

## 1 Invertebrates

### 2 Gastropods

3 **Humped tree snail.** Early partulid tree snail surveys by Crampton (1925) and Hopper and Smith (1992)  
4 did not survey locations inside the NMS except for the Mount Alifan area. The Guam tree snail was  
5 detected in the west-central highlands near Mount Alifan along with two other species, the humped tree  
6 snail and the newly described Mount Alifan tree snail (*Partula salifana*). Extensive surveys by Hopper  
7 and Smith (1992) on 1989 failed to detect any living partulid tree snails at this location. Surveys  
8 conducted in 2009 in the NMS found dead, weathered shells of humped tree snails in the Alamogosa  
9 Springs area. No live humped tree snails were found.

10 **Guam tree snail.** Early partulid tree snail surveys by Crampton (1925) and Hopper and Smith (1992) did  
11 not survey locations inside the NMS except for the Mount Alifan area. The Guam tree snail was detected  
12 in the west-central highlands near Mount Alifan along with the humped tree snail and the Mount Alifan  
13 tree snail. Extensive surveys by Hopper and Smith (1992) in 1989 failed to detect any living partulid tree  
14 snails at this location. Surveys conducted in 2008 found two populations of Guam tree snails along Kitts  
15 Road on the NMS (Smith et al. 2008) (see **Figure 4-14**).

16 **Mount Alifan tree snail.** Early partulid tree snail surveys by Crampton (1925) and Hopper and Smith  
17 (1992) did not survey locations inside the NMS except for the Mount Alifan area. It was at the Mount  
18 Alifan site that Crampton described a new species of partulid tree snail, the Mount Alifan tree snail. This  
19 species was subsequently found and verified by Abbott in 1945 and by Langford in 1946 (Hopper and  
20 Smith 1992). The Mount Alifan tree snail was found to be restricted to the west-central highlands of  
21 Guam in the vicinity of Mount Alifan. Extensive surveys for the species by Hopper and Smith (1992) in  
22 1989 failed to detect this species and it is assumed to be extinct.

### 23 **Flora**

24 **Tree fern.** The tree fern *Cyathea lunulata* was observed in the NMS during vegetation surveys conducted  
25 in 1989 (BioSystems Analysis, Inc. 1989). This tree fern is not a federally listed species, but GovGuam  
26 lists the species as endangered.

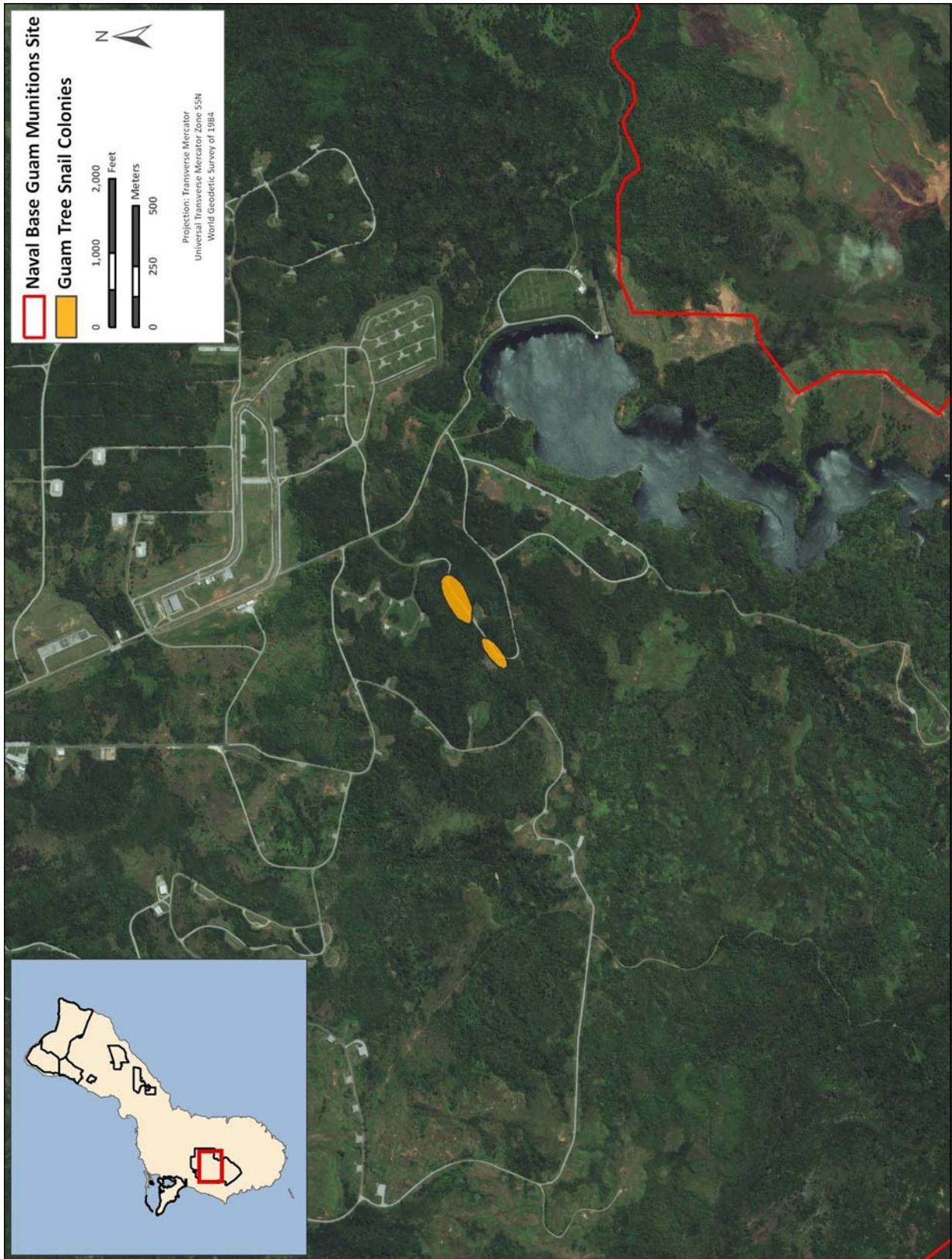
#### 27 4.3.2.6 Invasive Species

### 28 **Flora**

29 Common invasive tree species within the ravine forests on the NMS include betelnut palm, *Vitex*, bay rum  
30 tree, and limeberry (NAVFAC Pacific 2010b). Coconut and betelnut palms are common in the forested  
31 wetlands on the NMS (NAVFAC Pacific 2010b). Erosion in savanna communities is particularly evident  
32 within the NMS. Large areas of bare ground are present primarily due to wildland fires and destruction of  
33 vegetation by feral ungulates. The Navy has been working to reestablish vegetation in these areas with  
34 some success. Erosion within the savanna communities on the NMS creates areas vulnerable to the  
35 establishment of invasive plant species (U.S. Navy 2009).

### 36 **Fauna**

37 The Navy Munitions Site has a high population of invasive ungulates that impact vegetation communities,  
38 which in turn leads to habitat degradation, increased erosion, and reduced water quality (U.S. Navy 2009).  
39 Trend data compiled by the GDAWR indicate that the carabao population fluctuates; however, the trend  
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**Figure 4-14. Guam tree snail populations observed during surveys conducted in 2009 in NMS (Smith et al. 2008)**

1 from 1975 to 2000 suggested an increasing population on the NMS. Migration and immigration between  
2 the Navy Munitions Site herd and the Bubulao watershed herd is suspected. Immigration from recently  
3 escaped or released carabao from farms and villages also contributes to the herd size. Mortality in the  
4 carabao herds is low, although illegal poaching is common (U.S. Navy 2009). During the 2009 natural  
5 resources survey, ungulate activity on the NMS was evidenced by soil disturbance, such as rooting and  
6 browsing. Erosion, vegetation damage, and other disturbances from feral pigs, Philippine deer, and  
7 carabao are considered major problems at the NMS. The ungulate activity was especially conspicuous in  
8 the southern sector of the NMS, where active wallows, rooting, and live feral pigs were observed  
9 (NAVFAC Pacific 2010b). An Ungulate Management Plan has been developed for NBG including the  
10 NMS, and is included in **Appendix O** of this INRMP. The Ungulate Management Plan provides  
11 implementation strategies for management and control of ungulates on NBG and the NMS.

12 The carabao, deer, and pig populations on the Navy Munitions Site are causing widespread damage to  
13 natural resources around the Fena watershed. Resource damage includes accelerated soil erosion,  
14 trampling of native vegetation, creation of mud wallows, and degradation of water quality due to  
15 sedimentation, and fecal material. Facilities within the Navy Munitions Site are also being damaged by  
16 these species, including destruction of chain-link fences, erosion of protective soil covering ordnance  
17 storage bunkers and around utility poles, and damage to vehicles by charging. Grazing also results in the  
18 deposit of large quantities of fecal material on roadways and parking areas (U.S. Navy 2009). Natural  
19 regulation or environmental resistance of populations is low. Other than poachers and feral dogs, there  
20 are no predators of these species on Guam. Mortality of these species is likely caused by accidents and  
21 infections such as tetanus.

