marine environment (National Oceanic and Atmospheric Administration 2014).

Critical habitat is defined in the federal Endangered Species Act as specific geographic areas essential to the conservation of a threatened or endangered species and may require special management and protection. Critical habitat has not been designated for any marine species within the CNMI.

3.10.2 Regulatory Framework

Several laws, regulations, plans, and policies are applicable to the proposed action for marine biological resources. A complete listing of applicable regulations for this EIS/OEIS is provided in Appendix E, *Applicable Federal and Local Regulations*.

3.10.2.1 Federal Regulations

- Federal Endangered Species Act (16 U.S. Code §§ 1531–1544, as amended)
- Magnuson-Stevens Fishery Conservation and Management Act (16 U.S. Code §§ 703–712, as amended)
- Marine Mammal Protection Act (16 U.S. Code §§1361–1421h, as amended)
- Clean Water Act
  - Sections 401 & 404
- Executive Order 13089, Coral Reef Protection
- Executive Order 13112, Invasive Species
- Executive Order 13158, Marine Protected Areas
- Executive Order 13547, Stewardship of the Ocean, Our Coasts, and the Great Lakes
- Executive Order 12962, Recreational Fisheries, as amended by Executive Order 13474, Methodology

3.10.3 Methodology

Project-specific surveys were performed for coral, sea turtles, and marine mammals in support of this EIS/OEIS. Associated survey reports are in Appendix M, *Marine Biology Technical Memo and Survey Reports*. The *Marine Biology Technical Memo,* also included in Appendix M, provides detailed discussion of the coral communities at the beaches in order to support analysis of which coral resources may be affected by the proposed action, as well as details on the acoustic analysis pertaining to marine mammals. In addition, biological surveys that have been conducted in areas that encompass the region of influence were used as key sources of information for this section. A review of data and scientific literature provides an overview of marine resources in the region of influence for this EIS/OEIS.

The Mariana Archipelago Reef Assessment and Monitoring Program surveys, conducted by the National Oceanic and Atmospheric Administration Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Division, provide the basis of information presented in the Marine Flora and Fish sections. Marianas Archipelago Reef Assessment and Monitoring Program conducted surveys in 2003, 2005, and 2007 around the island and reefs of Guam and the CNMI to provide comprehensive information on the coral reef ecosystem including fish biomass and diversity and benthic habitats including occurrence and cover of macroalgae (both calcified and fleshy), crustose coralline red algae, and turf algae.

3.10.4 Tinian

3.10.4.1 Marine Habitat and Essential Fish Habitat

Due to the overlap of content, the marine habitats and Essential Fish Habitat discussions are both presented in this subsection. The Tinian coastline is generally lined with rocky intertidal areas, steep cliffs, and the occasional sandy beach or mudflat. Table 3.10-1 summarizes the amount of various physical characteristics (e.g., coastline, seafloor area, total reef habitat, and reef flat) for the Mariana Islands, southern CNMI, northern CNMI, and Tinian.

Table 3.10-1. Estimates of Select Total Physical Features Compared to Tinian

Physical Characteristic	***Mariana Islands***	***Tinian***
Coastline	313 miles	38 miles
Seafloor area from 0-98 feet (0-30 meters) depth	49,984 acres	4,000 acres
Total Reef Habitat	65,920 acres	5,696 acres
Reef flat‡	1,728 acres mostly on Guam	64--96 acres

Notes: † Estimations. Estimates based of the sources below.
Sources: Analytical Laboratories of Hawaii 2004; Bearden et al. 2008; Brainard et al. 2012; National Oceanic and Atmospheric Administration and National Centers for Coastal Ocean Science 2005; Riegl et al. 2008.

3.10.4.1.1 Hard Shores

Coastline within the region of influence for Tinian is dominated by hard shores and interspersed with soft shores. The hard shores primarily consist of rocky intertidal areas with steep cliffs and headlands, reinforced by large boulders at the base. Erosion and waves carve out these cliffs and create sea-level benches (DoN 2013a). From the base of these cliffs, the depth of nearshore waters increases rapidly to approximately 23 feet (7 meters) into spur-and-groove formations (hard bottom habitat) that support high biological diversity. In order of relative areal extent, fore reef is the most abundant coral reef habitat type in the Mariana Islands by a large margin, followed by reef crest, and very small extents of reef flats (Riegl and Dodge 2008; Brainard 2012). Reef flats occur offshore from many of the beaches within the Military Lease Area, but more generally, reef flats are absent from areas offshore from steep cliffs, which border much of Tinian (Minton et al. 2009).

3.10.4.1.2 Soft Shores

Tinian's shoreline has 13 beaches (10 on the west coast [leeward side] and 3 on the east coast [windward side]) and is mostly undeveloped, except for Tinian Harbor (Figure 3.10-2). These beaches are primarily comprised of medium to coarse sands, gravel, and coral rubble (DoN 2013a). Unai Chulu, Unai Babui, and Unai Lam are small beaches (soft shore habitat) along the northwest coast of Tinian, which is otherwise categorized as hard shore habitat consisting primarily of limestone cliffs. Unai Chulu and Unai Babui transition to narrow reef flats (Tinian has seven well-developed and two poorly-developed reef flats), before moving offshore to spur-and-groove formations (hard bottom habitat). The reef flats at both Unai Babui and Unai Chulu are shallow; ranging from 0.0 to 6.5 feet (0.0 to 2 meters) in depth. The reef crest and outer reef flat at Unai Lam are broad and well developed relative to Unai Babui and Unai Chulu. To the south of the beach, the reef flat zone transitions to a shallow bench. At Unai Babui, the reef slope supports higher diversity for algae, fish, and invertebrates than the reef flat. Conversely, the reef flat at Unai Chulu has higher diversity for algae, but lower diversity for fish and invertebrates (Minton et al. 2009). Unai Masalok is a small beach on the east side of Tinian. The reef area at Unai Masalok is physically complex with moderately deep (12-26 feet [4-6 meters]) regularly spaced grooves in the fore reef, transitioning rapidly to deep fore reef. The fore reef is more topographically complex than the deep fore reef at the beaches on the leeward side of Tinian (DoN 2013a).Coral reef habitat (hard bottom) covers approximately 8.9 square miles (23 square kilometers) of the area around Tinian (Brainard 2012) (see Table 3.10-1; Figure 3.10-2). The transition to hard bottom habitat from the shore at all the Tinian beaches is rapid. The hard bottom substrate moves from narrow reef flat to more well-developed spur-and-groove coral reef substrate (Minton et al. 2009). There are approximately 0.10-0.15 square miles (0.28-0.38 square kilometers) of reef flat around Tinian (Brainard 2012).

3.10.4.1.3 Hard Bottoms

Coral reef habitat (hard bottom) covers approximately 5,696 acres (2,305 hectares) of the area around Tinian (Brainard 2012) (see Table 3.10-1). The transition to hard bottom habitat from the shore at all the Tinian beaches is rapid. The hard bottom substrate moves from narrow reef flat to more well-developed spur-and-groove coral reef substrate (Minton et al. 2009). There are approximately 64-96 acres (179-249 hectares) of reef flat around Tinian (Brainard 2012).

3.10.4.1.4 Soft Bottoms

Limestone pavement (consolidated substrate, typically composed of calcareous elements, which have become cemented together), coral, and submerged boulders limit the development of soft bottom substrates in intertidal and subtidal areas of the CNMI. Tinian has one lagoon (soft bottom habitat) to the northwest of Tinian Harbor, on the southwest coast, where there are small boat piers and the substrate is dominated by sand and patches of coral (Minton et al. 2009).

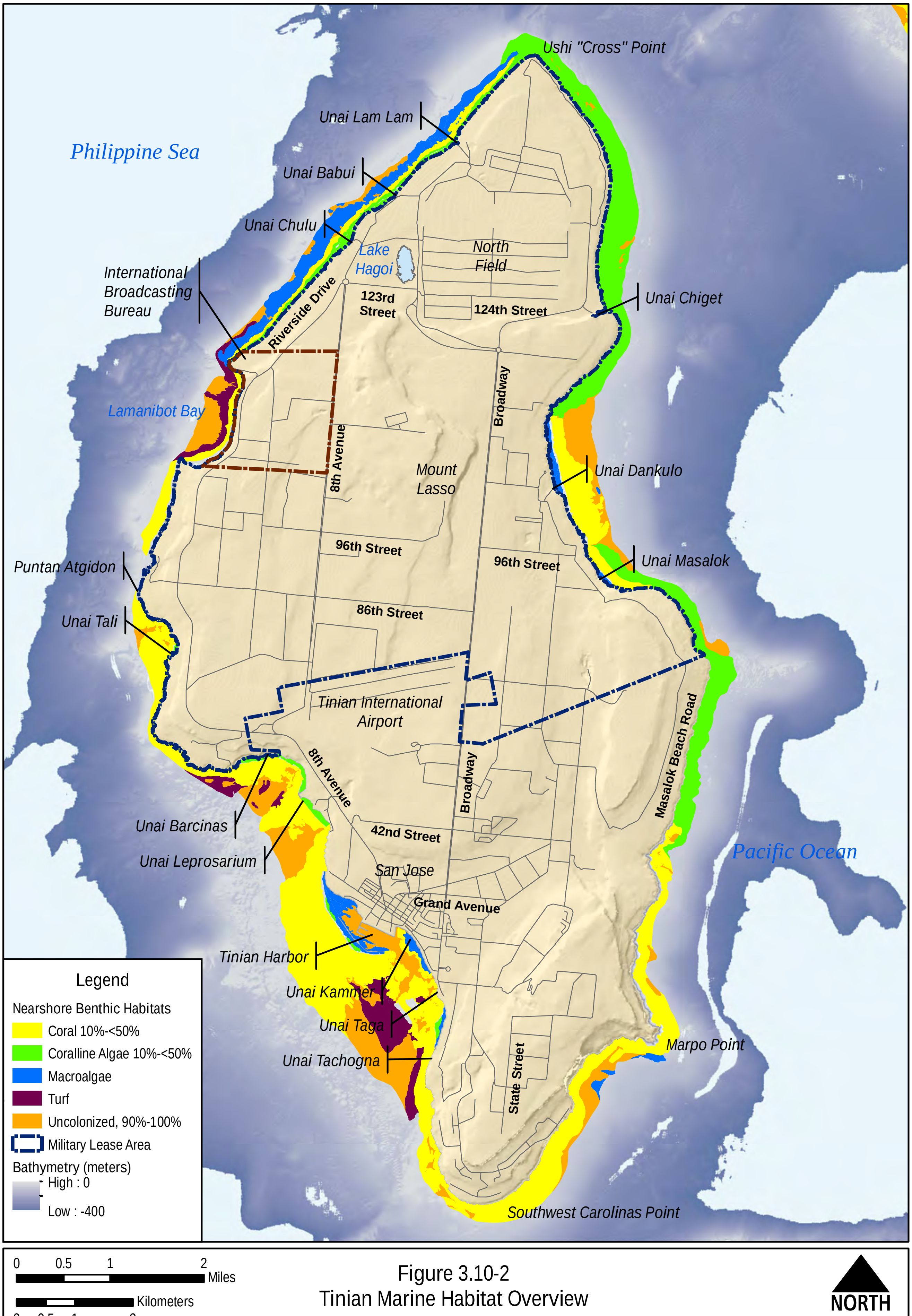


Figure 3.10-2
Tinian Marine Habitat Overview

Sources: National Centers for Coastal Ocean Science 2005, Pacific Islands Fisheries Science Center 2007, DoN 2010a

Table 3.10-2. Essential Fish Habitat and Habitat Areas of Particular Concern for Management Unit Species of the Western Pacific Region

Fishery Management Plan	*Essential Fish Habitat (Juveniles and Adults)*	*Essential Fish Habitat (Eggs and Larvae)*	*Habitat Area of Particular Concern*
Pelagics	Water column down to 3,280 feet (1,000 meters)	Water column down to 656 feet (200 meters)	Water column down to 3,280 feet (1,000 meters) that lies above seamounts and banks
Bottomfish and Seamount Groundfish	Bottomfish: Water column and bottom habitat down to 1,312 feet (400 meters) Seamount Groundfish: (adults only) water column and bottom from 80 to 600 meters, bounded by 29°-35°N and 171°E-179°W, which is outside of the Action Area	Bottomfish: Water column down to 1,312 feet (400 meters) Seamount Groundfish: (including juveniles) epipelagic zone 0 to 200 meters bounded by 29°-35°N and 171°E-179°W, which is outside of the Action Area	Bottomfish: All escarpments and slopes between 131 feet (40 meters) and 918 feet (280 meters), and three known areas of juvenile pink/crimson snapper habitat located in Hawaii No Habitat Areas of Particular Concern designated for Seamount Groundfish
Crustaceans	Lobsters: Bottom habitat from shoreline to a depth of 328 feet (100 meters) Deep-water shrimp: The outer reef slopes at depths from 984-2,296 feet (300-700 meters)	Water column down to 492 feet (150 meters) Water column and associated outer reef slopes from 1,804-2,296 feet (550-700 meters)	All banks with summits less than 98 feet (30 meters) from the surface No Habitat Areas of Particular Concern designated for deep-water shrimp
Coral Reef Ecosystems	Water column and benthic substrata to a depth of 328 feet (100 meters)	Water column and benthic substrata to a depth of 328 feet (100 meters)	All Marine Conservation Areas identified in Fishery Ecosystem Plan, all Pacific Remote Island Areas, many specific areas of coral reef habitat

Notes: All areas are bounded by the shoreline and the outer boundary of the Exclusive Economic Zone (200 nautical miles [370 kilometers] from the coast), unless otherwise indicated.
Source: Western Pacific Regional Fishery Management Council 2009.

3.10.4.1.5 Aquatic Beds

Emergent vegetation is not found around Tinian (International Business Publications, USA 2011), but seagrass is found along the coast (see Section 3.10.4.2, *Marine Flora* for more detailed information on seagrass in the region of influence).

3.10.4.1.6 Essential Fish Habitat

Designated Essential Fish Habitat categories for Tinian are those defined for Pacific pelagics, bottomfish and seamount groundfish, crustaceans, and coral reef ecosystems (Western Pacific Regional Fishery Management Council 2009). Precious corals have not been recorded within the Exclusive Economic Zone in the CNMI, save for pre-World War II reports of harvesting of the precious coral *Corallium* sp., north of Pagan (DoN 2005). There are no Habitat Areas of Particular Concern for precious corals in the CNMI. These categories are summarized in Table 3.10-2. The description of Essential Fish Habitat around Tinian includes information from the CNMI as a whole. The entire water column and seafloor, from the shoreline to the boundary of the Exclusive Economic Zone, is considered Essential Fish Habitat for at least one species.

Specific Essential Fish Habitat management units are summarized below:

Pelagics. Trolling is the most popular fishing method for the pelagic fishing industry. Skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and dolphinfish (*Coryphaena hippurus*) are the most commonly targeted species. The Essential Fish Habitat for pelagic species at Tinian is the water column down to 3,280 feet (1,000 meters); the waters at those depths that lie above seamounts and banks—including Esmeralda Bank, Tatsumi Reef, and innumerable unnamed seamounts—are defined as Habitat Areas of Particular Concern for pelagic species.

Bottomfish and Seamount Groundfish. All 17 of the managed bottomfish species have sustainable recreational, subsistence, and commercial fisheries. Essential Fish Habitat around Tinian includes the water column and bottom habitat down to depths of 3,281 feet (1,000 meters). Habitat Areas of Particular Concern for bottomfish at Tinian include escarpments (underwater steep slopes or long cliffs) and slopes between depths of 131 and 919 feet (40 and 280 meters).

Crustaceans. The spiny lobster is the managed crustacean most likely to comprise a fishery in Tinian, although there is likely only recreational or subsistence fishing. The most common species of spiny lobster, *Panulirus* spp., in the CNMI is generally restricted to windward surf zones of oceanic reefs with clear water where there is minimal terrestrial influence (Berger et al. 2005; DoN 2005). There are no Habitat Areas of Particular Concern for crustaceans in the CNMI.

Coral Reef Ecosystems. The Essential Fish Habitat for coral reef ecosystems in Tinian encompasses the entire water column and benthic substrate to a depth of 328 feet (100 meters).

3.10.4.2 Marine Flora

Of the major species groups of true algae indigenous to the Mariana Islands, there are 109 species of red algae, 31 species of brown algae, and 71 species of green algae (Lobban and Tsuda 2003). According to the Mariana Archipelago Reef Assessment and Monitoring Program algae surveys, Tinian had one of the highest mean macroalgal covers of all the islands in the Mariana Archipelago. The Mariana Archipelago Reef Assessment and Monitoring Program did not note a difference in crustose coralline red algae cover across the archipelago (Brainard 2012).

In 2003, mean macroalgae cover on Tinian fore reefs was 47% (Brainard 2012). The 2003 surveys did not separate macroalgae and algae. The highest mean macroalgal cover was on Tatsumi Reef (offshore of the southeast coast of Tinian). Tinian Harbor (southwest Tinian), and the areas between Puntans Chiget and Asia (northeast Tinian) had moderately dense areas of macroalgal cover. Dominant habitats included pavement or boulder habitats (Brainard 2012). Mean cover of crustose coralline red algae on Tinian fore reef habitats was 6% in 2003. The highest cover was found around Puntan Chiget (northeast region of the island) on spur-and-groove habitats (see Figure 3.10-2).

In 2005, mean macroalgae cover on Tinian fore reefs habitats was 56% and were abundant across the island. The highest areas of cover were in the northeast region of the island between Puntan Asiga and Unai Masalok, and around Tinian Harbor (southwest Tinian). *Halimeda*, a green alga, were found covering large areas in the northeast region near Puntan Tahgong (Brainard 2012). The 2005 survey reported 5% mean cover of crustose coralline red algae. Boulder and pavement habitats had the highest amount of the red algae cover. As in 2003, the northeast region of Tinian had the highest amount of macroalgae cover.

In 2007, mean macroalgae accounted for 40% of the algae cover on the fore reef around Tinian, while turf algae accounted for 52% (note: the macroalgae and turf algae surveys were conducted using different survey methods so the total cover does not equal 100%). Macroalgae species recorded included: *Halimeda* (green algae), *Padina* (brown algae), *Liagora* (red algae), *Asparagopsis* (red algae) and *Microdictyon* (a green algae). Mean crustose coralline red algae cover was 16% in 2007. Unlike other years, the area with the highest cover of macroalgae was along the northwest corner of the island (Brainard 2012).

The Mariana Islands have three species of seagrass; tape seagrass (*Enhalus acoroides*), narrowleaf seagrass (*Halodule uninervis*), and hartog seagrass (*Halophila minor*). Seagrass, a food source for some sea turtle species, is found along most of the coast of Tinian except for the southeastern region and the lower half of the southwestern region (DoN 2005). Tape seagrass was reported at Unai Chiget reef, Unai Masalok, and Lamonibot Bay (Commander, U.S. Naval Forces Marianas 2004).

3.10.4.3 Marine Invertebrates

The oldest and most developed coral reefs of the CNMI are located in the nearshore waters of the southern islands, including Tinian (Starmer et al. 2008). Coral, starfish, sea urchins, sea cucumbers, mollusks, and tube worms are the most common types of invertebrates found on Tinian reefs (DoN 2010). During the *Coral Marine Resource Survey* conducted in support of this EIS/OEIS, giant clams (*Tridacna* spp.) were observed at all beaches surveyed on Tinian, and spider conchs (*Lambis* spp.) were observed at Unai Chulu, Unai Babui, and Unai Masalok (DoN 2014a).

The island of Tinian is virtually surrounded by shore-attached fringing reef (Riegl and Dodge 2008; Brainard 2012). Most of the reef habitat on Tinian has 1-10% coral cover, but patches exceeding 50% cover do occur, particularly in shallow waters (Minton et al. 2009; Brainard 2012; DoN 2014a). Shore-attached fringing reefs are the dominant reef habitat type on Tinian. Well-developed reef crests are less common and reef flats are uncommon. There are seven well-developed reef flats on Tinian. These include Unai Chulu, Unai Babui, Unai Dankulo, Unai Masalok, Unai Barcinas and Unai Leprosarium, and Taga Beach (south of the Tinian Dynasty). There are two additional small or poorly-developed reef flats on the leeward side, one at the south end of the International Broadcasting Bureau property and one approximately 1 mile (1.6 kilometers) south of Puntan Atgidon. There are two additional areas on Tinian that may provide habitat similar to reef flats based on their relatively broad extents of shallow nearshore bathymetry. One is the broad 'shallow bench' south of Unai Lam Lam and one is the shallow habitat at the northwestern tip of Tinian Harbor. All of the reef flats on Tinian are extremely small compared with well-developed reef flat habitats in the Mariana Islands such as Tumon Bay and Piti Bay on Guam. Table 3.10-1 in Section 3.10.4.1, *Marine Habitat* and *Essential Fish Habitat*, summarizes the amount of coastline, seafloor area, total reef habitat, and reef flat for the Mariana Islands and Tinian.

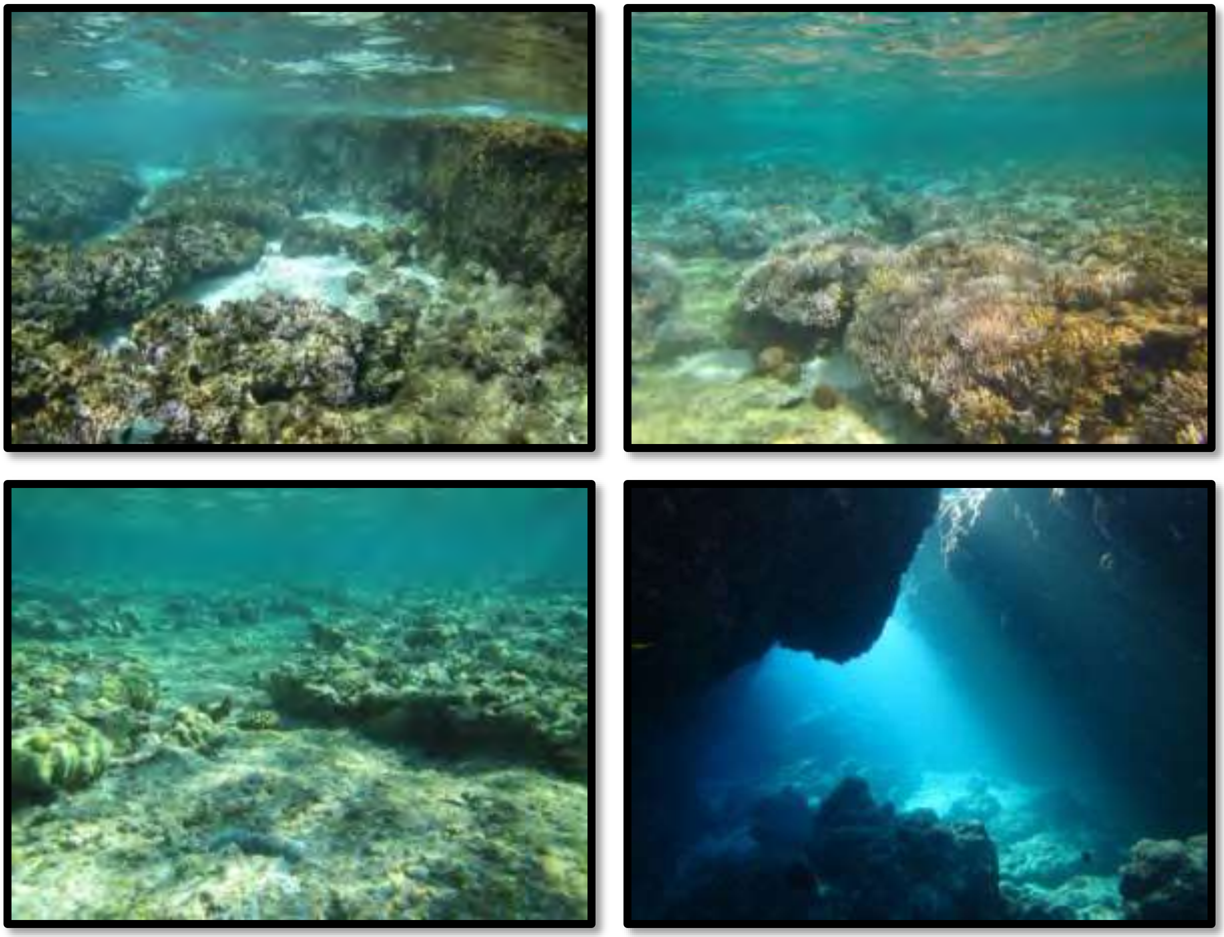
Brief summaries from the *Coral Marine Resources Survey Report* (see Appendix M, *Marine Biology Technical Memo and Survey Reports,* DoN 2014a) are presented in the following sections. The *Coral Marine Resources Survey Report* was conducted in support of this EIS/OEIS and discusses Unai Chulu, Unai Babui, Unai Masalok, Unai Lam Lam, and Unai Dankulo; however, Unai Dankulo is not part of the proposed action for beach landings and is not discussed in the following sections. Refer to Chapter 2, Section 2.3.2.2, *Refinement of Tinian Unit Level Range and Training Area Alternatives* for additional information.

3.10.4.3.1 Unai Chulu

The reef area at Unai Chulu is physically complex, with very deep, irregularly spaced spurs and grooves in the fore reef that transition rapidly to deep fore reef, with broken rock fragments in the grooves. The bases of the grooves have polished surfaces and polished cobble-sized fragments; indicating regular, active water motion and erosion. Many spurs are undercut by grooves that interconnect with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Reef zonation at Unai Chulu includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. To the south of the beach, the reef flat zone transitions to a shallow bench that is richer with coral cover than the reef flat itself. The habitat is heterogeneous (diverse) across different depths, particularly the shallow bench to the south of the beach, but homogeneous (similar) within the same depths.

The *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS revealed a total of 121 coral species with the most abundant species identified as *Goniastrea retiformis* (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*). *Goniastrea retiformis*, which is not listed under the federal Endangered Species Act, was also the most abundant species at the other surveyed beaches. Most of the area surveyed revealed low to moderate topographic complexity, low to moderate coral cover, and low sand cover (see Section 3.3 of the *Coral Marine Resources Survey Report* found in Appendix M for category description). There were scattered patches, however, that did have very high coral cover (50-70%). Representative images of Unai Chulu are presented below (Photos 3.10-1). Unai Chulu coral cover is shown in Figure 3.10-3.



Photos 3.10-1. Representative Images of Unai Chulu
(Clockwise from top left: rocky fore shore; shallow bench; grotto underneath reef crest; reef flat)

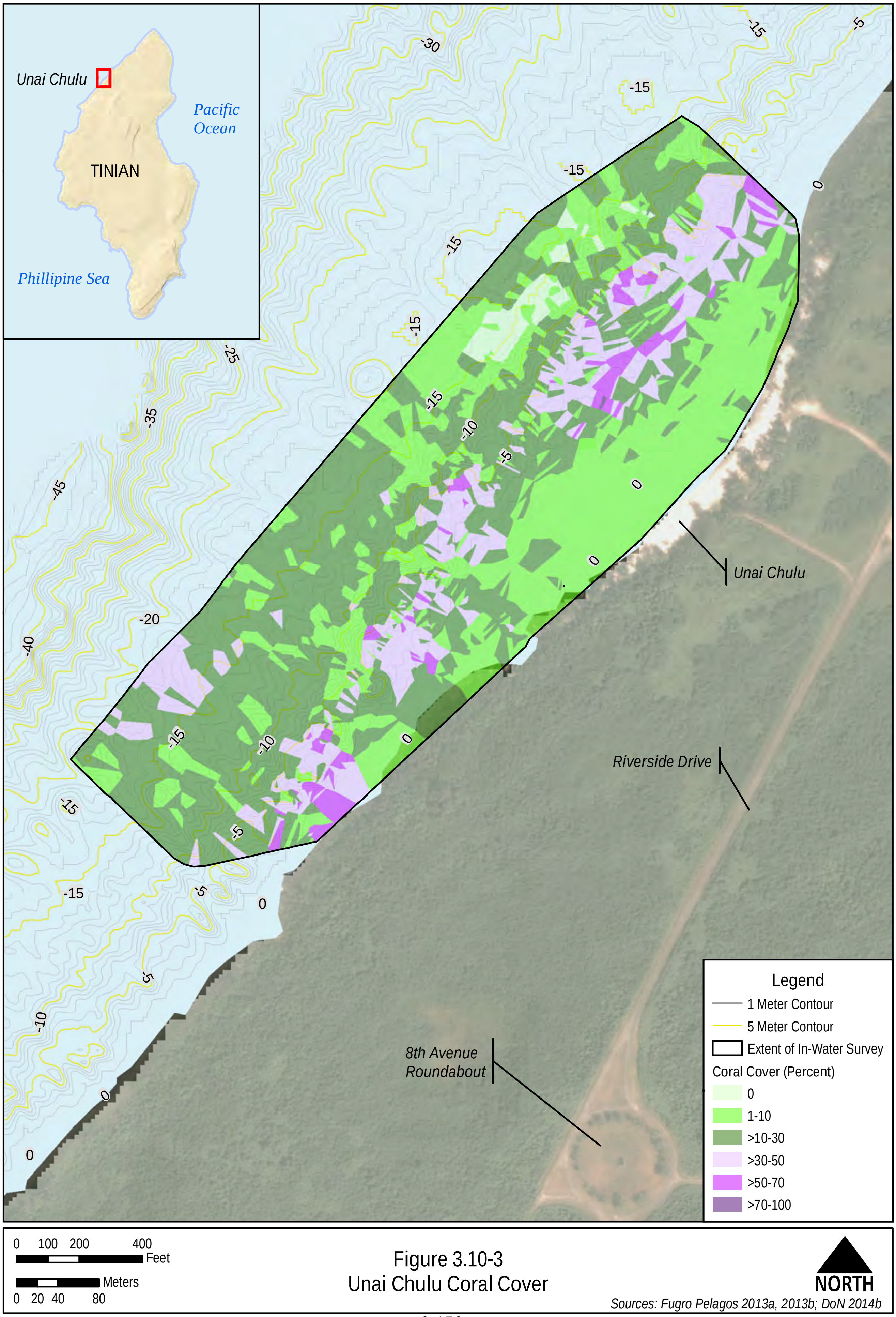


Figure 3.10-3
Unai Chulu Coral Cover

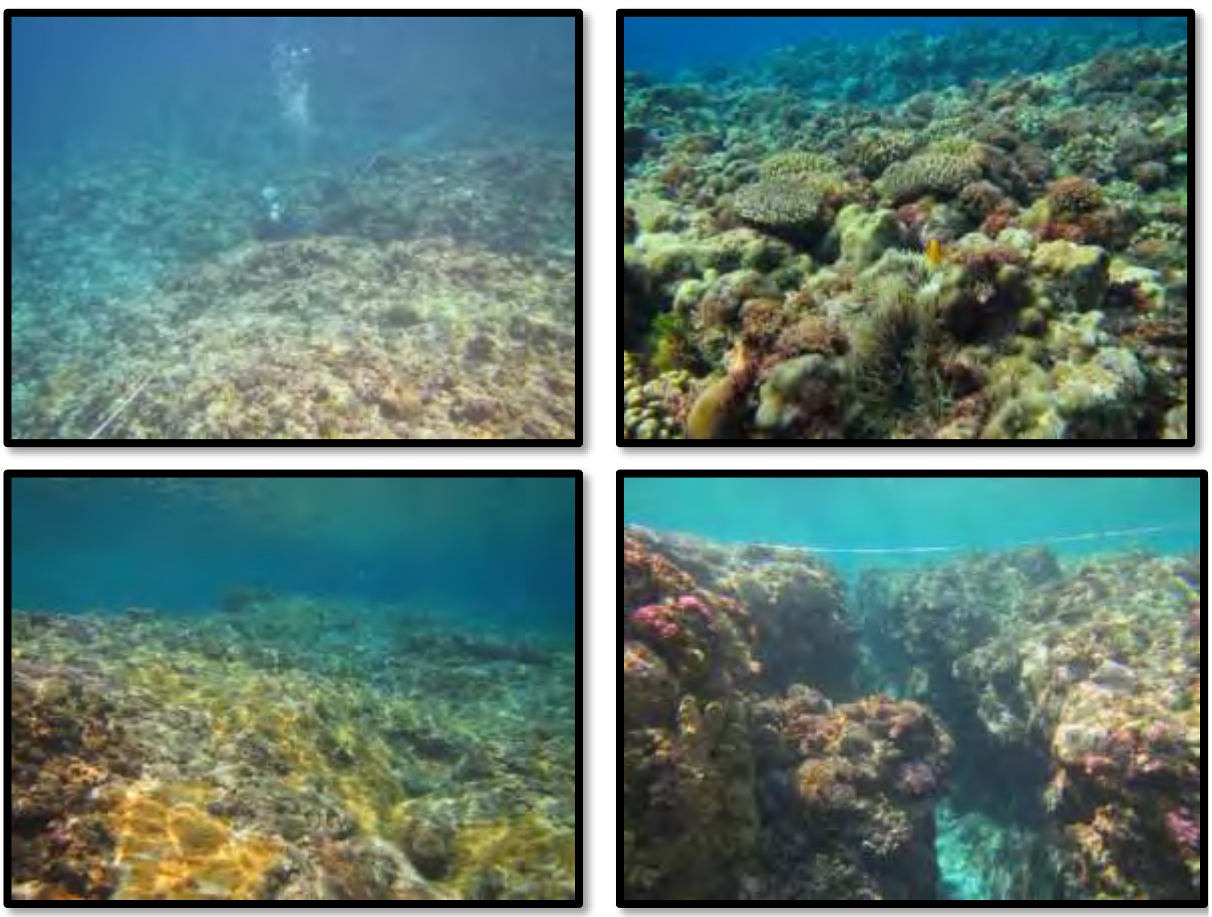
Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.3.2 Unai Babui

The reef area at Unai Babui is physically complex, and includes irregularly spaced grooves that are very deep in the fore reef, with broken rock fragments in the grooves. The bases of the grooves have polished surfaces and polished cobble-sized clasts, indicating high-energy sediment transport and erosion. Many spurs are undercut by grooves that interconnect with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a).

Reef zonation at Unai Babui includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. To the south of the beach, the reef flat zone transitions to a shallow bench that has denser coral cover than the reef flat itself. The habitat is heterogeneous across different depths, particularly the shallow bench to the south of the beach, but is relatively homogeneous within the same depths.

Similar to Unai Chulu, Unai Babui has moderate to high topographic complexity, low to moderate coral cover, low sand cover and patches of very high coral cover (70%-100%). Among the 107 coral species that were recorded during the *Coral Marine Resources Survey* conducted in support of this EIS/OEIS, the most abundant species was *Goniastrea retiformis*, (DoN 2014a). Representative images of Unai Babui are presented below (Photos 3.10-2). Unai Babui coral cover is shown in Figure 3.10-4.



Photos 3.10-2. Representative Images of Unai Babui
(Clockwise from top left: deep fore reef; shallow fore reef; fissure through reef crest; reef crest)

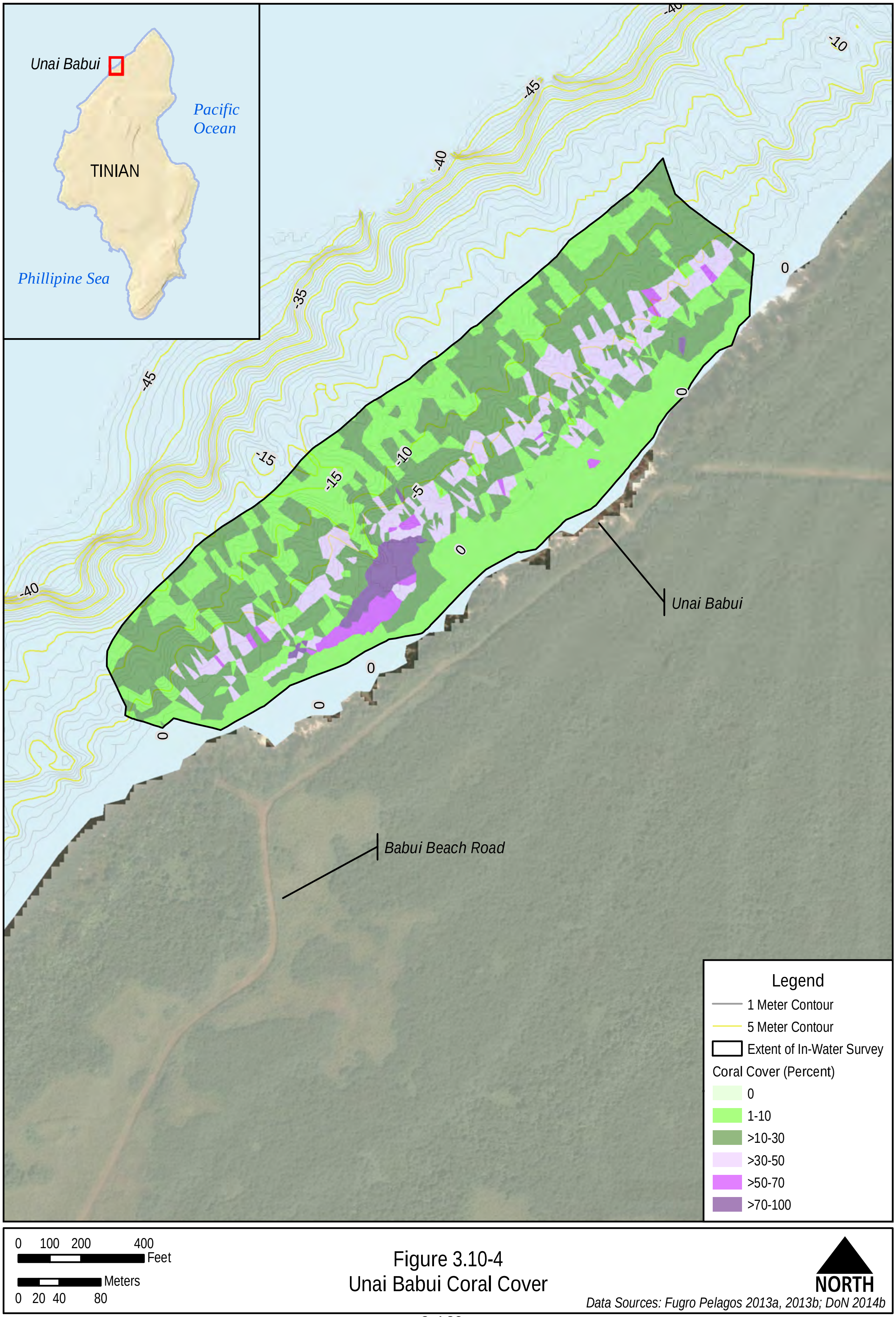


Figure 3.10-4
Unai Babui Coral Cover

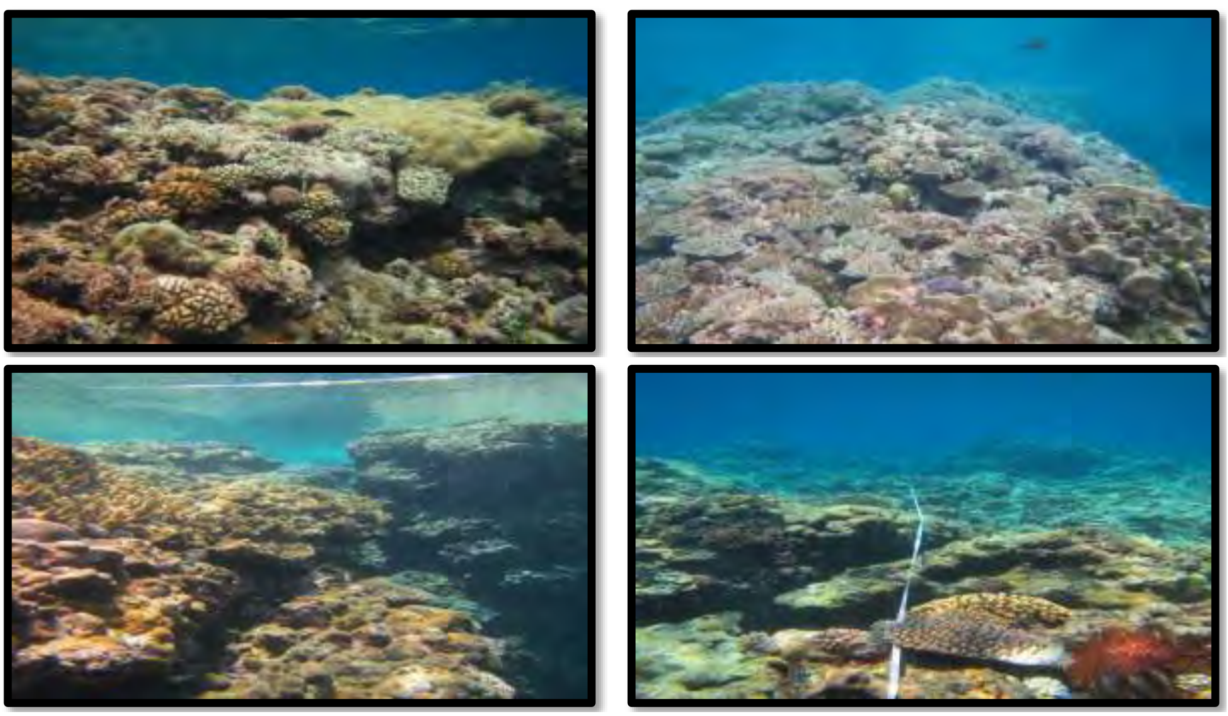
Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.3.3 Unai Lam Lam

The reef area at Unai Lam Lam is physically complex, with regularly spaced grooves that are very deep in the fore reef and transition rapidly to deep fore reef. A groove aligned with the center of the pocket beach is strewn with cobble and boulder-sized rubble, while most other grooves are lined with coarse sand. This feature is a sign of past human disturbance to the groove aligned with the center of the pocket beach. Metal debris observed in this area also suggests past human activities. Many spurs are undercut by grooves interconnecting with other grooves, resulting in a network of tunnels, grottoes, fissures, and chimneys penetrating from the fore reef under the reef crest, and occasionally from under the reef flat (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Reef zonation at Unai Lam Lam includes distinct deep fore reef, shallow fore reef, reef crest, outer reef flat, inner reef flat, and beach zones. The reef crest and outer reef flat are broad and well developed relative to Unai Babui and Unai Chulu. To the south of the beach the reef flat zone transitions to a shallow bench. This zone has high coral cover (90%). The habitat is somewhat heterogeneous across different depths and relatively homogeneous within the same depth, but this distinction is less pronounced than at Unai Chulu and Unai Babui. Zonation is still identifiable, but each zone is richer in species diversity than its counterpart at Unai Chulu and Unai Babui. Unai Lam Lam has several unique coral species and growth forms that are not found at the other surveyed beaches, especially branching Acropora species.

Overall, Unai Lam Lam has moderate to high topographic complexity, moderate coral cover, and low sand cover, except for one large offshore patch of 90-100% sand. Areas of Unai Lam Lam have very high coral cover (70%-90%). Among the 108 coral species recorded, the most abundant coral species was *Goniastrea retiformis* (DoN 2014a). Representative images of Unai Lam Lam are presented below (Photos 3.10-3). Unai Lam Lam coral cover is shown in Figure 3.10-5.



Photos 3.10-3. Representative Images of Unai Lam Lam
(Clockwise from top left: reef crest from inside a groove; shallow fore reef; transition from shallow to deeper fore reef; fissure through reef crest)

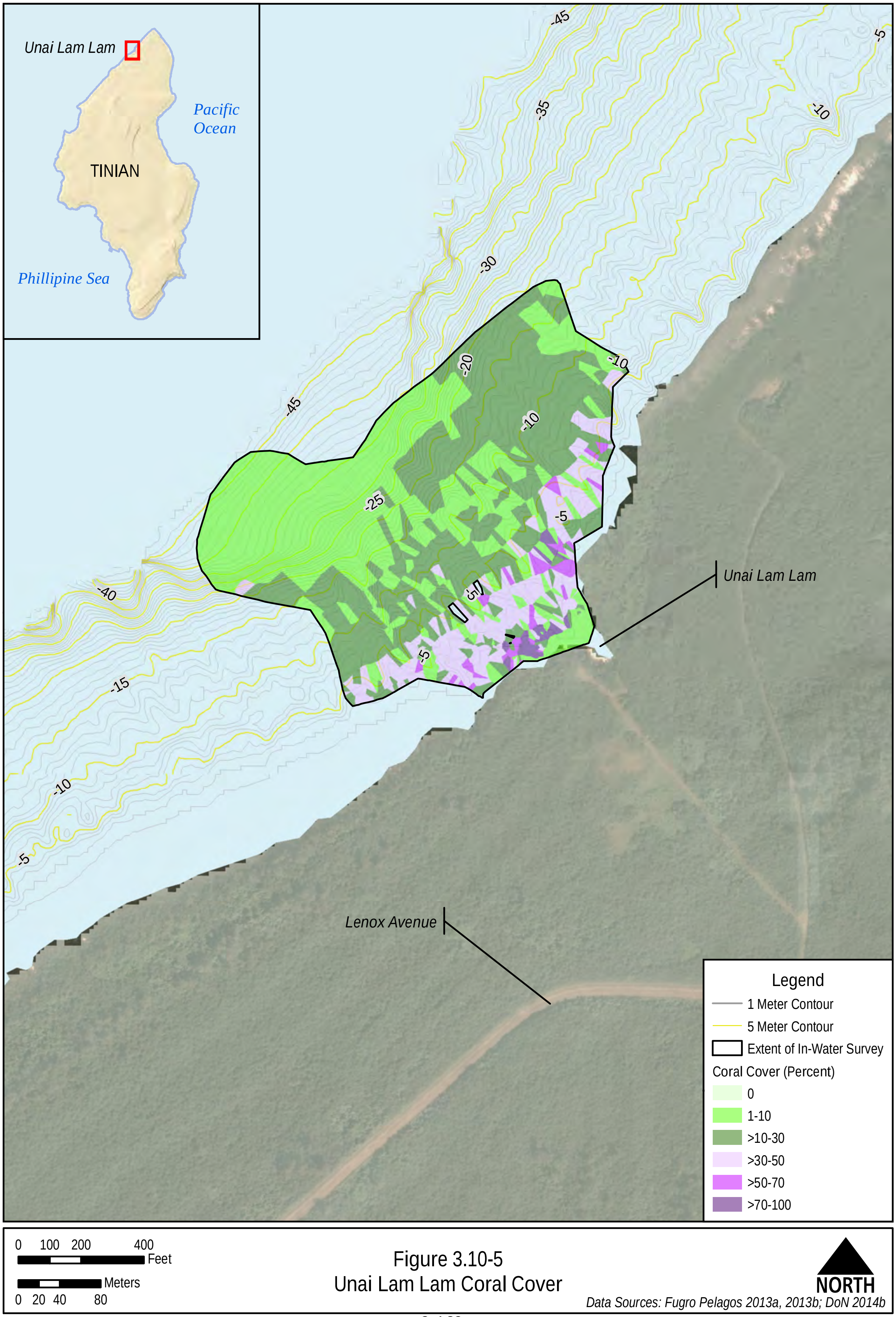


Figure 3.10-5
Unai Lam Lam Coral Cover

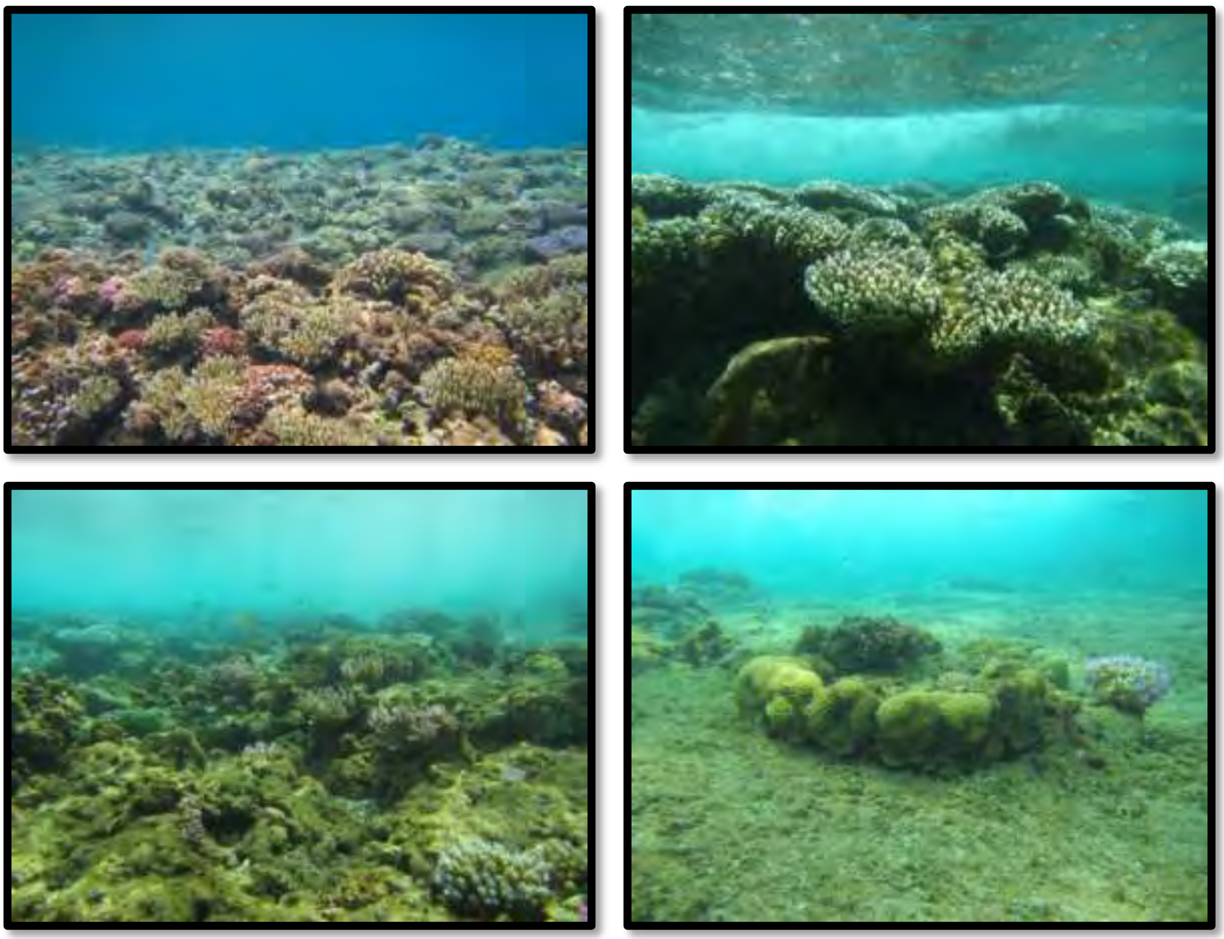
Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.4.3.4 Unai Masalok

The reef area at Unai Masalok is physically complex, and includes regularly spaced grooves that are moderately deep in the fore reef, transitioning quickly to deep fore reef that is much more topographically complex than the deep fore reef at Unai Chulu, Unai Babui, or Unai Lam Lam. Relatively few spurs are undercut or tunneled. Most of the reef flat area has low topographic complexity, low coral cover (10%-30%), and low sand cover. The reef flat area is physically and biologically homogeneous.

Among the 113 coral species that were recorded during the survey, the most abundant species was *Goniastrea retiformis* (DoN 2014a).

The habitat changes abruptly across different depths and is relatively homogeneous within the same depths. Most of the reef flat at Unai Masalok was lacking in numbers and variety of species characteristic of inner reef flat habitat. Representative images of Unai Masalok are presented below (Photos 3.10-4). The reef survey area at Unai Masalok was not contiguous due to sea state conditions. Coral cover within the survey area is shown in Figure 3.10-6.



