

APPENDIX F

GEOLOGY AND SOILS TECHNICAL MEMO

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1.0 INTRODUCTION

This technical memo supports discussions in Chapter 3, *Affected Environment*, and Chapter 4, *Environmental Consequences*, of the Commonwealth of the Northern Mariana Islands Joint Military Training (CJMT) Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS). Detailed descriptions and/or analysis of impacts to geological and soils resources are not presented within the technical memo. This approach to National Environmental Policy Act (NEPA) documentation facilitates reading the EIS/OEIS unencumbered by technical details of interest to resource specialists and regulators.

1.1 AFFECTED ENVIRONMENT

A general description of geological resources and soils on Tinian and Pagan is presented in Section 3.2, *Geology and Soils*, of the EIS/OEIS. Below is a detailed description and classification of soil units found on Tinian. A similar discussion for Pagan is not provided because a soil survey for Pagan is not available. The following discussion provides details that are useful in understanding the character of soils on Tinian and establishes a baseline for the resource that is further discussed in [Section 1.2](#), *Tinian Affected Environment* of this technical memo.

1.1.1 Soils on Tinian

Soil classes across Tinian were identified by the United States (U.S.) Department of Agriculture Soil Conservation Service in 1985 (Young 1989). [Table 1](#) describes the soil characteristics of soils found on Tinian. [Figure 1](#) depicts the horizontal distribution of these soil types across the island’s surface. As noted in [Table 1](#), most of the soil types are characterized by the slow water runoff or even the potential for water to pond, which can cause issues with flooding or problems with construction if adequate grading and drainage are not provided for structures and roads. These soil types are primarily located on relatively gentle slopes. The following [Table 1](#) is referenced throughout the technical memo tables and figures to define soil types.

Table 1. Tinian Soil Classifications

Soil Class Number/Name	Soil Description	Location	Erodibility	Runoff Rate
5-Banaderu Clay Loam, 3-5% slopes	Shallow, well-drained soil formed in sediment overlying porous coralline limestone; depth to limestone is 25-50 centimeters; permeability is moderate.	Uplifted Limestone Plateaus	Slight	Slow
7-Banaderu-Rock Outcrop	This unit is 50% Banaderu clay loam and 35% rock outcrop as well as other soil types; the components are intricately mingled; Banaderu soil is shallow, well drained, nearly level to moderately steep with rock outcrops; Banaderu soil formed in sediment overlying porous coralline limestone; depth to limestone is 25-50 centimeters; permeability is moderate.	Limestone Plateaus	Moderate	Medium

Table 1. Tinian Soil Classifications

Soil Class Number/Name	Soil Description	Location	Erodibility	Runoff Rate
9-Chacha Clay, Drained, 0-5% slopes	Deep, and poorly drained soil formed in sediment derived dominantly from coralline limestone; substratum reaches depths of 150 centimeters; permeability is slow.	Broad Depressional Areas on Limestone Plateaus	Slight	Ponded or Very Slow
10-Chinen Clay Loam, 0-5% slopes	Shallow, well-drained soil formed in sediment over porous crystalline limestone; depth to porous coralline limestone is 25-50 centimeters; permeability is moderate.	Limestone Plateaus	Slight	Slow
11-Chinen Clay Loam, 5-15% slopes	Shallow, well-drained soil formed in sediment over porous coralline limestone; depth to porous coralline limestone is dominantly 25 to 50 centimeters; permeability is moderate.	Limestone Plateaus	Moderate	Medium
12-Chinen Clay Loam, 15-30% slopes	Shallow, well-drained soil formed in sediment over porous coralline limestone; depth to porous coralline limestone is 25 to 50 centimeters; permeability is moderate.	Tilted and Dissected Limestone Plateaus	Severe	Medium
13-Chinen Very Gravelly Sandy Loam, 0-5% slopes	Moderately deep, well-drained soil formed in fill material that was spread over the natural soil surface during World War II; depth to porous coralline limestone is dominantly 50 to 100 centimeters; permeability is moderate.	Limestone Plateaus	Slight	Slow
14-Chinen Very Gravelly Sandy Loam, 5-15% slopes	Moderately deep, well-drained soil formed in fill material that was spread over the natural soil surface during World War II; depth to porous coralline limestone is dominantly 50 to 100 centimeters; permeability is moderate.	Limestone Plateaus	Slight	Medium
15-Chinen-Rock Outcrop Complex, 3-15% slopes	The unit is 50% Chinen clay loam, 30% limestone rock outcrop, 10% Takpochao soil, and Dandan and Saipan soils (about 10%); the components are intermingled; Chinen soil formed in sediment over porous coralline limestone; depth to porous coralline limestone is dominantly 25 to 50 centimeters in areas where the Chinen soil is present; permeability is moderate.	Limestone Plateaus	Moderate	Slow
16-Chinen-Rock Outcrop Complex, 15-30% slopes	The unit is 50% Chinen clay loam, 30% limestone rock outcrop, 15% Takpochao soil, and Dandan soil (about 5%); the components are intermingled; Chinen soil formed in sediment over porous coralline limestone; depth to porous coralline limestone is dominantly 25 to 50 centimeters in areas where the Chinen soil is present; permeability of the Chinen soil is moderate.	Limestone Plateaus	Severe	Medium

Table 1. Tinian Soil Classifications

Soil Class Number/Name	Soil Description	Location	Erodibility	Runoff Rate
17-Chinen-Urban Land, 0-5% slopes	The unit is 50% Chinen clay loam, 30% urban land, 15% Chinen very gravelly sandy loam, and small areas of Saipan and Dandan soils; the components are intermingled; Chinen soil formed in sediment over porous coralline limestone; urban land consists of paved and impervious areas; depth to porous coralline limestone is dominantly 25 to 50 centimeters in areas where the Chinen soil is present; permeability of the Chinen soil is moderate.	Limestone Plateaus	Slight	Slow
18-Chinen-Urban Land Complex, 5-15% slopes	The unit is 50% Chinen clay loam, 25% urban land, 15% Chinen very gravelly sandy loam, and small areas of Saipan and Dandan soils, limestone rock outcrop, and Chinen soils that have been bulldozed; the components are intermingled; Chinen soil formed in sediment over porous coralline limestone; urban land consists of paved and impervious areas; depth to porous coralline limestone is dominantly 25 to 50 centimeters in areas where the Chinen soil is present; permeability of the Chinen soil is moderate.	Limestone Plateaus	Moderate	Medium
19-Dandan-Chinen Complex, 0-5% slopes	This unit is 50% Dandan clay loam and 40% Chinen clay loam, and small areas of Saipan soils and areas where surface soils were cleared; the components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters where Dandan soil is present and 25 to 50 centimeters where Chinen soil is present; permeability of the soil unit is moderate.	Limestone Plateaus	Slight	Slow
20-Dandan-Chinen Complex, 5-15% slopes	This unit is 50% Dandan clay loam and 40% Chinen clay loam, and small areas of Saipan soils, limestone rock outcrop, and areas where surface soils have been removed; the components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters where Dandan soil is present and 25 to 50 centimeters where Chinen soil is present; permeability of the soil unit is moderate.	Limestone Plateaus	Moderate	Medium
21-Dandan-Chinen-Pits Complex, 0-5% slopes	This unit is 30% Dandan clay loam, 30% Chinen clay, 30% pits, and small areas of Saipan soils, limestone rock outcrop, and areas where surface soils have been removed; the components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters where Dandan soil is present and 25 to 50 centimeters where Chinen soil is present; permeability of the soil unit is moderate.	Limestone Plateaus	Slight	Slow

Table 1. Tinian Soil Classifications

Soil Class Number/Name	Soil Description	Location	Erodibility	Runoff Rate
22-Dandan-Chinen-Pits Complex, 5-15% slopes	This unit is 30% Dandan clay loam, 30% Chinen clay, 30% pits, and small areas of Saipan soils, limestone rock outcrop, and areas where surface soils have been removed; the components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters where Dandan soil is present and 25 to 50 centimeters where Chinen soil is present; permeability of the soil unit is moderate.	Limestone Plateaus	Moderate	Medium
23-Dandan-Saipan Clays, 0-5% slopes	This unit is 50% Dandan clay and 35% Saipan clay with small areas of Chinen and Akina soils; components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters for the Dandan soil and more than 100 centimeters for the Saipan soil; permeability for the soil unit is moderate.	Limestone Plateaus	Slight	Slow
24-Dandan-Saipan Clays, 5-15% slopes	This unit is 50% Dandan clay and 35% Saipan clay with small areas of Chinen, Saipan, and Dandan soils and areas previously disturbed areas; components are intermingled; depth to porous coralline limestone is dominantly 50 to 100 centimeters for the Dandan soil and more than 100 centimeters for the Saipan soil; permeability for the soil unit is moderate.	Limestone Plateaus	Slight	Slow
25-Inarajan Clay, 0-5% slopes	Deep, somewhat poorly drained soil formed in alluvium from volcanic and limestone uplands; substratum is about 150 centimeters; permeability is slow.	Foot slopes and Depressional Areas	Slight	Slow
26-Kagman Clay, 0-5% slopes	Very deep, well-drained soil; depth to limestone is more than 150 centimeters; permeability is slow.	Limestone Plateaus	Slight	Slow
27-Kagman Clay, 5-15% slopes	Very deep, well-drained soil; depth to limestone is more than 150 centimeters; permeability is moderately slow.	Limestone Plateaus	Moderate	Medium
30-Laolao Clay, 0-5% slopes	Moderately deep, well-drained soil; formed in andesitic residuum; depth to saprolite is dominantly between 50 and 100 centimeters; permeability is moderate.	Volcanic Uplands	Slight	Slow
31-Laolao Clay, 5-15% slopes	Moderately deep, well-drained soil; formed in residuum; depth to saprolite is dominantly between 50 and 100 centimeters; permeability is moderate.	Volcanic Uplands	Moderate	Medium
33-Laolao Clay, 30-60% slopes	Moderately deep, well-drained soil; formed in andesitic residuum; depth to saprolite is dominantly between 50 and 100 centimeters; permeability is moderate.	Volcanic Uplands	Severe	Rapid
37-Luta Cobbly Clay Loam, Moist, 5-15% slopes	Very shallow, well-drained soil, depth to limestone is commonly 10 to 25 centimeters; permeability is moderately rapid.	Limestone Plateaus	Moderate	Slow

Table 1. Tinian Soil Classifications

Soil Class Number/Name	Soil Description	Location	Erodibility	Runoff Rate
41-Mesei Variant Muck, 0-2% slopes	Very deep, very poorly drained soil, formed in marine deposits, alluvium, and organic material; unit depth is approximately 80 centimeters; permeability is moderate to a depth of 60 centimeters and rapid below that depth.	Depressional Areas	NA	Ponded
42-Rock Outcrop-Takpochao Complex, 60-99% slopes	This unit is 50% rock outcrop and 40% Takpochao very cobbly clay as well as small areas of Chinen soils; the components are intermingled; the Takpochao soil is shallow and well drained with a depth to limestone of only 10 to 25 centimeters; permeability is moderate.	Limestone Plateaus Escarpments and Canyons	Severe	Rapid
43-Saipan Clay, 0-5% slopes	Deep, well-drained soil formed over porous, coralline limestone, depth to limestone is about 120 centimeters; permeability is moderate.	Limestone Plateau	Slight	Slow
45-Saipan Very Gravelly Sandy Loam, 0-5% slopes	Very deep, well-drained soil formed in fill material that was spread over the natural soil surface during World War II; Limestone is at a depth of about 140 centimeters; permeability is moderate.	Limestone Plateau	Slight	Slow
48-Shioya Loamy Sand, 0-3% slopes	Very deep, excessively drained soil formed in water-deposited coral sand; depth to bedrock is more than 150 centimeters; permeability is rapid.	Coastal Strands	Slight	Slow
49-Shioya-Urban Land Complex, 0-3% slopes	This unit is 60% Shioya loamy sand and 30% urban land with small areas of land disturbed during World War II; components are intricately intermingled; permeability of Shioya soil is rapid and urban land is impervious or impermeable.	Coastal Strands	Slight	Slow
50-Takpochao-Rock Outcrop Complex, 3-15% slopes	This unit is 50% Takpochao very cobbly clay and 40% limestone rock outcrop with small areas of Chinen and Dandan soils; depth to coralline limestone is dominantly 10 to 25 centimeters in the Takpochao soil; permeability is moderate.	Limestone Plateaus	Slight	Slow
51-Takpochao-Rock Outcrop Complex, 15-30% slopes	This unit is 50% Takpochao very cobbly clay and 40% limestone rock outcrop with small areas of Chinen and Dandan soils, limestone quarries, nearly level benches, and steep escarpments; depth to coralline limestone is dominantly 10 to 25 centimeters in the Takpochao soil; permeability is moderate.	Tilted Limestone Plateaus	Moderate	Medium
52-Takpochao-Rock Outcrop Complex, 30-60% slopes	This unit is 50% Takpochao very cobbly clay and 40% limestone rock outcrop with small areas of Chinen and Dandan soils; Takpochao soil is very shallow, well drained, and formed in sediment overlying porous coralline limestone; depth to coralline limestone is dominantly 10 to 25 centimeters in the Takpochao soil; permeability is moderate.	Limestone Plateau Escarpments, Canyon Side Slopes, and Knolls	NA	Very Rapid
54-Quarry	No description	NA	NA	NA
55-Landfill	No description	NA	NA	NA

Legend: NA = not applicable.

Source: Young 1989.

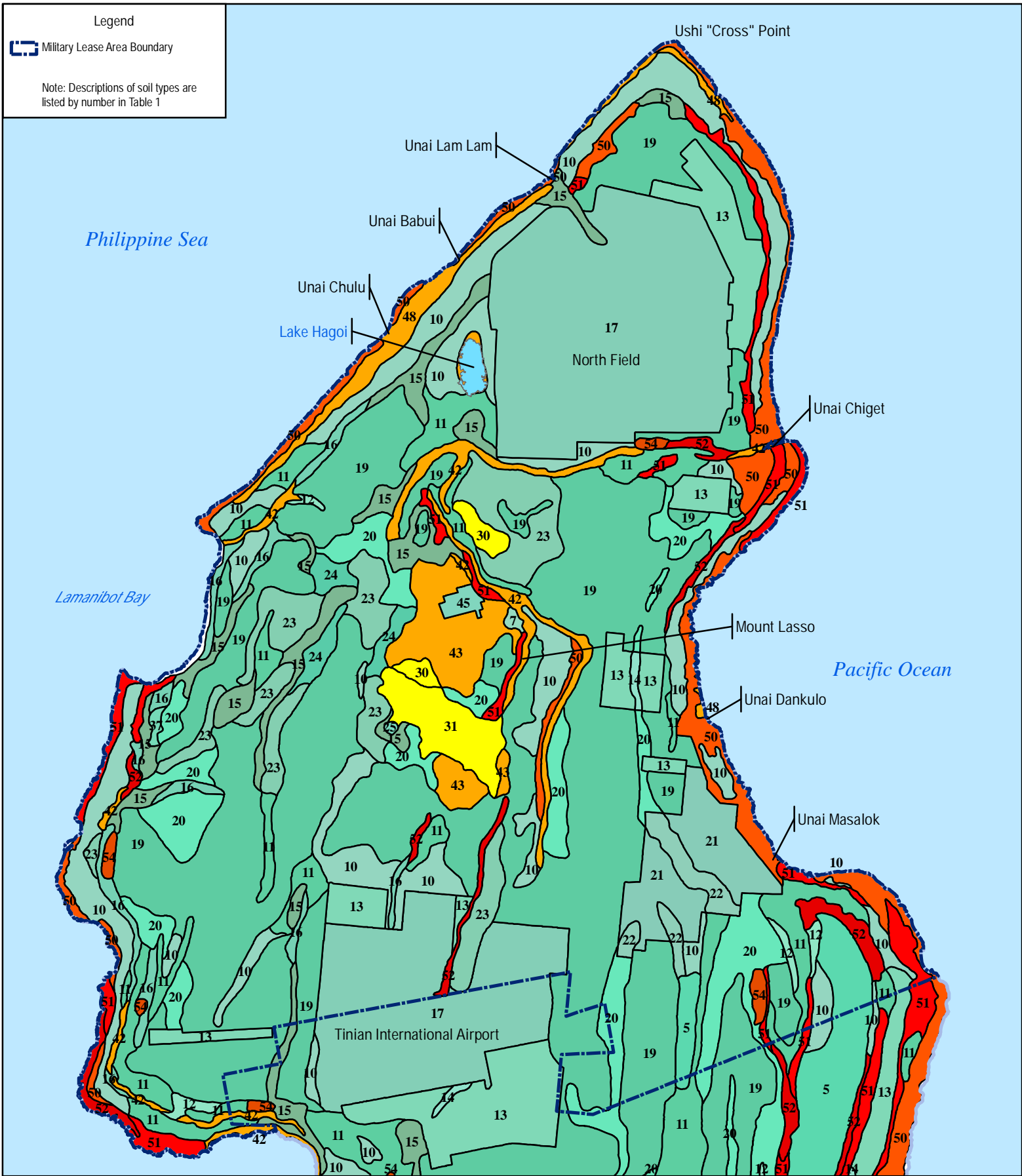


Figure 1
Soils Map of the Tinian Affected Environment

1.2 TINIAN AFFECTED ENVIRONMENT

The information used in the impact analysis for geology and soils for the Tinian Alternatives is provided in two parts: (1) an analysis of the support facilities and infrastructure ([Section 1.2.1](#)), and (2) training facilities ([Section 1.2.2](#)). A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology and geologic hazards, soil classifications, and location of any Prime Farmland soil units within each proposed facility is shown. To maintain Range and Training Area (RTA) operations, vegetation control would be required and undertaken by Range Control personnel. The degree of management varies depending on the requirements for each individual training facility. For example, accommodating line-of-sight, fire control, and equipment laydowns are factors dictating the degree of proposed vegetation maintenance. The following briefly describes how proposed vegetation maintenance would be conducted. Here are descriptions of proposed vegetation management, which are referenced throughout the following sections.

