

## CHAPTER 12.

# TERRESTRIAL BIOLOGICAL RESOURCES

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### 12.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementing the alternatives within the region of influence for this resource. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2. The locations described in Volume 2 include the region of influence for the utilities and roadway projects, and the chapters are presented in the same order as the resource areas contained in Volume 6.

Species mentioned in this section are described using the common name when there is an English common name that is in relatively common use on Guam (all wildlife and some plants). Common names are cross-referenced to scientific names in Appendix G. Where there is no commonly used English name for plants, the scientific name is used with the Chamorro name in parentheses when first used.

### 12.2 ENVIRONMENTAL CONSEQUENCES

#### 12.2.1 Approach to Analysis

##### 12.2.1.1 Methodology

The affected environment for terrestrial biological resources for the proposed roadway improvement projects is described in Volume 2 of this Environmental Impact Statement (EIS).

Biological resource issues and concerns include the potential direct, indirect, and cumulative impacts of the proposed actions and alternatives during the construction and operation phases. Impacts may be either temporary (reversible) or permanent (irreversible). Direct and indirect impacts are distinguished as follows.

*Direct impacts* are associated with proposed construction activities (e.g., ground-disturbing activities) and operations (e.g., noise and lighting). Potential types of direct impacts include, but are not limited to:

- Loss of habitat due to vegetation removal during construction.
- Temporary loss of habitat during construction from noise, lighting, and human activity.
- Potential loss of habitat due to disturbance of species in areas surrounding operations from noise, lighting, and human activity.
- Injury or mortality to wildlife or special-status species caused by the action that occur at the same time and place as the action.

*Indirect impacts* are caused by or result from project-related activities, are usually later in time, and are reasonably foreseeable (e.g., increased likelihood of non-native species moving into the area after disturbance). Potential indirect impacts include, but are not limited to:

- All disturbances from human activity, noise, and lighting that would potentially impact unoccupied suitable habitat for special-status species.
- Introduction of new non-native invasive species or increased dispersal of existing non-native invasive species on Guam.
- Dispersal of existing non-native invasive species from Guam to the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii, or other destinations.
- Adverse effects from pollutants that are released from construction or military operations.

General principles used to evaluate impacts are:

- The extent, if any, that the action would permanently lessen ecological habitat qualities that Endangered Species Act (ESA)-listed species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would diminish population sizes, distribution, or habitat of regionally important native plant or animal species.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any ESA-listed species.
- The extent, if any, that the action would be inconsistent with the goals of United States (U.S.) Fish and Wildlife Service (USFWS) recovery plans, Navy and Air Force Integrated Natural Resources Management Plans, or the Guam Comprehensive Wildlife Conservation Strategy.

Many of the proposed roadway improvement projects were excluded from further analysis of direct impacts if such projects would not require road widening, where all proposed improvements would occur within the existing impervious cover footprint because these projects would not directly or indirectly affect terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). In addition, roadway projects were excluded from further direct impact analysis if they would occur in developed areas with no appreciable effect to terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). These types of projects would require clearing of vegetation, but the area required for clearing has been so heavily degraded, modified, or characterized by urban vegetation that the loss of the area would not appreciably affect terrestrial biological resources (i.e., vegetation communities, wildlife resources, or special-status species). The analysis of indirect impacts for roadways considers the potential for noise impacts and impacts from runoff, sedimentation, and non-point source pollution inputs into freshwater (non-marine) aquatic environments and surrounding vegetation communities.

#### 12.2.1.2 Determination of Significance

Significance of impacts on vegetation, wildlife, and special-status species were determined using guidelines in the previous section. Special-status species are defined as ESA- and Guam-listed species and species that are designated candidates for ESA listing. Specific significance criteria are discussed below. If significant impacts are determined, then mitigation may be proposed to offset the impacts.

##### Vegetation

Impacts would be determined significant if any primary limestone forest (mature forest dominated by native species) would be cleared, unless determined to be very minor in the context of the surrounding forest areas. Any loss of this forest vegetation community would be considered significant because of the large historical and continuing losses of this forest type on Guam. Loss of wetland or mangrove vegetation would also be considered potentially significant. Note that impacts on vegetation types other than primary limestone forest could also be determined significant if these areas are habitat for protected wildlife or special-status species (as evaluated below).

##### Wildlife

Impacts would be determined significant if native wildlife species are present and the proposed project would result in more than minimal changes in population sizes or distributions of regionally important native animal species. These wildlife species include those designated as Species of Greatest Conservation Need in the Guam Comprehensive Wildlife Conservation Strategy (Guam Division of Aquatic and Wildlife Resources [GDAWR] 2006; excluding special-status species which are addressed

separately below). Non-native invasive species impacts that exceed the criteria specified above are evaluated. Historical impacts from non-native invasive species have been severe, particularly from the brown tree snake (BTS) (see discussion in Volume 2). Although the proposed action would not result in additional impacts from BTS on Guam, the concern is that the BTS would be inadvertently introduced to other islands throughout the Pacific. This concern is addressed comprehensively for all actions proposed in this EIS with mitigation measures described in Volume 2, Chapter 10.

### *Migratory Birds*

The Migratory Bird Treaty Act prohibits the taking, killing, or possessing migratory birds, with an exemption for military readiness activities (as defined in federal regulations) provided they do not result in a significant adverse effect on a population of a migratory bird species. Congress defined military readiness activities as all training and operations of the Armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (A) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (B) the operation of industrial activities; and (C) the construction or demolition of facilities used for a purpose described in A or B (50 Code of Federal Regulations Part 21).

The Department of Defense (DoD) must consult with the USFWS if it is determined that a military readiness activity would have a significant adverse effect on a population of a migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem.

Migratory bird conservation relative to non-military readiness activities is addressed separately in a Memorandum of Understanding developed in accordance with Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. The Memorandum of Understanding between the DoD and USFWS was signed in July 2006 and DoD responsibilities included, but are not limited to (1) incorporating conservation measures addressed in regional or state bird conservation plans and Integrated Natural Resources Management Plans; (2) managing military lands and activities other than military readiness in a manner that supports migratory bird conservation; and (3) avoiding or minimizing impacts on migratory birds, including incidental take and the pollution or detrimental alteration of the environments used by migratory birds.

The following species that occur on Guam are considered non-migratory birds and are not covered under the Migratory Bird Treaty Act: black francolin, black drongo, Eurasian tree sparrow, island-collard dove (previously known as Philippine turtle dove), common pigeon, and king quail.

### Special-Status Species

The presence of special-status species in the project areas was described in Volume 2. Background information is presented in the species profiles in Appendix G. Impacts would be determined significant if special-status species are present in the project area and any project action is likely to result in harassment or harm of an individual, population or species. Impacts on ESA-listed species would include vegetation clearing of designated undeveloped Overlay Refuge lands, or identified recovery habitat, unless it is determined that the removal of habitat or other affect is minor when considering all the remaining habitat and quality of habitat available to that species and considering USFWS recovery plan goals. Significant indirect impacts would also include disturbing ESA- and Guam-listed species due to noise, lighting, or

human activity. If unoccupied but recovery habitat is affected by operational noise, lighting, or human activity, impacts would be considered indirect and would be determined significant unless the area affected is considered minor when considering all the remaining habitat and quality of habitat available to that species.

The baseline area for Overlay Refuge on Guam is 21,690 acres (ac) (8,778 hectares [ha]) (USFWS 2008) with slight modifications made to correspond to the present Naval Computer and Telecommunications Station (NCTS)-Former Federal Aviation Administration (FAA) boundary (see Figure 10.1-2). The area of identified recovery habitat on Guam is 28,655 ac (11,596 ha) for the Mariana fruit bat and Guam Micronesian kingfisher, 27,124 ac (10,977 ha) for the Mariana crow, 49,564 ac (20,058 ha) for the Guam rail, and 11,668 ac (4,722 ha) for the *Serianthes* tree (USFWS 2010).

For ESA-listed species, federal agencies are required to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or its critical habitat. Analyses of potential impacts are based on review of plans for the proposed action and the available current and historical distributional data for each species. In accordance with Section 7 of the ESA, a Biological Assessment (BA) was prepared by the Navy to analyze the potential impacts on ESA-listed and critical habitat under the jurisdiction of the USFWS.

The BA and the subsequent Biological Opinion (BO) issued by the USFWS after their review of the BA, would be the final determination of impacts on ESA-listed species that are being evaluated in this EIS. The BO may provide an Incidental Take Statement that would list the amount or extent of take anticipated. Based on that take it would specify Terms and Conditions that the action proponent must comply with to be exempt from the prohibitions of Section 9 of the ESA. These are non-discretionary requirements. The BO may also specify Conservation Recommendations that are discretionary proponent activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

#### 12.2.1.3 Issues Identified during Public Scoping Process

Terrestrial biological resource issues identified by the public, including regulatory stakeholders, during the public scoping process that are applicable to the proposed action include the following:

- Activities associated with the military expansion (i.e., construction, expansion, renovation projects, and military training activities) may result in habitat loss and physical disturbance of federally listed endangered species and other federal trust species.
- Potential for harm to fragile ecosystems on Guam and in the CNMI from introducing non-native species due to increased traffic among the islands from the movement of personnel and materials. Such species include the BTS, flatworms, various insects, and some plants. The EIS should outline inspection and sanitary procedures to prevent this movement.
- Existing control and containment activities at air and sea ports for the BTS are insufficient to deal with the risk associated with the increased cargo and personnel movement from Guam to other vulnerable destinations. The issue “of utmost concern” is BTS interdiction and an effective, enforceable procedure for inspecting all military cargo, personnel, and equipment entering the CNMI must be instituted. The Navy must ensure funding to sustain a 100 percent (%) inspection rate of all cargo, vehicles, munitions, and household goods associated with the relocation of Marines. Guam regulation protocols 505 and 506 should be incorporated into a BTS control plan to be included as part of the EIS.

## 12.2.2 Power

### 12.2.2.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would recondition existing Combustion Turbines (CTs) and upgrade Transmission and Distribution (T&D) systems and would not require new construction or enlargement of the existing footprint of the facility. This work would be undertaken by the Guam Power Authority on its existing permitted facilities. Reconditioning would be made to existing permitted facilities at the Marbo, Yigo, Dededo (two units), and Macheche CTs. These CTs are currently being used very little if at all, and after reconditioning would be used as peaking and reliability reserve power. T&D system upgrades would be on existing above ground and underground transmission lines. This alternative supports proposed Main Cantonment Alternatives 1 and 2; proposed Main Cantonment Alternatives 3 and 8 would require additional upgrades to the T&D system.

All power line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact to terrestrial biological resources.

#### Proposed Mitigation Measures

No mitigation would be needed.

### 12.2.2.2 Summary of Impacts

Table 12.2-1 summarizes the potential impacts of the Basic Alternative 1. There would be less than significant impacts on terrestrial biological resources because the proposed alternative involves only upgrades to existing facilities and construction and installation of power lines in existing utility corridors in developed areas.

**Table 12.2-1. Summary of Potential Impacts on Terrestrial Biological Resources – Power (Basic Alternative 1)**

<i>Basic Alternative 1</i>	
<i>Construction (direct and indirect impacts same)</i>	
NI	<ul style="list-style-type: none"> <li>No impacts on vegetation, wildlife, and special-status species.</li> </ul>
Operation	
NI	<ul style="list-style-type: none"> <li>No impacts on vegetation, wildlife, and special-status species.</li> </ul>

*Legend: NI = No impact.*

## 12.2.3 Potable Water

As discussed in Volume 6, Chapter 2, Section 2.2.2, potable water alternatives are not distinguished as interim or long-term. Impacts from proposed potable water waterlines that run along public roadways are not evaluated since roadway improvements that would disturb these same areas are being evaluated for impacts in Volume 6, Chapter 4 and no additional impact beyond construction is anticipated.

### 12.2.3.1 Basic Alternative 1 (Preferred Alternative)

Basic Alternative 1 would provide additional water capacity of 11.3 MGd (42.8 MLd), which is anticipated to be met by an estimated 22 new wells at Andersen Air Force Base (AFB), rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 2.5 MG (9.5 ML) water storage tanks would be constructed at ground level at NCTS Finegayan. Up to two new elevated 1 MG (3.8 ML) water storage

tanks would be constructed at Finegayan within the Main Cantonment footprint. The placement of new underground waterlines and wells would be constructed along existing rights-of-way and areas of disturbed vegetation to the maximum extent possible.

In addition to the Basic Alternative 1 for the DoD water system, the GWA water system would need to be expanded to provide water to the construction workforce, induced civilian growth, and regularly expected civilian growth. The details of what GWA would specifically do to expand their water system are not known, but it would be roughly similar in magnitude to the DoD water system expansions. Not having details on this GWA water system expansion makes it impossible to accurately assess these potential indirect impacts on terrestrial biological resources. If the expansion of the GWA water systems does not occur, the civilian water customers would experience increased occurrences of low water pressure and irregular water service. This would not have an impact on terrestrial biological resources.

### Construction

#### *Vegetation*

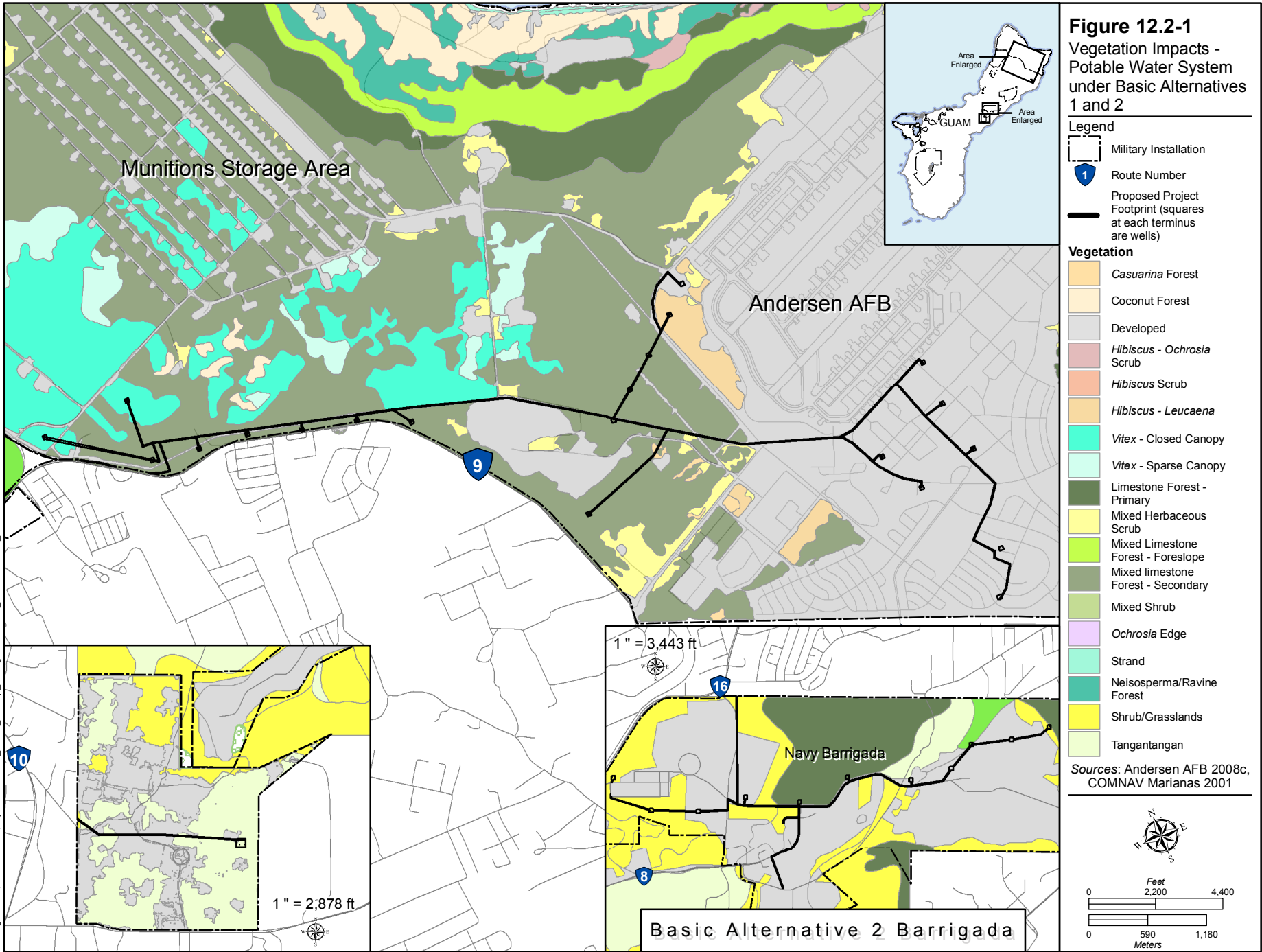
The vegetation associated with the various components under Basic Alternative 1 that would be removed is shown in Figure 12.2-1 and listed in Table 12.2-2. Disturbed limestone vegetation community types on Andersen AFB that would be affected are primarily mixed limestone forest (plateau/secondary and vitex) closed canopy forest. As mentioned above, the location for the placement of potable water components has not yet been determined. Uncommon tree species, such as *Tabernaemontana rotensis* would be avoided when placing these structures to the extent possible. At NCTS Finegayan, all water system components would be placed in areas already included in the proposed main cantonment area so that there would be no additional impacts on vegetation. Impacts on vegetation at Andersen AFB and Andersen South would be less than significant because minimal primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

**Table 12.2-2. Potential Direct Impacts on Vegetation Communities with Implementation of Potable Water Basic Alternative 1 (ac [ha])**

<i>Parcel and Activity</i>	<i>Limestone Forest, Disturbed</i>	<i>Tangantangan, Casuarina</i>	<i>Shrub/ Grasslands, Savanna</i>	<i>Developed</i>
<b>Andersen AFB</b>				
Water Wells	2.9 (1.2)	0.2 (0.1)	0	1.9 (0.8)
Waterlines	11 (4.5)	0.4 (0.2)	0	16 (6.5)
<b>Andersen South</b>				
Waterlines	2.3 (0.9)		0.1 (0.04)	0.1 (0.04)
<b>Total area removed</b>	<b>16 (6.5)</b>	<b>0.6 (0.2)</b>	<b>0.1 (0.04)</b>	<b>18 (7.3)</b>

*Legend:* ac = acre; AFB = Air Force Base; ha = hectare.