22 The island collared dove, black francolin, black drongo, blue breasted quail, and Eurasian tree sparrow  
23 occur on the NMS. These species are common, introduced, breeding residents in Guam (NAVFAC  
24 Pacific 2010b). During the 2008–2009 herpetofauna surveys performed on the NMS, seven introduced  
25 reptile and amphibian species were documented: curious skink, house gecko, brown treesnake, marine  
26 toad, eastern dwarf tree frog, crab-eating frog, and Gunther’s Amoy frog (NAVFAC Pacific 2010b). The  
27 continued widespread presence of the brown treesnake, curious skink, and other introduced amphibian  
28 species is of concern because of each species’ potential deleterious impacts on Guam’s native fauna  
29 (NAVFAC Pacific 2010b).

## 30 4.4 Naval Base Guam Telecommunications Site

### 31 4.4.1 General Physical Environment

#### 32 4.4.1.1 Climate

33 The climate at the NBG TS is the same as the climate for Guam as a whole. See **Section 4.1.1.1** for a  
34 description of the climate on Guam.

#### 35 4.4.1.2 Geology and Topography

36 NBG TS lies in the northern limestone structural province (see **Figure 4-1**). Elevations at the top of the  
37 plateau range from 500 to 600 feet (152 to 183 meters) above msl. At the edge of the plateau to the north,  
38 west, and east, steep cliffs drop down to an intermittent narrow coastal lowland terrace. The coastal areas  
39 range from 200 to 900 feet (61 to 274 meters), stretching from the base of the cliffs to the shore (see  
40 **Figure 4-2**). The substrate composes a heterogeneous mixture of limestone subtypes ranging from highly  
41 friable to well-cemented, depending on the depositional source (COMNAV Mariana 2001).

42 The coastline in this area includes two small, localized, but important, reef flats: one off Haputo Beach  
43 and the second inshore of Double Reef (also known as Pugua Patch Reef). The Haputo area is established  
44 as the HERA. The HERA has a diverse assemblage of marine habitats, including Double Reef. Double

1 Reef is the most striking offshore feature along the entire northwest coast of Guam because it is the  
2 beginning of a young barrier reef that breaks the ocean surface (Paulay et al. 2002). It lies on a shallow  
3 shelf that extends considerably farther from the coast than adjacent areas. The area around Double Reef  
4 is topographically heterogeneous because of variation created by reef growth and the erosive action of the  
5 large quantities of freshwater discharge from the islands freshwater aquifer (Paulay et al. 2002).

6 The ground surface elevation of NBG TS generally grades downward from east-northeast to  
7 west-southwest. A north-south trending fault pattern might control formation of the karst topography.  
8 Both the southwest and southeast portions of NBG TS have evidence of sinkhole formation and clay  
9 filling of sinkhole depressions (GHS 2008). There is a small valley oriented perpendicular to the cliffline  
10 in the northwestern area that might be enhancing the erosion of the Mariana Limestone along the cliffline,  
11 This could affect surface drainage patterns in the area (GHS 2008). Numerous solution cavities and caves  
12 exist within the porous limestone bedrock. Collapses of these subterranean cavities often form sinkholes  
13 (COMNAV Mariana 2001).

#### 14 4.4.1.3 Seismology

15 NBG TS overlies a minor fault line and is susceptible to earthquake events; however, the overall  
16 likelihood for the occurrence of landslides is generally low due to the lack of steep areas that contain soils  
17 vulnerable to slipping in seismic events. NBG TS has a low risk of liquefaction and tsunami inundation  
18 (JGPO 2010).

#### 19 4.4.1.4 Soils

20 The majority of the soils in NBG TS are shallow, well-drained soils occurring on limestone plateaus. The  
21 cliffline areas are primarily rock outcrops with very shallow and well-drained coralline limestone soils  
22 (COMNAV Mariana 2001). Nearly all of the plateau area consists of Guam cobbly clay loams with 3–7  
23 percent slopes (see **Figure 4-15**). Soils in the Guam-Urban Land complex and Guam-Yigo complex are  
24 also found at NBG TS.

#### 25 4.4.1.5 Hydrology

26 **Groundwater.** NBG TS overlies the Finegayan Subbasin of the NGLA (see **Section 4.1.1.5**).

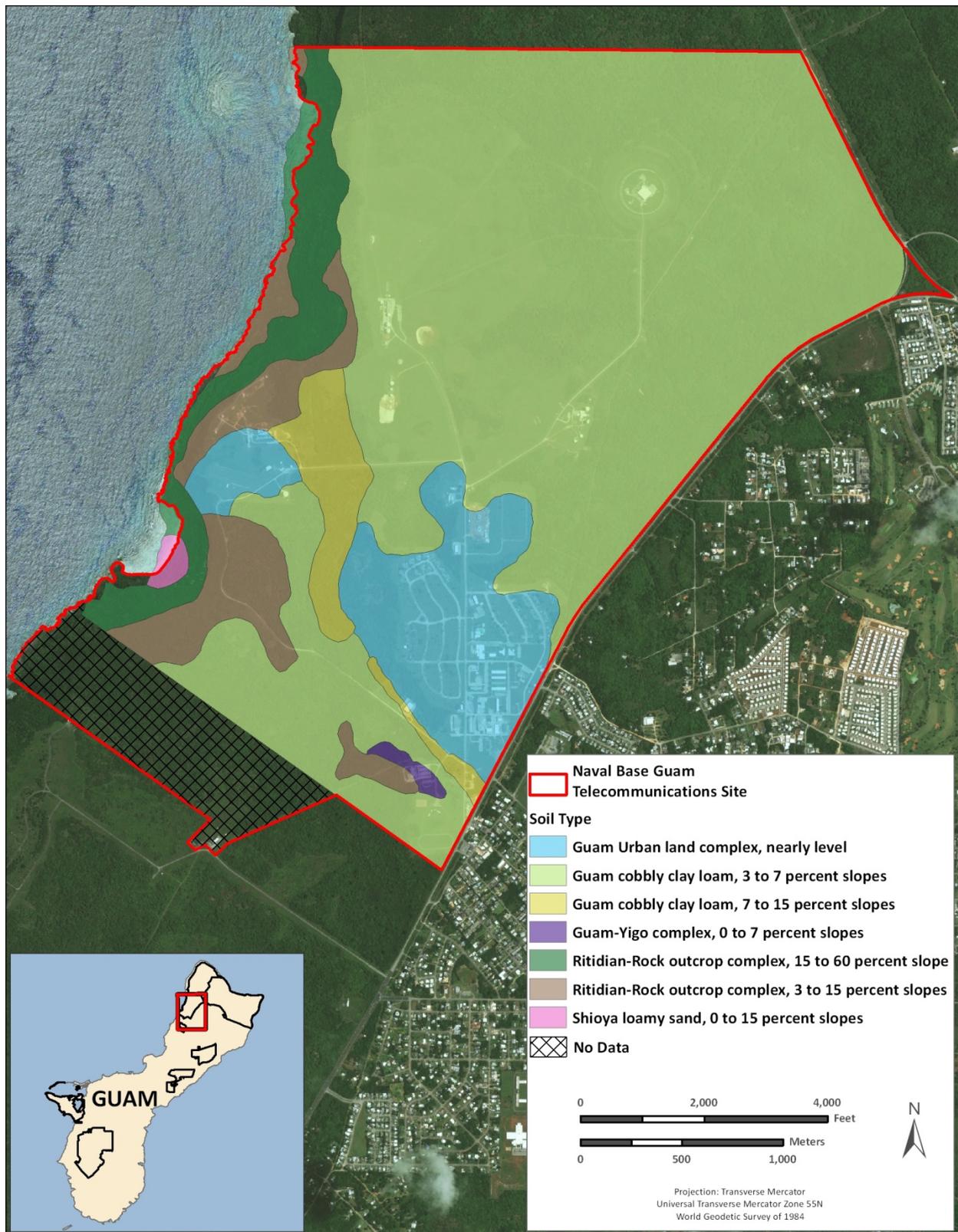
27 **Surface Water.** Because of the high permeability of the limestone substrate, no streams or other natural  
28 surface water drainage features occur on NBG TS.