- 100% Maintenance – All the vegetation is maintained at approximately 6 inches (15 centimeters) above the ground throughout the entire area identified.
- 75% Maintenance – Three quarters of the area is maintained at 1 foot (30 centimeters) above ground level and the remaining area (other 25%) remains uncleared.
- 15% Maintenance – Vegetation within 15% of the area is maintained at 2 to 3 feet (0.6 to 1 meter) above ground level for ground movement and maneuvering, the remaining (the other 85%) is not maintained.

1.2.1 Support Facilities and Infrastructure

Common to all Tinian (action) alternatives are improvements to the port and airfield, construction of a base camp and Munitions Storage Area, and construction and improvements to roadways and utilities. A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology and geologic hazards, soil classifications, and location of any Prime Farmland soil units within the proposed facility follows for support facilities and infrastructure. Utility improvements and construction are assumed to be included in the footprint of the support facilities and the roadways and, therefore, are not discussed separately as part of this impact analysis.

1.2.1.1 Port of Tinian Improvements: All Tinian Alternatives

The proposed Port of Tinian improvements consist of the following proposed improvements: (1) Biosecurity Vehicle and Cargo Inspection Area, (2) Biosecurity Cargo Holding Area, (3) Biosecurity Facility, (4) Vehicle Washdown Facility, (5) Washdown Water Treatment Stormwater Retention Ponds, (6) Bulk Fuel Storage Area, (7) Boat Ramps Improvements, and (8) Landscaped Area. These port improvements are common for all action alternatives.

1.2.1.1.1 Ground Disturbance

The proposed Port of Tinian improvements were assessed for ground disturbance by determining the area size and assuming 100% ground disturbance for each given area. Within the total 5 acres (2 hectares) associated with the Port of Tinian improvements activities would require 100% ground disturbance in 5 acres (2 hectares) of the area. The results of this assessment are shown in [Table 2](#).

Table 2. Port of Tinian Improvements: All Alternatives Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbed</i>
Biosecurity Vehicle and Cargo Inspection Area	0.6	0.2	100
Biosecurity Cargo Holding Area	0.9	0.4	100
Biosecurity Facility	0.4	0.2	100
Vehicle Washdown Facility	0.4	0.2	100
Stormwater Retention Ponds	0.4	0.2	100
Bulk Fuel Storage Area	0.7	0.3	100
Boat Ramp Improvements	1	0.4	100
Landscaped Area	0.5	0.2	100
Total	4.9	2.2	100%

1.2.1.1.2 Vegetation Maintenance

The proposed Port of Tinian improvements were assessed for vegetation maintenance by determining the total area of vegetation maintenance needed within the Port of Tinian improvement area. Vegetation within the approximately 5 acres (3 hectares) associated with these activities would require 100% vegetation maintenance in only 0.5 acre (0.2 hectare) of the area. Maintenance methods would include mowing, cutting, and herbicide application in the area surrounding the biosecurity facility. Port of Tinian improvements area totals 0.5 acre (0.2 hectare) of 100% vegetation maintenance during operations. The results of this assessment is shown in [Table 3](#) and mapped in [Figure 2](#).

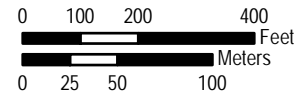
Table 3. Port of Tinian Improvements: All Alternatives Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Landscaped Area	0.5	0.2	100
Total	2	0.2	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.



Figure 2
Port of Tinian Improvements (All Alternatives):
Topographic and Geologic Map



1.2.1.1.3 Elevation and Slope

The proposed Port of Tinian improvements have been assessed for elevation and slope using U.S. Geological Survey (USGS) Geographic Information System (GIS) data to determine the major facility area’s elevation and change in elevation over the length of the area. The results of this assessment are shown in [Table 4](#) and are topographically shown in [Figure 2](#).

Table 4. Port of Tinian Improvements: All Alternatives Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Slope Direction</i>
Bulk Fuel Storage Area	20 to 26 feet (6 to 8 meters)	2%	West to East
Biosecurity Facility Area	14 to 17 feet (4 to 5 meters)	2%	West to East
Boat Ramp Improvements	5 or less feet (2 meters or less)	Gentle Slope	West to East

1.2.1.1.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The entire proposed Port of Tinian area is underlain by Mariana Limestone, as shown in the geological map [Figure 2](#).

1.2.1.1.5 Geologic Hazards

Geological hazards were assessed using a variety of data. Proposed Port of Tinian improvement areas have no published geological hazards however there is a potential for tsunami inundation since the area is low-lying. Unknown issues relating to liquefaction due to the presence of fill land exist within the Port of Tinian area. No faults, sink holes, or karst features were identified. Known features are shown in the geological map, [Figure 2](#).

1.2.1.1.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Port of Tinian improvements area are shown with their soil characteristics in [Table 5](#) below and are mapped in [Figure 3](#).

Table 5. Port of Tinian Improvements: All Alternatives Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#48 Shioya Loamy Sand	0% to 3% slopes	slow	slight

Note: *Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.1.1.7 Prime Farmland Soils

No prime farmland soils have been identified within the proposed Port of Tinian improvements area

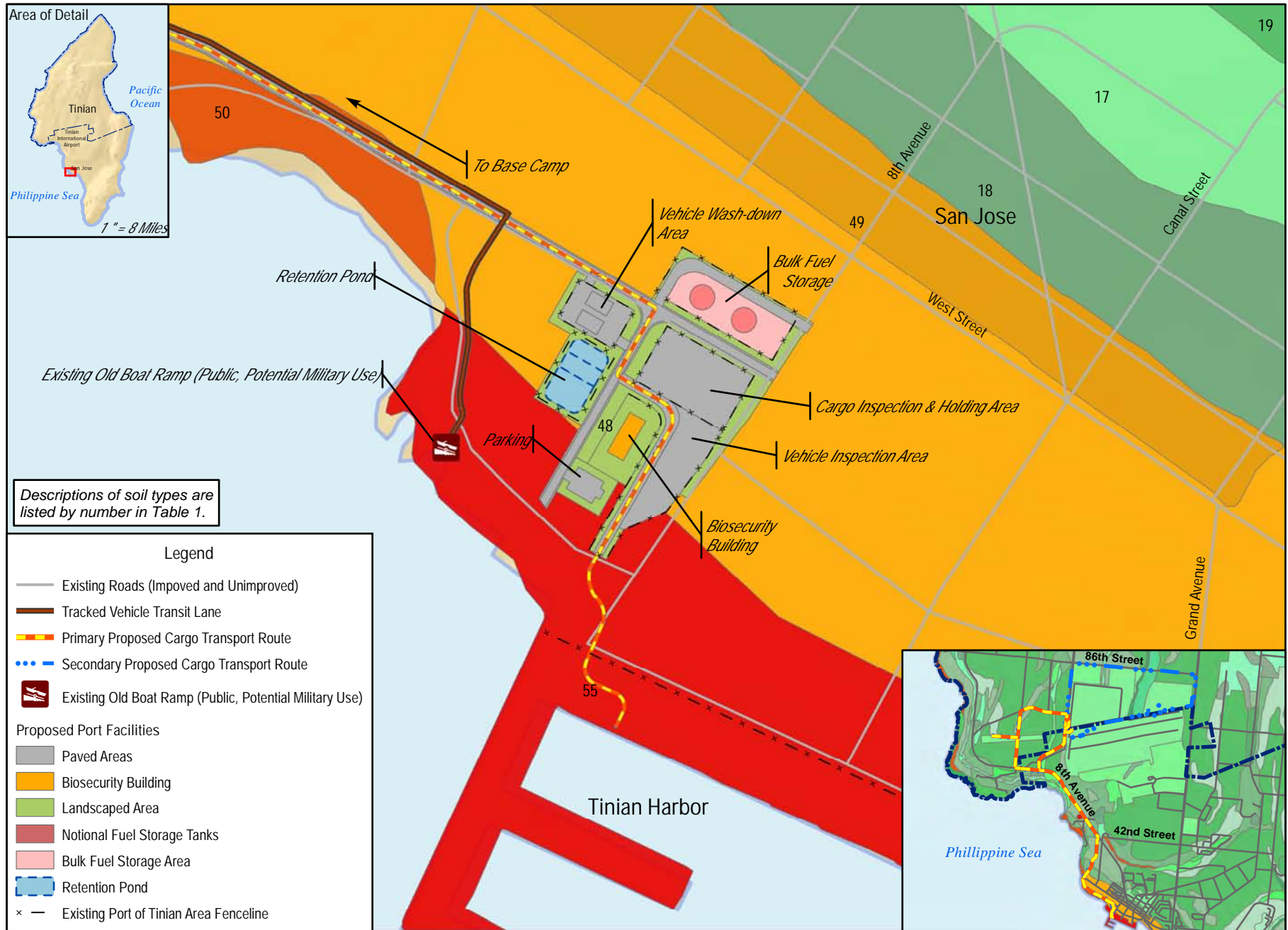
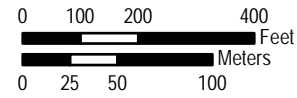


Figure 3
Port of Tinian Improvements (All Alternatives):
Soils Map



Source: NAVFAC Pacific 2013

1.2.1.2 Tinian Airfield, Base Camp Improvements, and Munitions Storage Area: All Tinian Alternatives

The proposed Tinian airfield, base camp, and munitions storage area consist of the following proposed improvements: (1) Base Camp Area, Range Control, and Staging Area; (2) Munitions Storage Area; and (3) Airfield Operations Area. The proposed improvements are common for all action alternatives.

1.2.1.2.1 Ground Disturbance

The proposed Tinian Base Camp, Munitions Storage Area, and Airfield Operations Areas were evaluated for ground disturbance by determining the area size and the total area of ground disturbance for each project area location. The proposed Tinian Base Camp Area, Range Control and Staging Area, Munitions Storage Area, and Airfield Operations Area total 336 acres (136 hectares) of 100% ground disturbance. The results of this assessment are shown in [Table 6](#).

**Table 6. Tinian Base Camp, Munitions Storage Area and Airfield Improvements: All Alternatives
 Ground Disturbance**

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbed</i>
Tinian Base Camp	257	104	100
Munitions Storage Area	38	15	100
Airfield Operations	41	17	100
Total	336	135	100%

1.2.1.2.2 Vegetation Maintenance

The proposed Tinian Base Camp, Range Control and Staging Area; Munitions Storage Area, and Airfield Operations Areas were assessed for vegetation maintenance by determining the area size and the total area of vegetation maintenance during operations for each project area. The base camp boundary encompasses 257 acres (104 hectares). Of this, 116 acres (47 hectares) is considered a laydown area within the camp and would require 100% vegetation maintenance. An additional 111 acres (45 hectares) within the base camp would require 100% vegetation maintenance. Within this area of the Tinian Base Camp 15 acres (6 hectares) would be considered landscaped area and would also require 100% vegetation maintenance. The base camp totals 227 acres (91 hectares) of 100% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at the base camp at about 6 inches (15 centimeters) above ground across the entire facility. Vegetation would be maintained at 100% across 30 acres (12 hectares) of the 38 acre (15 hectares) Munitions Storage Area facility. Methods to maintain this height include mowing and cutting. Of the 228 acres (92 hectares) associated with Airfield Operations, 187 acres (76 hectares) would require 100% vegetation maintenance. Mowing and cutting would be employed to maintain this level of maintenance. The proposed Tinian Base Camp, Munitions Storage Area, and Airfield Operations Area total 444 acres (179 hectares) of 100% vegetation maintenance. The results of this assessment are shown in [Table 7](#) and in [Figure 4](#).

**Table 7. Tinian Base Camp, Munitions Storage Area and Airfield Improvements: All Alternatives
 Vegetation Maintenance**

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Tinian Base Camp	227	91	100
Munitions Storage Area	30	12	100
Airfield Operations	187	76	100
Total	444	179	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.1.2.3 Elevation and Slope

The elevation and slope of the proposed Tinian Base Camp Area, Munitions Storage Area, and Airfield Operations area were determined using USGS GIS data. The results of this assessment are shown in [Table 8](#). [Figure 4](#) provides a topographic map of these areas.

**Table 8. Tinian Base Camp, Munitions Storage Area and Airfield Improvements: All Alternatives
 Elevation and Slope**

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Tinian Base Camp Area	243 to 270 feet (74 to 82 meters)	0.5%	West to East
Munitions Storage Area	235 to 259 feet (72 to 79 meters)	1%	West to East
Airfield Operations	254 to 279 feet (77 to 85 meters)	1%	West to East

1.2.1.2.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Base Camp, Munitions Storage Area, and Airfield Operations area are underlain by Mariana Limestone, as depicted in [Figure 4](#).

1.2.1.2.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Two faults are located within the proposed Airfield Operations area. Two faults are located within the Base Camp area. These features are shown in [Figure 4](#).

1.2.1.2.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Base Camp, Munitions Storage Area, and Airfield Operations area are shown with their soil characteristics in [Table 9](#) and are mapped in [Figure 5](#).

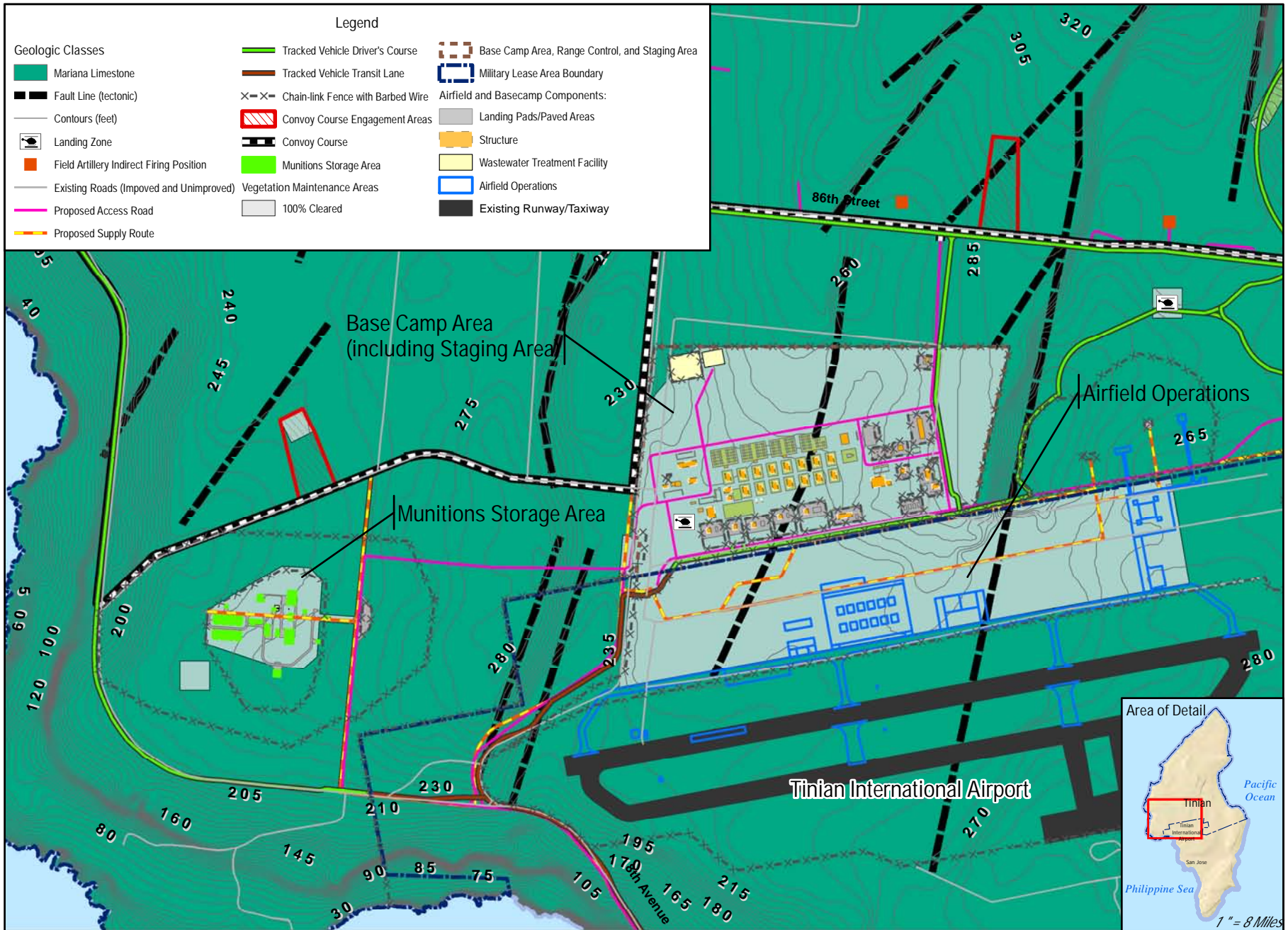


Figure 4
 Tinian Airfield Improvements, Base Camp, and Munitions Storage Area (All Alternatives):
 Topographic and Geologic Map

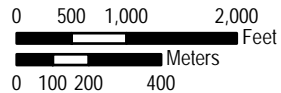


Table 9. Tinian Base camp, Munitions Storage Area and Airfield Improvements: All Alternatives Soil Classification

<i>Project Area</i>	<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
Airfield Operations	#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
	#17 Chinen-Urban Land Complex	0% to 5% slopes	slow	slight
Tinian Base Camp	#17 Chinen-Urban Land Complex	0% to 5% slopes	slow	slight
	#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
Munitions Storage Area	#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
	#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight

Note: *Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.1.2.7 Prime Farmland Soils

No prime farmland soils have been identified within the proposed Tinian Base Camp, Munitions Storage Area, and Airfield Operations area. The locations of these soils in the vicinity of the proposed Tinian Base Camp, Munitions Storage Area, and Airfield Operations area are mapped in [Figure 6](#).