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### Wildlife

Based on studies by others and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are common throughout Guam. Native species of skinks and geckos have not been reported in the project areas in any recent studies (within the past 10 years) and were not observed in surveys conducted in project areas for this EIS.

Proposed construction activities would displace the species and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species is abundant in surrounding areas. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities at Andersen AFB would be less than significant under Alternative 1.

### Special-Status Species

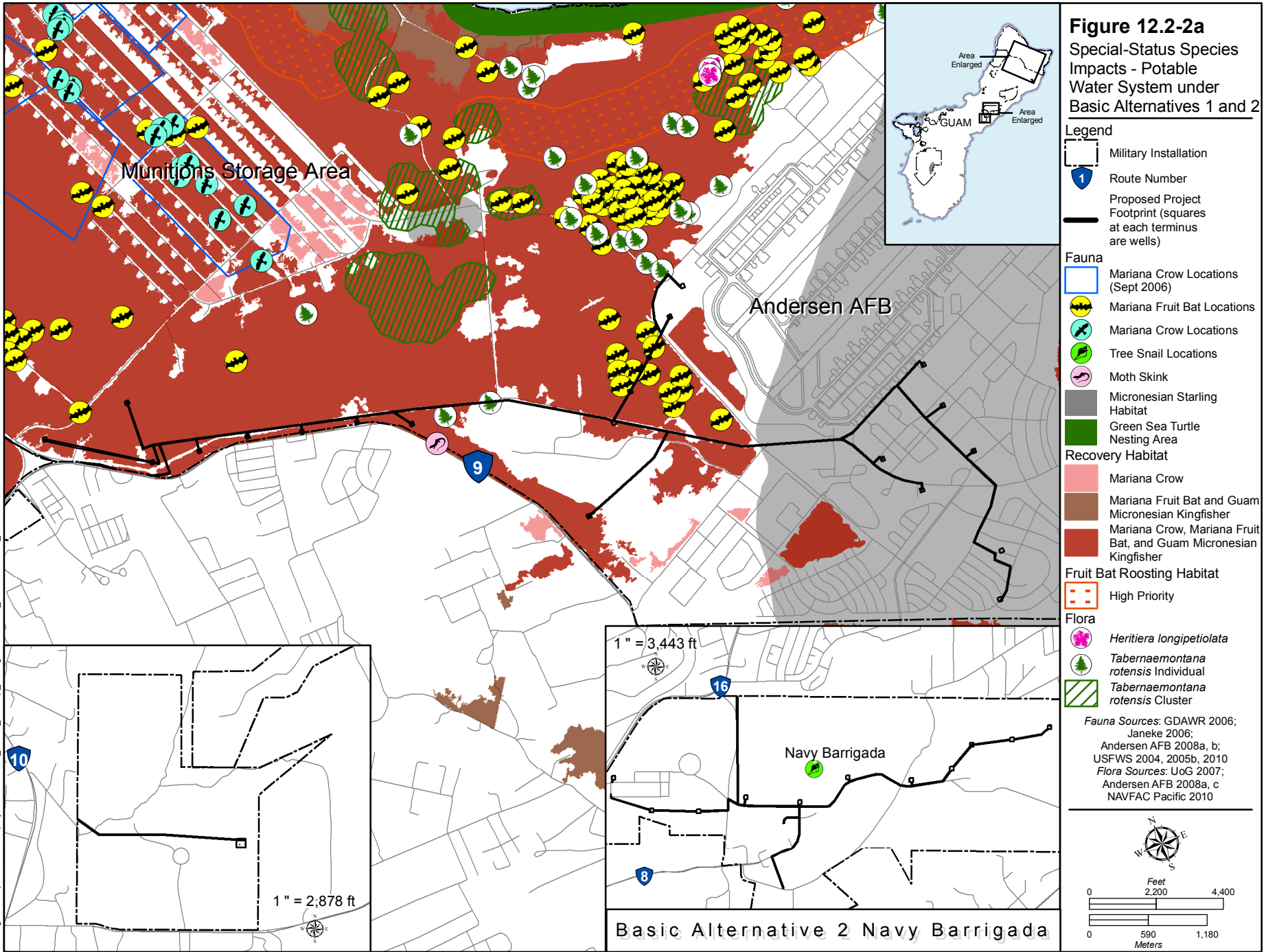
Specific identified habitat areas would be removed under Basic Alternative 1 for potable water, including Overlay Refuge and recovery habitat for the federal- and Guam-listed Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher (Figure 12.2-2 and Table 12.2-3). At NCTS Finegayan and the Former FAA parcel, all water system components would be in areas already included in the proposed main cantonment area so that there would be no additional impacts on habitat areas. Based on the removal of these habitat areas at Andersen AFB, there would be significant impacts on the three species. Several wells and connecting waterlines in the eastern cluster would be constructed in habitat of the Micronesian starling, a Guam-listed species (Figure 12.2-2) but loss if this small amount of habitat would result in less than significant impacts on this species.

*Mariana fruit bat.* Specific habitat areas would be removed under Basic Alternative 1 for potable water, including Overlay Refuge and recovery habitat for the fruit bat (Figure 12.2-2, Table 12.2-3). Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts on fruit bat. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6. Monitoring prior to construction would be conducted to determine if the fruit bat was present in the project area. If present, construction would be halted until the species left the area. With this mitigation, temporary indirect impacts on roosting and foraging activities of the Mariana fruit bat from noise and activity during construction would be less than significant.

*Mariana crow.* Specific habitat areas would be removed under Basic Alternative 1, including Overlay Refuge and recovery habitat for the crow (Figure 12.2-2a and Table 12.2-3). The Mariana crow is not currently present in areas where these projects would occur so there would be no impacts from construction. Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

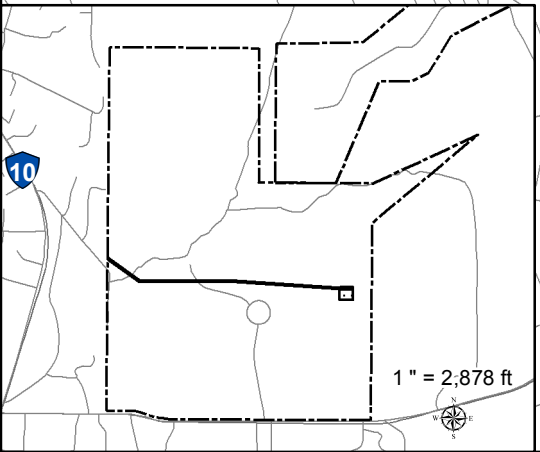
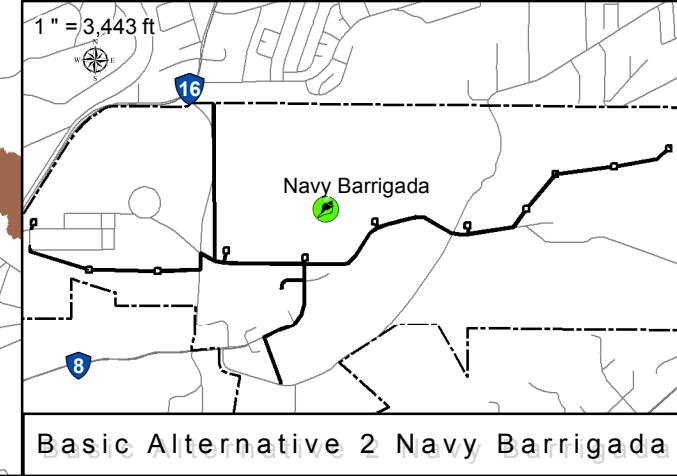


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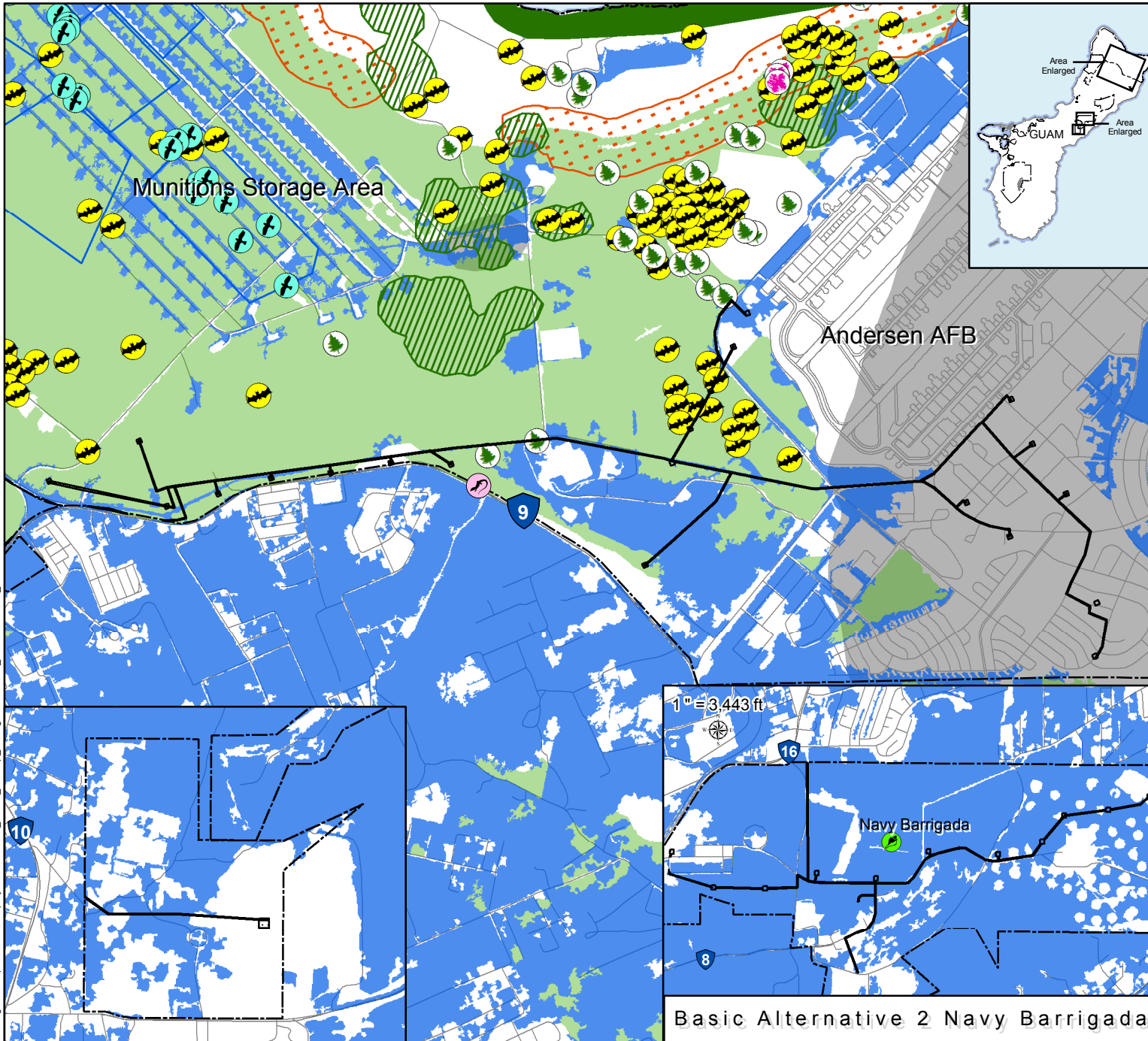


**Figure 12.2-2a**  
**Special-Status Species**  
**Impacts - Potable**  
**Water System under**  
**Basic Alternatives 1 and 2**

- Legend**
- Military Installation
  - Route Number
  - Proposed Project Footprint (squares at each terminus are wells)
- Fauna**
- Mariana Crow Locations (Sept 2006)
  - Mariana Fruit Bat Locations
  - Mariana Crow Locations
  - Tree Snail Locations
  - Moth Skink
  - Micronesia Starling Habitat
  - Green Sea Turtle Nesting Area
- Recovery Habitat**
- Mariana Crow
  - Mariana Fruit Bat and Guam Micronesia Kingfisher
  - Mariana Crow, Mariana Fruit Bat, and Guam Micronesia Kingfisher
- Fruit Bat Roosting Habitat**
- High Priority
- Flora**
- Heritiera longipetiolata*
  - Tabernaemontana rotensis* Individual
  - Tabernaemontana rotensis* Cluster
- Fauna Sources:* GDAWR 2006; Janeke 2006; Andersen AFB 2008a, b; USFWS 2004, 2005b, 2010  
*Flora Sources:* UoG 2007; Andersen AFB 2008a, c; NAVFAC Pacific 2010

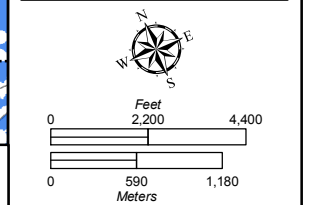


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**Figure 12.2-2b**  
**Special-Status Species**  
**Impacts - Potable**  
**Water System under**  
**Basic Alternatives 1 and 2**

- Legend**
- Military Installation
  - Route Number
  - Proposed Project Footprint (squares at each terminus are wells)
- Fauna**
- Mariana Crow Locations (Sept 2006)
  - Mariana Fruit Bat Locations
  - Mariana Crow Locations
  - Tree Snail Locations
  - Moth Skink
  - Micronesian Starling Habitat
  - Green Sea Turtle Nesting Area
- Recovery Habitat**
- Guam Rail
  - Serianthes nelsonii*
- Fruit Bat Roosting Habitat**
- High Priority
- Flora**
- Heritiera longipetiolata*
  - Tabernaemontana rotensis* Individual
  - Tabernaemontana rotensis* Cluster
- Fauna Sources:* GDAWR 2006; Janeke 2006; Andersen AFB 2008a, b; USFWS 2004, 2005b, 2010  
*Flora Sources:* UoG 2007; Andersen AFB 2008a, c; NAVFAC Pacific 2010



**Table 12.2-3. Potential Impacts on Special-Status Species Habitat with Implementation of Potable Water – Basic Alternative 1 (ac [ha])**

<i>Parcel and Activity</i>	<i>Overlay Refuge</i>	<i>Recovery Habitat – Bat and Kingfisher</i>	<i>Recovery Habitat – Crow</i>	<i>Recovery Habitat – Rail</i>	<i>Recovery Habitat – Serianthes</i>
<b>Direct Impacts from Construction – Habitat Removed</b>					
Andersen AFB					
Water Wells and Waterlines	11 (4.5)	10 (4.0)	10 (4.0)	8.8 (3.6)	11 (4.5)
<b>Total area removed</b>	<b>11 (4.5)</b>	10 (4.0)	10 (4.0)	8.8 (3.6)	11 (4.5)
Total Habitat Area of DoD Lands	21, 690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area of Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
Percentage of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.05%	0.03%	0.04%	0.02%	0.09%

Note: Each habitat category is considered independently of others and is not an additive.