Photos 3.10-4. Representative Images of Unai Masalok
(Clockwise from top left: shallow fore reef; outer reef crest; outer reef flat; inner reef flat)

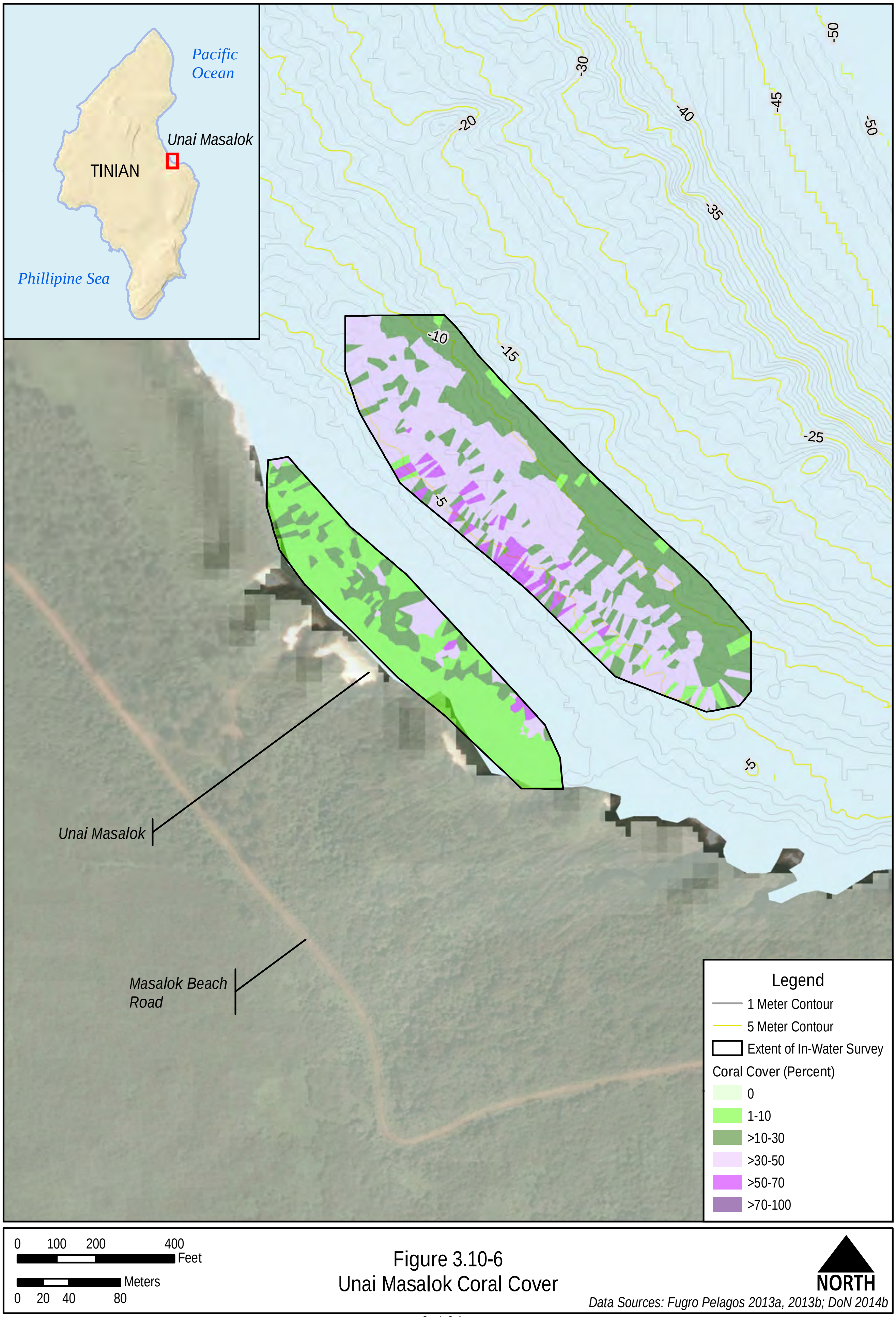


Figure 3.10-6
Unai Masalok Coral Cover

3.10.4.4 Fish

Myers and Donaldson (2003) report 1,106 fish species known in the Mariana Islands and adjacent waters; 1,020 of these are inshore species that inhabit coral reefs. Mariana Archipelago Reef Assessment and Monitoring Program's standard approach to reporting fish species richness and biomass (the total mass of organisms in a given area) is to calculate the number or mass of fish per square meter or per 100 square meters. The Mariana Archipelago Reef Assessment and Monitoring Program found Tinian's total fish biomass is going up over time; however, total fish biomass on Tinian was low compared to other sites surveyed in the CNMI in 2003, 2005, and 2007, respectively.

In 2003, reef sharks made up over half of the overall mean biomass on Tinian. Stingrays (*Dasyatidae*) made up 45% of the total biomass in the 2005 Tinian survey. Barracudas (*Sphyraendidae*) and sharks made up the largest portions of the total fish biomass in the 2007 survey. In 2007, 11 sharks were encountered including whitetip reef sharks (*Triaenodon obesus*), black tip reef sharks (*Carcharhinus melanopterus*) and tawny nurse sharks (*Nebrius ferrugineus*). Total biomass was higher in the 2007 surveys than the previous years (Brainard 2012). The fish biomass recorded for 2007 on Tinian was higher than the average observed for the southern islands, but was still low relative to other islands in the Mariana Islands. Surgeonfish (*Acanthuridae*) and parrotfish (*Scaridae*) accounted for over half the total mean fish biomass when averaged over all three surveys (Brainard 2012).

The Mariana Archipelago Reef Assessment and Monitoring Program's 2003, 2005, and 2007 Tinian surveys found similar fish species richness within the fore reef habitats surveyed at sites around Tinian (Brainard 2012). Overall, the most abundant fish families documented during the Mariana Archipelago Reef Assessment and Monitoring Program surveys on Tinian were surgeonfish, parrotfish, wrasse (*Labridae*), and damselfish (*Pomacentridae*), with the three most common damselfish species being the princess damselfish (*Pomacentrus vaiuli*), jewel damselfish (*Plectroglyphidodon lacrymatus*) and the midget chromis (*Chromis acares*). The two most common surgeonfish species include the striated surgeonfish (*Ctenochaetus striatus*) and the orange-spine unicornfish (*Naso lituratus*) (Brainard 2012).

Tinian, along with Saipan and Rota, supports much of the CNMI's bottomfish fishery, which includes snapper (particularly the long-tail snapper [*Etelis coruscans*]), grouper (particularly the eight-banded grouper [*Epinephelus striatus*]), and the redgill emperor (*Lethrinus rubrioperculatus*) and other emperor-type fish. Managed species targeted by the bottomfish fishing industry are described in more detail in Section 3.10.4.1.6, *Essential Fish Habitat*.

Damselfish live within coral reefs and depend on these reefs for shelter, reproduction, habitat, and food. Other fish species are not as heavily reliant on coral reef habitats. Several damselfish species are currently in decline due to degradation of certain coral reef habitats, caused by mass bleaching events and ocean acidification. Threats such as ocean warming and ocean acidification may directly affect these damselfish species by impairing sensory capabilities, behavior, and aerobic capacity (ability to get oxygen to the muscles) (Center for Biological Diversity 2012).

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. The survey found 265 fish species around Tinian. Unai Chulu had 175 species, Unai Babui had 158 species, Unai Lam had 67 species, and Unai Masalok had 101 species.

3.10.4.5 Special-status Species

3.10.4.5.1 Marine Invertebrates

Seventeen marine invertebrates have been designated by the CNMI Division of Fish and Wildlife as Species of Special Conservation Need. Five of the 17 have been reported in Tinian waters (Berger et al. 2005), see Table 3.10-3.

Table 3.10-3. CNMI Marine Invertebrate Species of Special Conservation Need of Tinian

Common Name/ Scientific Name	*Reported within Tinian Waters*
Ghost Crab (*Ocypode* spp)	No
Rock Crab (*Grapus* spp)	No
Spiny Lobster (*Panulirus* spp)	Yes
Land Hermit Crab (*Coenobita* spp)	No
Surf redfish (sea cucumber) (*Actinopyga mauritiana*)	Yes
Black teatfish (sea cucumber) (*Holothuria whitmaei*)	Yes
Sea urchin (*Toxopneustidae*)	No
Giant clam (*Tridacna* spp)*	Yes
Pectinate venus (*Gafrarium pectinatum*)	No
Common spider conch (*Lambis lambis*)	No
Horned helmet shell (*Cassis cornuta*)	No
Tapestry turban shell (*Turbo petholatus*)	No
Rough turban (*Turbo setosus*)	No
Silver-mouth turban (*Turbo argyrostoma*)	No
Triton's trumpet shell (*Charonia tritonis*)	Yes
Octopus (*Octopus* spp)	No

Note: *Tridacna spp includes the Fluted giant clam (*Tridacna squamosa*) and the Elongate giant clam (*Tridacna maxima*).
Source: Berger et al. 2005.

3.10.4.5.1.1 Coral Species

Twenty-two coral species are listed under the federal Endangered Species Act; 20 of which were newly listed in August 2014. Fifteen of the newly listed species occur in the Indo-Pacific, four are likely to occur in the CNMI, *Acropora globiceps*, *Acropora retusa*, *Pavona diffluens*, and *Seriatopora aculeata* (National Marine Fisheries Service 2014a; Veron 2014).

Based on the *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*), *Acropora globiceps* was the only coral species listed under the federal Endangered Species Act that was reported in Tinian nearshore waters; however the presence of the other three listed coral species is conceivable. *Acropora globiceps* was recorded at Unai Chulu, Unai Babui, Unai Lam, and Unai Masalok (Table 3.10-3) (DoN 2014a). *Acropora globiceps* colonies ranged in size from smaller than 7.9 inches (20 centimeters) to 36.6 square feet (3.4 square meters) (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

Species profiles for the special-status coral species listed in Table 3.10-4 can be found in Appendix L, *Biological Resources Supporting Documentation*.

Table 3.10-4. Special-status Coral Species of Tinian

Coral (Genus/Species)	*Endangered Species Act Status*	*Reported within Tinian Region of Influence*[1]
Acropora globiceps	Threatened	Yes; C B L M [2]
Acropora retusa	Threatened	No
Pavona diffluens	Threatened	No
Seriatopora aculeata	Threatened	No

Notes: [1] The region of influence for marine biological resources includes the waters surrounding Tinian from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2] C = Unai Chulu, B = Unai Babui, L=Unai Lam, and M= Unai Masalok.
Sources: DoN 2014a; National Marine Fisheries Service 2014a.

Acropora globiceps grow in small colonies and are usually described as digitate (having divisions arranged like those of a bird's foot or small hand). Each of the "digits," or branches, has varying size and appearance depending on the level of wave action and exposure; however, branches are always short and compacted closely together. Colonies are found in the intertidal zone, upper reef slopes, and reef flats in water depths shallower than 26 feet (8 meters). *Acropora globiceps* can be found in areas exposed to heavy wave action (Brainard et al. 2011).

Acropora retusa coral colonies are usually brown in color. They have a digitate morphology similar to *Acropora globiceps*, and form plates with thick short branchlets. Axial corallites are indistinct and radial corallites lay flat down the sides of branchlets (Brainard et al. 2011). The species is often confused with others in the digitate group with such as *Acropora globiceps* (Veron 2014). *Acropora retusa* occurs on upper reef slopes and tidal pools. They occur at depths ranging from 1 to 15 feet (0.3 to 5 meters). This species provides habitat structure for organisms small enough to shelter in branches of relatively compact colonies.

Pavona diffluens has a very narrow latitudinal and longitudinal distribution and is found in the region of the Red Sea and Arabian Gulf. It has also been reported in the northern Mariana Islands and American Samoa; however, it is considered unlikely to occur in the CNMI (Brainard et al. 2011). *Pavona diffluens* has been reported in most reef habitats in water depths ranging from 16 feet (5 meters) to 67 feet (20 meters) (Brainard et al. 2011).

Seriatopora aculeata coral colonies have short, tapered branches, typically fused in clumps. They have irregularly distributed corallites and their tentacles are commonly extended during the day. The colonies are pink or cream, and branches are thicker than other *Seriatopora aculeata* (Brainard et al. 2011). *Seriatopora aculeata* occupies shallow reef environments ranging in depths from 10 to 131 feet (3 to 40 meters) (Brainard et al. 2011). With irregular clumps of thick short branches, this species contributes to the overall reef structure and small-volume habitat.

3.10.4.5.2 Fish Species

Special-status fish species documented in the CNMI include the scalloped hammerhead shark (*Sphyrna lewini*), humphead wrasse (*Cheilinus undulatus*), and gray reef shark (*Carcharhinus amblyrhynchos*) (Table 3.10-4). The scalloped hammerhead shark Indo-West Pacific Distinct Population Segment is listed as threatened under the Endangered Species Act. The National Marine Fisheries Service considers the humphead wrasse a Species of Concern. This species has also been designated by the CNMI Division of Fish and Wildlife as a Species of Special Conservation Need. The CNMI also lists the gray reef shark as a

Species of Special Conservation Need (Table 3.10-4) (Berger et al. 2005). Species profiles of the species listed in Table 3.10-5 can be found in Appendix L, *Biological Resources Supporting Documentation*.

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. The humphead wrasse was observed at Unai Lam. The scalloped hammerhead shark was not observed at any site on Tinian during the surveys conducted in support of this EIS/OEIS (DoN 2013b), but it has been observed within the Mariana Islands (Dr. T. Donaldson, University of Guam, personal communication, 2014). It is possible that the Endangered Species Act-listed scalloped hammerhead shark may be present within the vicinity of Tinian, but it has not been documented in the nearshore environment of the CNMI. Tinian is located within the range of this migratory species, and the offshore pelagic waters, coral reefs, and turbid, nearshore waters surrounding the island of Tinian have the potential to serve as foraging, breeding, and nursery habitat for the scalloped hammerhead shark. The possibility that scalloped hammerhead sharks could occur in areas of potential impact by physical disturbance, acoustics, or indirect impacts is considered remote. Such occurrence would probably involve the transient occurrence of a small number of individuals whose most likely response would be to leave the immediate area in response to underwater noise and poor foraging conditions due to previous disturbance to the habitat.

Table 3.10-5. Special-status Fish Species of Tinian

Common Name/ Scientific Name	*Endangered Species Act Status*	*National Marine Fisheries Status*	*CNMI Status*[3]	*Reported within Tinian Region of Influence*
Scalloped hammerhead shark (*Sphyrna lewini)*	Threatened (Indo-West Pacific Distinct Population Segment)	—	None	No[(1)]
Humphead Wrasse (*Cheilinus undulatus)*	None	Species of Concern	Species of Special Conservation Needs	Yes[(2)]
Gray reef shark (*Carcharhinus amblyrhynchos)*	None	None	Species of Special Conservation Needs	Yes[(1)]

Notes: [1]Not observed during surveys in support of the EIS/OEIS (DoN 2014a), but reported in Tinian waters in other sources (Dr. T. Donaldson, University of Guam, personal communication, 2014; Berger et al. 2005).
[2]Observed at Unai Lam during surveys in support of the EIS/OEIS (DoN 2014b).
[3] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.
Sources: Berger et al. 2005; National Marine Fisheries Service 2013, 2014b; DoN 2014a.

3.10.4.5.3 Sea Turtles

Sea turtle species and their expected occurrences in the Tinian region of influence are listed in Table 3.10-6.

Table 3.10-6. Special-status Sea Turtle Species of Tinian

Common Name/Scientific Name	*Endangered Species Act Status*	*CNMI Status* [2]	*Reported within in the Tinian Region of Influence*
Green sea turtle (*Chelonia mydas)*	Threatened	Species of Special Conservation Need	Yes[1]
Hawksbill sea turtle (*Eretmochelys imbricata)*	Endangered	Species of Special Conservation Need	Yes[1]
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	None	Yes

Notes: [1]Observed during 2013 surveys in support of the EIS/OEIS (DoN 2014b).
[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

The green sea turtle occurs in most oceans, including the western, central, and eastern Atlantic, Mediterranean Sea, western, northern and eastern Indian, southeast Asia, and the western, central, and eastern Pacific. In the Pacific, the green sea turtle occurs around most of the islands, including the Hawaiian Island chain, American Samoa, Guam, and CNMI (DoN 2014b). The hawksbill sea turtle occurs throughout the tropics, from 30 degree North latitude to 30 degrees South latitude in the Atlantic, Pacific, and Indian Oceans and associated water bodies, including the Caribbean Sea and Gulf of Mexico. In the Pacific, the hawksbill sea turtle occurs around most islands, including the Hawaiian Islands, American Samoa, Guam, and CNMI. The green turtle and the hawksbill turtle have nearshore resident juvenile populations in the Mariana Islands, based on flipper tag data (Summers et al. 2012). A separate migratory population of nesting green turtles also occurs across the archipelago, based on satellite telemetry data (Summers 2011).

The leatherback turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans; however, is uncommon in the Tinian region of influence (Gilman 2008; Myers and Hays 2006; National Marine Fisheries Service and U.S. Fish and Wildlife Service 1992). Leatherbacks are also the most migratory sea turtles and are able to tolerate colder water than other species. Leatherback and olive ridley turtles are thought to remain primarily in the open ocean throughout their lives. There have been two reliable observations of the leatherback turtle (Hadpei, personal communication, 2013) in pelagic waters. The leatherbacks were sighted by a CNMI sea turtle biologist in 2004 and 2008 during personal recreational offshore fishing southwest of Marpi Reef, approximately 5 miles (8 kilometers) offshore of Banzai Cliff on Saipan. The sightings were identified as adults coming up for breaths of air. One turtle was observed just north of the buoy and one was observed between Banzai Cliff and the buoy.

One olive ridley turtle account (Pritchard 1977) in the Mariana Islands was document in the 1970s and recent available data suggest this species is not present in the region of influence. The loggerhead turtle nests north of the Mariana Islands and migrates to foraging grounds in Mexico; however, oceanographic conditions may be a barrier to its regular occurrence within the Mariana Islands. No sighting of a loggerhead sea turtle has been documented in the Mariana Islands. The rarity of olive ridley and loggerhead sea turtles in the Mariana Islands, in addition to their pelagic existence minimizes the potential of any impacts to these three species from this action to discountable; therefore, these species will not be discussed further in this EIS/OEIS.

Because of continued poaching of both nesting and in-water sea turtles in the populated Southern Mariana Islands (Berger et al. 2005; Maison et al. 2010), sub-adult and adult sea turtles are generally skittish in the presence of humans. Based on observations during the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, Appendix M, *Marine Biology Technical Memo and Survey Reports*), recent recruits and smaller juveniles may not be as adversely conditioned to humans (DoN 2014b). The *Comprehensive Wildlife Conservation Strategy for the CNMI* (Berger et al. 2005) states that the "green sea turtles are considered a delicacy and are generally reserved for special cultural occasions, primarily by the Carolinian community." Poaching of hawksbill sea turtles for the curio trade was also a noted threat in the *Comprehensive Wildlife Conservation Strategy for the CNMI* (Berger et al. 2005).Previous sea turtle research on Tinian is detailed in the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, Appendix M, *Marine Biology Technical Memo and Survey Reports*). The green sea turtle is the only sea turtle species known to commonly occur in nearshore waters of Tinian. Based on 1999-2001 data, there were an estimated 832 green sea turtles within the waters of Tinian in 2001 (Kolinski et al. 2004). Hawksbills are also observed from time to time, and are expected to frequent nearshore areas within the vicinity of known nesting areas, as well as adjacent suitable foraging areas. Recent survey efforts to gain a better understanding of the nearshore habitat use by sea turtles near strategic sites, mostly in Guam, Tinian, and Saipan, have documented hawksbill sea turtles migrating from Tinian to Guam (Jones and van Houtan 2014).

During the July 2013 *Sea Turtle Marine Resource Survey* conducted in support of this EIS/OEIS (DoN 2014b), an estimated 255 sea turtles were observed in Tinian waters. Surveys of various methods were conducted in the northwest, west, southwest, east and northeast zones around the island. Sea turtle densities are not uniform across Tinian. Along the northwestern coast of Tinian, specifically in the waters fronting Unai Chulu, Unai Babui, and Unai Lam Lam, sea turtle densities based on the towboard and swim transect surveys were relatively low. Sea turtle densities on Tinian are highest along the northeast, southeast, and southwest, with high density pockets of sea turtles in sheltered waters of the western coast. The survey estimates the sea turtle population on Tinian to be between 845 and 1,178 individuals. This equals between 46-471 sea turtles per square mile (18-182 sea turtles per square kilometer), depending on survey method used. Approximately 94% of the sea turtles observed were identified as green sea turtles, and approximately 75% of the green sea turtles were juvenile (Photo 3.10-17). Based on the this information, there is an estimated population of 795 to 1,107 green sea turtles and 50 to 71 hawksbill sea turtles in the waters around Tinian (DoN 2014b).

Details on the survey methods (e.g. cliffline surveys, snorkel/scuba swimming surveys, and opportunistic sightings) are provided in the *Sea Turtle Marine Resources Survey Report* (DoN 2014b, see Appendix M, *Marine Biology Technical Memo and Survey Reports*).

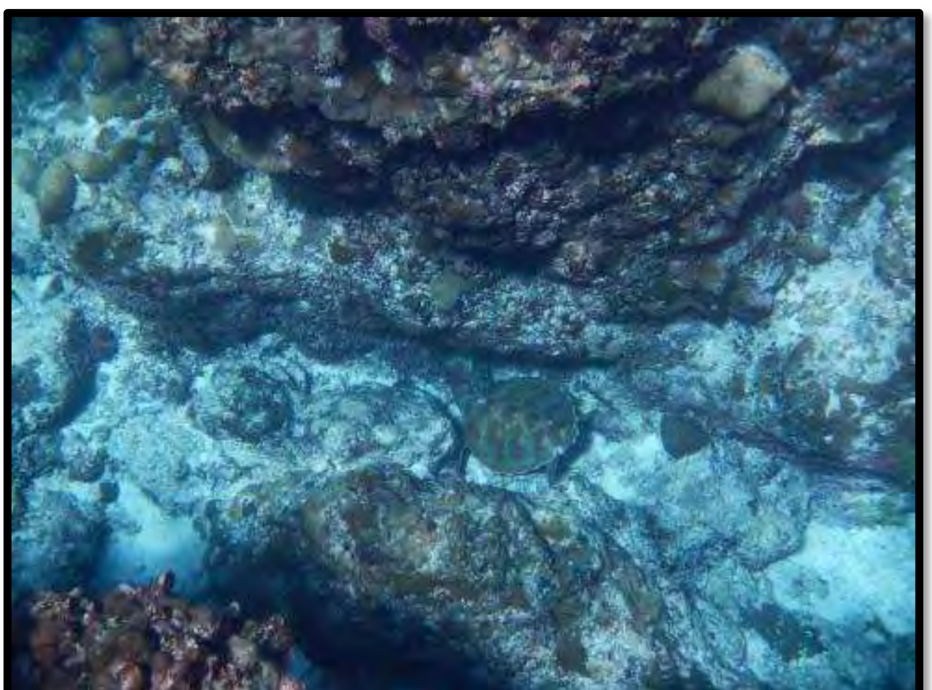


Photo 3.10-17. Juvenile green sea turtle observed feeding during DoN 2013 survey at Unai Chulu on Tinian

3.10.4.5.4 Marine Mammals

Historically, the Mariana Islands were a prominent whaling ground in the eighteenth century, with many catches of humpback whales and a lesser number of sperm whales (Townsend 1935). In the 1960s and 1970s, Japanese whaling companies conducted extensive tag (i.e., discovery tags) and recovery programs for large commercially hunted whale species in the North Pacific, including the Mariana Islands (Masaki 1972; Ohsumi and Masaki 1975). Most of the marine mammal information from this island group before 2006 comes from information attained after a marine mammal strandings/beaching, which is a relatively infrequent occurrence (Kami 1976, 1982; Donaldson 1983; Eldredge 1991, 2003; Trianni and Kessler 2002; Wiles 2005; Trianni and Tenorio 2012) and opportunistic sightings (Eldredge 1991, 2003; Miyashita et al. 1996; Wiles 2005; Jefferson et al. 2006). A marine mammal survey (DoN 2014c) was conducted in support of this EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*) and the survey results are summarized in the following paragraphs.

Earlier marine mammal surveys were limited to large-scale surveys that briefly passed through the Mariana Islands (Miyazaki and Wada 1978; Miyashita et al. 1996; Shimada and Miyashita 2001; Ohizumi et al. 2002). A few single-species surveys were directed primarily at humpback whales (Darling and Mori 1993; Yamaguchi 1995, 1996; Yamaguchi et al. 2002). Beginning in 2006, dedicated marine mammal surveys were conducted in the southern Mariana Islands (Mobley 2007; Oleson and Hill 2010; HDR 2011, 2012; Ligon et al. 2011; Hill et al. 2012, 2013). In January-April 2007 there was a large-scale, visual and acoustic line-transect survey of cetaceans and sea turtles conducted for the entire Mariana Islands Range Complex (DoN 2007). Analysis of some of the data from this Mariana Islands Sea Turtle and Cetacean Survey was later published and has provided current density estimates for some cetaceans in waters surrounding the Mariana Islands (Fulling et al. 2011; Norris et al. 2012).

Several marine mammal species have been detected or observed in the nearshore environment within 3.0 nautical miles (5.6 kilometers) of Tinian (E. M. Oleson and Hill 2010; Fulling et al. 2011; Ligon et al. 2011; Hill et al. 2012, 2013; DoN 2014c). According to the five-year report (Hill et al. 2014), spinner dolphins were the most frequently encountered species (54% of encounters). All of the locations where these encounters occurred were in depths less than 300 meters, and the vast majority of the locations were in depths less than 100 meters. Spinner dolphins were also encountered at offshore reefs (Marpi Reef and Rota Bank; 17-18 kilometers from shore). Ligon et al. (2011) did not sight spinner dolphins off Tinian during a survey around the island, but did report anecdotal evidence of ferries seeing spinner dolphins off Tinian Harbor on the southwestern coast of the island. This species is highly likely to be island-associated with single groups associated with more than one island. No individuals have been documented moving between the southern islands of the CNMI and Guam or Rota Bank. Genetic evidence suggests a more diverse population than the visual data supports. Martien et al. (2014) suggest that the genetic transfer within the Marianas may be facilitated by offshore individuals that make temporary visits to nearshore populations or by males moving among the insular populations.

According to the five-year report (Hill et al. 2014), pantropical spotted dolphins were the second most frequently encountered species. The groups were encountered in the widest range of depths, as well as the deepest depths (333 meters to 3012 meters). Bottlenose dolphins ranked third highest in encounter rates. In addition, one sighting of spotted dolphins (offshore of Saipan near Malakis Reef a.k.a Ruby Seamount) was the farthest from shore (52.8 kilometers) of all cetacean encounters. Four groups of bottlenose dolphins were observed during encounters with one or more other species (short-finned pilot whales, false killer whales, rough-toothed dolphins, and spinner dolphins). Their locations ranged 18-734 meters in depth and 0.3-18.7 kilometers distance from shore. Genetic analysis has indicated that bottlenose dolphins around the Mariana Islands contain genetic material common with Fraser's dolphin (*Lagenodelphis hosei*), a pelagic dolphin species. This suggests that the local population has some level of hybridization with Fraser's dolphin (Martien et al. 2014). Bottlenose dolphins would be expected to have island associated and pelagic populations. Photo-identification and telemetry data suggest that a nearshore population is distributed among the southern islands of CNMI and as far north as Sarigan in the Northern Mariana Islands (Martien et al. 2014).

According to the five-year report (Hill et al. 2014), short-finned pilot whales were the fourth most observed species by National Marine Fisheries Service. They were encountered in depths that ranged from 215 meters to 967 meters. Two groups of pilot whales were associated with bottlenose dolphins. Genetic analysis revealed significant genetic differences between individuals off Saipan, Tinian, and Aguigan (3-Islands complex) and those collected from individuals off Guam and Rota suggesting limited gene flow and interaction between the populations (Martien et al. 2014). Individuals resighted between these locations suggest that the genetic differences may be a reflection of the groups not mixing socially, that there is male-mediated gene flow, or that the 3-islands region is an area of overlap between the two populations, one population's range extending to the north and the other extending south to Guam (Martien et al. 2014).

National Marine Fisheries Service false killer whale encounters occurred in depths that ranged from 88 meters to 2107 meters and distances from shore of 0.7-7.9 kilometers (Hill et al. 2014). Blainville's beaked whale and Cuvier's beaked whale may also occasionally occupy the waters near Tinian, as they have been acoustically detected; however, these species have not been confirmed within 3.0 nautical miles (5.6 kilometers) of shore (Baumann-Pickering et al. 2012; DoN 2014c). The humpback whale, minke whale, sei whale, pygmy killer whale, rough-toothed dolphins, short-finned pilot whale, blue whale, and fin whale are also known to occur in Tinian waters as discussed below (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014). However, the blue whale and fin whale have been heard in Tinian waters; however, blue whale and fin whale calls can be heard over great distances (thousands of miles) and cannot be used to determine the presence of these species in particular areas.

Sperm whales have been visually and acoustically detected near Tinian (Hill et al. 2012, 2013; Norris et al. 2012; DoN 2014c). Sperm whales were encountered three times by National Marine Fisheries Service, at depths of 374 meters, 1971 meters, and 1617 meters depth, at varying distances from land (1.1 kilometers, 22.0 kilometers and 19.4 kilometers, respectively (Hill et al. 2014). Evaluation of the sperm whale acoustics suggests the CNMI waters are predominantly used by females with possible social links between the eastern and western North Pacific Ocean (Hill et al. 2013).

Humpback whales have been observed within 3.0 nautical miles (5.6 kilometers) of Tinian during the winter and spring months (Hill et al. 2012, 2013; DoN 2014c). Humpback whales currently are not considered to have island-associated populations due to their annual migrations (Hill et al. 2013; DoN 2014c; DoN 2007). Potential breeding behaviors, including singing) have been acoustically and visually documented in the nearshore waters of Tinian and Saipan (Norris et al. 2012; DoN 2014c; DoN 2007). Observed potential breeding behaviors suggest these areas may represent important wintering/breeding habitats (Fulling et al. 2011; Norris et al. 2012; DoN 2014c; DoN 2007). In addition, research indicates that there is overlap of acoustic features between humpback whales in the waters of Hawaii and the CNMI, as well as possibly with the Philippines (Norris et al. 2012).

Minke whales have been acoustically detected in the proximity of the Mariana Islands during the winter and spring (DoN 2014c). Acoustic detections have originated from the waters east of Tinian and Saipan, near some of the deepest parts of the Mariana Trench (Norris et al. 2012). It is believed that these waters likely represent wintering areas for minke whales. Sei whales were visually and acoustically detected during the winter/spring surveys of Norris et al. (2012), with most sightings associated near, but not in, the deepest parts of the Mariana Trench. Previous studies have found sei whales to be a frequently sighted species (DoN 2007; Fulling et al. 2011).

Melon-headed whales have been sighted within 3.0 nautical miles (5.6 kilometers) of the coast of Tinian (Oleson and Hill 2010; Fulling et al. 2011; Hill et al. 2012, 2013). Melon-headed whales have been encountered twice by National Marine Fisheries Service in relatively large group sizes (300-400 animals at a depth of 1,014 meters 15.1 kilometers from shore and approximately 100 animals at a depth of 1,975 m 6.5 kilometers from shore (Hill et al. 2014).

Acoustic and visual data collected during the summer and winter-spring months documented eight marine mammal species in Tinian waters during both time periods (Hill et al. 2013). These include common bottlenose dolphins, false killer whales, pantropical spotted dolphins, pygmy killer whales, rough-toothed dolphins, short-finned pilot whales, spinner dolphins and sperm whales (DoN 2007, 2014c; Norris et al. 2012; Hill et al. 2013). Rough-toothed dolphins were encountered at depths that ranged from 260 meters to 616 meters and the distances from shore were 0.4-10.4 kilometers (Hill et al. 2014).

In total, 14 marine mammal species have been documented in the waters surrounding Tinian, with 8 confirmed within 3.0 nautical miles (5.6 kilometers) of the shore (Mobley 2007; E. M. Oleson and Hill 2010; Fulling et al. 2011, 2011; Hill et al. 2012, 2013; Norris et al. 2012; Trianni and Tenorio 2012; DoN 2014c; DoN 2007). These species are presented in Table 3.10-7. Species profiles for the species listed in Table 3.10-6 can be found in Appendix L*, Biological Resources Supporting Documentation.*

Table 3.10-7. Marine Mammals Species with Reported Occurrence in the Region of Influence Surrounding Tinian

Common Name/Scientific Name	***Marine Mammal Protection Act Status[1]***	***Endangered Species Act Status***	***CNMI Status[2]***	***Regional Occurrence in Guam-CNMI Waters[3]***		***Reported within the Tinian Region of Influence[4]***
				Summer (Jun-Nov)	***Winter (Dec-May)***	
Sperm whale (*Physeter macrocephalus*)	Depleted	Endangered	-	Regular	Regular	Yes
Sei whale (*Balaenoptera borealis*)	Depleted	Endangered	-	Rare	Regular	No
Blue whale (*Balaenoptera musculus*)	Depleted	Endangered	-	Rare	Rare	No
Fin whale (*Balaenoptera physalus*)	Depleted	Endangered	-	Rare	Rare	No

Table 3.10-7. Marine Mammals Species with Reported Occurrence in the Region of Influence Surrounding Tinian

Common Name/Scientific Name	*Marine Mammal Protection Act Status*[1]	*Endangered Species Act Status*	*CNMI Status*[2]	*Regional Occurrence in Guam-CNMI Waters*[3]		*Reported within the Tinian Region of Influence*[4]
				Summer (Jun-Nov)	*Winter (Dec-May)*	
Humpback whale (*Megaptera novaeangliae*)	Depleted	Endangered	-	Rare	Regular	Yes
Common Minke whale (*Balaenoptera acutorostrata*)	-	-	-	Rare	Regular	No
Short-finned pilot whale (*Globicephala macrorhynchus*)	-	-	-	Regular	Regular	Yes
False killer whale (*Pseudorca crassidens*)	-	-	-	Regular	Regular	Yes
Melon-headed whale (*Peponocephala electra*)	-	-	-	Regular	Regular	Yes
Common bottlenose dolphin (*Tursiops truncatus*)	-	-	-	Regular	Regular	Yes
Pantropical spotted dolphin (*Stenella attenuata*)	-	-	-	Regular	Regular	Yes
Spinner dolphin (*Stenella longirostris*)	-	-	Species of Special Conservation Need	Regular	Regular	Yes
Blainville's beaked whale (*Mesoplodon densirostris*)	-	-	-	Regular	Regular	No
Cuvier's beaked whale (*Ziphius cavirostris*)	-	-	-	Regular	Regular	No

Notes:[1] Status from Carretta et al. 2014. All marine mammals are protected under the Marine Mammal Protection Act. Populations or stocks that have fallen below the optimum sustainable population level are considered "Depleted." The Hawaii stocks of sperm whale, sei whale, blue whale, fin whale, and the American Samoa stock of humpback whale are also listed as "Strategic" under the Marine Mammal Protection Act; this status would apply if research determines that these are the stocks that inhabit CNMI waters.

[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

[3] Regular = a species that occurs as a regular or usual part of the fauna of the area, regardless of how abundant or common it is; Rare = a species that occurs in the area only sporadically. Occurrence designations from the Navy's Mariana Islands Marine Resource Assessment (DoN 2012/2013, updated with new information as described in DoN 2013, (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014).

[4] The region of influence for marine mammals includes the waters surrounding Tinian from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. However, the potential for acoustic effects due to pile driving/extraction extends to approximately 7.3 nautical miles (13.6 kilometers) from shore.

Sources: DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014.

The *Marine Mammal Survey* conducted in support of this EIS/OEIS (Appendix M, *Marine Biology Technical Memo and Survey Reports*) collected data about the occurrence and distribution of mammals around Tinian and Pagan. The study area selected for the survey was between 0 and 3.0 nautical miles (5.6 kilometers) from the coast of Pagan and Tinian; which is the same as the region of influence for this EIS/OEIS. Data collection events were conducted on the leeward inshore waters of Tinian in 2 days. A total of 38.8 nautical miles (71.8 kilometers) of predetermined transect lines were completed at Tinian and no marine mammals were sighted.

3.10.5 Pagan

3.10.5.1 Marine Habitats

The Pagan coastline is rocky and rugged, but several beaches allow access to the northern part of the island (Sukhraj et al. 2010). Pagan is a younger active volcanic island, and its coral communities are mostly a thin layer on top of igneous substrate, rather than built-up limestone reef (Suhkraj et al. 2010). In general, Pagan has patch reef habitat, particularly on the southern half of the island and in the deeper waters adjacent to South Beach (Suhkraj et al. 2010; DoN 2014a). Green, Red, and Blue Beach are on the west (leeward) shore of Pagan. North Beach is a small, isolated beach on the northern tip of the island. South Beach is a long, crescent-shaped beach on the east (windward) side of Pagan that experiences constant wave energy due to the persistent trade winds from the east. Gold Beach is also on the windward side of Pagan and is located at the end of an irregularly shaped, cliff-lined cove (DoN 2014a).

Figure 3.10-7 provides an overview of marine habitat around Pagan. Table 3.10-8 summarizes the amount of various physical characteristics (e.g., coastline, seafloor area, total reef habitat, and reef flat) for the Mariana Islands, and Pagan.

Table 3.10-8. Estimates of Select Total Physical Characteristics Compared to Pagan

Physical Characteristics	*Mariana Islands (†MC)*	*Pagan (†VHC)*
Coastline	313 miles	25 miles
Seafloor area from 0-98 feet (0-30 meters) depth	49,984 acres	4,025 acres
Total Reef Habitat	65,920 acres	4,416 acres
Reef flat‡	1,728 acres mostly on Guam	Possibly 0.22 acre

Notes: † Estimations. See below for estimation confidence levels below; ‡ other habitat types (i.e., reef crest, fore reef, and deep bank), or particular values could only be approximated with confidences below Medium Confidence. Because their inclusion would not be informative, the estimates were not presented. Measurements and estimations have different uncertainties associated with them. For the purposes of this discussion, uncertainty is expressed using the Intergovernmental Panel on Climate Change treatment of uncertainties (Intergovernmental Panel on Climate Change 2007, 2013). The uncertainty guidance draws a distinction between levels of confidence in scientific understanding and the likelihood of specific results. Confidence and likelihood here are distinct concepts but are often linked in practice. The standard terms used to define levels of confidence in this report follow the Intergovernmental Panel on Climate Change approach, namely: VHC= Very high confidence; MC= Medium confidence;.

Sources: Analytical Laboratories of Hawaii 2004; Bearden et al. 2008; Brainard et al. 2012; National Oceanic and Atmospheric Administration and National Centers for Coastal Ocean Science 2005; Riegl et al. 2008.

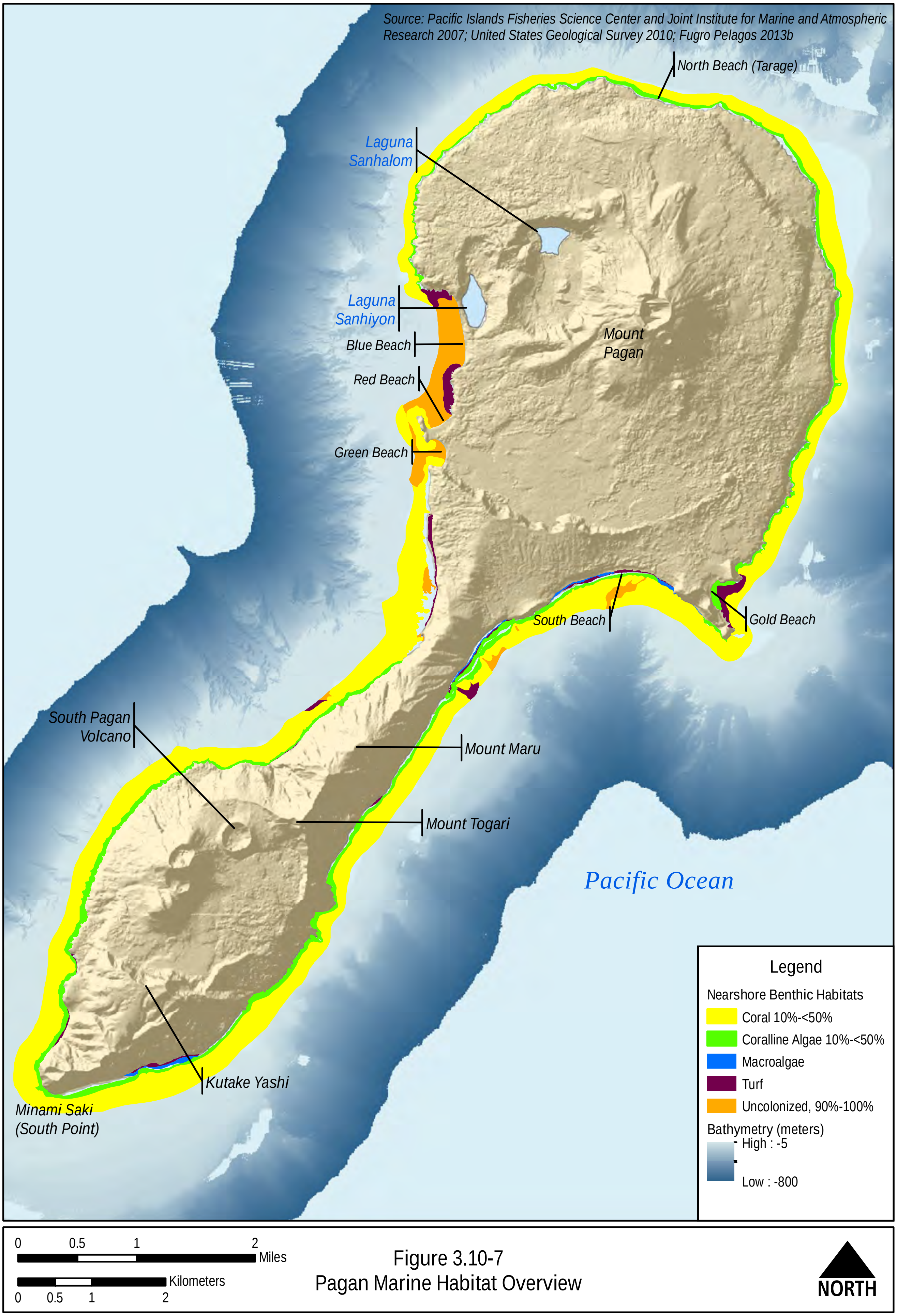


Figure 3.10-7
Pagan Marine Habitat Overview

3.10.5.1.1 Hard Shores

Coastline within the region of influence for Pagan is dominated by hard shores, as is the case for the CNMI in general, though Pagan is interspersed with soft shores (resulting in beaches that allow access to the northern part of the island). In the vicinity of Blue Beach, Sukhraj et al. (2010) noted the northern and southern ends of Laguna Bay have hardened shorelines extending into the ocean (hard bottom habitat).

3.10.5.1.2 Soft Shores

Soft shore habitat in Pagan includes the following beaches: North Beach, Gold Beach, South Beach, Green Beach, Red Beach, and Blue Beach. In the general vicinity of South Beach, Sukhraj et al. (2010) determined that the beach (soft shore) immediately transitions to hard bottom habitat (spur-and-groove formations). This area is exposed to high energy conditions due to onshore winds and lack of a protective embayment.

In the southern portion of Blue Beach, Sukhraj et al. (2010) noted there is a semi-protected embayment (Laguna Bay), this beach does not have a reef flat, having instead a sandy bottom with occasional rocks and boulders to a depth of at least 30 feet (10 meters). Similarly, surveys performed in the vicinity of Green Beach noted the lack of a reef flat and a sandy substrate with sporadic rocks and patches of coral (hard bottom) to the north and south of the sandy area. A semi-protected embayment in the vicinity of Red Beach also lacks a reef flat and has a sandy bottom bounded to the north and south by patches of coral (hard bottom).

3.10.5.1.3 Hard Bottoms

Hard bottom habitat in the South Beach region is characterized by large coral reef features (reef benches and platforms) that are exposed at low tide and decrease rapidly to depth beyond the reef flat boundary (Suhkraj et al. 2010).

The distribution and cover of hard bottom habitat consisting of coral reef around Pagan are described in detail under Section 3.10.5.3, *Marine Invertebrates,* and general coral nearshore benthic habitat is illustrated in Figure 3.10-7. Coral reef habitat (hard bottom) covers approximately 4,416 acres (1,787 hectares) of the area around Pagan and is estimated to have 0.22 acre (0.08 hectare) of reef flat (Brainard 2012).

3.10.5.1.4 Soft Bottoms

There are no lagoons in Pagan (Minton et al. 2009).

3.10.5.1.5 Aquatic Beds

There are no mangrove areas around Pagan (International Business Publications, USA 2011) and seagrass was not noted in any of the surveys referenced for this section. Detailed information on macroalgal cover within the region of influence can be found under Section 3.10.5.2, *Marine Flora.*

3.10.5.1.6 Essential Fish Habitat

Designated Essential Fish Habitat categories for Pagan are those defined for Pacific pelagics, bottomfish and seamount groundfish, crustaceans, and coral reef ecosystems (Western Pacific Regional Fishery

Management Council 2009). The entire water column and seafloor, from the shoreline to the boundary of the Exclusive Economic Zone, is considered Essential Fish Habitat for at least one species.

3.10.5.2 Marine Flora

In 2003, mean macroalgae cover on Pagan fore reefs was 46% (Brainard 2012). The northernmost part of the west region of the island had the highest mean macroalgal cover (Brainard 2012). The dominant habitat in this area was spur and groove pavement with rock boulders. Sand flats were interspersed throughout the area. Mean cover of crustose coralline red algae on Pagan fore reef habitats was 7% in 2003. The highest cover was found on west region of the island on pavement and rock boulder habitats.

In 2005, mean macroalgae cover on Pagan fore reefs habitats was 18%. The highest areas of cover were in the north region of the island west of Tarage (North Beach). The 2005 survey reported 12% mean cover of crustose coralline red algae with the highest cover in the south region of the island. Mean macroalgae was reported at 17% in 2007 with the highest cover in the south region of the island. *Asparagopsis* (red algae), *Padina* (brown alga), *Halimeda* (green alga), and cyanobacteria were the dominate species reported (Brainard 2012). Mean crustose coralline red algae cover was 14% in 2007. Unlike other years, the area with the highest cover was along the northwest coast of the island.

Overall, the highest cover of macroalgal populations were in the northern areas of Pagan and included *Halimeda* (green alga)*, Caulerpa* (green algae)*, Neomeris* (green alga)*, Padina* (brown alga)*, Asparagopsis* (red algae)*, and Liagora* (red algae)*.*

3.10.5.3 Marine Invertebrates

Like Tinian, the most common types of non-coral invertebrates found along Pagan's reefs are starfish, sea urchins, sea cucumbers, mollusks, and tube worms. During the *Coral Marine Resource Survey* conducted in support of this EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*), giant clams were observed at all six surveyed beaches on Pagan (DoN 2014a). Spider conchs were observed at Green and Red Beaches (DoN 2014a).

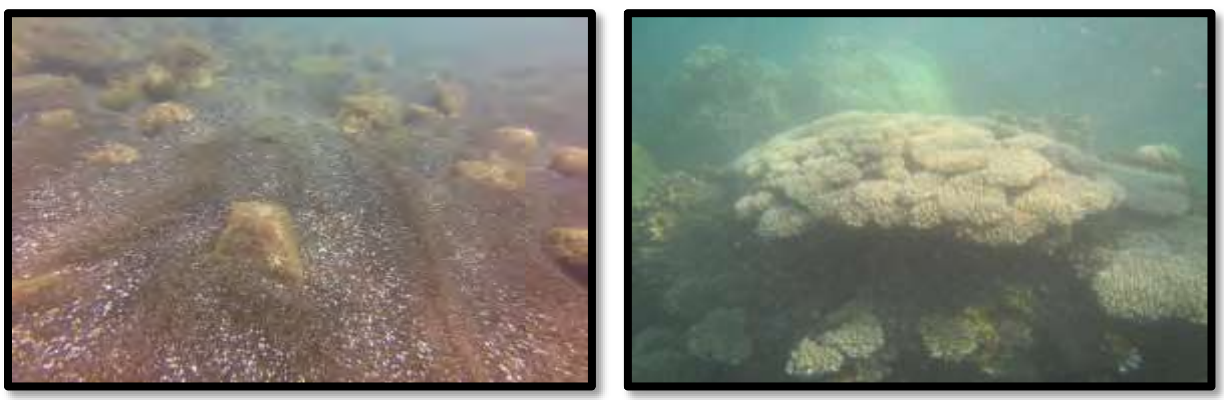
Pagan is surrounded by heterogeneous habitat types including shore-attached fringing reefs, non-constructional volcanic sediments (from boulders to sand beaches), uncolonized volcanic substrate, and uncolonized primary coral framework (old coral limestone that currently only supports scattered corals), which is unique to Pagan (Riegl and Dodge 2008; Houk and Starmer 2010). Pagan has no reef flat habitats that can be readily measured. Patch reef habitat is located on the southern half of the island and in the deeper waters adjacent to South Beach (Suhkraj et al. 2010; DoN 2014a). Most of the reef habitat on Pagan has 5-20% coral cover, but patches to 50% cover are not uncommon (Suhkraj et al. 2010; Brainard et al. 2011; DoN 2014a).

A *Coral Marine Resource Survey*, provided in Appendix M (*Marine Biology Technical Memo and Survey Reports*), was conducted in support of this EIS/OEIS and is summarized in the subsections below. The survey focused on substrate shallower than 12 feet (4 meters) (DoN 2014a).

3.10.5.3.1 Green Beach

Overall, Green Beach has low topographic complexity, low coral cover, and high sand cover. There is a relatively large and contiguous area in the center of Green Beach that has especially low cover for organisms and high cover for sand. The central portion of Green Beach is largely devoid of sessile plants or animals. The visibility and apparent water quality at Green Beach is degraded relative to the other leeward beaches on the island, potentially from human sources. The seafloor had a number of kitchen scraps including chicken and cow bones (DoN 2014a).

A total of 70 coral species were recorded during the survey. Green Beach has relatively large heads of *Porites* corals, with one of the largest measuring 98 feet (29.8 meters) in circumference. These large corals were found across the entrance to Green Beach oriented from north to south, though many were also growing throughout the northern and southern rock formations. Representative images (Photos 3.10-28) of Green Beach are presented below. Green Beach coral cover is shown in Figure 3.10-8 (DoN 2014a).