1.2.1.3 Tinian Road Improvements: All Alternatives

Common to all Tinian (action) alternatives are construction and improvements to roadways. A summary of the ground disturbance, vegetation maintenance, elevation and slope, geology, soil classifications, and location of any Prime Farmland soil units within the roadways project areas is described below.

1.2.1.3.1 Ground Disturbance and Vegetation Maintenance

All proposed roadways require 100% ground disturbance and require various levels of vegetation maintenance according to surface type. Roadway construction and improvements total approximately 133 acres (53 hectares). Each roadway's total acreage and vegetation maintenance is shown in [Table 10](#) and mapped in [Figure 7](#).

Table 10. Tinian Roadways: All Alternatives Ground Disturbance and Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>Surface Type and % Vegetation Maintenance</i>
Repaired Existing Road for Public Use	38	15	Existing Road
Repair Existing Road for General Use	12	5	Existing Road
Construct New Gravel Road (includes Observation Post access roads)	8	3	Gravel; 100%
Establish Military Training Road	18	7	100%
Construct New Paved Road	29	12	Paved
Improve ROW for Utilities	2	1	NA
Perimeter Road Patrol	26	10	100%
Total	133	53	NA

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

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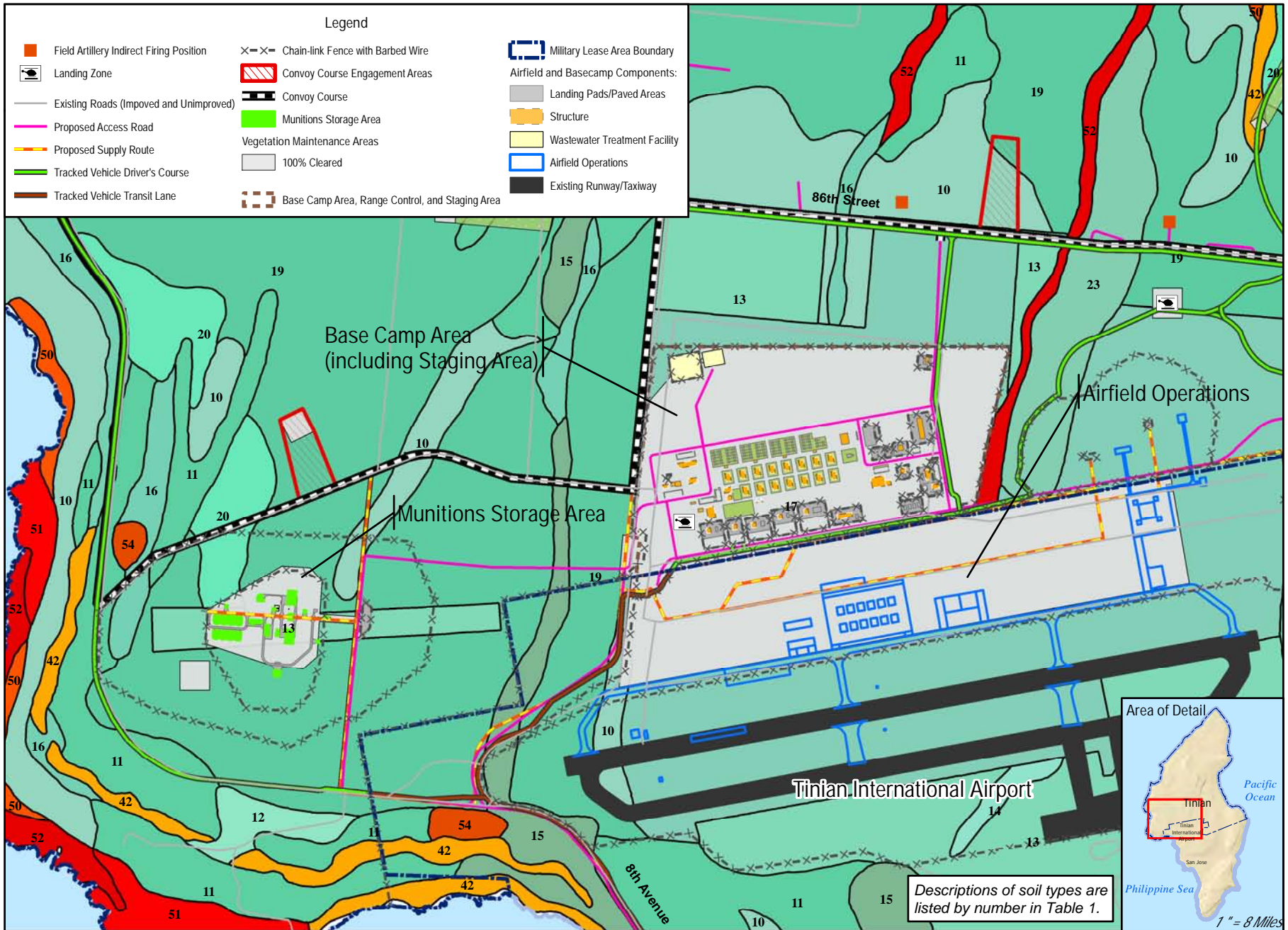


Figure 5
Tinian Airfield Improvements, Base Camp, and Munitions Storage Area (All Alternatives):
Soils Map



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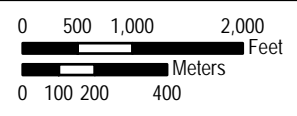
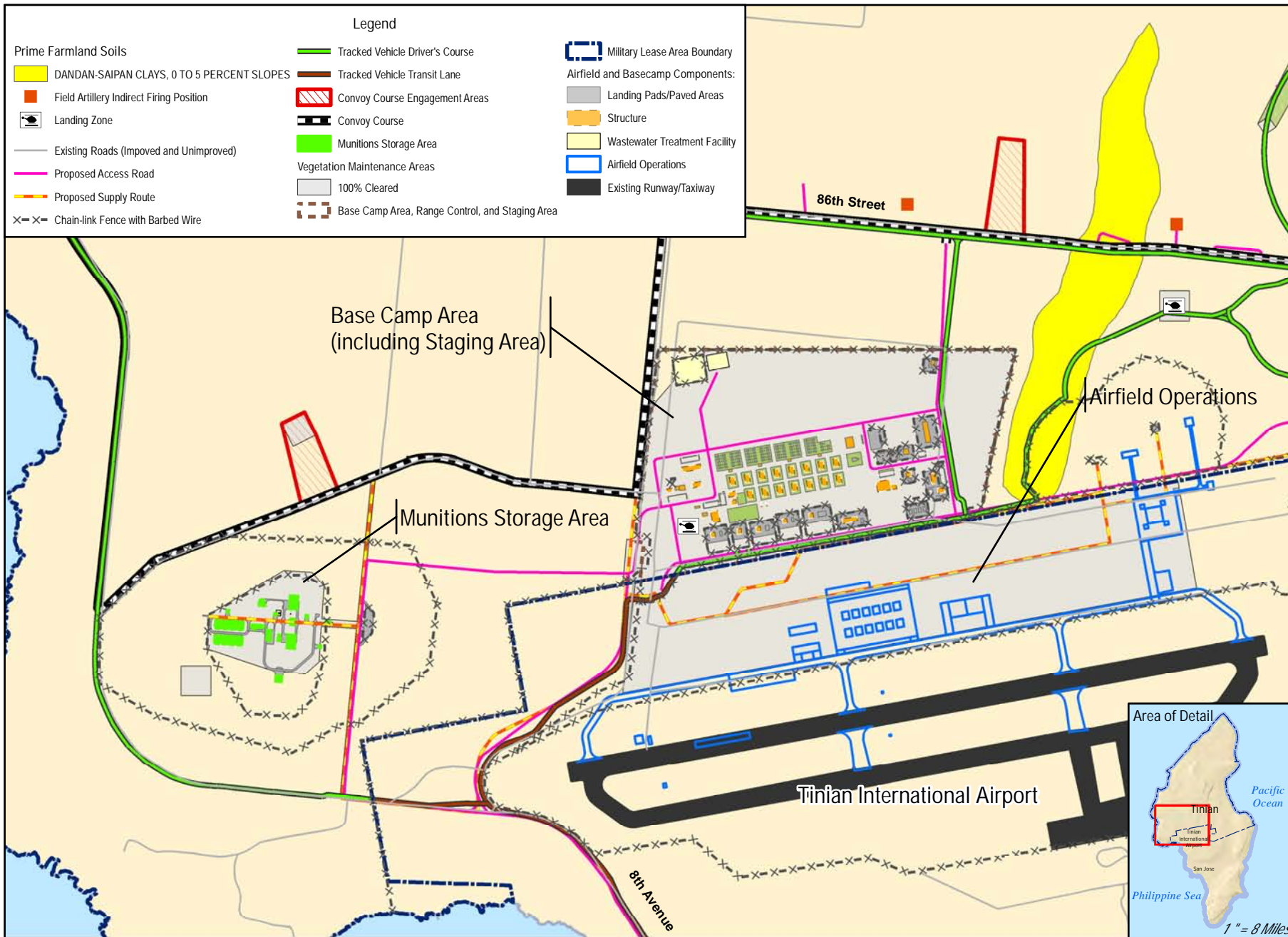


Figure 6
Tinian Airfield Improvements, Base Camp, and Munitions Storage Area (All Alternatives):
Prime Farmland Soils Map



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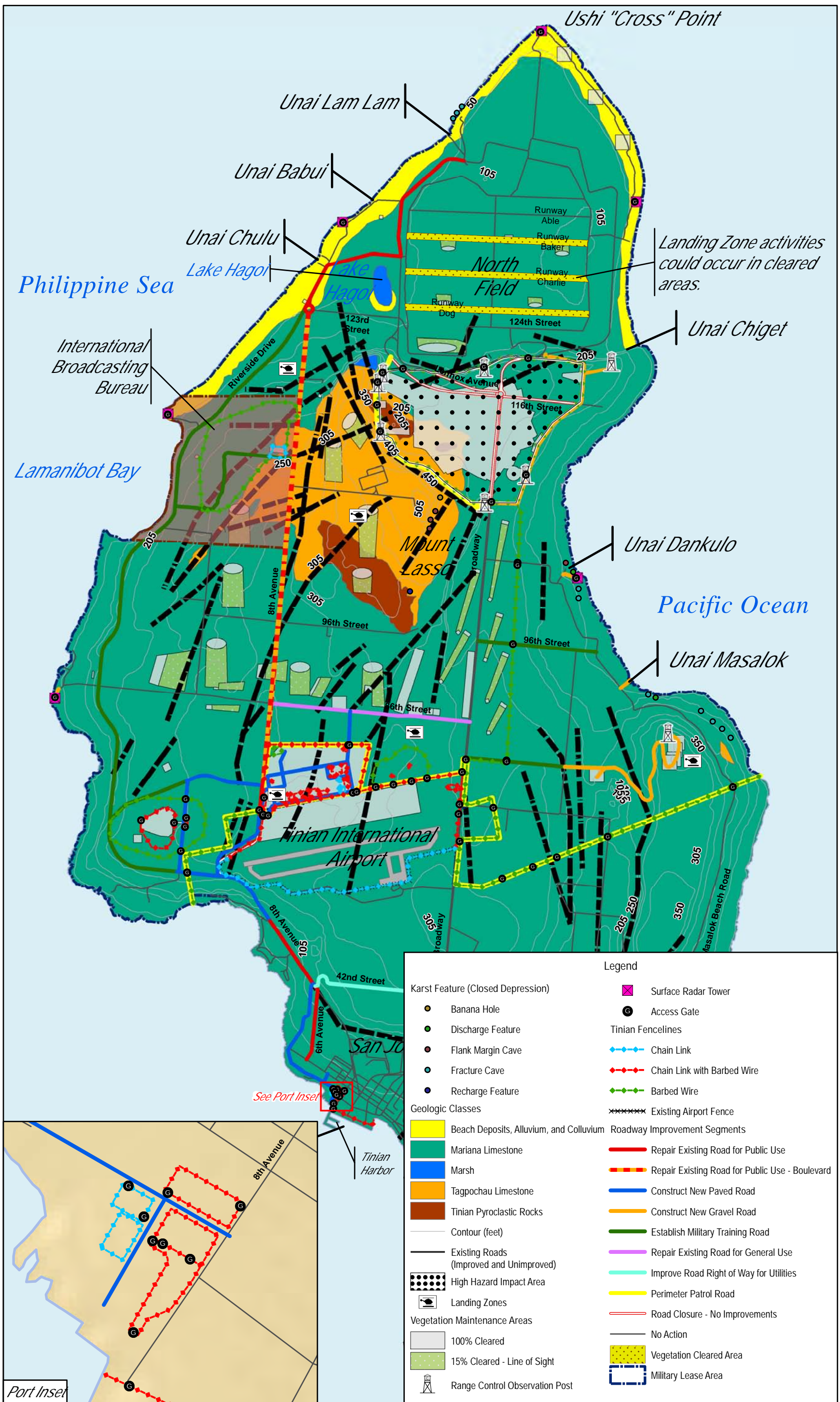


Figure 7
Tinian All Action Alternatives Roadway Improvements:
Topographic and Geologic Map



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1.2.1.4 Soils, Elevation, and Slope

[Table 11](#) below depicts roads with slopes greater than 10% and highly erodible soils. These roadways are topographically mapped in [Figure 8](#).

Table 11. Tinian Roadways: All Alternatives Slopes Greater Than 10% and Erodible Soils

<i>Description</i>	<i>Slope</i>	<i>Erodible Soils*</i>	<i>Erodibility</i>
Establish Military Training Road	Contains slopes 15-30%	#12 Chinen-Clay Loam, and #16 Chinen-Rock Outcrop Complex	severe
Construct New Gravel Road: Access road to OP#3	Contains slopes 15-30%	#12 Chinen-Clay Loam	severe
Perimeter Patrol Road	Contains slopes 60-99%	#42-Rock Outcrop-Takpochao Complex	severe

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.1.4.1 Prime Farmland Soils

Prime farmland soils within the proposed road improvements are shown in [Table 12](#) below and mapped in [Figure 9](#).

Table 12. Tinian Roadways: All Alternatives Prime Farmland Soils

<i>Description</i>	<i>Prime Farmland Soils within Roadway</i>	<i>Acres</i>	<i>Hectares</i>
Repair Existing Road for Public Use	Dandan-Saipan Clays, 0-5% slopes	3	1
Establish Military Training Road	Dandan-Saipan Clays, 0-5% slopes	3	1
Perimeter Patrol Road	Dandan-Saipan Clays, 0-5% slopes	1	0.4
Total	Dandan-Saipan Clays, 0-5% slopes	7	2.4

1.2.2 Training Facilities

Common to all Tinian action alternatives are the construction of proposed training facilities: (1) Range Complex A, (2) Range Complex B, (3) Range Complex C, (4) Range Complex D, and (5) Military Lease Area-wide training facilities. A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology and geologic hazards, soil classifications, and location of any Prime Farmland soil units for the training facilities for each action alternative is described below.