Legend: ac = acre; AFB = Air Force Base; DoD = Department of Defense; ha = hectare.

*Guam Micronesian kingfisher.* The kingfisher survives only in captivity at this time. Specific habitat areas would be removed under Basic Alternative 1, including Overlay Refuge and recovery habitat for the kingfisher (Figure 12.2-2a, Table 12.2-3). Based on the removal of 10 ac (4.0 ha) of recovery habitat that is also Overlay Refuge, there would be significant impacts to the kingfisher. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 6, Chapter 10, Section 10.2.2.6.

*Guam rail.* The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that is potential foraging and nesting habitat for the Guam rail. A total of 8.8 ac (3.6 ha) of recovery habitat would be removed. (Volume 6, Chapter 10, Figure 10.2-13b). Numerous mitigation measures, described in Volume 2, Chapter 10, Section 10.2.2.6, would be implemented to improve the likelihood that this species could eventually be reintroduced successfully to suitable habitat on Guam. Based on these measures and the presence of large areas of recovery habitat for the species throughout much of Guam, the proposed construction at the Andersen South and non-DoD lands would result in a less than significant impact to the species.

*Micronesian starling.* Several wells and connecting waterlines in the eastern cluster would be constructed in habitat of the Micronesian starling, a Guam-listed species (Figure 12.2-2b). The loss of small areas of habitat would result in less than significant impacts on this species.

*Serianthes Tree.* Although no individual trees would be affected, a total of 11 ac (4.5 ha) of recovery habitat for this tree species would be removed for construction of the various project components on Andersen AFB (Table 12.2-3). This removal action represents about 0.09% of the recovery habitat identified by USFWS for the species. Based on no impact to existing individual *Serianthes* and the low amount of habitat affected compared to the total habitat remaining for the species, impacts would be less than significant.

*Mariana eight spot butterfly.* The two host plant species for this butterfly were not observed in field work conducted in project areas in September 2009. Furthermore, these host plants are generally associated with primary limestone forest in areas of pinnacle karst (karren), which is not present in the project areas.

Therefore, it is unlikely the eight spot butterfly is present in the project area so removal of vegetation within these areas due to construction would have no impact on the species.

*All special-status species.* Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of non-native plant and animal species to Guam, within Guam, and to other locations from Guam. Non-native species would affect special-status species or degrade habitat, thus are potential indirect impacts resulting from actions proposed in Basic Alternative 1. Special status species impacts may be significant but numerous mitigation measures, such as Hazard Analysis and Critical Control Point planning would be implemented to reduce impacts to less than significant.

#### Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines and wells would require minimal maintenance.

#### Proposed Mitigation Measures

Impacts on special-status species recovery habitat resulting from proposed potable water projects would be mitigated with a suite of protection and conservation measures for all impacts on Guam described in Volume 2, Chapter 10, Section 10.2.2 for a description of these measures. Mitigation measures directly applicable to potential impacts from proposed potable water projects are summarized in Section 12.2.3.4 of this chapter. Best Management Practices (BMPs) that would be employed during all project construction and operations are described in Volume 7.

##### 12.2.3.2 Basic Alternative 2

Basic Alternative 2 would provide additional water capacity of 11.7 MGd (44.3 MLd), which is anticipated to be met by an estimated 20 new wells at Andersen Air Force Base (AFB) and 11 new wells at Air Force Base Barrigada, rehabilitate existing wells, interconnect with the Guam Waterworks Authority (GWA) water system, and associated treatment, storage and distribution systems. Two new 1.8 MG (6.8 ML) water storage tanks would be constructed at ground level at NCTS Finegayan and one 1 MG (3.8 ML) water storage tank would be construction at Air Force Base Barrigada. Up to two new elevated 1 MG (3.8 ML) water storage tanks would be constructed at Finegayan within the Main Cantonment footprint.

Indirect impacts on the GWA water system would be the same as described in Basic Alternative 1.

#### Andersen AFB and Andersen South

##### *Construction*

*Vegetation.* Impacts would be the same as those under Basic Alternative 1 except that two water wells and associated piping would not be installed. Acreages affected are listed in Table 12.2-4. Impacts would be less than significant because no primary limestone forest would be removed.

*Special-Status Species.* Impacts would be the same as those under Basic Alternative 1 except that two water wells and associated piping would not be installed so fewer habitats would be affected. Acreages affected are shown in Table 12.2-5.

**Table 12.2-4. Potential Direct Impacts on Vegetation Communities with Implementation of Potable Water – Basic Alternative 2 (ac [ha])**

<i>Parcel and Activity</i>	<i>Limestone Forest, Primary</i>	<i>Limestone Forest, Disturbed</i>	<i>Tangantangan or Casuarina</i>	<i>Shrub/ Grasslands, Savanna</i>	<i>Developed</i>
<b>Andersen AFB</b>					
Water Wells	0	2.1 (0.8)	0.2 (0.1)	0	1.4 (0.6)
Waterlines	0	11 (4.5)	0.4 (0.2)	0	16 (6.5)
<b>Andersen South</b>					
Waterlines	0	2.3 (0.9)	0	0.1 (0.04)	0.1 (0.04)
<b>Navy Barrigada</b>					
Water Wells and Waterlines	0.5 (0.2)*	0	0	2.8 (1.1)	9.8 (4.0)
<b>Air Force Barrigada</b>					
Water Storage Tank	0	0	0.8 (0.3)	0	0.1 (0.04)
Waterlines	0	0	1.0 (0.04)	0	1.1 (0.4)
<b>Total area removed</b>	<b>0.5 (0.2)</b>	<b>15 (6.1)</b>	<b>2.4 (1.0)</b>	<b>2.9 (1.2)</b>	<b>29 (12)</b>

Note: \*This primary limestone forest removal is already accounted for in the development of the Army Cantonment in Volume 5, Alternative 2.

Legend: ac = acre; AFB = Air Force Base; ha = hectare.

### Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines, tanks, and wells would require minimal maintenance.

**Table 12.2-5. Potential Impacts on Special-Status Species Habitat with Implementation of Potable Water – Basic Alternative 2 (ac [ha])**

<i>Parcel and Activity</i>	<i>Overlay Refuge</i>	<i>Recovery Habitat – Bat and Kingfisher</i>	<i>Recovery Habitat – Crow</i>	<i>Recovery Habitat – Rail</i>	<i>Recovery Habitat – Serianthes</i>
<b>Direct Impacts from Construction – Habitat Removed</b>					
<b>Andersen AFB</b>					
Water Wells and Waterlines	11 (4.5)	0	0	4.7 (1.9)	0
<b>Total area removed</b>	<b>11 (4.5)</b>	<b>0</b>	<b>0</b>	<b>4.7 (1.9)</b>	<b>0</b>
Total Habitat Area - DoD Lands	21,690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area - Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
% of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.05%	0%	0%	0.01%	0%

Note: Each habitat category is considered independently of others and is not additive.

Legend: ac = acre; AFB = Air Force Base; DoD = Department of Defense; ha = hectare.

### Barrigada

#### Construction

*Vegetation.* The vegetation associated with Navy and Air Force Barrigada components under Basic Alternative 2 that would be removed are listed in Table 12.2-4. Two water wells would be constructed within the limestone forest but they would be at the edge of the forest, near the road. Habitats near the roads are typically partially invaded by non-native species so the forest is of lower quality. Because of the

size and location of the forest that would be removed, impacts on the primary limestone forest would be less than significant.

*Wildlife.* Wildlife species that currently occur at Barrigada are native and non-native species that are common elsewhere on Guam, such as Pacific golden plover, yellow bittern, island collared dove, western cattle egret, black francolin, Eurasian tree sparrow, blue-tailed skink, mutilating gecko, and mourning gecko. All these species are common on Guam. Proposed construction activities would displace wildlife from suitable habitat in the proposed project areas. Smaller, less mobile species, and those seeking refuge in burrows, could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because these species are abundant in surrounding areas and would rapidly repopulate suitable portions of the affected area. Therefore, the impacts on wildlife would be less than significant.

Construction activities for the operation buildings would generate noise. Only a few, widespread migratory bird species are present that would be affected. They would move away from the construction areas but there are other areas of suitable habitat nearby. There would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Basic Alternative 1.

*Special-Status Species.* Proposed construction activities at Navy and Air Force Barrigada would not impact any designated habitat areas. There would be no indirect impacts on special-status species. Species that would be directly affected are described below.

*Guam tree snail.* The Guam tree snail, an ESA candidate species, was documented in the primary limestone forest on one transect during site-specific surveys in 2008 in support of this EIS (see Figure 12.2-2a). The distribution and numbers of tree snails at the site is unknown. Proposed construction activities would remove 0.5 ac (0.2 ha) of primary limestone forest habitat. This area would be surveyed prior to removing vegetation and if present, tree snails would be relocated. With this mitigation, impacts would be less than significant.

### Operation

Terrestrial biological resources would not be affected under this alternative because, once installed, the potable water lines, wells, and tanks would require minimal maintenance.

### Proposed Mitigation Measures

Proposed mitigation measures for Andersen AFB, and Finegayan components would be the same as for Basic Alternative 1. Proposed mitigation for Navy Barrigada would be part of overall conservation measures that are described in Volume 2, Chapter 10 for Navy Barrigada. Mitigation measures directly applicable to potential impacts from proposed potable water projects are summarized in Section 12.2.3.4 of this chapter.

#### 12.2.3.3 Summary of Impacts

Table 12.2-6 provides a summary of the potential impacts of each alternative.

Impacts would be less than significant to vegetation because no limestone forest would be removed. Impacts on wildlife would be less than significant because there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Significant impacts would result from construction of water wells and waterlines at Andersen AFB because some of the areas where they would be placed is Overlay Refuge and identified recovery habitat for the Mariana fruit bat,



Guam Micronesian kingfisher, and Mariana crow. These impacts would be mitigated to less than significant with measures described in this section and in Volume 2, Chapter 10.

**Table 12.2-6. Summary of Potential Impacts on Terrestrial Biological Resources - Potable Water**

<i>Basic Alternative 1*</i>	<i>Basic Alternative 2</i>
Construction Impacts (direct with indirect impacts in parentheses if different)	
LSI <ul style="list-style-type: none"> <li>Less than significant impact to vegetation; no primary limestone forest would be removed.</li> </ul> LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul> SI (SI-M) <ul style="list-style-type: none"> <li>Significant direct impacts due to removal of recovery habitat for several special-status species at Andersen AFB; habitat is also NWR Overlay; potential significant indirect impacts from noise and activity disturbance, mitigated to less than significant.</li> </ul>	LSI <ul style="list-style-type: none"> <li>A minimal amount of primary limestone forest (0.5 ac [0.2 ha]) would be removed along the forest edge.</li> </ul> LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul> SI (SI-M) <ul style="list-style-type: none"> <li>Significant direct impacts due to removal of recovery habitat for several special-status species at Andersen AFB; habitat is also NWR Overlay; potential significant indirect impacts from noise and activity disturbance, mitigated to less than significant.</li> <li>Significant impacts at Navy Barrigada due to possible presence of the Guam tree snail in the area, mitigated to less than significant.</li> </ul>
Operation	
NI <ul style="list-style-type: none"> <li>No impact to vegetation, wildlife, and special-status species.</li> </ul>	NI <ul style="list-style-type: none"> <li>No impact to vegetation, wildlife, and special-status species.</li> </ul>

*Legend:* ac = acre; AFB = Air Force Base; ha = hectare; LSI = Less than significant impact; NI = No impact; NWR = National Wildlife Refuge; SI = Significant impact; SI-M = Significant impact mitigable to less than significant. \*Preferred Alternative.

12.2.3.4 Summary of Proposed Mitigation Measures

Table 12.2-7 provides a summary of the proposed mitigation measures of each alternative.

**12.2.4 Wastewater**

12.2.4.1 Basic Alternative 1a (Preferred Alternative)

Basic Alternative 1a supports the proposed Main Cantonment Alternatives 1 and 2 and combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the Northern District Wastewater Treatment Plant (NDWWTP). The difference between Alternatives 1a and 1b is a requirement for a new sewer line from Barrigada housing to NDWWTP for Alternative 1b.

**Table 12.2-7. Summary of Proposed Terrestrial Biological Mitigation – Potable Water**

<i>Alternatives 1 and 2</i>	<i>Alternative 2 Additional</i>	<i>No-Action Alternative</i>
<b>Vegetation</b>		
None specifically for vegetation.	None	None Necessary
<b>Wildlife and Special-Status Species</b>		
Develop the Micronesia Biosecurity Plan (see Volume 2, Chapter 10, Section 10.2.2.6)	Conduct pre-construction surveys in limestone forest within proposed water well footprint at Navy Barrigada and, if found, translocate Guam tree snails.	None Necessary
Use HACCP planning for construction projects (see Volume 2, Chapter 10, Section 10.2.2.6)		
Biological survey would be conducted for crows and bats before clearing (see Volume 2, Chapter 10, Section 10.2.2.6)		
Natural resource awareness briefings would be conducted for construction personnel (see Volume 2, Chapter 10, Section 10.2.2.6)		
The existing Navy Ungulate Management Plans would be updated to include the new lands to be used for training and cantonment areas and additional project-specific actions that would be necessary to ensure sensitive ecological resources are protected (see Volume 2, Chapter 10, Section 10.2.2.6)		
Establish or expand ecological reserves and conservation areas (see Volume 2, Chapter 10, Section 10.2.2.6)		

*Legend:* HACCP = Hazard Analysis and Critical Control Points.

Basic Alternatives 1a and 1b handle the increased demand from the direct DoD population increase. However, indirect impacts on the rest of the GWA sewage treatment systems would result from civilian population growth from the construction workforce, induced civilian growth, and regularly expected civilian growth. GWA would need to upgrade their sewer collection and treatment systems to properly meet this additional demand. The exact location of these upgrades would be up to GWA to specify. They do not have this need in their current resource management plan. Thus, the impact is currently impossible to assess. However, it appears that GWA would not be able to manage these improvements within the timeframe available. Thus, the wastewater system, except for the NDWWTP, would continue to not meet its National Pollutant Discharge Elimination System requirements and the collection systems would experience continued and additional overflow events. These affects would be at ocean outfalls.

Construction

*Vegetation*

Construction of a new sewer line from the Former FAA parcel to the NDWWTP would require a 24 feet (ft) (7.3 meter [m]) corridor approximately 8,300 ft (2,530 m) in length for a total of 4.6 ac (1.9 ha). The sewer line would follow trails that are evident on aerial photographs and traverse primarily through shrub/grassland and tangantangan habitat. Based on vegetation mapping by the U.S. Forest Service (2006), at most 1,000 ft (305 m) would traverse through disturbed limestone habitat; although, there are also open trails in through these areas that would be used for some of the pipeline corridor. Assuming the entire 1,000 ft (305 m) would need to be cleared, 0.6 ac (0.2 ha) disturbed limestone forest would be cleared, in addition to areas of shrub/grassland and tangantangan. Impacts from this removal would be less than significant because no primary limestone forest would be removed. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact.



### *Wildlife*

Based on studies by others and observations in other similar areas on the Former FAA parcel and South Finegayan, (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are ubiquitous throughout Guam. The GDAWR has noted in comments on the Draft EIS that the area serves as a refuge for breeding yellow bitterns. Native species of skinks and geckos have not been reported in nearby project areas and were not observed in surveys conducted in project areas for this EIS (Naval Facilities Engineering Command [NAVFAC] Pacific 2010).

Proposed construction activities would displace the yellow bittern and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. DoD would minimize impacts on all migratory birds during the project. Due to the ubiquitous nature of the yellow bittern, per numerous reports and our field observations during project field studies, the proposed removal of habitat is not expected to adversely affect the population of yellow bitterns on Guam. Overall, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Alternative 1a.

### *Special-Status Species*

No special-status species have been identified in the area of proposed new gravity sewer in recent studies or in recent project-specific surveys in similar nearby areas at South Finegayan and Former FAA parcel (NAVFAC Pacific 2010). However, recovery habitat for the Guam rail has recently been mapped by the USFWS in the area. Proposed construction would primarily be along existing cleared corridors and would not reduce the amount of shrubby edge habitat that is preferred habitat of the Guam rail. Impacts on the Guam rail would be less than significant. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact. There would be no impacts on other special-status species.

### Operation

Terrestrial biological resources would not be affected under this alternative as proposed activities involve only upgrades to existing facilities and infrastructure and sewer pipelines would be placed underground.