Photos 3.10-28. Representative Images of Green Beach
(Center of beach; corals on northern rocky outcrop)

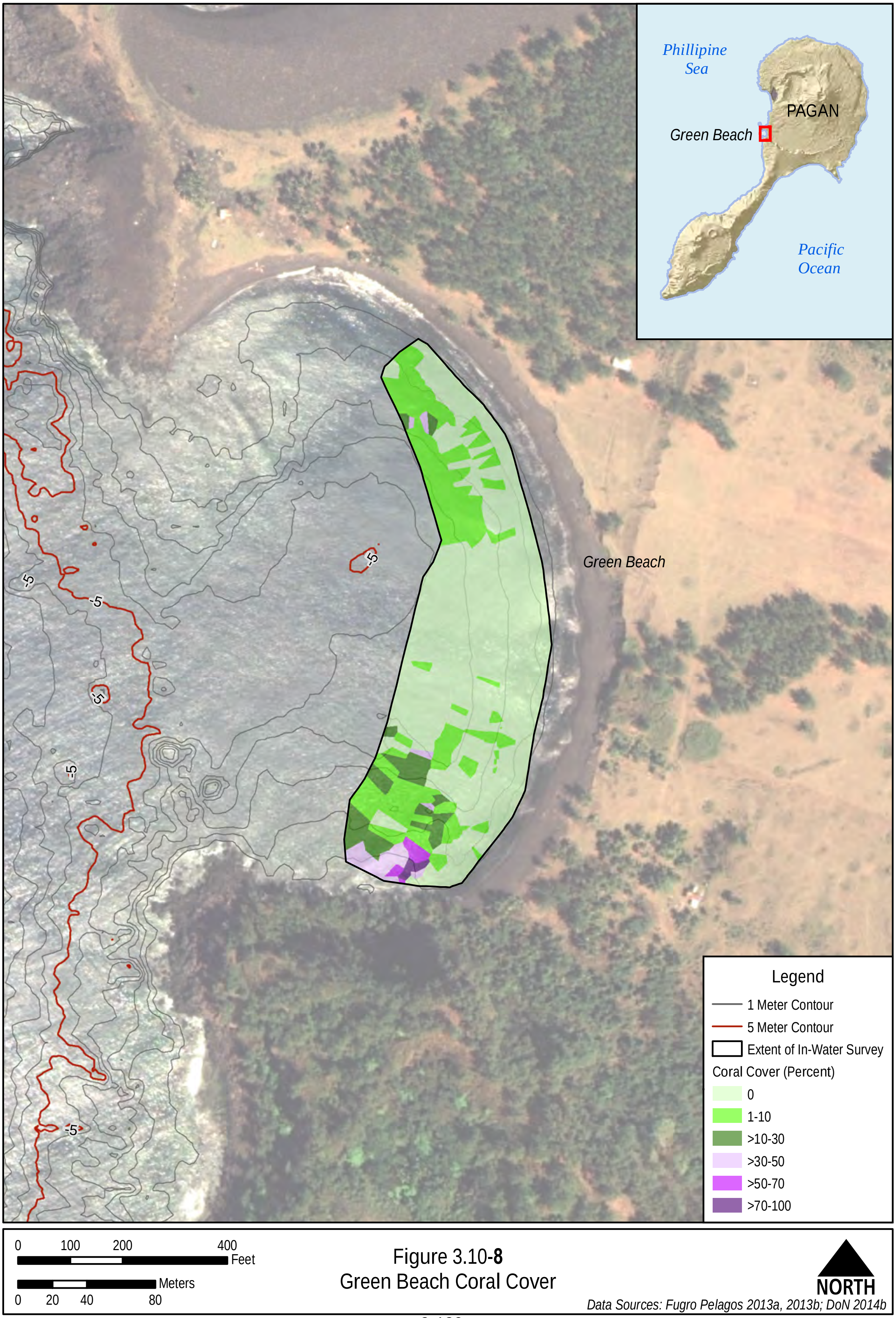
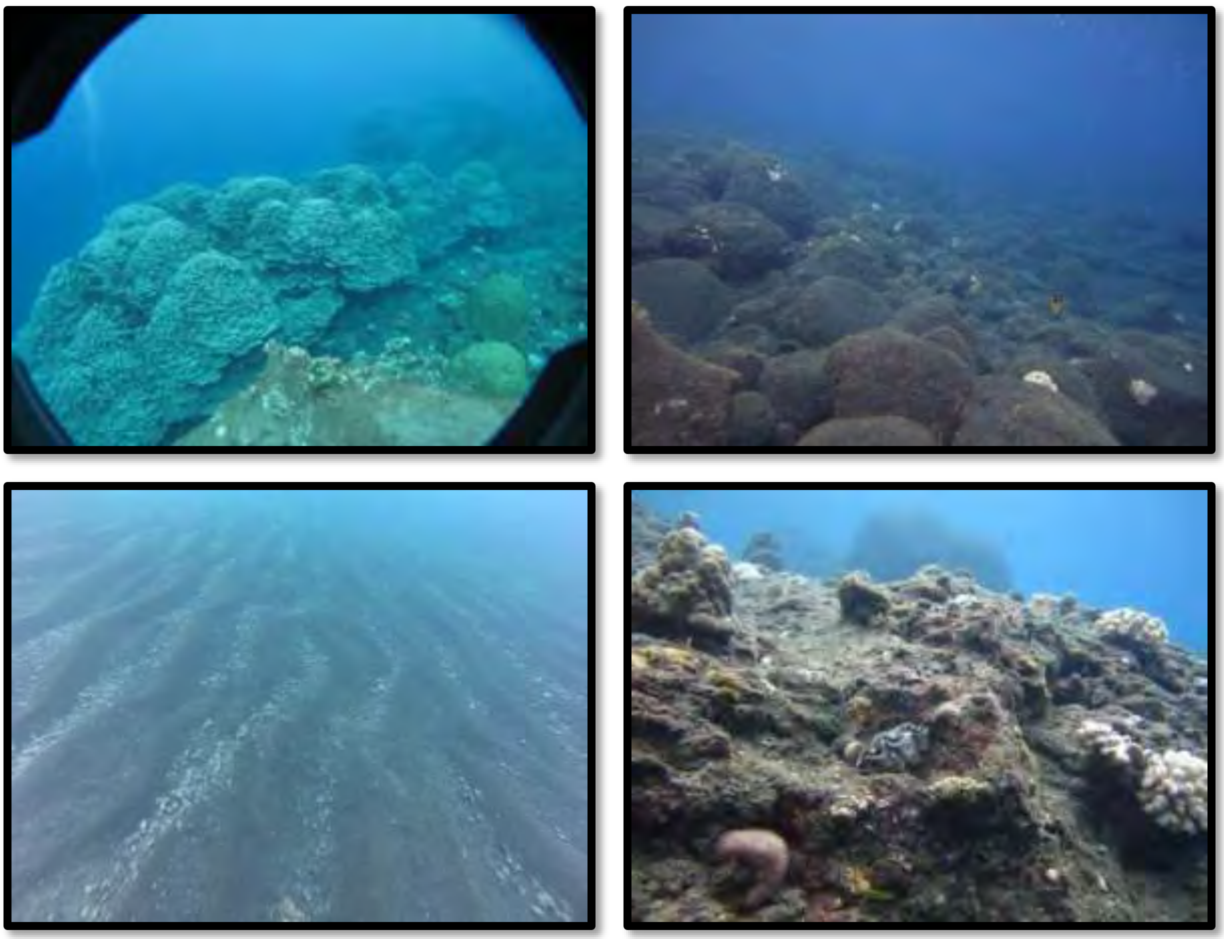


Figure 3.10-**8**
Green Beach Coral Cover

3.10.5.3.2 Red Beach

The majority of the area surveyed at Red Beach has low topographic complexity, low coral cover, and high sand cover. No portions of the Red Beach seafloor were of high complexity, and none had moderate or high coral cover. A total of 90 coral species were recorded during the survey (DoN 2014a). The majority of the coral was observed at depths shallower than 12 feet (4 meters) at the headlands to the north and south of Red Beach, but not directly in front of the sandy beach. Representative images of Red Beach are presented below. Red Beach coral cover is shown in Photos 3.10-29 and Figure 3.10-9.



Photos 3.10-29. Representative Images of Red Beach

(Clockwise from left: large *Porites rus* colony on southern headland; northern headland – inner; southern headland, showing many small coral colonies and juvenile giant clam; center of beach)

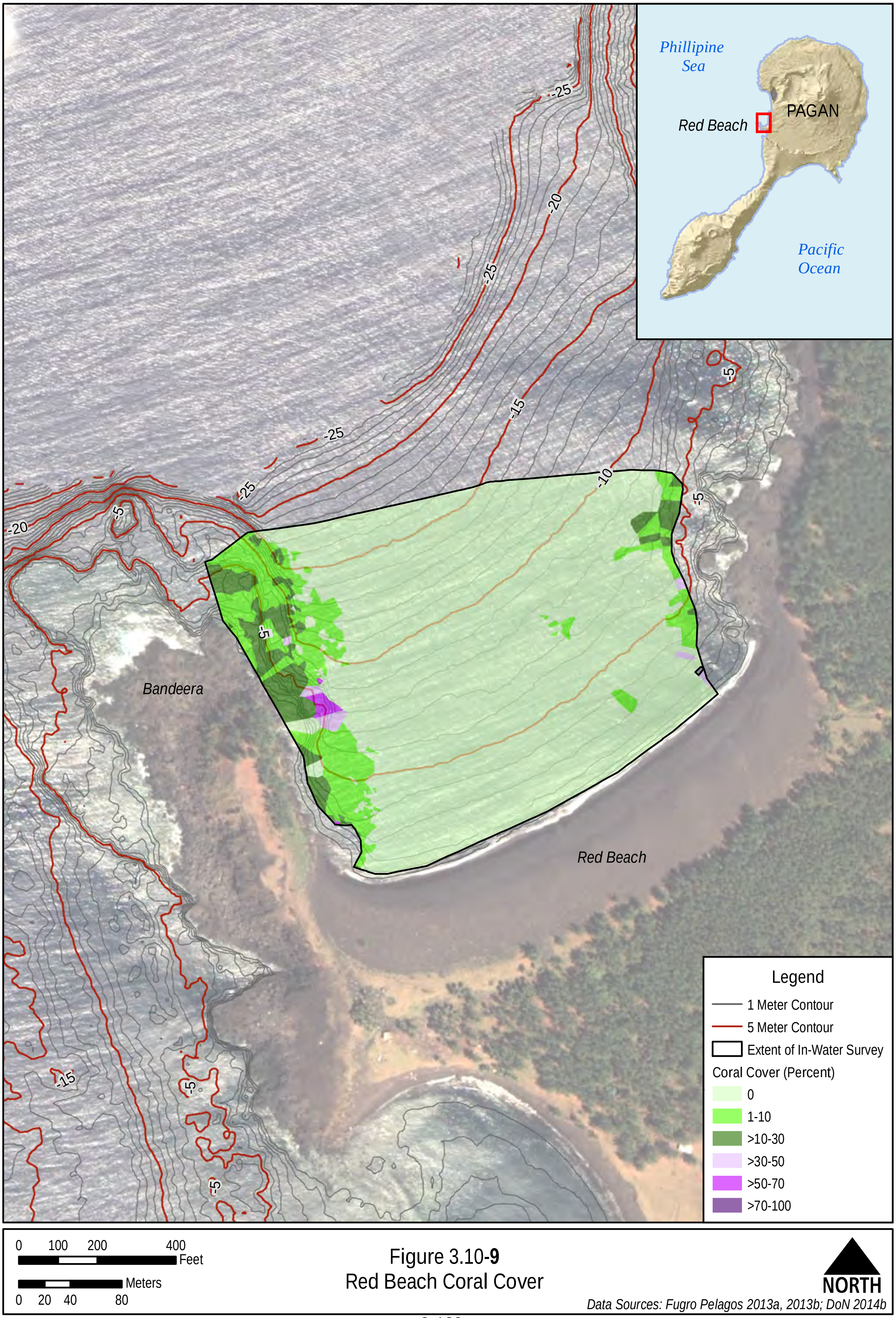
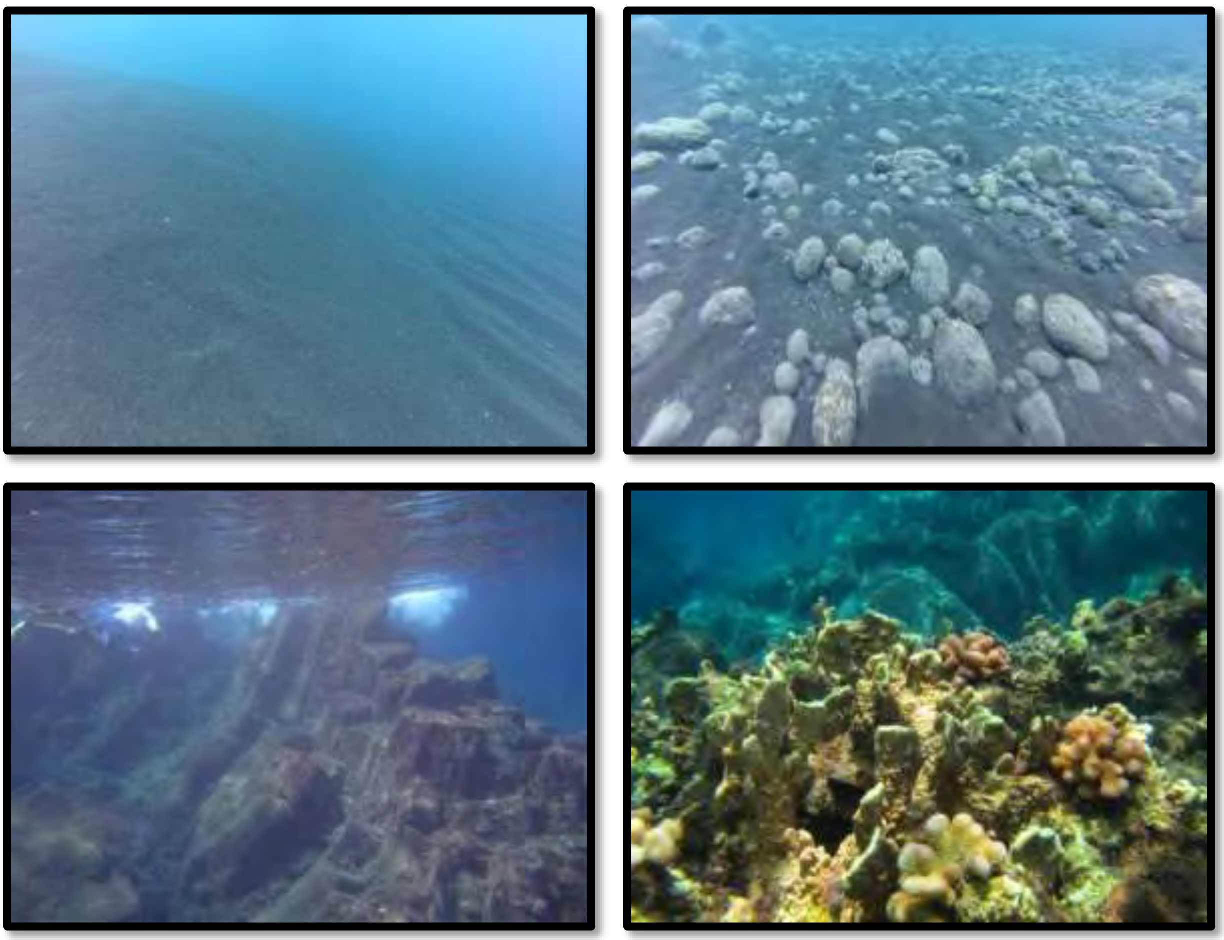


Figure 3.10-**9**
Red Beach Coral Cover

Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.5.3.3 Blue Beach

Blue Beach is in a semi-protected embayment on the northwest coast of Pagan and is not fronted by a shallow reef flat. Most of the area surveyed at Blue Beach has low topographic complexity, low coral cover, and high sand cover. Within the survey area, there are no portions of the Blue Beach seafloor that have high complexity, nor have moderate or high coral cover. The bottom substrate is coarse-grain igneous sand and cobble. Where corals occur, the dominant substrate is igneous and there is no evidence of carbonate framework buildup (DoN 2014a). A total of 108 coral species were recorded during the surveys. Representative images of Blue Beach are presented below. Blue Beach coral cover is shown in Photos 3.10-30 and Figure 3.10-10.



Photos 3.10-30. Representative Images of Blue Beach
(Clockwise from top left: center of beach; center of beach; patches of richer coral growth at northern headland; southern headland)

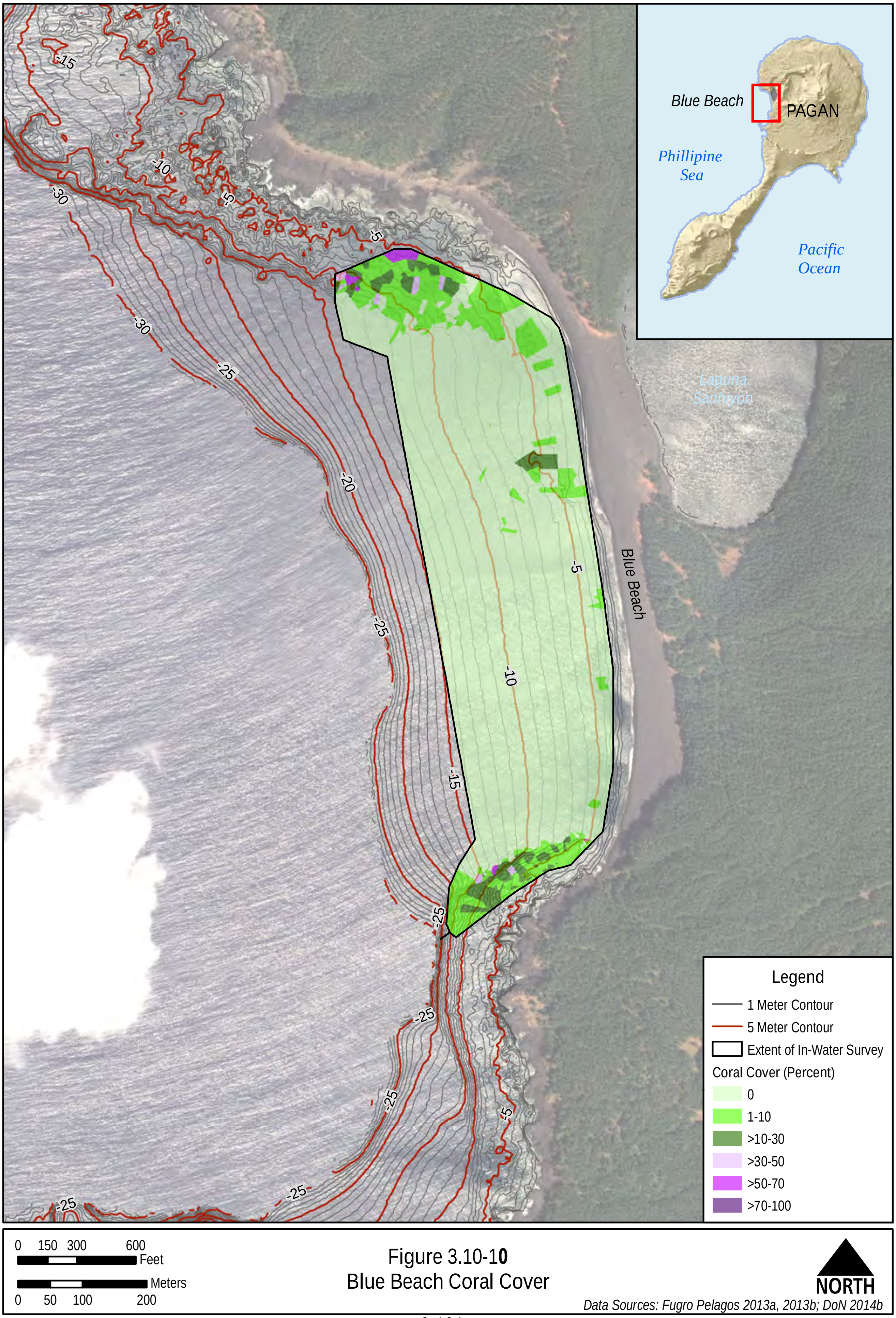
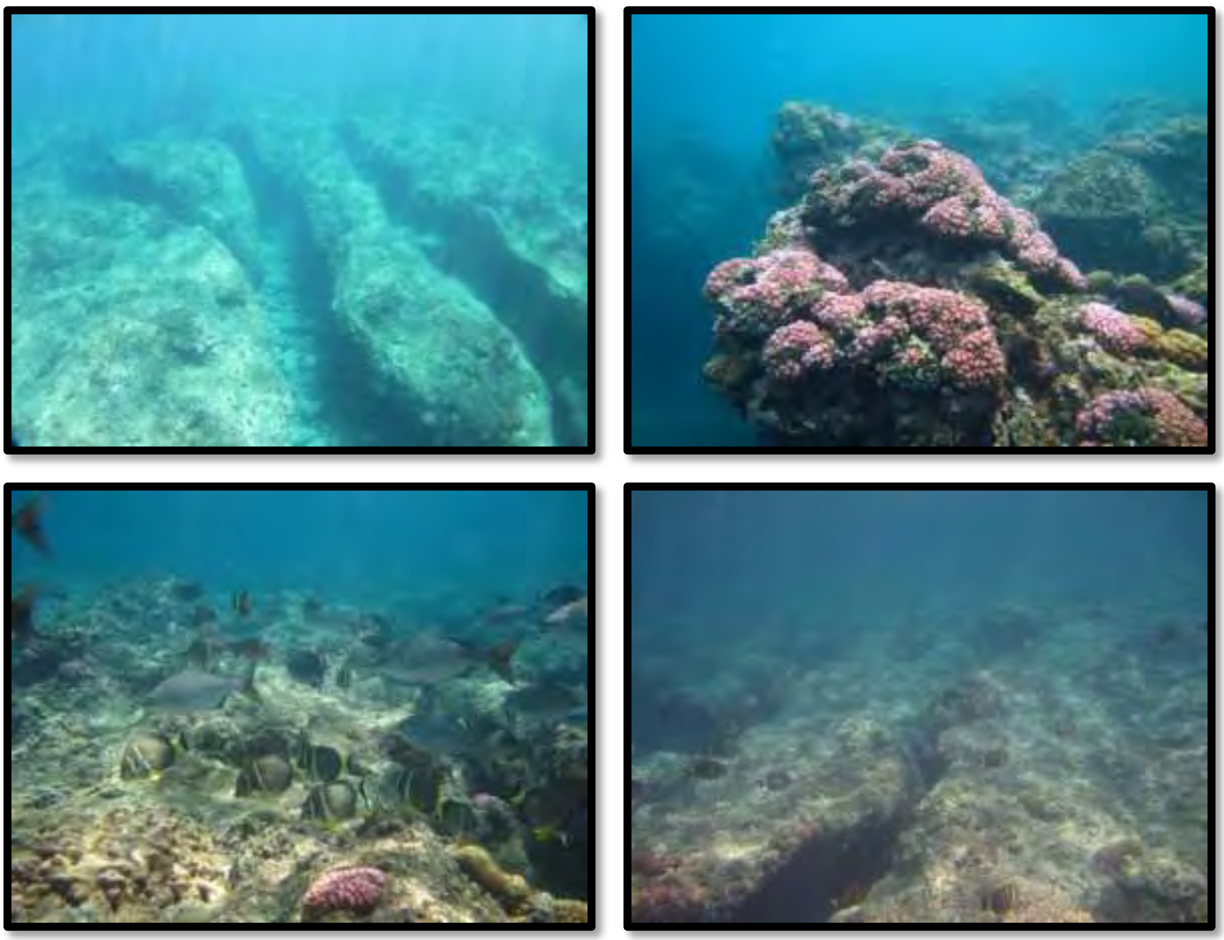


Figure 3.10-10
Blue Beach Coral Cover

Data Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.5.3.4 North Beach

The shoreline of North Beach is a shore-attached fringing reef crest with karst characteristics (chemically weathered limestone). Grooves are relatively regular, narrow, and deep. Other narrow grooves run diagonally to the shore's normal spur-and-groove pattern, and these have the physical characteristics of cracks or fissures. Many of the spurs are deeply undercut, and fracturing seems likely in this geologically active setting (Riegl and Dodge 2008). The bases of grooves often have polished surfaces indicating high-energy sediment transport and erosion. Thirty-three coral species were recorded at North Beach, which is low relative to other sites on Pagan (DoN 2014a). Representative images of North Beach are presented in Photos 3.10-31.



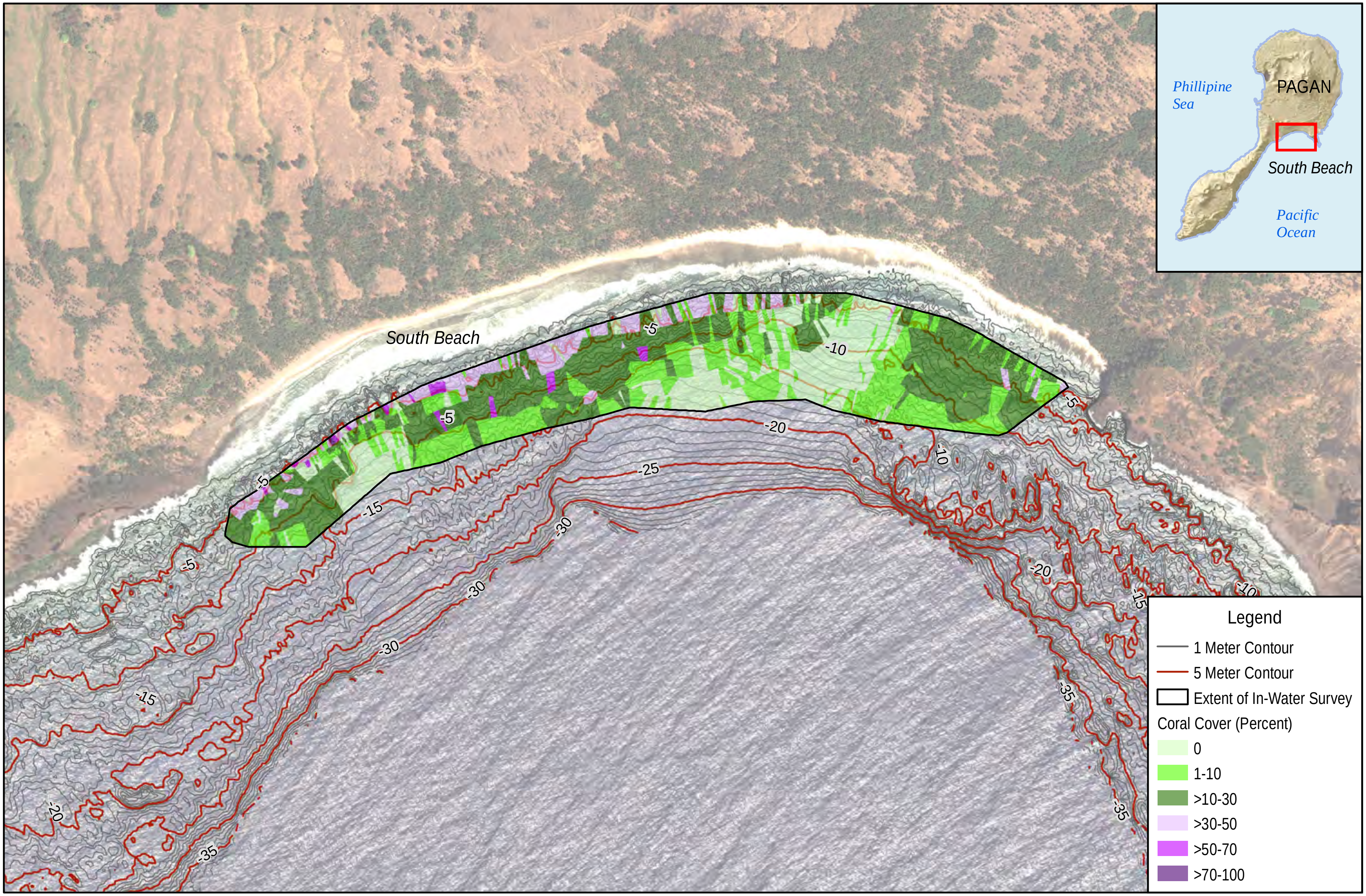
Photos 3.10-31. Representative Images of North Beach

(Clockwise from top left: fissures in shallow fore reef; corals on shallow fore reef; fissures in fore reef; typical shallow fore reef)

3.10.5.3.5 South Beach

South Beach is fronted by a fringing reef. Most of the area surveyed at South Beach has low to moderate topographic complexity, low to moderate coral cover, and low to high sand cover in various locations. The reef area is physically complex, with narrow regular grooves in the shallow fore reef transitioning rapidly to deep fore reef morphology of low-relief relict spurs, punctuated by large *Porites* colonies (typically 10-20 feet [3-6 meters] in diameter). The bottom substrate is limestone, and no igneous substrate or clasts were visible. The bases of grooves shallower than 16 feet (5 meters) often had polished surfaces and polished cobble-sized clasts, indicating high-energy sediment transport and erosion. The shoreline of South Beach is a shore-attached fringing reef crest with karst characteristics (chemically weathered limestone). Shallower than 10 feet (3 meters), the South Beach fringing reef is homogenous. An exception is the prominent sand channel running from offshore to inshore just east of the center of South Beach. This sand channel is about 330 feet (100 meters) wide and runs up to the exposed shore-attached fringing reef crest. A total of 101 coral species were recorded at South Beach. Representative images of South Beach are presented in Photos 3.10-32. South Beach coral cover is shown in Figure 3.10-11.

Photos 3.10-32. Representative Images of South Beach
(Clockwise from top left: typical shallow fore reef; typical deeper fore reef; typical large *Porites* head; deeper sand channel)



0 150 300 600 Feet

0 50 100 200 Meters

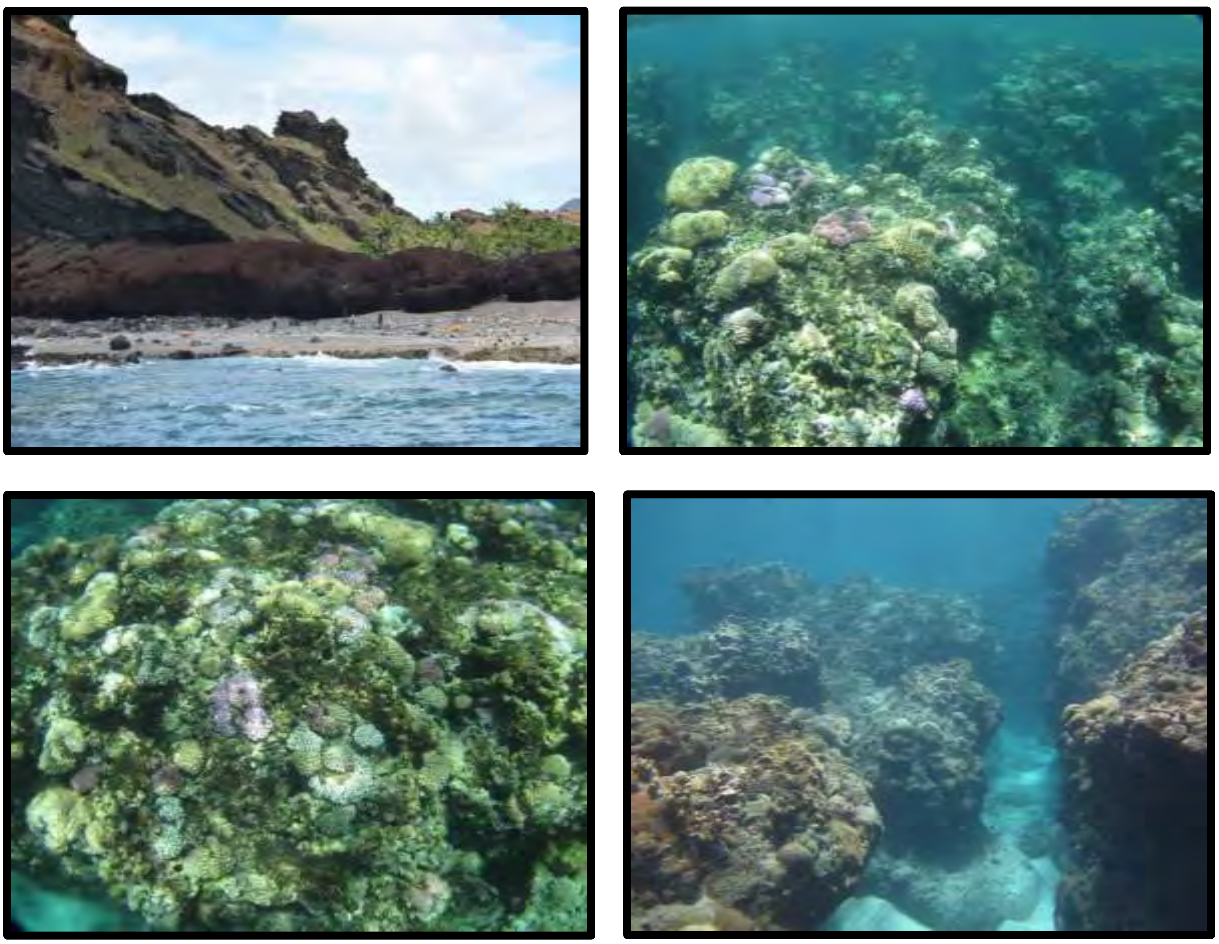
Figure 3.10-11
South Beach Coral Cover

NORTH

Sources: Fugro Pelagos 2013a, 2013b; DoN 2014b

3.10.5.3.6 Gold Beach

Gold Beach is located at the end of an irregularly shaped, cliff-lined cove. The shoreline of Gold Beach is a shore-attached fringing reef crest. The cliff walls and steep fringing reef are a result of incoming waves from several directions. This wave action often results in rough seas and dangerous waves. This water motion transports sand to deeper waters. Gold Beach has moderate topographic complexity, high coral cover, and low or no sand cover. The bottom substrate is limestone. The reef area is physically complex, with deep irregular grooves and fractures. The bases of grooves have polished surfaces, indicating high-energy sediment transport and erosion. Because of dangerous conditions, most survey efforts could not be safely conducted in the shallows of Gold Beach (DoN 2013a). Habitats shallower than 6 feet (2 meters) were inaccessible and areas shallower than 12 feet (4 meters) were too rough to survey (DoN 2013a). During the limited survey effort, a total of 92 coral species recorded at Gold Beach. Representative images of Gold Beach are shown in Photos 3.10-33, and Gold Beach coral cover is shown in Figure 3.10-12.



Photos 3.10-33. Representative Images of Gold Beach
(Clockwise from top left: Southern half of Gold Beach, topographically complex shallow fore reef, topographically complex deeper fore reef, typical shallow fore reef)

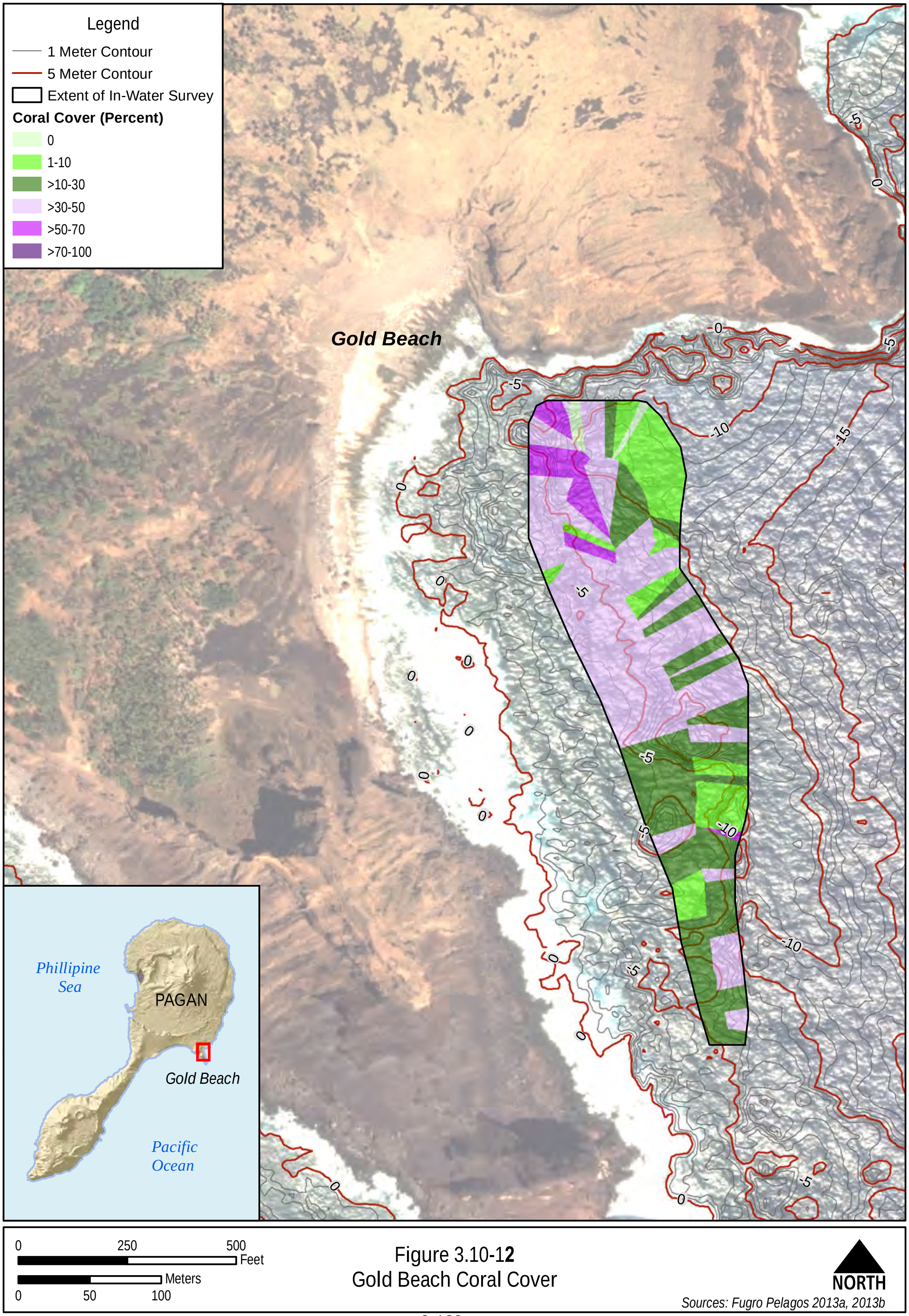


Figure 3.10-12
Gold Beach Coral Cover

3.10.5.4 Fish

The Mariana Archipelago Reef Assessment and Monitoring Program conducted Pagan fish surveys in 2003, 2005, and 2007, and provide the basis of information in this section. The surveys found that total fish biomass on Pagan was high compared others Mariana Islands.

In 2003, snappers and reef sharks dominated in terms of biomass at Pagan. Surgeonfish, mainly the orangespine unicornfish (*Naso lituratus*), also largely contributed to Pagan's 2003 total fish biomass. Surgeonfish were the dominant species in 2005 and 2007, but total fish biomass results were similar to that in 2003.

The Mariana Archipelago Reef Assessment and Monitoring Program surveys found similar fish species richness for the fore reef habitats surveyed at various survey sites around Pagan. The fish species richness remained consistent for all three years, with wrasses being the most represented family, recording an average of 27 species per year. Overall, the most abundant fish families include wrasse and damselfish, with the most common species being the ornate wrasse (*Thalassoma pavo*), Vanderbilt's chromis (*Chromis vanderbilti*), and the midget chromis.

During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were recorded and summarized in a species list report. The survey found 278 species of fish at Pagan. Green Beach had 82 species, Red Beach had 180 species, Blue Beach had 64 species, North Beach had 35 species, Gold Beach had 86 species, and South Beach had 160 species.

3.10.5.5 Special-status Species

3.10.5.5.1 Marine Invertebrates

Seventeen marine invertebrates have been designated by the CNMI Division of Fish and Wildlife as Species of Special Conservation Need; nine of which are confirmed to be present in Pagan waters (Table 3.10-9) (Berger et al. 2005).

Table 3.10-9. Marine Invertebrates Identified by the CNMI Division of Fish and Wildlife Marine Species of Special Conservation Need in Pagan

Common Name/Scientific Name	*Reported in Pagan Region of Influence* [1]
Ghost Crab (*Ocypode* spp)	Yes
Rock Crab (*Grapus* spp)	No
Spiny Lobster (*Panulirus* spp)	No
Land Hermit Crab (*Coenobita spp*)	No
Surf redfish (sea cucumber) (*Actinopyga mauritiana*)	Yes
Black teatfish (sea cucumber) (*Holothuria whitmaei*)	Yes
Sea urchin (*Toxopneustid* spp)	No
Giant clam (*Tridacna spp)* [2]	Yes
Pectinate venus (*Gafrarium pectinatum*)	Yes
Common spider conch *(Lambis lambis*)	No
Horned helmet shell (*Cassis cornuta*)	Yes
Tapestry turban shell (*Turbo petholatus*)	Yes
Rough turban (*Turbo setosus*)	Yes
Silver-mouth turban (*Turbo argyrostoma*)	Yes
Triton's trumpet shell (*Charonia tritonis*)	No
Octopus (*Octopus* spp)	Yes

Notes: [1] Reported by Berger et al. 2005.
[2] *Tridacna* spp includes the Fluted giant clam *(Tridacna squamosa)* and the Elongate giant clam *(Tridacna maxima).*
Source: Berger et al. 2005.

3.10.5.5.1.1 Coral Species

Coral species that are listed under the Endangered Species Act and confirmed to occur in Pagan's nearshore environment are provided in Table 3.10-10. Based on the *Coral Marine Resources Survey* conducted in support of the EIS/OEIS (see Appendix M, *Marine Biology Technical Memo and Survey Reports*), one coral species listed under the Endangered Species Act*, Acropora globiceps*, was recorded at Green Beach, Red Beach, Blue Beach, North Beach, Gold, and South Beach (Table 3.10-10) (DoN 2014a).

Table 3.10-10. Special-status Coral Species of Pagan

Coral (Genus/Species)	*Endangered Species Act Status*	*Reported within Pagan Region of Influence* [1]
Acropora globiceps	Threatened	Yes; Gr R B N S Gd[2]
Acropora retusa	Threatened	No
Pavona diffluens	Threatened	No
Seriatopora aculeata	Threatened	No

Notes: [1] The region of influence for marine biological resources includes the waters surrounding Tinian and Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2] Gr = Green Beach, B = Blue Beach, R = Red Beach, N= North Beach, S=South Beach, Gd=Gold.
Sources: DoN 2014a; National Marine Fisheries Service 2014a.

The *Coral Marine Resources Survey Report* conducted in support of this EIS/OEIS (DoN 2014a, see Appendix M, *Marine Biology Technical Memo and Survey Reports*) surveyed and recorded Endangered Species Act coral species at each beach.

Acropora globiceps was recorded in the vicinity of Green Beach, Red Beach, Blue Beach, North Beach, Gold Beach, and South Beach (DoN 2014a). Surveys conducted at Green Beach recorded 20 colonies of *Acropora globiceps*. The average size of a colony was 16 square inches (106 square centimeters) with the largest colony measuring 73 square inches (471 square centimeters). A total of 31 colonies were recorded at Red Beach with an average colony size of 11 square inches (73 square centimeters) and 5 colonies were recorded at South Beach, averaging in size of 30 square inches (196 square centimeters). *Acropora globicep* was not found directly in front of the sandy beach at Blue Beach, or at depths shallower than 12 feet (4 meters). Survey efforts at Gold Beach were limited due to rough sea conditions.

Acropora retusa, Pavona diffluens, and *Seriatopora aculeata* were not observed during the survey (DoN 2014a); however, their presence is conceivable.

3.10.5.5.2 Fish

Special-status fish species documented in the CNMI include the scalloped hammerhead shark, humphead wrasse, and gray reef shark. During the various marine resources surveys conducted in support of this EIS/OEIS, fish species were also recorded and summarized in a species list report. No Endangered Species Act listed or candidate species were observed on Pagan (DoN 2013b).

3.10.5.5.3 Sea Turtles

The green sea turtle, hawksbill sea turtle, and leatherback sea turtle are potentially found in the Pagan region of influence. These species and their expected occurrences in Pagan waters are listed in Table 3.10-11.

Table 3.10-11. Special-status Sea Turtle Species of Pagan

Common Name/Scientific Name	***Endangered Species Act Status***	***CNMI Status*** [3]	***Confirmed in Pagan Region of Influence*** [1]
Green sea turtle (*Chelonia mydas)*	Threatened	Species of Special Conservation Need	Yes[2]
Hawksbill sea turtle (*Eretmochelys imbricata)*	Endangered	Species of Special Conservation Need	Yes[2]
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	None	No

Notes: [1]The region of influence for marine biological resources includes the waters surrounding Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore.
[2]Observed during 2013 surveys in support of the EIS/OEIS (DoN 2014b).
[3]The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

Assessments using the Kolinski 2003 data estimated the Pagan sea turtle population to be between 21 and 83 sea turtles, with 96% identified as green sea turtles and 4% hawksbill sea turtles (Kolinski 2003). The July 2013 *Sea Turtle Marine Resource Survey* (see Appendix M, *Marine Biology Technical Memo and Survey Reports*) conducted in support of this EIS/OEIS identified green and hawksbill sea turtles (Photo 3.10-33) in Pagan nearshore waters (DoN 2014b). Based on the survey, the sea turtle population at Pagan is estimated at 448 individuals. No conclusion could be made regarding any seasonal or infrequent transient sea turtles to the area or regarding the resident sea turtle home range or foraging habits across the islands. The population results from Kolinski's survey and the survey conducted in support of this EIS/OEIS differ; although this analysis cannot determine the cause of the difference, possible explanations include seasonality, changes in habitat or sea turtle behavior, or an increase in sea turtle population (DoN 2014b).

Photo 3.10-33. Hawksbill Sea Turtle Observed during 2013 Survey near South Beach on Pagan

On Pagan, surveys of various methods were conducted along the northwest, west, south, east, and the Green-Red-Blue Beach complex zones around the island. Sea turtle densities appear relatively uniform based on towboard data, with density calculations of 122 sea turtles per square mile (47 sea turtles per square kilometer). Cliffline data for the two sectors (northwest and west), provided the highest density estimates, of 196 sea turtles/square mile (75.8 sea turtles/square kilometer) and 262 sea turtles/square mile (101 sea turtles/square kilometer), respectively. Along the northwest coast, the difference in calculated densities between the two methods could be due to a greater density of sea turtles occurring closer to shore; topography prohibited conducting the towboard survey closer to shore due to diver safety issues. The cliffline density estimates for the west sector result largely from observations at a single location, where a greater extent of available habitat and sheltered waters may support an increased density in this portion of the west sector of Pagan.

Based on the total number of sea turtles identified during the DoN 2013 survey, there are an estimated 297 green sea turtles, consisting mostly of juveniles and subadults. An estimated population of 151 hawksbill sea turtles was recorded, also consisting of mostly juveniles and subadults (DoN 2014b). Hawksbill sea turtles are a substantial percentage of the sea turtles in the waters around Pagan, which is unique for the CNMI as these sea turtles are rarely recorded in waters around the Rota, Guam, Aguijan, Tinian, and Saipan (DoN 2014b).

3.10.5.5.4 Marine Mammals

Several studies have included Pagan waters within their study areas (Yamaguchi 1995; Ohizumi et al. 2002; Trianni and Kessler 2002; Norris et al. 2012; DoN 2007; Fulling et al 2011), including the 2013 survey conducted in support of this EIS/OEIS summarized in the section below.

The *Marine Mammal Survey* conducted in support of this EIS/OEIS identified five marine mammals in the nearshore waters of Pagan using both acoustic and visual methods. These included sperm whales, common bottlenose dolphins, spinner dolphins, Cuvier's beaked whales, and Blainville's beaked whales. The five marine mammal species confirmed in the nearshore environment of Pagan, and their Marine Mammal Protection Act and Endangered Species Act designations, are presented above in Table 3.10-12.

Table 3.10-12. Marine Mammals with Reported Occurrence in the Region of Influence Surrounding Pagan

Common Name/Scientific Name	*Marine Mammal Protection Act Status*[1]	*Endangered Species Act Status*	*CNMI Status*[2]	*Reported within the Pagan Region of Influence*[4]
Sperm whale (*Physeter macrocephalus*)	Depleted	Endangered	-	Yes
Common bottlenose dolphin (*Tursiops truncatus*)	-	-	-	Yes
Spinner dolphin (*Stenella longirostris*)	-	-	Species of Special Conservation Need	Yes
Blainville's beaked whale (*Mesoplodon densirostris*)	-	-	-	Yes
Cuvier's beaked whale (*Ziphius cavirostris*)	-	-	-	Yes

Notes: [1] Status from Carretta et al. 2014. All marine mammals are protected under the Marine Mammal Protection Act. Populations or stocks that have fallen below the optimum sustainable population level are considered "Depleted." The Hawaii stocks of sperm whale, sei whale, blue whale, fin whale, and the American Samoa stock of humpback whale are also listed as "Strategic" under the Marine Mammal Protection Act; this status would apply if research determines that these are the stocks that inhabit CNMI waters.

[2] The Comprehensive Wildlife Conservation Strategy identified species in greatest need of conservation and uses the phrase "species of special conservation need." Berger et al. 2005 outlines the criteria used to select species for this designation.

[3] Regular = a species that occurs as a regular or usual part of the fauna of the area, regardless of how abundant or common it is; Rare = a species that occurs in the area only sporadically. Occurrence designations from the Navy's Mariana Islands Marine Resource Assessment (DoN 2012/2013), updated with new information as described in DoN 2013, (DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014).

[4] The region of influence for marine mammals includes the waters surrounding Pagan from the shoreline to 3.0 nautical miles (5.6 kilometers) offshore. However, the potential for acoustic effects due to pile driving/extraction extends to approximately 7.3 nautical miles (13.6 kilometers) from shore.

Sources: DoN 2014c; E. Oleson 2014; National Oceanic and Atmospheric Administration 2014.

The marine mammal survey conducted in support of this EIS/OEIS was the first systematic survey that focused on the Pagan nearshore environment (within 3.0 nautical miles [5.6 kilometers]) (DoN 2014c).

Most spinner dolphin sightings and detections were on the east side of Pagan, and all sightings were within 0.54 nautical mile (1.0 kilometer) of shore (DoN 2014c). Generally, spinner dolphins were sighted near Green Beach on the west side (DoN 2014c). Of the spinner dolphins observed, 75% of the groups included calves (DoN 2014c). Results of the photo-identification analyses indicate that spinner dolphins identified at Pagan were later resighted in the same survey.

Bottlenose dolphins were observed twice on Pagan, both on the west side of the island, although one sighting was near the northern tip. Both sightings were within 0.54 nautical mile (1.0 kilometer) of shore and one was 0.25 nautical mile (0.46 kilometer) from Blue Beach. This sighting was in relatively shallow water of 118 feet (36 meters), while the other was in moderately deep water of 1,535 feet (468 meters).

There were three sightings of unidentified dolphins, all on the west side of the island, although one was near the southern tip. They were seen in a range of water depths, from 95 to 2,385 feet (29 to 727 meters) and at a range of distances from shore, 0.27 to 1.1 nautical miles (0.5 to 2 kilometers). One of the unidentified groups was thought to be spinner dolphins, due to their slim profile. The other two groups were thought to be bottlenose dolphins, based on slightly robust bodies and pronounced dorsal fins. The body proportions of these dolphins was too short and not robust enough to be larger species, such as melon-headed whales or pygmy killer whales (DoN 2014c).

In addition to the confirmed sightings, recordings of unidentified dolphins and assumed Delphinid vocalizations were collected and compared to pre-recorded vocalizations of rough-toothed dolphins, false killer whales, spotted dolphins, striped dolphin (*Stenella coeruleoalba*), spinner dolphins, and bottlenose dolphins (DoN 2014c). Vocalizations that matched the striped/spinner category were most likely associated with spinner dolphins (DoN 2014c).

The sperm whale was the only large species of whale detected during the survey. The acoustic detection of sperm whales indicates its presence; however, the sonobuoy methods used in this study are not able to estimate the locations of the vocalizing animals. The sperm whales were detected off the west side of the island from using sonobuoys off Red Beach and Blue Beach, and Green Beach areas(DoN 2014c).

Two species of beaked whales, Cuvier’s and Blainville, were also identified. The Cuvier’s beaked whale was detected visually within 1.5 nautical miles (2.7 kilometers) of shore off the southwestern end of the island, while the Blainville’s beaked whale was detected acoustically in the more northern waters (DoN 2014c); however the precise location cannot be determined from the acoustic detection As with sperm whales, both beaked whale species are usually associated with deep waters. The presence of these species within 3.0 nautical miles of shore is likely attributed to the proximity of deep waters close to the Pagan shore. All detections came from deep water, close to shore, and both species are likely common around Pagan as the are other Mariana Islands (DoN 2014c).

3.11 CULTURAL RESOURCES

Section 3.11 provides a summary of the general condition and character of cultural resources on Tinian and Pagan. The region of influence for cultural resources, which is equivalent in this case to the area of potential effect under the National Historic Preservation Act, includes the land and waters of Tinian and Pagan (out to a distance of 1,000 feet [300 meters]; the distance is based on the footprint of amphibious training under the proposed action), because of ground disturbance caused by construction, training activities, and maintenance operations associated with the no-action alternative and proposed action alternatives that have the potential to impact cultural resources. Indirect impacts to cultural resources may result from access restrictions to certain types of resources, inadvertent disturbance due to an increase in population, or soil erosion from land-clearing activities.

Currently, Department of Defense actions within this area are covered by two Programmatic Agreements—one for military training activities relating to the Mariana Islands Range Complex EIS/OEIS (DoN 2010a) and one for the Guam and CNMI Military Relocation EIS (DoN 2010b) to establish four ranges on Tinian.

3.11.1 Definition

Cultural resources are defined as the collective evidence of past human activities and accomplishments, and typically include archaeological resources, architectural properties, and traditional cultural properties. These terms are defined below.

- **Archaeological Resources:** Those areas or locations (sites) where human activity measurably altered the earth or left deposits of physical remains, such as *latte* or pottery.
- **Architectural or Built Properties:** Those standing buildings, dams, canals, bridges, and other structures which have historic, engineering, or aesthetic significance.
- **Traditional Cultural Properties:** A specific type of historic property that is often classified as a site. They usually consist of landscapes with a defined overlay of traditional cultural significance derived from associations 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. Traditional cultural properties may include sites carrying religious importance or have ceremonial significance.

Under the National Historic Preservation Act**,** a historic property is a particular type of cultural resource defined as a district, site, building, structure, or object that meets the specific criteria of the National Register of Historic Places. Under NEPA, impacts to historic properties and other resources of cultural importance are evaluated. Examples of other resource types include: cultural practices, cemeteries, memorials, sacred sites, medicinal plants, or other resources that hold special traditional, religious, or cultural significance.