### 29 4.4.2 General Biotic Environment

#### 30 4.4.2.1 Terrestrial Ecosystems

##### 31 **Flora**

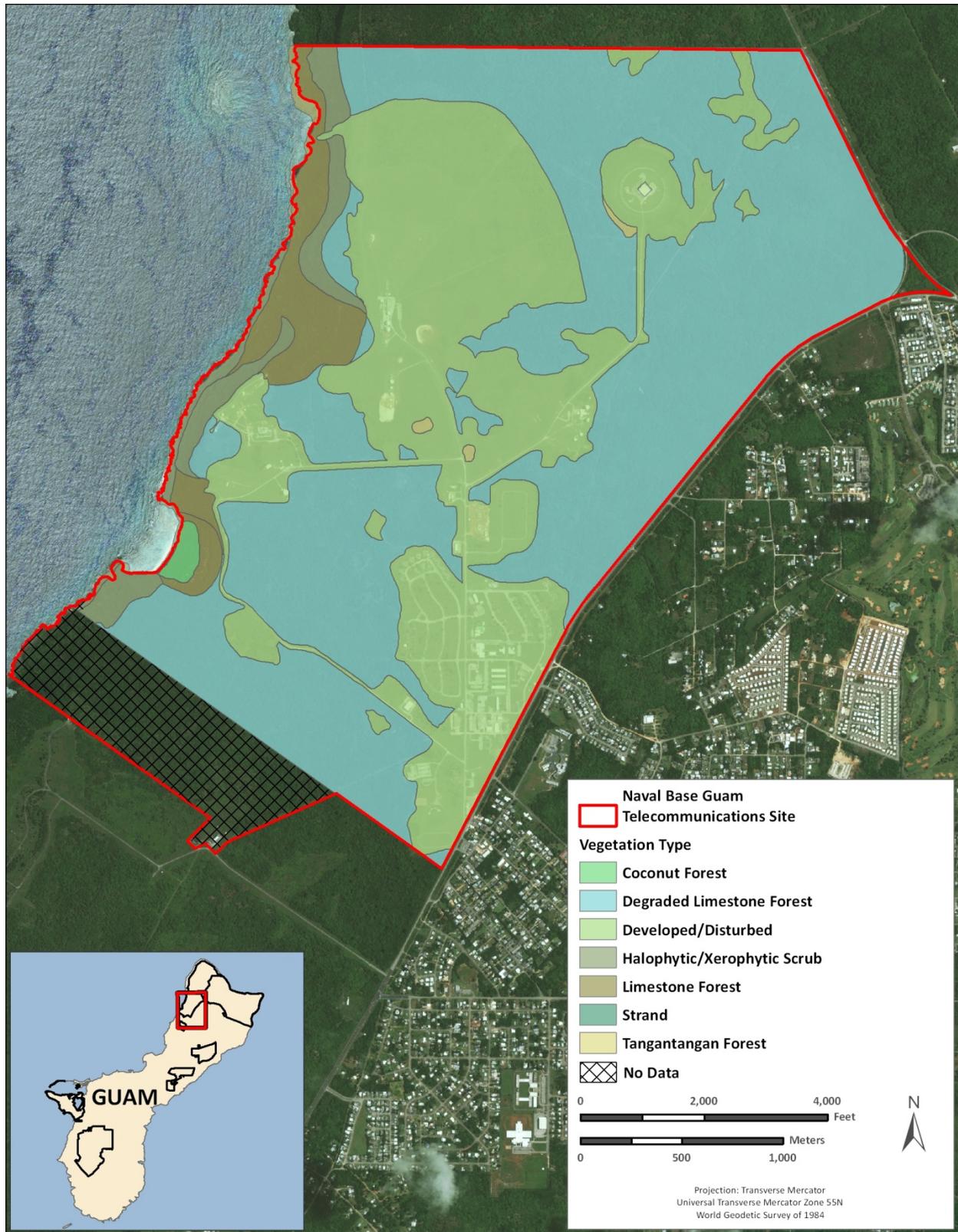
32 NBG TS is composed primarily of open areas (e.g., mowed grasslands) and secondary forest that is  
33 dominated by screwpine, *Guamia mariannae* (known as paipai in Chamorro), *Vitex*, and *Hibiscus*  
34 *tiliaceus* (NAVFAC Pacific 2010b). See **Figure 4-16** for a map of the vegetation communities occurring  
35 on NBG TS. Receiving antennas and other communications equipment require open areas to prevent  
36 interference from surrounding trees or buildings. As a result, much of NBG TS has been cleared and is  
37 maintained as mowed grasslands. This has allowed for the establishment of nonnative vegetation,  
38 primarily in the transition areas between the mowed grasslands and the forest areas. These nonnative  
39 plant species have also moved into the forested areas, especially along the roadsides where safety areas  
40 are maintained. This disturbance and increase in nonnative vegetation has contributed to a highly  
41 disturbed habitat and a severe decline in native forest species (U.S. Navy 2009).



Source: Data and Imagery provided by NAVFAC GRC Marianas and Air Force GeoBase

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**Figure 4-15. Soils on Naval Base Guam Telecommunications Site**



2 **Figure 4-16. Vegetation Communities on Naval Base Guam Telecommunications Site**

1 Three vegetation types were described on NBG TS North (previously called Finegayan North) in 2008:  
2 limestone forest, coconut grove, and disturbed/weed community (see **Figure 4-16**) (NAVFAC Pacific  
3 2010b). The disturbed/weed plant community occurs at forest edges and in patches within the forest  
4 (NAVFAC Pacific 2010b). The predominant vegetation community in NBG TS South is disturbed  
5 limestone forest (NAVFAC Pacific 2010b). Limestone forest and the coconut grove are described in  
6 greater detail in the following paragraphs.

7 **Limestone Communities.** Limestone forests on NBG TS North occur on the upper plateau and below the  
8 cliffline (NAVFAC Pacific 2010b). The largest area of halophytic-xerophytic scrub sub-type exists on  
9 the cliff of HERA. The majority of the plateau area supports disturbed limestone communities composed  
10 of nonnative species (U.S. Navy 2009).

11 During 2008 vegetation surveys performed on NBG TS North, 13 of the 19 tree species encountered on  
12 the transects in the limestone forests on the upper plateau of the annex were native trees. However, *Vitex*,  
13 an introduced species, is a dominant component of these forests. *Vitex* had the highest relative density  
14 (about 22 percent), followed by native screwpine and endemic *Guamia mariannae* trees, with densities of  
15 about 17 percent each (NAVFAC Pacific 2010b). The limestone forest below the cliffline on NBG TS  
16 North is a distinctive community comprising a stand of *Merrilliodendron megacarpum* trees that provide  
17 habitat for the Guam tree snail. The forest is situated close to sea level along the base of an escarpment  
18 and overlies karst limestone substrate. From north to south, the site transitions from faniok-dominated  
19 forest to a more mixed community (NAVFAC Pacific 2010b).

20 In the forests of the southern section of NBG TS North, the three species with the highest relative  
21 densities were *G. mariannae*, screwpine, and *Neisosperma oppositifolia*, which are all native species and  
22 collectively accounted for 62 percent of the overall density. All native tree species within the southern  
23 section of NBG TS North had a combined density of 87 percent. Two native tree species, *G. mariannae*  
24 and *Aglaiia mariannensis*, are endemic to the Mariana Islands and had a combined density of 27 percent  
25 (NAVFAC Pacific 2010b).

26 The west-central sector of NBG TS North in the vicinity of Pugua Point contains limestone forest with a  
27 native species density of 66 percent (NAVFAC Pacific 2010b). The limestone forest in lower NBG TS  
28 North is a distinctive community composed of a stand of *M. megacarpum* trees that provides habitat for  
29 the Guam tree snail (NAVFAC Pacific 2010b). *Merrilliodendron megacarpum* is a native species found  
30 in only a few localities on Guam in limestone forests (GDAWR 2006a). The forest is situated close to sea  
31 level along the base of an escarpment and overlies karstic limestone substrate. From north to south, the  
32 site transitions from faniok-dominated forest to a more mixed community (NAVFAC Pacific 2010b).

33 The limestone forested area on NBG TS South is dominated by nonnative *Vitex*, tangantangan, and  
34 papaya, which compose 67 percent of the trees. The remaining 33 percent of tree cover was by five  
35 native species, none of which are endemic to Guam or the other Northern Mariana Islands. The low  
36 native tree component might be the result of past clearing activities at the annex (NAVFAC Pacific  
37 2010b).

38 **Coconut Grove.** A coconut grove that is a remnant from an abandoned copra plantation occurs along the  
39 coast of the HERA embayment. A disturbed/weed plant community occurs at the forest edges and in  
40 patches within the forest. This area is located close to sea level below the limestone plateau of the main  
41 annex. *Hernandia peltata*, an indigenous tree, has a relative density of about 22 percent and coconut  
42 palms composed the remainder of the trees (NAVFAC Pacific 2010b).

43 **Wetlands.** No wetlands occur on NBG TS (COMNAV Mariana 2001). Geologic conditions needed to  
44 support wetland areas (i.e., hydric soils) are not found in highly permeable limestone plateau of northern  
45 Guam (NRCS 1988, Wiles and Ritter 1993, COMNAV Mariana 2001, NRCS 2010). Sites with the  
46 greatest likelihood to support wetlands (e.g., sinkholes or drainage swales) on NBG TS were evaluated by

1 wetland scientists in May 2010, but no wetlands were found. These areas are mapped as wetlands by the  
2 USFWS National Wetlands Inventory (NWI) and were mapped as containing hydric soils by the NRCS  
3 (NRCS 2010). Site visits conducted in May 2010 on NBG TS document the absence of these  
4 NWI-mapped wetlands (USFWS 2009a) and NRCS-mapped hydric soils (NRCS 2010). The results of  
5 the site visit support the conclusion that no wetlands are known or expected to occur on NBG TS  
6 (NAVFAC Pacific 2010a).