#### 12.2.4.2 Basic Alternative 1b

Basic Alternative 1b supports proposed Main Cantonment Alternatives 3 and 8 combines upgrade to the existing primary treatment facilities and expansion to secondary treatment at the NDWWTP. Under Basic Alternative 1b, the existing primary treatment system at NDWWTP would be refurbished and upgraded to accept additional wastewater flow and load from both central and northern Guam, and new sewer lines and lift pump stations. In addition to the sewer line proposed in Basic Alternative 1a, a new sewer line and pump stations would be installed to convey wastewater generated from Barrigada housing to the NDWWTP.

### Indirect impacts are the same as described above under Basic Alternative 1a Construction

#### *Vegetation*

Construction of a new sewer line from the Former FAA parcel to the NDWWTP and a new force main from the NDWWTP to the southeast where it would intersect road corridors would require a 24 ft (7.3 m) corridor approximately 15,000 ft (4,572 m) in length for a total of 8.3 ac (3.3 ha). The sewer line would follow trails that are evident on aerial photographs and traverse primarily through shrub/grassland and tangantangan habitat. Based on vegetation mapping by the U.S. Forest Service (2006), at most 1,000 ft (305 m) would traverse through disturbed limestone habitat in the northern segment, although there are also open trails in through these areas that would be used for some of the pipeline corridor. Assuming the entire 1,000 ft (305 m) would need to be cleared, 0.6 ac (0.2 ha) disturbed limestone forest would be cleared, in addition to areas of shrub/grassland and tangantangan. Impacts from this removal would be less than significant because no primary limestone forest would be removed. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact.

#### *Wildlife*

Based on studies by others and observations in other similar areas on the Former FAA parcel and South Finegayan, (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden plover in open areas; both species are ubiquitous throughout Guam. The GDAWR has noted in comments on the Draft EIS that the area serves as a refuge for breeding yellow bitterns. Native species of skinks and geckos have not been reported in nearby project areas and were not observed in surveys conducted in project areas for this EIS (NAVFAC Pacific 2010).

Proposed construction activities would displace the yellow bittern and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. DoD would minimize impacts on all migratory birds during the project. Due to the ubiquitous nature of the yellow bittern on Guam, per numerous reports and our field observations during project field studies, the proposed removal of habitat is not expected to adversely affect the population of yellow bitterns on Guam. Overall, there would be no diminished population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts on wildlife due to proposed construction activities would be less than significant under Alternative 1b.

#### *Special-Status Species*

No special-status species have been identified in the area of proposed new gravity sewer or force main in recent studies or in recent project-specific surveys in similar nearby areas at South Finegayan and Former FAA parcel (NAVFAC Pacific 2010). However, recovery habitat for the Guam rail has recently been mapped by the USFWS in the area. Proposed construction would be along existing cleared corridors in many areas and overall would not reduce the amount of shrubby edge habitat that is preferred habitat of the Guam rail. Other sewer line installations or upgrades would occur along existing disturbed utility or roadway corridors and would result in a less than significant impact. Impacts on the Guam rail would be less than significant.

Operation

Terrestrial biological resources would not be affected under this alternative as proposed activities involve only upgrades to existing facilities and infrastructure, sewer pipelines would be placed underground, and the pump station would be located within already developed area.

12.2.4.3 Summary of Impacts

Table 12.2-8 summarizes the potential impacts of each alternative.

**Table 12.2-8. Summary of Potential Impacts on Terrestrial Biological Resources – Wastewater**

<i>Basic Alternative 1a*</i>	<i>Basic Alternative 1b</i>
<b>Construction Impacts (there are direct impacts only)</b>	
VG – LSI • Less than significant impacts on vegetation WF – LSI • Less than significant impacts on wildlife SS – LSI • Less than significant impacts on special-status species	VG – LSI • Less than significant impacts on vegetation WF – LSI • Less than significant impacts on wildlife SS – LSI • Less than significant impacts on special-status species
<b>Operation Impacts</b>	
VG, WF, SS – NI • No impact	VG, WF, SS – NI • No impact

*Legend:* LSI = Less than significant impact; NI = No impact; SS = Special-Status Species; VG = Vegetation; WF = Wildlife. \*Preferred Alternative.

Installation of a new sewer line from Former FAA parcel to the NDWWTP would traverse disturbed and developed vegetation in areas with widely distributed wildlife species so impacts would be less than significant. No special-status species or recognized habitat areas are in the area so there would be no impact.

**12.2.5 Solid Waste**

12.2.5.1 Basic Alternative 1 (Preferred Alternative)

The Preferred Alternative would be to continue to use the Navy landfill at Apra Harbor for municipal solid waste (MSW) until the new Government of Guam (GovGuam) Layon landfill at Dandan is available for use. Disposal of other waste streams excluded from Layon landfill would continue at the Navy landfill. Construction and demolition (C&D) debris would continue to be disposed at the Navy hardfill.

The existing Navy landfill and landfill extent would be used and not expanded until the GovGuam landfill was ready. Since operations would not change substantially from present conditions, terrestrial biological resources would not be affected under this alternative. The proposed Layon landfill and its impacts were analyzed in a separate EIS by the GovGuam.

12.2.5.2 Summary of Impacts

Table 12.2-9 summarizes the potential impacts of Alternative 1.

**Table 12.2-9. Summary of Potential Impacts on Terrestrial Biological Resources – Solid Waste**

<i>Basic Alternative 1</i>
Construction and Operation
VG, WF, SS – NI
<ul style="list-style-type: none"> <li>• No impact</li> </ul>

*Legend:* NI = No impact; VG = Vegetation; WF = Wildlife; SS = Special-Status Species.

There would be no impacts on any terrestrial biological resources because the proposed alternative involves no expansion of the fill area of the existing Navy landfill that would be used until the new GovGuam landfill opens. No special-status species are known to reside in the area of the landfill. The proposed Layon landfill and its impacts were analyzed in a separate EIS by the GovGuam.

### 12.2.6 Off Base Roadways

As discussed in Volume 6, Chapter 2, Section 2.5, some Guam Road Network (GRN) projects involve road widening, bridge and culvert replacements, new road construction or roadway realignment, and pavement strengthening projects (some pavement strengthening projects can include road widening). This section addresses the potential direct and indirect impacts of the proposed GRN projects to terrestrial biological resources and also describes mitigation measures to avoid or minimize these potential impacts. Each project included under the alternatives described in Volume 6, Chapter 2, Section 2.5 is analyzed below and grouped by each region (North, Central, Apra Harbor, and South). The type and duration of the impact may vary depending on the project location and the project description. For instance, projects that involve pavement strengthening would occur within the existing roadway corridor on previously developed surfaces and no direct impacts on terrestrial biological resources are anticipated; however, surrounding areas outside of the roadway corridor may be subject to indirect impacts associated with runoff during the construction phase of the pavement strengthening activity. Other project types may potentially directly or indirectly impact terrestrial biological resources. Potential runoff impacts would be addressed with BMPs. Table 12.2-10 describes the direct and indirect impacts for each type of roadway project (non-widening pavement strengthening, intersection improvements, projects that require vegetation removal [e.g., roadway widening, new road construction, and roadway realignment projects], military access point modification or construction, and bridge and culvert replacements). Table 12.2-11 describes potential direct and indirect impacts for each roadway improvement project within the North Region. Table 12.2-12, Table 12.2-13, and Table 12.2-14 describe the same information for projects within the Central, Apra Harbor, and South regions, respectively.

**Table 12.2-10. GRN Project Type and Potential Impacts on Terrestrial Biological Resources**

<i>Project Type</i> <sup>1</sup>	<i>Type of Impact Evaluated</i>	<i>Potential Impact Description</i> <sup>2</sup>
Pavement Strengthening	Indirect impacts during construction phase	Uncontrolled runoff may impact downstream or downgradient vegetation communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of construction activity.
Intersection Improvements		
Roadway Widening, New Road Construction (Finegayan Connection), Military Access Point Modifications / Construction, & Road Realignment (Route 15)	Direct impacts	Removal of vegetation. Some vegetation may support special status species habitat, and displacement of wildlife.
	Indirect impacts-construction phase	Uncontrolled runoff may impact downgradient vegetation communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of construction activity.
	Indirect impacts-operational phase	Additional impervious cover would contribute runoff to adjacent terrestrial habitats. Increased potential for wildland fires and non-native invasive species encroachment along new edges.
Bridge and Culvert Replacements (Agana, Aguada, Asan #1, Asan #2, Atantano, Fonte, Laguas, & Sasa Bridges)	Direct impacts	Removal of vegetation on streambed slopes adjacent to bridge and culvert structures. Disturbance of aquatic habitats under and adjacent to the bridge structures during construction.
	Indirect impacts-construction phase	Uncontrolled runoff may impact downstream aquatic communities, wildlife, and special status species that utilize these areas during the construction phase. Construction noise may disturb special status species and wildlife within the vicinity of the bridge replacement.
	Indirect impacts-operational phase	Alteration of the hydraulic conveyance due to the new bridge design may impact downstream aquatic habitats.

*Notes:*

<sup>1</sup> The GRN project descriptions and alternatives are included in Volume 6, Chapter 2, Section 2.

<sup>2</sup> Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

*Legend:* GRN = Guam Road Network.

**Table 12.2-11. North Region GRN Projects, Alternatives, and Potential Impacts**

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
8	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas north of Okkodo School (e.g., Navy Refuge Overlay unit).	<b>None:</b> This project does not require widening, only pavement strengthening, to modify the access to Okkodo High School on the interior portion of the road.
9	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas west of Route 3 (e.g., Navy Refuge Overlay unit and Andersen AFB Refuge Overlay unit). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	Wildlife displacement and removal of vegetation communities through the road widening areas from NCTS Finegayan to Route 28 along Route 3, including Navy Refuge Overlay lands, recovery habitat areas, and lands designated as recovery zones.
10	x	x	x	x		Wildlife displacement and removal of vegetation communities through the road widening areas from NCTS Finegayan to Route 9 along Route 3.
22	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	Wildlife displacement and removal of vegetation communities through the road widening areas from Route 3 to the proposed Andersen AFB North Gate along Route 9.
22A	X	x	x	x	Runoff during the construction phase for the medians and shoulders and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units).	Although this project is a pavement strengthening project, medians and shoulders would be added, that would expand the project footprint into forested areas of Andersen AFB along Route 9 between the Andersen AFB North Gate and the Andersen AFB Main Gate.
23	x	x	x	x	Runoff during the construction phase for these projects and construction noise in areas north of Route 9 (e.g., Andersen AFB Refuge Overlay units). Increased potential for non-native invasive species encroachment and wildland fires along new edges after construction.	<b>None:</b> This project does not require widening, only pavement strengthening, from Chalan Lujuna to Route 9.
38		x	x			These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
38A	x			x		These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
39		x	x			These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
39A	x			x		These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
41		x				These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
41A	x			x		These MAP projects would require the removal of limestone forest within recovery habitat areas for the Mariana crow, Mariana fruit bat, and Micronesian kingfisher.
42	x	x	x	x		This MAP project, although within limestone forests, was analyzed as part of the Intelligence, Surveillance, and Reconnaissance/Strike Final EIS (Andersen AFB 2006).

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
57	x	x	x	x	Runoff during the construction phase for these projects.	This road widening project would require the removal of scrub forest vegetation that may contain important resources for the recovery of special-status species.
117	x	x	x	x		<b>None:</b> This intersection project would occur in previously developed lands with no disturbance to vegetation communities other than urban cultivated areas.
124	x	x		x	Runoff during the construction phase for this project and construction noise in areas along the new road corridor (e.g., Navy Refuge Overlay unit). Increased potential for non-native species encroachment and wildland fires along new edges after construction.	The Finegayan connector road would require clearing through limestone forest, scrub forests, and tangantangan thickets. Although most of the road corridor is through previously developed areas, the limestone and scrub forest communities may contain important resources for the recovery of special-status species.

Notes:

<sup>1</sup> The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2, Section 2.5.

<sup>2</sup> Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: AFB = Air Force Base; GRN = Guam Road Network; MAP = Military Access Point; NCTS = Naval Computer and Telecommunications Station.

**Table 12.2-12. Central Region GRN Projects, Alternatives, and Potential Impacts**

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
1	x	x	x	x	<b>None:</b> The proposed intersection improvement for Route 1 and 8 (GRN # 1) and Route 1 and 3 (GRN # 2) would occur in a previously developed commercial area in Hagatna. Runoff or construction noise would not impact terrestrial biological resources (i.e., vegetation communities, wildlife, or special-status species).	<b>None:</b> Intersection improvements Routes 1/8 and Routes 1/3 on previously cleared land in developed areas and would not directly impact terrestrial biological resources.
2	x	x	x	x		
3	x	x	x	x	Potential sedimentation along the 260 feet (80 meter) streambed of the Agana River between Agana Bridge and the river terminus (between East Hagatna Beach and Paseo de Susana Park).	The Agana bridge replacement occurs over riverine aquatic habitat away from sea turtle nesting and other special status species locations; therefore, no direct impacts on special status species. Construction activities would remove vegetation and alter aquatic habitats in the immediate project footprint.
6	x	x	x	x	<b>None:</b> The proposed road widening would occur in previously developed mixed commercial / light industrial areas (e.g., Tumon Tank Farm). Runoff or construction noise would not impact terrestrial biological resources.	<b>None:</b> Construction (road-widening) on previously cleared land and would not impact terrestrial biological resources.
7	x	x	x	x	<b>None:</b> The proposed road widening would occur in previously developed mixed commercial / light industrial areas (e.g., Micronesia Mall). Runoff or construction noise would not impact terrestrial biological resources.	

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
11	x	x	x	x	<i>None:</i> The proposed roadway improvement along Chalan Lujuna would occur in residential areas (e.g., Perez Acres subdivision). Potential runoff or noise would not impact terrestrial biological resources.	<i>None:</i> This project does not require widening, only pavement strengthening, from Route 1 to Route 15 along Chalan Lujuna to improve flow for truck traffic.
12	x	x	x	x	Runoff during the construction phase for this project. Special status species are not expected to utilize the area, so construction noise would not impact special status species.	<i>None:</i> This project does not require widening, only pavement strengthening, from the Smith Quarry to Chalan Lujuna on Route 15 to Route 3 along Chalan Lujuna.
13	x	x	x	x	Runoff during the construction phase for this project, particularly into Asan River. Special status species are not expected to utilize the area, so construction noise would not impact special status species.	<i>None:</i> These projects do not require widening, only pavement strengthening along Route 1 from 11 to Asan Bridge (GRN # 13), Asan Bridge to Route 6 (GRN # 14), and Route 6 to Route 4.
14	x	x	x			
15	x	x	x			
16	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 8 would occur in commercial (Home Depot) and industrial (Airport) areas. Potential runoff or noise would not impact terrestrial biological resources.	<i>None:</i> These projects do not require widening, only pavement strengthening from Tiyan Parkway to Route 1 along Route 8 (GRN # 16) and Route 10 to Tiyan Parkway (GRN # 17).
17	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 8 would occur in commercial areas (e.g., Harmon Flea Market, Compadres Mall) and industrial areas (e.g., Guam Power Authority substations). Potential runoff or noise would not impact terrestrial biological resources.	<i>None:</i> These projects do not require widening, only pavement strengthening along Route 16 from Route 27 to Route 10A (GRN # 18), Route 10A to Sabana Barrigada Drive (GRN # 19), Sabana Barrigada Drive to Route 8/10 (GRN # 20).
18	x	x	x			
19	x	x	x			
20	x	x		x		
21	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 27 would occur in commercial areas (e.g., Compadres Mall), residential areas (e.g., Las Palmas Subdivision), and recreational areas (e.g., Robbie Webber Soccer Field). Potential runoff or noise would not impact terrestrial biological resources.	<i>None:</i> This project does not require widening, only pavement strengthening along Route 27.
28	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 26 would occur in commercial areas (e.g., Dededo Mall), and residential areas (e.g., Summer Place Subdivision). Potential runoff or noise would not impact terrestrial biological resources.	<i>None:</i> This project does not require widening, only pavement strengthening along Route 26 between Route 1 and route 15.
29	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 25 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	<i>None:</i> Although road widening is necessary for this project, the project occurs in previously developed areas and would not impact terrestrial biological resources.



GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
30	x	x	x	x	<i>None:</i> The proposed roadway improvements along Route 10 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	<i>None:</i> This project does not require widening, only pavement strengthening along Route 10 between Route 15 and route 18.
31	x	x		x	<i>None:</i> The proposed roadway improvements along Route 10 would occur in residential areas, and some open fields of tangantangan of no value to special status species or wildlife resources.	<i>None:</i> This project does not require widening, only pavement strengthening along Route 8A between Route 16 and the NAVCAMS Barrigada.
32	x	x	x	x	<i>None:</i> The proposed roadway improvements along this section of Route 15 would occur along residential areas, recreational areas (Navy recreational fields), and open fields of tangantangan of no value to special status species or wildlife resources.	<i>None:</i> This project does not require widening, only pavement strengthening and intersection improvements along Route 15 between Route 10 to Chalan Lujuna.
33	x	x	x	x	Portions of the proposed roadway improvements along Route 1 are adjacent to Asan Bay and Hagatna beaches; however, sea turtle nesting is not known to occur here. Potential for runoff into Agana River and stormwater drainages that terminate into Tumon Bay and Tumon Bay Marine Preserve.	<i>None:</i> This project does not require widening, only pavement strengthening and intersection improvements along Route 1 between Route 8 to Route 13.
35	x	x	x	x	Potential sedimentation between each bridge and the spanned river terminus. Aguada, Laguas Bridge, and Sasa Bridge replacements are upstream of mangrove and estuarine areas of Sasa Bay Marine Preserve. These habitats are not preferred Mariana common moorhen habitat, but may occasionally support foraging habitat for this species.	The bridges proposed for replacement occur over riverine aquatic habitats that may directly or indirectly impact wetland communities within the drainage. Furthermore, these areas may represent Mariana common moorhen habitat.
36	x	x	x	x	Runoff during the construction phase for this project and construction noise in areas, primarily to the south (downgradient) of the proposed route. Increased potential for non-native species encroachment and wildland fires along new edges after construction.	The relocation of Route 15 would require clearing through limestone forest, scrub forests, and tangantangan thickets. Although most of the road corridor is through previously developed areas, the limestone and scrub forest communities may contain important resources for the recovery of special-status species.
44	x	x	x	x	<i>None:</i> The proposed MAP improvement would occur in previously developed and degraded areas of Andersen South. Runoff or construction noise would not impact terrestrial biological resources.	<i>None:</i> This MAP project would occur in previously developed lands with no disturbance of vegetation communities other than degraded tangantangan thickets.
46	x	x	x	x		

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
47			x		<b>None:</b> The proposed MAP improvement would occur in a previously developed and degraded area of Barrigada (Navy). Runoff or construction noise would not impact terrestrial biological resources.	<b>None:</b> These MAP projects would occur in previously developed lands with no disturbance of vegetation communities other than urban cultivated areas.
48			x			
49			x		<b>None:</b> The proposed MAP improvement would occur in a previously developed and degraded area of Barrigada (Air Force). Runoff or construction noise would not impact terrestrial biological resources.	<b>None:</b> These MAP projects would occur in previously developed lands with no disturbance of vegetation communities other than urban cultivated areas in the vicinity of Barrigada (Air Force).
49A			x	x		
63			x			
74			x			
113	x	x	x	x		

Notes:

<sup>1</sup> The GRN project descriptions and alternatives are described in detail in Section 2.5 of this Volume.

<sup>2</sup> Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network; MAP = Military Access Point; NAVCAMS = Naval Communication Area Master Station

**Table 12.2-13. Apra Harbor GRN Projects, Alternatives, and Potential Impacts**

GRN #	Alternative <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
4	x	x	x	x	<b>None:</b> The proposed MAP improvement would occur in a previously developed and degraded area along Route 11. Runoff or construction noise would not impact terrestrial biological resources.	<b>None:</b> The proposed improvements along Route 11 between the commercial port and Route 1 (GRN # 4) do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor. The addition of the weigh station would require some vegetation removal (tangantangan thickets and grasses), but there are no biological resources along Route 11 that would be affected by the proposed project. The Route 11 and Route 1 intersection improvement (GRN #5) would be constructed on grounds that have been previously cleared and would not impact terrestrial biological resources.
5	x	x	x	x		
24	x	x	x	x	Portions of the proposed roadway improvements along Route 1 are adjacent to Sasa Bay Marine Preserve (on the west side of Route 1) and freshwater wetlands (on the east side of Route 1). Potential for runoff during the construction phase into Sasa Bay and Sasa River, Laguas River, Aguada River, and Atantano River, which terminate at Sasa Bay or Inner Apra Harbor.	<b>None:</b> These projects do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor with no gain in impervious cover.

GRN #	Alternative <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
26	x	x	x	x	Portions of the proposed roadway improvements along Route 2A are adjacent freshwater wetlands formed by the Atantano River. Potential for runoff during the construction phase into the wetlands and other stormwater drainages that terminate at Inner Apra Harbor.	<b>None:</b> These projects do not require road widening (only pavement strengthening); therefore, no terrestrial biological resources would be affected because all work would be confined within the existing road corridor with no gain in impervious cover.
50	x	x	x	x	<b>None:</b> The proposed MAP improvement would occur in a previously developed and degraded area of Naval Base Guam. Runoff or construction noise would not impact terrestrial biological resources.	<b>None:</b> This MAP project would occur in previously developed lands with no disturbance of vegetation communities around the proposed location at Naval Base Guam.

Notes:

<sup>1</sup> The GRN project descriptions and alternatives are described in detail in Section 2.5 of this Volume.

<sup>2</sup> Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network; MAP = Military Access Point.

**Table 12.2-14. South Region GRN Projects, Alternatives, and Potential Impacts**

GRN #	Alternatives <sup>1</sup>				Potential Impact Type and Description <sup>2</sup>	
	1	2	3	8	Indirect	Direct
25	x	x	x	x	Although most of the portions of the proposed roadway improvements along Route 5 are adjacent to residential areas (e.g., Apra Heights), some portions have potential for construction runoff into freshwater wetlands formed by the Namo River near the Agat Commercial Center. The Namo River terminates at Agat Bay.	<b>None:</b> These projects do not require widening, only pavement strengthening along Route 5 from Route 2A to Route 17 (GRN # 25), and Route 17 to the NMS. (GRN # 27).
27	x	x	x	x		
52	x	x	x	x	Potential for runoff during the construction phase into upper reaches of the Namo River.	<b>None:</b> This MAP project at NMS would occur in previously disturbed lands with no disturbance of vegetation communities other than degraded tangantangan thickets.
110	x	x	x	x	<b>None:</b> The proposed intersection improvement for Route 2 and 12 would occur near commercial and light industrial areas (e.g., Agat Commercial Center). Runoff or noise during the construction phase would not impact terrestrial biological resources.	<b>None:</b> The Route 2 and Route 12 intersection improvement would be constructed on grounds that have been previously cleared and would not impact terrestrial biological resources.

Notes:

<sup>1</sup> The GRN project descriptions and alternatives are described in detail in Volume 6, Chapter 2, Section 2.5.

<sup>2</sup> Mitigation measures are included later in this chapter that minimize or avoid potential direct or indirect impacts.

Legend: GRN = Guam Road Network.

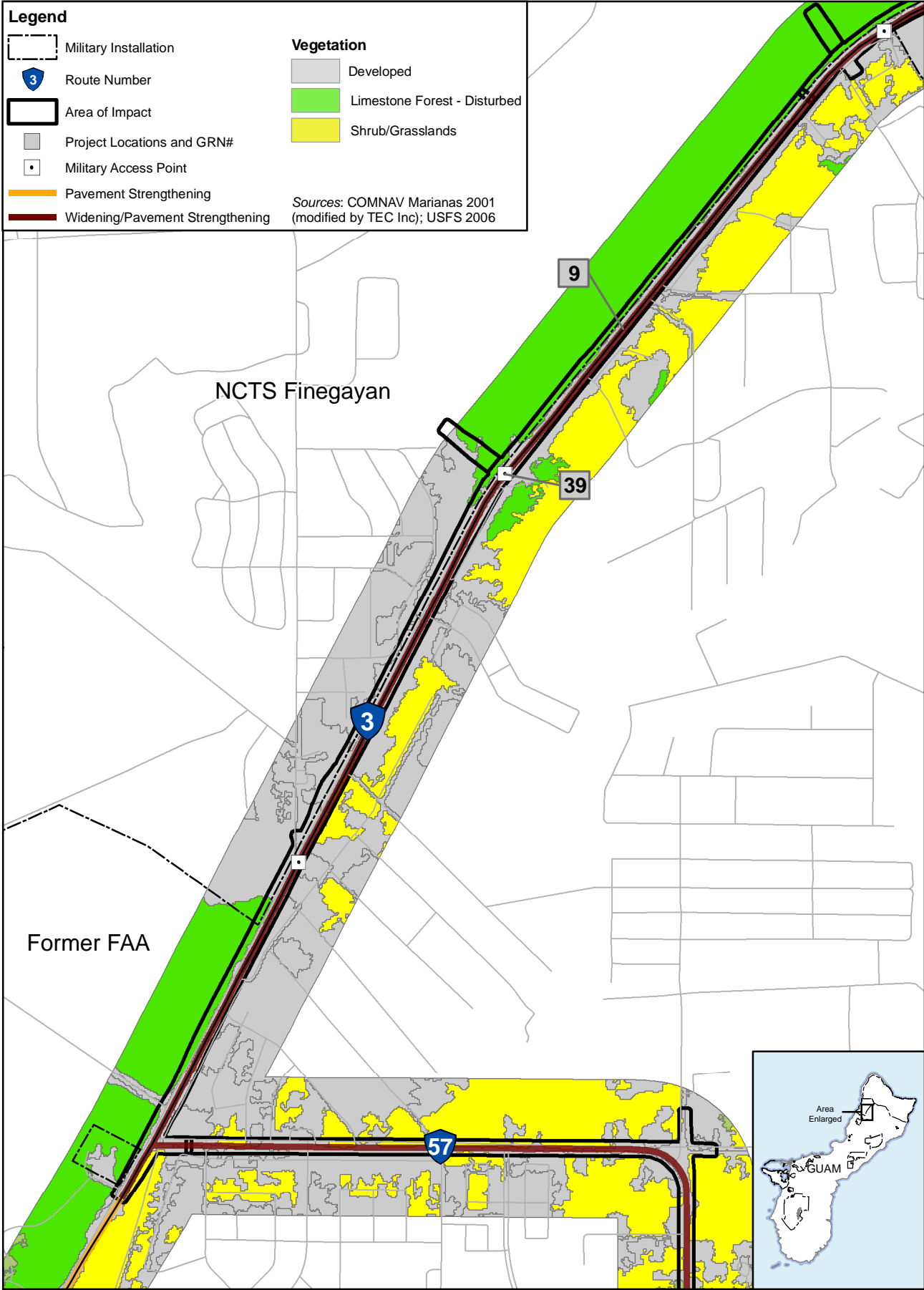
**Legend**

- Military Installation
- Route Number
- Area of Impact
- Project Locations and GRN#
- Military Access Point
- Pavement Strengthening
- Widening/Pavement Strengthening

**Vegetation**

- Developed
- Limestone Forest - Disturbed
- Shrub/Grasslands

Sources: COMNAV Marianas 2001 (modified by TEC Inc); USFS 2006













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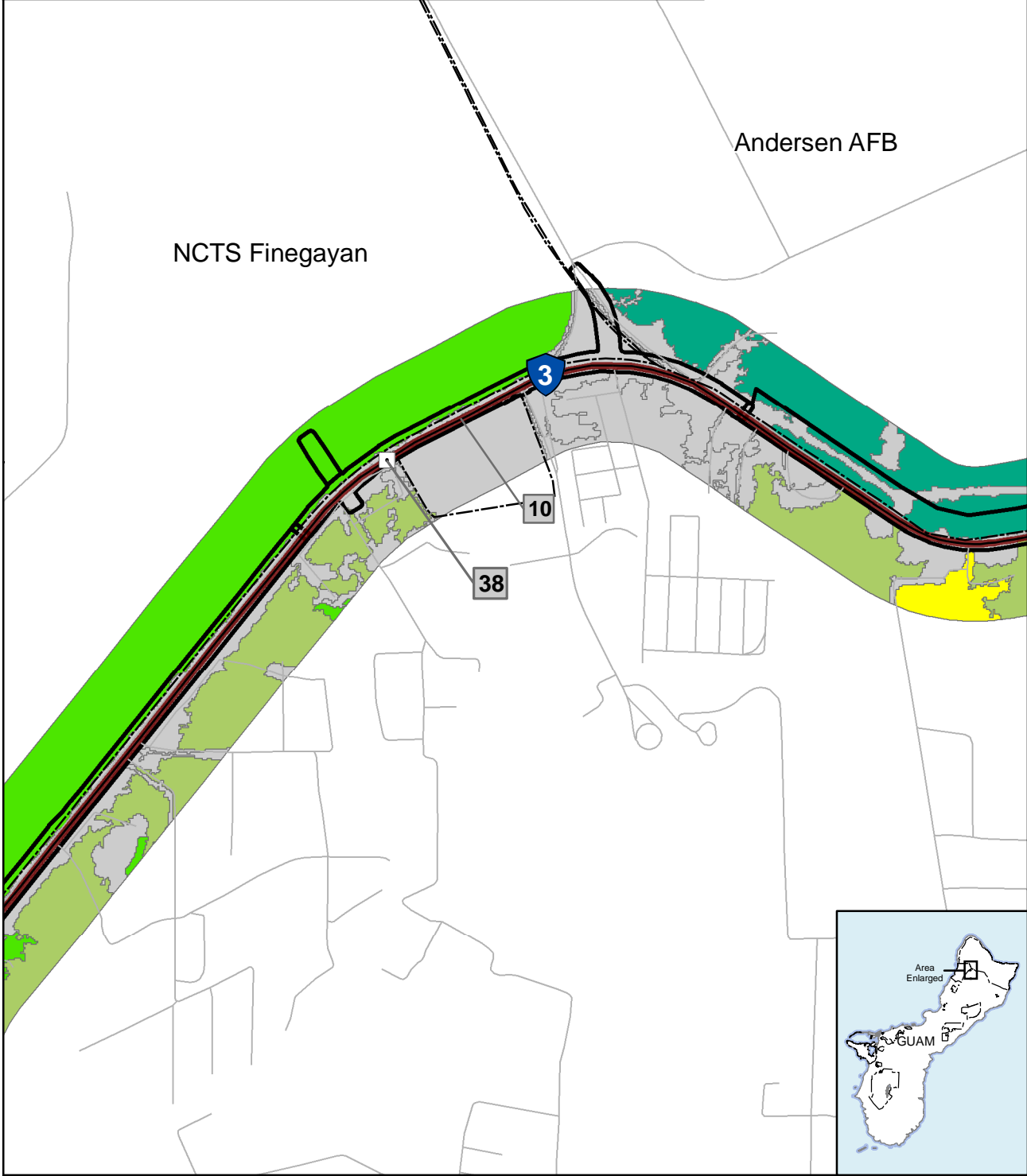
**Figure 12.2-3**  
**GRN Projects in the North Region Considered for Analysis - Map 1**



**Legend**

	Military Installation	<b>Vegetation</b>		Developed
	Route Number			Limestone Forest - Disturbed
	Area of Impact			Mixed Limestone Forest - Plateau/Secondary
	Project Locations and GRN#			Shrub/Grasslands
	Military Access Point			
	Widening/Pavement Strengthening			

Sources: COMNAV Marianas 2001 (modified by TEC Inc); USFS 2006; Andersen AFB 2008c