3.11.2 Regulatory Framework

A brief listing of the regulatory framework governing cultural resources follows and is described in greater detail in Appendix N, *Cultural Resources Technical Memo*. A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations*.

- Abandoned Shipwreck Act, 43 U.S. Code § 2101-2106
- Historic Sites Act, 16 U.S. Code § 461-467
- National Historic Preservation Act, 54 U.S. Code 300101 et seq.
- Sunken Military Craft Act of 2004, 10 U.S. Code 113-118
- Determinations of Eligibility for Inclusion in the National Register of Historic Places (36 CFR 63)
- National Historic Landmarks Program (36 CFR 65)
- Curation of Federally-Owned and Administered Archeological Collections (36 CFR 79)
- Protection of Historic Properties (36 CFR 800)
- Preservation of American Antiquities (43 CFR 3)
- Executive Order 11593, Protection and Enhancement of the Cultural Environment
- Executive Order 13287, Preserve America

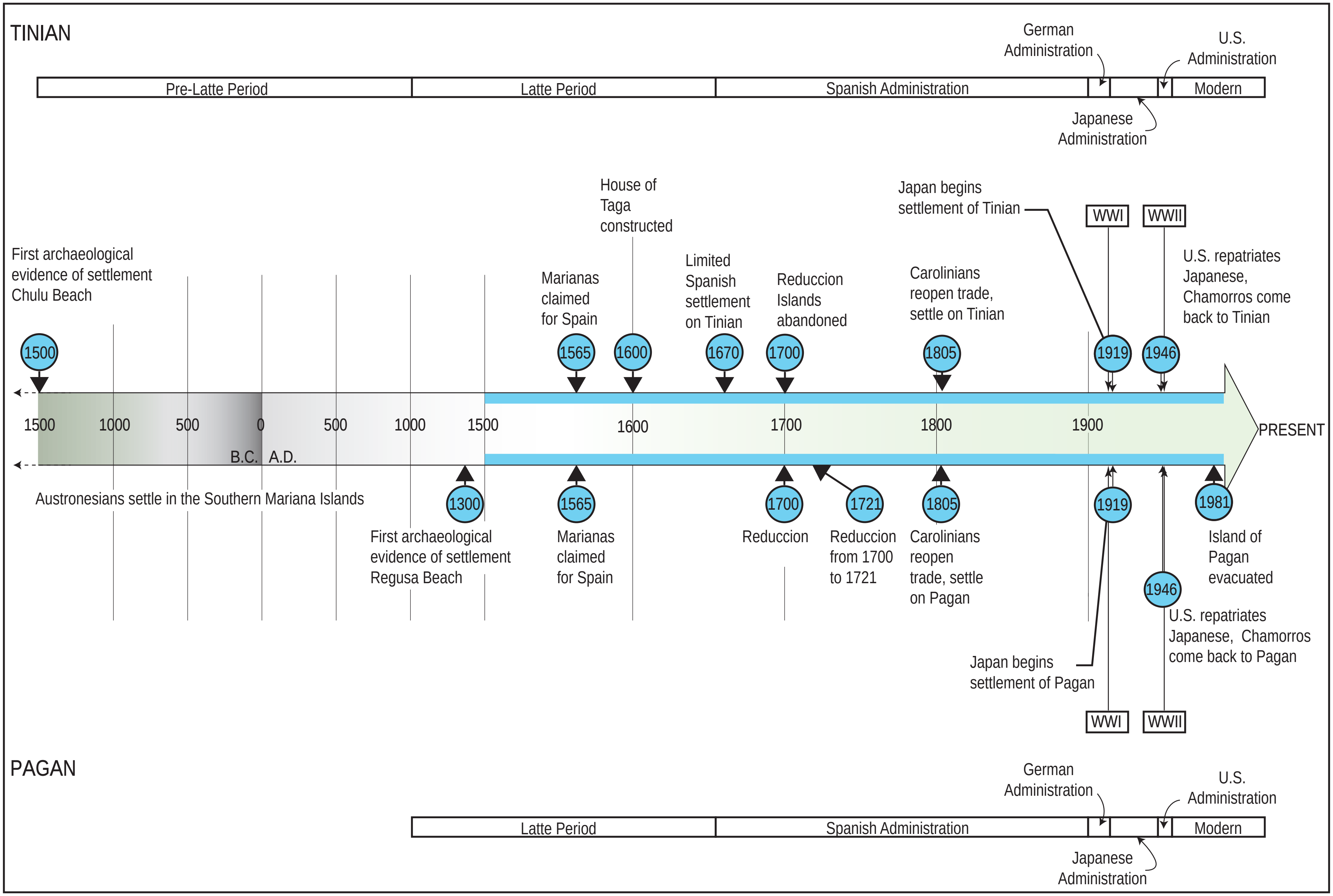
3.11.3 Methodology

The process for identifying and evaluating historic properties is established under the National Historic Preservation Act and other laws and regulations. National Historic Preservation Act Section 106 regulations direct federal agencies to make reasonable and good faith efforts to identify historic properties (36 CFR § 800.4(b)(1)) in regards to a proposed action. Agencies are to take into account past planning, research and studies; the magnitude and nature of the action and the degree of federal involvement; the nature and extent of potential effects on historic properties; and the likely nature and location of historic properties within areas that may be affected.

For this EIS/OEIS, the DoN used a combination of methods (i.e., archival research, ground surveys, archaeological and architectural surveys, ethnography and oral histories) to identify historic properties and other cultural resources described in Section 3.11.1*, Definition,* and analyze potential impacts for each alternative. The DoN reviewed previous studies to identify existing information on historic properties and resources of cultural importance within the area of potential effect and identified the locations that would require additional study. Additional surveys and archival and oral history studies were conducted as part of this EIS/OEIS.

3.11.4 Tinian

The Tinian region of influence includes the Military Lease Area and adjacent submerged lands, and improvement areas north of Tinian International Airport, at the Port of Tinian, and access roads from the Port of Tinian to the Military Lease Area. A summary of the prehistory and history of Tinian is included in Appendix N, *Cultural Resources Technical Memo.* A general timeline of major historic events is included in Figure 3.11-1.



CJMT-153-032415

Figure 3.11-1 Major Historic Events for Tinian and Pagan

3.11.4.1 Previous Cultural Resource Studies and Recorded Resources

3.11.4.1.1 Military Lease Area

Our analysis identified 52 cultural resource investigations in the Military Lease Area, north of Tinian International Airport, and the Port of Tinian improvements area. These include archaeological assessments, Phase I surveys, Phase II testing, data recovery excavations, architectural surveys, and traditional cultural property studies, as well as a cultural landscape study. Testing and/or intensive excavation have been part of nine major studies. Extensive research of archives in the U.S., Japan, and Micronesia, including references to collections of historical maps and photographs, supplemented the intensive excavation. Appendix N, *Cultural Resources Technical Memo,* provides specific detail on these studies and the resources recorded.

Approximately 98% of the Military Lease Area has been surveyed for archaeological resources with only a portion of the property leased by the International Broadcasting Bureau on the western side of the island, yet to be surveyed. Previous studies identified 356 archaeological sites; of these, 2 are listed in the National Register of Historic Places (North Field National Historic Landmark and the Unai Dankulo petroglyphs) and 319 are considered eligible for listing in the National Register of Historic Places. These include Pre-Contact *latte* sites; most of the Japanese Administration sites such as shrines, defensive caves, farmsteads, and internment camps; World War II sites; and petroglyphs. There are no intact buildings within the Military Lease Area that retain architectural integrity. There are only remnant structures associated with pre-war Japanese farmsteads and World War II Japanese and American military structures. As such, these structures are considered archaeological resources.

North Field, the landing beaches, and Ushi Point were collectively designated a National Historic Landmark for their role in World War II. The landmark comprises structures and structural remains, four runways and sites used to assemble and load the atomic bombs that were dropped on Hiroshima and Nagasaki (Figure 3.11-2). As defined by the National Register nomination form (Thompson 1984), the National Historic Landmark boundaries include 26 recorded archaeological sites; however only a few of the features within the National Historic Landmark are considered to be contributing features to the Landmark (Table 3.11-1). The entire National Historic Landmark is within the area of potential effects and impacts to any contributing features of the National Historic Landmark would be considered an impact the integrity of the National Historic Landmark over all.

Table 3.11-1. Contributing Features to the North Field National Historic Landmark

Contributing Feature	*Site Number*
Landing Beach White 1	TN-1-0074 (landing beach only)
Landing Beach White 2 and Japanese Pillbox	TN-5/6-0016
North Field Runways, Taxiways, and Service Aprons	TN-6-0364 and TN-6-0402
Air Operations Building	TN-6-0364
Two Air Raid Shelters	
Japanese Service Apron	
Air Administration Building	

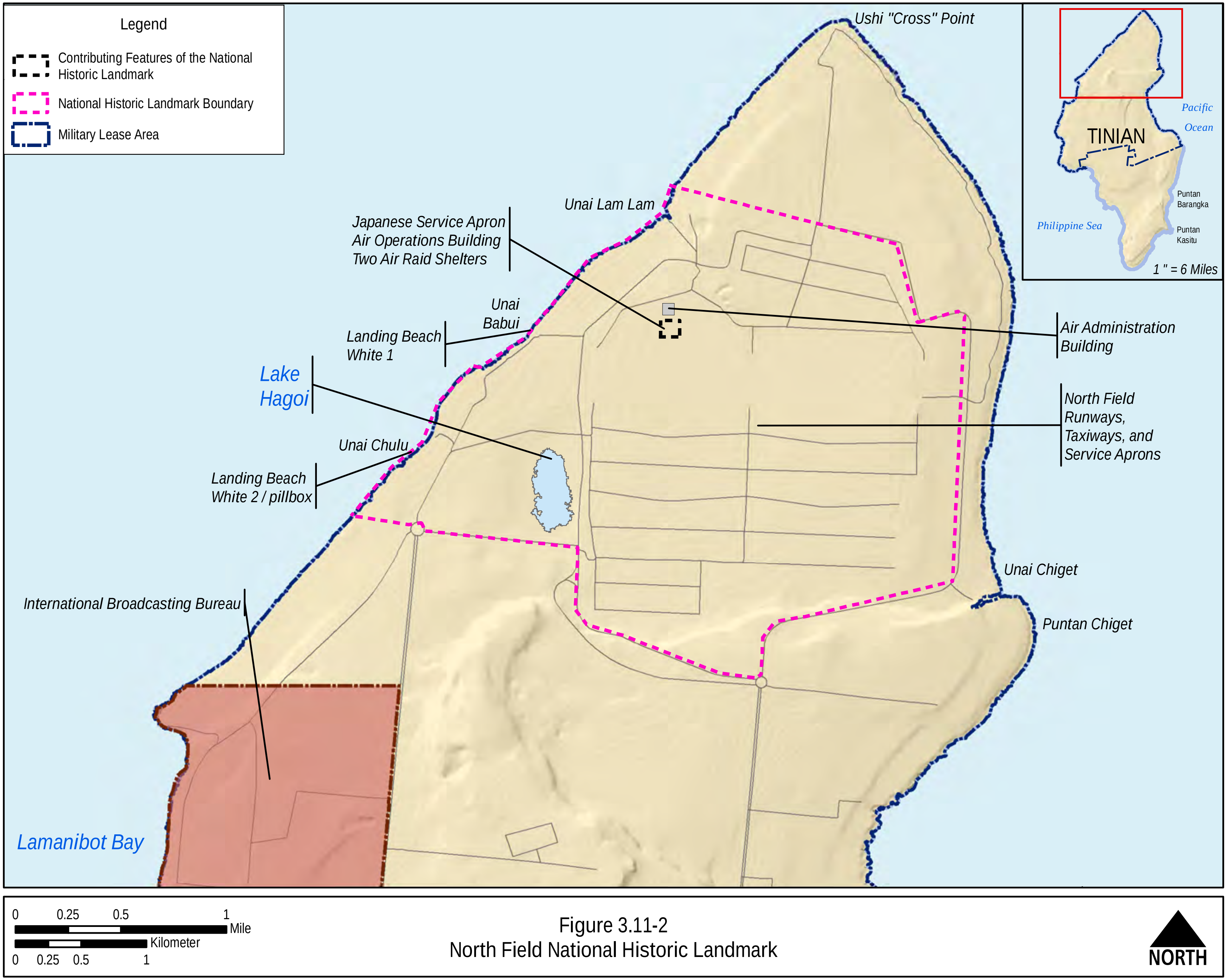


Figure 3.11-2
North Field National Historic Landmark

Potential traditional cultural properties within the Military Lease Area include three beaches: Unai Chulu, Unai Dankulo, and Unai Masalok. Based on discussions from Tinian residents, additional resources such as medicinal plants are collected by cultural practitioners from the native limestone forests within the Military Lease Area (DoN 2014a). Memorials such as the Hinode American Memorial, the Mount Lasso Shrine, the 86th Street Shrine, the NKK Shrine, and the Ushi memorial are also found in the Military Lease Area.

3.11.4.1.2 North of Tinian International Airport

All of the area north of the Tinian International Airport runways has been surveyed for archaeological resources. Within the Tinian International Airport area, two archaeological sites have been recorded that are considered eligible for listing in the National Register of Historic Places. These include one farm site from the Japanese Administration era and one World War II American military site (West Field) (Dixon and Welch 2002). The area immediately north of Tinian International Airport runways was originally constructed by the Japanese during World War II. The U.S. military expanded the airfield to provide a base to support B-29 operations against Japan in 1945.

3.11.4.1.3 Port of Tinian

Seventeen studies have been conducted at the Port of Tinian and adjacent areas (see Figure 1, Appendix N, *Cultural Resources Technical Memo).* In 2008, an architectural survey and archival study for the entire Port of Tinian, which included all structures along the wharf or quay, was conducted (Thursby 2010). Some of the port features, including the breakwater, although lacking in architectural integrity, are considered eligible for listing in the National Register of Historic Places as an archaeological site.

In 2014 and 2015, archaeological surveys of the area around the port and adjacent to 6th and 8th Avenues were completed (DoN 2014a, DoN 2015). Two sites were recorded in the proposed port improvement area and consisted of Japanese tank debris from World War II, World War II-era American Administration concrete pads, and a prehistoric pottery scatter. Because the sites are so deteriorated, they are not eligible for listing in the National Register of Historic Places. Thirteen sites were identified along the proposed road corridors from the Port of Tinian and the Military Lease Area. These include Pre-Contact artifact scatters, concrete foundations, railroad remnants, and World War II defenses. Eight of the sites are eligible for listing in the National Register of Historic Places and five sites are not eligible.

3.11.5 Pagan

The Pagan region of influence includes the island and adjacent submerged lands. This broad area was identified because proposed military training activities could impact cultural resources described in Section 3.11.1, *Definition*, across the island and along the shoreline. A summary of the prehistory and history of Pagan is included in Appendix N, *Cultural Resources Technical Memo.* A general timeline of major historic events is included in Figure 3.11-1.

3.11.5.1 Previous Cultural Resource Studies and Recorded Resources

Eight cultural resource investigations have been conducted on Pagan; these include a historical overview, intensive and reconnaissance level surveys, limited archaeological excavations, and traditional cultural property studies (see Figure 2 in Appendix N, *Cultural Resources Technical Memo*). Extensive research of archives in the U.S., Japan, and Micronesia, including reviews of collections of historical maps and photographs, supplemented the fieldwork completed for this EIS/OEIS. Appendix N, *Cultural Resources Technical Memo,* Section 2.2.2, provides specific detail on these studies and the resources recorded.

Approximately 60% of the island is covered in lava or has topography with slopes greater than 30%, which are unlikely to contain historic properties. Of the areas with less than 30% slope, approximately 33% of Pagan has been surveyed for archaeological resources. However, many of these areas are in the central portion of the island and are not located near coastlines where most sites tend to be found. Unsurveyed areas with the potential to contain historic properties occur primarily in the southern portion of Pagan. To provide information on unsurveyed areas, archaeological surveys were supplemented by aerial inspections and oral history interviews with former residents, which included additional information on the presence of Pre-Contact villages and other resources of cultural importance in the area (Athens 2009; DoN 2014b). A total of 181 sites have been identified through archaeological surveys for Pagan (Athens 2009; Higelmire and DeFant 2013) including a survey conducted in support of this EIS/OEIS (Athens 2009; Higelmire and DeFant 2013; DoN 2014b). Of the 181 sites, 110 were evaluated and recommended as eligible to the National Register of Historic Places and 71 were recommended not eligible. Most of the sites are located in the relatively flat areas in central Pagan, south of the Mount Pagan caldera. Sites with *latte* features tend to be concentrated on low terraces above beaches. Sites on south Pagan are found along the edges of the caldera, in the limited pockets of relatively level areas. Additionally, Japanese military sites are found in cliff sides and on top of high points overlooking beaches.

Potential traditional cultural properties include traditional fishing areas and traditional healing locations, as well as South Beach (Regusa), Red Beach (Shomshon), Paliat, Pialama, Apansanmena, and a mortar/medicine stone.

Resources of cultural importance include a variety of medicinal plants, including *fofgo* (morning glory vine), *gàso'so'* (type of bush), *puntan talisai* (tips of *Terminalia catappa*), *galak* (*Asplenium nidus*, a fern), *niyok* (coconut), *Flores Mayu* (a flower) and *ahgao* (*Premna obtusifolia,* a tree). Gathering locations for these plants are widely dispersed across the island, and occur in upland settings and along clifflines adjacent to the shore. Beaches and near-shore reefs used as traditional fishing areas occur along the coast. There are also named locations for the gathering of resources such as *gaddo'* (wild yam), *gapgap* (arrowroot), *suni* (taro), *pugua* (betel nut), *dagu* (yams), and *kahet* (oranges).These are dispersed resource patches that tend to cluster along the southwestern and eastern coasts of the island. Shomshon Bay is used for mortuary practice. The gathering of betel nuts as a cultural practice occurs in certain locations along the steep slopes on the isthmus and is associated with marriage rituals.

3.12 VISUAL RESOURCES

Section 3.12 describes the existing visual resources that may be impacted as a result of the proposed action. Visual resources include scenic areas, thoroughfares, and access ways that provide natural-appearing or aesthetically pleasing places or views. Visual resource descriptions focus on well known specific places, views, and scenic overlooks. These resources also include viewsheds that people are accustomed to seeing as part of the general landscape. The region of influence for visual resources includes the islands and surrounding scenic vistas of Tinian and Pagan. The specific study areas are provided under the description for each island.

Visual resources are often associated with historic, cultural, and recreational resources. Descriptions of visual resources that are also recreational resources are discussed in Section 3.8, *Recreation*.

Descriptions of visual resources that are also cultural resources are discussed in Section 3.11, *Cultural Resources*.

3.12.1 Definition

Natural views include shorelines, seascapes, and cliffs. Man-made views include unique buildings, landscaping, parks, and cultural features. Views are described in terms of foreground, middle-ground, and background elements. For this analysis, the foreground is defined as up to 0.25 mile (0.4 kilometer) from the viewpoint; middle-ground is defined as between 0.25 mile (0.4 kilometer) and 3 miles (5 kilometers) from the viewpoint; and background is defined as greater than 3 miles (5 kilometers) from the viewpoint. Visual resources are further defined by:

- 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., cattle grazing adjacent to a former World War II military facility with the central highlands as a backdrop)
- Elements of line, color, form, and texture
- Distinctive visual edges (e.g., a housing tract adjacent to a forested area)

3.12.2 Regulatory Framework

NEPA requires federal agencies to consider scenery and aesthetic resources in federally supported projects. Federal agencies, including the Federal Highway Administration, the U.S. Forest Service, and the Bureau of Land Management, have developed guidance to implement NEPA with respect to the evaluation of visual resources.

3.12.3 Methodology

The methodology for analysis of visual impacts in this EIS/OEIS is based on the guidelines found in the *Bureau of Land Management Manual H-8410-1 – Visual Resource Inventory* (Bureau of Land Management 1986a), and *Bureau of Land Management Manual 8431 – Visual Resource Contrast Rating* (Bureau of Land Management 1986b). The Bureau of Land Management guidance was chosen as the methodology for this proposed action, as it has the desired flexibility to accommodate the varying landforms and visual environments found within the project area.

The methodology consists of the following steps:

1. Establish the visual character and visual quality of the affected environment. Visual character includes elements such as landforms, vegetation, water surfaces, and modifications that give a landscape its visually aesthetic qualities. The visual quality of a landscape is determined by factors such as its uniqueness, harmonious appearance, prominence, diversity, and viewer sensitivity.
2. Determine Key Observation Points to represent the most critical viewpoints related to visual quality and the aesthetic experience. These are usually along commonly traveled routes or at other public observation points. Factors considered in selecting Key Observation Points include:
   - Visual quality of the landscape
   - Angle of observation
   - Number of potential viewers
   - Length of time a facility or activity is in view
   - Relative size of facilities and activities
   - Season of use
   - Light conditions (e.g., time of day and shadowing)

3.12.4 Tinian

3.12.4.1 Regional Visual Environment and Study Area

The island of Tinian is characterized by a series of limestone plateaus, steep slopes, and cliffs. The steep cliffs along the shoreline are concentrated on the southeast and northwest sides of the island and provide a dramatic visual backdrop. The central part of the island is a relatively flat plateau extending from the village of San Jose along Broadway Avenue corridor, north almost to North Field. The same type of flat plateau is located along the 8th Avenue corridor. Both of these corridors have intermittent forested areas within grassland, and topography that provide broad views north and south on the island, with the north-central highlands area situated between the two corridors. Unlike other islands in the Mariana Island chain, Tinian has large areas of relatively flat expanses, such as North Field.

The study area for visual analysis on Tinian consists of the Military Lease Area that covers the northern two-thirds of the island. The study area includes three major visual environments, shown in Figure 3.12-1. Key Observation Points are shown, indicating their respective number and view orientation.

- **North Lowland:** North Field sits on a relatively flat plateau that slopes away to the ocean on the north, east, and west sides of the island (see Section 3.2, *Geology and Soils,* Figure 3.2-2). There is some undulation across the plateau. The southern side of the plateau is defined by a steep escarpment that connects to the Mount Lasso ridge line. Lake Hagoi is the lowest point on North Field plateau, with a minimum elevation of approximately 10 feet (3 meters) above MSL.

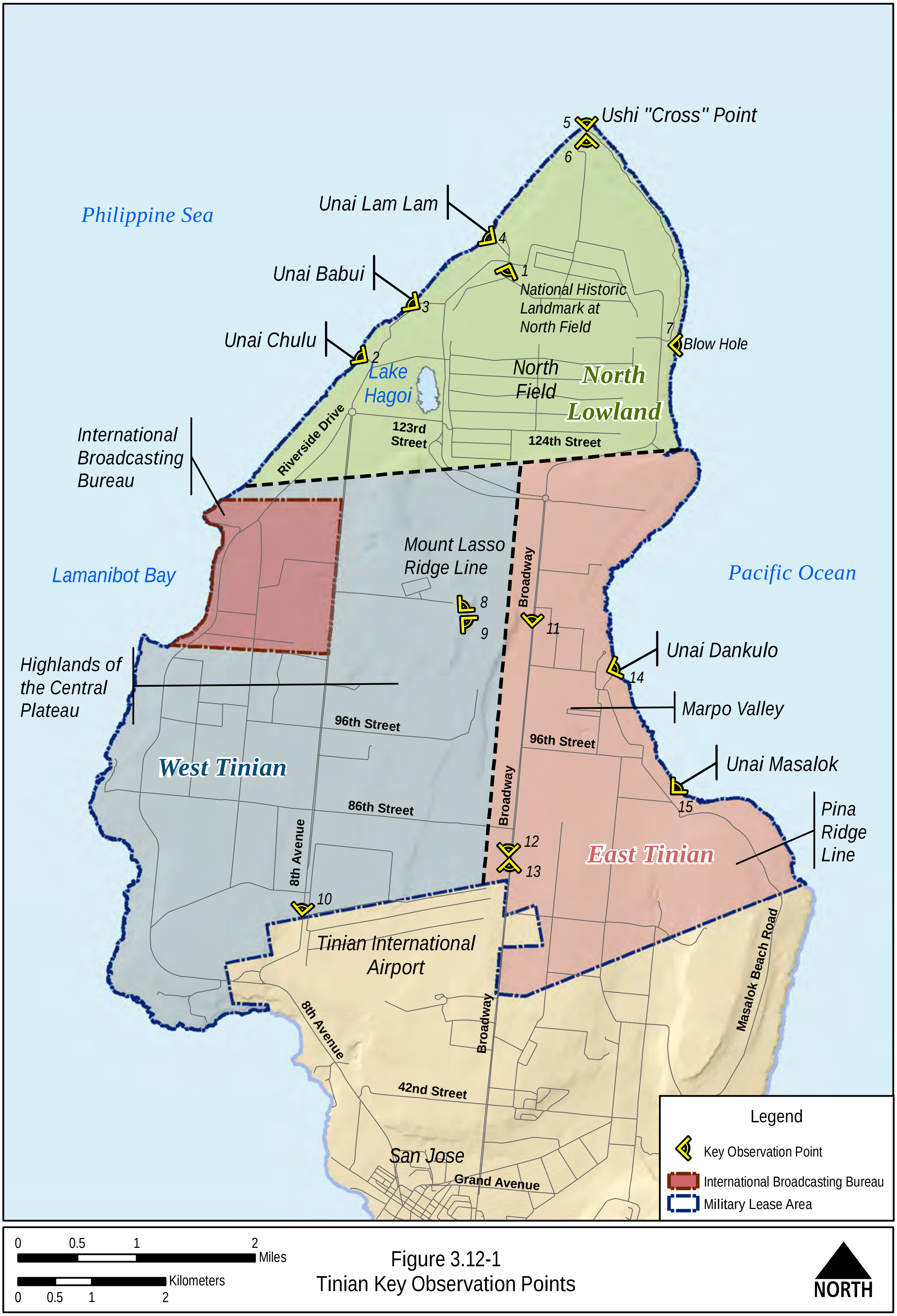


Figure 3.12-1
Tinian Key Observation Points

- **West Tinian:** Western Tinian includes the highlands of the central plateau west of Broadway. This area extends north from Marpo Valley and is broad and gently sloping, with the majority of the vertical relief along the western shoreline. The north central highland area is within the northern part of the central plateau and midway between the east and west coasts of the island. The maximum elevation of the highland is 545 feet (166 meters) above MSL on Mount Lasso (see Section 3.2, *Geology and Soils,* Figure 3.2-2). Eighth Avenue provides the central corridor through this area with steep cliffs extending along the west side of Riverside Drive where the steep slopes extend to the sea.

- **East Tinian:** This land area extends north from Marpo Valley (see Section 3.2, *Geology and Soils,* Figure 3.2-2) and includes all of central Tinian east of Broadway, and portions of northern Tinian. The plateau is broad and gently sloping, with the majority of the vertical relief along the southern and northern boundaries. Unlike western Tinian, the shoreline areas in the windward (eastern) side of the Military Lease Area consist of gently sloping topography to the sea and beach areas. Most of these areas are rocky and windier than their counterparts on the leeward (western) side of the island.

3.12.4.2 North Lowland

Photo 3.12-1. North Lowlands

The north lowland area (Photo 3.12-1) is primarily composed of previously developed and disturbed lands with an historic World War II-era airfield (North Field) extending from east to west. With the exception of the cleared airfield, northern Tinian is mostly overgrown with vegetation carpeting the area around the airfield and associated facilities. Views from within the north lowland area are generally close-in and somewhat constrained due to the surrounding dense vegetation. The dominant feature of the north lowland area is the National Historic Landmark at North Field. Both the north and northeast coastlines are covered with low, windblown vegetation and generally afford open and expansive views of Saipan, the Pacific Ocean, and the Philippine Sea. The northwest coastline is better protected, with denser vegetation than that of the leeward side. Views from the northwest coastline are open and expansive toward the Philippine Sea and horizon beyond.

3.12.4.2.1 Key Observation Points within the North Lowland

Seven Key Observation Points were identified in the north lowland for the visual analysis. The Key Observation Points are named for the primary element within their viewshed. The actual Key Observation Point includes not only the primary element they were named for, but the surrounding landscape as well. These points are shown on Figure 3.12-1.

- 1: National Historic Landmark at North Field
- 2: Unai Chulu

- 3: Unai Babui
- 4: Unai Lam Lam
- 5: Ushi "Cross" Point A
- 6: Ushi "Cross" Point B
- 7: Blow Hole

3.12.4.2.1.1 1: National Historic Landmark at North Field

The National Historic Landmark at North Field is listed in the National Register of Historic Places and is regularly visited by tourists. The aesthetic value of North Field lies in its visual landscapes, relationship of various structures to each other, and the comparison of what the area looked like during World War II (at its height of development) to what it looks like today (remnant airfield facilities surrounded by overgrown vegetation). The field and surrounding facilities are now overgrown and abandoned, but the historic significance remains and the associated aesthetic values continue to draw visitors year round.

The viewshed from this Key Observation Point, looking south, includes pavement in the foreground and dense vegetation in the middle-ground and background (Photo 3.12-2). Degraded tarmac, Japanese air raid shelters, and other World War II structures make up other views from this Key Observation Point. The entire area was once open and clear, to accommodate the World War II air combat operations. However, the visual connections and relationships between airfield buildings and structures are presently much harder to recognize amidst the significant overgrown vegetation. Two bomb loading pits are preserved at North Field. The aprons surrounding these bomb pits were preserved in a mostly paved, unvegetated state, so that the views around and between the bomb pits are unobstructed. The bomb pits themselves are covered by protective enclosures of metal and lexiglas with historical photos and text within.

Locations, descriptions, and photos of representative structures within North Field are provided in Section 3.8, *Recreation*. According to the Tinian Mayor's Office, the atomic bomb pits at North Field have approximately 100 visitors per day (DoN 2014). The North Field National Historic Landmark is the site of anniversary tours sponsored by private tour operators, such as Stephen Ambrose Historical Tours. The North Field National Historic Landmark is also a destination of the Tinian Dynasty North Side tour.

Photo 3.12-2. Key Observation Point 1 – National Historic Landmark Looking Toward Mount Lasso

3.12.4.2.1.2 2: Unai Chulu, 3: Unai Babui, and 4: Unai Lam Lam

Unai Chulu (Photo 3.12-3), Unai Babui (Photo 3.12-4), and Unai Lam Lam (Photo 3.12-5), are located on the west coast of Tinian. The largest of these beaches, Unai Chulu, is the easiest to access. Unai Chulu is popular with visitor groups who come with tours for various beach activities. Unai Chulu is a long, wide beach with open vegetated areas located between the beach and the densely vegetated area further inland. These areas are commonly used for picnics and social gatherings, as they provide an open view of the beach and the ocean. Unai Babui is a smaller beach (e.g., less sand area) with rugged coral outcrops along the shoreline edge and thick vegetation extending close to the shoreline's edge. The shallow reef flat is easily seen from the coastline. Unai Lam Lam is made up of a small sandy cove that is a beach even smaller than Unai Babui. The vegetation is thick and extends to the edge of the sand and coral outcroppings.

Photo 3.12-3. Key Observation Point 2 – View of Beach Area and Expansive View Corridor of Unai Chulu

Photo 3.12-4. Key Observation Point 3 – Unai Babui Looking North Toward Saipan

Photo 3.12-5. Key Observation Point 4 – View of Rocky Coast and Narrow Expanse at Unai Lam Lam

3.12.4.2.1.3 5: Ushi "Cross" Point A and 6: Ushi "Cross" Point B

Ushi "Cross" Point A (Photos 3.12-6 and 3.12-7) is the northern-most point of the island. It contains several memorials to various residents from Tinian, primarily fishermen. These whitewashed memorials are in sharp contrast to the natural surroundings that consists of a landscape of green, low vegetated ground cover, and the ocean with the island of Saipan in the distance. The area also contains a small three-sided memorial chapel and a maritime navigational aid beacon on a concrete base. It is exposed to a nearly continuous breeze from the trade winds coming off the ocean, which also create windswept vegetation along the shoreline and whitecaps in the waters offshore. Unlike other parts of Tinian, the shoreline immediately around the point contains no large jungle areas, only low shrubbery and ground cover. This allows expansive views from east to west including the Philippine Sea and the island of Saipan.

Photo 3.12-6. Key Observation Point 5 – View North toward Saipan from Ushi "Cross" Point

Photo 3.12-7. Key Observation Point 5 – Saipan across Channel from this View near Ushi "Cross" Point

Ushi "Cross" Point B (Photos 3.12-8 and 3.12-9) is in the same location as Key Observation Point 5 described above, but is directly south and facing away from the ocean. This view mostly consists of a green, low vegetated ground cover. The memorials and a U.S. Geological Survey navigational aid facility are in the foreground, and a gently sloping trail leading through a forested area is in the middle-ground.

Photo 3.12-8. Key Observation Point 6 – Memorial Chapel at Ushi "Cross" Point

Photo 3.12-9. Key Observation Point 6 – View Looking South from Ushi "Cross" Point

3.12.4.2.1.4 7: Blow Hole

The Tinian Blow Hole (Photo 3.12-10) is on the northeastern side of Tinian on a rocky outcrop common to this part of the island. A natural phenomenon made by weather and waves has carved a cave under the limestone ledge over the years. Waves enter the underwater cave and exit forcefully via a hole above, resulting in columns of water shooting high in the air. The coastal feature of low growing vegetation and coral outcrops forms the foreground, the rugged coastline's green/blue water composes the middle-ground, and Saipan in the distance makes up the background of this scenic vista that is often visited by tourists. Wind provides a more dramatic display as water is carried in a spray, sometimes resulting in a rainbow.

Photo 3.12-10. Key Observation Point 7 – Tinian Blow Hole

3.12.4.3 West Tinian

West Tinian consists of the portion of the central plateau centered on 8th Avenue along with the central highlands area. Eighth Avenue traverses the island in a north-south direction and connects the memorials, historic sites and recreational features of the western side of Tinian (Photo 3.12-11). Eighth Avenue also connects directly to the North Field Historic Landmark complex. Dominated by Mount Lasso, the central highlands area is situated in north-central Tinian and just south of the north lowlands. The steep topography along the eastern edge of Mount Lasso consists of some native limestone forest vegetation. The steep, rugged terrain here is not conducive to farming and was not cleared for sugarcane under the Japanese rule. Native vegetation therefore remains. The western coast of west Tinian consists of steep cliffs, starting south of Unai Chulu and accessed via Riverside Drive. West Tinian is visually dominated by the International Broadcasting Bureau transmitter antenna array consisting of tall towers and suspended antennas west of 8th Avenue in central west Tinian.

Photo 3.12-11. Central Plateau Area of Tinian

3.12.4.3.1 Key Observation Points within West Tinian

Three Key Observation Points were identified within west Tinian for the visual analysis:

- 8: Mount Lasso Scenic Lookout A
- 9: Mount Lasso Scenic Lookout B
- 10: 8th Avenue-North of the Airport

These points are shown on Figure 3.12-1.

3.12.4.3.1.1 8 and 9: Mount Lasso Scenic Lookout A and B

South of North Field, Mount Lasso is a scenic lookout point frequently visited by tourists. As Tinian's highest point, the location was an important communications and visual reconnaissance center during World War II. Both Japanese and American radar systems were located on top of Mount Lasso during World War II, and concrete mountings for the facilities remain (Photo 3.12-12). The approach to the lookout involves passing the foundation of a former U.S. Army hospital from the World War II era and a Japanese Shinto shrine near the lookout area.

Photo 3.12-12. Mount Lasso Tower at Top of Hill with Remnants of Shinto Shrine in Foreground

Views to the northeast (Mount Lasso Scenic Lookout A) afford a panoramic view over the eastern half of Tinian with Saipan in the background to the north, where development on the south end of Saipan is visible (Photo 3.12-13).

Photo 3.12-13. Key Observation Point 8 – View from Mount Lasso Scenic Lookout North to Saipan

Views to the southeast (Mount Lasso Scenic Lookout B) provide a view of the jungle landscape, eastern coast of Tinian, Pina Plateau and the Pacific Ocean (Photo 3.12-14). Views to the west are blocked by dense vegetation. Due to a topographical plateau below the lookout in the middle-ground, the views of Broadway Avenue and structures along the route are blocked. Areas to the south, including the village of San Jose, are not visible from the Mount Lasso Scenic Lookout.

Photo 3.12-14. Key Observation Point 9 – View from Mount Lasso Scenic Lookout Southeast toward the Pina Plateau in South Tinian

3.12.4.3.1.2 10: 8th Avenue-North of the Airport

This point is just north of the Tinian International Airport, where 8th Avenue turns directly north after bordering the airfield. The scenery changes from a completely cleared airfield and surrounding area of maintained low ground cover to a dense jungle extending along both sides of 8th Avenue as it heads north (Photo 3.12-15). The development in this area consists of fenced agricultural fields and a small pull-off to allow for access to the water filling station. This roadway serves as a primary route to the National Historic Landmark at North Field.

Photo 3.12-15. Key Observation Point 10 – Looking North on 8th Avenue South Towards the Airport

3.12.4.4 East Tinian

This area consists of the central plateau east of the escarpment flanking the Mount Lasso area just east of Broadway Avenue (Photo 3.12-16). Like the central plateau in west Tinian, it is a layered limestone plateau mostly blanketed by dense vegetation. Some areas of fenced, semi-cleared agricultural lands are located in this area. Street trees along Broadway Avenue provide an impression of this area during the World War II era. The Broadway Avenue corridor traverses the island in a north-south direction and is an important route that connects the memorials,

Photo 3.12-16. Aerial View of East Tinian Looking West with the Airport in the Distance at the Upper Left Corner

historic sites, and recreational features of the central plateau and North Field Historic Landmark complex.

3.12.4.4.1 Key Observation Points within East Tinian

Five Key Observation Points were identified within east Tinian for the visual analysis:

- 11: Broadway North
- 12: Broadway South A
- 13: Broadway South B
- 14: Unai Dankulo
- 15: Unai Masalok

These points are shown on Figure 3.12-1.

3.12.4.4.1.1 11: Broadway North

Along this stretch of Broadway Avenue, tall vegetation has been cleared out to a distance of 600 feet (180 meters) on both sides of the roadway, allowing light to penetrate (Photo 3. 12-17). These cleared strips contain palm trees that were planted in a linear configuration when the road was built during World War II. The cleared conditions provide a more expansive viewshed in both northward and southward directions than those seen along many of the other existing roads. These views are seen as one travels along the roadway from San Jose to the American memorial round-about. Broadway Avenue is a primary north-south road utilized by both visitors and residents.

Photo 3.12-17. Key Observation Point 11 – Broadway Avenue Looking North

3.12.4.4.1.2 12 and 13: Broadway South A and B

These two Key Observation Points are located near the center of the island at the highest point along Broadway Avenue (Photos 3.12-18 and 3.12-19). This is where the developed areas of the village of San Jose and airport transition to the rural northern two-thirds of Tinian in the Military Lease Area. Cattle, cleared agricultural fields, and interspersed trees are visible toward the north in the foreground and middle-ground. Dense jungle vegetation is visible in the background.

The Broadway South A Key Observation Point 12 mirrors the views of the Broadway North Key Observation Point 11. The Broadway South B Key Observation Point 13 faces south (Photo 3.12-19). It provides a view to the Carolinas Plateau, Marpo Valley to the southeast, and development in the village of San Jose. Broadway Avenue is a primary north-south roadway utilized by both visitors and residents.

Photo 3.12-18. Key Observation Point 12 – Broadway Avenue Looking North

Photo 3.12-19. Key Observation Point 13 – Broadway Avenue Looking South with Carolinas Plateau in the Background

3.12.4.4.1.3 14: Unai Dankulo

This area is accessible through a forested trail that opens to an expansive beach extending north. The beach and flat nearshore environment allow direct vehicle access to picnic spots that are located within somewhat shaded coconut groves adjacent to the beach (Photo 3.12-20). While more windswept than the leeward beaches, the wind is buffered by inland vegetation. Views from this beach include the adjacent shoreline of Tinian, parts of Saipan in the distance, and the open ocean. The beach consists of an open, relatively flat area of coarse sand with chunks of coral near the water, with the sand becoming more fine-grained as it transitions towards the coconut grove and understory vegetation. Unai Dankulo is frequented by shore-based spear fishermen and is accessed by local tour companies (Mariana Visitors Authority 2014).

Photo 3.12-20. Key Observation Point 14 – West toward Unai Dankulo

3.12.4.4.1.4 15: Unai Masalok

Like Unai Lam Lam and Unai Babui, this beach is accessible via a narrow rocky foot trail (Photo 3.12-21). The beach itself is a narrow cove, fringed by large rock outcroppings. The beach provides views northeast to Saipan and some limited views of Tinian's eastern coast to the north and south. This beach is small, less open than Unai Dankulo,

Photo 3.12-21. Key Observation Point 15 – East toward the Shoreline and Unai Masalok

and is surrounded by steep topography. Vegetation extends nearly to the edge of the water. Seashells and pieces of coral are mixed with the fine white sand at this beach. This location is somewhat unique due to the variations in the brown colors of the rock and soil and the deep green colors of the vegetation.

3.12.5 Pagan

Pagan has officially been uninhabited since the 1981 volcanic eruption and the evacuation of the island for safety reasons. However, small groups of private citizens do occasionally visit the island, small scientific parties have conducted research on the island, and one group of ecotourists have toured the island. There are currently two tour options being offered for Pagan: Pagan ecotour adventure and the Silver Explorer cruise ship. There is a 10-person minimum for the Pagan ecotour (Goodridge, W.F.J., personal communication, August 28, 2014) and the Silver Explorer cruise ship accommodates 132 guests and 117 crew members (Silversea Expeditions 2012).

Key Observation Points are, by definition, those features and views that are accessible visually to the public (e.g., residents and regular visitors). Designating Key Observation Points on Pagan would imply a permanent or regular viewing audience. Therefore, the visual environment on Pagan is described in general terms below and shown in Figure 3.12-2.

In general, with few man-made alterations, the dramatic views of Mount Pagan on the north end of the island, South Pagan Volcano on the south end, and ocean beyond provide relatively unspoiled view corridors and experiences for both visitors to the island and for travelers passing nearby on marine vessels.

3.12.5.1 North Pagan

Natural features that dominate the North Pagan area include Mount Pagan, and two brackish, inland lakes (Figure 3.12-2 and Photo 3.12-22).

Photo 3.12-22. View of Inland Brackish Lagoon near Green Beach with a Japanese Monument in Foreground

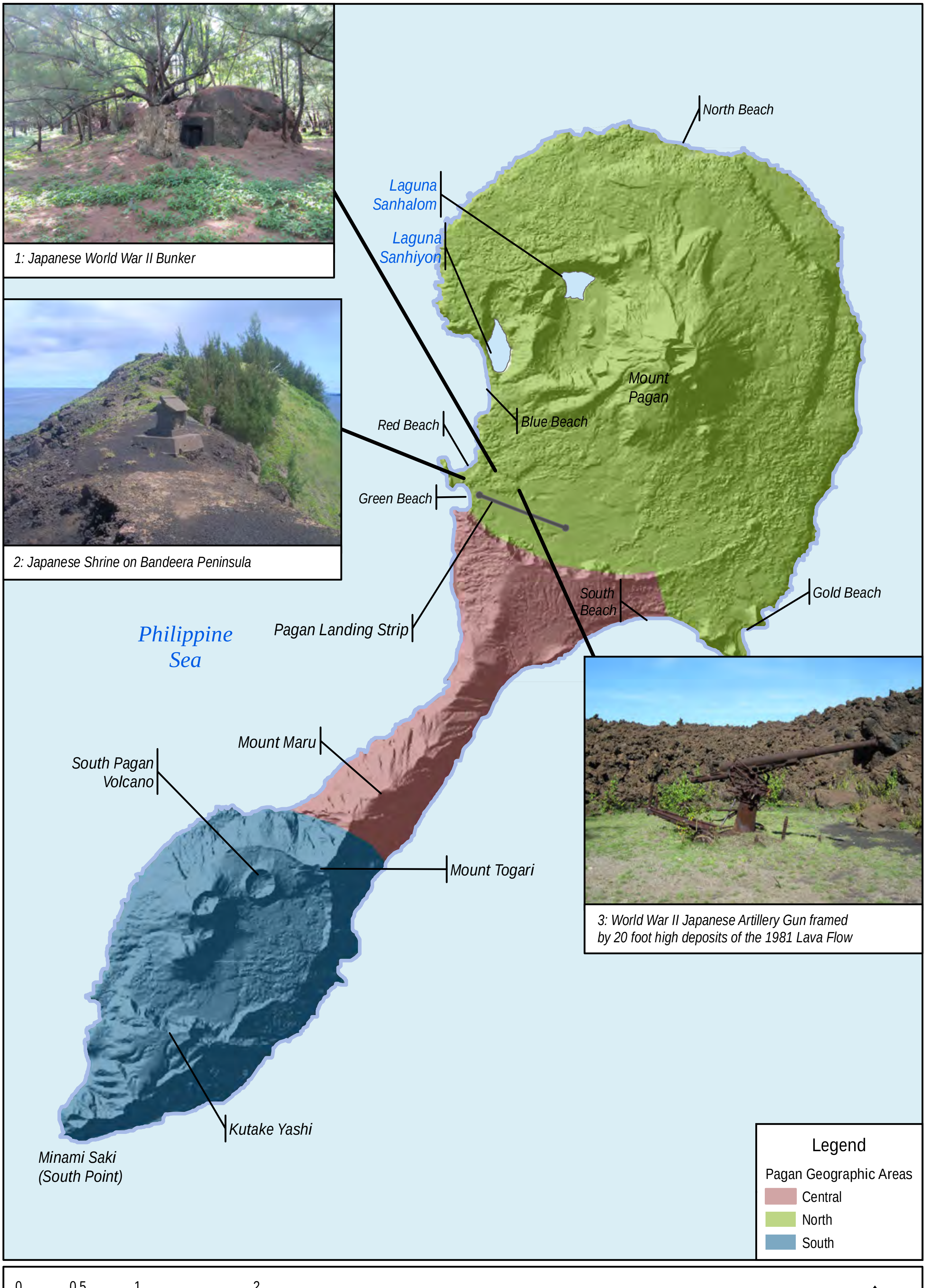


Figure 3.12-2
Pagan Visual Resources

The active volcano at the center of the North Pagan provides a unique landmark visible from most parts of the island, as its caldera emits a stream of gasses on a near-continual basis. The 1981 volcanic eruption of Mount Pagan left the landscape of northern Pagan with large areas of barren lava, surrounded by vegetation (Photo 3.12-23). The north shoreline of Mount Pagan is covered by dense, green vegetation that becomes less dense as one moves inland towards Mount Pagan. The barren lava areas provide a dark gray or black landscape. The western shoreline of North Pagan is dominated by a large black sand beach and contiguous brackish water lake just inland from the shore. The eastern shoreline of North Pagan has rockier beach areas and steeper terrain that is less accessible from inland areas.

Photo 3.12-23. View of North Pagan (looking south) showing Mount Pagan and Landscape

The largest man-made feature in North Pagan is the landing strip constructed in an east-west direction extending inland from the shoreline of Green Beach (Photo 3.12-24). Over two-thirds of this former grass landing strip was covered by a massive lava flow as a result of the 1981 volcanic eruption of Mount Pagan. This lava flow covered much of the landing strip with approximately 20 feet (6.1 meters) of lava, rendering the landing strip severely impaired. This rugged and barren lava flow provides a sharp contrast to both the vegetated area found at its immediate periphery and the large conical volcano in the background. Remnants of World War II Japanese equipment (guns, airplanes) and structures (bunkers) are still evident in North Pagan, primarily in the flat area surrounding the former air strip (see Figure 3.12-2, Photos 1 and 3). This flat area generally remains clear of thick vegetation. There is a Japanese shrine on Bandeera Point (see Figure 3.12-2, Photo 2).

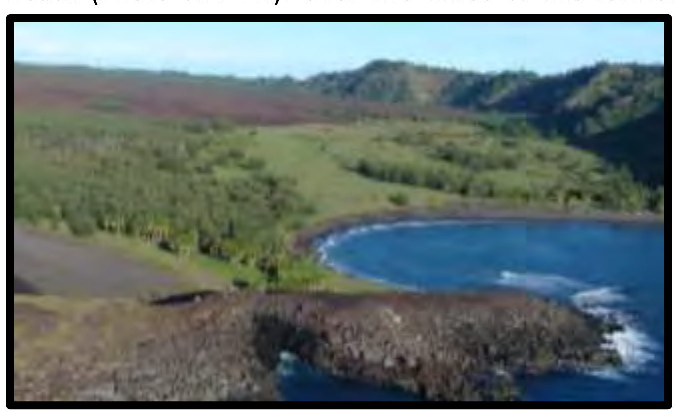


Photo 3.12-24. North Pagan Landing Strip (looking east) with Green Beach in the forefront

Dirt/grass vehicle pathways are located inland from the western shoreline of North Pagan and provide access to inland lakes, the various beach areas, and the former landing strip area.

3.12.5.2 Central Pagan

Central Pagan consists of the center portion of a narrow isthmus that connects North Pagan with South Pagan. Central Pagan consists of a rugged, steep escarpment containing open green grasslands and near-vertical drops to the sea. Beach areas are limited, as most of the shoreline in central Pagan is rocky and vertical, providing dramatic shoreline formations (Photos 3.12-25 and 3.12-26).

Photo 3.12-25. View of Central Pagan Looking South

Photo 3.12-26. Off-Shore View of West Side of Central Pagan

3.12.5.3 South Pagan

South Pagan consists of a narrow peninsula dominated by the South Pagan Volcano (Photo 3.12-27). Like central Pagan, this area is steep, with difficult terrain. The lack of shoreline makes this area difficult to access. South Pagan has a few archaeological sites and remnants of coconut groves. There are dramatic, unspoiled visual corridors in the area from both land and off-shore locations.

Photo 3.12-27. Central Pagan View Towards South Pagan

3.13 TRANSPORTATION

Section 3.13 provides a summary of the general condition and character of transportation facilities and infrastructure on the islands of Tinian and Pagan. Transportation refers to the act or process of moving people or goods and includes those resources, infrastructure, systems and devices used for moving passengers or goods from one place to another. Common forms of transportation include airplanes, pedestrians, trains, automobiles, two-wheeled vehicles (e.g., bicycles, motorcycles), and boats. The region of influence for transportation includes the air, ground, and marine transportation facilities and infrastructure on and surrounding Tinian and Pagan. Airspace and air traffic management resources are included in Section 3.6, *Airspace*. A discussion of resources that fall under Section 4(f) of the *Department of Transportation Act of 1966* is included in Section 4.19, *Section 4(f) Evaluation*.

3.13.1 Definition

Air transportation resources refer to the existing public airport facilities, specifically the Tinian International Airport and the Pagan airfield, as well as private and military air transportation facilities that would potentially be affected by the proposed action.

Ground transportation includes transportation facilities and infrastructure; specifically, the road features that would support vehicle traffic, public transportation service, and pedestrian and bicycle facilities. Level of Service is a measurement used to describe the performance of a road and ranges from Level of Service A, which indicates free-flow of traffic or excellent conditions, to Level of Service F, which indicates congested or overloaded conditions. For a detailed description of Level of Service categories refer to Table 2.1-2 in Appendix O, *Transportation Study*.

Marine transportation refers to marine vessels and facilities used to support commercial, military, and recreational uses.

3.13.2 Regulatory Framework

The regulatory framework governing transportation is briefly summarized below and described in greater detail in Appendix O, *Transportation Study*. A complete listing of applicable regulations is provided in Appendix E, *Applicable Federal and Local Regulations*.

3.13.2.1 Air Transportation

Reference is made to the following order, instruction and the CNMI regulations where applicable:

- Federal Aviation Administration Order 1050.1E Change 1, Environmental Impacts: Policies and Procedures
- DoN, Office of the Chief of Naval Operations Instruction 5090.1C Change Transmittal 1, Environmental Readiness Program Manual
- Commonwealth Ports Authority Title 40-10, Airport Division

3.13.2.2 Ground Transportation

Applicable laws, regulations, and standards include the following:

- CFR Title 23, Highways
- CNMI Administrative Code: Commonwealth Department of Public Works Title 155-20.1, Public Rights-of-way and Related Facilities Regulations
- American Association of State Highway and Transportation Officials. Federal Highway Administration's *A Policy on Geometric Design of Highways and Streets.* 2011.
- Department of Defense. United Facilities Criteria 3-250-18FA, *General Provisions and Geometric Design for Roads, Streets, Walks, and Open Storage Areas.* 2004.