## 7 ***Fauna***

8 The following avian species were identified during the 2008–2010 roadside and forest bird surveys  
9 performed on NBG TS South: Pacific golden-plover, island collared dove, black drongo, Eurasian tree  
10 sparrow, common pigeon (*Columba livia*), and yellow bittern. The Pacific golden-plover, a nonbreeding  
11 visitor to Guam, was the most common species observed on NBG TS South (NAVFAC Pacific 2010b).  
12 The yellow bittern is a common native resident on Guam. The island collared dove, black drongo,  
13 Eurasian tree sparrow, and common pigeon are common, introduced, residents in Guam  
14 (NAVFAC Pacific 2010b).

15 The shoreline and cliff line along NBG TS North support a number of shorebird species, which are  
16 protected under the MBTA (U.S. Navy 2009).

17 ***Mammals.*** The Mariana fruit bat has been documented on NBG TS North (U.S. Navy 2009). In 2008,  
18 two bats were observed during a fruit bat survey on NBG TS North, one below the cliff line of the HERA  
19 and the other crossing Route 3A (NAVFAC Pacific 2010b).

20 ***Reptiles and Amphibians.*** Ten herpetofauna species were documented on NBG TS North during 2008–  
21 2009 herpetofauna surveys. Of these, six species are native to Guam: Pacific blue-tailed skink, moth  
22 skink, mourning gecko, stump-toed gecko, monitor lizard, and Pacific slender-toed gecko; four species  
23 are introduced to Guam: curious skink, house gecko, brown treesnake, and marine toad (NAVFAC  
24 Pacific 2010b). The capture of two Guam-listed endangered species (i.e., moth skink and Pacific slender-  
25 toed gecko) on NBG TS North is noteworthy. The distribution and abundance of the moth skink on  
26 Guam is unknown, due to the variability of information presented by authors. The Pacific slender-toed  
27 gecko is a rarely seen gecko. Both species were captured in the northeastern forested portion of NBG TS  
28 North (NAVFAC Pacific 2010b). The continued widespread presence of the brown treesnake, curious  
29 skink, and other introduced amphibian species is of concern because of each species' potential deleterious  
30 impacts on Guam's native fauna (NAVFAC Pacific 2010b).

31 Green sea turtle nesting has been documented on the beaches at NBG TS North (U.S. Navy 2009). See  
32 **Section 4.1.3.2** for additional information on this species.

33 Five herpetofauna species were documented on NBG TS South during the 2008–2009 herpetofauna  
34 surveys. Of these, two species are native to Guam: Pacific blue-tailed skink and stump-toed gecko; and  
35 three species are introduced: curious skink, house gecko, and marine toad. The continued widespread  
36 presence of the curious skink and other introduced amphibian species is of concern because of each  
37 species' potential deleterious impacts on Guam's native fauna (NAVFAC Pacific 2010b).

38 ***Invertebrates.*** A tree snail survey was performed in 2008 on NBG TS North centered on the southern  
39 area of the annex, Haputo Beach, and along the cliff line at Pugua Point in the central-western area of the  
40 annex. The only colonies found were at Haputo Beach and Pugua Point. At Pugua Point, the colony was  
41 made up of fragile tree snails and Guam tree snails. The colony at Haputo Beach consisted of humped  
42 tree snails and radiolate tree snails. Shells of the introduced giant African snail and both live individuals  
43 and shells of the introduced snail *Satsuma mercatoria* (no common name) were observed within the  
44 northeastern limestone forests on NBG TS North (NAVFAC Pacific 2010b).

1 A small patch of *Procris pedunculata*, the host plant for the Mariana eight-spot butterfly was observed  
2 scattered in one area of cockscomb limestone on NBG TS North (NAVFAC Pacific 2010b). The Mariana  
3 eight-spot butterfly was not observed.

#### 4 4.4.2.2 Freshwater Ecosystems

5 There are no freshwater ecosystems on NBG TS.

#### 6 4.4.2.3 Estuarine Ecosystems

7 There are no estuarine ecosystems on NBG TS.

#### 8 4.4.2.4 Submerged Lands

9 JRM-managed submerged lands which extend 3 nautical miles seaward from the coastline at NBG TS  
10 include the entire area from Taguison Point to Urunao Point, and a small section of submerged land  
11 extending out from Taguison Beach Park (see **Figure 4-17**) (PCR Environmental 2007). NBG TS  
12 submerged lands include the HERA. The reefs within the HERA were considered to be in the best  
13 condition of those areas surveyed during the 2005 UOG laboratory assessment (Porter et al. 2005).

14 The coastline off of NBG TS includes two small reef flats and the Double Reef habitat. Double Reef is  
15 the most striking offshore feature along the entire northwest coast of Guam because it is the beginning of  
16 a young barrier reef that breaks the ocean surface (Paulay et al. 2001). It lies on a shallow shelf that  
17 extends considerably further from the coast than adjacent areas (PCR Environmental 2007). Other than  
18 Double Reef, the forereef areas of the northwest coasts of Guam show relatively little variation in  
19 macrohabitat, but do illustrate widespread, fine-scale variation in benthic communities (Paulay et al.  
20 2001).

#### 21 4.4.2.5 Protected Species

### 22 ***Fauna***

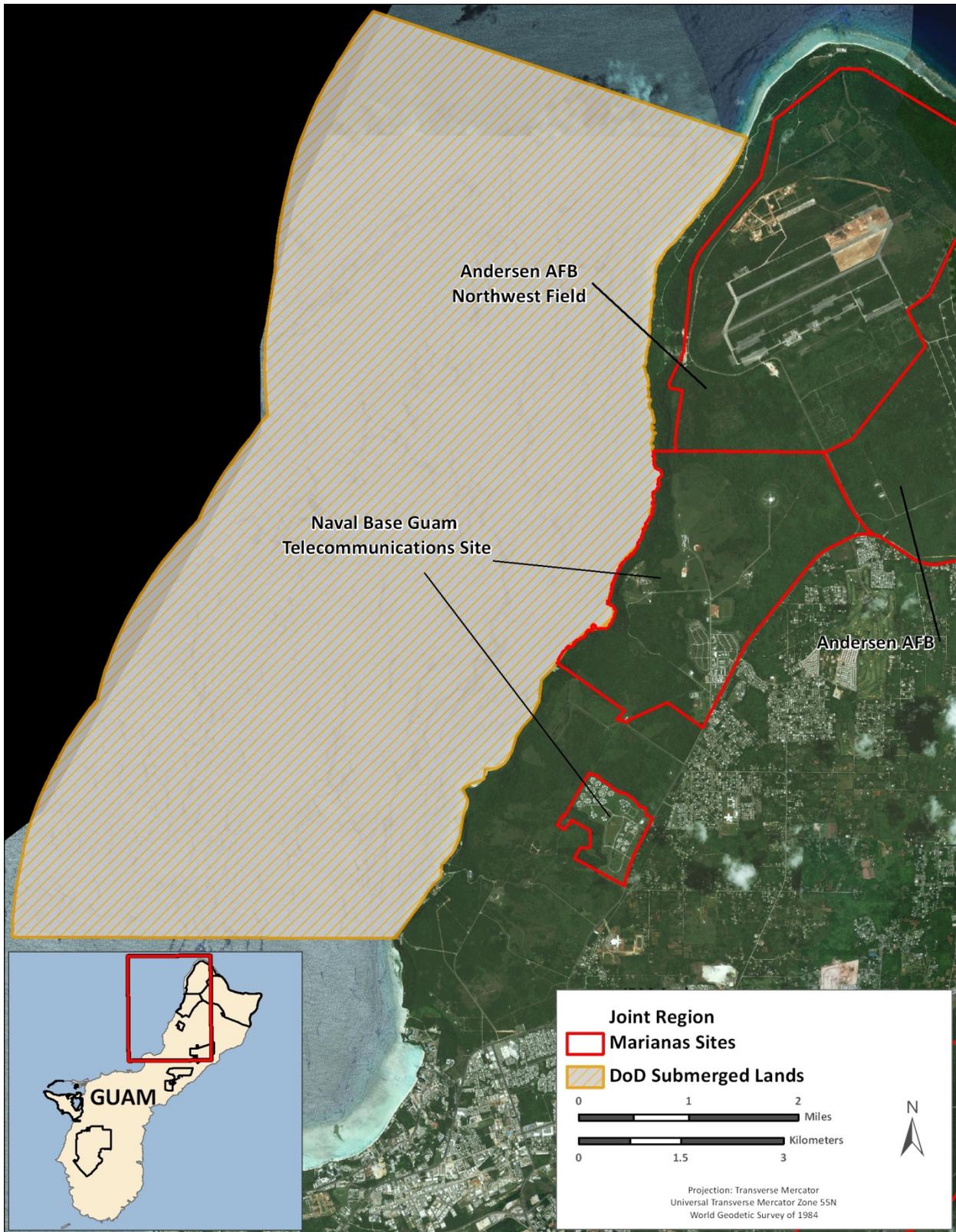
#### 23 Terrestrial Species

#### 24 **Birds**

25 ***Micronesian starling.*** One of the few native bird species still surviving on Guam, it is known to occur in  
26 housing areas where brown treesnake populations might be reduced. An unknown number of  
27 Micronesian starlings occur near the entrance to NBG TS (e<sup>2</sup>M 2008).