1.2.2.1 Range Complex A: All Tinian Alternatives

Proposed Range Complex A contains a High Hazard Impact Area (HHIA). Within the HHIA footprint is a perimeter road, a firebreak/buffer, and four ground ranges: (1) a Live Hand Grenade Range, (2) a Grenade Launcher Range, (3) a Light Anti-armor Weapon Range, and (4) a Mortar Range (with 10 firing positions). In addition, within the HHIA are target areas for the ground ranges as well as targets for Indirect Artillery Firing Range (firing positions are distributed within various locations in the Military Lease Area) and two aviation ranges – Offensive Air Support Range and Close Air Support Range.

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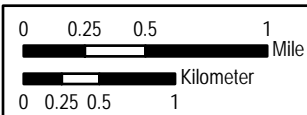
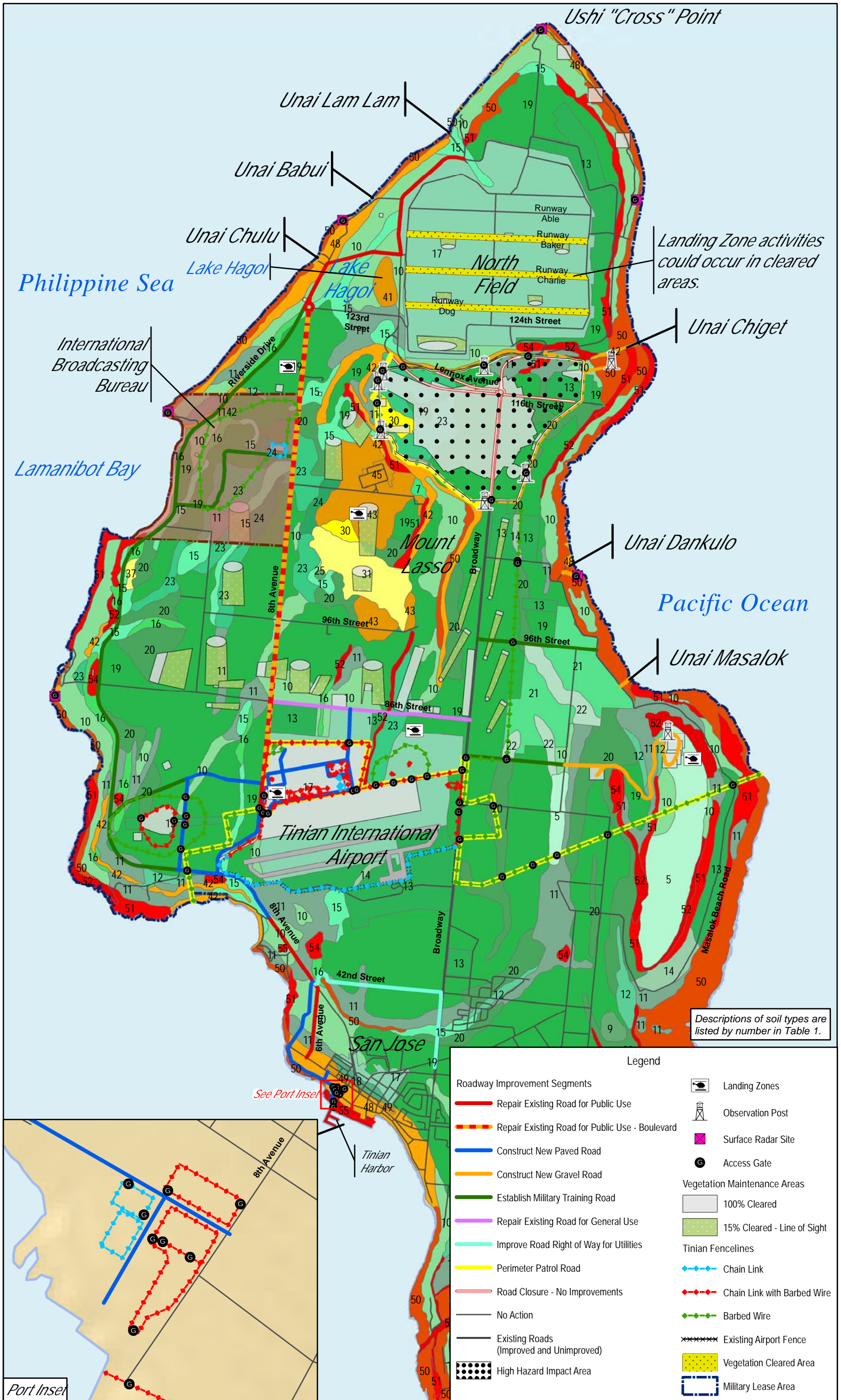


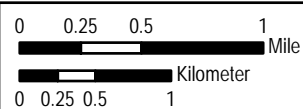
Figure 8
Tinian All Action Alternatives Roadway Improvements:
Soils Map



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Figure 9
Tinian All Action Alternatives Roadway Improvements:
Prime Farmland Soils Map



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1.2.2.1.1 Ground Disturbance and Vegetation Maintenance

Ground disturbance for each training and support facility within the proposed Range Complex A is presented in [Table 13](#). Within the proposed range complex, vegetation maintenance would be required within the target areas, perimeter roads, and buffer/fire break and would not be required in the remainder of the HHIA. Vegetation would be maintained through controlled fires or chemical means as access to the interior of the range would be limited due to the presence of unexploded ordnance. This range complex would require 100% vegetation maintenance for each of the target objectives, along the fire break/perimeter road, and the maintenance road for a total of 527 acres (213 hectares). All other portions of Range Complex A would be left in its natural state. Once the range complex is activated, the area within the HHIA would contain unexploded ordnance and therefore ordinary vegetation maintenance such as mowing, cutting, and clearing would not be practical. For this reason, other methods of vegetation maintenance would be employed (e.g., controlled burning, herbicide applications) to maintain lines of sight to targets and to maintain the fire break. The total vegetation maintenance is mapped in [Figure 10](#) and would be the same footprint as the ground disturbance (see [Table 13](#)) or a total of 527 acres (213 hectares).

Table 13. Tinian Range Complex A: All Alternatives Ground Disturbance and Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbance and Maintenance</i>
HHIA Target Area	527 (Inside HHIA)	213 (Inside HHIA)	100
Live Hand Grenade Range	3 (inside HHIA Target Area)	1 (inside HHIA Target Area)	100
Grenade Launcher Range	9 (inside HHIA Target Area)	4 (inside HHIA Target Area)	100
Light Anti-Armor Weapon Live Range	26 (inside HHIA Target Area)	10 (inside HHIA Target Area)	100
Grenade Launcher Range	88 (inside HHIA Target Area)	35 (inside HHIA Target Area)	100
Mortar Firing Range	2 (inside HHIA Target Area)	1 (inside HHIA Target Area)	100
Proposed Access Roads	3 (inside HHIA Target Area)	1 (inside HHIA Target Area)	100
Total	527	213	100%

Legend: HHIA = High Hazard Impact Area.

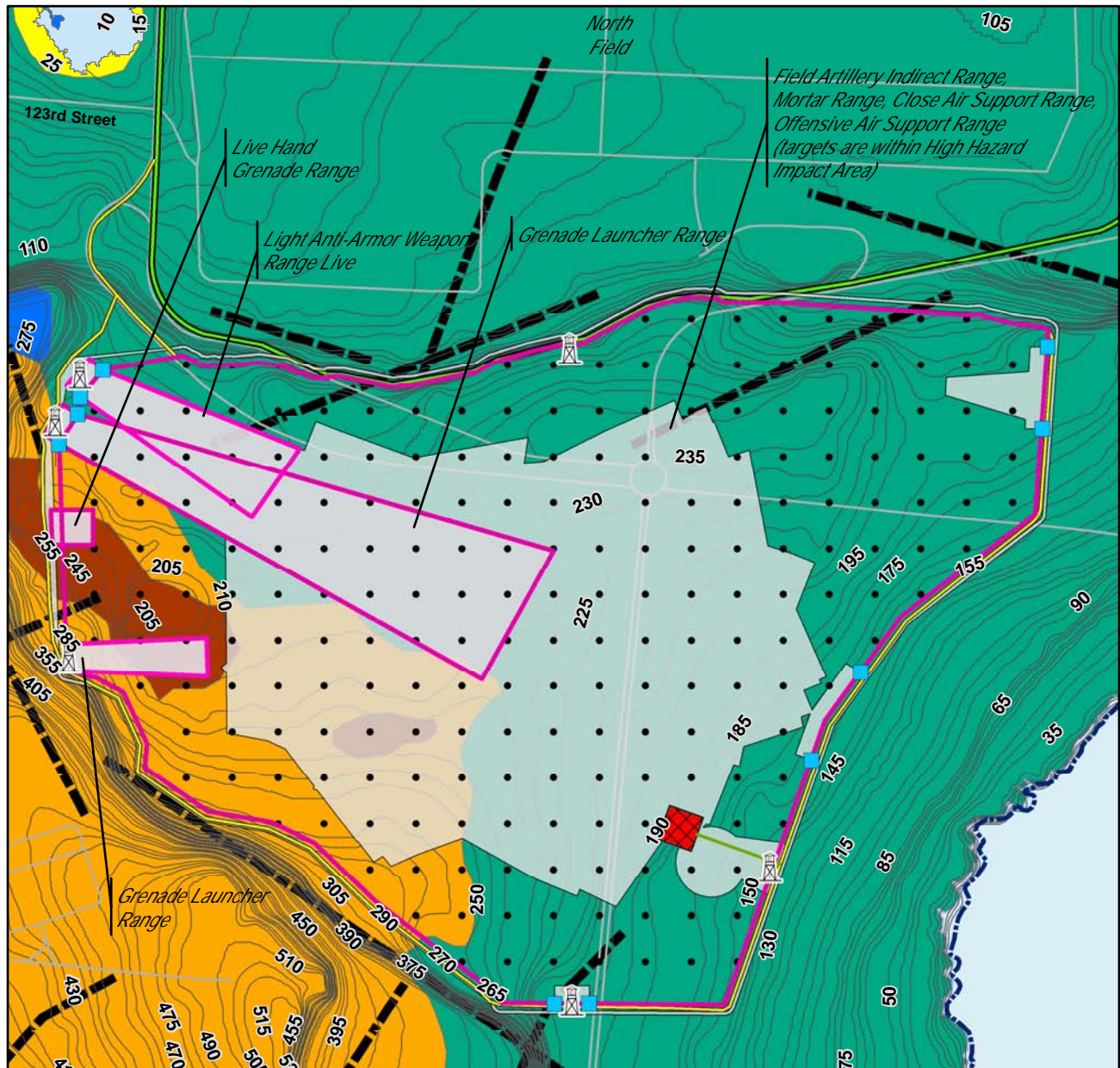
Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.1.2 Elevation and Slope

Within the proposed Range Complex A, general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 14](#) and are topographically shown in [Figure 10](#).

Table 14. Tinian Range Complex A: All Alternatives Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex A	145 to 285 feet (44 to 87 meters)	1% to 11%	East to West



Legend

Geologic Classes	Proposed Actions:
Beach Deposits, Alluvium, and Colluvium	Range Areas
Mariana Limestone	Observation Post
Marsh	Mortar Firing Position
Tagpochau Limestone	Proposed Perimeter Road/Firebreak/Buffer Area
Tinian Pyroclastic Rocks	Tracked Vehicle Driver's Course
Karst Feature (Closed Depression)	Existing Roads (Improved and Unimproved)
Banana Hole	High Hazard Impact Area
Discharge Feature	Demolition Range Features
Flank Margin Cave	Detonation Area
Fracture Cave	Proposed Demolition Range Access Trail
Recharge Feature	Vegetation Maintenance Areas
Fault Line (tectonic)	100% Cleared
Contour (feet)	
Military Lease Area	

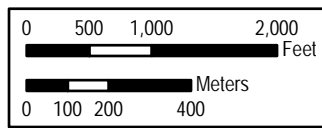


Figure 10
Tinian All Action Alternatives Range Complex A:
Topographic and Geologic Map



1.2.2.1.3 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Range Complex A area is underlain by Mariana Limestone, Tagpochau Limestone (southwest side) and Tinian pyroclastic rocks. These are shown in the geological map [Figure 10](#).

1.2.2.1.4 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Within the proposed Range Complex A, four faults were identified - two along the northern portion of the range complex, one on the western boundary, and one at the center southern boundary. The features are shown in [Figure 10](#).

1.2.2.1.5 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex A with their soil characteristics in [Table 15](#) and are mapped in [Figure 11](#).

Table 15. Tinian Range Complex A: All Alternatives Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#7 Banderu-Rock Outcrop	NA	medium	moderate
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#30 Laolao Clay	0% to 5% slopes	slow	slight
#45 Saipan Clay	0% to 5% slopes	slow	slight
#51 Takpochao-Rock Outcrop Complex	3% to 15% slopes	medium	moderate

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.1.6 Prime Farmland Soils

Proposed Tinian Range Complex A includes 205 acres (83 hectares) of Dandan-Saipan Clays, 0% to 5% slopes, within the western portion of the range complex inside the HHIA. The locations of these soils are mapped in [Figure 12](#).

1.2.2.2 Range Complex B: All Tinian Alternatives

Proposed Range Complex B for all Tinian alternatives consists of: (1) a Combat Pistol Range, (2) a Battle Sight Zero Range, (3) a Multi-Purpose Training Range, (4) Multi-Purpose Range Complex Objective Areas, (5) Multi-Purpose Range Complex Lines of Sight, and (6) Access Roads. These proposed action features are common for all action alternatives.