3.13.2.3 Marine Transportation

The following federal and CNMI regulations are applicable:

- 33 CFR Part 165.1403
- 33 CFR Part 110.239
- 33 CFR Part 166
- 33 CFR Part 167 Commonwealth Ports Authority Title 40-20
- CNMI Administrative Code: Commonwealth Department of Public Works Title 155-20.1, Public Rights-of-way and Related Facilities Regulations

3.13.3 Methodology

3.13.3.1 Air Transportation

The preparation of the affected environment discussion for air transportation relied upon a review of the current Tinian International Airport Layout Plan, reports and records from the Federal Aviation Administration and the Commonwealth Ports Authority, site visits, meetings with the Commonwealth Ports Authority and air carriers, and information in the public domain, such as local newspapers and other environmental impact statements, etc.

3.13.3.2 Ground Transportation

The preparation of the affected environment discussion for ground transportation relied on available traffic analyses and engineering evaluations prepared for the Commonwealth Department of Public Works, available traffic data, and the *Highway Capacity Manual* (Transportation Research Board 2000) methodology to determine roadway Level of Service. This approach is not used for Pagan since only all-terrain vehicle pathways exist on the island and the Highway Capacity Manual methodology does not address the unique characteristics of all-terrain vehicle pathways or trail users. Therefore, a qualitative discussion of the affected environment for ground transportation on Pagan is provided based on observations and site visits.

3.13.3.3 Marine Transportation

The preparation of the affected environment discussion of the marine transportation relied upon available records and reports pertaining to the existing port facilities of Tinian and Pagan, as well as marine traffic patterns in adjacent waters. Current conditions were evaluated through research, interviews with authorities, and a site visit to Tinian Harbor and the Port of Tinian.

3.13.4 Tinian

3.13.4.1 Air Transportation

3.13.4.1.1 Tinian International Airport

Tinian International Airport is classified by the Federal Aviation Administration as a primary commercial service airport and is designed for code D-V aircraft such as 777/747 with a single east-west runway (Runway 08/26) of 8,600 feet (2,621 meters) long and 150 feet (46 meters) wide. Runway 08/26 is paved and marked for precision approaches with centerline, runway designation, threshold, aiming point, touchdown zone markings, and edge stripes. The runway pavement is asphalt and is in good condition. Tinian International Airport also has two apron taxiways, connecting the aircraft parking apron to the parallel Taxiway A. Both taxiways are 75 feet (23 meters) wide with approximately 35 foot wide (10.5 meter) shoulders on each side. The taxiway pavement is asphalt and is in good condition. The apron is the ramp area north of the passenger terminal building. The apron area is approximately 35,000 square yards (29,000 square meters), including an apron edge taxi lane. The apron area connecting to Hangar One west of the passenger terminal building is mainly for general aviation. The existing pavement of the apron is asphalt. Figure 3.13-1 illustrates the Tinian International Airport facilities.

Tinian International Airport is owned, managed, and operated by the Commonwealth Ports Authority and is used primarily for interisland travel between the islands of Saipan, Rota, and Guam. Star Marianas Air provides passenger charters between the islands of Saipan and Tinian, and cargo charters between Guam, Rota, Tinian, and Saipan. The current fleet for Star Marianas Air consists of seven Cherokee Six aircraft and three twin-engine Navajo aircraft all based at Hangar One in Tinian International Airport. Arctic Circle Air provides air cargo services and has expanded to include passenger flights. No regularly scheduled international flights currently operate at Tinian International Airport. Arrangements for immigration and customs services at Tinian International Airport must be made in advance with Chief Immigration Saipan. As indicated during a meeting with Star Marianas Air personnel, there are limitations in existing hospital capacity for handling emergency incidents involving large jet aircraft.

The U.S. military has previously coordinated with the Commonwealth Ports Authority for military training activities at Tinian International Airport. Temporary time slots for the exclusive use of the airfield by the military have been arranged for previous training exercises. U.S. military aircraft and chartered air carriers have operated at Tinian International Airport for transportation purposes as part of previous activities associated with Exercise Forager Fury 2012 and Forager Fury II in 2013. They include B747-400 for delivery of gear and equipment, B737 for transportation of personnel, and C-17 Globemaster III / KC-130J Hercules for delivery of equipment, vehicle, and fuel.

In 2013 there were approximately 49,116 operations (an average of 134 flight operations per day) at Tinian International Airport (Federal Aviation Administration 2014). For more details on the existing facilities at Tinian International Airport, see Appendix O, *Transportation Study.*

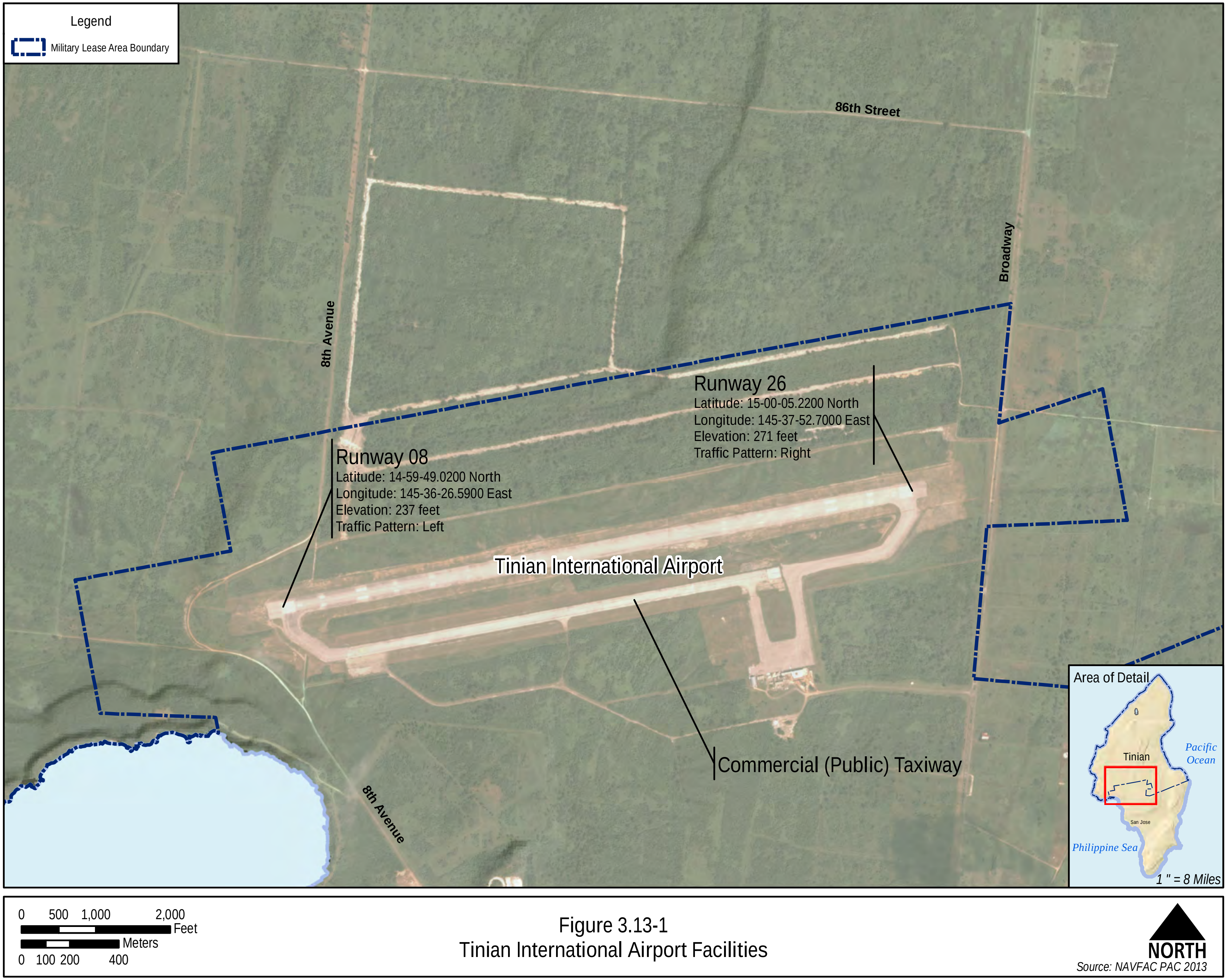


Figure 3.13-1
Tinian International Airport Facilities

Source: NAVFAC PAC 2013

3.13.4.1.2 North Field

There is an existing expeditionary landing field located in the northern portion of the Military Lease Area, i.e. North Field, which is used exclusively by the military. The North Field is not a transportation facility open to the public. North Field is a largely unimproved World War II-era airfield located in the northern portion of the Military Lease Area (see Photo 3.5-1). It remains in use as an expeditionary landing field and supports military fixed wing and helicopter training activities (DoN 2010). The U.S. military currently conducts training at North Field. These training activities have included airlift of personnel and cargo drops into the Military Lease Area (approximately 60 times per year) (DoN 2014) as well as firefighting, search-and-rescue, and expeditionary airfield clearance and flight operations during recent Forager Fury exercises.

3.13.4.1.3 Heliports

Three heliports (two owned by Dynasty Hotel and Casino and one by Americopters) currently exist on Tinian, all within 2.5 miles (4 kilometers) south of Tinian International Airport in the vicinity of the Dynasty Hotel and Casino. The heliports are used by private and charter helicopters for transportation to and from Saipan International Airport to the Dynasty Hotel and Casino.

3.13.4.2 Ground Transportation

3.13.4.2.1 Road Network

Tinian has about 68 miles (110 kilometers) of roads. Most roads were designed, developed, and constructed in 1944 to accommodate heavy truck traffic when the U.S. military population on Tinian was about 150,000. Many of the existing roads throughout Tinian are now in poor condition and traffic volumes are low. There are no roads that are part of the Interstate Highway System on Tinian. Two north/south roads, Broadway Avenue and 8th Avenue, connect the village of San Jose to the Military Lease Area and areas north of the Tinian International Airport. Two east/west roads (Canal Street [Route 202] and Route 201) connect the village of San Jose to 8th Avenue and Broadway Avenue. These roads have the highest traffic volumes with about 1,520 and 2,240 vehicles per day, respectively.

The current state and general conditions of the existing road network, average daily traffic volumes, and roadway Level of Service are shown in Figure 3.13-2 and described below for roadways within and outside of the Military Lease Area. For additional photos of the existing roads refer to Photo 2.1-1 to Photo 2.1-13 in Appendix O, *Transportation Study*.

Within the Military Lease Area:

- **Broadway Avenue:** Within the Military Lease Area, Broadway Avenue is a two-lane, divided, paved road with 20 foot (6 meter) wide lanes and a 32 foot (10 meter) wide median (Photo 3.13-1). Lack of maintenance has resulted in the southbound lane to become moderately to severely overgrown and unsuitable for use by wheeled vehicles. Broadway Avenue carries about 90 vehicles per day within the Military Lease Area.

Photo 3.13-1. View of Broadway Avenue in Central Tinian

Figure 3.13-2
Tinian Existing Roads and Average Daily Traffic
(vehicles per day)

Source: Commonwealth Department of Public Works 2008

- **8th Avenue:** Within the Military Lease Area, 8th Avenue is an 18 foot (5 meter) wide two-lane, undivided, paved road. This segment was previously a divided road with two 18 foot (5 meter) wide lanes and a 36 foot (11 meter) wide median. Lack of maintenance has resulted in the southbound lane being moderately to severely overgrown and unsuitable for use by wheeled vehicles. 8th Avenue carries up to 90 vehicles per day on this segment within the Military Lease Area.
- **86th Street:** 86th Street is a two-lane, undivided, paved road in poor condition that runs from 8th Avenue to Broadway, north of Tinian International Airport. 86th Street carries about 100 vehicles per day.
- **Other Roads:** Other roads within the Military Lease Area are typically unpaved, moderately to severely overgrown, with traffic volumes of less than 100 vehicles per day.

Outside of the Military Lease Area:

- **Broadway Avenue:** Outside of the Military Lease Area, Broadway Avenue is a two-lane, divided, paved road with 20-foot (6-meter) wide lanes and a 32-foot (10-meter) wide median. Broadway Avenue carries about 1,470 vehicles per day south of 42nd Street, and 390 vehicles per day north of 42nd Street outside of the Military Lease Area.
- **8th Avenue:** This road has two distinct segments outside of the Military Lease Area:
  - 42nd Street to Tinian International Airport, 8th Avenue is a 24-foot (7-meter) wide two-lane, undivided, unpaved road in poor condition. 8th Avenue carries about 180 vehicles per day on this segment.
  - Near Riverside Drive intersection, 8th Avenue is an 18-foot (5-meter) to 22-foot (7-meter) wide two-lane, undivided, paved/gravel road in poor condition. 8th Avenue carries approximately 180 vehicles per day on this segment.
- **Canal Street (Route 202):** Canal Street (Route 202) is two-lanes, undivided, with no median, and connects the village of San Jose to Broadway Avenue and residential and recreational areas to the northeast. Canal Street (Route 202) carries approximately 1,520 vehicles per day.
- **Route 201:** Route 201 is two-lanes, undivided, with no median, and connects the village of San Jose to Broadway Avenue and residential and recreational areas to the east. Route 201 carries about 2,240 vehicles per day.
- **42nd Street:** 42nd Street is two-lanes, undivided, with no median, that runs from 8th Avenue to Broadway, north of the village of San Jose. 42nd Street carries approximately 150 vehicles per day.
- **Other Roads:** Other roads not listed here are typically two lanes, undivided, with no median, and carry between 25 and 300 vehicles per day.

Based on the analysis conducted in the CNMI Comprehensive Highway Master Plan (Commonwealth Department of Public Works 2008), all roads on Tinian are operating under capacity at acceptable Level of Service A in their existing condition, as evidenced by free flowing traffic and no traffic delays.

3.13.4.2.2 Transit Network

There is no existing transit service on Tinian due to the relatively low population density.

3.13.4.2.3 Pedestrian and Bicycle Network

Limited designated bicycle paths are located along major roads and in main tourist attractions (Commonwealth Department of Public Works 2008). Isolated sidewalks can be found along short segments of some roads within San Jose. In general, continuous sidewalks do not exist on the majority of the roads on Tinian. Typically, the outside lane or shoulder, which is generally unpaved, functions as a pedestrian/bicycle space. Bicyclists are required to share the road with vehicles on existing travel lanes, and pedestrians are required to walk on the unpaved shoulder or landscaped area off to the side of the roads.

3.13.4.3 Marine Transportation

3.13.4.3.1 Harbor and Port Facilities

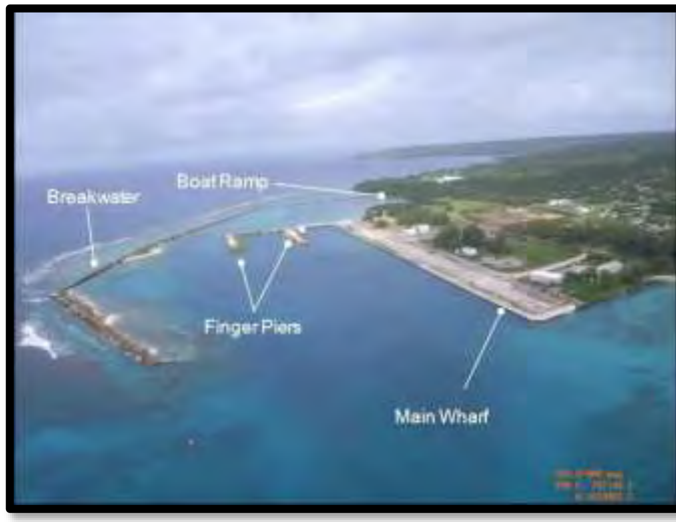


Photo 3.13-2. Aerial view of Tinian Harbor and the Port of Tinian

Tinian Harbor (shown on Photo 3.13-2) is located near the town of San Jose and is accessible via a channel with a navigable width of 500 feet (152 meters) and a minimum depth of 27 feet (8 meters) (survey conducted May 2007). The harbor was constructed in 1944 to accommodate up to eight Liberty Ship cargo vessels (U.S. Commander Pacific Fleet 1999), each with a length of about 465 feet (142 meters), a beam (maximum width) of 57 feet (17 meters), and a draft [maximum hull depth below water] of up to 28 feet (8 meters). The Port of Tinian consists of a main wharf, two finger piers, and a breakwater. The main wharf has a usable length of 1,600 feet (488 meters), with depths varying between 24 and 29 feet (7 and 9 meters). The two finger piers (Pier 1 and Pier 2) are southwest of the main wharf (Global Security 2005). A concrete boat ramp used by Amphibious Assault Vehicles is north of the finger piers and adjacent to a public dock and a public boat ramp. An adjacent grassy staging area is used for vehicles brought ashore or for staging, cleaning, and reloading (U.S. Commander Pacific Fleet 1999). A mooring buoy 2 miles (3 kilometers) from Tinian Harbor has been removed, but the anchoring system is still in place and could be used for large draft ships (DoN 2013).

The two finger piers are in a state of disrepair and are unusable. The Municipality of Tinian declared a state of emergency in October 2009 to repair these piers.

The DoN estimates that the main wharf has the capacity to process 4,500 tons (4,082 metric tons) of cargo daily. Figure 3.13-3 shows recent annual data for revenue tonnage in and out of the port. The Commonwealth Ports Authority estimates that the harbor has the capacity to accommodate passenger vessels holding up to 1,500 passengers.

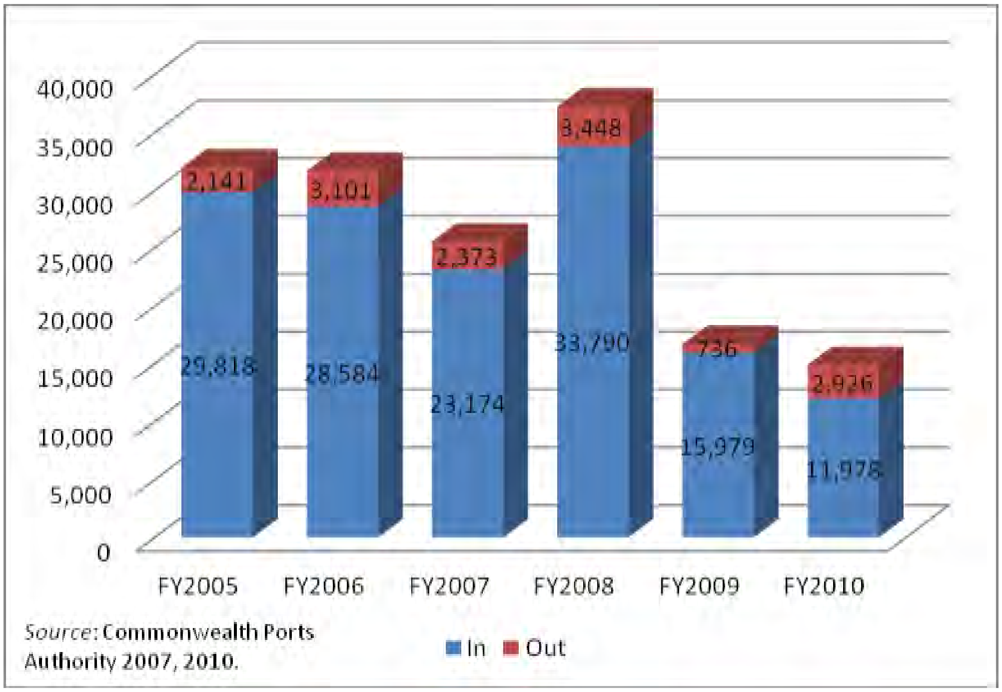


Figure 3.13-3 Port of Tinian Cargo Tonnage Handled

The main wharf has a single mobile crane with a capacity of 50 tons (45 metric tons). A tugboat and lightering barge (smaller barge to transport cargo and passengers from larger-draft vessels that cannot enter the harbor) are available on an as-needed basis at Tinian Harbor (T. Gotti, Ambyth Shipping, personal communication December 4, 2012). The Port of Tinian also has a facility for biosecurity/brown treesnake (*Boiga irregularis*) control, with a capacity of four shipping containers. Current lighting at the Port of Tinian is insufficient for nighttime operations.

The harbor is used by commercial and supply barges, as well as U.S. Coast Guard vessels and military supply shipments on Joint High Speed Vessels. Gasoline and diesel fuel can be obtained at the Mobil Oil tank compound at the Port of Tinian.

Fuel supply and regular day-to-day commodities are shipped through Tinian Harbor. Fuel is shipped by a fuel tanker on a monthly basis. The fuel tanker is berthed at the main wharf area, where its fuel is piped to storage tanks located about 300 feet (91 meters) inland. Usual stay time for the fuel tanker is 1 day. Tinian's commodities are transported from Saipan via a privately owned SM5 Boat (Landing Craft Mechanized, Mark-6) that transits daily. The SM5 Boat is off-loaded at the shore ramp facility located near the small floating boat pier.

For larger shipments, typically once every 60 days, a tug and barge are used to bring intermodal containers from Saipan. When the larger cargo quantity is delivered, the barge is docked at the main wharf. The stay time for the barge is typically 1 day.

3.13.4.3.2 Marine Shipping Traffic Patterns

Shipment of cargo (to and from Saipan) typically transits to the west of Tinian due to the calmer waters. Large vessels maintain a distance of about 1 mile (2 kilometers) offshore, while smaller vessels come within 100 feet (30 meters) of shore (Crisostomo, G., PTI Com, personal communication, January 2014). There are no known restrictions to marine traffic in the vicinity of Tinian.

3.13.5 Pagan

3.13.5.1 Air Transportation

The Pagan airfield (Photo 3.13-3) is classified by the Federal Aviation Administration as a basic general aviation airport and is considered a public airport. It is owned and managed by the Commonwealth Ports Authority and administered by the Department of Public Lands. It is unattended and has no scheduled flights. Limited charter flights/air taxi and general aviation operations occur at the airstrip for visitors, but no aircrafts are based there. The volcanic eruption in 1981 significantly reduced the runway's length. The Pagan airfield currently has a single runway (Runway 11/29) measuring 1,500 feet (457 meters) long and 120 feet (37 meters) wide. The runway surface is turf and gravel, with a load-bearing capacity of 4,000 pounds (1,800 kilograms) for single-wheel aircraft. For more details on the existing facilities at the Pagan airfield, see Appendix O, *Transportation Study*.

Photo 3.13-3. Pagan Airfield

3.13.5.2 Ground Transportation

There are no roads, transit networks, or pedestrian or bicycle facilities on Pagan and no significant vehicular traffic patterns. Only all-terrain vehicle pathways exist and their use is limited. For photos of the existing pathways refer to Photos 2.2-1 through 2.2-4 in Appendix O, *Transportation Study*. All residents of Pagan were evacuated to Saipan in May 1981 after the eruption of Mount Pagan; as a result there currently are no permanent residents (U.S. Census Bureau 2010), only visitors to the island.

3.13.5.3 Marine Transportation

3.13.5.3.1 Port Facilities

Pagan has no functional marine port facilities. The only pier on the island was built in the 1940s. The medium-depth pier was 200 feet (61 meters) in length when completed, but is severely degraded and not usable in its current condition (Photo 3.13-4). The pier was described as being in need of repair in the 1970s (Office of Transition Studies and Planning 1978), and there has been no regular

Photo 3.13-4. Current Condition of the Pagan Pier

maintenance since residents were evacuated from the island in 1981. When the island was inhabited, cargo and passengers for delivery to the island had to be transferred to vessels with smaller drafts at sea (i.e., lightering) (Office of Transition Studies and Planning 1978). Anchorage is possible in bays offshore and visitors use smaller vessels to get from anchored boats to shore.

3.13.5.3.2 Marine Shipping Traffic Patterns

No substantial marine traffic occurs within the vicinity of Pagan. Regular, but infrequent, tourism and research vessels occur within adjacent waters (described in Section 3.8, *Recreation*). While no regular schedule exists, tourism and research vessels are not expected to visit more than once per month.

3.14 UTILITIES

Section 3.14 provides a summary of the general condition, and character of, the utilities on the islands of Tinian and Pagan. The region of influence for utilities includes the U.S. government and public utilities on Tinian and Pagan.

3.14.1 Definition

Utilities refer to public utilities provided to the general population for basic services, including electrical power, potable water, wastewater services, stormwater infrastructure, municipal solid waste, and information technology/communications services.

3.14.2 Regulatory Framework

The Commonwealth Utilities Corporation is the public corporation that owns and is responsible for providing electrical power, water, and wastewater services for the CNMI. CNMI Public Law 15-35 established the Public Utilities Commission as the agency for regulatory purposes such as approval of prices, fees, charges, and terms/services for the Commonwealth Utilities Corporation.

A listing of regulatory guidelines is provided in Appendix E, *Applicable Federal and Local Regulations*. The Commonwealth Utilities Corporation is subject to all applicable regulatory requirements and the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality administers the following programs as delegated by the U.S. Environmental Protection Agency:

- Clean Air Act
- Clean Water Act
- Resource Conservation and Recovery Act
- Safe Drinking Water Act
- CNMI Wastewater Treatment and Disposal Rules and Regulations
- CNMI Underground Injection Well Regulations
- CNMI Water Quality Standards

The CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality has the following responsibilities:

- **Electrical Power:** Administers air emission permits and regulation enforcement required for power generation facilities in the CNMI.
- **Potable Water:** Oversees issues related to water quality including safe drinking water.
- **Wastewater:** Enforces the CNMI Wastewater Treatment and Disposal Rules and Regulations, the CNMI Well Drilling and Well Operations regulation, the CNMI Water Quality Standards, and U.S. Environmental Protection Agency National Pollutant Discharge Elimination System permitting requirements related to wastewater treatment and disposal.
- **Stormwater:** Oversees issues related to stormwater control, quality, and permits. They have prepared stormwater management criteria and guidance for implementation of appropriate stormwater design features as well as island stormwater practice design specifications.

- **Solid Waste:** Functions as the regulatory body that would issue the required permits to operate any new landfills, incinerators, and solid waste transfer stations, or other solid waste handling facilities. The planned solid waste facilities associated with CNMI Joint Military Training (CJMT) operations would also come under the regulatory umbrella of the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality.

The Federal Communications Commission regulates all commercial information technology/ communications activities in the CNMI.

3.14.3 Methodology

Site visits, facility and system tours (electrical generating facility, water system), document searches and reviews, and meetings with various agencies were conducted to determine current conditions for utilities on Tinian and Pagan.

Potable water use data includes data from 2002 collected for a U.S. Army Corps of Engineers Study (Army Corps of Engineers 2003). More recent information was requested from the Commonwealth Utilities Corporation and potable water production and metered use from October 2011 through August 2014 have been received and analyzed (Commonwealth Utilities Corporation 2014). Average production and metered use values for the 2011-2014 time period were utilized to evaluate the capacity of the existing potable water system on Tinian.

3.14.4 Tinian

A Utilities Study has been prepared in support of this EIS/OEIS and is provided in Appendix P, *Utilities Study*. For more detailed information, refer to Appendix P, *Utilities Study.*

3.14.4.1 Electrical Power

The Commonwealth Utilities Corporation is responsible for providing electrical power on Tinian. CNMI TeleSource, Inc. has been contracted by the Commonwealth Utilities Corporation to operate and maintain the entire electrical power infrastructure on Tinian. This contract currently extends up to year 2035 (Deposa 2014). The electrical power resource on Tinian includes generation units and distribution facilities that make up the existing island-wide power system. This includes above ground and underground transmission and distribution cables, manholes, transformers, substations, meters, and all other supporting facilities.

3.14.4.1.1 Supply and Demand

The electrical power available from the Commonwealth Utilities Corporation power station totals 17.0 megawatts, as shown in Table 3.14-1. Current peak demand is approximately 4.5 megawatts which leaves 8 megawatts available (4.5 megawatts standby generator is kept in reserve). This peak demand can be met when one of the two largest units is down for maintenance.

Table 3.14-1. Power-Generating Facility on Tinian

Unit	*Design Megawatts*	*Available Megawatts*	*Status*
Tinian Power Plant			
Diesel Engine No. 1	5.0	4.5	Operational
Diesel Engine No. 2	5.0	4.5	Standby
Diesel Engine No. 3	2.5	2.0	Standby
Diesel Engine No. 4	2.5	2.0	Standby
Diesel Engine No. 5	2.5	2.0	Standby
Diesel Engine No. 6	2.5	2.0	Standby
Totals	**20.0**	**17.0**	**-**

Note: No. = number.

3.14.4.1.2 Generation

The power generation facility (Photo 3.14-1) consists of the following components: diesel generators, exhaust stacks, and an above ground fuel delivery pipeline from the Port of Tinian fuel storage tank to a storage tank adjacent to the power plant facility. The power generation facility is located near the coast outside of San Jose, at 25 feet (7.6 meters) above MSL. The power generation facility is 15 years old, and appears to be in very good condition and well maintained.

Photo 3.14-1. Power Generation Facility

There are other private standby electrical power generators on Tinian that include the Tinian Dynasty Casino, the International Broadcasting Bureau facility, and personal-use standby generators.

3.14.4.1.3 Distribution

Figure 3.14-1 displays the existing distribution system on Tinian. The distribution lines are 13.8 kilovolts. A primary distribution line runs from the generation facility to the International Broadcasting Bureau via 8th Avenue. This line is above ground mounted on wooden poles except for a portion west of the airport that is underground to facilitate the clear zone for the runway. The maximum anticipated load from the International Broadcasting Bureau is 1.4 megawatts which is the peak load measured by the Commonwealth Utilities Corporation. The power facilities at the International Broadcasting Bureau transmitting station were designed for a peak demand load of approximately 7 megawatts. Although the highest recorded load is 4 megawatts, if the International Broadcasting Bureau determines it is necessary to operate all of the transmitters simultaneously at full power using normal amplitude modulation or dynamic carrier control modulation, the station's peak loading on the Commonwealth Utilities Corporation power supply could approach that 7 megawatts peak design load and greatly exceed the 1.4 megawatts.

Figure 3.14-1
Tinian Power Distribution

The overhead line that provides power to the International Broadcasting Bureau has capacity of up to 13.6 megawatts. However, the total additional load that can be added is limited by the drop in voltage caused by electrical losses in the transmission line. Voltage drop depends on the length of the transmission line from the power source to the electrical load and the amount of electrical load on the transmission line.

A separate 13.8-kilovolts distribution line runs from the generation facility to the airport. This line runs above ground along Broadway north to the airport access road, then runs west along this road to the airport.

Based on the characteristics of the existing distribution system and outage records from 2011, 2012, and part of 2013, the island-wide electrical power utility system is currently providing reliable service and is well positioned to keep providing an acceptable level of service into the future. The outage history from this 2.5 year period recorded 12 brief (average of 68 minutes) occurrences, only three of which were island-wide outages (see Appendix P, *Utilities Study*).

3.14.4.2 Potable Water

Tinian's public water system is owned and operated by the Commonwealth Utilities Corporation. It services the southern third of Tinian, where the civilian population lives. This system consists of one functioning supply well (Maui Well #2), a chlorine injection system for water treatment, pumps, three storage tanks, distribution piping (typically underground), water meters, and other supporting facilities.

3.14.4.2.1 Production

Currently, Maui Well #2 supplies all potable water to the Commonwealth Utilities Corporation Tinian water system, operating three of its four pumps almost constantly (Commonwealth Utilities Corporation 2013b). With the need to keep one pump on standby for maintenance purposes, Maui Well #2 is operating near full capacity.

Between October 2011 and August 2014, the water system produced an average of 1,056,553 gallons (3,999,488 liters) per day of potable water. The potential water production from Maui Well #2 has been estimated as at least 1 million gallons per day (3.8 million liters) of potable water in the dry season and 1.5 million gallons (5.7 million liters) per day in the wet season (Army Corps of Engineers 2003). The analysis of the potable water system assumed that a maximum average pump rate of 1,260,000 gallons (4,769,619 liters) per day was a sustainable level.

Photo 3.14-2. Chlorine Injection System at Maui Well #2

Recent water quality testing has shown chloride levels range from 172 to 217 milligrams per liter, with an average of 190 milligrams per liter. Chlorides may be associated with salt content, and the general acceptable limit of chlorides in drinking water is 250 milligrams per liter to avoid affecting the taste of drinking water. A chlorine injection system treats the water at Maui Well #2 (Photo 3.14-2). The injection system consists of two 150-pound (68-kilogram) chlorine cylinders, a vacuum regulator mounted to the top of each cylinder, and a small pressurizing pump for the chlorination circuit. The Maui Well #2 pump house and equipment are shown in Photos 3.14-3 and 3.14-4.

Photo 3.14-3. Maui Well #2 Pump

Photo 3.14-4. Maui Well #2 Pump Equipment

3.14.4.2.2 Storage

The water system includes three water storage tanks: Marpo Tank, Carolinas Tank, and Tinian Airport Tank. The Marpo Tank (Photo 3.14-5) is a 250,000-gallon (950,000-liter) tank that serves the Marpo Valley agricultural area and Marpo Heights residential area. The largest storage tank, the Carolinas Tank (Photo 3.14-6) is a 500,000-gallon (1.9 million-liter) tank located above the Carolinas residential area. It serves the Carolinas Heights Subdivision, San Jose, Tinian Dynasty Casino, Carolinas Heights Agricultural Homesteads, and a portion of Marpo Valley. The Airport tank (Photo 3.14-7) is a 60,000-gallon (227,000-liter) tank located along the airport access road and serves only the airport facilities.

Photo 3.14-5. Marpo Water Storage Tank (250,000 Gallon Tank)

Photo 3.14-6. Carolinas Water Storage Tank (500,000 Gallon Tank)

Photo 3.14-7. Tinian Airport Potable Water Storage Tank (60,000 Gallon Tank)

3.14.4.2.3 Distribution

Figure 3.14-2 shows the existing potable water distribution system. All water transmission lines also serve as distribution lines. The waterlines between Maui Well #2 and the storage tanks also serve as distribution lines to residents. A 6-inch (150-millimeter) polyvinyl chloride water line transmits water to Marpo Tank, and an 8-inch (200-millimeter) polyvinyl chloride water line transmits water to Carolinas Tank.

Figure 3.14-2
Tinian Potable Water Distribution

The system has substantial leaks due to old galvanized and transite distribution piping, overflows at storage tanks due to lack of functioning telemetry controls, and leaks due to high pressures. The large water losses result in significantly more water being pumped from the well to make up for the losses in the system.

As of November 2013, the Commonwealth Utilities Corporation provides the potable water for a total of 833 metered accounts, which includes residential, commercial, and government customers (Commonwealth Utilities Corporation 2013b). Unaccounted for water is the result of leaks, unmetered uses, and unplanned overflows within the system. The typical unaccounted for water from efficient systems should be less than 25% of the water produced. The Commonwealth Utilities Corporation has indicated that unaccounted for water (water pumped from the supply well but not billed to customers) is estimated to be approximately 75% to 80% of the water produced (Commonwealth Utilities Corporation 2013a).

The average recorded water production in all of 2002 was 1,200,000 gallons (4,500,000 liters) per day. Over the first 7 months of 2002, a monthly average of 680,265 gallons (2,575,083 liters) per day of potable water was metered to users (Army Corps of Engineers 2003). This indicates that in 2002, approximately 641,781 gallons (2,429,405 liters) of potable water was lost within the distribution system on Tinian daily (an average unaccounted for water of 48%).

Between October 2011 and August 2014, the water system produced an average of 1,056,553 gallons (3,999,412 liters) per day of potable water (Commonwealth Utilities Corporation 2014). The monthly average of 320,384 gallons (1,212,785 liters) per day of potable water was metered to residential, commercial and government users. This means that between 2011 and 2014, daily potable water lost within the distribution system averaged 787,031 gallons (2,979,236 liters) per day, (an average unaccounted for water of 70%).

Although the Tinian International Airport relies on the Commonwealth Utilities Corporation system for its water source, it has its own local water distribution system. In addition, the International Broadcasting Bureau facilities are not connected to the Commonwealth Utilities Corporation Tinian municipal water supply system. Instead, they use non-potable rainwater collection, non-potable bulk water trucked in from the Commonwealth Utilities Corporation system, and bottled drinking water.

3.14.4.3 Wastewater

Figure 3.14-3 shows the existing wastewater systems on Tinian. There is no centralized municipal wastewater collection and treatment system on Tinian. Decentralized collection and treatment systems on Tinian serve some residential areas, such as the housing area in San Jose, and lead to a central septic and leaching field system. Most public and private buildings on Tinian use septic tanks with leaching fields or cesspools for treatment and disposal of wastewater. The Tinian Dynasty Hotel and Casino owns the largest private wastewater system on Tinian and the only treatment system that does not use a septic tank. The Dynasty Hotel and Casino uses a tertiary treatment plant that is permitted to discharge a maximum average monthly flow of 0.24 million gallons (0.91 million liters) per day. Discharge monitoring reports from April 2014 to May 2014 show that the average daily wastewater flow to the plant ranged from 0.14 to 0.15 million gallons (0.51 to 0.57 million liters) per day. The system discharges the treated effluent to leaching fields on the hotel's property.

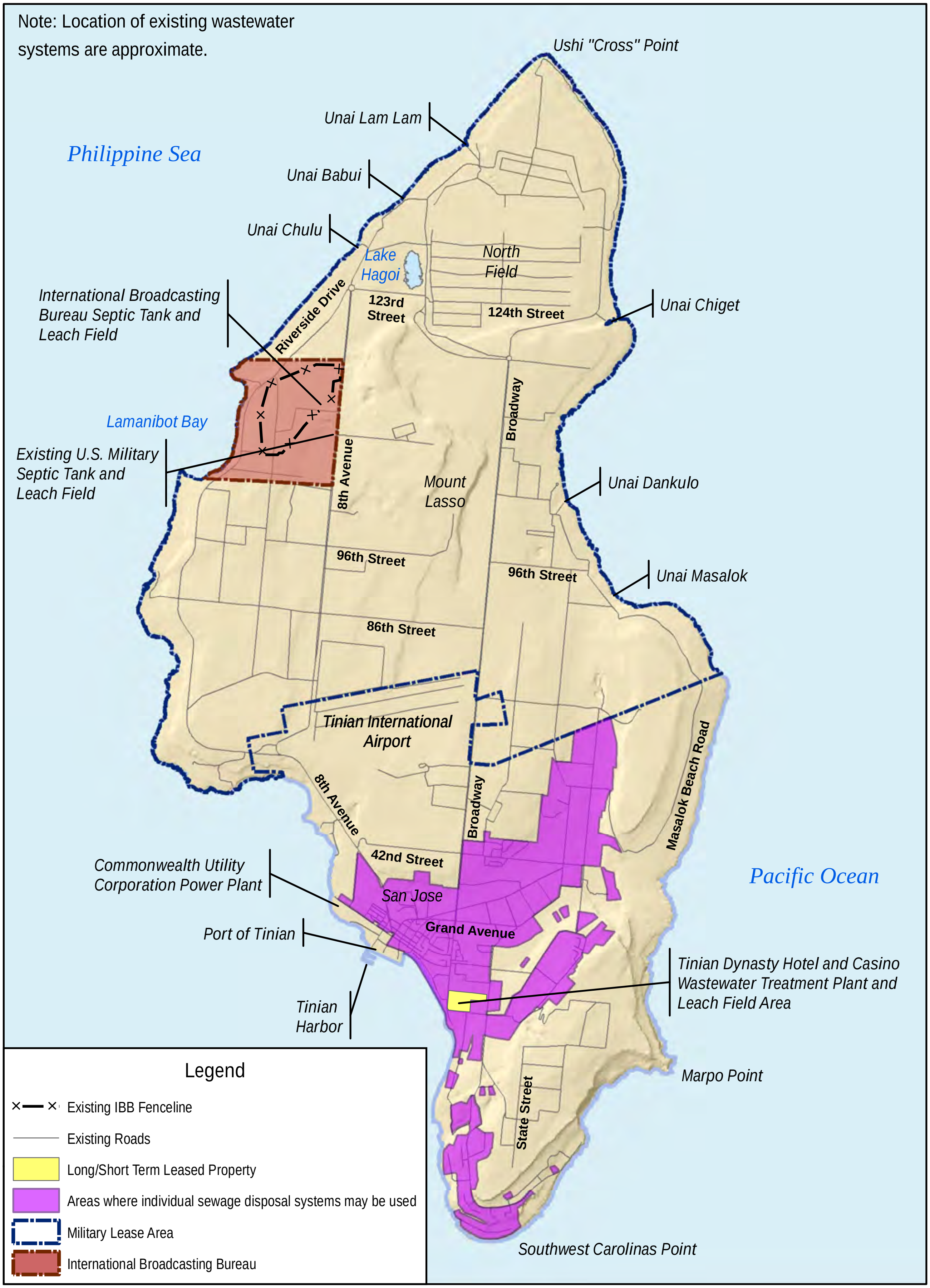


Figure 3.14-3
Tinian Wastewater Systems

A U.S. military septic tank and leaching field system was constructed on Tinian to support military training personnel. It was first made available during a military training exercise in March-April 1999. The system is located south of the International Broadcasting Bureau fence line adjacent to the west side of 8th Avenue. It was sized to support a population of 2,500 military training personnel and to an average daily flow of 6,640 gallons per day (25,000 liters per day). The system is currently not operational. There are plans for its rehabilitation.

3.14.4.4 Stormwater

As discussed in Section 3.3, *Water Resources,* Rainfall on Tinian averages 83 inches (212 centimeters) per year (Water and Environmental Research Institute 2003), 58% of which typically occurs from July to November while only 14% typically occurs during the dry season from January to April (DoN 2010). Stormwater management within the Military Lease Area is minimal, consisting primarily of shallow roadside swales for conveyance. Due to the high porosity of the soils and karst surface geology, the majority of stormwater collects in naturally occurring depressions and infiltrates into the ground. Outside of the Military Lease Area, such as in portions of San Jose, a few areas contain curb and gutter for stormwater conveyance. Most other areas allow stormwater to flow naturally away from the roadways.

3.14.4.5 Solid Waste

Photo 3.14-8. Current Solid Waste Disposal on Tinian

The existing solid waste facility consists of an unlined, open disposal site located about 0.5 mile (0.8 kilometer) north of San Jose and west of 8th Avenue (Photo 3.14-8 and Figure 3.14-4). This disposal site receives all of the municipal solid waste generated on Tinian. The CNMI Department of Public Works operates the facility, which does not comply with the CNMI Administrative Code Chapter 65-80 Solid Waste Management Regulations or the Resource Conservation and Recovery Act Subtitle D regulations applicable to municipal solid waste landfills (40 CFR Part 258) and were issued a Cease and Desist Administrative Order, CASE NO. DEQ SWM 2010-01 in 2010. The CNMI government has initiated contracting and construction for a solid waste transfer station that would handle the solid waste generated by the civilian population.

Figure 3.14-4
Tinian Solid Waste Facility

3.14.4.6 Information Technology/Communications

The information technology/communications resources on Tinian include all telephone, internet, cable, and satellite information technology/communications infrastructure. Tinian has commercial information technology/communications services provided by IT&E, which supplies phone and internet services through overhead distribution in the southern part of Tinian but not in the Military Lease Area. Cellular phone service is also provided by towers that serve the southern part of the island. Marianas Cable Vision Broadband provides cable television service on Tinian. There is no commercial or existing military information technology/communications infrastructure in the Military Lease Area. The International Broadcasting Bureau has significant broadcasting facilities on the northwest portion of Tinian but is not served by commercial services. It relies instead on wireless communications with infrastructure on Saipan.

An undersea fiber optic cable links Tinian and other islands in the CNMI to the Trans-Pacific Cable hub on Guam. In addition to the undersea fiber optic cable, a microwave system between Saipan, Tinian, and Rota provides alternative connectivity and provides diverse and redundant capability for IT&E commercial communications to Tinian in the event the undersea fiber optic cable is disabled (IT&E n.d.). The IT&E Cable Landing Facility is located on Tinian near Broadway and Canal Street in San Jose.

3.14.5 Pagan

3.14.5.1 Electrical Power

There is no public electrical generation or distribution infrastructure on Pagan. Visitors to Pagan may utilize personal-use generators or other power sources.

3.14.5.2 Potable Water

There is no potable water infrastructure or known freshwater source on Pagan. There are two large lakes in northern Pagan; Laguna Sanhiyon and Laguna Sanhalom. Knowledge of the groundwater resources of Pagan is limited to a 1957 study of the geology and hydrogeology of the island (Corwin et al. 1957), a 1978 planning study by the CNMI Office of Transition Studies and Planning; and limited water sampling conducted by the U.S. Geological Survey in 1983 and 2001 (U.S. Geological Survey 2014).

Figure 3.3-3 shows the location of the known groundwater wells on Pagan. Six relatively broadly-distributed groundwater samples were collected from accessible wells on Pagan by the U.S. Geological Survey in 1983 and two were collected in 2001 (U.S. Geological Survey 2014). Three of the wells Corwin et al. (1957) tested (Wells 1, 2, and 3) had total dissolved solids below the secondary drinking water maximum contaminant level. Two of these wells (Wells 2 and 3) had nitrate concentrations below the primary drinking water maximum contaminant level (i.e., mandatory drinking water quality standards under the Safe Drinking Water Act). Therefore these two wells might be considered potable; however both of these have water high in silica.

Visitors to Pagan utilize rainwater harvesting techniques to supply water for personal use. Additional information is provided in the Appendix P, *Utilities Study* (Volume III, Section 2.5.2 [DoN 2014]) and Section 3.3, *Water Resources*.

3.14.5.3 Wastewater

There is currently no publicly operated wastewater infrastructure on Pagan.

3.14.5.4 Stormwater

Average annual rainfall on Pagan is 70 to 80 inches (178 to 203 centimeters). There are no existing man made serviceable stormwater management features on Pagan. Existing culverts near Blue Beach are rusted, filled with holes, and partially crushed. The only related improvements include some grading around the airstrip performed decades ago.

3.14.5.5 Solid Waste

There is no publicly operated solid waste infrastructure on Pagan.

3.14.5.6 Information Technology/Communications

There is no existing information technology/communications infrastructure on Pagan.

3.15 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

Section 3.15 provides a summary of the general condition and character of CNMI socioeconomics and potential environmental justice issues. Because of the size and singular government of the CNMI, some of the anticipated socioeconomic impacts are expected to affect the Commonwealth as a whole but also at individual island level. Therefore, the region of influence includes the CNMI with particular emphasis on Tinian and Pagan (and in some cases Saipan).

3.15.1 Definition

Socioeconomics is generally defined as the study of the interrelation between social behavior and economics. Socioeconomic analyses typically address issues such as population, demographics, business activity, employment and income, and environmental justice. Impacts to these fundamental socioeconomic components can also influence other systemic issues such as housing, the provision of public services (e.g., emergency services, education, health services), and the general quality of life in a community.

The U.S. Environmental Protection Agency 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" (U.S. Environmental Protection Agency 2012). It goes on to clarify that "no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies." The U.S. Environmental Protection Agency guidance states that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of Northern Mariana Islands."

Minority populations are "identified where either: (a) the minority population of the affected area exceeds 50% or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis" (Executive Order 12989). Minority populations include populations that report their ethnicity as something other than non-Hispanic White alone, including Native Hawaiian or other Pacific Islander, Asian, Black or African American, Hispanic or Latin, American Indian, or Alaska Native (U.S. Census Bureau 2011); specifically, for this EIS/OEIS, minority populations are primarily Pacific Islanders (Chamorro and Carolinian) and Asians.

Low-income populations "should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty" (Executive Order 12989). The Bureau of Census further defines poverty areas as "census tracts or block numbering areas where at least 20% of residents were below the poverty level."

Children are defined as those individuals under the age of 18 years old (Executive Order 13045).

3.15.2 Regulatory Framework

The Council on Environmental Quality regulations implementing NEPA state that when economic or social effects and natural or physical environmental effects are interrelated, the EIS would discuss these effects on the human environment (40 CFR § 1508.14). The Council on Environmental Quality regulations further state that the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." In addition, 40 CFR § 1508.8 states that agencies need to assess not only direct effects, but also "aesthetic, historic, cultural, economic, social, or health" effects. Following from these regulations, the socioeconomic analysis in this EIS/OEIS evaluates how elements of the human environment such as population, employment, housing, and public services might be affected by the proposed action.

Two executive orders deal directly with the socioeconomic conditions and concerns of potentially affected communities. Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations requires federal agencies to assess whether their actions could have disproportionately high and adverse environmental and health impacts on minority or low-income populations. Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks requires a similar analysis for children.

3.15.3 Methodology

Information presented in this section is based on research, analysis, and personal interviews conducted for Appendix Q of this EIS/OEIS, the *Socioeconomic Impact Analysis Study* (DoN 2014). In order to gather data for the *Socioeconomic Impact Assessment Study*, a series of interviews with CNMI and Tinian government agencies, non-governmental organizations, and private organizations were conducted on Tinian and on Saipan during the final week of January and first week of February 2014 (see Appendix B of the *Socioeconomic Impact Assessment Study* (Appendix Q) for interview meeting records). Information from those interviews supplements data gathered from other sources, which include those published by the U.S. Census and other U.S. federal government agencies, CNMI government agencies, and academic institutions. This information gathered through personal interviews was noted as being a statement that was made by the interviewee, and the *Socioeconomic Impact Assessment Study* (Appendix Q) (DoN 2014) was provided as the citation. Interview meeting records are presented in complete form in Appendix Q, *Socioeconomic Impact Assessment Study* (see Appendix B of the study).

Information presented in this section includes some projections of future economic activity. The projections, collectively, comprise the expected future baseline to which effects of the proposed action were compared to determine the magnitude of impacts. These projections were developed using a methodology that is presented in Appendix A of the *Socioeconomic Impact Assessment Study* (Appendix Q), and more detailed information on these projections can also be found in Chapter 4 of the *Socioeconomic Impact Assessment Study* (Appendix Q). Some of the projections indicate whether certain economic development projects would be expected to occur absent the proposed action. Development of these expectations is consistent with methods described in reference to cumulative impact assessment (see Chapter 5, *Cumulative Impacts*, Section 5.3.1) but also take economic feasibility into consideration.

While the footprint of the proposed action would be limited to Tinian and Pagan, the entire population of the CNMI may be affected by the proposed action. As such, data on the population and economy of Saipan and Rota were included. The ways in which the proposed action may affect the CNMI (to include Tinian, Pagan, Saipan, and Rota) are through potential changes to the overall economic activity in the CNMI and changes to CNMI government revenues, which are distributed to each CNMI municipality.

Typically, an analysis of environmental justice is begun by determining the presence and proximity of low-income and minority populations relative to potential adverse impacts of a proposed action. In conjunction, a comparison of populations, that may be impacted, is made to determine the potential for disproportionate effects (i.e., the potential for disproportionate effects is established by looking at whether impacts would have greater effects on certain locations than other locations). However, in this case, environmental justice analysis is complicated by the CNMI's unique capability to meet the purpose and need of the proposed action. As summarized in Chapter 1, the Department of Defense has identified the need for increased training capabilities in the Western Pacific with the greatest number of unfilled training requirements in the Mariana Islands, specifically the CNMI. As described in Chapter 2, of the 14 CNMI islands, only a combination of Tinian and Pagan meet unit level and combined level screening criteria, and could satisfy the unfilled training requirements. In this analysis, the populated islands in the CNMI (Saipan, Tinian, and Rota) were analyzed to determine the presence of low-income and minority populations.

3.15.4 Socioeconomic Context

3.15.4.1 Commonwealth of the Northern Mariana Islands

As described in Chapter 1, in June of 1975, with 78.8% of votes cast in favor, the people of the CNMI accepted the *Covenant to Establish a Commonwealth of the Northern Mariana Islands in Political Union with the U.S.* On November 4, 1986, the final provision of the 1976 Covenant came into effect and U.S. citizenship was conferred upon qualified CNMI residents.

The late 1980s and early 1990s were a boom period for the CNMI economy, in large part due to Japanese investments that were geared towards making the CNMI a tourist destination. Also contributing to the boom was growth in Chinese investments in the garment manufacturing industry. During the early part of the boom period, it became clear that the CNMI labor pool could not support the magnitude of its economy (DoN 2014). To meet labor demand, non-resident workers were brought in on CNMI-Only Transitional Worker visas. The visa allows CNMI business owners to apply for temporary permission to employ foreign (nonimmigrant) workers.