#### 28 **Mammals**

29 ***Mariana fruit bat.*** Fruit bat surveys were conducted in NBG TS between 1963 and 1968 as part of a  
30 regular effort by the GDAWR to monitor fruit bat populations (Perez 1972). Fruit bat densities in the  
31 area were found to have decreased from about 32 fruit bats per 100 acres to about 18 fruit bats per  
32 100 acres over the survey period (Perez 1972). In the early 1980s, Wiles (1987b) estimated that  
33 approximately 50 to 100 fruit bats occupied the cliffline forest of northern Guam as solitary individuals or  
34 small groups, outside of the large colonies on Andersen AFB. However, fruit bat surveys in forested  
35 cliffline habitat between Amantes Point and Achae Point in 1984 did not detect any bats (Wiles 1987b).  
36 There are no historical records of large fruit bat colony roosts in the cliffline forest areas of NBG TS.  
37



1 Source: Data and Imagery provided by NAVFAC GRC Marianas and Air Force GeoBase

2 **Figure 4-17. JRM-Managed Submerged Lands at Naval Base Guam Telecommunications Site**

1 Fruit bat surveys conducted on NBG TS in 2008 recorded two Mariana fruit bats (Brooke 2008). Both  
2 bats were observed returning to their day-roost in the early morning. NBG TS and the HERA contain  
3 some of the best remaining fruit bat habitat on JRM-managed lands. The native canopy and understory  
4 trees in the HERA have the potential to support foraging and roosting activities; however, there are no  
5 know roost sites present on the HERA (SWCA 2010b).

#### 6 Reptiles

7 **Moth skink.** Moth skinks have an unknown distribution on Guam and are not frequently encountered.  
8 Eight moth skinks were recorded during herpetofauna surveys in the northern NBG TS in 2008 (DoN  
9 2010). One individual was captured in a glue-board trap, and seven others were observed during visual  
10 surveys. The moth skink is not a federally listed species, but GovGuam lists the species as endangered.

11 **Pacific slender-toed gecko.** Two Pacific slender-toed geckos were recorded during herpetofauna surveys  
12 on NBG TS in 2008 (DoN 2010). This species is rarely seen and has been listed as an endangered species  
13 by GovGuam. It is not a federally listed species.

#### 14 Invertebrates

#### 15 Insects

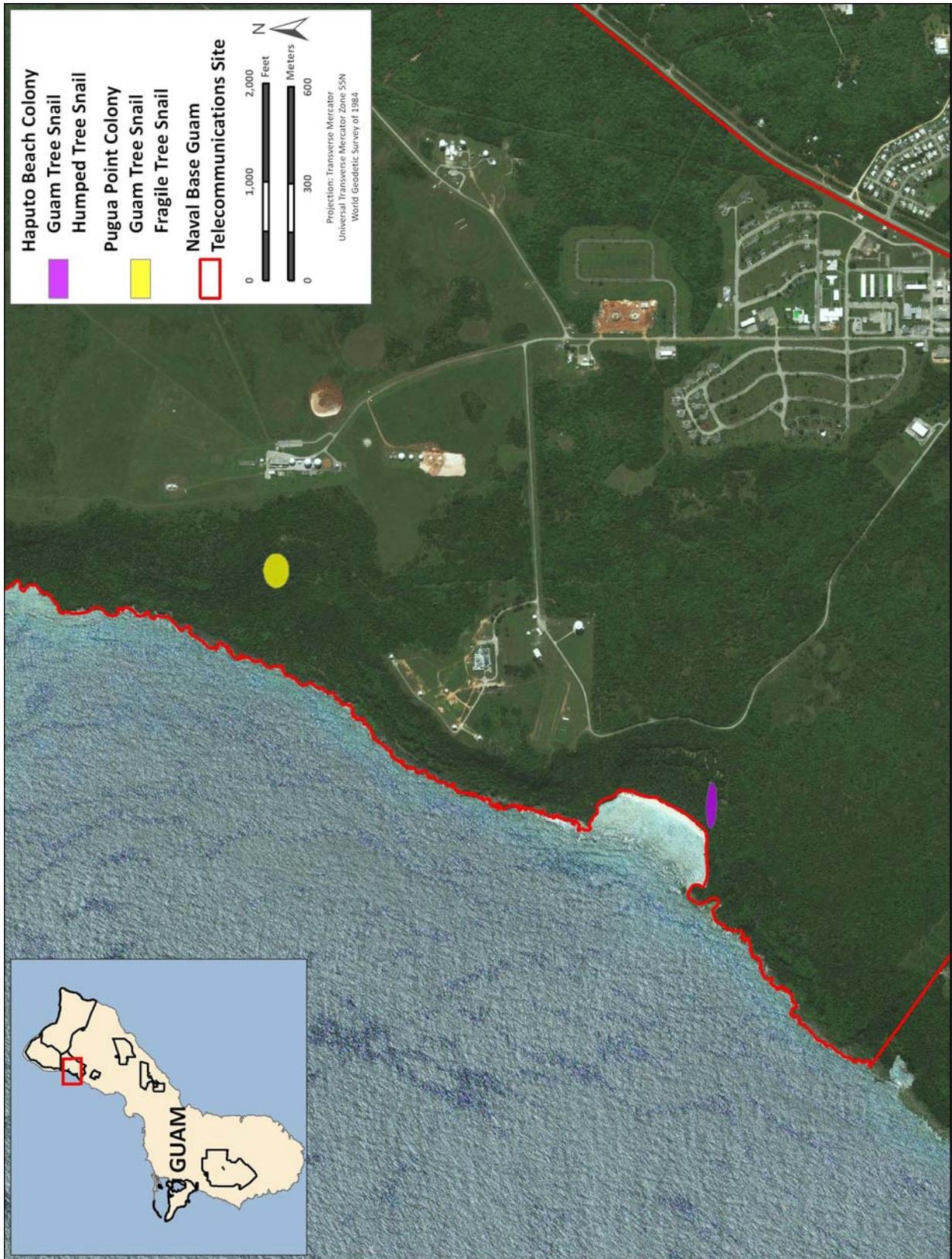
16 **Mariana eight-spot butterfly.** The Mariana eight-spot butterfly was recently observed during surveys  
17 conducted in 2010 at the HERA. The butterfly was also observed at Hilann Point, less than 2 miles  
18 (3.2 kilometers) south of the HERA (SWCA 2010b).

#### 19 Gastropods

20 **Humped tree snail.** Humped tree snails were once the most common partulid tree snail on Guam and the  
21 most widely dispersed species in the Mariana Islands (Crampton 1925, Hopper and Smith 1992). The  
22 humped tree snail is now found at a single location on Guam at Haputo Beach on NBG TS (see  
23 **Figure 4-18**). The humped tree snail was first documented on NBG TS in 1989 by Hopper and Smith  
24 (1992). The location has been under frequent monitoring over the years and was resurveyed in 2008.  
25 While the population is still present, the density of snails is declining (Smith et al. 2008).

26 **Guam tree snail.** The Guam tree snail was first documented on NBG TS by Hopper and Smith (1992) in  
27 1989. It was found to co-occur with a population of humped tree snails at Haputo Beach (see  
28 **Figure 4-18**). Surveys conducted in 2008 detected a second population of Guam tree snail co-occurring  
29 with a newly discovered population of fragile tree snails at Pugua Point, north of Haputo Beach on NBG  
30 TS.

31 **Fragile tree snail.** The fragile tree snail was never as abundant on Guam as the Guam tree snail and the  
32 humped tree snail, but it was more widespread than the Mount Alifan tree snail. Surveys by Crampton  
33 (1925) in 1920 found the fragile tree snail at 10 of 39 survey sites. A re-survey of Crampton's sites in  
34 1989 by Hopper and Smith (1992) found fragile tree snails at 6 of the previously occupied survey sites.  
35 By 1994, fragile tree snails were present in only 3 sites on Guam and were considered the rarest of the  
36 three surviving partulid tree snail species on Guam (Smith and Hopper 1994). By 1996, the fragile tree  
37 snail had disappeared from their 3 remaining sites. A single population of fragile tree snails was  
38 discovered at Pugua Point on NBG TS in 2008 (Smith et al. 2008) (see **Figure 4-18**). This is currently  
39 the only population of fragile tree snails on Guam; one population might also remain on Rota (Smith et al  
40 2008).



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Figure 4-18. Partulid Tree Snail Populations on Naval Base Guam Telecommunications Site

## 1 Marine Species

### 2 Marine Mammals

3 In 2007, SRS-Parsons et al. (2007) conducted a marine mammal and sea turtle survey covering  
4 170,500 square nautical miles around Guam and the CNMI. The survey area was bounded by 10°–18° N  
5 Latitude and 142°–148° E longitude. Nine unique marine mammal species were identified, including the  
6 federally endangered sei, sperm, and humpback whales. Sperm whales were the most commonly  
7 observed whale during the study. Marine mammals have the potential to occur in JRM-managed  
8 submerged lands that extend 3 nautical miles seaward from the coastline at NBG TS.

9 Spinner dolphins are often observed in the area surrounding Double Reef. In addition, spinner dolphins  
10 and bottlenose dolphins are frequently observed in the HERA (SWCA 2010b).