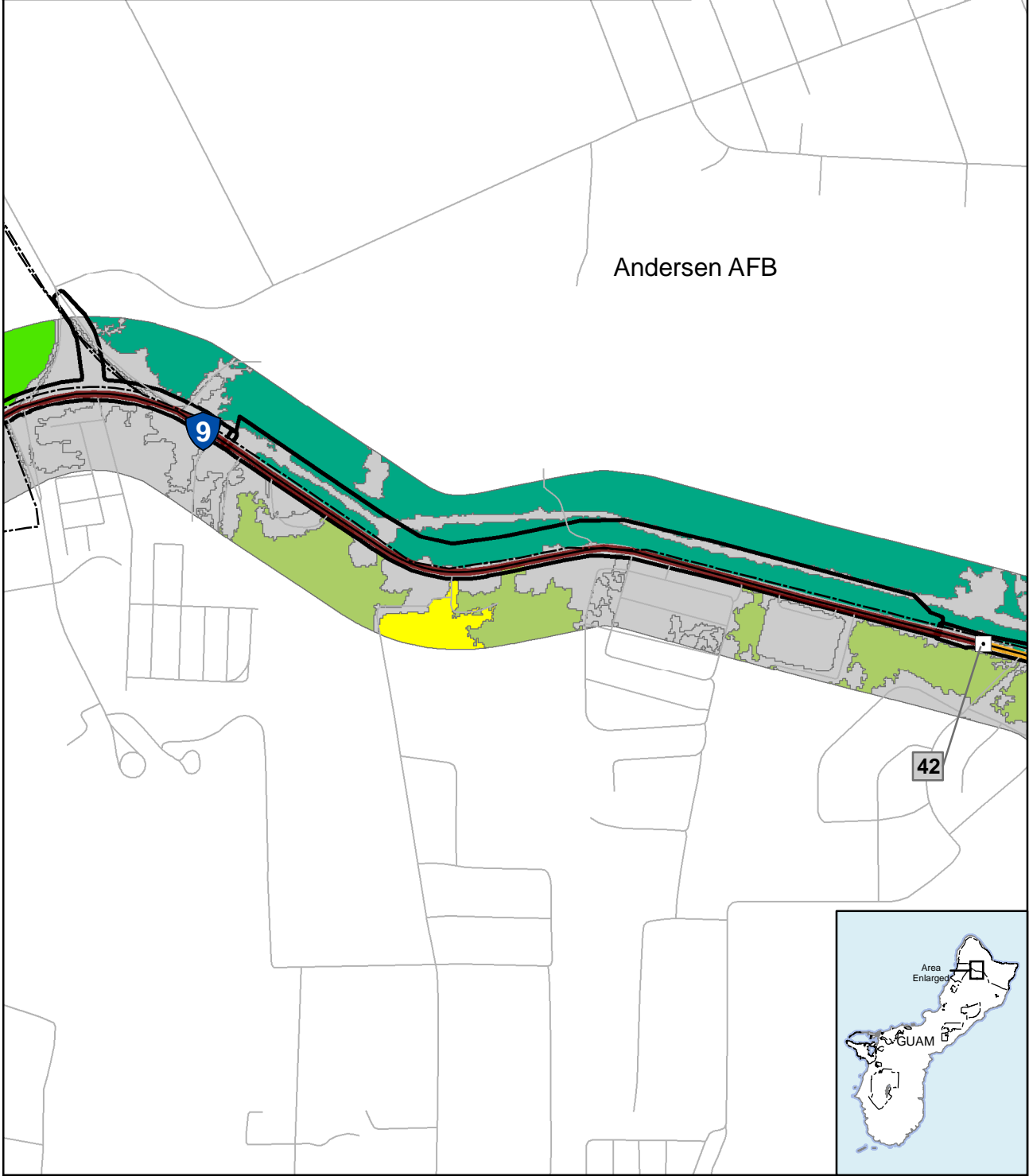
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**Figure 12.2-4**  
**GRN Projects in the North Region Considered for Analysis - Map 2**



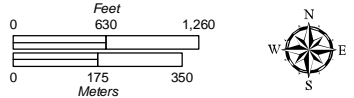
**Legend**

 Military Installation	<b>Vegetation</b>
 Route Number	 Developed
 Area of Impact	 Limestone Forest - Disturbed
 Project Locations and GRN#	 Mixed Limestone Forest - Plateau/Secondary
 Military Access Point	 Shrub/Grasslands
 Widening/Pavement Strengthening	<i>Sources: USFS 2006; Andersen AFB 2008c</i>















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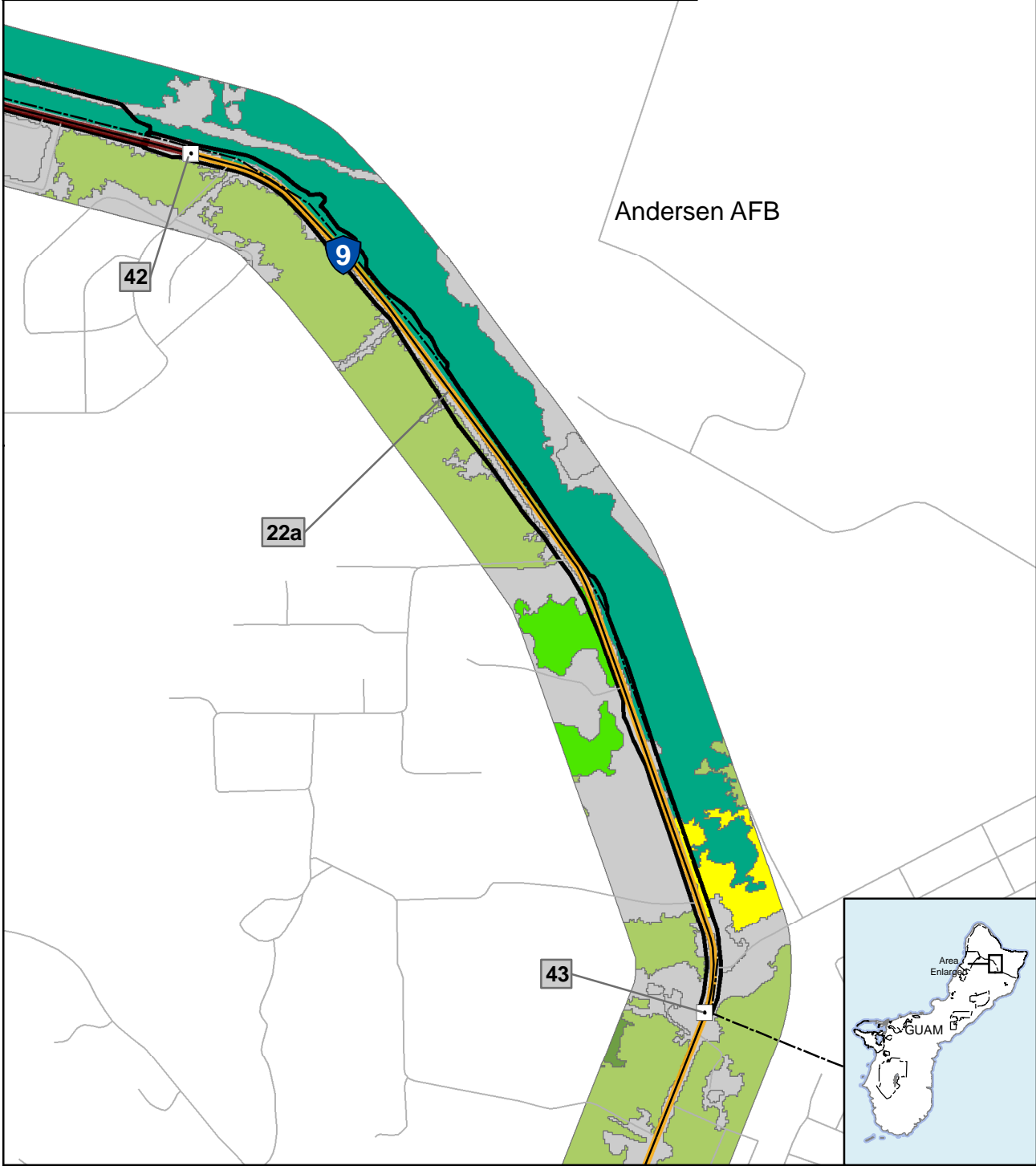
**Figure 12.2-5**  
**GRN Projects in the North Region Considered for Analysis - Map 3**



**Legend**

 Military Installation	<b>Vegetation</b>
 Route Number	 Developed
 Area of Impact	 Limestone Forest - Disturbed
 Project Locations and GRN#	 Mixed Limestone Forest - Plateau/Secondary
 Military Access Point	 Shrub/Grasslands
 Widening/Pavement Strengthening	 Agriculture Field
 Pavement Strengthening	

Source: USFS 2006; Andersen AFB 2008c














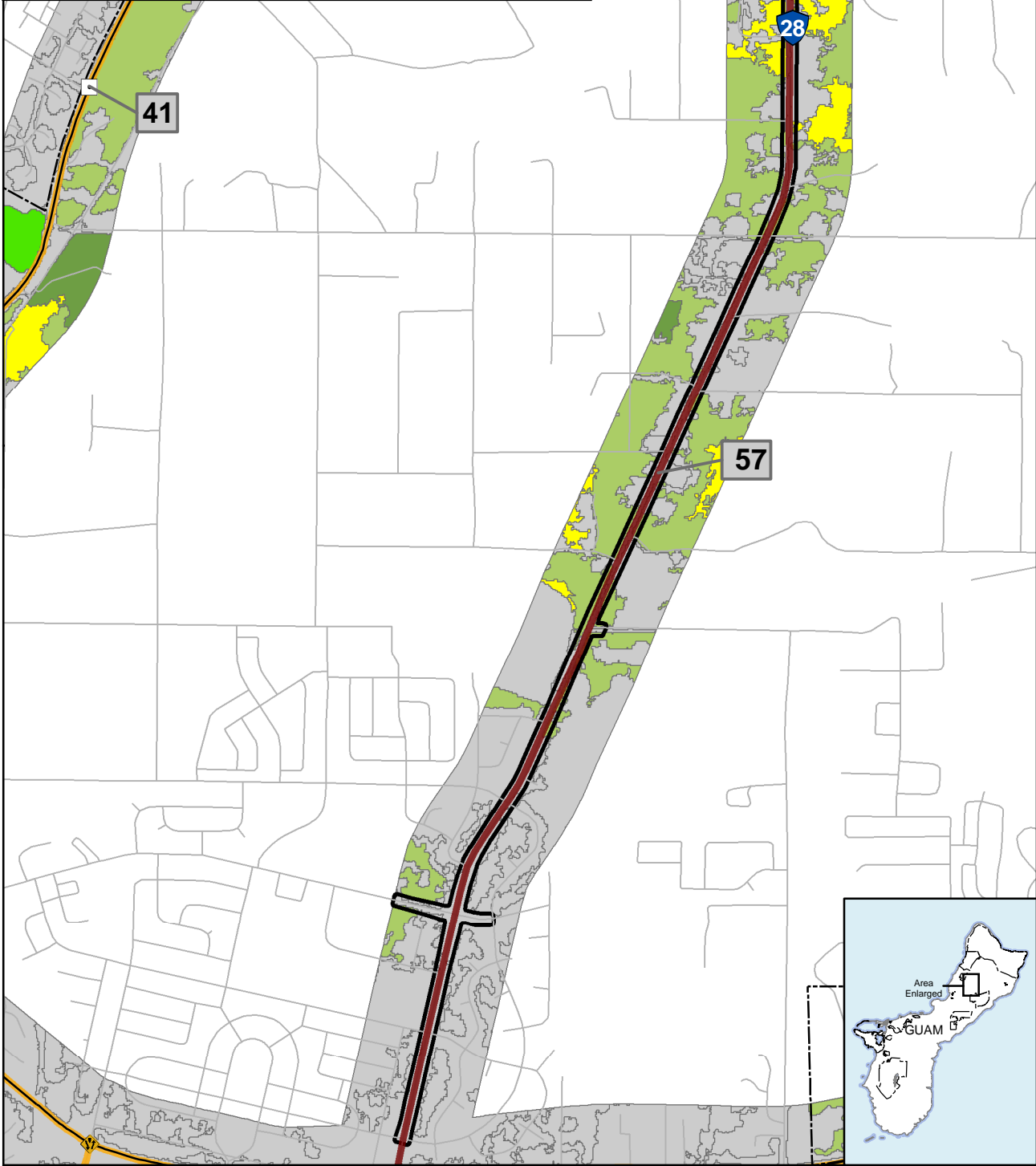
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**Figure 12.2-6**  
**GRN Projects in the North Region Considered for Analysis - Map 4**



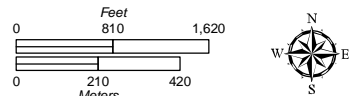
**Legend**

 Military Installation	<b>Vegetation</b>
 Route Number	 Developed
 Area of Impact	 Limestone Forest - Disturbed
 Project Locations and GRN#	 Shrub/Grasslands
 Military Access Point	 Agriculture Field
 Widening/Pavement Strengthening	
 Pavement Strengthening	Source: USFS 2006

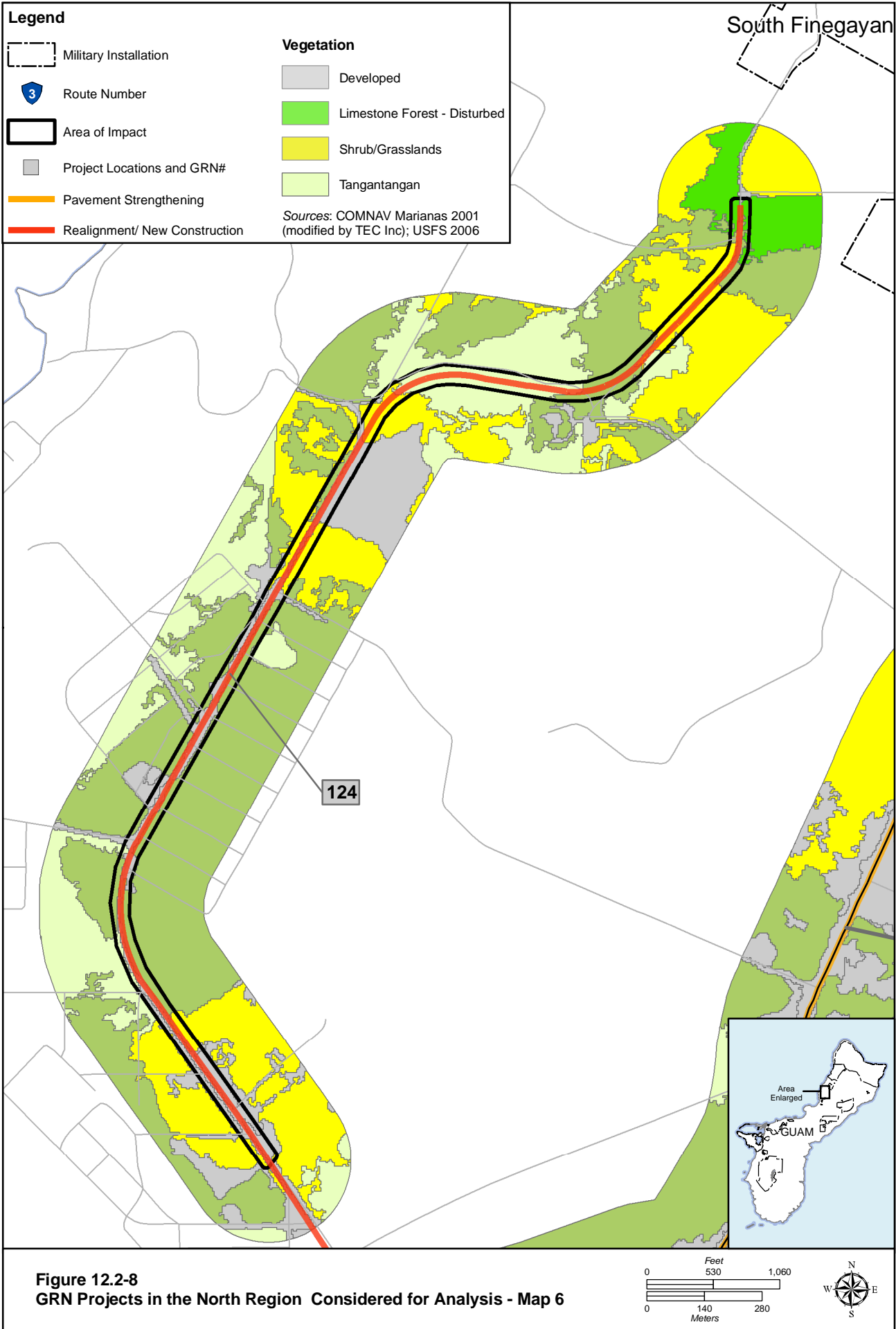


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**Figure 12.2-7**  
**GRN Projects in the North Region Considered for Analysis - Map 5**

