In 2005, the U.S. entered a global trade agreement that removed the quota system for garments made overseas allowing even cheaper textile imports from other parts of the world into the U.S., effectively closing down the CNMI garment manufacturing industry and ending the boom. In 2006, Japan Airlines withdrew from the CNMI due to a declining Japanese tourism market. These and other factors led to a prolonged contraction of the CNMI economy from 2002 to 2011 (DoN 2014).

Data show that from 2011 to 2012, the CNMI economy began to improve as gross domestic product increased for the first time in over a decade, by 7.7% (DoN 2014). The improvement was in large part due to increases in the number of Chinese visitors. Compared to traveling to the mainland U.S., travel to the CNMI, for Chinese tourists, is relatively simple because of the allowance, referred to as "parole in place," whereby the U.S. government permits visits of up to 45 days without requiring a visa.

3.15.4.2 Tinian

In January 1983, the U.S. and the CNMI governments finalized a lease agreement for military use of approximately two-thirds of northern Tinian (i.e., the Military Lease Area). In 1994, the U.S military signed a lease back agreement for a portion of the land that it had leased; this Lease Back Area was made available to Tinian residents for subsistence agriculture and grazing. One-year agricultural permits were administered by the CNMI Department of Public Lands and limited to 12 acres (5 hectares). The 1994 lease back agreement has since expired but the CNMI and U.S. have continued the terms of the lease back agreement on a short-term, interim basis while negotiations continue on a long-term lease back agreement.

Since the 1990s, Tinian's economy has been led by tourism and local government employment (U.S. Census Bureau 2010a, 2014). The Tinian Dynasty Hotel and Casino, which opened on April 25, 1998, currently draws visitors to Tinian, primarily from China. Tinian Dynasty management indicated that Chinese visitors purchase tour packages that typically include visits to Saipan for a couple of nights and Tinian for a couple of nights (DoN 2014). Tinian Dynasty Management and a Tinian tour operator also noted that visitors often take windshield tours of the island that stop at historical, scenic, and beach sites (DoN 2014).

3.15.4.3 Pagan

The first post-war economic development on Pagan took place in 1951 when the Northern Islands Development Company brought Chamorros to Pagan to collect and market copra (coconut meat) (Russell 1998). In 1976, about 75 tons (83 metric tons) of copra was produced on Pagan, generating sales of about $13,000 (CNMI Office of Transition Studies and Planning 1978). As of 1978, there were no stores on Pagan or evidence of cash exchanges among residents for goods or services. There was "limited potential for development" on Pagan due to lack of comparative advantage over other islands in the region, relative inaccessibility, and lack of modern infrastructure necessary to make potentially productive operations (e.g., basalt mining) feasible (CNMI Office of Transition Studies and Planning 1978).

Pagan is home to two active volcanoes, one of which (Mount Pagan) erupted in May 1981 forcing the evacuation of all residents to Saipan; the island remains unpopulated because of continued safety concerns. While no official homesteading has occurred on Pagan, there is anecdotal information indicating that people periodically visit the island and some may stay for extended periods. In 2010, the CNMI enacted Public Law 16-50, a homesteading law to establish the Northern Islands Village and Agricultural Homesteading program for current or former residents of the Northern Islands or any qualified person interested in residing on the Northern Islands. The law, however, requires extensive municipal planning and infrastructure development prior to homesteading deeds being issued, and to date, the CNMI has not deeded any land on Pagan (DoN 2014).

3.15.5 Population Characteristics

Figure 3.15-1 shows the population trend over time for the CNMI overall, Saipan, Tinian, Rota, the Northern Islands, and temporary residents. According to the 2010 Census, Saipan, Tinian, and Rota are the only three islands in the CNMI with permanent residents (U.S. Census Bureau 2010a). The CNMI population increased by 730% between 1958 and 2000 (from 8,290 to 69,221) but decreased from 2000 to 2010 by 22% (from 69,221 to 53,883).

The first major population influx was during the 1980s. During that decade, the CNMI population more than doubled from 16,780 to 43,345. The population increased substantially again during the 1990s, growing 60% from 43,345 to 69,221. The massive population influxes during the 1980s and 1990s were driven by the introduction and increasing numbers of temporary non-residents (Pacific Web 2013).

A range of projections indicates that during the time that the proposed action would be implemented, CNMI (including Tinian) population could range between 3% lower than counted in the 2010 Census and 18% higher than 2010 levels. See Appendix Q, *Socioeconomic Impact Assessment Study* (Section 4.1.1 of the study).

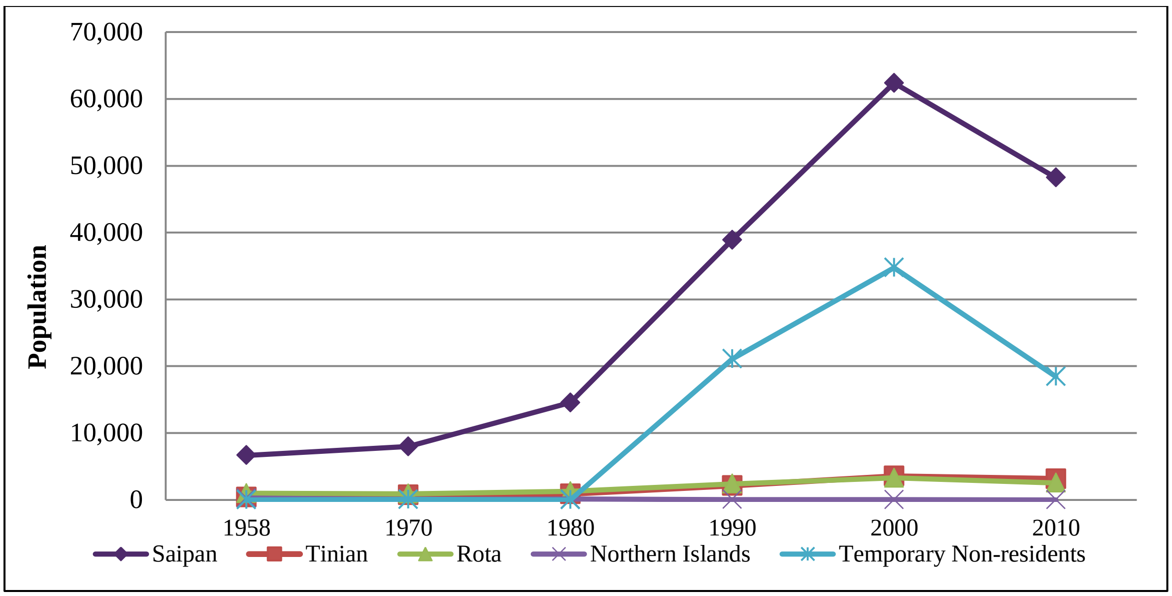


Figure 3.15-1 CNMI Population Trends, 1958-2000
Source: U.S. Census Bureau 2000, 2010a; Pacific Web 2013.

The racial composition of the CNMI is primarily Asian and Pacific Islander. As of 2010, 50% of the population was Asian (mostly Filipino) and 35% was Pacific Islander (mostly Chamorro) (U.S. Census Bureau 2010a). On Tinian in 2010, 47% of the population was Asian while 39% was Pacific Islander. Of the 1,222 Pacific Islanders on Tinian in 2010, 1,183 were Chamorro (97%) (U.S. Census Bureau 2010a). On average, CNMI households had 3.26 people and a median annual income of $19,958. Of the municipalities in the CNMI, Tinian had the fewest persons per household (3.21) and the highest median household income ($24,470); Saipan had the most people per household (3.27) and the lowest median household income ($19,607) (U.S. Census Bureau 2010a).

3.15.6 Economic Characteristics

3.15.6.1 Employment and Income

According to the 2010 Census, the labor participation rate in the CNMI was 72%, and 11.2% of the labor force in the CNMI was unemployed (U.S. Census Bureau 2010a). In comparison to the CNMI as a whole, Tinian's unemployment rate was low, at 6.7%. Table 3.15-1 lists the number and percent of the labor force, employed, and unemployed in the CNMI overall and broken down into Tinian, Saipan, and Rota.

Table 3.15-1. CNMI Labor Force, Employment, and Unemployment, 2010

Labor Force	*CNMI*	*Tinian*	*Saipan*	*Rota*
Population 16 Years and Over	38,679	2,311	34,581	1,787
Not in Labor Force	10,711	433	9,855	423
Labor Force Participation Rate	72%	81%	71%	76%
In Civilian Labor Force	27,949	1,878	24,709	1,362
Employed	24,826	1,752	21,816	1,258
Unemployed	3,123	126	2,893	104
Unemployment Rate	11.2%	6.7%	11.7%	7.6%

Source: U.S. Census Bureau 2010a.

Table 3.15-2 shows 2010 employment by industry for the CNMI and Tinian. In 2010, the industry with the highest number employed both in the CNMI and on Tinian was the arts, entertainment, recreation, accommodation and food services industry; this tourism-related industry employed 672 people on Tinian (38% of employment) and 5,519 people in the CNMI (22% of employment).

Table 3.15-2. Employment by Industry, 2010

Industry	*CNMI Overall*	*CNMI % of Employment*	*Tinian*	*Tinian % of Employment*
Arts, entertainment, recreation, accommodation, and food services	5,519	22%	672	38%
Educational services, health care, and social assistance	3,085	12%	178	10%
Retail trade	2,645	11%	76	4%
Other services, except public administration	2,553	10%	131	7%
Public administration	2,414	10%	320	18%
Professional, scientific, management, administrative, and waste management services	1,974	8%	53	3%
Construction	1,786	7%	79	5%
Transportation and warehousing, and utilities	1,429	6%	127	7%
Finance, insurance, real estate, rental, and leasing	1,064	4%	31	2%
Wholesale trade	700	3%	10	1%
Manufacturing	689	3%	5	0%
Information	496	2%	29	2%
Agriculture, forestry, fishing, hunting, and mining	472	2%	41	2%

Source: U.S. Census Bureau 2010a.

Projections indicate that during the timeframe that the proposed action would be implemented, CNMI (including Tinian) employment could range between 8.4% and 35% higher than 2010 Census levels. See Appendix Q, *Socioeconomic Impact Assessment Study* (Section 4.2.3 of the study).

In the CNMI, the average hourly wage was $9.67, in 2011, and the median hourly wage was $6.00. This is lower than the U.S. minimum wage of $7.25 per hour because the CNMI does not fall under U.S. minimum wage regulations. Average annual pay was $20,114 and the median annual pay was $12,480. The highest paying jobs were legal (average annual pay of $59,467) and healthcare practitioner (average annual pay of $48,693). The lowest paying was food preparation and service-related occupations (average annual pay of $11,606). Table 3.15-3 presents 2011 CNMI income by occupation (CNMI Department of Commerce 2012a).

Table 3.15-3. CNMI Income by Occupation, 2011

Occupation	*Hourly Wage*		*Annual Pay*	
	Average	*Median*	*Average*	*Median*
Weighted Average[1]	**$9.67**	**$6.00**	**$20,114**	**$12,480**
Management	$15.55	$13.07	$32,344	$27,186
Business and Financial Operations	$11.56	$9.30	$24,045	$19,344
Computer and Mathematical	$16.11	$14.18	$33,509	$29,494
Architecture and Engineering	$14.48	$10.13	$30,118	$21,070
Life, Physics, and Social Science	$12.58	$10.50	$26,166	$21,840
Community and Social Services	$9.12	$8.40	$18,970	$17,472
Legal	$28.59	$27.31	$59,467	$56,805
Education, Training, and Library	$16.18	$16.43	$33,654	$34,174
Arts, Design, Entertainment, Sports, and Media	$8.36	$6.09	$17,389	$12,667
Healthcare (Practitioners and Technical)	$23.41	$16.68	$48,693	$34,694
Healthcare Support	$7.52	$5.94	$15,642	$12,355
Protective Service	$8.27	$7.56	$17,202	$15,725
Food Preparation and Serving Related	$5.58	$5.05	$11,606	$10,504
Building and Grounds Cleaning and Maintenance	$5.79	$5.05	$12,043	$10,504
Personal Care and Service	$6.42	$5.09	$13,354	$10,587
Sales and Related	$5.80	$5.05	$12,064	$10,504
Office and Administrative Support	$8.45	$5.82	$17,576	$12,106
Farming, Fishing, and Forestry	$6.58	$5.05	$13,686	$10,504
Construction and Extraction	$6.21	$5.05	$12,917	$10,504
Installation, Maintenance, and Repair	$7.38	$5.67	$15,350	$11,794
Production	$7.27	$5.15	$15,122	$10,712
Transportation and Material Moving	$7.11	$5.25	$14,789	$10,920

Note: [1]Weighting based on number of employees in each occupation.
Source: CNMI Department of Commerce 2012a.

Figure 3.15-2 shows the trend for CNMI total employee compensation and gross domestic product over the years of 2002-2012. Over that period, total employee compensation was greatest in 2004 ($752 million), a year before the garment manufacturing industry experienced losses. After 2004, total compensation declined every year up to 2012, reaching a low of $482 million (U.S. Bureau of Economic Analysis 2012, 2013).

Projections indicate that during the timeframe that the proposed action would be implemented, due to anticipated expansion in the tourism industry and expected increases in the minimum wage, CNMI total compensation could range between 21% and 51% higher than 2012 levels shown in Figure 3.15-2. See Appendix Q, *Socioeconomic Impact Assessment Study* (Section 4.2.3 of the study).

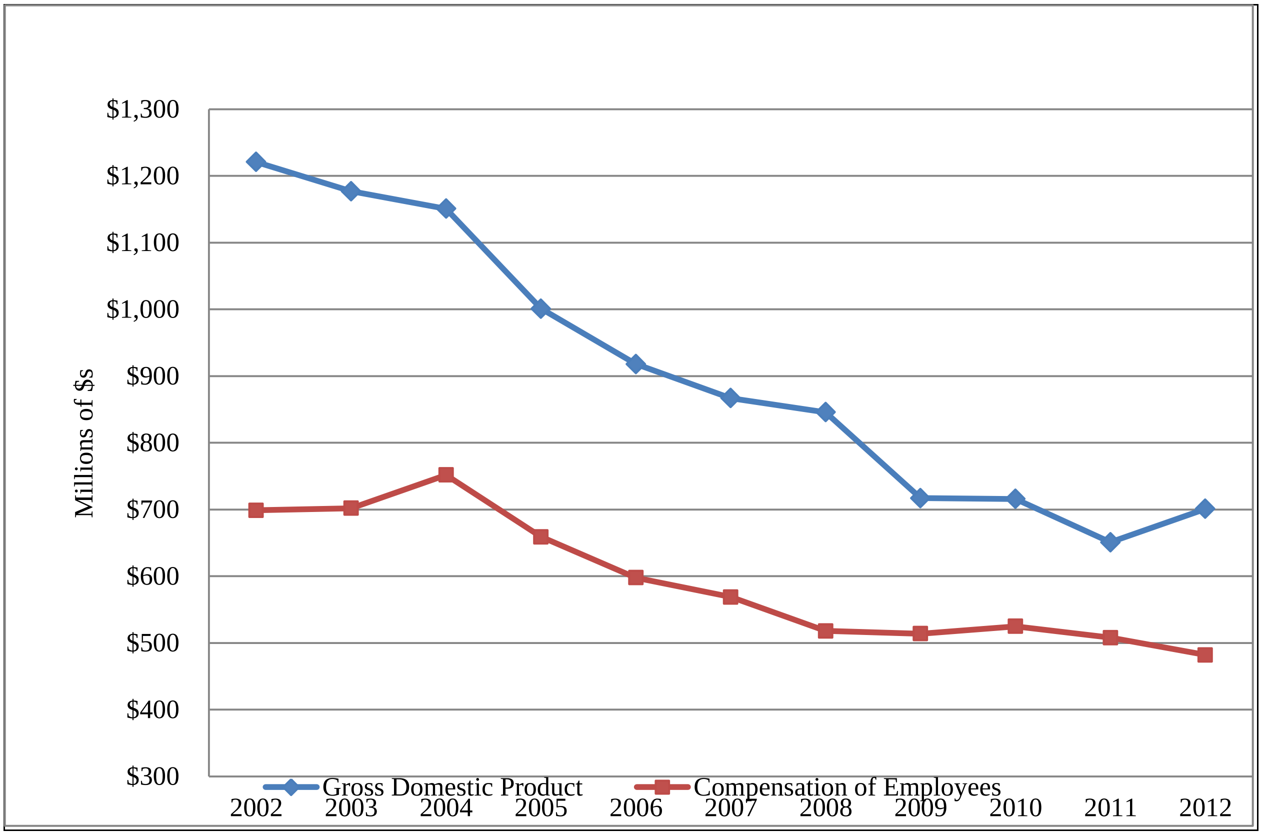


Figure 3.15-2 Compensation and Gross Domestic Product

Source: U.S. Bureau of Economic Analysis 2012, 2013.

3.15.6.2 Gross Domestic Product

Gross domestic product is a measure of overall economic activity in a region. It typically is the market value of all officially recognized final goods and services produced within an area in a given year. The CNMI's gross domestic product declined every year from 2002 to 2009 (see Figure 3.15-2), decreasing from $1.22 billion in 2002 to $651 million in 2011 (a 47% decline). From 2011 to 2012, the gross domestic product of the CNMI increased for the first time since 2002, to $701 million, up 7.7% from 2011 levels (U.S. Bureau of Economic Analysis 2012, 2013).

Projections indicate that during the timeframe that the proposed action would be implemented, due to anticipated expansion in the tourism industry, CNMI gross domestic product could range between 25% and 56% higher (unadjusted for price changes) than 2012 Census levels. See Section 4.2.2 of the *Socioeconomic Impact Assessment Study*.

3.15.6.3 Commonwealth Government Finances

CNMI government revenues, by source, are presented in Table 3.15-4. Revenues increased from 2002 to 2004, but declined from 2004 to 2009. Data from the first two quarters of 2010 indicate that government revenues increased from 2009 to 2010 (CNMI Department of Commerce 2013).

Table 3.15-4. CNMI Government Revenues by Source, 2002-2009 (Millions of $'s)

Revenue Type	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Business Gross Receipt Tax	$48.6	$50.6	$54.5	$58.3	$54.1	$49.0	$51.8	$44.8
Wage and Salary Tax	$31.2	$31.1	$35.0	$32.7	$28.6	$26.2	$25.1	$24.4
Personal/Corporate Income Tax[1]	$12.8	$17.0	$11.2	$10.0	$15.1	$8.3	$12.9	$15.5
Garment Certification Fee	$30.9	$29.3	$30.6	$24.1	$18.1	$11.4	$3.6	$0.1
Excise Tax	$18.7	$22.3	$24.4	$23.9	$24.4	$20.6	$19.7	$18.0
Hotel Occupancy Tax	$4.9	$5.4	$6.0	$6.5	$5.5	$4.9	$5.6	$5.1
Fuel/Container/Bar tax	$6.8	$8.2	$9.9	$10.2	$7.3	$6.8	$7.3	$6.4
Fees, Charges, and Other Revenues	$34.2	$45.8	$46.4	$44.6	$33.8	$39.3	$33.2	$30.0
Transfers from Other Funds	-	-	-	-	-	-	$7.3	$12.1
Revenue Transfer to Other Funds	-	-	-	-	-	-$3.5	-$3.6	-$1.7
Total	**$187.9**	**$209.8**	**$217.9**	**$210.3**	**$192.0**	**$163.0**	**$162.8**	**$154.7**

Note: [1]Northern Marianas Territorial Income Taxes.
Sources: CNMI Department of Commerce 2006, 2008, 2012b.

Projections indicate that during the timeframe that the proposed action would be implemented, due to anticipated increases overall economic activity spurred by expansion in the tourism industry, CNMI government revenues could range between 14% and 42% higher than 2009 levels. See Section 4.2.4 of the *Socioeconomic Impact Assessment Study* (Appendix Q).

3.15.6.4 Housing

In 2010, there were 20,850 housing units in the CNMI, most of which were in Saipan (18,683). Vacancy rates in the CNMI as a whole were 23%. Tinian was at 22%, twice the U.S. average (U.S. Census Bureau 2010b). The least expensive housing units in the CNMI were on Rota (valued at $109,900) and the most expensive were on Saipan (valued at $127,600) (U.S. Census Bureau 2010a). There were 1,118 housing units on Tinian in 2010, 874 were occupied, 244 were vacant, and 101 were for rent (U.S. Census Bureau 2010a).

The West San Jose Village Homestead, located in northwest San Jose and south of the airport, broke ground on February 5, 2014 and 170 families received homestead permits to build homes. Five other homestead sites are expected to be developed on Tinian that would house an additional 345 families (Eugenio 2014).

3.15.6.5 Tourism

3.15.6.5.1 CNMI Overall

From 1999 to 2011, there has been a general decline in the number of tourism visitors. Figure 3.15-3 presents the number of tourists and Figure 3.15-4 illustrates the percent change over the same years (CNMI Department of Commerce 2006, 2008, 2012b). There are a variety of reasons for this decline, including the exit of Japan Airlines from the CNMI market, the March 2011 Japan natural disaster, and confusion over visas for Russian and Chinese visitors (Mariana Visitors Authority 2012). From 2011 to 2013, however, the number of visitors increased, rising from 340,957 in 2011 to 438,978 in 2013.

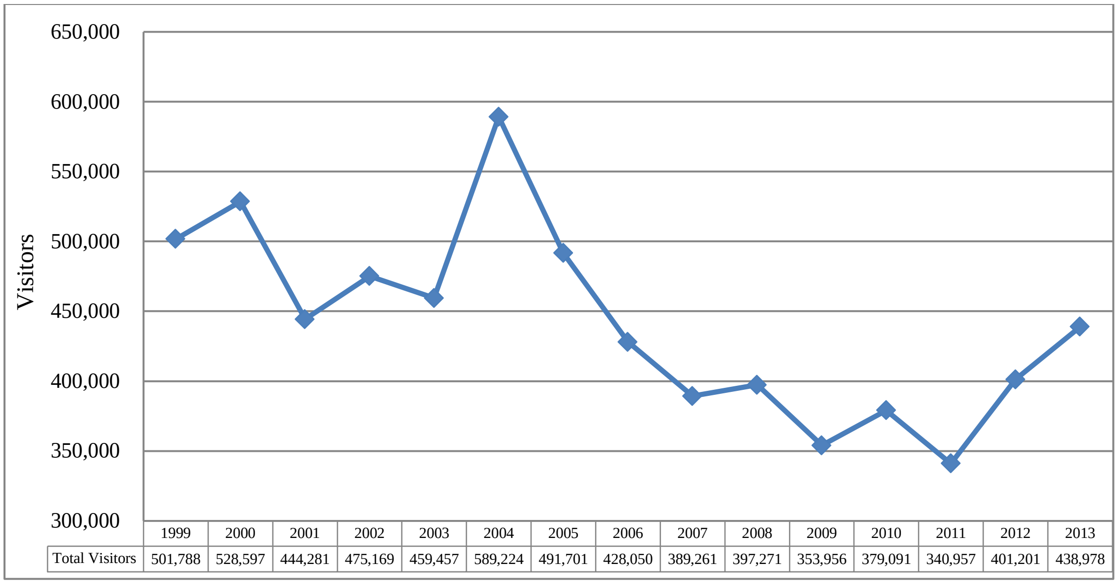


Figure 3.15-3 CNMI Total Visitors, 2000-2013

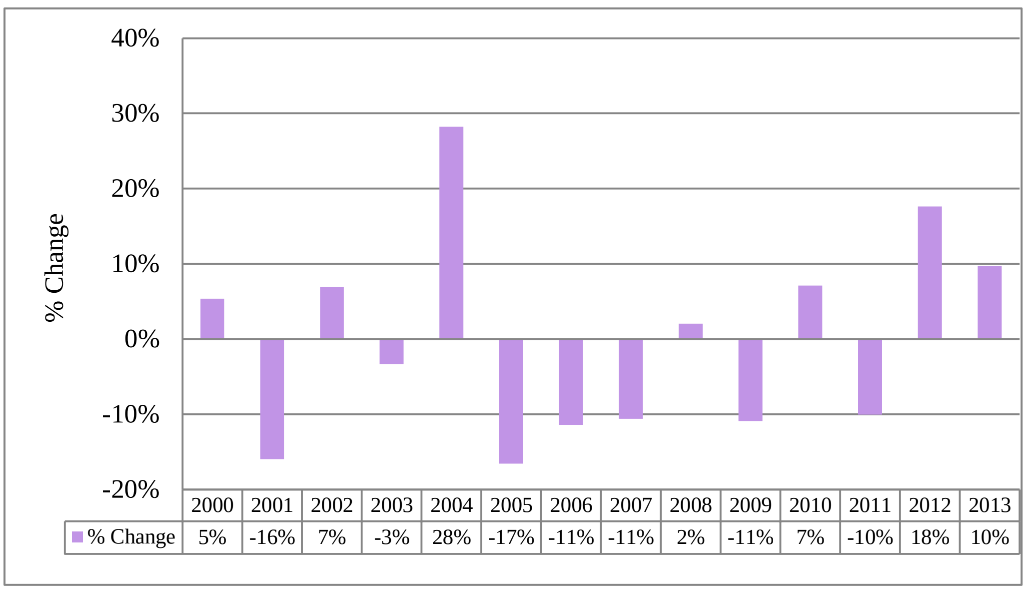


Figure 3.15-4 Percent Change in Total Visitors to the CNMI, 2000-2013

Projections indicate that during the timeframe that the proposed action would be implemented, the number of CNMI tourism visitors could be between 25% and 56% higher than 2012 levels, due to continued growth from Chinese and Korean markets. See Section 4.2.1 of the *Socioeconomic Impact Assessment Study* (Appendix Q).

3.15.6.5.2 Tinian

According to Tinian Dynasty management, over 90% of all Tinian visitors stay overnight at the Tinian Dynasty Hotel and Casino (the remaining 10% may not stay overnight or may stay at other accommodations). In 2013, 54,814 visitors from off-island stayed at the Tinian Dynasty. About 80% of visitors were from China and about 10% were from Korea. Tinian Dynasty management indicated that visitors tend to participate in multiple activities while on Tinian that included island tours and nature activities such as scenic viewing and diving (DoN 2014).

3.15.6.5.3 Pagan

Scientific research draws some visitors to Pagan, as does camping and hunting activities (see Section 3.8, *Recreation*); however, there has been little direct economic activity related to tourism on Pagan since the 1981 evacuation. The Silver Explorer, a cruise ship operated by Silversea Expeditions, stopped at Pagan on its way from Otaru, Japan to Apra, Guam on September 28, 2014 bringing tourists to the island for an afternoon.

3.15.6.6 Commercial Agriculture

Data presented in this section were derived from the 2007 Agricultural Census (U.S. Department of Agriculture 2009) and relate to places with agricultural operations qualifying as farms according to the census definition. This included all places from which $1,000 or more of agricultural products were produced and sold during the 2007 calendar year. Data from the 2007 Agricultural Census is the most recent available as the U.S. Department of Agriculture has not conducted, and does not intend on publishing, an updated agricultural census for the CNMI (U.S. Department of Agriculture 2014).

Research provides no indication that any commercial agricultural activity occurs on Pagan (DoN 2014) and therefore, the topic is not discussed further with relation to Pagan.

3.15.6.6.1 CNMI Overall

Farms are found on all of the populated islands in the CNMI. In 2007, Saipan had the most farms (128), Rota the second most (97), and Tinian had the fewest (31) (U.S. Department of Agriculture 2009). Fruits and nuts (45%), vegetables and melons (43%), and root crops (41%) made up nearly all of the $1.85 million in agricultural product sales in the CNMI in 2007 (U.S. Department of Agriculture 2009). Additionally, CNMI farms had sales of livestock and poultry.

3.15.6.6.2 Tinian

3.15.6.6.2.1 Farms

As of 2014, 29 lots in the Military Lease Area were permitted for noncommercial, subsistence agriculture and grazing; these lots constituted 2,375 acres (961 hectares) (DoN 2014). Based on the Census definition, a person is engaged in subsistence activities if he or she mainly produces goods for his or her own or family's use and needs, and not solely for commercial purposes (U.S. Census Bureau 2014). While it is not possible to discern with any certainty, Agricultural Census data suggest that some lots in the Military Lease Area sold more than $1,000 worth of agricultural products and therefore are considered farms (U.S. Department of Agriculture 2009); however, other lots, that had less than $1,000 in sales, would not be considered farms.

Table 3.15-5 provides information on the number of Tinian farms and the amount of land in those farms. In 2007, there were 31 farms on Tinian, an increase of 8 farms from 2002. Farms with sales over $1,000 used 2,071 acres (838 hectares) of Tinian land in 2007 (U.S. Department of Agriculture 2009).

Table 3.15-5. Farms, Land in Farms, and Land Use by Municipality, 2002 and 2007

Farms	Tinian	
	2002	2007
Number of Farms	23	31
Land in Farms (acres)	672/272	2,071/838

Source: U.S. Department of Agriculture 2009.

Of the 31 farms on Tinian in 2007, 74% were owned by individuals, 15% by a partnership, and 6% by corporations; 29% of farms were on owned land and 71% were on rented land from others; 29 of the 31 farms used unpaid labor (indicating family workers); 77% of farms were operated by Chamorros and 19% were operated by Asians; 13% of farm operators were not a U.S. citizen (U.S. Department of Agriculture 2009).

3.15.6.6.2.2 Agricultural Products

In 2007, the market value of all agricultural products sold on Tinian (including root crops, vegetables, melons, fruits, and nuts) totaled $152,537. Fruits and nuts, and vegetables and melon sales were $72,339 and $77,188, respectively (U.S. Department of Agriculture 2009).

3.15.6.6.2.3 Gathering

Multiple Tinian government agencies and other anecdotal reports indicated that hot peppers named “Donni Sali” are sometimes gathered, processed, and sold. According to the Tinian Department of Labor, pepper gathering for sale is a common source of income for community members that are not working and is a supplement to income for those who need extra money (DoN 2014).

3.15.6.6.2.4 Livestock

As of 2014, the Lease Back Area (i.e., southern portion of the Military Lease Area) supported approximately 2,375 acres (961 hectares) of agricultural grazing permits. However, not all of that land was utilized. Data and research of cattle grazing on Tinian have been published in the Beef Cattle Herd Survey, 2013, by the Northern Marianas College Cooperative Research, Extension, and Education Service (NMC-CREES) (2013). Table 3.15-6 provides information on the Tinian herd as presented in that report. According to the Cattle Herd Survey, in 2013, there were 37 ranching operations that covered 1,834 acres (742.5 hectares) (NMC-CREES 2013). Of these 37 ranching operations, the Tinian Cattlemen’s Association estimates that 32 are located in the Military Lease Area (DoN 2014). Of the 1,834 acres on Tinian being used for cattle grazing, an estimated 1,010 is in the Military Lease area.

Table 3.15-6. Tinian Cattle Ranching Data, December 2012-February 2013

Ranching Operations	Cattle and Calves	Acres in Production	Cattle/Calves per Acre	Estimated Value of Tinian Herd (2012 $s)[1]
37	1,043	1,834	0.6	$547,850

Note: [1]Live weight value as determined in the cattle survey. Based on average live weight Tinian market values for 2012.
Source: NMC-CREES 2013. Data collected over a period of three months (December 2012 through February 2013) via personal interviews.

In 2012, 177 cattle were sold (with a permit) for a total of $97,350. In 2013, the herd numbered 1,043 and the live weight value, calculated based on sales in 2012, was about $547,850 (NMC-CREES 2013). According to the survey, there were about 0.6 cattle per acre (1.4 per hectare) on Tinian around the start of 2013. The Tinian Cattlemen's Association indicated that there was no crowding of cattle, that there was more than enough space for the number of cows in the herd, and that ideally there could be more cows per acre (1 per acre or 2.5 per hectare were noted to be ideal) (NMC-CREES 2013).

3.15.6.7 Commercial Fishing

Commercial fishing occurs throughout the CNMI, mostly around Saipan and Tinian. Interviews conducted with groups that have knowledge of fishing in waters off of Pagan indicated that Pagan waters are good for fishing but costs associated with fishing there are very high due to Pagan's remoteness, and therefore only a small amount of fishing is conducted there (DoN 2014). Therefore, the topic is not discussed further with relation to Pagan.

3.15.6.7.1 CNMI Overall

An estimated $503,822 worth of fish were landed in the CNMI in 2010 (217,099 pounds (98,474 kilograms) at an average price of $2.32 per pound), over 90% of which were landed on Saipan (National Oceanic and Atmospheric Administration 2013a).

3.15.6.7.2 Tinian

As of 2011, the number of fishing boats on Tinian was between 15 and 20, with the majority of those boats less than 25 feet (8 meters) in length (National Oceanic and Atmospheric Administration 2013b). While the waters to the northwest of Tinian are used for fishing by the Saipan commercial fishing fleet, there is no evidence of a commercial fishing industry based out of Tinian. According to the Tinian Department of Land and Natural Resources and the Western Pacific Fishery Management Council, fishing boats on Tinian are not used for commercial fishing; when fish are sold, it is to cover the expenditures of fishing excursions (DoN 2014).

Table 3.15-7 and Figure 3.15-5 identify fishing areas around Tinian and the type of fishing that takes place at each area. While the CNMI has a moratorium on gill nets, the Department of Land and Natural Resources reports gill net fishing so it is included here. The water is notably calmer on the western side of Tinian, which makes it more attractive for fishing than the eastern side. Types of fishing that require boats are almost exclusively limited to the western side of the island. According to the Tinian Department of Land and Natural Resources, waters on the eastern side are rougher and, for the most part, only good for land-based cliff-fishing (DoN 2014).

Table 3.15-7. Tinian Fishing Areas and Type of Fishing

Location	*From*	*To*	*Type of Fishing*
Northwest	Puntan Tahgong	Puntan Diapblo	Spearfishing, rod and reel (casting from boat), and cliff fishing
Southwest	Puntan Diapblo	Puntan Carolinas	Trolling and bottom fishing
Southeast	Puntan Carolinas	Puntan Baranga	Spearfishing and cliff fishing
East	Puntan Baranga	Puntan Chiget	Cliff fishing
Northeast	Puntan Chiget	Puntan Tahgong	Sea crab, throw net, cast net, gill net, and spearfishing

Source: DoN 2014.

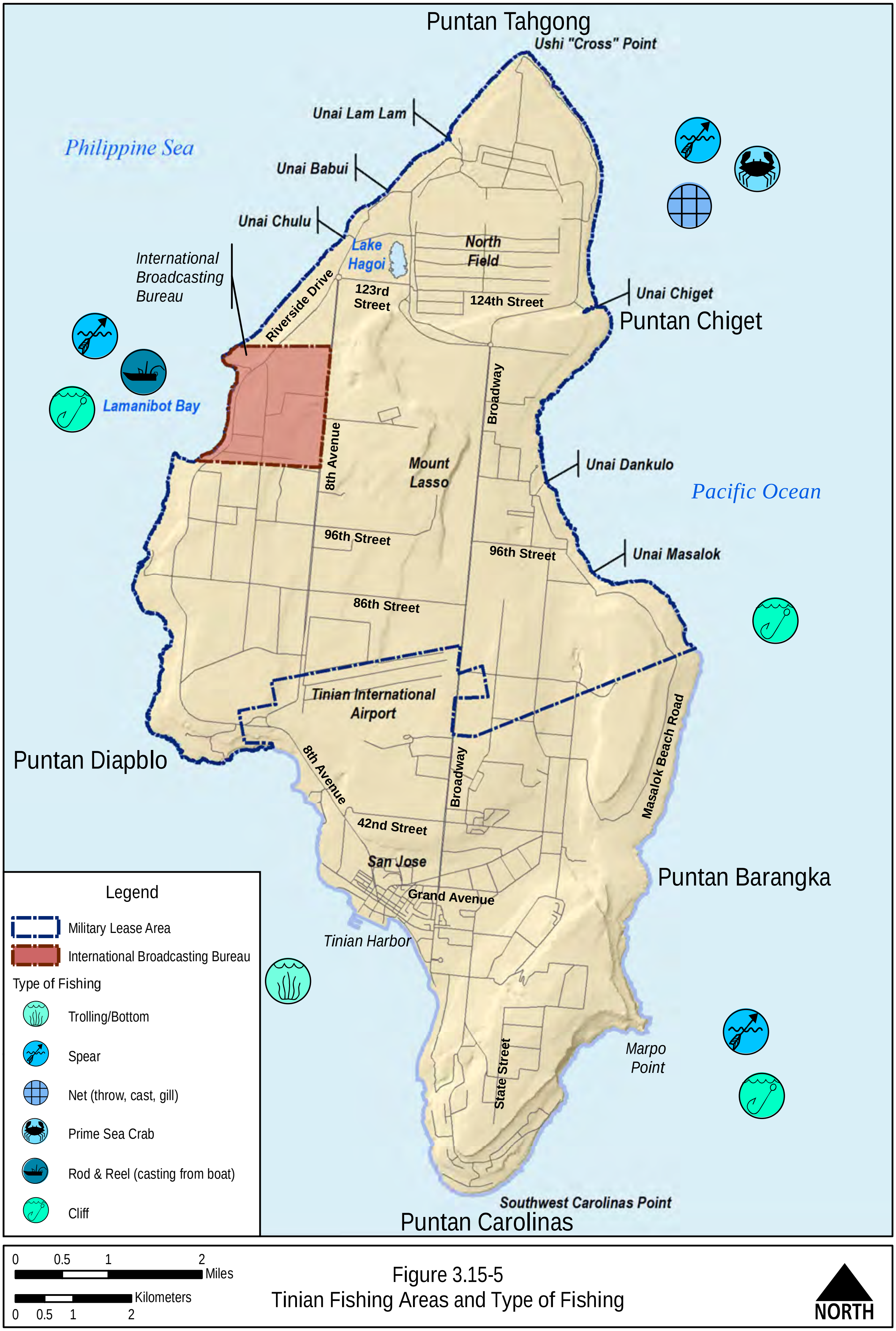


Figure 3.15-5
Tinian Fishing Areas and Type of Fishing

3.15.6.7.3 Saipan

Saipan residents surveyed in 2005 (Van Beukering et al. 2006), who said they were active and/or commercial fishermen, were asked to answer questions to better understand the cultural importance of fishing on Saipan and the social and economic role it plays among households and individuals (Van Beukering et al. 2006). Saipan anglers reported that about 90% of their catch was consumed by themselves, family, and friends while about 8% of their catch was sold. The survey showed that the cost of fishing exceeded fish sales for almost every income group except those fishermen earning over $501 a month and those earning less than $26 (National Oceanic and Atmospheric Administration 2013b). The survey authors concluded that even those fishermen that do sell fish, do not sell to earn a profit but rather, sell fish to recover some of the costs of fishing (Van Beukering et al. 2006). This condition is thought to be the same for anglers throughout the CNMI (DoN 2014).

3.15.6.8 Aquaculture

Aquaculture in the CNMI is primarily land-based with major products that include tilapia and shrimp. Production in 2009 was estimated at 10 metric tons (11 tons) with a value of $56,000. Fish are sold live or fresh, usually at a size of 7-9 ounces (200-250 grams), for a price of $2-$3 per pound ($5-$6 per kilogram). As of 2011, there were eight tilapia farmers in the CNMI (five on Saipan, two on Rota, and one on Tinian) (NMC-CREES 2011). A local source with expertise in aquaculture indicated that the two farms on Rota were government-sponsored demonstration farms, four of the five Saipan farms were for subsistence, and the continued operation of the farm on Tinian was uncertain since the passing of its operator (Michael Ogo, personal communication, May 2014).

3.15.6.9 Commercial Hunting

Research indicated that no commercial hunting takes place in the CNMI; rather, hunting is limited to subsistence purposes only (DoN 2014).

3.15.6.10 Minerals

3.15.6.10.1 Tinian

Through ownership in FPA Pacific Corp., Hawaiian Rock has operated a quarry and ready mix concrete plant on Tinian since 1993.

3.15.6.10.2 Pagan

Mineral resources have been identified on Pagan and include basalt and pozzolan (a substance used as an additive for producing cement). The 1978 Pagan Physical Development Master Plan (CNMI Office of Transition Studies and Planning 1978) noted that one possibility for economic development on Pagan might be the exploitation of the island's basalt deposits (basalt is sometimes used in construction as an aggregate mixed into concrete). The Master Plan noted that investigation by the Government of Guam Department of Public Works suggested that although the basalt resource on Pagan was extensive, the cost of infrastructure improvements necessary to mine, process, and transport the basalt would make mining it too expensive to earn a profit. To make it feasible, “joint development funding including capital improvement program development funds from the Northern Mariana Islands Capital Improvement Program, Economic Development Authority Funds, Federal Aviation Administration, Airport

Development Aid Program funds, and finally a long term contract for supplying basalt to Guam would appear to be necessary to make such a program successful" (CNMI Office of Transition Studies and Planning 1978).

Pozzolan is the result of the 1981 eruption of Mount Pagan and is defined as any substance that, if in small enough particles, reacts chemically to form compounds that contain cement-like properties. Economic use of pozzolan is to mix it with Portland cement to create blended cement. On Pagan, the pozzolan material is primarily volcanic ash and glass (pumice and pumicite).

In 2007, a field program drilled samples from 32 sites on Pagan and conducted analysis of the pozzolan material that was extracted. The study indicated there was an estimated 13.1 million tons (11.9 million metric tons) of pozzolan that could be extracted and that the pozzolan was suitable for industrial use (DoN 2014).

The price of pozzolan in 2012 was $35 per metric ton (U.S. Geological Survey 2013), which is lower than the cost would be to ship pozzolan to market (Saipan Shipping Company 2014), indicating that, while a permit to mine pozzolan was provided by the CNMI Department of Public Lands to a private mining company, a pozzolan mine on Pagan may not be economically feasible (see Appendix Q, *Socioeconomic Impact Assessment Study*, Section 4.2.10 for more information). One of the permit conditions is to provide an economic feasibility study within 1 year of permit issuance.

3.15.6.11 Airports and Sea Ports

The Commonwealth Ports Authority operates, maintains, and is responsible for improvements of all airports and sea ports in the CNMI. Airports and sea ports are located on Tinian, Saipan, and Rota and facilitate economic activity in the CNMI. Airports facilitate the movement of tourists and goods between islands and sea ports facilitate the transportation of goods between islands. As of September 30, 2012, the Commonwealth Ports Authority had 122 employees on Saipan, 25 on Tinian, and 21 on Rota (Commonwealth Ports Authority 2013).

3.15.6.11.1 Airports

There are three major airports in the CNMI: Saipan International Airport, Tinian International Airport, and Rota International Airport. Air taxi operations (i.e., aircraft designed to carry 60 or fewer passengers or carry up to 18,000 pounds of cargo) constituted 76% of operations at Saipan International Airport and 94% of operations at Tinian International Airport. Military operations constituted 4.1% of operations at Rota International Airport, 1% of operations at Tinian International Airport, and 0.3% of operations at Saipan International Airport. The Pagan airfield is partially covered by lava from the 1981 volcanic eruption, is unattended, and has not received a Federal Aviation Administration inspection since 1980 (Federal Aviation Administration 2014).

3.15.6.11.2 Sea Ports

In fiscal year 2012, a total of 395,070 inbound revenue tons and 14,244 outbound revenue tons were brought in and out of CNMI ports. The Port of Tinian is located on the southwest side of the island and is currently used for fuel supply and other commodities such as food. Fuel is brought in by tanker that makes deliveries on a monthly basis (Commonwealth Ports Authority 2014). The fuel tanker docks at the port and fuel is piped to storage tanks located about 300 feet (91 meters) inland. A tug and barge are used to bring shipping containers over from Saipan. According to the Saipan Shipping Company and Tinian Marine Stevedores Incorporated, the barge only transits about once every other month (DoN 2014). Recently completed improvements at the Port of Tinian include new fenders and bollards and repairs to the concrete cap (Commonwealth Ports Authority 2014). There are no port facilities on Pagan.

3.15.6.12 Power Utility Rates

The CNMI's electric system is owned by the Commonwealth Utilities Corporation, which is a public corporation that is part of the CNMI government. All CNMI electricity customers pay a fuel surcharge that varies with the world price of diesel fuel; this surcharge is known as the Levelized Energy Adjustment Clause rate. Large commercial electricity consumers on Tinian include the Tinian Dynasty and the International Broadcasting Bureau, which, combined, consume an average daily load of 0.75 megawatts (see Appendix P, *Utilities Study*). There are no electric utility systems on Pagan.

3.15.7 Public Services

3.15.7.1 Education

3.15.7.1.1 CNMI

The CNMI Public School System, created in 1988, is a state education agency for preschool, elementary, and secondary education. It also includes the Early Intervention Program for infants up to 3 years old, and Head Start for children aged 3 to 4. Public education services are funded through a mixture of CNMI and federal funds. During fiscal year 2011, the CNMI Public School System received $58,374,747 in overall federal grants (Deloitte 2013a), though much of that ($28 million) was awarded under the American Recovery and Restoration Act, which is a temporary source of funding.

The CNMI Public School System comprises 12 elementary schools, 4 junior high schools, and 5 high schools. Kindergarten is offered at every elementary school, and there are 10 Head Start centers (CNMI Public School System 2013). Enrollment in elementary schools was 5,412 students, and in secondary schools it was 5,093 students (DoN 2014).

3.15.7.1.2 Tinian

There are two accredited public schools on Tinian, an elementary school (grades kindergarten through grade 6) and a junior/senior high school (grades 7 through 12). Both schools are located in the village of San Jose. According to 2011 to 2012 school year data, published by the CNMI Public School System, Tinian elementary had 14 teachers and 260 students (student to teacher ratio of 19:1), and Tinian Junior/Senior High School had 15 teachers and 229 students (student to teacher ratio of 15:1). The overall student to teacher ratio on Tinian during the 2011 to 2012 school year was 17:1. There is one Head Start center on Tinian, and as of 2011, there were 34 children enrolled and one staff member (CNMI Public School System 2013).

Representatives of the CNMI Public School System indicated that due to Tinian's declining population, Tinian schools are using less of their capacity than during previous years. The total of 489 students for the 2011 to 2012 school year is below the highest number of students that recent data show for Tinian, which was 615 students during the 2007 to 2008 school year (CNMI Public School System 2011).

3.15.7.1.3 Pagan

Research indicated that no education services are currently provided on Pagan (DoN 2014).

3.15.7.2 Emergency Services

3.15.7.2.1 CNMI

The Department of Public Safety provides emergency services including police, fire, and emergency medical services in the CNMI. The Department consists of four major divisions, including the Commonwealth State Police Division, the Fire Division, the Bureau of Motor Vehicles, and the Commissioner. Emergency services are funded through a mixture of CNMI and federal funds. In fiscal year 2011, the CNMI received over $2 million in grants from the U.S. Department of Justice (Deloitte 2013b).

In 2013, the CNMI Department of Public Safety handled 4,604 Emergency Medical Services incidents, 3,521 fire related incidents, and there were a total of 3,105 criminal offenses (including 1,129 burglaries/robberies/thefts, 699 disturbances, 569 violent crimes, and 316 property crimes) (CNMI Department of Public Safety 2013a).

3.15.7.2.2 Tinian

The Tinian Department of Public Safety indicated that, as of February 2014, they were staffed by 17 police officers (a ratio of 6 officers for every 1,000 residents) and 11 firefighters (a ratio of 3.8 firefighters per 1,000 residents) (CNMI Department of Public Safety 2013a). While Tinian police officers are often responsible for a variety of tasks (for example, the same officer may be trained in boating safety and 911 call reception), the 6 officers per 1,000 residents is double the average for the U.S. as a whole, which is less than 3 officers per 1,000 residents (Bureau of Justice Statistics 2003). In addition, the ratio of 3.8 firefighters per 1,000 residents greatly exceeds the historical U.S. ratio of about 1.7. Since ratios of both officer and firefighter per 1,000 residents on Tinian are more than double of those in the U.S., Tinian emergency safety services are generally considered to have the capacity to meet the needs of the public.

The condition of the Department of Public Safety’s building was noted as fair and able to accommodate current personnel and operations (DoN 2014). Additionally, the Department indicated that it has a refurbished fire engine and ambulance, and that a boating safety facility will be operational sometime in 2014 (DoN 2014). The Commonwealth Ports Authority maintains firefighting capability at Tinian International Airport as a requirement for airport operations. This capability is available to the Tinian Department of Public Safety in the event of an emergency. According to the Commonwealth Ports Authority, Tinian International Airport has two fire-fighting vehicles (DoN 2014).

In 2013, 86 criminal offenses were recorded in San Jose; the most common offenses included 30 thefts or burglaries, 15 incidences of disturbing the peace, and 15 assaults (CNMI Department of Public Safety 2013b). It was noted that burglary is often drug-related and domestic violence is often alcohol-related and that these crimes are also related to weak economic conditions (DoN 2014).

3.15.7.2.3 Pagan

The Department of Public Safety indicated that it maintains no personnel or facilities on Pagan and if a visitor on Pagan were to require emergency assistance, the CNMI government would likely contract a charter helicopter or airplane to fly to Pagan and bring the individual to Saipan for treatment (DoN 2014). The CNMI Homeland Security and Emergency Management Office requires travelers to the Northern Islands, which includes Pagan, to provide notification if they plan to visit so that the agency can better respond to requests for emergency assistance.

3.15.7.3 Health

3.15.7.3.1 CNMI

Public health services are funded through a mixture of patient fees and CNMI and U.S. federal government funds. The Commonwealth Healthcare Corporation is an autonomous public corporation of the CNMI government. It provides hospital, primary care, and public health services to Saipan, Tinian, and Rota. There is no major trauma center in the CNMI; the closest major trauma center is on Guam.

3.15.7.3.2 Tinian

The Tinian Health Center is the island's primary health care facility. Part of the Commonwealth Healthcare Corporation, the Health Center facility was built in 1987, currently has five holding beds, and in 2013, the Health Center accommodated 8,000 outpatient visits and 1,600 urgent care visits (DoN 2014). Information provided by staff indicates that there is one full-time physician, one nurse practitioner, four registered nurses, five licensed practical nurses, one nursing aide, and a dentist that visits periodically (DoN 2014). Medical staff explained that non-communicable diseases such as diabetes and hypertension are a major concern on Tinian, much like the rest of the CNMI (DoN 2014).

Despite clearly apparent limitations necessitated by operational efficiencies in areas with small populations such as Tinian (e.g., major emergency and specialty medical cannot be provided here but in Saipan), Health Center staff did not indicate that the facility was overburdened in any way. Some concerns were expressed about available space for treatment, but expansions are underway that should alleviate those concerns (DoN 2014).

3.15.7.3.3 Saipan

The largest hospital in the CNMI, the Commonwealth Health Center, is located on Saipan. Recent information indicates that the hospital offers inpatient and outpatient medical and surgical services, emergency care, public and mental health services, dental services, hemodialysis, electrocardiography, ultrasound, radiology, as well as other ancillary and diagnostic services (Air Force 2012). According to Health Center staff, as of 2014, there were 32 physicians employed (DoN 2014). Commonwealth Health Center management further indicated that it treats approximately 60,000 outpatient visitors (including those from Tinian) per year (DoN 2014). The Health Center indicated that the hospital is of sufficient size to accommodate existing staff and patients and has 86 beds, 76 of which are functioning (DoN 2014). In addition to the Commonwealth Health Center, there are private health, dental, and optical clinics on Saipan (Air Force 2012).

3.15.7.3.4 Pagan

No health services are provided on Pagan. Research indicated that emergency care requires evacuation by plane or helicopter to Saipan for treatment (DoN 2014).

3.15.8 Social and Community Topics

Community and social topics are a collection of activities or goals that are important to a social group or community. Changes to community and social topics are measured in terms of changes in community character and community cohesion.

Community character is the distinctive identity of a particular place that results from the interaction of many factors that give it unique or special characteristics—built form, landscape, history, people, and activities within the place as a whole (American Planning Association 2011). The topic areas of homesteads, agriculture, fishing, and hunting in particular contribute to community character in the CNMI and are detailed in the sections below.

Community or social cohesion measures the levels of “relationship between individuals, groups, and organizations within a community” (Holdsworth 2009). In a community with strong community cohesion, high levels of characteristics such as social ties, interdependence, trust, and reciprocity exist and bind people within that community together. A lack of community cohesion occurs when there are “divisions between groups, individuals, and systems” (Stone and Hughes 2002). Again, the topic areas of homesteads, agriculture, fishing, and hunting are the characteristics within the region that allow the building of relationships between individuals, groups, and organizations within the community and are thus covered in the sections below.