### 11 Sea Turtles

12 Green sea and hawksbill turtles are known to frequent the waters within the HERA (Helber, Hastert and  
13 Fee 2005).

14 **Green sea turtle.** Green sea turtles can occur in the JRM-managed submerged lands and can nest on the  
15 beaches within NBG TS. The Navy monitors for sea turtle nesting on selected beaches throughout the  
16 year. Green sea turtles were observed in 2009 either underwater or on the surface at the HERA (SWCA  
17 2010b). Regular monitoring for sea turtle nesting activity was initiated in 2007, and two suspected green  
18 sea turtle nest attempts and two false crawls were documented in 2008 (SWCA 2010b). Nesting habitat is  
19 present at Haputo Beach.

20 **Hawksbill sea turtle.** Hawksbill sea turtles also occur in the JRM-managed submerged lands, and can  
21 nest on the beaches within NBG TS. The Navy monitors for sea turtle nesting on selected beaches  
22 throughout the year. Nesting habitat is present at Haputo Beach; however, it is unclear whether hawksbill  
23 sea turtles use the beaches of the HERA (SWCA 2010b).

### 24 **Flora**

25 ***Heritiera longipetiolata.*** This species has not been recorded from NBG TS at this time. However,  
26 *Heritiera longipetiolata* was recorded as a notable species in the area of Pugua Point during the 2011  
27 surveys of the HERA and OPERA. *Heritiera longipetiolata* occurs in forested cliffline areas around  
28 Guam.

#### 29 4.4.2.6 Invasive Species

### 30 **Flora**

31 Receiving antennas and other communications equipment require open areas to prevent interference from  
32 surrounding trees or buildings. As a result, much of Communications Annex NBG TS has been cleared  
33 and is maintained as mowed grasslands. This has allowed for the establishment of nonnative vegetation,  
34 primarily in the transition areas between the mowed grasslands and the forest areas. These nonnative  
35 plant species have also moved into the forested areas, especially along the roadsides where safety areas  
36 are maintained. This disturbance and increase in nonnative vegetation has contributed to a highly  
37 disturbed habitat and a severe decline in native forest species (U.S. Navy 2009).

1 *Vitex* is a dominant component of the limestone forests occurring on NBG TS (NAVFAC Pacific 2010b).  
2 The limestone forested area on NBG TS South is dominated by nonnative *Vitex*, tangantangan, and  
3 papaya (NAVFAC Pacific 2010b).

#### 4 ***Fauna***

5 In 2009, ungulate activity was observed most frequently in the form of rubbings on tree trunks and  
6 evidence of browsing on NBG TS North. A toppled fadang tree was observed, most likely caused by  
7 feral pigs to feed on the pith material in the trunk (NAVFAC Pacific 2010b). Ungulate activity at NBG  
8 TS South was evidenced by rubbings and soil disturbance (NAVFAC Pacific 2010b). Feral pig  
9 populations are also impacting the annex facilities by rooting up soil in the housing area (e.g., the  
10 children's playground) and around communication structures (U.S. Navy 2009). Ungulate Management  
11 Plans for NBG and AAFB have been developed and are included in **Appendix O** of this INRMP.

12 The feral pig and Philippine deer are present in the HERA and have significantly affected natural  
13 ecosystem by causing soil erosion, stream and reef siltation, loss of native plant and animal species,  
14 vegetation damage, and degradation of native habitat (SWCA 2010b). Illegal hunting of ungulates has  
15 also occurred on the HERA. Other invasive fauna present on the HERA include rats, feral cats, musk  
16 shrews, house mice, and feral dogs (SWCA 2010b).

17 The island collared dove, black drongo, Eurasian tree sparrow, and black francolin occur on NBG TS  
18 North (NAVFAC Pacific 2010b). These species are common, introduced, breeding residents in Guam  
19 (NAVFAC Pacific 2010b). On NBG TS South, invasive bird species include island collared dove, black  
20 drongo, Eurasian tree sparrow, and common pigeon (NAVFAC Pacific 2010b). The black drongo is very  
21 territorial and aggressive and has been known to displace smaller birds that might otherwise nest within  
22 their territory (Fritts and Rodda 1998).

23 Four introduced herpetofauna species were documented on NBG TS North during the 2008–2009  
24 herpetofauna surveys: curious skink, house gecko, brown treesnake, and marine toad; and three  
25 introduced species were documented on NBG TS South: curious skink, house gecko, and marine toad  
26 (NAVFAC Pacific 2010b). Other species documented in the HERA include eastern dwarf frogs (*Litoria*  
27 *fallax*), greenhouse frogs (*Eleutherodactylus planirostris*), crab-eating frogs, Hong Kong whipping frogs  
28 (*Polypedates megacephalus*), and Gunther's Amoy frogs (Christy et al. 2007).

### 29 **4.5 Communications Site Barrigada**

#### 30 **4.5.1 General Physical Environment**

##### 31 **4.5.1.1 Climate**

32 The climate at the Communications Site Barrigada is the same as the climate for Guam as a whole. See  
33 **Section 4.1.1.1** for a description of the climate on Guam.

##### 34 **4.5.1.2 Geology and Topography**

35 Communications Site Barrigada is situated in the northern limestone structural province of Guam  
36 (see **Figure 4-1**). The substrate composes a heterogeneous mixture of limestone subtypes ranging from  
37 highly friable to well-cemented depending on the depositional source. Elevations at the site range from  
38 approximately 240 feet (73 meters) to 500 feet (152 meters) above msl (see **Figure 4-2**). The most  
39 prominent feature is Barrigada Hill, which rises in the north-central part of the area with a maximum  
40 height of roughly 600 feet (183 meters) just north of the site boundary.

1 The geology of Communications Site Barrigada is characterized by a broad limestone reef plateau  
2 underlain by volcanic rocks. Most of the site consists of young limestone rock (Pliocene to Pleistocene,  
3 1.5–5 million years old) but the central-northern portion of Communications Site Barrigada is old  
4 limestone rock (Miocene to Pliocene, 5–25 million years old). Numerous cavities and caves exist within  
5 the porous limestone bedrock in the general area and collapses of these subterranean cavities form  
6 sinkholes (COMNAV Mariana 2001).

#### 7 4.5.1.3 Seismology

8 While the Communications Site Barrigada does not directly overlie any fault lines, the area is susceptible  
9 to earthquake events. The overall likelihood for landslides to occur at Communications Site Barrigada is  
10 low due to the lack of steep areas that contain soil vulnerable to slipping in seismic events.  
11 Communications Site Barrigada is not in an area vulnerable to liquefaction, nor is it in danger of tsunami  
12 inundation (JGPO 2010).

#### 13 4.5.1.4 Soils

14 The soils at Communication Site Barrigada are similar to NBG TS, except for areas consisting of shallow,  
15 well-drained soils formed from argillaceous limestone, which contain clay soil particles (see  
16 **Figure 4-19**).

17 Soil formation on northern and most of central Guam is the result of intense weathering of the permeable  
18 limestone, which forms silica-poor soils rich in iron oxides and gibbsite clays (NRCS 1988). The  
19 following soil types occur on Communications Site Barrigada: (1) Guam cobbly clay loam with  
20 3 to 7 percent slopes, (2) Pulantat clay, (3) Pulantat-Chacha clay complex, (4) Chacha clay, and  
21 (5) Ritidian-Rock Outcrop complex (JGPO 2010). Guam cobbly clay loams are the dominant soil type on  
22 Communications Site Barrigada. In general, erosion risks at Communications Site Barrigada are slight to  
23 moderate, but do not present a major problem because the area is situated on a broad limestone reef  
24 plateau.

#### 25 4.5.1.5 Hydrology

26 **Surface Water.** Because of the high permeability of the limestone substrate, no streams or other natural  
27 surface water drainage features occur on Communications Site Barrigada.