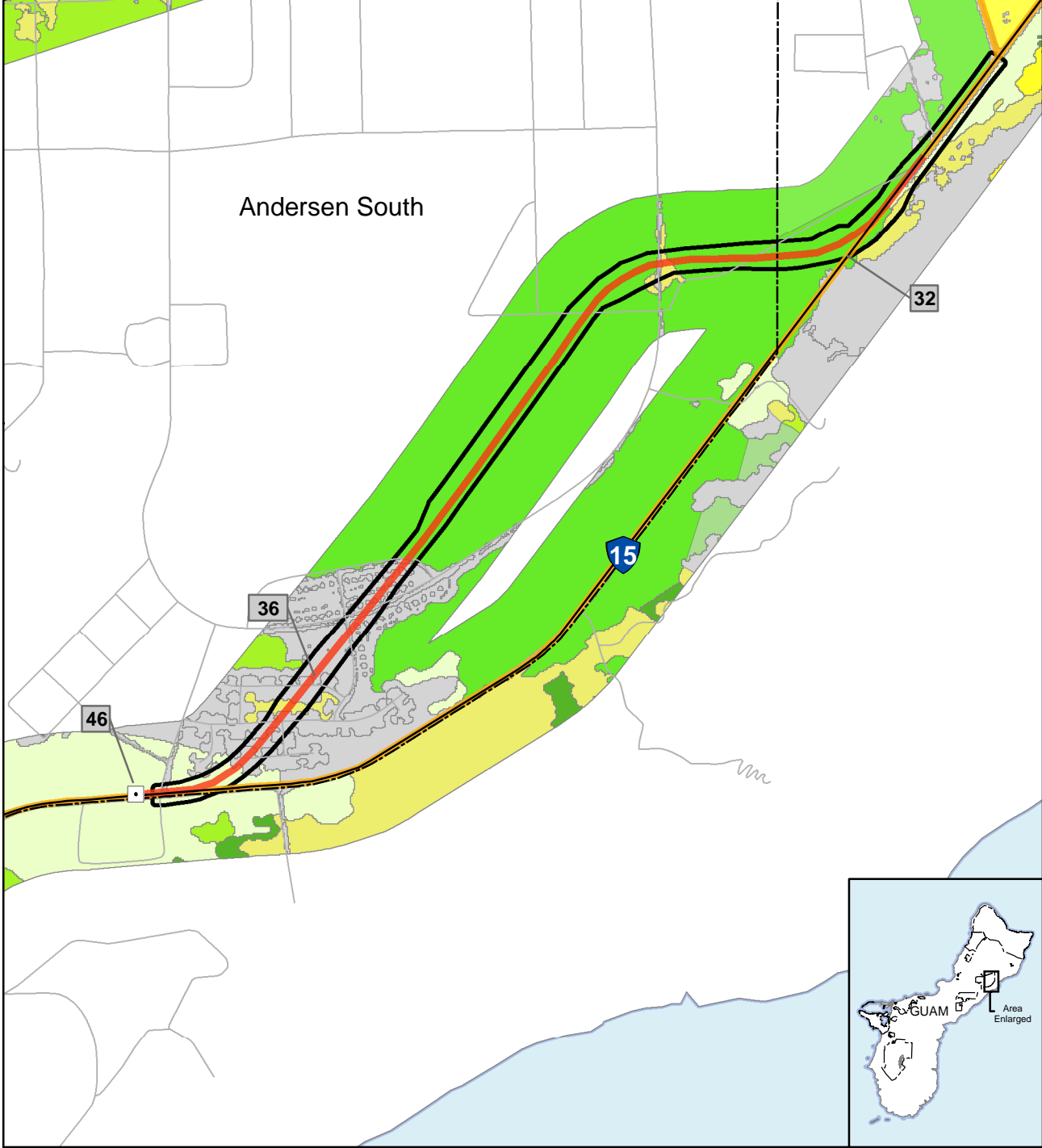


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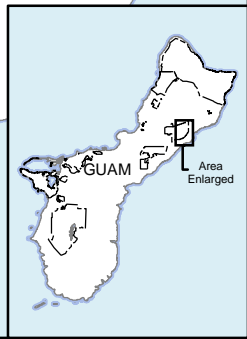
**Figure 12.2-8**  
**GRN Projects in the North Region Considered for Analysis - Map 6**

**Legend**

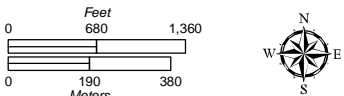
	Military Installation		Developed
	Route Number		Limestone Forest
	Area of Impact		Limestone Forest - Disturbed
	Project Locations and GRN#		Shrub/Grasslands
	Military Access Point		Tangantangan
	Pavement Strengthening	<i>Source: USFS 2006 (modified by TEC Inc)</i>	
	Realignment/ New Construction		
















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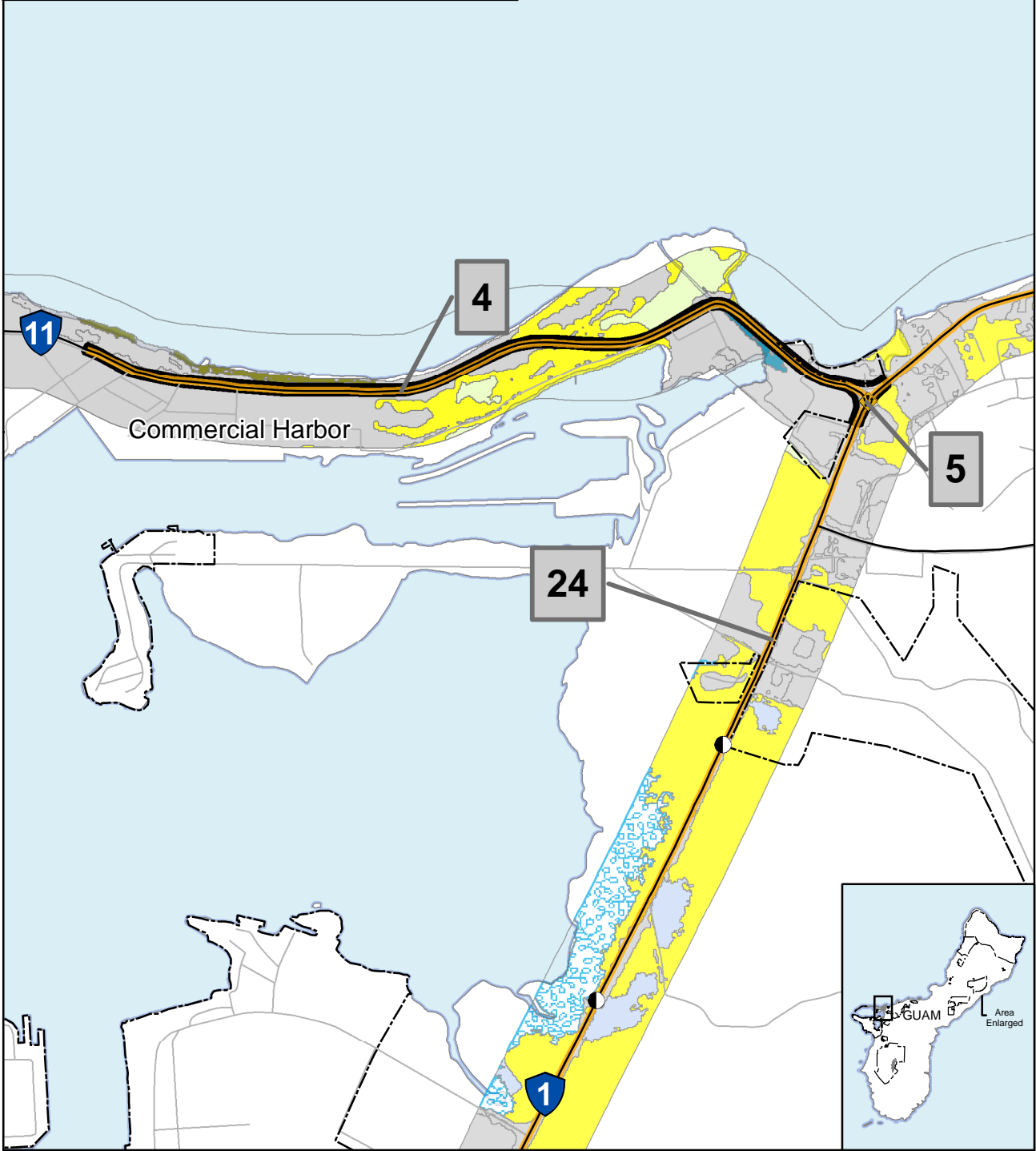
**Figure 12.2-9**  
**GRN Projects in the Central Region Considered for Analysis -**  
**Route 15 Relocation**



**Legend**

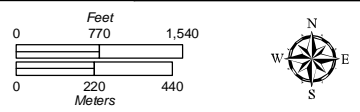
	Military Installation		Barren
	Route Number		Developed
	Area of Impact		Shrub/Grasslands
	Project Locations and GRN#		Tangantangan
	Bridge Replacement		Mangrove
	Intersection Improvement		Water
	Pavement Strengthening		

Source: USFS 2006



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**Figure 12.2-10**  
**GRN Projects in the Apra Harbor Region Considered for Analysis**



## 12.2.6.1 Alternative 1

Volume 6, Chapter 2, Section 2.5 describes Alternative 1 for the proposed GRN and how they relate to alternatives associated with the proposed military relocation. As described earlier, GRN #9, 10, 22, 22A, 38A, 39A, 41, 42A, 57, and 124 were identified as having potential impacts on terrestrial biological resources within the North Region.

North*Vegetation*

Direct impacts associated with these projects include clearing vegetation, primarily on the northern side of Route 9 and the western side of Route 3, and other road projects within the North Region. The vegetation community types subject to removal for each road project proposed for the North Region are listed in Table 12.2-15.

Impacts on vegetation would be less than significant because no primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

**Table 12.2-15. Potential Direct Impacts on Vegetation Communities with Implementation of Roadways Alternative 1**

GRN #	Limestone Forest, Disturbed ac (ha)	Mixed Limestone Forest-Plateau/Secondary ac (ha)	Tangantangan (Leucaena) ac (ha)	Scrub Forest ac (ha)	Mixed Herbaceous Scrub ac (ha)	Developed Land ac (ha)
<b>Option A</b>						
09 (North)	16 (6.5)	0	0	1.1 (0.4)	0	34 (14)
10 (North)	6.8 (2.8)	1.0 (0.4)	0	0.0	0	13 (5.3)
22 (North)	0.3 (0.1)	30 (12.1)	0	0.4 (0.2)	0	14 (5.7)
22A (North)	0	13 (5.3)	0	1.2 (0.5)	1.1 (0.4)	16 (6.5)
38A (North)	1.6 (0.7)	0	0	0	0	0
39A (North)	0	0	0	0	0	2.4 (1.0)
41 (North)	1.9 (0.8)	0	0	0	0.2 (0.1)	0.3 (0.1)
42A (North)	0	1.4 (0.6)	0	0	0	0.2 (0.1)
57 (North)	0	0	0	13 (5.3)	2.5 (1.0)	58 (23)
124 (North)	0.9 (0.4)	0	5.9 (2.4)	11 (4.5)	7.7 (3.1)	12 (4.9)
3 (Central)*	0	0	0	0	<0.1 (<0.1)	<0.1 (<0.1)
35 (Central)*	0	0	0	0	0.2 (<0.1)	0.2 (<0.1)
36 (Central)	30 (12.1)	0	5.5 (2.2)	8.2 (3.3)	2.4 (1)	16 (6.5)
Totals	58 (23.3)	46 (19)	11 (4.5)	35 (14)	14 (5.7)	166 (67)
<b>Option B (identical to Option A except removing GRN #36 (Route 15 realignment))</b>						
Totals	28 (11)	46 (19)	5.9 (2.4)	27 (11)	12 (4.9)	150 (61)

Note: Impacts associated with bridge replacement projects, such as GRN # 3 (Agana Bridge) and GRN # 35 (Aguada, Asan # 1, Asan # 2, Atantano, Fonte, Laguas, and Sasa Bridges), are shown in Table 12.2-17.

Legend: ac = acre; GRN = Guam Road Network; ha = hectare.

*Wildlife*

Based on observations during field visits and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the project areas are the yellow bittern and possibly the Pacific golden

plover in open areas; both species are common throughout Guam. Also abundant throughout Guam are the blue-tailed skink, mutilating gecko, and mourning gecko found in the area.

Proposed construction activities would displace the species and other wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the species are abundant in surrounding areas. Therefore, impacts on wildlife would be less than significant with implementation of Alternative 1 roadways.

#### *Special-Status Species*

The ESA-listed species potentially affected by the removal of habitat include the Mariana fruit bat, the Mariana crow, the Guam Micronesian kingfisher, and the Guam rail. Table 12.2-16 lists the areas subject to removal of Overlay Refuge lands and special-status species recovery habitat.

**Table 12.2-16. Potential Direct Impacts on Special Status Species Habitat with Implementation of Roadways Alternative 1**

GRN #	Overlay Refuge ac (ha)	Recovery Habitat – Bat and Kingfisher ac (ha)	Recovery Habitat – Crow ac (ha)	Recovery Habitat – Rail ac (ha)	Recovery Habitat – Serianthes ac (ha)
<b>Direct Impacts from Construction – Habitat Removed</b>					
Options A and B					
09 (North)	8.1 (3.3)	10.9 (4.4)	10.9 (4.4)	25.5 (10.3)	6.9 (2.3)
10 (North)	8.1 (3.3)	1.3 (3.3)	1.3 (3.3)	12.4 (5.0)	1.3 (3.3)
22 (North)	30 (12)	25.6 (10.3)	22.7 (9.2)	11.8 (4.8)	24.2 (9.8)
22A (North)	3.1 (1.3)	11.2 (4.5)	11.7 (4.7)	12.5 (5.1)	5.1 (2.1)
38A (North)	1.6 (0.6)	1.7 (0.7)	1.7 (0.7)	0	1.7 (0.7)
39A (North)	2.4 (1.0)	1.5 (0.6)	1.5 (0.6)	0.9 (0.4)	1.5 (0.6)
41 (North)	2.4 (1.0)	1.5 (0.6)	1.5 (0.6)	0.9 (0.4)	1.5 (0.6)
42A (North)	1.7 (0.7)	1.7 (0.7)	1.7 (0.7)	0	1.7 (0.7)
57 (North)	0	0	0	32.5 (13.2)	0
124 (North)	0	0.9 (0.4)	0.9 (0.4)	22.2 (9.0)	0
3 (Central)*	0	0	0	0	0
35 (Central)*	0	0	0	0	0
36 (Central)	0	0	0	47.3 (19.1)	0
<b>Total area removed</b>	<b>57 (23)</b>	<b>56 (23)</b>	<b>54 (22)</b>	<b>166 (67)</b>	<b>44 (18)</b>
Total Habitat Area - DoD Lands	21,690 (8,778)	16,105 (6,517)	16,087 (6,510)	8,976 (3,632)	9,082 (3,654)
Total Habitat Area - Non-DoD Lands	0	12,550 (5,079)	11,037 (4,467)	40,588 (16,425)	2,640 (1,068)
Percentage of Habitat Area on Guam that is Removed (DoD and Non-DoD Lands)	0.26%	0.20%	0.20%	0.33%	0.37%

Note: Each habitat category is considered independently of others and is not an additive.

Legend: ac = acre; DoD = Department of Defense; GRN = Guam Road Network; ha = hectare.

*Mariana fruit bat.* Specific designated habitat areas would be removed under Alternative 1 including Overlay Refuge and recovery habitat for the fruit bat (Table 12.2-16). There would be no temporary direct impacts from noise and activity during construction at Andersen AFB to roosting and foraging activities of the Mariana fruit bat. Removal of these areas due to construction would have a significant impact on

recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

*Mariana crow.* Specific designated habitat areas would be removed under Alternative 1, including Overlay Refuge and recovery habitat for the crow (Table 12.2-16). The Mariana crow is not currently present in areas where these projects would occur so there would be no noise or disturbance impacts from construction. Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

*Guam Micronesian kingfisher.* The kingfisher survives only in captivity at this time. Identified kingfisher recovery habitat would be removed under Alternative 1, including Overlay Refuge (Table 12.2-16). Removal of these areas due to construction would have a significant impact on recovery habitat available for the species. The magnitude of the impacts would be reduced with a suite of actions described in Volume 2, Chapter 10, Section 10.2.2.6.

*Guam rail.* The rail survives only in captivity at this time. Proposed construction activities would include the loss of shrub/grassland habitat that has been identified as rail recovery habitat. Only a very small portion of the area is scrub and shrublands that is suitable potential rail recovery habitat. Because of minimal loss of habitat for a species not currently present, removal of these areas due to construction would result in a less than significant impact.

*Pacific slender-toed gecko.* The gecko was found in recent surveys (NAVFAC Pacific 2010) in northeastern NCTS Finegayan in a forested area. However, because the roadway impacts would be in or along adjacent disturbed areas, the species would be unlikely to be present in the project areas. Impacts would be less than significant.

The DoD has completed section 7 ESA consultation with the USFWS to avoid, minimize, or offset the potential direct and indirect impacts on ESA-listed species associated with Alternative 1.