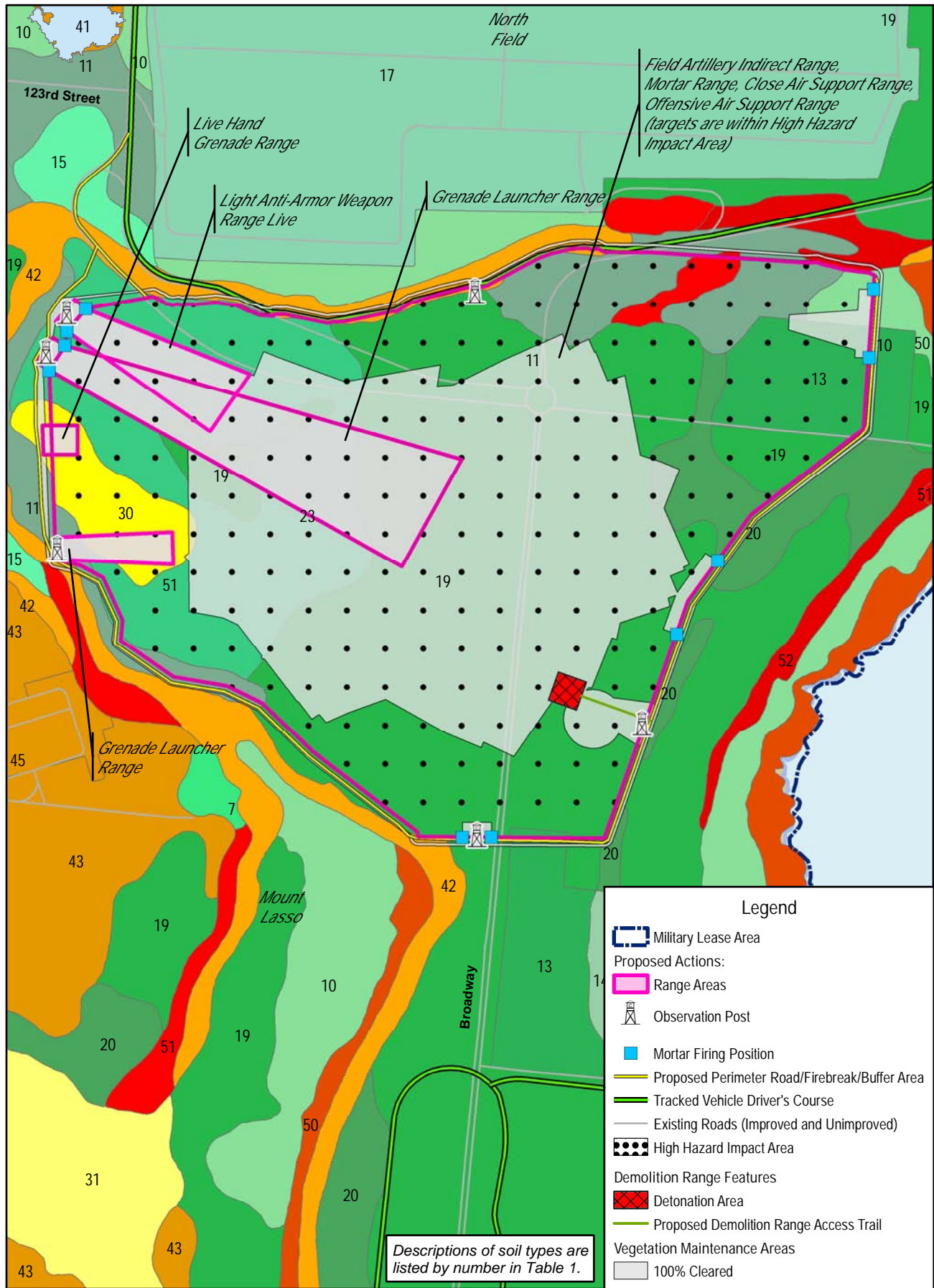


Figure 11
Tinian All Action Alternatives Range Complex A:
Soils Map

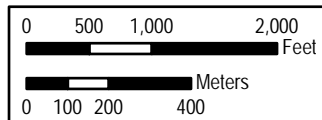
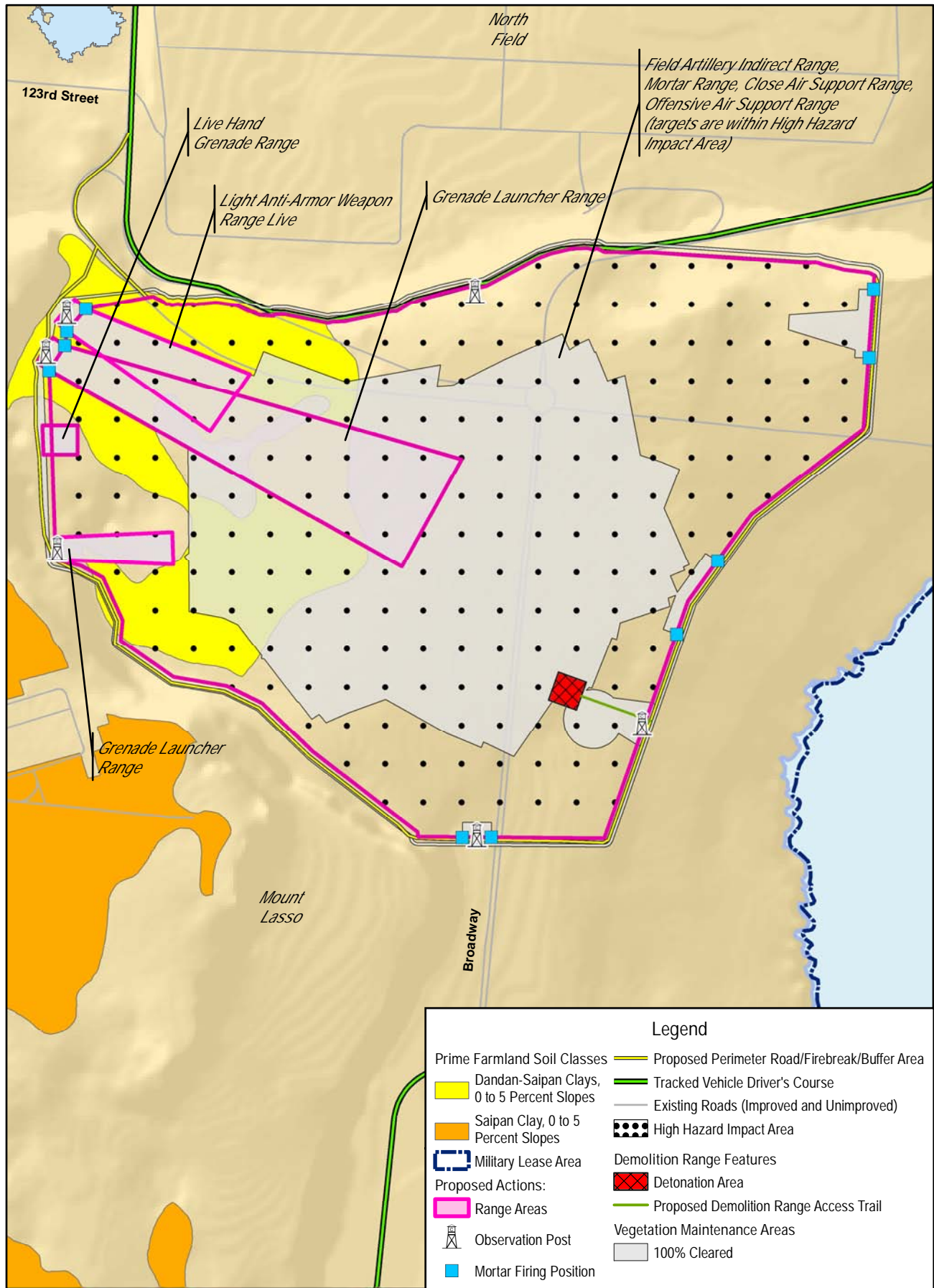


Figure 12
 Tinian All Action Alternatives Range Complex A:
 Prime Farmland Soils Map



1.2.2.2.1 Ground Disturbance

Ground disturbance for the training facilities within the proposed Range Complex B total 47 acres (20 hectares) and are presented in [Table 16](#) and depicted in [Figure 13](#). The range lines of sight (i.e., the area from the firing point to the target objective) would have 0% ground disturbance.

Table 16. Tinian Range Complex B: All Alternatives Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Combat Pistol Range	2	1	100
Battle Sight Zero Range	2	1	100
Multi-Purpose Training Range	23	9	100
Multi-Purpose Range Complex Objective Areas	16	7	100
Access Roads	4	2	100
Total	47	20	100%

1.2.2.2.2 Vegetation Maintenance

The training facilities within the proposed Range Complex B have been assessed for vegetation maintenance by determining the area size and the total area of vegetation maintenance during operations for each given area. The lines of sight from the firing points to the target objectives within the Multi-purpose Range Complex total approximately, 83 acres (33 hectares) and require 15% vegetation maintenance. The remaining range objective areas and access roads total 47 acres (20 hectares) and require 100% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at this range complex. The results of this assessment are shown in [Table 17](#) and the areas are mapped in [Figure 13](#).

Table 17. Tinian Range Complex B: All Alternatives Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Combat Pistol Range	2	1	100
Battle Sight Zero Range	2	1	100
Multi-Purpose Training Range	23	9	100
Multi-Purpose Range Complex Objective Areas	16	7	100
Multi-Purpose Range Complex Lines of Sight	83	34	15
Access Roads	4	2	100
Totals	47	20	100%
	83	34	15%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.2.3 Elevation and Slope

Within the proposed Range Complex B, general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 18](#) and are topographically shown in [Figure 13](#).

Table 18. Tinian Range Complex B: All Alternatives Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex B	125 to 290 feet (38 to 88 meters)	1-35%	East to West

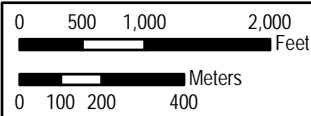
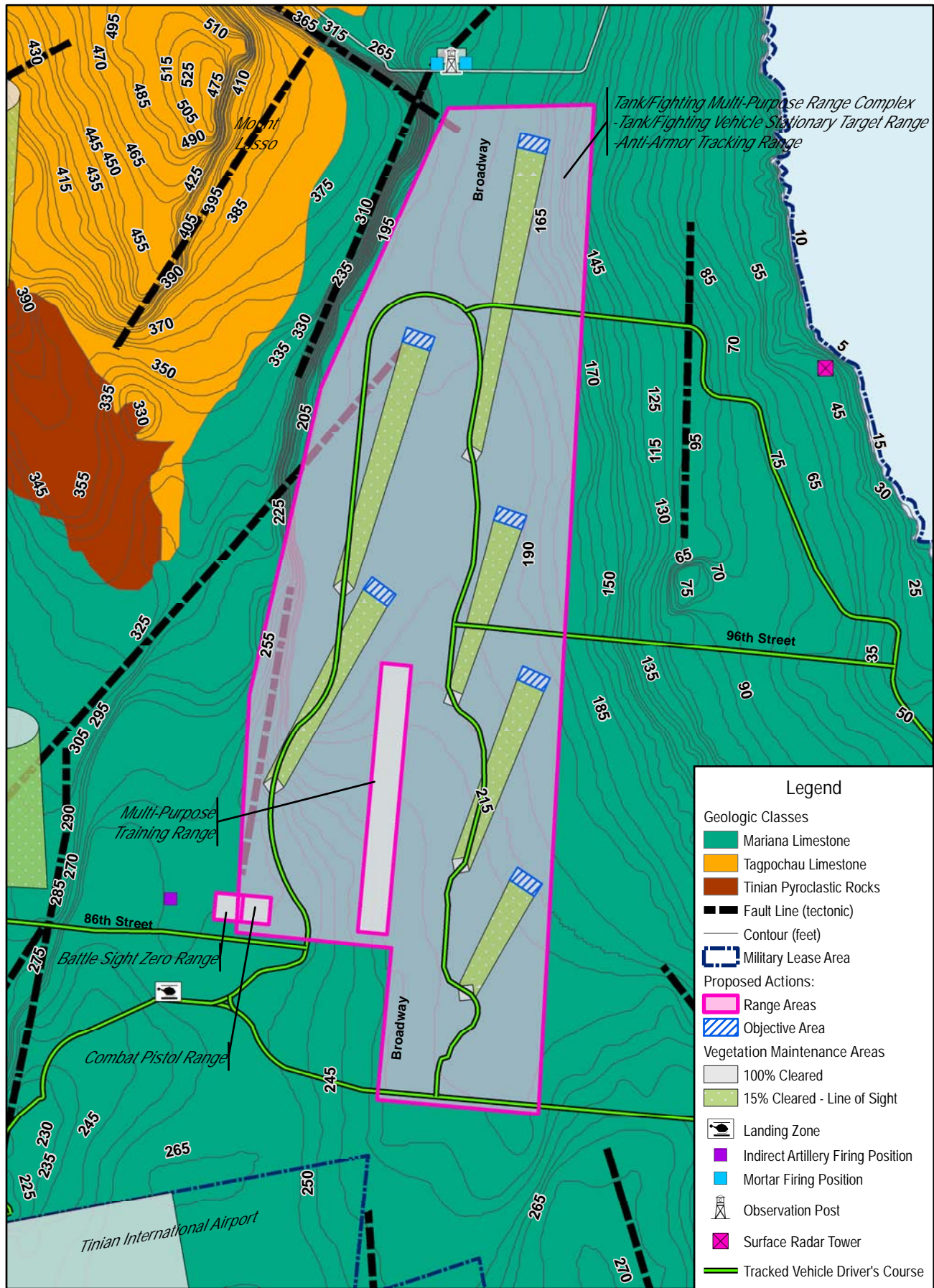


Figure 13
 Tinian All Action Alternatives Range Complex B:
 Topographic and Geologic Map



1.2.2.2.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Range Complex B area is underlain by Mariana Limestone shown in the geological map [Figure 13](#).

1.2.2.2.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Three faults were identified for the proposed Range Complex B along the western boundary. These features are shown in [Figure 13](#).

1.2.2.2.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex B are shown with their soil characteristics in [Table 19](#) and are mapped in [Figure 14](#).

Table 19. Tinian Range Complex B: All Alternatives Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#9 Chacha Clay, Drained	0% to 5% slopes	ponded or very slow	slight
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#13 Chinen Very Gravelly Sandy Loam	0% to 5% slopes	slow	slight
#14 Chinen Very Gravelly Sandy Loam	5% to 15% slopes	medium	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#21 Dandan-Chinen-Pits Complex	0% to 5% slopes	slow	slight
#22 Dandan-Chinen-Pits Complex	5% to 15% slopes	medium	moderate
#50 Takapochao-Rock Outcrop Complex	3% to 15% slopes	slow	slight

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.2.7 Prime Farmland Soils

No prime farmland soils have been identified within the proposed Range Complex B.

1.2.2.3 Range Complex C: Tinian Alternative 1 (no southern Battle Area Complex)

Under Tinian Alternative 1, the proposed Range Complex C consists of: (1) a Multi-Purpose Automated Unknown Distance Range, (2) Infantry Platoon Battle Course Objective Areas, (3) Infantry Platoon Battle Course Lines of Sight, (4) Urban Assault Course South Objective Area, (5) Urban Assault Course South Line of Sight, and (6) Infantry Platoon Battle Course Access Roads. Within the Infantry Platoon Battle Course there are firing points, lines of sight to the targets (objective areas), and objective areas. Within the Urban Assault Course there are approximately 20 one-story open-roofed structures as well as target objective areas. These training facilities are also common to Alternatives 2 and 3.

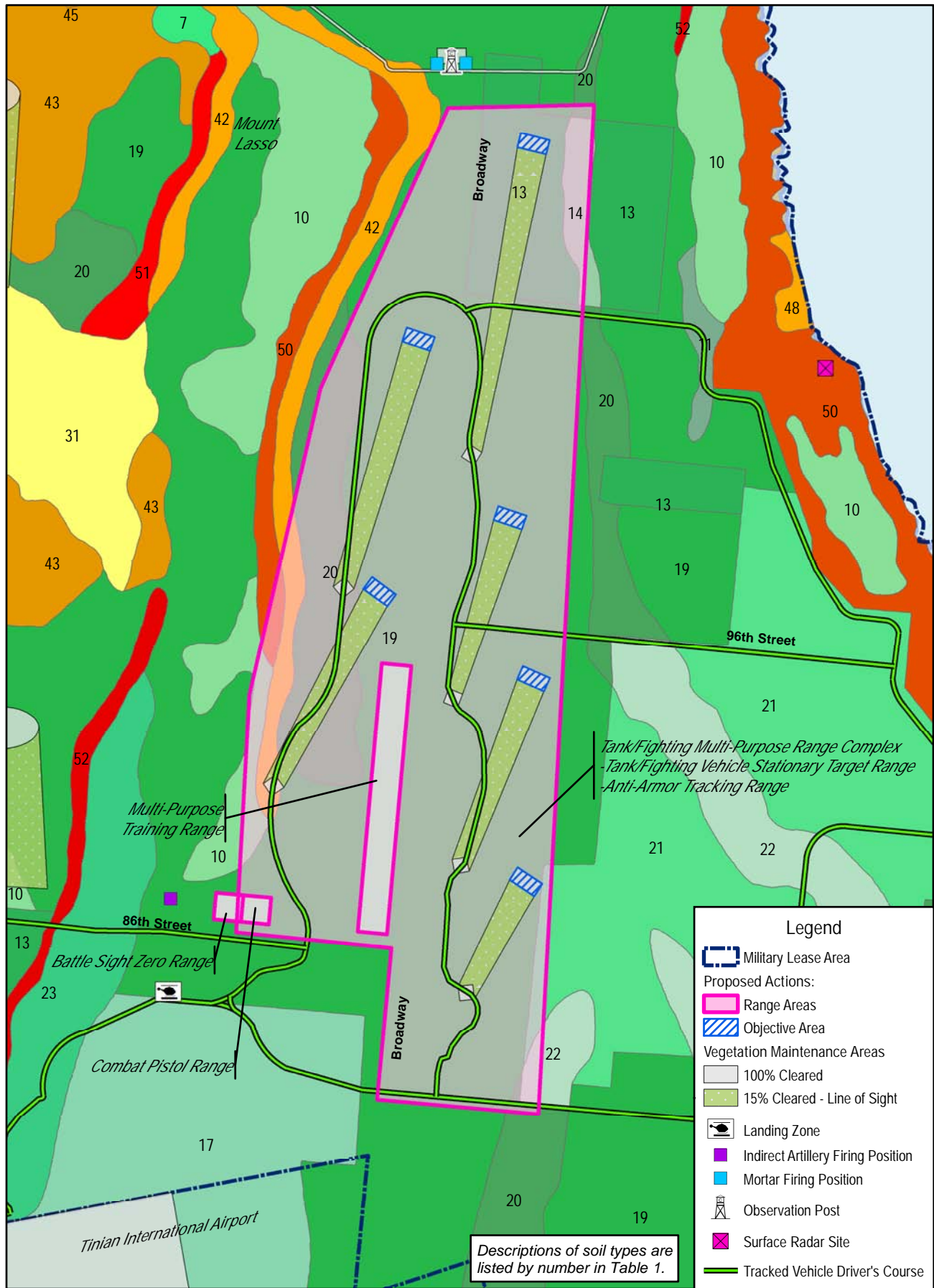


Figure 14
 Tinian All Action Alternatives Range Complex B:
 Soils Map

1.2.2.3.1 Ground Disturbance

Ground disturbance for the training facilities within the proposed Range Complex C (Alternative 1) is presented in [Table 20](#) and the project area locations are mapped in [Figure 15](#). The range lines of sight (i.e., the area from the firing point to the target objective) would have 0% ground disturbance.

Table 20. Tinian Range Complex C: Alternative 1 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Multi-Purpose Automated Unknown Distance Range	31	13	100
Infantry Platoon Battle Course Objective Areas	23	10	100
Urban Assault Course South Objective Area	24	10	100
Infantry Platoon Battle Course Access Roads	2	1	100
Total	80	34	100%

1.2.2.3.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Range Complex C under Tinian Alternative 1 during operations are presented in [Table 21](#). Proposed Range Complex C (Alternative 1) totals 88 acres (35 hectares) of 15 % vegetation maintenance and 80 acres (34 hectares) of 100% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at this range complex

Table 21. Tinian Range Complex C: Alternative 1 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Multi-purpose Automated Unknown Distance Range	31	13	100
Infantry Platoon Battle Course Objective Areas	23	10	100
Urban Assault Course South Objective Area	24	10	100
Infantry Platoon Battle Course Lines of Sight	45	18	15
Urban Assault Course (South) Lines of Sight	43	17	15
Infantry Platoon Battle Course Access Roads	2	1	100
Totals	88	35	15%
	80	34	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.3.3 Elevation and Slope

Within the proposed Range Complex C (Alternative 1), general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 22](#) and are topographically shown in [Figure 15](#).