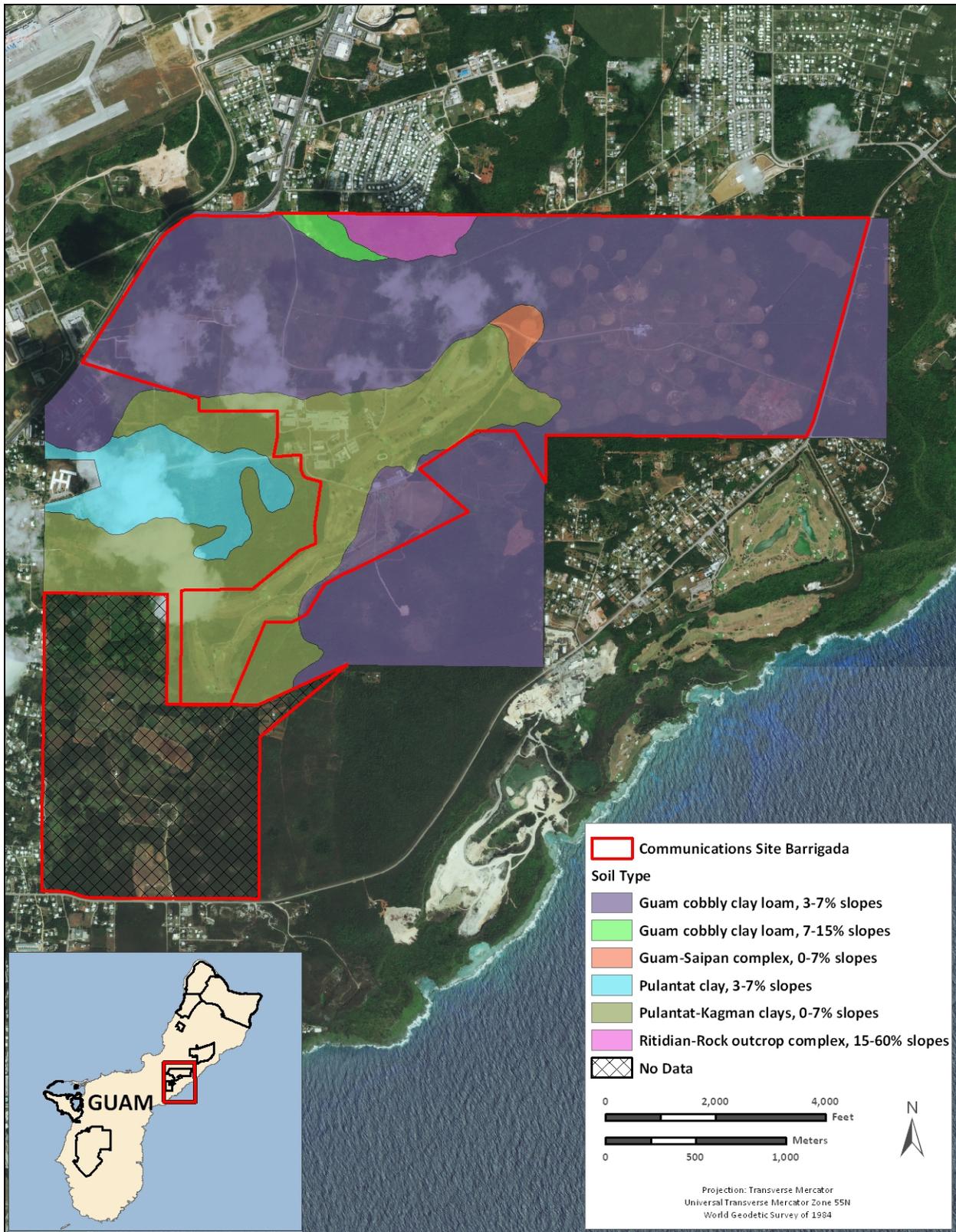
28 **Groundwater.** Communications Site Barrigada is underlain primarily by very permeable limestone in the  
29 Finegayan subbasin of the NGLA (see **Section 4.1.1.5**).

### 30 4.5.2 General Biotic Environment

#### 31 4.5.2.1 Terrestrial Ecosystems

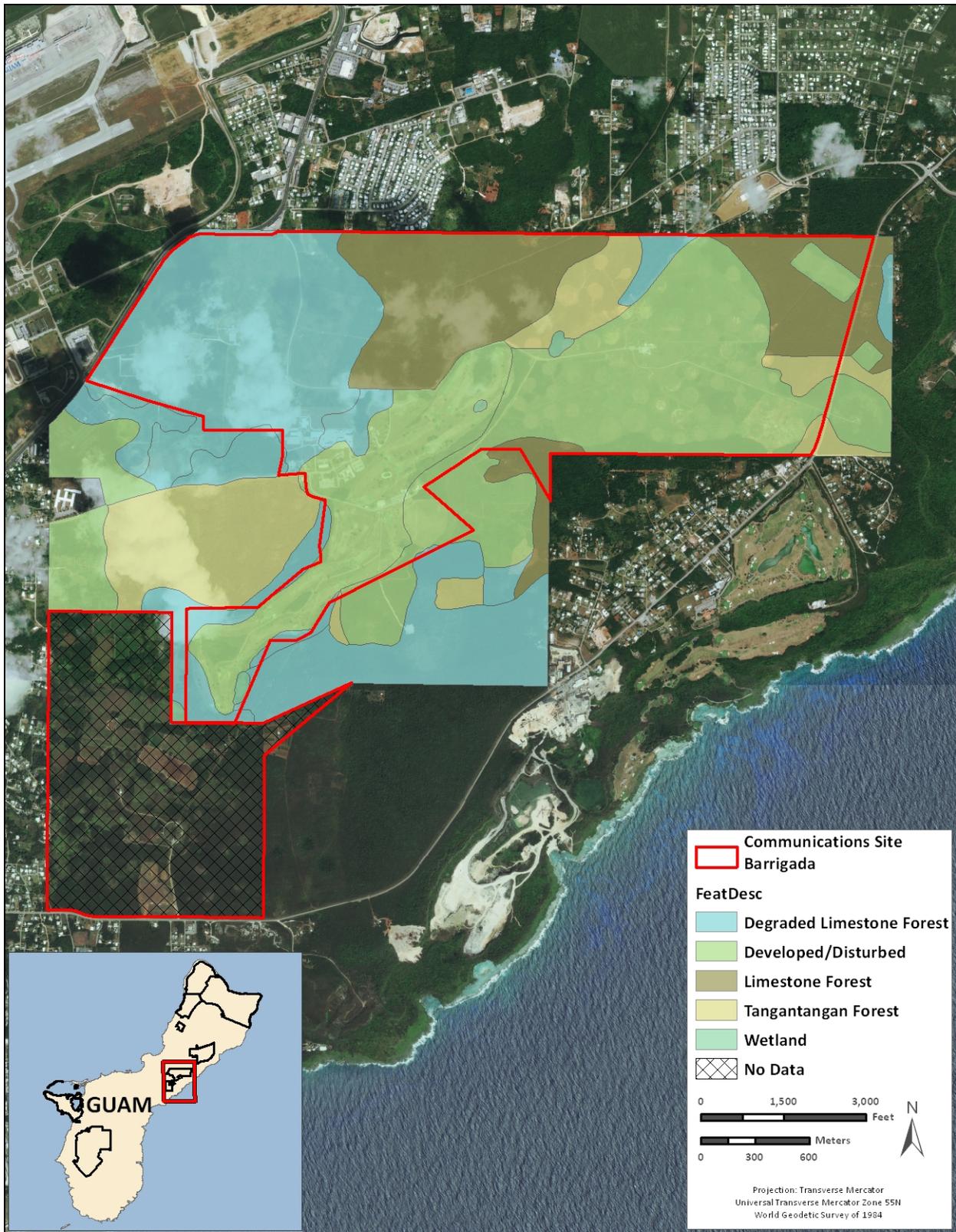
##### 32 **Flora**

33 The activities carried out at Communications Site Barrigada require large amounts of cleared, maintained  
34 land for operation. The disturbance of land has led to an increase of nonnative and invasive species. The  
35 degree of disturbance within the annex has resulted in portions of the remaining forested plant  
36 communities being highly modified and dominated by tangantangan and African tulip (U.S. Navy 2009).  
37 See **Figure 4-20** for a map of the vegetation communities occurring on Communications Site Barrigada.



1 Source: Data and Imagery provided by NAVFAC GRC Marianas and Air Force GeoBase

2 **Figure 4-19. Soils on Communications Site Barrigada**



1 Twenty tree species were documented on transects conducted during the 2008 vegetation surveys  
2 performed on Communications Site Barrigada (NAVFAC Pacific 2010b). The highest dominance  
3 observed was for the strangler fig, an overstory species with numerous aerial roots that contribute to its  
4 large footprint. The species with the second- and third-highest dominances were *Hibiscus tiliaceus* and  
5 *Neisosperma oppositifolia*, which typically occupy the overstory. All three species are native to Guam.  
6 *Guamia mariannae*, which is also native, is a dominant understory species within the forests on  
7 Communications Site Barrigada. Common introduced species on Communications Site Barrigada include  
8 custard apple (*Annona reticulata*), limeberry, and tangantangan. Native species had a combined relative  
9 density of approximately 77 percent, far exceeding the relative density of introduced species for the  
10 survey transects at Communications Site Barrigada (NAVFAC Pacific 2010b).