3.15.8.1 CNMI

3.15.8.1.1 Homesteads

The Northern Islands Village and Agricultural Homesteading Act of 2008 was passed by the CNMI legislature to:

a) Establish the Northern Islands Village and Agricultural Homesteading program for current or former residents of the Northern Islands or any qualified person interested to reside on the Northern Islands.

b) Enable residents of the Northern Islands who hold a homestead permit to borrow money to build a safe and sanitary home.

c) Initiate and promote economic development on the Northern Islands through long-term commercial leases and permanent settlements.

d) Provide the Department of Public Lands sufficient authority and flexibility to administer this act.

e) Allow the Department of Public Lands to review homestead claims on their merits.

In addition, per Article 11 Section 5 of the CNMI constitution, some portions of public lands are to be set aside for a homestead program. In concept, one gains ownership of an unowned natural resource by performing an act of original appropriation under the program. Appropriation could be enacted by putting an unowned resource to active use (as with using it to produce a product), joining it with previously acquired property, or by marking it as owned (as with livestock branding). Eligibility requirements to receive a homestead permit, set forth in Title 2 Section 4303 of the Commonwealth Code, provide that an applicant must be of Northern Marianas descent and an applicant is eligible for a homestead permit on only one lot. Once a permit is granted, the recipient of the permit may begin to make improvements on the homestead lot. A deed of ownership of the homestead lot may be granted after a period of time if certain conditions are met, such as subdivision conditions consistent with modern planning standards (i.e., power and water utilities are present) and that a home has been built on the lot, or a minimum $10,000 investment has been made on the land.

3.15.8.2 Tinian

The early history of Tinian is covered in Section 3.11, *Cultural Resources*. The modern Tinian community is small and quiet with only a few stores and restaurants. Families often go to the beaches on weekends and attend barbeques. People also engage in agriculture, fishing, and hunting activities for both traditional and subsistence purposes. These agriculture, gathering, hunting, fishing, and grazing activities, when mainly conducted for a person's own or family's use and needs and not primarily for commercial purposes, are considered subsistence activities (U.S. Census Bureau 2014). The 2010 Census identified 103 Tinian residents over the age of 16 that participated in subsistence activities (U.S. Census Bureau 2010a). Of the 103 people that engaged in subsistence activity, 91 were elsewhere employed (part-time), 44 were unemployed, and 8 were not in the labor force.

3.15.8.2.1 Agriculture

The CNMI Department of Community and Cultural Affairs indicated that agricultural products grown in the Military Lease Area include taro, sweet potatoes, and melons (DoN 2014). Other agricultural products harvested in the Military Lease Area include hot peppers, yams, and beef (DoN 2014).

***Farming*.** According to Tinian and CNMI government agencies, farming is done for subsistence on Tinian; as of 2014, 29 lots in the Military Lease Area were permitted for subsistence agriculture (DoN 2014). According to staff at the Tinian Health Center, Tinian is traditionally an agricultural community, but has become less so over the past several years. The trend has been away from foods that are produced locally and towards processed food that are purchased at stores (DoN 2014).

Ranching. Cattle grazing has occurred on Tinian since cattle were first introduced by the Spanish in the 16^{th} century (NMC-CREES 2013). After the Spanish-Chamorro War, for a few hundred years, feral cattle roamed across Tinian. When Tinian was transferred from Spanish to German control, the Germans preserved the herd for food and the monetary value. The Japanese administration later oversaw a decrease in the size of the herd as sugarcane fields took over the Tinian landscape. After World War II, much of Tinian was leased to Ken Jones, a businessman who expanded the herd to include 7,000 beef cows and 1,000 milk cows; during this time the Tinian herd was the primary source of beef and milk products consumed by residents of Tinian, Saipan, Guam, and other nearby islands. The modern herd provides local residents with fresh beef for regular consumption and for traditional cultural events (NMC-CREES 2013). Tinian beef cannot be sold commercially because slaughtering facilities do not meet U.S. federal standards (21 CFR §§ 601).

Gathering. According to multiple Tinian government agencies, people gather yams and hot peppers as a cultural tradition. It is often something that mothers and daughters do together (DoN 2014). The hot pepper is also the basis for the island's largest community event—the Pika Festival. This festival has been ongoing for more than 10 years and features song and dance performances, including performances by school groups, and events such as a crab race, a hot pepper eating contest, and a pika burger eating contest (Camacho 2014). While the peppers have more of a cultural value than for subsistence purposes, Tinian government agency sources indicated that yams are consumed by gatherers and their families (DoN 2014).

3.15.8.2.2 Fishing

On April 19, 1999, the National Marine Fisheries Service officially identified the CNMI as a fishing community. The legal concept of a fishing community means "a community which is substantially dependent on, or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs" (National Oceanic and Atmospheric Administration 2012). According to multiple Tinian government agencies, fishing is a cultural and traditional activity that is passed down from father to son at an early age (DoN 2014).

According to the Tinian Department of Land and Natural Resources and the Western Pacific Fishery Management Council, Tinian fishermen typically do not sell fish to earn a profit, they do so to obtain food for themselves and their family (DoN 2014). The frequency and value of subsistence fishing on Tinian is not known, but on Saipan data indicate that 90% of the catch was consumed by fishermen, family, and friends, while about 8% was sold.

3.15.8.2.3 Hunting

According to Tinian government agencies, hunting is a cultural and traditional activity that is passed down from father to son (DoN 2014). The Tinian Department of Land and Natural Resources indicated that wildlife that are hunted include turtledoves, coconut crabs, sea crabs, as well as feral goats and chickens (DoN 2014). While the entire island could be considered a hunting ground, the majority of hunting resources are located in the unpopulated northern two-thirds of the island, in the Military Lease Area. The reason for this in part is because there are laws against firing weapons in populated, residential areas found in the south (DoN 2014). Agencies noted that the mid-west to east part of the island is prime coconut crab area, but during the coconut crab season they can be hunted anywhere on the island, and that a prime area for sea crabs is on the northeast coast within the Military Lease Area (DoN 2014).

3.15.8.3 Pagan

Throughout the early history of Pagan there has been a pattern of settlement and relocation and a continuous desire to settle the island. The early history of Pagan is discussed in Section 3.11, *Cultural Resources*.

There are no official residents of Pagan, though research indicates that about 100 families claim that they have personal or ancestral ties (DoN 2014). Some people that grew up on Pagan currently live on Saipan because of the 1981 eruption of Mount Pagan; others have ancestors that lived on the island or are buried there (DoN 2014). People with personal or ancestral ties consider Pagan as part of their language and culture and they have expressed a desire to go back permanently (DoN 2014); others have indicated they want to visit their former home sites.

Since the passage of the Northern Islands Village and Agricultural Homesteading Act of 2008, no Northern Islands homesteads have been permitted or deeded (a permit would allow home construction on a homestead lot while a deed would imply actual ownership of the homestead lot). In 2013, CNMI House Bill 18-109 was enacted to simplify the homestead permit process by waiving certain eligibility requirements. Eligibility requirements notwithstanding, the Department of Public Lands indicates that while homestead permits may be issued, they cannot legally provide homestead deeds until the homestead lands have the infrastructure (i.e., water, electricity) necessary to ensure safe and sanitary living (DoN 2014).

CNMI government agencies indicate that they would need to make provisions to provide public services for any villages that would be developed on Pagan (DoN 2014). Because physical and public services infrastructure would need to be developed on the distant island, homesteading on Pagan would be very costly to the CNMI government (DoN 2014). Those who wish to re-settle Pagan indicate that they do not require publicly provided infrastructure; they can live in housing that uses sustainable techniques that make large-scale public infrastructure unnecessary (DoN 2014). However, development without public services may violate certain public safety and child protective statutes of the CNMI.

3.15.9 Environmental Justice and the Protection of Children

Tinian is a small island of approximately 39 square miles (101 square kilometers) in size with a little over 3,000 residents. Local residents occupy the southern one-third of the island and live generally in the villages of San Jose, Marpo, and Carolinas, with the majority in San Jose. The population is predominately of Pacific Islander and Asian decent with low numbers of other races. Approximately 30% of the Tinian population is made up of children less than 18 years of age.

Pagan does not support any permanent residents or schools (U.S. Census Bureau 2010b) for whom environmental justice and the protection of children evaluations could be made.

3.15.9.1 Minority Population Areas

Table 3.15-8 shows the 2010 minority population proportions for the CNMI overall and Tinian. The CNMI minority population comprised 97.9% of the total population (2.1% of CNMI population was non-minority), while the Tinian population is 98.2% minority. As defined by Council on Environmental Quality guidelines and presented in Section 3.15.1, *Definition*, any area where 50% or more of the population is minority, then it is considered a minority population area. Therefore, all of Tinian is considered a minority population area.

Table 3.15-8. Minority Population Areas (> 50%) by Census Tract

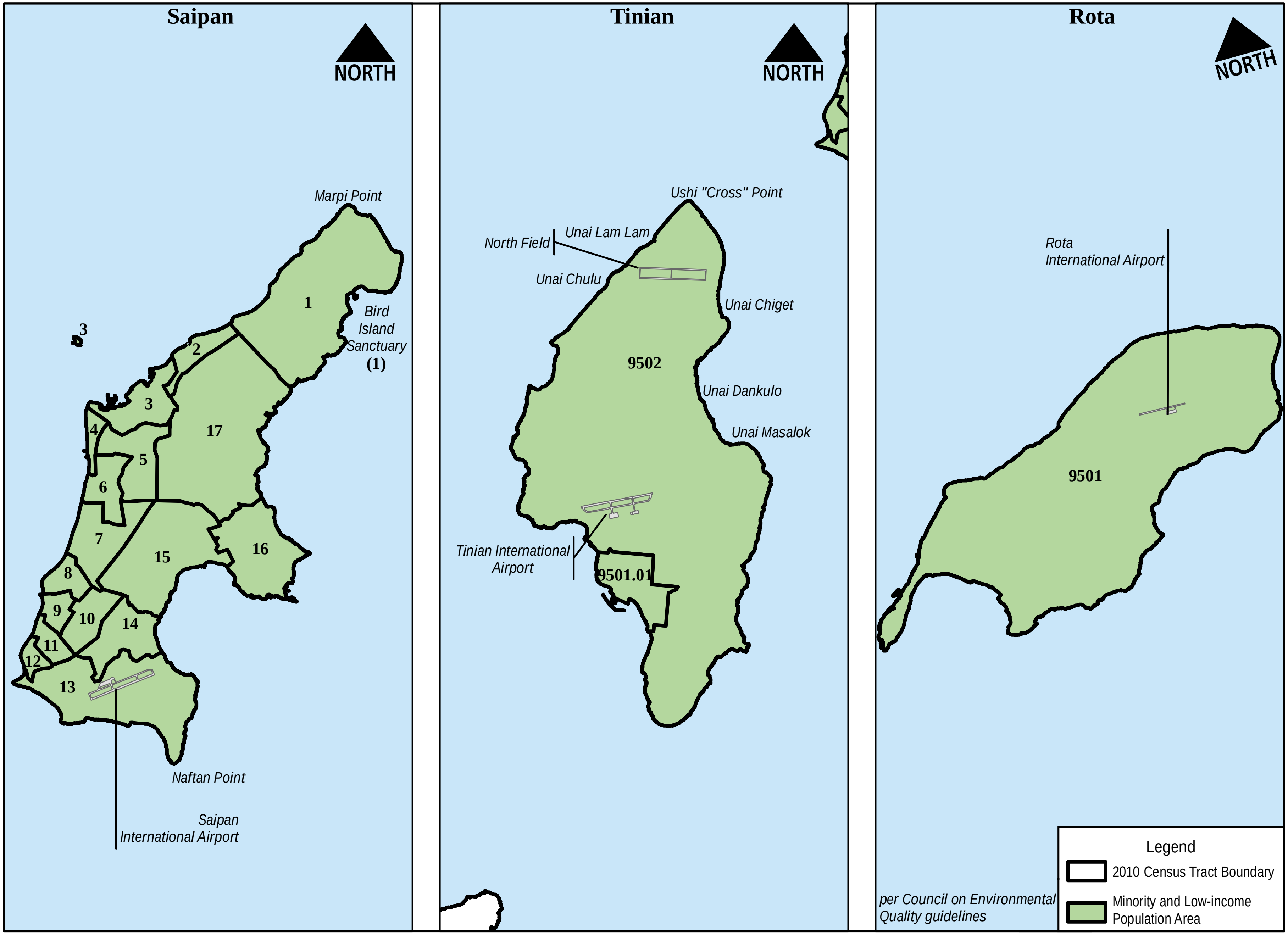
Location	*Total Population*	*Minority Population*	*% Minority*
Census Tract 9501, Rota	2,527	2,488	98.5%
Census Tract 1, Saipan	1,527	1,455	95.3%
Census Tract 2, Saipan	1,457	1,419	97.4%
Census Tract 3, Saipan	1,705	1,598	93.7%
Census Tract 4, Saipan	3,983	3,953	99.2%
Census Tract 5, Saipan	2,820	2,776	98.4%
Census Tract 6, Saipan	2,577	2,504	97.2%
Census Tract 7, Saipan	3,369	3,334	99.0%
Census Tract 8, Saipan	2,078	2,051	98.7%
Census Tract 9, Saipan	3,650	3,634	99.6%
Census Tract 10, Saipan	2,451	2,420	98.7%
Census Tract 11, Saipan	1,520	1,503	98.9%
Census Tract 12, Saipan	2,635	2,590	98.3%
Census Tract 13, Saipan	3,272	3,252	99.4%
Census Tract 14, Saipan	4,980	4,916	98.7%
Census Tract 15, Saipan	3,853	3,687	95.7%
Census Tract 16, Saipan	4,226	4,204	99.5%
Census Tract 17, Saipan	2,117	1,903	89.9%
Census Tract 9501.01, Tinian	1,939	1,904	98.2%
Census Tract 9502, Tinian	1,197	1,175	98.2%

Source: U.S. Census Bureau 2010a.

The Tinian population is further defined in the 2010 Census as 47% Asian, 39% Pacific Islander (of which 97% was Chamorro), and 12% two or more races.

3.15.9.2 Low-income Population Areas

The 2010 low-income population proportions for the CNMI overall and Tinian are presented by Census Tract on Figure 3.15-6 and in Table 3.15-9. For the CNMI overall, 52% of the population was below the poverty line in 2010. On Tinian, 43.6% of the population was below the poverty line as defined by the Bureau of Census. Therefore, the island is low income and from the perspective of Executive Order 12898, the majority of the residents of Tinian are both minority and low income.



0 1 2 4 Miles

0 1 2 4 Kilometers

Figure 3.15-6
Minority and Low-income Population Areas

Source: United States Census 2010

Table 3.15-9. Low-income Population Areas (>20%) by Census Tract

Location	*Total Population*	*Population Below the Poverty Line*	*% Below Poverty Line*
Census Tract 9501, Rota	2,520	1,118	44%
Census Tract 1, Saipan	1,522	712	47%
Census Tract 2, Saipan	1,456	770	53%
Census Tract 3, Saipan	1,696	696	41%
Census Tract 4, Saipan	3,967	2,476	62%
Census Tract 5, Saipan	2,806	1,535	55%
Census Tract 6, Saipan	2,416	1,149	48%
Census Tract 7, Saipan	3,348	1,901	57%
Census Tract 8, Saipan	1,944	1,214	62%
Census Tract 9, Saipan	3,629	2,313	64%
Census Tract 10, Saipan	2,440	1,339	55%
Census Tract 11, Saipan	1,509	940	62%
Census Tract 12, Saipan	2,627	1,784	68%
Census Tract 13, Saipan	3,254	1,819	56%
Census Tract 14, Saipan	4,964	2,398	48%
Census Tract 15, Saipan	3,815	1,697	44%
Census Tract 16, Saipan	4,216	2,013	48%
Census Tract 17, Saipan	2,111	683	32%
Census Tract 9501.01, Tinian	1,937	916	47%
Census Tract 9502, Tinian	1,189	448	38%

Source: U.S. Census Bureau 2010a.

3.15.9.3 Areas with High Concentration of Children

The presence of children follows closely with the overall population concentrations. Within these populated areas, certain locations such as schools, parks, and playgrounds have higher concentrations of children. Table 3.15-10 shows the percentage of children living on Tinian and the CNMI overall.

Table 3.15-10. Children in the CNMI and Tinian, 2010

Age	*CNMI*	*% of CNMI Population*	*Tinian*	*% of Tinian Population*
Under 5 years	4,827	9.0%	275	8.8%
5 to 9 years	4,613	8.6%	247	7.9%
10 to 14 years	4,921	9.1%	257	8.2%
15 to 17 years	2,788	5.2%	158	5.0%
Total	**17,149**	**31.8%**	**937**	**29.9%**

Source: U.S. Census Bureau 2010a.

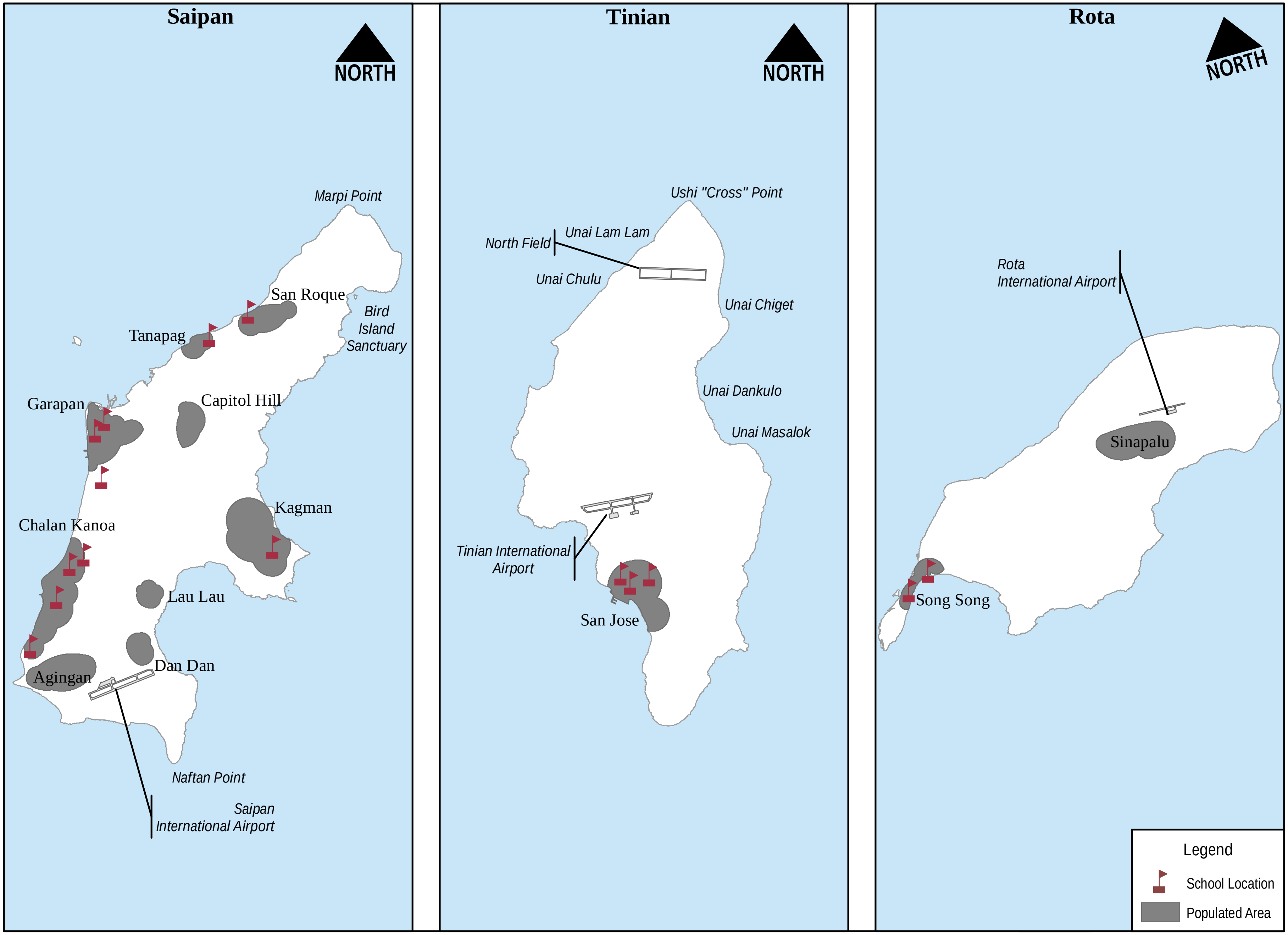
Table 3.15-11 shows the percentage of children living under the poverty line on Tinian and in the CNMI overall.

Table 3.15-11. Percentage of Children Below the Poverty Line

Age	*CNMI*	*Tinian*
Under 5 years	59%	49%
5 years	58%	48%
6 to 11 years	56%	45%
12 to 17 years	50%	36%
All Children	**55%**	**43%**

Source: U.S. Census Bureau 2010a.

Figure 3.15-7 shows populated areas and school locations on Tinian, as well as on Saipan and Rota for comparison purposes. The greatest concentration of schools on Tinian is located in the village of San Jose, to the southeast of the Military Lease Area and in the southwest end of Saipan.



0 1 2 4 Miles

Kilometers 0 1 2 4

Figure 3.15-7
Schools and Highly Populated Areas

Source: Pacific Disaster Center 2013

3.16 HAZARDOUS MATERIALS AND WASTE

Section 3.16 provides a summary of the general condition and character of hazardous materials, toxic substances, hazardous waste, and sites impacted by these materials (i.e., contaminated sites) within the region of influence for the proposed action and alternatives. The region of influence for hazardous materials and waste on Tinian includes the Military Lease Area, the Tinian International Airport, and areas to the north and the vicinity of Port of Tinian where the activities related to the proposed action alternatives would occur. The region of influence for hazardous materials and waste on Pagan comprises the entire island. Live-fire maneuvers would be limited to the northern portion of the island and non-live-fire maneuvers would occur on the southern portion of the island.

3.16.1 Definitions

The phrase “hazardous substance” is used in this document to describe any item or agent (i.e., biological, chemical, or physical) that has the potential to cause harm to humans, animals, or the environment and may include “hazardous materials,” “toxic substances,” and/or “hazardous wastes.” Additionally, sites that are environmentally affected by releases of hazardous substances are referred to as “contaminated sites.” These terms are briefly summarized below and more fully defined in Appendix R, *Hazardous Materials and Waste Technical Memo*.

3.16.1.1 Hazardous Materials

The term “hazardous materials” is defined under Section 1802 of the Hazardous Materials Transportation Act as “a substance or material in a quantity and form which may pose an unreasonable risk to health and safety or property when transported in commerce” (49 U.S. Code §§ 5101-5127).

When discussed in this document, hazardous materials currently present or that may be used as part of the proposed action include petroleum, oils, and lubricants; cleaning agents; adhesives; paints; pesticides; and other products necessary to perform essential functions. Fueling operations to support aircraft, watercraft, vehicle operations, and power generation on Tinian require the storage of bulk quantities of petroleum, oils, and lubricants. As such, these hazardous materials are stored in aboveground and underground storage tanks and distributed with pumps and pipelines. The storage areas for petroleum, oils, and lubricants represent potential sources of leaks, releases, or spills. Other types of hazardous materials (e.g., paints, pesticides, adhesives, cleaning agents) are distributed in smaller quantities in authorized containers such as drums, 5-gallon containers, and bottles.

3.16.1.2 Toxic Substances

The U.S. Environmental Protection Agency defines a toxic substance as “any chemical or mixture that may be harmful to the environment and to human health if inhaled, swallowed, or absorbed through the skin.” The Toxic Substances Control Act of 1976 provides the U.S. Environmental Protection Agency with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures as well as the production, importation, use, and disposal of specific chemicals including asbestos, lead-based paint, polychlorinated biphenyls, and radon.

Descriptions of these substances are provided in Appendix R, *Hazardous Materials and Waste Technical Memo.*

3.16.1.3 Hazardous Waste

Hazardous wastes are defined and regulated under the under the federal Resource Conservation and Recovery Act (U.S. Environmental Protection Agency 2014). Before a material can be classified as a hazardous waste, it must first be defined as a solid waste, which can include discarded materials such as solids, liquids, and gases. 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 may be a hazardous waste. The U.S. Environmental Protection Agency defines several hazardous waste types: (1) listed wastes (wastes that the agency has determined are hazardous); (2) characteristic wastes (e.g., corrosive, ignitable, reactive, toxic wastes); (3) universal wastes (e.g., batteries, pesticides, mercury-containing equipment); and (4) mixed wastes (contains both radioactive and hazardous wastes) (U.S. Environmental Protection Agency 2014).

3.16.1.4 Contaminated Sites

Contaminated sites discussed as part of this EIS/OEIS are described below and include those addressed under the Defense Environmental Restoration Program and the CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Site Assessment and Remediation Branch. These areas were identified to have historical or current use of materials and wastes that have been recognized as hazardous. While they have not all been evaluated and confirmed to be contaminated, they are collectively referred to as contaminated sites.

3.16.1.4.1 Defense Environmental Restoration Program

The Department of Defense primarily conducts environmental restoration activities in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act. The Department of Defense began cleaning up contamination in 1975. For the purposes of this EIS/OEIS, applicable environmental restoration activities include those conducted under the Installation Restoration Program, the Military Munitions Response Program, and Formerly Used Defense Sites described in the following paragraphs.

3.16.1.4.1.1 Installation Restoration Program

The Installation Restoration Program focuses on cleaning up releases of hazardous substances that pose risks to the public and/or the environment at properties actively owned or used by the U.S. military.

3.16.1.4.1.2 Military Munitions Response Program

The Military Munitions Response Program addresses non-operational range lands with suspected or known hazards from munitions and explosives of concern that occurred prior to September 2002, but are not already included within an Installation Response Program site cleanup activity.

The Military Munitions Rule was published as a final rule in 1997 and identifies when conventional and chemical military munitions become Resource Conservation and Recovery Act 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 (U.S. Environmental Protection Agency 2008b). Under the Military Munitions Rule, wholly inert items and non-munitions training materials are not defined as military munitions (U.S. Environmental Protection Agency 1997).

The Department of Defense 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, discarded military munitions, and munitions constituents. Unexploded ordnance, discarded military munitions, and munitions constituents all present potential explosive hazards and are collectively referred to as munitions and explosives of concern. In 1997, the Final Military Munitions Rule (40 CFR 266, Subpart M) was published defining munitions and explosives of concern handling requirements.

Military munitions that are used for their "intended purposes" are not considered waste per the Military Munitions Rule (40 CFR 266.202). In general, military munitions become subject to Resource Conservation and Recovery Act 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.

Munitions and explosives of concern are found on active, inactive, and closed military training ranges. Active ranges include areas being used on a periodic, ongoing basis for 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 U.S. Environmental Protection Agency interpretation, the Military Munitions Rule "...applies only to the recovery, collection, and on range destruction of unexploded ordnance and munitions fragments during range clearance activities at active or inactive ranges. With regard to closed ranges, U.S. Environmental Protection Agency did not generally intend to include these range clearance activities to be within the scope...of the intended use...exception to Subtitle C of Resource Conservation and Recovery Act granted by the Military Munitions Rule..." munitions and explosives of concern located on closed ranges therefore "...would at some point become a solid waste potentially subject to the Resource Conservation and Recovery Act and also may include hazardous substances, pollutants or contaminants subject to the Comprehensive Environmental Response Conservation and Liability Act..." In summary, munitions and explosives of concern at closed ranges are classified as solid waste and would likely be subject to Resource Conservation and Recovery Act Subtitle C hazardous waste handling and disposal requirements as well and therefore subject to regulatory oversight (U.S. Environmental Protection Agency 2005).

3.16.1.4.1.3 Formerly Used Defense Sites

This program manages environmental cleanup on eligible properties formerly owned, leased, possessed, or used by the U.S. military. The program only applies to properties that transferred from the U.S. military before 1986 (U.S. Army Corps of Engineers 2014).

3.16.2 Regulatory Framework

Hazardous substances are controlled in the U.S. primarily by laws and regulations administered by the U.S. Environmental Protection Agency, the U.S. Occupational Safety and Health Administration, and the U.S. Department of Transportation. Each agency incorporates hazardous substance controls and safeguards according to its unique Congressional mandate. U.S. Environmental Protection Agency regulations focus on the protection of human health and the environment. U.S. Occupational Safety and Health Administration regulations primarily protect employee and workplace health and safety. U.S. Department of Transportation regulations promote the safe transportation of hazardous substances used in commerce.

The CNMI oversees and administers federal environmental regulations through the CNMI Bureau of Environmental and Coastal Quality. The CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Hazardous and Solid Waste Management Branch regulates hazardous waste generated within the CNMI. In 1984, the CNMI Bureau of Environmental and Coastal Quality adopted the federal hazardous waste regulations under the Resource Conservation and Recovery Act and the hazardous and solid waste amendments (CNMI Bureau of Environmental and Coastal Quality 2008). The CNMI does not have hazardous waste regulations that are more stringent than U.S. Environmental Protection Agency regulations.

The CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Toxic Waste Management Branch protects human health and the environment through the enforcement and ongoing inspections of hazardous waste and emergency response. The CNMI Bureau of Environmental and Coastal Quality regulates hazardous and toxic materials through Title 65: Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Chapter 65-50, Hazardous Waste Management Regulations.

All Department of Defense operations on Tinian are required to comply with the CNMI, as well as applicable federal and Department of Defense laws and regulations. The following federal and CNMI laws, rules, and regulations would be followed. Refer to Appendix R, *Hazardous Materials and Waste Technical Memo*, for a detailed description and information about hazardous materials, hazardous wastes, and toxic substances. Appendix E, *Applicable Federal and Local Regulations*, provides a complete listing of applicable regulations.

3.16.2.1 Federal Regulations

- Comprehensive Environmental Response, Compensation, and Liability Act
- Resource Conservation and Recovery Act
- Military Munitions Rule
- Emergency Planning and Community Right-to-Know Act
- Toxic Substances Control Act

- Oil Pollution Act
- Pollution Prevention Act
- Occupational Safety and Health Administration laws and regulations
- Department of Transportation laws and regulations, including the Transportation Safety Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Federal Environmental Pesticide Control Act
- Federal Facilities Compliance Act
- Underground Storage Tank regulations
- Ship-Borne Hazardous Substance regulations
- Executive Order 12088, Federal Compliance with Pollution Control Standards

3.16.2.2 CNMI Regulations

- Commonwealth Environmental Protection Act
- Harmful Substance Clean Up Regulations
- Hazardous Waste Management Regulations
- Used Oil Management Rules and Regulations

3.16.3 Methodology

The following sections summarize the baseline hazardous materials and waste environment as it relates to those areas on Tinian and Pagan that would be affected by the proposed action or alternatives. As the first step, historical, topographical, and geological conditions of Tinian and Pagan were reviewed to establish a baseline of conditions present at each location. For Tinian, the 1997 Environmental Baseline Survey (GMP Associates, Inc. 1997) provided the best currently available data for Tinian; however, information was updated where more recent data was available. For Pagan, a 2013 historical ordnance assessment (DoN 2013a) provided the best currently available data. As was done for Tinian, information regarding the potential presence of hazardous materials and waste on Pagan was updated where more recent data was available.

As the second step, to determine the potential impacts, individual "areas of disturbance" under the proposed action or alternatives were examined to determine whether current or historic hazardous materials conditions may have affected or have the potential to affect these areas. Factors that are considered when making these determinations include the severity and probability of the potential for the release of hazardous materials within the area of disturbance, as well as conditions that may have affected the migration of hazardous materials. The discussion is organized as follows: (1) hazardous materials, (2) toxic substances, (3) hazardous waste, and (4) contaminated sites.

3.16.4 Tinian

The following provides a historical context of activities on Tinian that potentially could contribute to the use of hazardous materials, toxic substances, hazardous wastes, and/or creation of contaminated sites. Appendix R, *Hazardous Materials and Waste Technical Memo*, provides greater detail on land use as it pertains to the historical use of these types of substances on Tinian.

Tinian was sparsely populated prior to Spanish missionaries coming to the Northern Mariana Islands in 1668 (see Section 3.11, *Cultural Resources*). The island was largely depopulated from approximately

1700 until the early 1920s. Large-scale sugar cane cultivation began on Tinian beginning around 1922 and continued until the U.S. takeover of the island in 1944. Military use of the island by the Japanese occurred during the early 1940s, ending with the Battle of Tinian in August 1944. The U.S. military continued operations on the island during the war with a peak population of approximately 150,000 service personnel in 1944. Following World War II, small-scale U.S. military activity continued through to the present time. Meanwhile, civilian agriculture, cattle ranching, and eventually tourist activities began to take place on the island and continue today.

3.16.4.1 Hazardous Materials

3.16.4.1.1 Military Lease Area

Activities in the Military Lease Area that use hazardous materials include military training activities and use of the International Broadcasting Bureau; agricultural activities associated with cattle grazing and food production; and general public use.

3.16.4.1.1.1 Military Training Activities

As part of current military training exercises, portable, aboveground 60,000-gallon (200,000-liter) bulk diesel storage containers have been temporarily staged and used at North Field. These containers are called fuel bladders and assist in offloading fuel from aircraft (DoN 2014a). To prevent accidental releases, the fuel bladders are staged on existing pavement within temporary berms with impervious liners or secondary containment (DoN 2010). Military training activities include the use of vehicles and heavy equipment which could require refueling within the Military Lease Area.

Military training activities are conducted in compliance with standard operating procedures as described in an unpublished military training manual (M. Cruz, Joint Region Marianas, personal communication, December 2014). This includes proper storage and handling of hazardous materials inside an impervious barrier and away from catch basins, storm drains, and waterways; implementing a Spill Control Plan; and having trained spill response teams. Approved cleanup equipment is used in the event of an accidental release during military fueling activities (DoN 2010). Oily waste and bilge water from amphibious vehicles are disposed at disposal facilities on Guam and/or Saipan (DoN 2010). Plans are updated and implemented as part of continuous review for ongoing training.

3.16.4.1.1.2 International Broadcasting Bureau

The International Broadcasting Bureau is located within a compound on the west side of the Military Lease Area. The facility compound has a standby power plant consisting of three diesel-fired generators, two free-standing 30,000-gallon (100,000-liter) aboveground storage tanks, and a fuel pump house. The aboveground storage tanks are surrounded by an earthen containment berm connected to an oil/water separator for the drainage from the containment berm. In fiscal year 2012, the International Broadcasting Bureau used approximately 12,000 gallons (45,000 liters) of diesel fuel to operate the standby power plant (DoN 2013b). Fuel is delivered to the aboveground storage tanks via tanker truck. No petroleum releases related to the fuel storage activities at the International Broadcasting Bureau have been reported.

3.16.4.1.1.3 Agricultural Activities

Within the Military Lease Area, there are an estimated 32 cattle ranching operations. According to the Tinian Cattlemen Association, cattle ranching activities on Tinian are organic (i.e., do not use pesticides, herbicides, or insecticides) (L. Duponcheel, Tinian Cattlemen Association, personal communication, December 6, 2013). No permanent structures (e.g., buildings, storage facilities, aboveground or underground storage tanks) are allowed as part of the lease agreements with the ranchers. Visual observations from a windshield survey of accessible portions of the cattle ranch lands did not reveal any obvious areas of hazardous material storage or releases (i.e., soil staining, dead or stressed vegetation). However, within several of the ranch lots, observations of old appliances (e.g., washing machines) and plastic or metal drums were made. These appliances and containers are reportedly used by ranchers for water catchment and as barricades. It is unknown if these items were properly decommissioned or if they contain any potential hazardous materials.

3.16.4.1.1.4 Public Use

Access to the Military Lease Area is largely unrestricted; therefore, there is the potential for unpermitted disposal of hazardous materials and unreported releases of petroleum products from vehicles using the area in association with tourism or simply passing through. Visual observations from a windshield survey of accessible portions of the Military Lease Area did not reveal any unpermitted disposal sites or obvious areas of chemical storage or releases.

3.16.4.1.2 Tinian International Airport

The existing runways and the area north of the existing runways at Tinian International Airport that would be part of the action alternatives comprises parts of the active runway, World War II-era pavement, and otherwise undeveloped land. The Tinian International Airport uses, handles, and stores hazardous materials for daily airport operations; however, due to the limited aircraft maintenance and repair capabilities available at Tinian International Airport, the amounts of these hazardous materials are limited. Common hazardous materials at Tinian International Airport include pesticides and herbicides; industrial and household cleaning products; hydraulic fluids; paints; solvents; and petroleum, oils and lubricants (Air Force 2012). Hazardous materials are stored and managed by Tinian International Airport personnel in accordance with applicable federal and CNMI regulations.

The Tinian International Airport has two aboveground diesel storage tanks: 2,000-gallons (7,600-liter) and 1,500-gallons (5,700 liters) (CNMI Bureau of Environmental and Coastal Quality, personal communication, January 30, 2014). Fueling operations at Tinian International Airport are limited to small containers (55-gallon drums) of aviation fuel brought to the island for emergency fuel needs by commuter airlines (Commonwealth Ports Authority, personal communication, December 2013). Military training also includes fueling expeditionary vehicles at Tinian International Airport on the west end of the taxi ramp, similar to the fueling operations described for North Field.

The Micronesian Development Company holds a lease for cattle grazing south of the airport (R-12). For the past 2 years Micronesian Development Company has been applying Effective Microorgansim-1 as a pesticide/fertilizer. This product contains lactic acid, photosynthetic organisms, and yeast and is mixed with (drinking) alcohol. It is undetermined whether any other pesticides and herbicides are applied in this location.

3.16.4.1.3 Port of Tinian

The area in the vicinity of the Port of Tinian where the proposed action alternatives would occur includes the storage, use, and/or management of hazardous materials. A bulk fuel storage facility owned and operated by Mobil Oil is located at the port but not within the proposed footprint of the action alternatives. The plant provides Tinian with gasoline and diesel fuel, including fuel for the Commonwealth Utility Corporation power plant. Other aboveground storage tanks at the Mobil bulk fuel storage facility include a 63,000-gallon (240,000-liter) diesel tank and an approximately 30,000-gallon (100,000-liter) gasoline tank (CNMI Division of Environmental Quality, personal communication, January 30, 2014). A fuel tanker vessel delivers fuel to the tanks on a monthly basis (DoN 2014a). There is also a truck fueling facility for gasoline distribution at this facility.

An 1,167-foot (356-meter) long, single-walled, steel, aboveground pipeline delivers fuel from the Mobil bulk fuel plant to a 500,000-gallon (1,900,000-liter) aboveground diesel storage tank at the Commonwealth Utility Corporation power plant located to the northwest of the port at the corner of West Street and 6th Avenue (Figure 3.16-1). The pipeline is approximately 3 inches (8 centimeters) in diameter and has no secondary containment. No releases have been reported in association with the pipeline. The Commonwealth Utility Corporation has two 15,000-gallon (57,000-liter), two 7,000-gallon (26,500-liter), and one 2,000-gallon (7,600-liter) aboveground diesel fuel storage tanks (CNMI Division of Environmental Quality, personal communication, January 30, 2014). All tanks at this site are provided with secondary containment using concrete or concrete lined earthen berms. No releases have been reported at the power plant.

3.16.4.2 Toxic Substances

The 1997 Environmental Baseline Survey examined the environmental condition of the Military Lease Area including the presence and management toxic substances (GMP Associates, Inc. 1997). The results are summarized in the following subsections.

3.16.4.2.1 Island-wide Hazards

No radon testing has occurred on Tinian. However, radon testing on Guam resulted in a definite correlation between the type of surficial geology and radon concentrations. In almost all cases, elevated radon concentrations were found in buildings located above Barrigada and Mariana limestones but not in those located above alluvial clay deposits, beach deposits, and volcanic rocks (Burkhart et al. 1993). A large portion of the geology of Tinian consists of Mariana limestone, and therefore there is the potential for radon intrusion into structures constructed on Tinian.

3.16.4.2.2 Military Lease Area

3.16.4.2.2.1 Asbestos

The 1997 Environmental Baseline Survey noted the presence of asbestos-containing materials at Site L-5, the former Micronesian Development Company slaughterhouse (Figure 3.16-1) (GMP Associates, Inc. 1997). No other asbestos-containing materials were noted within the Military Lease Area.

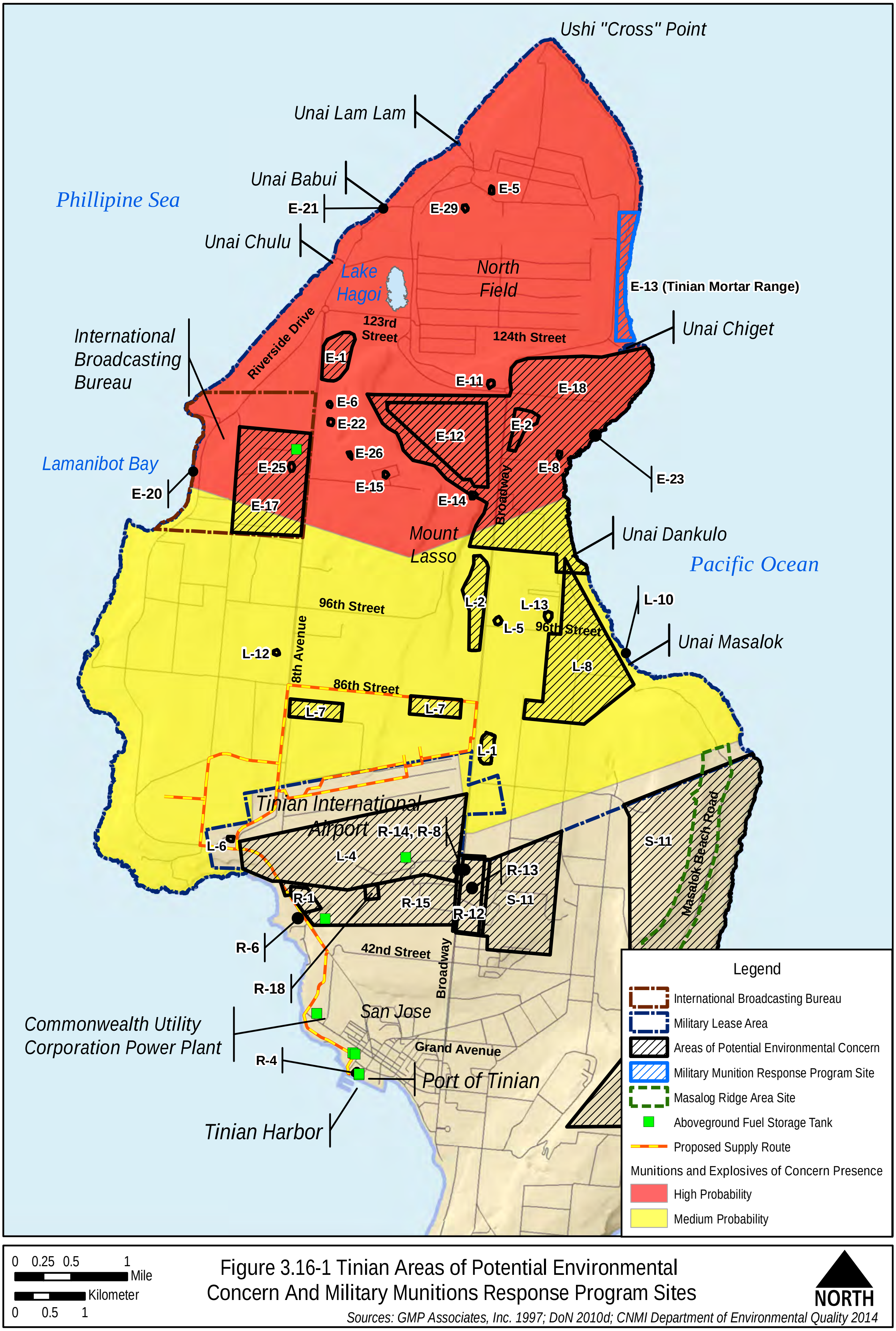


Figure 3.16-1 Tinian Areas of Potential Environmental Concern And Military Munitions Response Program Sites

Sources: GMP Associates, Inc. 1997; DoN 2010d; CNMI Department of Environmental Quality 2014

The International Broadcasting Bureau facilities were constructed in four phases from 1999 through 2003 (International Broadcasting Bureau 2009). No changes that would require the use of asbestos-containing materials are known have been made to this facility since its completion in 2003. Asbestos-containing materials are not known to be present in the International Broadcasting Bureau facilities (D. Gifford, International Broadcasting Bureau, personal communication, 2013).

3.16.4.2.2.2 Lead

No evidence of lead-based paint was found in the Military Lease Area in the 1997 Environmental Baseline Survey (GMP Associates, Inc. 1997). Additionally, lead-based paint is not known to be present in the International Broadcasting Bureau facilities (D. Gifford, International Broadcasting Bureau, personal communication, 2013). The use of lead-based paint was banned in 1978; therefore, no lead-based paint has been introduced to the site since the 1997 Environmental Baseline Survey or the construction of the International Broadcasting Bureau, and the results of the survey remain valid.

3.16.4.2.2.3 Polychlorinated Biphenyls

No evidence of historical use of polychlorinated biphenyls was found in the Military Lease Area (GMP Associates, Inc. 1997). However, existing electrical power lines were documented along Broadway and extending to the Micronesian Development Company Slaughterhouse (L-5). The presence/absence of polychlorinated biphenyls in the electrical transformers was not confirmed.

The International Broadcasting Bureau obtains its electricity from the Commonwealth Utility Corporation via off-site, overhead power distribution lines connect to a ground-mounted electrical transformer located within the facility compound. The electrical transformer and other the electrical equipment in the International Broadcasting Bureau facilities are reported to be free of polychlorinated biphenyls (D. Gifford, International Broadcasting Bureau, personal communication, 2013).

3.16.4.2.3 Tinian International Airport

The existing runways and the area north of the existing runways at Tinian International Airport that would be part of the action alternatives comprises parts of the active runway, World War II-era pavement, and otherwise undeveloped land. There are no existing structures in that portion of the airport that would potentially contain asbestos-containing materials, lead-based paint, or polychlorinated biphenyls.

3.16.4.2.4 Port of Tinian

The areas of the port that would be part of the action alternatives are comprised of concrete ramps, fenced areas, and open land. There are no structures in these areas that could potentially contain asbestos-containing materials, lead-based paint, or polychlorinated biphenyls.

3.16.4.3 Hazardous Waste

3.16.4.3.1 Military Lease Area

3.16.4.3.1.1 Military Training Activities

There are no active live-fire ranges on Tinian. However, live-fire training with small arms into bullet traps that are temporarily set up occurs at various locations within the Military Lease Area. Each temporary range is cleared of expended hazardous materials, such as lead bullet fragments, in accordance with the Mariana Islands Range Complex Management Plan (U.S. Pacific Fleet 2007). Expended materials are removed after an exercise is completed (DoN 2010) and range byproducts expended in range firing lines, stationary defensive positions, and bullet traps are collected for removal from training areas, taken back aboard ship (as appropriate), or to Guam for proper disposal. Other range byproducts, such as brass cartridges and links, would be collected from training area roadways and recycled or managed as solid waste.

Under the Military Munitions Response Program, fired munitions are considered a solid waste when they are removed from their landing spot and then managed off-range (i.e., when transported off-range and stored, reclaimed, treated, or disposed of).

3.16.4.3.1.2 International Broadcasting Bureau

The International Broadcasting Bureau generates hazardous waste mainly in the form of used oil, fluorescent light bulbs, and batteries. These wastes are stored temporarily in the facility's hazardous waste storage area and periodically removed for proper disposal/recycling off-site (DoN 2013b).

3.16.4.3.1.3 Public Use

Access to the Military Lease Area is largely unrestricted; therefore, there is the potential for unpermitted disposal of hazardous wastes by the general public. Visual observations from a windshield survey of accessible portions of the Military Lease Area did not reveal any unpermitted waste sites or obvious areas of chemical releases.

3.16.4.3.2 Tinian International Airport

The existing runways and the area north of the existing runways at Tinian International Airport that would be part of the action alternatives comprises parts of the active runway, World War II-era pavement, and otherwise undeveloped land. There are no existing facilities or operations in this area that potentially generate hazardous waste. Access to the Tinian International Airport is restricted; therefore, disposal of hazardous wastes does not occur.

3.16.4.3.3 Port of Tinian

The areas of the port that would be part of the action alternatives are comprised of concrete ramps, fenced areas, and open land. These areas are either undeveloped or do not have activities that would generate hazardous waste.

3.16.4.4 Potential and Confirmed Contaminated Sites

Historic military activities on Tinian have resulted in adverse impacts on the area with regards to hazardous materials and wastes. An Environmental Baseline Survey conducted in 1997 identified several U.S. military sites of environmental concern on Tinian (see Figure 3.16-1). These areas were identified to have historical use of materials and wastes that have been recognized as hazardous. However, they have not all been evaluated and confirmed to be contaminated. The sites identified consisted of fuel drum sites, hazardous materials sites, and concentrated ordnance sites. While an Environmental Baseline Survey is not a comprehensive assessment of contamination, in response, the U.S. military, the U.S. Environmental Protection Agency, and the CNMI have established mitigation and cleanup activities under a variety of programs. These programs are summarized in Section 3.16.1.4, *Contaminated Sites*, and Appendix R, *Hazardous Materials and Waste Technical Memo*. Activities conducted at Tinian through these programs are addressed in this section.

3.16.4.4.1 Island-wide Sites

Activities on Tinian during World War II resulted in the potential for contaminants to be present throughout the island. According to a 1997 Environmental Baseline Survey, numerous areas of concern were identified that were the result of wartime activities and are described in detail in the following sections (GMP Associates, Inc. 1997). Island-wide hazards were also identified, including isolated ordnance, pesticide residues (i.e., dichlorodiphenyltrichloroethane or DDT), and sodium arsenate. Isolated ordnance may be encountered across Tinian as a result of historic wartime and training activities. According to the 1997 Environmental Baseline Survey, the archeological consultant documented the location of approximately 137 pieces of isolated ordnance (GMP Associates, Inc. 1997).

The 1997 Environmental Baseline Survey also documented the historical application of DDT as having occurred regularly at various locations on the island (GMP Associates, Inc. 1997). DDT was sprayed at least twice a month, but the duration of the spraying activity was not determined. Documents indicated that pesticide applications occurred at galleys, mess halls, and restroom facilities, however, the exact locations were also not determined. Subsequent testing for DDT and its byproducts in groundwater in the Marpo Municipal Well indicated that groundwater at that location had not been contaminated with DDT or its byproducts. However, further testing of soil was recommended due to the persistence of DDT in the environment.

Finally, pit latrines were used during World War II for the disposal of human waste where/when restroom facilities were not present. The holes were backfilled when capacity was reached and new holes were dug. While in use, the holes were sprayed daily with oil and sodium arsenite for sanitation purposes. Sodium arsenite is water soluble and highly toxic. The actual locations of the pit latrines were not determined; therefore, sodium arsenite is considered an island wide hazard both in soil and groundwater. Testing conducted and the Marpo Municipal Well has indicated that this substance has not contaminated the aquifer near the well site.

3.16.4.4.2 Military Lease Area

3.16.4.4.2.1 Military Training Activities

Site E-13 (the Tinian Mortar Range; also known as the Chiget Mortar Range) identified in the 1997 Environmental Baseline Survey is being investigated under the Navy's Military Munitions Response Program (see Figure 3.16-1) (DoN 2014b; GMP Associates, Inc. 1997). Chiget Mortar Range is located next to the Blow Hole attraction on Tinian. It occupies approximately 97.5 acres (39.5 hectares) of land.

The Tinian Mortar Range was part of the World War II battlefield and was used for military live-fire training from 1945 through 1994. During training exercises, small arms caliber munitions (i.e, up to .50 caliber), 40 millimeter rifle grenades, 60 millimeter mortars, and 81 millimeter mortars were used on the range. The range was closed in 1994. The Tinian Mortar Range is currently unused by the military and is being investigated to address hazards associated with munitions and explosives of concern and munitions constituents.

A Preliminary Assessment was completed in 2006 and noted the observation of mortar fragments, cartridge casings, unexpended grenades, and various expended munitions and munitions debris. Based on the findings of the Preliminary Assessment report, a Site Inspection to address Munitions and Explosives of Concern and Munitions Constituents at the Tinian Mortar Range was recommended and conducted from May to October 2014.

The Site Inspection confirmed the presence of metal constituents at levels exceeding 2008 Guam Environmental Protection Agency Pacific Basin Environmental Screening Levels for unrestricted land use where groundwater is a current or potential source of drinking water (DoN 2014b). Chromium and iron were the most common metals to exceed project action levels. The Site Inspection determined that munitions constituents concentrations did not exceed project action levels (DoN 2014b).