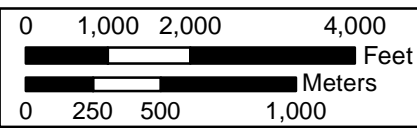
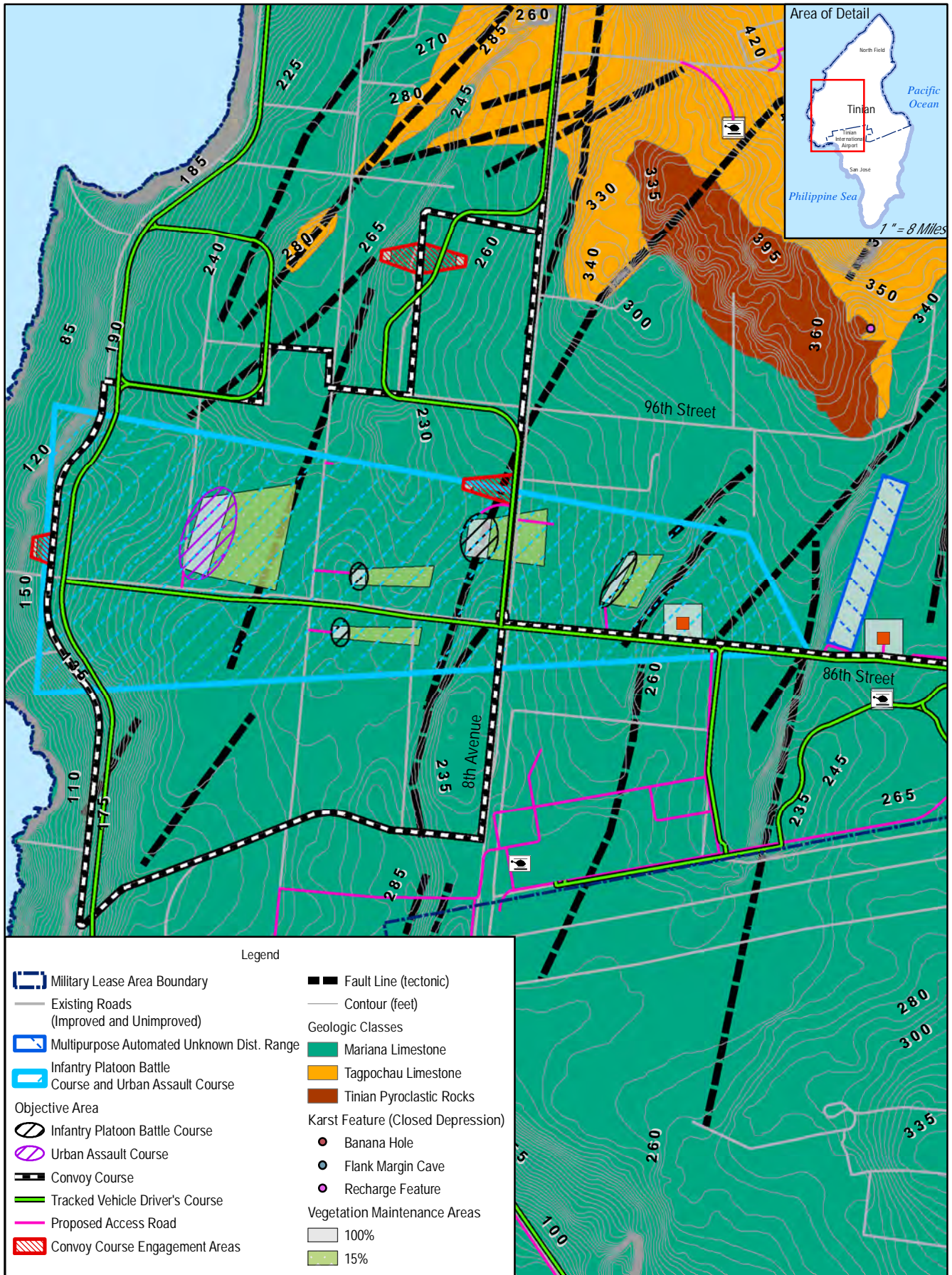


Figure 15
Tinian Alternative 1 Range Complex C:
Topographic and Geologic Map



Table 22. Tinian Range Complex C: Alternative 1 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex C (Alternative 1)	85 to 310 feet (26 to 94 meters)	1-11%	West to East

1.2.2.3.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Range Complex C (Alternative 1) is underlain by Mariana Limestone, shown in the geological map [Figure 15](#).

1.2.2.3.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Four faults were identified - through the center and eastern boundaries of Range Complex C (Alternative 1). Features are shown in the geological map [Figure 15](#).

1.2.2.3.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex C (Alternative 1) are shown with their soil characteristics in [Table 23](#) and are mapped in [Figure 16](#).

Table 23. Tinian Range Complex C: Alternative 1 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
#15 Chinen-Rock Outcrop Complex	3% to 15% slopes	slow	moderate
#16 Chinen-Rock Outcrop Complex	15% to 30% slopes	medium	severe
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#22 Dandan-Chinen-Pits Complex	5% to 15% slopes	medium	moderate
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#43 Saipan Clay	0% to 5% slopes	slow	slight
#52 Takpochao-Rock Outcrop Complex	30% to 60% slopes	very rapid	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.3.7 Prime Farmland Soils

Proposed Range Complex C (Alternative 1) includes 14 acres (6 hectares) of Dandan-Saipan Clays, 0% to 5% slopes, within the southern portion of the Multi-Purpose Automated Unknown Distance Range. The locations of these soils are mapped in [Figure 17](#).

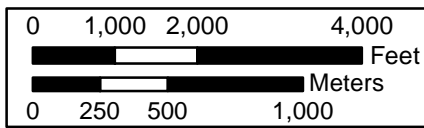
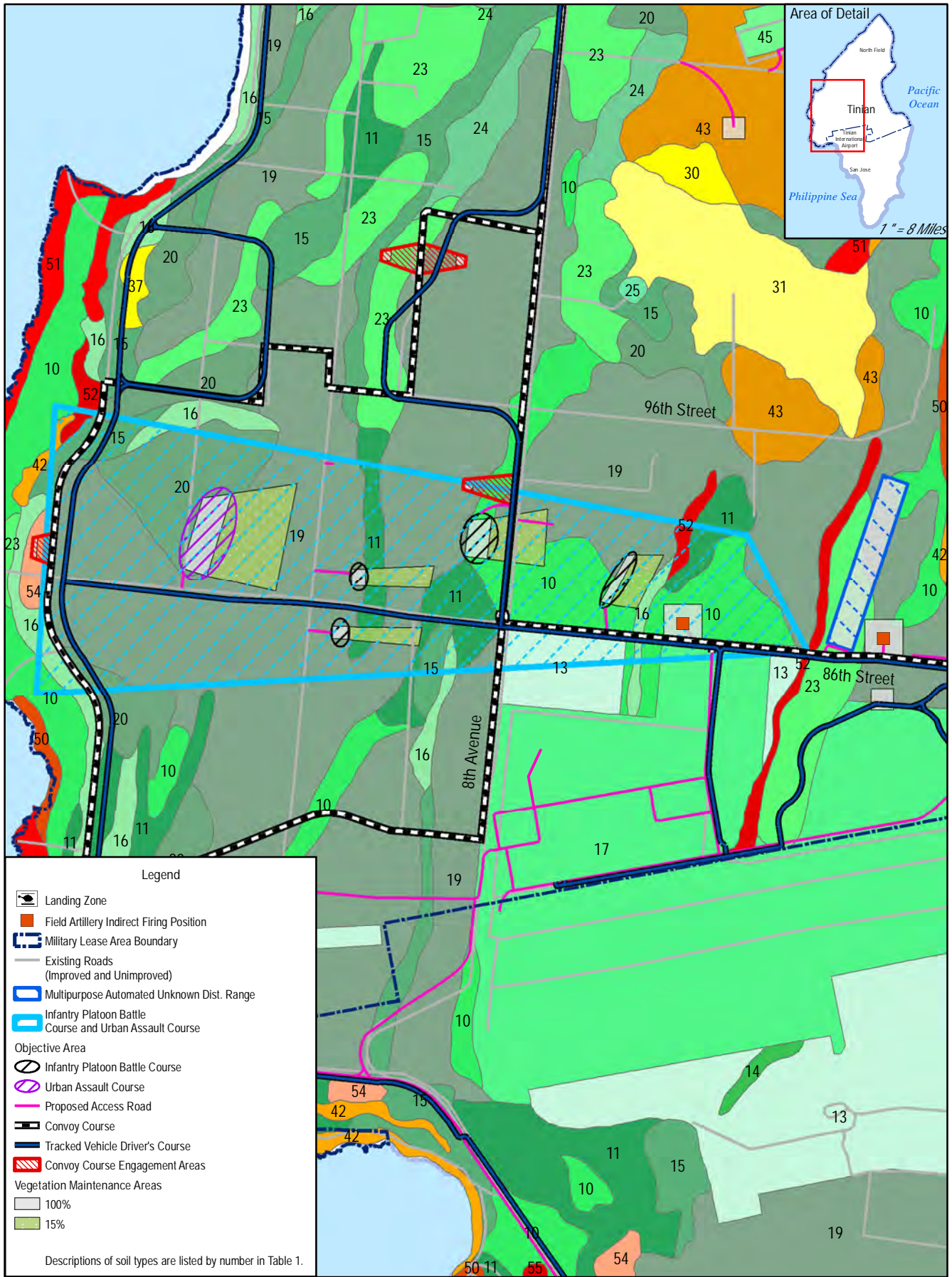


Figure 16
Tinian Alternative 1 Range Complex C:
Soils Map

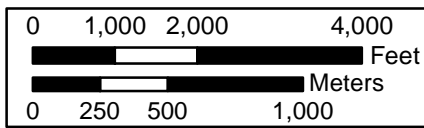
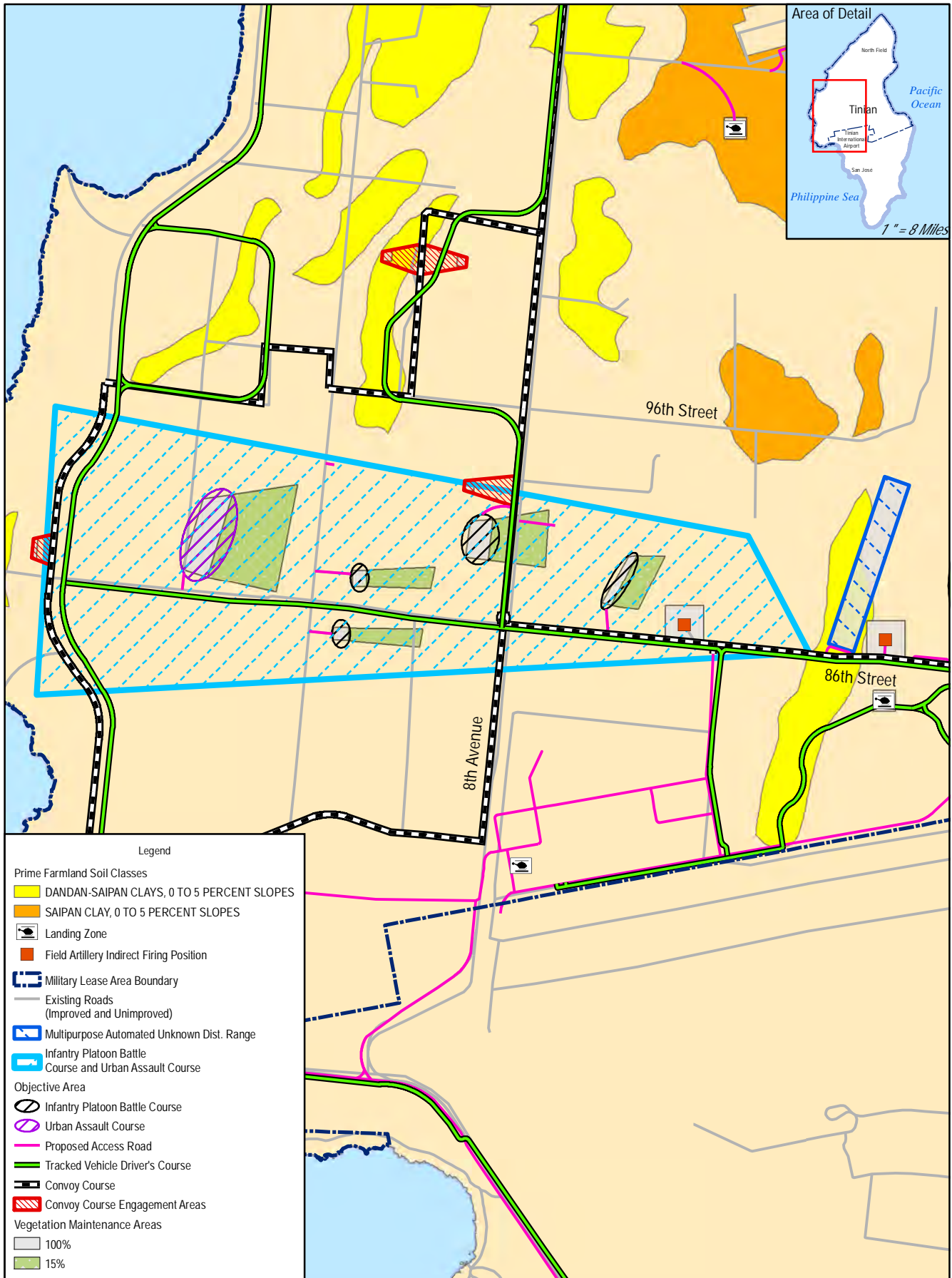


Figure 17
Tinian Alternative 1 Range Complex C:
Prime Farmland Soils Map

1.2.2.4 Range Complex C: Tinian Alternatives 2 and 3 (contains Southern Battle Area Complex)

Under Tinian alternatives 2 and 3 the proposed Range Complex C (Alternatives 2 and 3) consists of: (1) a Multi-Purpose Automated Unknown Distance Range, (2) Infantry Platoon Battle Course Objective Areas, (3) Infantry Platoon Battle Course Lines of Sight, (4) Urban Assault Course South Objective Area, (5) Urban Assault Course South Line of Sight, (6) Infantry Platoon Battle Course Access Roads, (7) southern Battle Area Complex Objective Areas, (8) southern Battle Area Complex Lines of Sight, (9) southern Battle Area Complex Access Roads, (10) southern Battle Area Complex Urban Assault Course Objective Area, and (11) southern Battle Area Complex Urban Assault Course Line of Sight. Within the Infantry Platoon Battle Course there are firing points, lines of sight to the targets (objective areas), and objective areas. Within the Urban Assault Course there are approximately 20 one-story open-roofed structures as well as target objective areas. The southern Battle Area Complex is unique to Tinian Alternatives 2 and 3 and includes objective areas and lines of sight and an additional Urban Assault Course objective area and line of sight.

1.2.2.4.1 Ground Disturbance

Ground disturbance for the training facilities within the proposed Range Complex C total 157 acres (65 hectares) and are presented in [Table 24](#). The range lines of sight (i.e., the area from the firing point to the target objective) would have 0% ground disturbance.

Table 24. Tinian Range Complex C: Alternatives 2 and 3 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Multi-purpose Automated Unknown Distance Range	31	13	100
Infantry Platoon Battle Course Objective Areas	23	10	100
Urban Assault Course South Objective Area	24	10	100
Infantry Platoon Battle Course Access Roads	2	1	100
Southern Battle Area Complex Objective Areas	59	24	100
Southern Battle Area Complex Access Roads	10	4	100
Southern Battle Area Complex Urban Assault Course Objective Area	8	3	100
Total	157	65	100%

1.2.2.4.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Range Complex C under Tinian Alternatives 2 and 3 during operations are presented in [Table 25](#) and mapped in [Figure 18](#). Proposed Range Complex C (Alternatives 2 and 3) totals 157 acres (65 hectares) of 100% vegetation maintenance and 338 acres (136 hectares) of 15 % vegetation maintenance. The range lines of sight (i.e., the area from the firing point to the target objective) would have 15% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at this range complex.

Table 25. Tinian Range Complex C: Alternatives 2 and 3 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Multi-purpose Automated Unknown Distance Range	31	13	100
Infantry Platoon Battle Course Objective Areas	23	10	100
Urban Assault Course South Objective Area	24	10	100
Infantry Platoon Battle Course Lines of Sight	45	18	15
Urban Assault Course (South) Lines of Sight	43	17	15
Infantry Platoon Battle Course Access Roads	2	1	100
Southern Battle Area Complex Objective Areas	59	24	100
Southern Battle Area Complex Lines of Sight	230	93	15
Southern Battle Area Complex Access Roads	10	4	100
Southern Battle Area Complex Urban Assault Course Objective Area	8	3	100
Southern Battle Area Complex Urban Assault Course Line of Sight	20	8	15
Totals	338	136	15%
	157	65	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.4.3 Elevation and Slope

Within the proposed Range Complex C (Alternatives 2 and 3), general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 26](#) and are topographically shown in [Figure 18](#).