Indirect impacts associated with these projects may further degrade limestone forests that are important to species recovery efforts. The indirect impacts may include: increasing edge effect of limestone forests, thereby facilitating the further encroachment of aggressive non-native vines and herbaceous vegetation; possible facilitation of access to poachers into habitat areas for the Mariana fruit bat during construction phases; increased wildland fire risk in fine fuels due to construction activities (canopy fires are not expected in northern Guam) that would encourage non-native invasive species encroachment; increased noise and activity levels during construction and operation; and displacement of ungulates (i.e., Philippine deer, carabao, and feral pig), along with other non-native invasive species (e.g., BTS, feral cat, and dog, rat, cane toad) into adjacent habitats. However, since roadways projects are along existing transportation corridors and heavily disturbed habitat, these impacts are expected to be less than significant with implementation of standard BMPs.

## Central

### *Vegetation*

Direct impacts associated with these projects include the proposed clearing of vegetation through the relocated Route 15 road corridor and eight bridge and culvert replacements proposed for the Central Region. The vegetation community types subject to removal for each road project proposed for the Central Region are listed in Table 12.2-15. The proposed Route 15 relocation would clear areas that transition from disturbed limestone forest in the west to scrub forest towards the east of the proposed

route. Some areas of the Andersen South parcel, especially the southeast and southwest corners of the parcel, contain mature vegetation canopy layers with some areas dominated by native species. Reconnaissance surveys in support of this EIS and separate reconnaissance surveys conducted in support of the proposed Route 15 relocation indicate a high feral pig population, as evidenced by heavy damage to substrates, vegetation impacts, and numerous wallows.

Impacts on vegetation associated with the road improvements and bridge and culvert replacements would be less than significant because minimal primary limestone forest would be removed. Vegetation removed does provide habitat for wildlife and special-status species. These impacts are evaluated in subsequent sections.

#### *Wildlife*

Impacts on aquatic environments associated with the bridge and culvert replacements are shown in Table 12.2-17. The eight bridge and culvert replacements are proposed to span crossings along Route 1 over the Agana River, Atantano River, Laguas River, Sasa River, and Fonte River. These rivers are considered perennial (flowing water for all or most of the year). As shown in Table 12.2-17, construction activities associated with the eight bridge and culvert replacements would temporarily remove a total area of approximately 1.52 ac (0.61 ha). Temporary direct impacts associated with construction activities include the potential for increased erosion associated with grading into the subsoil within and outside the stream channel and potential impacts on aquatic communities in the immediate area of the bridge replacement.

Indirect impacts may occur further downstream outside of the immediate construction area and be prolonged in time. These indirect effects may include degradation of stream channel aquatic habitats and marine habitats supporting coral communities and fisheries. Federal Highway Administration (FHWA) and Guam Environmental Protection Agency have mandated Standard Operating Procedures and BMPs specific to sediment control that accounts for stormwater runoff and other Guam-specific criteria for pollution prevention during construction and operation of the proposed roads. Hydraulic conveyance under the new bridge and culvert replacements would improve, which may benefit downstream stream segments, wetland areas and open water habitats by decreasing scour along the stream bank near the bridge and culvert replacements and decreasing sediment inputs into downstream freshwater and marine habitats. In summary, the bridge and culvert replacement would potentially impact 1.52 ac (0.61 ha) of riverine aquatic habitats and indirectly impact aquatic habitats downstream; however, the impacts would be minimized through individual BMPs cooperatively developed by the FHWA and Guam Environmental Protection Agency, the temporary nature of the impact, and possible improved hydraulic conveyance under the proposed bridge and culvert replacements. With the BMPs, impacts would be less than significant.

**Table 12.2-17. Potential Direct Impacts on Special Status Species Habitat with Implementation of Roadways Alternative 1**

GRN Project #	Bridge Name	Potential Direct Impacts on Aquatic Habitats <sup>1</sup>		Potential Indirect Impacts on Aquatic Habitats <sup>2</sup>
		Acres	Hectares	
3	Agana Bridge	0.15	0.06	Potential sedimentation along the 260 ft (80 m) streambed of the Agana River between Agana Bridge and the river terminus (between East Hagatna Beach and Paseo de Susana Park).
35	Atantano Bridge	0.14	0.06	Potential sedimentation along the 1,150 ft (350 m) streambed of the Aguada River between Route 1 and the shoreline of Sasa Bay. The Aguada River flows through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Aguada Bridge	0.015	0.06	Potential sedimentation along the 1,150 ft (350 m) streambed of the Aguada River between Route 1 and the shoreline of Sasa Bay. The Aguada River flows through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Asan # 1	0.28	0.11	Potential sedimentation along the 320 ft (98 m) streambed of this length of the Asan River between the box culvert and the shoreline of Asan Bay.
	Asan # 2	0.26	0.11	Potential sedimentation along the 99 ft (30 m) streambed of this drainage between the box culvert and the shoreline of Asan Bay.
	Fonte Bridge	0.28	0.11	Potential sedimentation along the 290 ft (90 m) streambed of the Fonte River between Fonte Bridge and the river terminus (between West Hagatna Beach and the Governor's Complex).
	Laguas Bridge	0.13	0.05	Potential sedimentation inputs along the 1,600 ft (480 m) streambed of the Sasa River between Sasa Bridge and the river terminus and 800 ft (240 m) streambed of the Laguas River to the river terminus. Both rivers flow through the Sasa Bay Marine Preserve, which supports the largest mangrove forested area within the Mariana Islands.
	Sasa Bridge	0.13	0.05	
<b>Total Area</b>		<b>1.52</b>	<b>0.61</b>	

*Notes:*

<sup>1</sup> Stream channel widths were calculated by averaging the width of four cross-stream lines between observed OHWM for each bridge. Two upstream lines and two downstream lines were measured for each bridge.

The estimated area of direct impacts on potential waters of the U.S. was calculated by the following equation: (Stream channel width) x (Structure width) + (Assumed area of upstream channel modifications [30 square feet]) + (Assumed area of downstream channel modifications [30 square feet]).

<sup>2</sup> Potential indirect impacts are considered temporary for construction activities. Mitigations (BMPs) are in development as a joint effort between GEPA, FHWA, and FHWA design contractors to minimize or avoid impacts during and after the construction phase. Examples of mitigative BMPs are included in CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006).

*Legend:* BMP = Best Management Practice; ft = feet; HWA = Federal Highway Administration; GEPA = Guam Environmental Protection Agency; GRN = Guam Road Network; m = meter; NA = not applicable; OHWM = ordinary high water marks.



Based on observations during field visits and observations in other similar areas on Andersen AFB, NCTS Finegayan, and Andersen South (discussed in Volume 2, Chapter 10, Section 10.1), the only native bird species likely to be present in the inland project areas are the yellow bittern and Pacific golden plover. At the bridge and culvert crossings near the coast various migratory birds are likely to utilize the area, and tidal influences (e.g., exposed tidal mudflats) and estuarine banks provide seasonal foraging and loafing habitat. Annual migrants to Guam that might be found there are Pacific golden plover, greenshank, Mongolian plover, gray-tailed tattler, whimbrel, ruddy turnstone, and cattle egret (Commander Navy Region Marianas 2008, Eggleston 2009, NAVFAC Pacific 2010). A recent field survey of the proposed bridge crossings (NAVFAC Pacific 2010) did not record any native bird species. The species that are likely to regularly use the area, particularly near roadways, would be species common on Guam.

During recent surveys conducted in support of this EIS, three native reptile species were found within the forested areas at Polaris Point: Pacific blue-tailed skink, mourning gecko, and mutilating gecko (NAVFAC Pacific 2010). Native land hermit crabs and coconut crabs are present on the base in coastal and estuarine areas (Commander Navy Region Marianas 2008). The presence of these species is unknown in the Biological Resource Study Area.

Proposed construction activities would displace these species of wildlife from suitable habitat in the proposed project areas. Smaller, less-mobile species and those seeking refuge in burrows could inadvertently be killed during construction activities; however, long-term, permanent impacts on populations of such species would be less than significant because the area affected does not expand greatly from presently disturbed areas and would be very small in comparison to the total habitat available. In addition, most species known to be present are abundant in surrounding areas (with the possible exception of the coconut crab). Overall, impacts on wildlife would be less than significant with implementation of Alternative 1 roadways.

#### *Special-Status Species*

Construction within the Central Region would not remove recovery habitat for the Mariana fruit bat, Mariana crow, Guam Micronesian kingfisher or Guam rail; or areas designated as Overlay Refuge. The shrub/grassland habitat that would be removed is potential habitat for reintroduction of the Guam rail in the future, but the areas removed have no special habitat designation. Wetlands and stream corridors may be considered primary or secondary habitats for the Mariana common moorhen; the only wetlands directly affected through road construction activities are associated with bridge and culvert replacements along the Atantano, Asan, Aguada, Agana, Fonte, Laguas, and Sasa rivers. Moorhens prefer calm palustrine and estuarine wetlands and are not likely to use the more dynamic stream corridors. Direct impacts on special-status species in the Central Region would be less than significant.

Potential indirect impacts associated with GRN projects may include increasing edge effects for non-native species, displacement of ungulates, increased noise and activity levels, and wildland fire risk. For the Mariana common moorhen, construction noise at projects near known moorhen habitat areas (e.g., Agana swamp, Sasa Bay Marine Preserve, Harmon Sink) may cause temporary disturbance to nesting or foraging moorhens, although these areas are along existing road corridors subject to ambient and episodic noise events associated with normal traffic. Preconstruction surveys and monitoring of known or suspected moorhen areas along road corridors would be conducted. Indirect effects associated with roadway construction and operations are expected to be less than significant because these projects are along existing roadway corridors and heavily disturbed habitat.

### Apra Harbor

There were no projects proposed for the Apra Harbor Region identified as having potential to impact terrestrial biological resources under Alternative 1. Therefore, there would be no significant impacts on terrestrial biological resources (vegetation communities, wildlife resources, and special-status species) associated with Alternative 1.

### South

There were no projects proposed for the South Region identified as having potential to impact terrestrial biological resources under Alternative 1. Therefore, there would be no significant impacts on terrestrial biological resources (i.e., vegetation communities, wildlife resources, and special-status species) associated with Alternative 1 implementation.

### Proposed Mitigation Measures

Impacts on terrestrial vegetation communities, aquatic habitats and special-status species habitat resulting from proposed roadway projects would be mitigated with a suite of protection and conservation measures for all impacts on Guam described in this EIS. See Volume 7, Chapter 2 for a summary table of these measures and Volume 2, Chapter 10 for details of these measures. Specifically, the USFWS during review of the Draft EIS raised the concern that Mariana common moorhens may temporarily be disturbed by noise events associated with construction where road projects are adjacent to known or suspected moorhen habitats. As a result, the FHWA would conduct pre-construction surveys in wetland areas along Route 1 and other pavement strengthening projects adjacent to the Barrigada Sink.

The biosecurity plan is described in Volume 2, Chapter 10. Because the eight bridge and culvert replacements occur within potential waters of the U.S., the FHWA would be engaging the U.S. Army Corps of Engineers Honolulu District Office in the Section 404 Clean Water Act permitting process. During this process additional BMPs or mitigations may be required as part of the permit conditions.

#### 12.2.6.2 Alternative 2 (Preferred Alternative)

Volume 6, Chapter 2 describes Alternative 2 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 2 differs from Alternative 1 in the way that NCTS Finegayan would be utilized. Proposed road projects under Alternative 2 are the same as the proposed road projects under Alternative 1, with the exception of military access point locations at NCTS Finegayan and Andersen AFB. These military access point projects that are included as part of Alternative 2 (GRN #s 38, 39, and 41) would have the same direct and indirect impacts as those military access point projects included as part of Alternative 1 (GRN #s 38A, 39A, and 41A); therefore, impacts on terrestrial biological resources of Alternative 2 are similar to Alternative 1 for each region.

### Proposed Mitigation Measures

The mitigation measures for Alternative 2 are the same as those for Alternative 1.

#### 12.2.6.3 Alternative 3

Volume 6, Chapter 2 describes Alternative 3 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 3 differs from Alternative 1 and 2 in the way that NCTS Finegayan would be utilized, as well as other federal parcels. The land use differences require a different configuration of the proposed GRN military access point configurations. Proposed road projects under Alternative 3 are the same as the proposed road projects under Alternative 1, except that Alternative 3 includes GRN #s 38, 47, 48, 49, 63, and 74, and it excludes GRN #s 20, 31,

38A, 39A, 41A, and 124. GRN # 47, 48 and 49 are associated with new access to Barrigada (Navy and Air Force); however, these projects would occur in previously disturbed areas of no value to special status species or wildlife. Further, indirect impacts associated with increased impervious cover (e.g., runoff during the construction phase of the projects) would not degrade these habitats. Gate locations for Alternative 3 are the same for Alternative 1, except that NCTS Finegayan Main Gate and commercial gate locations (GRN #s 38 and 39) are in different locations than the Main Gate and commercial gate locations in Alternative 1 (GRN #s 38A and 39A). The GRN # 38 and 39 locations would have the same direct and indirect impacts as GRN #s 38A and 39A. Therefore, impacts on terrestrial biological resources of Alternative 3 are similar to Alternative 1 for each region.

#### Proposed Mitigation Measures

The mitigation measures for Alternative 3 are the same as those for Alternative 1.

#### 12.2.6.4 Alternative 8

Volume 6, Chapter 2 describes Alternative 8 for the proposed GRN and how this alternative relates to the alternatives associated with the proposed military relocation. Alternative 8 differs from Alternative 1 in the way that NCTS Finegayan would be utilized, as well as other federal parcels. Proposed road projects under Alternative 8 are the same as the proposed road projects under Alternative 1, with the exception of the military access point location at Air Force Barrigada. This gate location project included as part of Alternative 8 (GRN # 49A) would have the same direct and indirect impacts as the military access point project included as part of Alternative 3 (GRN # 49); therefore, impacts on terrestrial biological resources of Alternative 8 are similar to Alternatives 1 and 3 for each region.

#### Proposed Mitigation Measures

The mitigation measures for Alternative 8 are the same as those for Alternative 1.

#### 12.2.6.5 Firing Range Option

The alternatives described in Volume 2, Chapter 2, for the relocation include the Main Cantonment action alternatives with either a Firing Range Option A or B. Option A would require the realignment of Route 15 (GRN #36), while Option B does not require realignment of Route 15; therefore, by choosing Option B, the impacts associated with proposed road projects within the Central Region study area to terrestrial biological resources would not occur.

#### 12.2.6.6 Summary of Impacts

Table 12.2-18 summarizes the potential impacts of each alternative.

There would be no removal of primary limestone forest habitat; therefore, impacts on vegetation would be less than significant. Wildlife species that are documented as present are common species and the proposed roadway improvements would not affect populations of these species so impacts would be less than significant. The removal of recovery habitat for ESA-listed species in the North Region would be a significant impact, mitigated to less than significant. The encroachment would also remove habitat from the Refuge Overlay units on Finegayan and Andersen AFB.

**Table 12.2-18. Summary of Potential Impacts on Terrestrial Biological Resources, Roadway Projects**

<i>Alternative 1</i>	<i>Alternative 2*</i>	<i>Alternative 3</i>	<i>Alternative 8</i>
<b>Vegetation</b>			
LSI <ul style="list-style-type: none"> <li>There would be no removal of primary limestone forest.</li> </ul>	LSI <ul style="list-style-type: none"> <li>There would be no removal of primary limestone forest.</li> </ul>	LSI <ul style="list-style-type: none"> <li>There would be no removal of primary limestone forest.</li> </ul>	LSI <ul style="list-style-type: none"> <li>There would be no removal of primary limestone forest.</li> </ul>
<b>Wildlife</b>			
LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul>	LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul>	LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul>	LSI <ul style="list-style-type: none"> <li>Less than significant impacts on wildlife.</li> </ul>
<b>Special-Status Species</b>			
SI-M <ul style="list-style-type: none"> <li>Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.</li> </ul>	SI-M <ul style="list-style-type: none"> <li>Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.</li> </ul>	SI-M <ul style="list-style-type: none"> <li>Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.</li> </ul>	SI-M <ul style="list-style-type: none"> <li>Significant direct impact due to the removal of identified recovery habitat for 3 endangered species and Overlay Refuge.</li> </ul>

*Legend:* LSI = Less than significant impact; SI-M = Significant impact mitigable to less than significant. \*Preferred Alternative.

12.2.6.7 Summary of Mitigation Measures

Table 12.2-19 summarizes the proposed mitigation measures for roadway projects impacts on terrestrial biological resources.

**Table 12.2-19. Summary of Proposed Mitigation Measures for Roadway Projects Impacts to Roadway Biological Resources**

<i>Phase</i>	<i>Mitigation Measure</i>
Construction	Pre-construction surveys for Mariana common moorhen in wetland areas along Route 1 adjacent to the bridge replacement projects and other pavement strengthening projects adjacent to the Barrigada Sink.
Operation	None