Utilizing the Munitions and Explosives of Concern and Munitions Constituents findings acquired during the Site Inspection, an explosive, chemical and health hazard evaluation was documented, and a Munitions Response Site Priority of 4 was determined based on application of the Munitions Response Site Prioritization Protocol. Munitions Response Site priorities range from 1 (highest priority) to 8 (lowest priority). A further investigation to delineate the extent and magnitude of metals contamination and to assess the potential human health and environmental risks associated with past operational practices was recommended.

3.16.4.4.2.2 International Broadcasting Bureau

According to the 1997 Environmental Baseline Survey, a lessee using the southwestern portion of the International Broadcasting Bureau site for cattle grazing reported finding glass bottles in the 1950s that he buried onsite (GMP Associates, Inc. 1997). The lessee stated that the bottles had a unique but unidentifiable odor. The location of the bottles was not ascertained and the bottles are assumed to still be present on the site.

3.16.4.4.2.3 Agricultural Activities

Historic agricultural activities on Tinian have resulted in the potential for contaminated sites within the proposed action area. An Environmental Baseline Survey conducted in 1997 identified eight sites of environmental concern within or just south of the Military Lease Area (see Figure 3.16-1) that are summarized in Table 3.16-1 and described in the following paragraphs.

Table 3.16-1. Sites of Potential Environmental Concern Associated with Agricultural Activities within the Tinian Military Lease Area

Site	*Description/Materials and Location*	*Activities/Category*
E-17	Bio Pacific Agricultural Area/possible pesticide use west of 8th Avenue, surrounding International Broadcasting Bureau inside Military Lease Area	The Bio Pacific Company stored fertilizers and pesticides at a warehouse outside the Military Lease Area. The amount of fertilizers and pesticides from the warehouse that may have been applied to the agricultural land are not known; this site is considered Category 6*
E-18**	Micronesian Development Company Cattle Grazing Land/possible pesticide use south of North Field and west of Broadway	Land was used primarily for grazing cattle from 1965 through 1994. However, several chemicals including pesticides were inventoried at the Micronesian Development Company in 1990 and it is unknown whether the pesticides were used on the grazing land; therefore, this site is considered Category 6*
L-13	Micronesian Development Company slaughterhouse disposal site	Disposal of waste products from slaughterhouse. Presence of stressed vegetation documented Category 7*
R-8	Micronesian Development Company Dairy Plant	Former location of “dipping wells” for bathing cattle in a tick repellent/pesticide
R-12	Micronesian Development Company Cattle Grazing Land/possible pesticide use	Land was used primarily for grazing cattle and several chemicals including pesticides may have been used on the grazing land; therefore, this site is considered Category 7*
R-13	Micronesian Development Corporation pesticide disposal site, 590 feet east of Broadway and 1800 feet South of the ranch office	Pesticide burial took place in 1989 in an excavated trench approximately 30 feet in length and 3 feet deep. In 1994 Environmental Engineering, Inc. removed contaminated soil and treated remaining contaminated soil. This site is considered a Category 4* because all removal and remedial actions have been taken
R-14	Micronesian Development Company contaminated soil	Storage of drums containing contaminated soil excavated from site R-13 remediation activities. Category 7*
S-11**	Micronesian Development Company Agricultural Parcels/pesticides, southeastern portion of island	Most of this land is used for cattle grazing. However, it is unknown whether pesticides were used on these lands; therefore, the site is considered Category 7*

Legend: *Category 1: Areas where no storage or disposal of hazardous substances or petroleum has occurred.
Category 2: Areas where only storage of hazardous substances has occurred, but no release or disposal has occurred.
Category 3: Areas where storage or release of hazardous substances has occurred but at concentrations that do not require a removal or remedial response.
Category 4: Areas where storage or release of hazardous substances has occurred and all removal or remedial actions to protect human health and the environment have been taken.
Category 5: Area where storage or release of hazardous substance has occurred, and removal actions are underway, but all required remedial actions have not yet been taken.
Category 6: Area where storage or release of hazardous substances has occurred, but required actions have not yet been implemented.
Category 7: Area not evaluated or that requires additional evaluation.

Sources: GMP Associates, Inc. 1997; J. Victorino, Naval Facilities Engineering Command (NAVFAC) Pacific, personal communication, 2014.

The 1997 Environmental Baseline Survey identified three areas within the Military Lease Area that supported agricultural uses (GMP Associates, Inc. 1997). The first was located near the current site of the International Broadcasting Bureau and was leased by the Bio Pacific Company for approximately 10 years in the 1980s (E-17). The site was used for the experimental production of fruit trees. Numerous fertilizers, pesticides, fungicides, herbicides, and reagents were left behind when Bio Pacific Company vacated the site. The Tinian Department of Public Works removed the chemicals from the site. Because many of the chemicals are classified as hazardous materials and no application data was available, soil sampling was recommended to determine whether remedial actions are warranted. The second site was located in the eastern half of the Military Lease Area and may have been used by the Micronesian Development Company for cattle grazing under a 30-year lease between 1965 and 1994 (E-18). Several pesticides and herbicides were inventoried in association with this site but it is unknown whether any were applied. The Micronesian Development Company also held a lease just south of the Military Lease Area on the western coast of Tinian (S-11) that also may have been subject to pesticide/herbicide application. The third site is the Micronesian Development Company disposed of waste from their slaughterhouse at a site located east of Broadway at the end of 96th Street just south of the Military Lease Area. This site was also used for aircraft disposal during World War II (see L-13 depicted in Figure 3.16-1).

A dairy plant operated from 1973 through 1982 or 1983, near the current Micronesian Development Corporation ranch office along Broadway (R-8) just south of the Military Lease Area boundary. Near the dairy were “dipping wells” for bathing cattle in a tick repellent/pesticide. This site is considered a Category 7 (see description of Categories under Table 3.16-1) because it was not surveyed during the 1997 Environmental Baseline Survey and more information is needed about the dairy operation.

The Micronesian Development Corporation leased an area just south of the Military Lease Area for cattle grazing (R-12). Pesticide and fertilizer applications are suspected to have occurred in this area. Additionally, the Micronesian Development Corporation established a pesticide disposal site, 590 feet (180 meters) east of Broadway and 1,800 feet (550 meters) south of the ranch office (R-13) near the Military Lease Area boundary. Pesticide burial took place in 1989 in an excavated trench approximately 30 feet (9 meters) in length and 3 feet (1 meter) deep. In 1994 Environmental Engineering, Inc. removed contaminated soil and treated remaining contaminated soil. The CNMI Bureau of Environmental and Coastal Quality indicates that five barrels of contaminated materials from site R-13 are stored at the Micronesian Development Corporation ranch office warehouse, East of Broadway and just North of the pesticide disposal site (R-14) and are awaiting approval from U.S. Environmental Protection Agency to ship the barrels off-island (GMP Associates, Inc. 1997).

3.16.4.4.2.4 World War II Activities

Former activities by both the United States and Japanese militaries during World War II have the potential to affect site conditions in the Military Lease Area. These sites were identified in the 1997 Environmental Baseline Survey (GMP Associates, Inc. 1997). Twenty-three fuel storage facilities, ordnance sites, and disposal sites used during World War II are located on in the Military Lease Area and have the potential to have affected site conditions. These sites are summarized in Table 3.16-2 and depicted in Figure 3.16-1.

Table 3.16-2. Sites of Potential Environmental Concern Associated with World War II Activities within the Tinian Military Lease Area

Site	*Description/Materials and Location*	*Activities/Category*
E-1	12 World War II Aviation Fuel Storage Tanks/ordnance east of 8^{th} Avenue, south of the traffic circle at the intersection of 8^{th} Avenue and 125^{th} Street	Some, but not all of the fuel tanks were removed as scrap metal following World War II. Small munitions may also remain at this site; this site is considered Category 5*
E-2	19 World War II Aviation Fuel Storage Tanks/ordnance east side of Broadway, south of the traffic circle at the intersection of Broadway and 116^{th} Street	Some, but not all of the fuel tanks were removed as scrap metal following World War II. Small munitions may also remain at this site; this site is considered Category 5*
E-5	World War II Japanese Fuel Bunker/petroleum products, end of a shallow gorge in the northwestern corner of North Field	The fuel bunker was bombed or burned during the war and unburned fuel likely leaked from containers. No subsequent cleanup took place; this site is considered Category 6*
E-6	World War II Asphalt Plant/asphalt east of 8^{th} Avenue, between 110^{th} and 125^{th} Streets	Due to asphalt on the ground and metal equipment at the site, this site is considered Category 6*
E-8	World War II Mine Assembly Buildings/ordnance east of Broadway	Historical maps showed a cluster of mine assembly buildings that were not found during the 1997 Environmental Baseline Survey; this site is considered Category 7*
E-11	World War II Lube Oil Storage and Dumping Unit/petroleum products west of the traffic circle at northern end of Broadway	A historical map showed a lube oil storage and dumping unit at the location indicated. No further information was available and the site was not surveyed during the 1997 Environmental Baseline Survey; this site is considered Category 7*
E-12	World War II Central Bomb Dump/ordnance south of North Field	Historical records show that this facility had storage capacity for 10,000 tons of high explosive bombs and 15,000 tons of incendiary bombs. However, it is reported that there are no areas on Tinian with concentrated munitions, so most of the munitions may have been removed from this location. Because complete removal cannot be confirmed, this site is considered Category 5*
E-14	Caves Below Mount Lasso/ordnance caves along the cliffs below the east side of Mount Lasso used as Japanese defensive positions in World War II	According to archeological records, multiple munitions were found at Japanese positions along cliffs. However, no munitions were found in the Mount Lasso cliff caves during the 1997 Environmental Baseline Survey. A more thorough survey is needed to be sure that no munitions are present; this site is considered Category 7*
E-15	World War II Army Hospital/unknown, 110^{th} Street east of 8^{th} Avenue	A historical map indicated the presence of an Army Hospital at this location. No further information was found, and the site was not analyzed under the 1997 Environmental Baseline Survey; the site is considered Category 7*
E-20	Coke Dump Site	This is an ocean dump site located between Earle Point and Hilo Point. The site was used for the wholesale dumping of vehicles, tools, equipment and trash at the end of World War II

Table 3.16-2. Sites of Potential Environmental Concern Associated with World War II Activities within the Tinian Military Lease Area

Site	*Description/Materials and Location*	*Activities/Category*
E-21	Trash Dump Site	This World War II trash dumping site is located along the coast between Unai Chulu and Unai Babui. The trash dump consisted of a ramp that was used to dump small garbage into the ocean. No information regarding the exact type of trash was obtained
E-22***	World War II Trash Dump Site/garbage east of 8th Avenue and International Broadcasting Bureau	A historical map identified a World War II trash dump. The site is considered Category 7* because it was not assessed during the 1997 Environmental Baseline Survey
E-23	World War II Scrap Metal Dump Site/ordnance on northeastern coast, south of Asiga Point	Scrap metal, bullets, and other evidence of ammunition were found during the 1997 Environmental Baseline Survey. This site is considered Category 6*
E-25**	World War II Scrap Metal Dump Site/ordnance west of 8th Avenue, within Site E-17 described above	This site was identified from a historical map that indicated it contained scrap metal and possibly bombs. The site was not viewed during the 1997 Environmental Baseline Survey; therefore, the site is considered Category 7*
E-26	World War II Scrap Metal Dump Site/ordnance and petroleum products east of 8th Avenue and International Broadcasting Bureau south of Site E-22	Fuel containers, bombs, and bomb casings possibly remain at this site after partial removal; therefore, the site is considered Category 5*
E-29	World War II Japanese Air Traffic Control Building/unidentified stain on floor, northern boundary of North Field	Stain on floor was not investigated during the 1997 Environmental Baseline Survey. Therefore, the site is considered Category 7*
L-1	World War II Fuel Storage Tanks/ordnance, east of Broadway and northeast of the eastern end of the Tinian International Airport Runway	Rusted fuel tanks were noted during the 1997 Environmental Baseline Survey and historical evidence suggests munitions may remain; this site is considered Category 5*
L-2	World War II Fuel Storage Tanks/ordnance, west of Broadway across 96th Street	Fuel tanks were removed after World War II, but historical evidence suggests munitions may remain; this site is considered Category 5*
L-5	Former World War II Japanese Communication Building now Micronesian Development Company Slaughterhouse/potential asbestos and petroleum, northeastern corner of Broadway and 96th Street	Due to broken, suspected friable asbestos corrugated sheeting, World War II aboveground storage tanks, and a 55-gallon container with unknown contents, the site is considered Category 7*
L-8	Masalog Bomb Dump/ordnance, eastern portion of the island, inland from Unai Masalok	This site historically had 469 compartments for bomb storage and could accommodate 18,800 tons of high explosive bombs. All of the historic munitions may not have been removed, so this site is considered Category 5*
L-12	World War II Scrap Metal Dump Site/petroleum products and ordnance, west of 8th Avenue between 96th and 86th Streets	Historical records indicated that scrap metal, bombs, fuel, and grease from World War II may not all have been removed. The site was not viewed during the 1997 Environmental Baseline Survey; therefore, the site is considered to be Category 5*

Table 3.16-2. Sites of Potential Environmental Concern Associated with World War II Activities within the Tinian Military Lease Area

Site	*Description/Materials and Location*	*Activities/Category*
L-13***	West Field "Boneyard"	World War II aircraft junkyard. The site is assigned Category 7*
R-1	World War II Fuel Tank Farm located east of 8th Avenue south of the airport. Possible presence of ordnance	Undetermined whether all fuel tanks were removed after World War II. Historical evidence suggests munitions may remain; this site is considered Category 5*

Legend: *Category 1: Areas where no storage or disposal of hazardous substances or petroleum has occurred.
Category 2: Areas where only storage of hazardous substances has occurred, but no release or disposal has occurred.
Category 3: Areas where storage or release of hazardous substances has occurred but at concentrations that do not require a removal or remedial response.
Category 4: Areas where storage or release of hazardous substances has occurred and all removal or remedial actions to protect human health and the environment have been taken.
Category 5: Area where storage or release of hazardous substance has occurred, and removal actions are underway, but all required remedial actions have not yet been taken.
Category 6: Area where storage or release of hazardous substances has occurred, but required actions have not yet been implemented.
Category 7: Area not evaluated or that requires additional evaluation.
Sources: GMP Associates, Inc. 1997; J. Victorino, NAVFAC Pacific, personal communication, 2014.

3.16.4.4.2.5 Masalog Ridge Area Site

The Masalog Ridge Area Site encompasses approximately 292 acres (118 hectares) and is part of an ordnance storage depot located in what is known as the Masalog Ridge Area. The site is located along Masalok Beach Road near Masalog Point along the eastern coast of Tinian and is partially within the Military Lease Area. The U.S. military used the site immediately following the capture of the Mariana Islands in World War II to stage ordnance for aircraft, especially B-29 Bombers for the invasion of Japan. The ordnance storage area was extensive, consisting of over a hundred open revetments with unknown quantity of ordnance stored over a large area.

The unexploded ordnance contamination occurred after World War II, during the Trust Territory of the Pacific Islands government (which was administered by the U.S. government), prior to the CNMI acquiring the property. The property was returned from the Trust Territory government when the CNMI government was created in 1976. The property is currently owned by the Department of Public Lands, which is in charge of managing public properties in the CNMI and is under the Executive Branch of the CNMI government.

Unexploded ordnance and the potential for other explosive components currently present a significant health hazard to general public at this site. The site has remained idled and undeveloped since after its use as an ordnance storage depot (CNMI Division of Environmental Quality 2014).

The CNMI Bureau of Environmental and Coastal Quality, Division of Environmental Quality, Site Assessment and Remediation branch had completed and submitted U.S. Environmental Protection Agency Eligibility Determination Checklist on July 28, 2013, which was approved by U.S. Environmental Protection Agency on August 16, 2013, as a Brownfields site. A Phase 1 Environmental Site Assessment was scheduled to occur in 2014 and a Phase II Environmental Site Assessment is scheduled to occur in 2015 (CNMI Division of Environmental Quality 2014).

3.16.4.4.3 Tinian International Airport

The existing runways and the area north of the existing runways at Tinian International Airport that would be part of the action alternatives comprises parts of the active runway, World War II-era pavement, and otherwise undeveloped land. A World War II-era asphalt plant located at end of Riverside Drive was identified in the vicinity of the Tinian International Airport by the 1997 Environmental Baseline Survey (see L-6 depicted in Figure 3.16-1). Due to containers of asphalt, spilled asphalt at the plant site and on Riverside Drive, plant equipment, and scrap metal, this site is considered Category 6 (see description of Categories under Table 3.16-3) and is being addressed under the Defense Environmental Restoration Program for Formerly Used Defense Sites (GMP Associates, Inc. 1997).

3.16.4.4.3.1 Tinian Asphalt Drum Dump Site

A Defense Environmental Restoration Program for Formerly Used Defense Sites site, known as the "Tinian Asphalt Drum Dump Site" at Puntan Diaplo, has been identified at the western end of the runway at Tinian International Airport. Few details regarding the extent of possible contamination at this dump site are available; however, this site is believed to have resulted from military activities during the World War II era (Air Force 2012). This site is also identified as site L-6 in the 1997 Environmental Baseline Survey Report and shown in Figure 3.16-1. The 1997 report documented remnants of asphalt plant equipment, drums, and scrap metal at the site (GMP Associates, Inc. 1997).

3.16.4.4.3.2 Surplus Area – West Field

According to the U.S. Army Corps of Engineers, the Surplus Area-West Field site is suspected to contain containerized and non-containerized hazardous or toxic waste (U.S. Army Corps of Engineers 2012) and a soil removal action is recommended. Few details regarding the possible contamination at this site are available; however, this site is believed to be located in the vicinity of the Tinian International Airport and was deemed ineligible for remediation under the Formerly Used Defense Sites program (U.S. Army Corps of Engineers, personal communication, December 5, 2014).

3.16.4.4.4 Port of Tinian

In 1992, approximately 10,000 gallons (38,000 liters) of unleaded fuel were released at the Mobil bulk fuel storage facility (located in the vicinity of the proposed port improvements) as a result of tank bottom failure. Contamination of soils and groundwater was confirmed and remediation using a combination of in situ air sparging, free product recovery, and air stripping was implemented with quarterly groundwater monitoring.

3.16.4.4.5 Supply Route

Table 3.16-3 lists sites of environmental concerns that were identified by the 1997 Environmental Baseline Survey in the vicinity of the proposed supply route on Tinian (see Figure 3.16-1).

Table 3.16-3. Sites of Potential Environmental Concern within the Tinian Military Lease Area

Site	*Description/Materials and Location*	*Activities/Category*
R-1	World War II Fuel Tank Farm (located east of 8th Avenue south of the airport. Possible presence of ordnance)	Undetermined whether all fuel tanks were removed after World War II. Historical evidence suggests munitions may remain; this site is considered Category 5*
R-6	Tinian Solid Waste Facility	Unrestricted dumping of municipal, hospital and military waste in unlined disposal site. No monitoring daily cover, compaction or established boundaries. Category 6*
R-15	Bio Pacific Lease Area	Area was used during the 1980s for the experimental cultivation of sugar cane. Several chemicals including pesticides may have been used on the grazing land; therefore, this site is considered Category 6*
L-4	Tinian International Airport/post- World War II-era petroleum, oil, and lubricant products	The airport has a 1,500-gallon (5,700 liters) aboveground diesel storage tank inside a concrete containment berm and a 2,000-gallon (7,600-liter) aboveground diesel storage tank. Minor leaks of hydraulic fluid were probable, but at concentrations that do not require a removal or remedial response. Therefore, this site is considered Category 3*
L-6	World War II Asphalt Plant/ asphalt, end of Riverside Drive	Due to containers of asphalt, spilled asphalt at the plant site and on Riverside Drive, plant equipment, and scrap metal, this site is considered Category 6*
L-7	World War II-era Service Aprons and Engineering Areas/petroleum, oil, and lubricant products, north of Tinian International Airport	Occasional small spills of petroleum products were likely, but at concentrations that do not require a removal or remedial response. Therefore, this site is considered Category 3*

Legend: *Category 1: Areas where no storage or disposal of hazardous substances or petroleum has occurred.
Category 2: Areas where only storage of hazardous substances has occurred, but no release or disposal has occurred.
Category 3: Areas where storage or release of hazardous substances has occurred but at concentrations that do not require a removal or remedial response.
Category 4: Areas where storage or release of hazardous substances has occurred and all removal or remedial actions to protect human health and the environment have been taken.
Category 5: Area where storage or release of hazardous substance has occurred, and removal actions are underway, but all required remedial actions have not yet been taken.
Category 6: Area where storage or release of hazardous substances has occurred, but required actions have not yet been implemented.
Category 7: Area not evaluated or that requires additional evaluation.

Sources: GMP Associates, Inc. 1997; DoN 2014b; J. Victorino, NAVFAC Pacific, personal communication, 2014.

3.16.4.4.5.1 Tinian Solid Waste Facility

Solid waste on Tinian is currently transported by residents and business entities to an open disposal site west of 8th Avenue and south of the Tinian International Airport. This site is unlined and does not comply with Resource Conservation and Recovery Act Subtitle D regulations governing landfills. The CNMI Department of Public Works is required to maintain the existing Tinian Solid Waste Facility in accordance with an Administrative Order issued by the CNMI Division of Environmental Quality, which requires the application of daily cover material and prohibits burning wastes, among other operational requirements. The Administrative Order was issued in 2010 as a cease-and-desist action serving to document the findings of violations of the CNMI solid waste regulations (DoN 2014).

3.16.5 Pagan

Land uses on Pagan have varied historically from being largely uninhabited until the early 1920s, to predominant agricultural use throughout the 1920s and 1930s, and then to predominant military use during World War II. Following World War II, small-scale U.S. military activity remained until the 1950s at which point small scale agricultural use resumed. The remaining 53 residents were evacuated from Pagan due to the large-scale eruption of Mount Pagan in 1981. This eruption covered half of the runway and destroyed much of Shomushon. Many of the structures were covered by ash (over 3 feet [1 meter] thickness) and lava (over 30 feet [9 meters] thickness). Any existing hazardous materials, hazardous wastes or expended military munitions may have been covered/destroyed. Since that time the island has not been resettled or used for industrial or agricultural purposes. This type of information provides a historical context from which to evaluate the use of hazardous substances over time on the island. A detailed summary of the land uses on Pagan as it pertains to the historical use of hazardous substances can be found in Appendix R, *Hazardous Materials and Waste Technical Memo.*

3.16.5.1 Hazardous Materials

Currently, Pagan is uninhabited, and therefore no hazardous materials are used on the island. Ongoing land uses on Pagan are limited to visitor encampments and ecotourism trips. Hazardous materials associated with these uses would be limited to small volumes of fuel for vehicles and cooking. These materials would likely be consumed or brought back to their point of origin and would not be stored or disposed of on Pagan.

3.16.5.2 Toxic Substances

Historic land uses have left remnants of equipment, structures, and buildings on Pagan that have the potential to contain toxic substances such as asbestos-containing materials, lead-based paint, and polychlorinated biphenyls.

All units and surficial deposits of Mount Pagan, where known, are composed of either basalt or basaltic andesite or a combination of the two (U.S. Geological Survey 2006). Basalt has relatively little uranium and is unlikely to generate high radon levels (Brill et. al. 1994).

3.16.5.3 Hazardous Waste

Currently, Pagan is uninhabited and, therefore, no hazardous wastes are generated on the island. Ongoing land uses on Pagan are limited to visitor encampments and ecotourism trips. These uses are not likely to result in the generation of hazardous wastes.

3.16.5.4 Potentially and Confirmed Contaminated Sites

United States and Japanese military activities during World War II potentially resulted in the presence of hazardous substance contamination and/or munitions and explosives of concern on Pagan. Based on review of historical documentation, the *Final Historical Ordnance Assessment Study, Pagan, Commonwealth of the Northern Mariana Islands* (DoN 2013a) estimated a determination of areas on Pagan with moderate to high or low probability of munitions and explosives of concern and munitions potentially presenting an explosive hazard presence based on the historical locations of Japanese defense positions. See Figure 3.16-2 for a map showing the probability of munitions and unexploded ordnance of concern on Pagan.

Historic uses on the island include residential, agricultural, and military operations that may have utilized hazardous materials. The storage and disposal of hazardous materials on Pagan was not determined, therefore, traces of these materials may still be present on the island.

Other potentially contaminated sites include the historical Japanese Imperial Army infrastructure at the former Japanese airfield and in the foothills of Mount Pagan, including an aircraft hangar, bunkers, gun placements, fuel dumps, a mining camp, and a pier on Shomshon Bay.

Table 3.16-4 lists potential historical hazardous waste sites and munitions and explosives of concern areas at on Pagan (DoN 2013a).

Table 3.16-4. Potential Historical Hazardous Waste Sites and Munitions and Explosives of Concern Areas on Pagan

Site	*Description/Materials and Location*	*Status*
Former Japanese Airfield and Surrounding Area	Potential unexploded ordnance and potential munitions constituents in soils from World War II munitions storage and aerial bombardment of primary military targets on and surrounding the airfield. World War II activities could also include potential storage and use of petroleum, oils, and lubricants, and petroleum residues that may be present in soils.	According to the *Final Historical Ordnance Assessment Study Pagan, Commonwealth of the Northern Mariana Islands* (DoN 2013a) the area around the airfield and support facilities is considered to have a moderate to high level of probability of munitions and explosives of concern presence, requiring "On-call" unexploded ordnance contractor support.
Foothills of Mount Pagan	Potential unexploded ordnance and potential munitions constituents in soils from World War II aerial bombardment of non-military targets during air raids.	According to the *Final Historical Ordnance Assessment Study Pagan, Commonwealth of the Northern Mariana Islands* (DoN 2013a) non-military positions were also bombed and are considered to have a moderate to high level of probability of munitions and explosives of concern presence, requiring "On-call" unexploded ordnance contractor support.

Source: DoN 2013a.

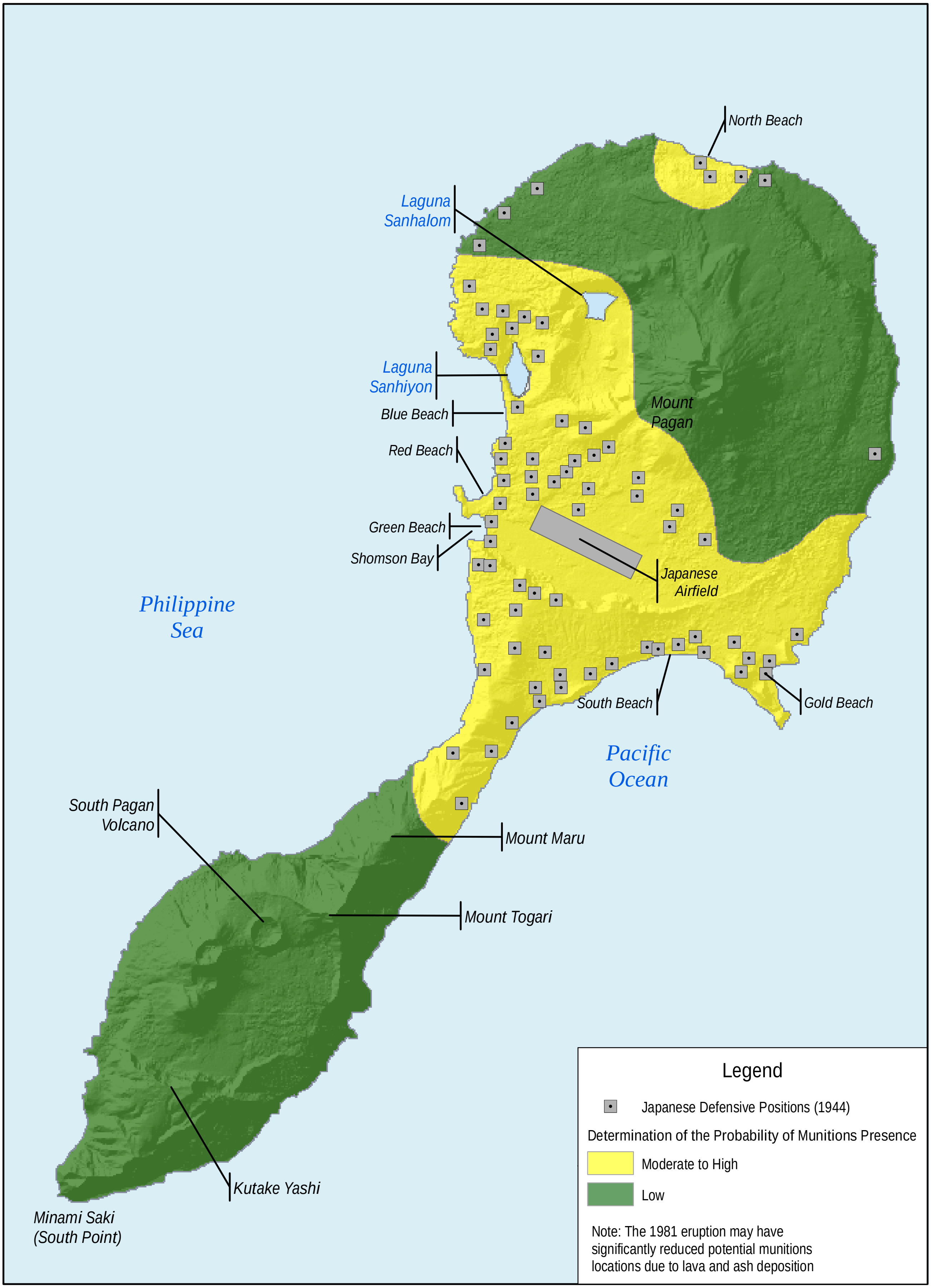


Figure 3.16-2
Probable Munitions Presence Locations

Source: DoN 2013c

3.17 PUBLIC HEALTH AND SAFETY

Section 3.17 describes the existing public health and safety issues on Tinian and Pagan. Public health and safety refers to the health and well-being of the general public living on or visiting the region of influence. The region of influence includes the airspace, land areas, and marine waters (sea space) of Tinian and Pagan. The evaluation of health and safety in this EIS/OEIS addresses issues related to the capacity of emergency response organizations (i.e., police, fire, medical) to respond to emergency as needed in the region of influence is provided in Section 3.15, *Socioeconomics and Environmental Justice*.

3.17.1 Definition

Health and safety issues addressed in this EIS/OEIS include: risks of public exposure to military operations, and local/regional emergency response matters. Risks related to military operations may be related to flight safety, ground training munitions-related hazards, energy hazards, and marine safety. Flight safety issues may include potential accidents resulting from mid-air collisions, collisions with manmade structures or terrain, weather-related accidents, mechanical failure, pilot error, or wildlife-aircraft collisions. Ground safety issues may be related to vehicle and maneuvers, munitions use, range maintenance activities, traffic safety, and other military activities. Energy hazards may include human exposure to electromagnetic frequencies and lasers as well as hazards that electromagnetic radiation may present to storage and use of munitions. Marine safety issues may include potential accidents resulting from vessel collisions with other vessels or wildlife, vessels running aground, munitions danger zones over the water, and other military activities.

3.17.2 Regulatory Framework

The information presented in this section focuses on the health and safety of the general public. The health and safety of military personnel is not addressed in this EIS/OEIS. Military personnel would follow health and safety requirements as outlined by Department of Defense regulations in order to minimize the risk to their health and safety.

The Marine Corps Safety Program (DoN 2011a) governs Marine Corps policies, responsibilities, and procedures to protect and preserve Marine Corps personnel and property against accidental injury or loss of life. Other U.S. military services (i.e., the Navy, Army, and Air Force) have similar safety programs that apply to their operations and would be followed when undertaking their operations. Federal and CNMI laws, rules, and regulations that are applicable to protecting public health and safety are detailed in Appendix E, *Applicable Federal and Local Regulations*. Marine Corps policies include:

- The Marine Corps practices Operational Risk Management as specified in Office of the Chief of Naval Operations Instruction 3500.39C (DoN 2010a)
- Marine Corps Order 3500.27B (DoN 2011b)

Safety risks to construction personnel are addressed under 29 CFR 1910 et seq., *Occupational Health and Safety Standards*. Due to adherence to these regulations, health and safety of construction personnel is not addressed further in this EIS/OEIS.

3.17.3 Methodology

Existing procedures for ensuring public health and safety associated with military training activities were derived from U.S. military standard operating procedures related to the use of specific training areas, ranges, and facilities within the region (Guam and the CNMI). These standard operating procedures are applicable to military units of all Services (personal communication with Mark Cruz, Joint Region Marianas). Historical ordnance assessments conducted provide a general assessment for the probability of encountering unexploded ordnance and historically discarded munitions on Tinian and Pagan (DoN 2010b, 2013a).

3.17.4 Tinian

As summarized in Chapter 1, *Introduction*, Section 1.4, since 1983, the U.S. government has leased approximately two-thirds of the island (i.e., the Military Lease Area) (Figure 3.17-1). There are no homes within the Military Lease Area. The Military Lease Area is unfenced except for a formerly used unexploded ordnance area known as the Tinian Mortar Range (described in Section 3.17.4.2.3, *Unexploded Ordnance and Historically Discarded Military Munitions*), fences associated with cattle ranging operations, and perimeter fencing around the International Broadcasting Bureau.

3.17.4.1 Aircraft Operations

Civilian and military airspace and air transportation facilities are described in Section 3.6, *Airspace*, and 3.13, *Transportation*, respectively.

3.17.4.1.1 Civilian Activities

There are no control towers for aircraft on Tinian. Coordination of flight and ground taxi is accomplished through the Saipan control tower and via a common traffic advisory frequency. Aircrews use the common frequency to deconflict their arrivals and departures, providing location and intent to other aircraft in the vicinity. This procedure is applicable to both civilian and military air traffic. Airport lighting and aircraft rescue and firefighting capabilities are available at Tinian International Airport during field operating hours. Aircraft refueling services are not normally available at Tinian International Airport (Federal Aviation Administration 2014).

Figure 3.17-1
Tinian Military Lease Area

Tinian International Airport has two Runway Protection Zones, one at either end of the runway, which are to be kept clear of all above-ground objects and all facilities supporting incompatible activities. Runway Protection Zones are established to enhance the protection of people and property on the ground under the flight approach zones. This is best achieved through airport owner control over Runway Protection Zones. Control is preferably exercised through the acquisition of sufficient property interest in the Runway Protection Zones and includes clearing Runway Protection Zones areas (and maintaining them clear) of incompatible objects and activities. The Tinian Runway Protection Zones are trapezoidal in shape and centered about the extended runway centerline, at both ends. At 2,700 feet (820 meters) from the runway edge, the Runway Protection Zones width is 1,750 feet (530 meters), and then narrows toward the runway edge (Federal Aviation Administration 1999, 2012).

3.17.4.1.2 Military Activities

Military aircrews currently use both the Tinian International Airport and Tinian's North Field for training. Recent exercises have centered on fixed-wing aircraft arrested landings and refueling at the Tinian International Airport and expeditionary landing and take-off operations by cargo aircraft at North Field. Other military activities include humanitarian assistance/disaster relief practice, off-loading of cargo, and helicopter night vison landings using North Field as a landing zone. Aircraft-delivery of munitions does not occur.

At its aviation facilities, the Department of Defense normally establishes Accident Potential Zones, which depict areas with a significant or measurable potential (not the probability) for accidents. Tinian International Airport does not have any associated Accident Potential Zone.

Military air operations within the local Tinian airspace are conducted under Federal Aviation Administration visual flight rules, which specify certain flight altitudes based on direction of flight. Military and civilian activities are deconflicted based primarily on a see-and-avoid concept, and the use of a common frequency for local situational awareness. Air traffic control personnel at the Saipan tower provide additional information as requested. The U.S. military standard operating procedures specify aircraft training flight restrictions over certain areas within the Military Lease Area associated with bird habitat. There is currently no Special Use Airspace for Tinian.

3.17.4.1.3 Aircraft-related Accidents

The Federal Aviation Administration has recorded three safety-related incidents at Tinian International Airport over the past 10 years (Federal Aviation Administration n.d.-a). All involved small, single engine air taxi/commuter aircraft and were related to taxi or take-off from the airport. In July 2004, an aircraft experienced a landing gear bolt failure on landing, with minor aircraft damage. The flight incident report indicates no personal injury. In May 2012, an aircraft lost power on initial take-off and sustained minor damage. The flight incident report indicates no personal injury. Personal accounts from passengers on this flight indicate they sustained various injuries (De Guzman 2012). In October 2013, an aircraft sustained substantial damage when it struck a raised concrete berm after failing to maintain its position on the taxiway. The flight incident report indicates no personal injury.

Recent aircraft incidents occurring on Tinian (but not at Tinian International Airport) include a fatal crash near Mount Lasso on the northern portion of Tinian, at night. In October 2013, an air taxi aircraft that had departed from Tinian International Airport en route to Saipan International Airport crashed, there were three survivors and four fatalities (Guerrero 2013). In November 2012, an air taxi aircraft departing Saipan International Airport bound for Tinian International Airport was substantially damaged when it crashed at the Saipan Airport. There was one fatality, five individuals seriously injured, and one sustaining minor injury (National Transportation Safety Board 2012; Flight Safety Foundation 2012).

There have been two reported bird strike incidents, occurring during take-off and climb-out from Tinian International Airport. Both were air taxi aircraft and neither sustained serious damage (Federal Aviation Administration n.d.-b). A Wildlife Hazard Assessment was completed for Tinian International Airport (U.S. Department of Agriculture 2008) that recommended a Wildlife Hazard Management Plan be developed. A Bird Aircraft Strike Hazard Plan, implemented on Department of Defense installations used to help prevent or reduce bird strikes by aircraft) does not exist for Tinian International Airport.

3.17.4.2 Ground Operations

3.17.4.2.1 Civilian Activities

As described in Section 3.15, *Socioeconomics and Environmental Justice*, the Tinian Department of Public Safety indicated that, as of February 2014, they were staffed by 17 police officers (a ratio of 6 officers for every 1,000 residents) and 11 firefighters (a ratio of 3.8 firefighters per 1,000 residents) (CNMI Department of Public Safety 2013a). The condition of the Department of Public Safety's building was noted as fair and able to accommodate current personnel and operations (DoN 2014). In 2013, 86 criminal offenses were recorded in San Jose; there were 30 thefts or burglaries, 15 incidences of disturbing the peace, and 15 assaults (CNMI Department of Public Safety 2013b). Descriptions of the police divisions, fire divisions, and health services are presented in Section 3.15, *Socioeconomics and Environmental Justice*.

As described in Section 3.13, *Transportation,* ground transportation facilities on Tinian include the existing road network (primarily developed in 1944 to accommodate the U.S. military), with limited designated bicycle paths, and isolated sidewalks along roads within San Jose. Many of the existing roads throughout Tinian are in poor condition.

The Commonwealth Department of Public Safety, Highways Safety Office develops, coordinates, and promotes safety programs and provides policy and public awareness on highway safety. Highway safety, in general terms, includes the following initiatives: reduction of traffic crashes, impaired driving traffic-related injuries and fatalities, and property damages as a result of a traffic collision; and improving pedestrian and motorcycle safety, community outreach, occupant protection, child restraint, and emergency medical services. Under CNMI Public Law 3-61, §1 (§ 101), the Department of Public Safety, Police Traffic Services is the enforcement authority of all laws relating to traffic matters on the islands of Saipan, Tinian, and Rota.

The Department of Public Services division on Tinian is required to submit a monthly traffic report. The report includes motor vehicle crashes, seat-belt usage, impaired driving, speeding, pedestrian, and traffic fatalities/injuries, and other data related to traffic safety. One of the five fatal collisions reported within the CNMI in 2010 occurred on Tinian. No other fatal collisions occurred on Tinian during the 5-year period from 2008 through 2012. Of the 7,332 collisions that occurred during the 5-year period, 94% resulted in property damage, 5% resulted in injury, and 1% resulted in fatality. Alcohol was a factor in 63% of the 27 fatal collisions. None of the collisions reported during the 5-year period resulted in a bicyclist or motorcyclist death. The 5 year (2008-2012) collision summary for the CNMI is summarized in Table 3.17-1.

Table 3.17-1. CNMI Five Year (2008-2012) Collision Summary

Data Element	*2008*	*2009*	*2010*	*2011*	*2012*	*5-Year Average*
Total Collisions	1,630	1,868	1,212	906	1,717	1,466
Property Damage	1,569	1,694	1,207	853	1,599	1,384
Injury Collisions	52	167	0	51	114	77
Fatal Collisions	9	7	5	2	4	5
Pedestrian Fatalities	3	2	2	0	0	1
Bicycle Fatalities	0	0	0	0	0	0
Motorcycle Fatalities	0	0	0	0	0	0

Legend: Total Collisions includes Property Damage Only, Injury Collisions, and Fatal Collisions. Pedestrian, bicycle, and motorcycle fatalities are non-occupant fatalities. All other fatalities are occupant fatalities.
Source: CNMI Department of Public Safety, Highways Safety Program 2013.

The Military Lease Area is open to the public at the discretion of the military, generally during times when U.S. military training is not occurring. Activities occurring in the Military Lease Area include daily use of the International Broadcasting Bureau, cattle grazing lots, all-terrain vehicle off-roading, and visitation to other locations (e.g., historic sites, beaches) by visitors and residents.

Potential public exposure to electromagnetic radiation hazards (as defined by American National Standards Institute) associated with the radio transmission activities of the International Broadcast Bureau is a public health and safety concern. The area of potential exposure is largely contained within the International Broadcasting Bureau's fenced boundaries. The risk of exposure is minimized through public exclusion from the fenced boundaries.

3.17.4.2.2 Military Activities

Military operations and training have occurred in the Military Lease Area, (i.e., northern two-thirds of the island) since the 1940s. Public safety is a concern within the Military Lease Area because the public visits numerous historic and scenic sites within the Military Lease Area. This includes North Field National Historic Landmark, beaches, scenic viewpoints, and other points of interest. The public also uses the Military Lease Area for hunting, fishing, and plant gathering when the military is not conducting training. Additional details on civilian use of the Military Lease Area are provided in Section 3.7, *Land Use*, Section 3.8, *Recreation,* and Section 3.15, *Socioeconomics and Environmental Justice.*

The military notifies the CNMI Government and the Tinian Mayor's office 45 days in advance of scheduled training in the Military Lease Area. To ensure public safety, the area is cleared of unauthorized civilian personnel and cordoned off prior to the start of potentially hazardous training operations. Traffic control points are located on 8th Avenue and Broadway Avenue to prevent unauthorized access (DoN 2013b).

Training maneuvers and limited live-fire training activities follow range, aviation, and munitions safety standard operating procedures. During hazardous training activities such as maneuvers and small arms fire involving live and inert munitions, a qualified range safety officer is always on duty. Range safety officers ensure 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 that the training area is clear of live rounds.

3.17.4.2.3 Unexploded Ordnance and Historically Discarded Military Munitions

Due to the historic use of Tinian during World War II, unexploded and historically discarded military munitions are known to exist within the Military Lease Area and may exist in the Tinian Harbor and other civilian locations. There are confirmed reports of the use of artillery, mortars, and tanks, in addition to naval gunfire and aircraft bombs, along with common infantry weapons in the historical record of the battle fought on the island by advancing U.S. military forces against defending Japanese forces in World War II (i.e., the Battle of Tinian). In response, the U.S. military, the U.S. Environmental Protection Agency, and the CNMI have established ordnance and munitions mitigation and cleanup activities under a variety of programs. These programs are summarized in Appendix R, *Hazardous Materials and Waste Technical Memo*. In addition, the community is routinely advised not to handle or step on any suspicious items, and to report such findings immediately. Unexploded ordnance and historically discarded military munitions have been discovered periodically since the end of World War II. There have been no reported incidents of serious injury or death related to unexploded ordnance and historically discarded military munitions on Tinian in the past 50 years. Clearances for unexploded military munitions have been conducted. Unexploded ordnance and historically discarded military munitions are identified to determine disposal requirements. Normally, an unexploded ordnance and historically discarded military munitions item may be removed offsite for disposal. If unstable, it may need to be blown in place. This determination is made by qualified military explosive ordnance disposal technicians.

Although portions of the island have been developed, unexploded military munitions may still be present. A historical ordnance assessment (DoN 2010b) was completed in 2010 and categorized areas of Tinian based on the probability (low, medium, and high) of such ordnance and munitions being present. The assessment was limited to current U.S. military properties where military construction may occur, which included the Military Lease Area (see Figure 3.16-1, Section 3.16, *Hazardous Materials and Waste*).

Medium and high probabilities of unexploded ordnance and the presence of historically discarded military munitions are the general risk assessment categories assigned to the Military Lease Area on Tinian (DoN 2010b). Light ordnance (e.g., hand grenades, projected grenades, and light mortars) likely comprise a large majority of unexploded ordnance that could be found within 4 feet (1.2 meters) of the ground surface. Heavier munitions (e.g., artillery projectiles, naval projectiles, and aerial bombs) can likely be found at greater depths since their force of impact tends to bury them deeper below the ground surface if they fail to detonate. In addition, there is a possibility of encountering historically discarded military munitions from either individual losses of ammunition or abandoned munitions. The northern portion of the Military Lease Area is considered a high-probability area due to the intensive pre-invasion bombardment and the intensive combat associated with the amphibious training that occurred during World War II. The southern portion of the area is assessed as medium probability because movement through this area was relatively rapid after the capture of Mount Lasso (DoN 2010b). Section 3.16, *Hazardous Materials and Waste* (Table 3.16.1) provides a description and location of known sites containing either unexploded ordnance and/or historically discarded military munitions.

A portion of the Battle of Tinian site was used as a military training range (Tinian Mortar Range) from 1945 to 1994. The former training range is located along the road north of Unai Chiget and south of Blow Hole, which is fenced off and marked as containing unexploded ordnance.

The Historical Ordnance Assessment (DoN 2010b) did not take into account that the majority of the Military Lease Area was bulldozed during World War II to develop airfields and supporting infrastructure. Despite prior development activities on the island, there is no record of unexploded ordnance surface or subsurface clearance having been performed. Unexploded ordnance and historically discarded munitions could be present in undeveloped areas and at depths below previous earth disturbing activities.

3.17.4.3 Marine Operations

3.17.4.3.1 Civilian Activities

The Port of Tinian is used by the public, commercial and supply barges, as well as U.S. Coast Guard vessels. The current port docking facilities consist of a main wharf that is approximately 2,000 feet (610 meters) long with a usable length of 1,600 feet (488 meters). The harbor has no fixed shore-side cranes or lighting. West of the main wharf are two finger piers, both are in complete disrepair and unusable.

As described in Section 3.8, *Recreation* and Section 3.15 *Socioeconomics and Environmental Justice*, waters to the northwest of Tinian are used for fishing by the Saipan commercial fishing fleet. The water is notably calmer on the western side of Tinian, which makes it more attractive for fishing than the eastern side. Additionally, shorelines are used for recreational fishing, primarily located south of Dump Coke South and north of the Two Coral (Turtle Cove) diving sites on the west side of Tinian.

3.17.4.3.2 Military Activities

North of the main wharf and adjacent to the current public dock and ramps is an old concrete boat ramp that has been used by military Amphibious Assault Vehicles. This ramp has an adjacent grassy staging area suitable for storing vehicles brought ashore, or for staging, cleaning, and reloading (U.S. Commander Pacific Fleet 1999). There are no recurrent military operations within waters surrounding Tinian. There is currently no marine danger zones associated with Tinian.

3.17.4.3.3 Marine Vessel Accidents

The Lloyd’s Maritime Information Service Casualty Register collects data on and reports vessel casualties. Vessel casualties consist of accidental groundings and shipwrecks. In 1997 the South Pacific Regional Environment Programme published a research paper which included a list of all casualties in the South Pacific between 1976 and 1996. During this 20-year period there were seven documented wrecks or groundings in the vicinity of the Northern Marianas. Four of the seven documented events involved heavy weather of typhoons. Only one vessel casualty was recorded in the waters surrounding Tinian. In August 1986, a refrigerated cargo ship carrying frozen fish stranded while entering the Tinian Harbor. The hold and engine room of the ship flooded (Preston et al. 1997). Based on a review of National Transportation Safety Board, Marine Accident Reports issued since 1996, there have been no accidents reported in the waters surrounding Tinian, during the past 18 years (National Transportation Safety Board 2014).

3.17.5 Pagan

3.17.5.1 Aircraft Operations

The population of Pagan was evacuated to Saipan in May 1981 due to the eruption of Mount Pagan and has not been formally re-inhabited since. The active volcano located on Northern Pagan is monitored by the U.S. Geological Survey via satellite. Procedures and support during natural disasters and area advisories to inform travelers of safety risks is provided by the CNMI Homeland Security and Emergency Management Office. Temporary visitors to Pagan on approved visits generally travel by private or chartered boats or aircraft (i.e., helicopters) and are required to have the ability to contact the CNMI Homeland Security and Emergency Management Office.

3.17.5.1.1 Civilian Activities

As described in Section 3.6, *Airspace* and Section 3.13, *Transportation*, Pagan airfield is an unattended/uncontrolled World War II-era, grass field, truncated at one end by a 30-foot-thick lava flow. It has no airport control tower, communications or other airport facilities. There are no scheduled flights. These conditions limit the type of aircraft that can land there, generally small aircraft and helicopters. It is used as an evacuation airfield for medical emergencies in the Northern Islands, coordinated via satellite phone. There are no recorded wildlife strike events at or near the Pagan airfield and no published Runway Protection Zones.

3.17.5.1.2 Military Activities

Limited military training has occurred in recent years on Pagan as part of the Forager Fury and Forager Fury II training exercises. The training consisted of 1-day combat search and rescue training missions in the northern section of Pagan. A rotary-wing aircraft (MV-22 Osprey) was utilized to extract personnel from a simulated downed aircraft. No live-fire training has occurred as part of these activities. There is currently no Special Use Airspace for Pagan.

3.17.5.2 Ground Operations

3.17.5.2.1 Civilian Activities

There is no resident population on Pagan but people visit Pagan for recreation and resource gathering. Visitors have been observed using temporary encampments to over-night on the island. Abandoned livestock have become feral and roam the entire island. The Department of Public Safety maintains no personnel or facilities on Pagan. There is no information available to suggest that accidents and safety are a current issue.

3.17.5.2.2 Military Activities

No military ranges exist on Pagan, with military operations confined to recent, 1-day, non-live-fire, aviation events described in Section 3.17.5.1.2, *Military Activities*.

3.17.5.2.3 Unexploded Ordnance and Historically Discarded Military Munitions

As describe in Section 3.16, *Hazardous Materials and Wastes,* Pagan was a Japanese Imperial Army stronghold that was continuously bombed from June 1944 through September 1945. There is the possibility that unexploded ordnance and/or historically discarded military munitions could be encountered throughout the island. The historic ordnance study conducted in support of this EIS/OEIS (DoN 2013a) summarized the probability of the presence of unexploded ordnance (i.e., unexploded munitions and explosive hazards) on Pagan. In this study, the island is described in terms of moderate-to-high-potential and low-potential hazard areas. Areas with moderate-to-high-potential were identified by historical records indicating locations of military importance based on the level of historic military use of the area. Low-potential areas include areas where there is no evidence or documentation of military use and areas that lacked structures during World War II (i.e., the entire southern portion of Pagan) (see Figure 3.16-2, Section 3.16, *Hazardous Materials and Waste*).

3.17.5.3 Marine Operations

3.17.5.3.1 Civilian Activities

There is no operable pier or port facilities on Pagan and there are no regularly scheduled marine operations. Ships that have travelled to Pagan have anchored off the northwestern shore, and personnel have used small boats to come ashore. However, as described in Section 3.8, *Recreation,* there are currently two tour options being offered for Pagan: Pagan ecotour adventure and the Silver Explorer cruise ship. In September 2014, the Silver Explorer cruise ship anchored and shuttled people between the ship and Pagan for a day trip nature excursion before sailing on to Saipan and Tinian.

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3.17.5.3.3 Marine Vessel Accidents

As reported by the South Pacific Regional Environment Programme from data compiled by the Lloyd's Maritime Information Services Casualty Register, during the 20-year period from 1976 to 1996 there were no reported vessel casualties in the waters surrounding Pagan (Preston et al. 1997). Based on a review of National Transportation Safety Board, Marine Accident Reports issued since 1996, there have been no accidents reported in the waters surrounding Pagan, during the past 18 years (National Transportation Safety Board 2014).

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