Table 26. Tinian Range Complex C: Alternatives 2 and 3 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex C (Alternatives 2 and 3)	85 to 435 feet (26 to 133 meters)	1-22%	West to East

1.2.2.4.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Range Complex C (Alternatives 2 and 3) area is underlain by Mariana Limestone, Tagpochau Limestone (Northeast side), and Tinian pyroclastic rocks (East). Locations are shown in [Figure 18](#).

1.2.2.4.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Nine faults were identified – four through the center of the Infantry Platoon Battle Course and five through the southern Battle Area Complex. These features are shown in [Figure 18](#).

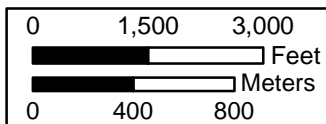
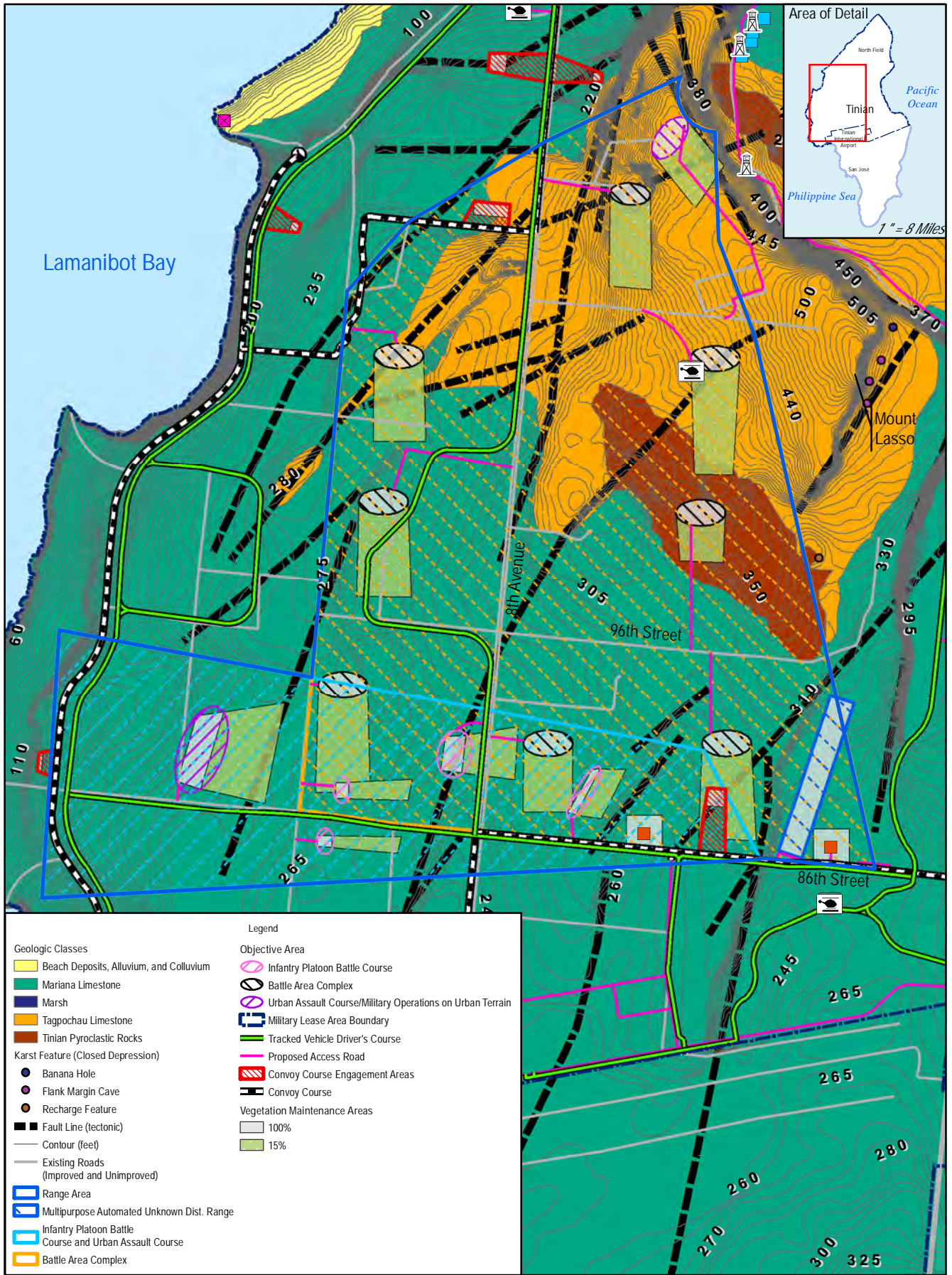


Figure 18
Tinian Alternatives 2 and 3 Range Complex C:
Topographic and Geologic Map

1.2.2.4.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex C (Alternatives 2 and 3) are shown with their soil characteristics in [Table 27](#) and are mapped in [Figure 19](#).

Table 27. Tinian Range Complex C: Alternatives 2 and 3 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#7 Banderu-Rock Outcrop, medium runoff rate, moderate erodibility	NA	medium	moderate
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
#15 Chinen-Rock Outcrop Complex	3% to 15% slopes	slow	moderate
#16 Chinen-Rock Outcrop Complex	15% to 30% slopes	medium	severe
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#22 Dandan-Chinen-Pits Complex	5% to 15% slopes	medium	moderate
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#24 Dandan-Saipan Clays	5% to 15% slopes	slow	slight
#30 Laolao Clay	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe
#43 Saipan Clay	0% to 5% slopes	slow	slight
#45 Saipan Very Gravelly Sandy Loam	0% to 5% slopes	slow	slight
#50 Takpochao-Rock Outcrop Complex	3% to 15% slopes	slow	slight
#51 Takpochao-Rock Outcrop Complex	15% to 30% slopes	medium	moderate
#52 Takpochao-Rock Outcrop Complex	30% to 60% slopes	very rapid	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.4.7 Prime Farmland Soils

Range Complex C (Alternatives 2 and 3) includes 23 acres (9 hectares) of Dandan-Saipan Clays, 0% to 5% slopes, and 8 acres (3 hectares) of Saipan Clays, 0% to 5%, slopes throughout the southern Battle Area Complex. The locations of these soils are mapped in [Figure 20](#).

1.2.2.5 Range Complex D: Tinian Alternatives 1 and 2 (contains northern Battle Area Complex)

Proposed Range Complex D (Alternatives 1 and 2) consists of: (1) a Drop Zone, (2) a Landing Zone, (3) northern Battle Area Complex Objective Areas, (4) northern Battle Area Complex Lines of Sight, (5) Urban Assault Course North Objective Area, and (6) Urban Assault Course North Line of Sight and (within the Battle Area Complex). The Landing Zone, an Unmanned Aircraft Systems Ground Station, and a Forward Arming and Refueling Point would be located within the Drop Zone on North Field.

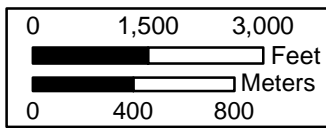
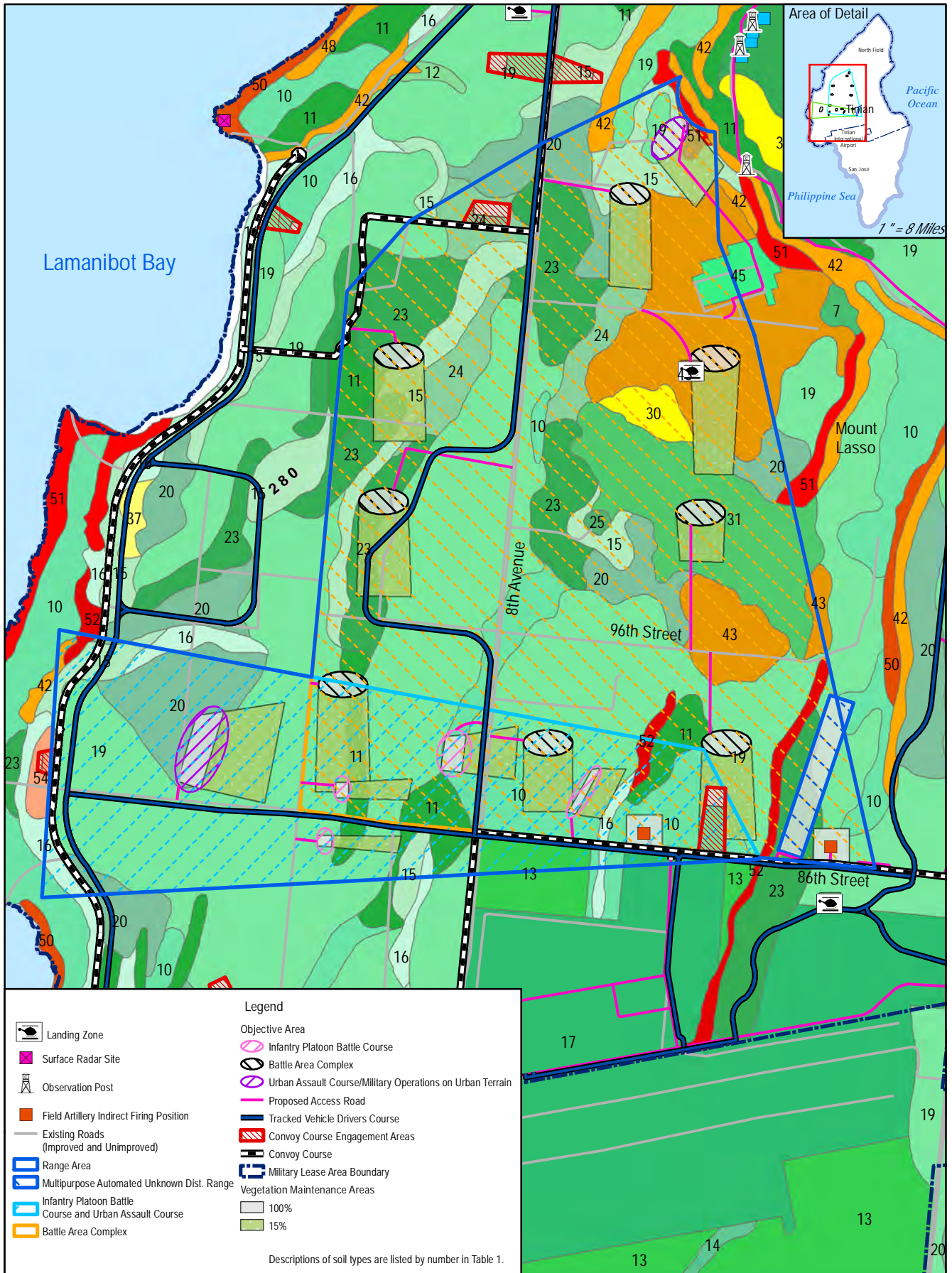


Figure 19
 Tinian Alternatives 2 and 3 Range Complex C:
 Soils Map

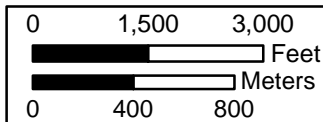
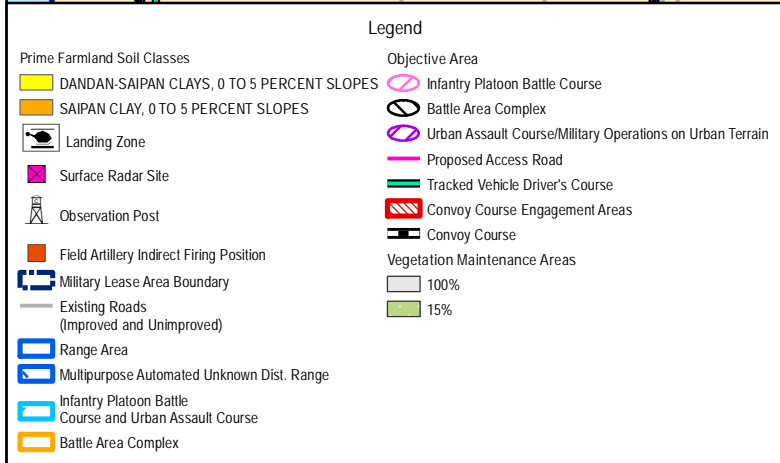
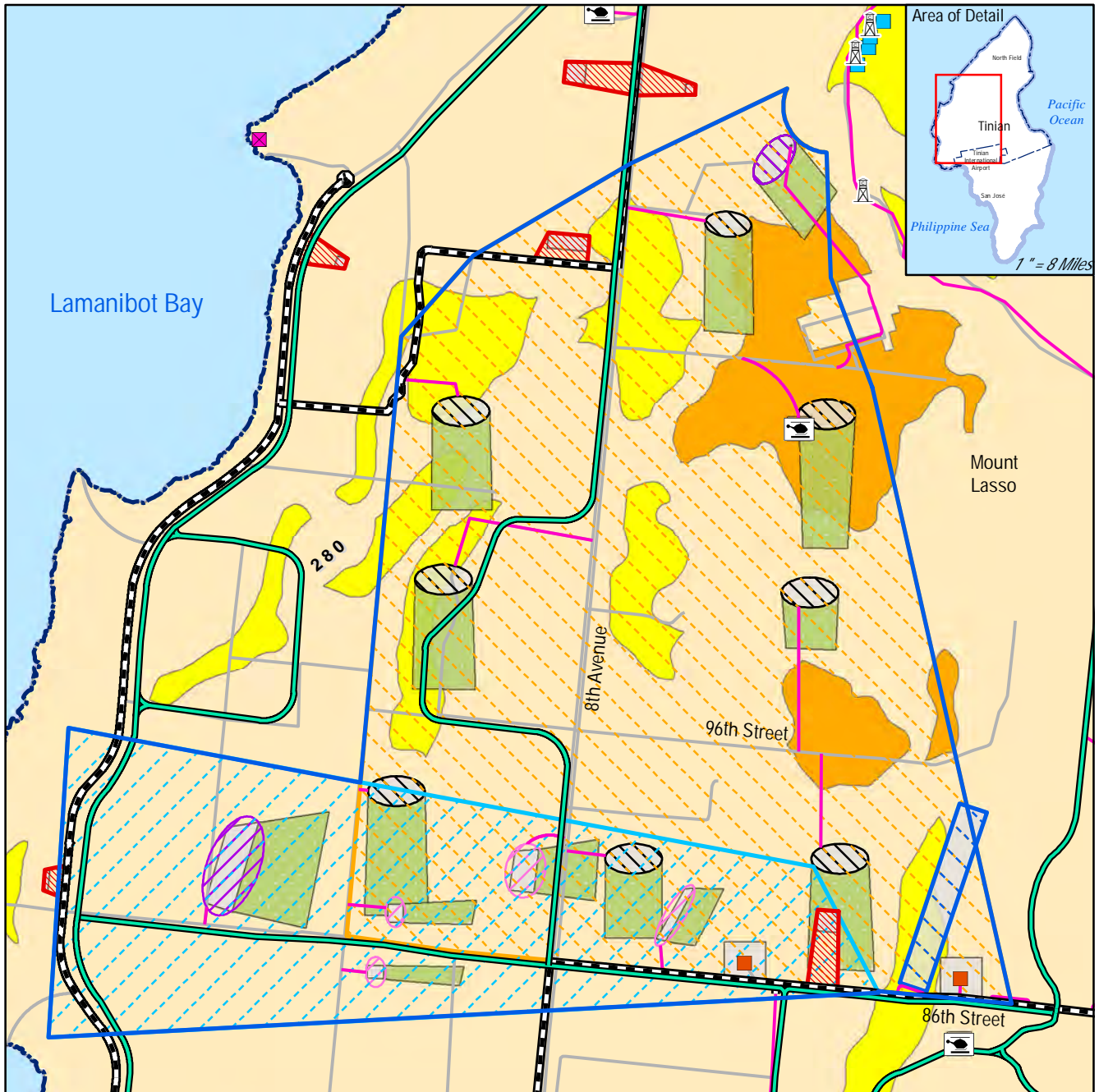


Figure 20
Tinian Alternatives 2 and 3 Range Complex C:
Prime Farmland Soils Map

1.2.2.5.1 Ground Disturbance

Ground disturbance for the training facilities within the proposed Range Complex D (Alternatives 1 and 2) totals 475 acres (192 hectares) of 100% ground disturbance these results are presented in [Table 28](#) and depicted in [Figure 21](#). The range lines of sight (i.e., the area from the firing point to the target objective) would have 0% ground disturbance.