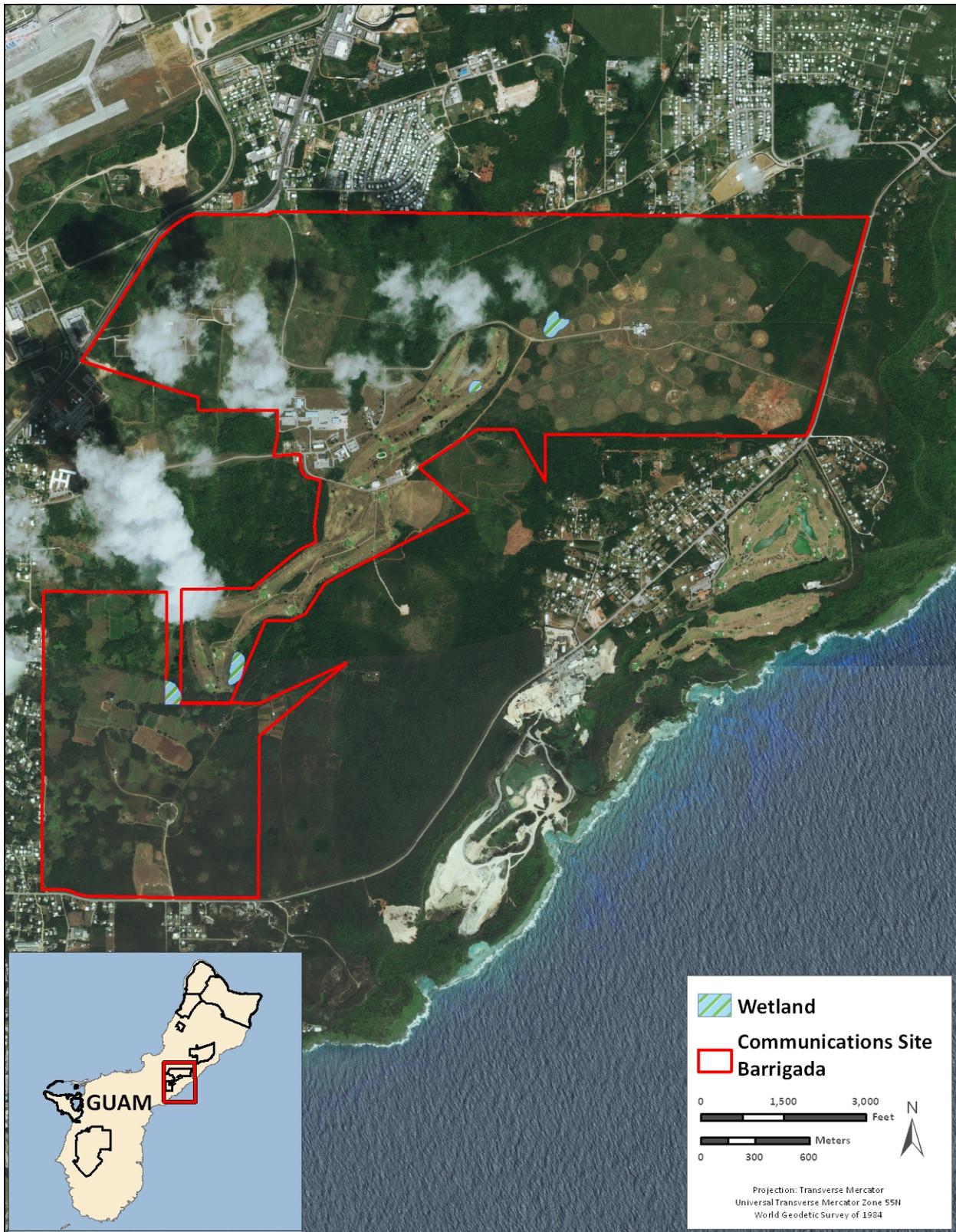
11 **Wetlands.** The 2001 INRMP indicates the presence of several small man-made ponds in the vicinity of  
12 the Nimitz Golf Course (COMNAV Mariana 2001). These and other potential wetland areas were  
13 investigated in 2007 (AECOS and Wil Chee 2009) and some were found to lack wetland vegetation and  
14 hydrology. One wetland area, B-02, was identified in the southeast corner of Barrigada North, close to  
15 the southern end of the Nimitz Golf Course. The recent 2010 wetland study (NAVFAC Pacific 2010a)  
16 confirmed the existence of this small palustrine emergent wetland of 1 acre (0.4 hectares).

17 Delineated and NWI-indicated wetland areas have been identified on Barrigada South (AECOS and Wil  
18 Chee 2009, USFWS 2009a). Two small sinkhole wetlands were delineated on Barrigada South in 2007:  
19 Wetland Areas Barr-03 and Barr-04 (AECOS and Wil Chee 2009). In 2007, these wetlands were  
20 described as not providing marginally useful habitat to waterbirds. These wetlands were observed to be  
21 overgrown with para grass and did not have any open water. The dense para grass within these wetlands  
22 suggests wet soil conditions rather than periodic flooding (AECOS and Wil Chee 2009). To evaluate  
23 wetlands further on Barrigada South, a wetland study was conducted in May 2010 (NAVFAC Pacific  
24 2010a, JGPO 2010). The recent study delineated Wetland Areas B-01, B-04, B-05, B-06, B-07, B-08,  
25 and B-09 on Barrigada South; Wetland Area B-03 is located just outside the boundary (see **Figure 4-21**).  
26 Wetland Areas B-01, B-03, B-05, B-06, B-07, B-08, and B-09 are NWI wetlands confirmed to meet  
27 USACE wetland criteria and NWI boundaries were adjusted during recent field studies (NAVFAC Pacific  
28 2010a). Wetland Area B-04 was previously delineated in 2007 (AECOS and Wil Chee 2009) and the  
29 boundaries were adjusted during recent field studies (NAVFAC Pacific 2010a). The delineated wetland  
30 areas on Barrigada South total approximately 2.4 acres (1.0 hectares) and Wetland Area B-03, located  
31 adjacent to Barrigada South, is approximately 1.1 acres (0.4 hectares) (NAVFAC Pacific 2010a, JGPO  
32 2010).

### 33 **Fauna**

34 **Birds.** The following avian species were identified during 2008–2010 roadside bird surveys performed  
35 on Communications Site Barrigada: Pacific golden-plover, black drongo, western cattle egret, island  
36 collared dove, Eurasian tree sparrow, black francolin, and yellow bittern (NAVFAC Pacific 2010b). The  
37 Pacific golden-plover was the most commonly observed species during this survey. The yellow bittern is  
38 a common native breeding resident on Guam. The island collared dove, black drongo, Eurasian tree  
39 sparrow, and black francolin are common, introduced, breeding residents on Guam. The Pacific  
40 golden-plover and western cattle egrets are common nonbreeding visitors to the island (NAVFAC Pacific  
41 2010b).

42 The constructed wetlands within Communications Site Barrigada are regularly used as resting and  
43 foraging areas for migrating birds, which are protected under the MBTA. Bird species observed during  
44 the 2009 natural resources survey on Communications Site Barrigada that could use the freshwater  
45 wetlands include the yellow bittern, western cattle egret, and Pacific golden-plover (NAVFAC Pacific  
46 2010b).



1  
2  
3

**Figure 4-21. Wetlands on Communications Site Barrigada**

1 The open grasslands within Communications Site Barrigada are also regularly used as resting and  
2 foraging areas for migrating birds.

3 **Mammals.** Potential habitat for the Mariana fruit bat occurs on Communications Site Barrigada due to  
4 the native understory and canopy trees within the annex. No fruit bats were documented on  
5 Communications Site Barrigada during a May 2008 fruit bat survey (NAVFAC Pacific 2010b).

6 **Reptiles and Amphibians.** Seven herpetofauna species were documented on Communications Site  
7 Barrigada during the 2008–2009 herpetofauna surveys. Of these, three species are native to Guam:  
8 Pacific blue-tailed skink, mourning gecko, and stump-toed gecko; and four species are introduced to  
9 Guam: curious skink, house gecko, greenhouse frog, and Hong Kong whipping frog (NAVFAC Pacific  
10 2010b). The continued widespread presence of curious skink and other introduced amphibian species is  
11 of concern because of each species' potential deleterious impacts on Guam's native fauna. Of particular  
12 concern is the ability of the introduced species to serve as additional food sources for the brown treesnake  
13 (NAVFAC Pacific 2010b).

14 **Invertebrates.** Four butterfly species were identified during the 2009–2010 butterfly survey: blue-banded  
15 king crow (*Euploea eunice*), blue moon (*Hypolimnas bolina*), common Mormon (*Papilio polytes*), and  
16 common evening brown (*Melanitis leda*). The butterfly transect was within a forested area on  
17 Communications Site Barrigada with several small clearings. None of the four species are considered  
18 endangered or threatened, and all are fairly well-distributed throughout Guam and the Northern Mariana  
19 Islands (NAVFAC Pacific 2010b).

20 No living partulid tree snails or their shells were observed on Communications Site Barrigada during the  
21 2008–2010 tree snail surveys. Shells of the introduced giant African snail and both live individuals and  
22 shells of the introduced snail *Satsuma mercatoria* were seen on the transects. Additionally, live  
23 introduced Manokwar flatworms, which are predators of land snails, were observed on Communications  
24 Site Barrigada (NAVFAC Pacific 2010b).

#### 25 4.5.2.2 Freshwater Ecosystems

26 There are no freshwater ecosystems on Communications Site Barrigada. One decorative man-made pond  
27 with a fountain occurs on the Nimitz Golf Course; however, the value of freshwater habitat provided by  
28 this pond is assumed to be negligible. Several wetlands were delineated on Communications Site  
29 Barrigada in 2007 and 2010 (AECOS and Wil Chee 2009, NAVFAC Pacific 2010a).

#### 30 4.5.2.3 Estuarine Ecosystems

31 There are no estuarine ecosystems on Communications Site Barrigada.

#### 32 4.5.2.4 Submerged Lands

33 No JRM-managed submerged lands are associated with Communications Site Barrigada.

#### 34 4.5.2.5 Protected Species

### 35 **Fauna**

#### 36 Terrestrial Species

#### 37 **Birds**

38 There are no known Federal or Guam-listed birds at Communications Site Barrigada.