Table 28. Tinian Range Complex D: Alternatives 1 and 2 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Drop Zone	453	183	100
Range Complex D Landing Zone	3.31 (In Drop Zone)	1.3 (In Drop Zone)	100
Northern Battle Area Complex Objective Areas	9	4	100
Urban Assault Course North Objective Area	13	5	100
Total	475	192	100%

1.2.2.5.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Range Complex D (Alternatives 1 and 2) during operations total 475 acres (192 hectares) of 100% vegetation maintenance and 33 acres (14 hectares) of 15% vegetation maintenance. These results are presented in [Table 29](#) and mapped in [Figure 21](#). The range lines of sight (i.e., the area from the firing point to the target objective) would have 15% vegetation maintenance. The Landing Zone, Unmanned Aircraft Systems Ground Station and a Forward Arming and Refueling Point would be located on the existing paved areas. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at this range complex.

Table 29. Tinian Range Complex D: Alternatives 1 and 2 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Drop Zone	453	183	100
Range Complex D Landing Zone	3.31 (In Drop Zone)	1.3 (In Drop Zone)	100
Northern Battle Area Complex Objective Areas	9	4	100
Northern Battle Area Complex Line of Sight	17	7	15
Urban Assault Course (North) Objective Areas	13	5	100
Urban Assault Course (North) Line of Sight	16	7	15
Totals	33	14	15%
	475	192	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

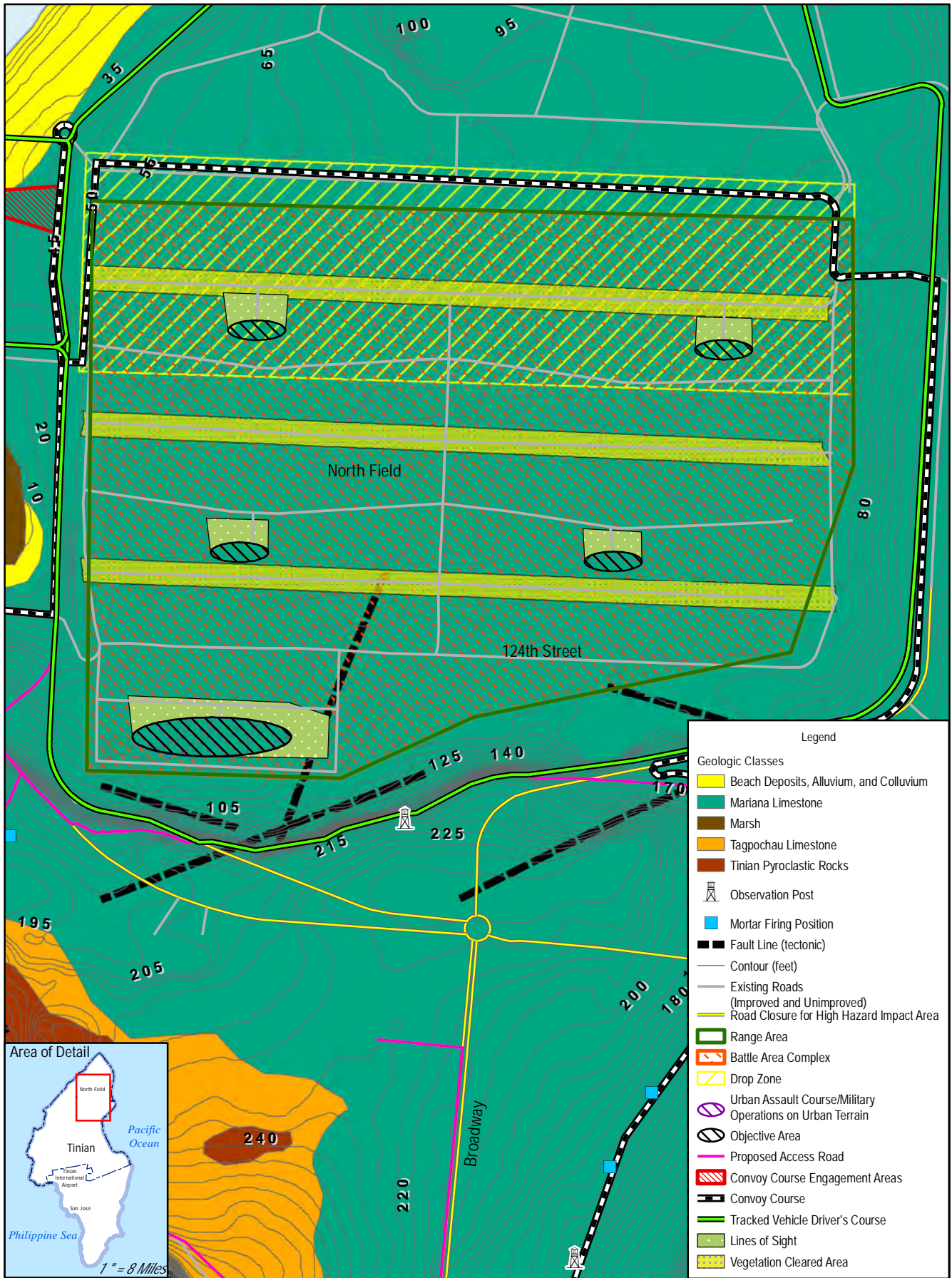


Figure 21
Tinian Alternatives 1 and 2 Range Complex D:
Topographic and Geologic Map

Source: NAVFAC PAC 2013

1.2.2.5.3 Elevation and Slope

Within the proposed Range Complex D (Alternatives 1 and 2), general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 30](#) and are topographically shown in [Figure 21](#).

Table 30. Tinian Range Complex D: Alternatives 1 and 2 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex D including Drop Zone	35 to 115 feet (11 to 35 meters)	1-9%	West to East

1.2.2.5.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. Proposed Complex D (Alternatives 1 and 2) areas are underlain by Mariana Limestone, shown in [Figure 21](#).

1.2.2.5.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Two faults were identified – along the southern border of the proposed Range Complex D (Alternatives 1 and 2). Features are shown in [Figure 21](#).

1.2.2.5.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex D (Alternatives 1 and 2) are shown with their soil characteristics in [Table 31](#) and are mapped in [Figure 22](#).

Table 31. Tinian Range Complex D: Alternatives 1 and 2 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#17 Chinen-Urban Land	0% to 5% slopes	slow	slight
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe
#50 Takpochao-Rock Outcrop Complex	3% to 15% slopes	slow	slight
#51 Takpochao-Rock Outcrop Complex	15% to 30% slopes	medium	moderate
#54 Quarry	NA	NA	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.5.7 Prime Farmland Soils

No prime farmland soils were identified within the proposed Range Complex D (Alternatives 1 and 2).

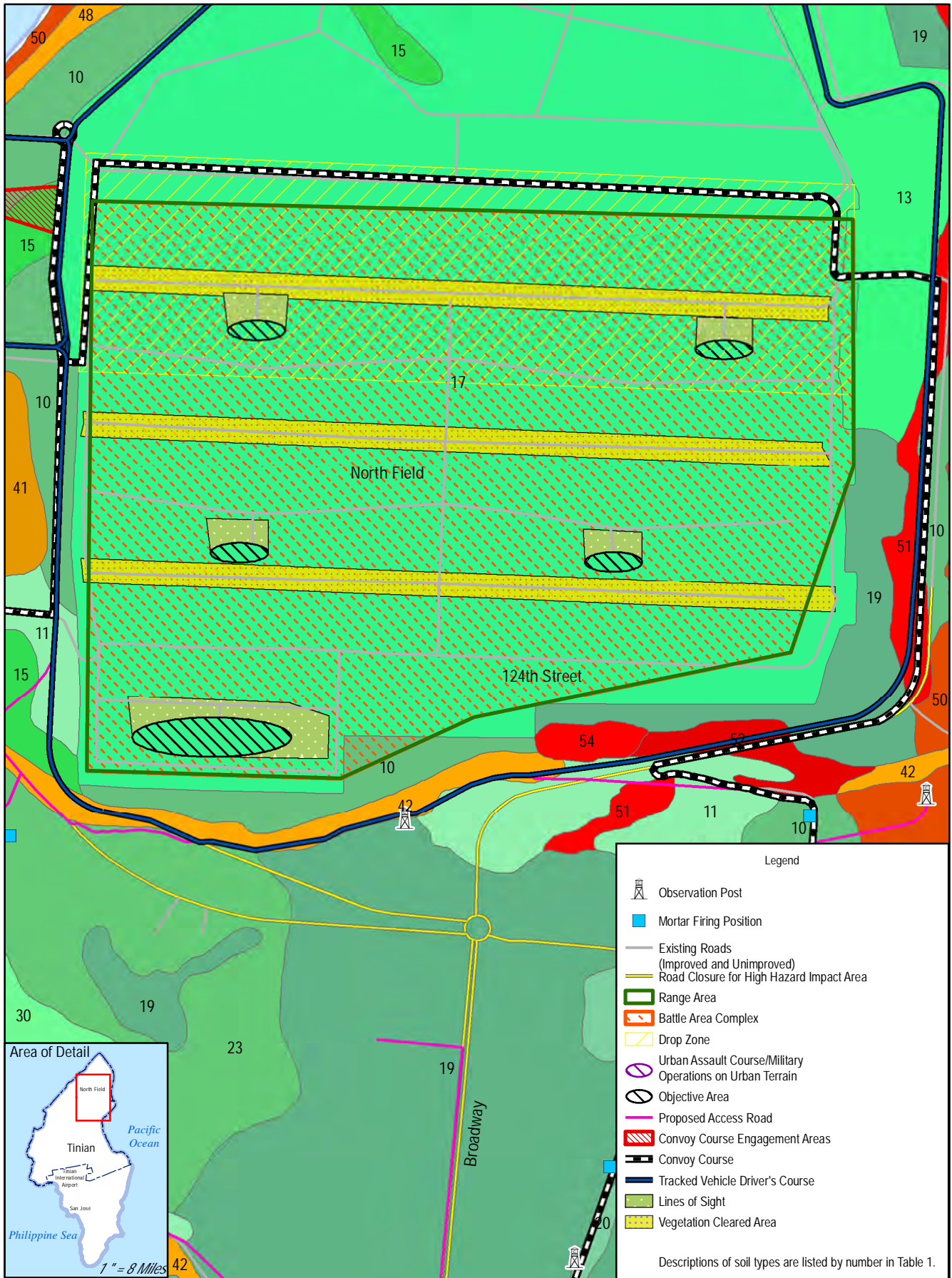


Figure 22
Tinian Alternatives 1 and 2 Range Complex D:
Soils Map

1.2.2.6 Range Complex D: Tinian Alternative 3 (no northern Battle Area Complex)

Proposed Range Complex D (Alternative 3) consists of: (1) a Drop Zone and (2) a Landing Zone on North Field. The Landing Zone, an Unmanned Aircraft Systems Ground Station, and a Forward Arming and Refueling Point would be located within the Drop Zone.

1.2.2.6.1 Ground Disturbance

Ground disturbance for the training facilities within Range Complex D (Alternative 3) totals 453 acres (183 hectares) of 100% ground disturbance and is presented in [Table 32](#) and depicted in [Figure 23](#).

Table 32. Tinian Range Complex D: Alternative 3 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Drop Zone	453	183	100
Range Complex D Landing Zone	3.31 (In Drop Zone)	1.3 (In Drop Zone)	100
Total	453	183	100%

1.2.2.6.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Range Complex D (Alternative 3) during operations total 453 acres (183 hectares) of 100% vegetation maintenance and is presented in [Table 33](#) and mapped in [Figure 23](#). The Landing Zone, Unmanned Aircraft Systems Ground Station and a Forward Arming and Refueling Point would be located on the existing paved areas. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation at this range complex.

Table 33. Tinian Range Complex D: Alternative 3 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Drop Zone	453	183	100
Range Complex D Landing Zone	3.31 (In Drop Zone)	1.3 (In Drop Zone)	100
Total	453	182	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.6.3 Elevation and Slope

Within the proposed Range Complex D (Alternative 3), general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 34](#) and are displayed topographically in [Figure 23](#).

Table 34. Tinian Range Complex D: Alternative 3 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Range Complex D including the Drop Zone	35 to 115 feet (11 to 35 meters)	1-9%	West to East

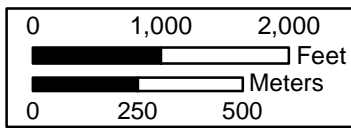
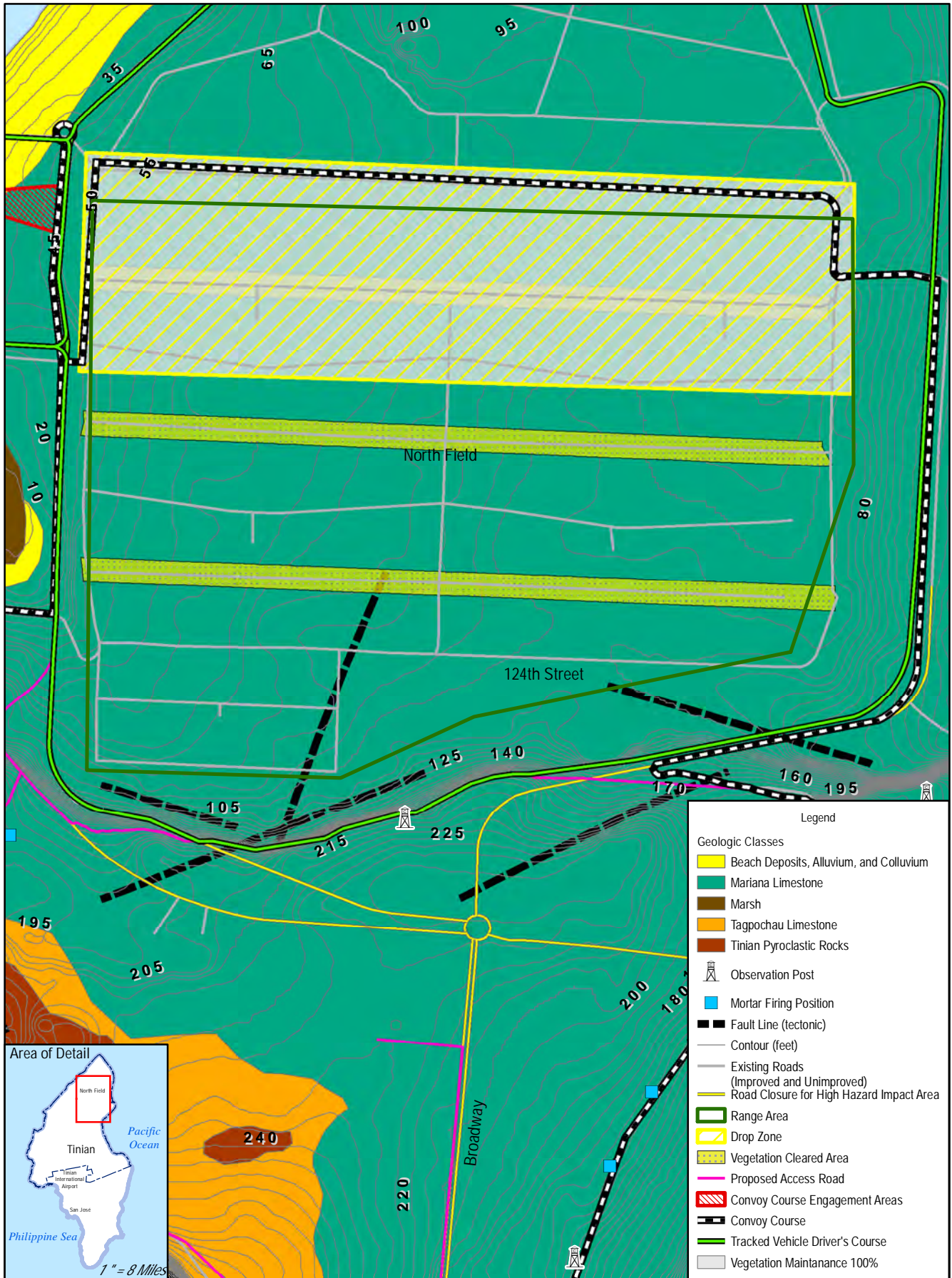


Figure 23
 Tinian Alternative 3 Range Complex D:
 Topographic and Geologic Map

1.2.2.6.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Range Complex D (Alternative 3) area is underlain by Mariana Limestone, shown in [Figure 23](#).

1.2.2.6.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Within the proposed Range Complex D (Alternative 3), two faults were identified– both along the southern border of the range complex (see [Figure 23](#)).

1.2.2.6.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Range Complex D (Alternative 3) are shown with their soil characteristics in [Table 35](#) and are mapped in [Figure 24](#).

Table 35. Tinian Range Complex D: Alternative 3 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#17 Chinen-Urban Land	0% to 5% slopes	slow	slight
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe
#50 Takpochao-Rock Outcrop Complex	3% to 15% slopes	slow	slight
#51 Takpochao-Rock Outcrop Complex	15% to 30% slopes	medium	moderate
#54 Quarry	NA	NA	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.6.7 Prime Farmland Soils

No prime farmland soils were identified within the proposed Range Complex D (Alternative 3).

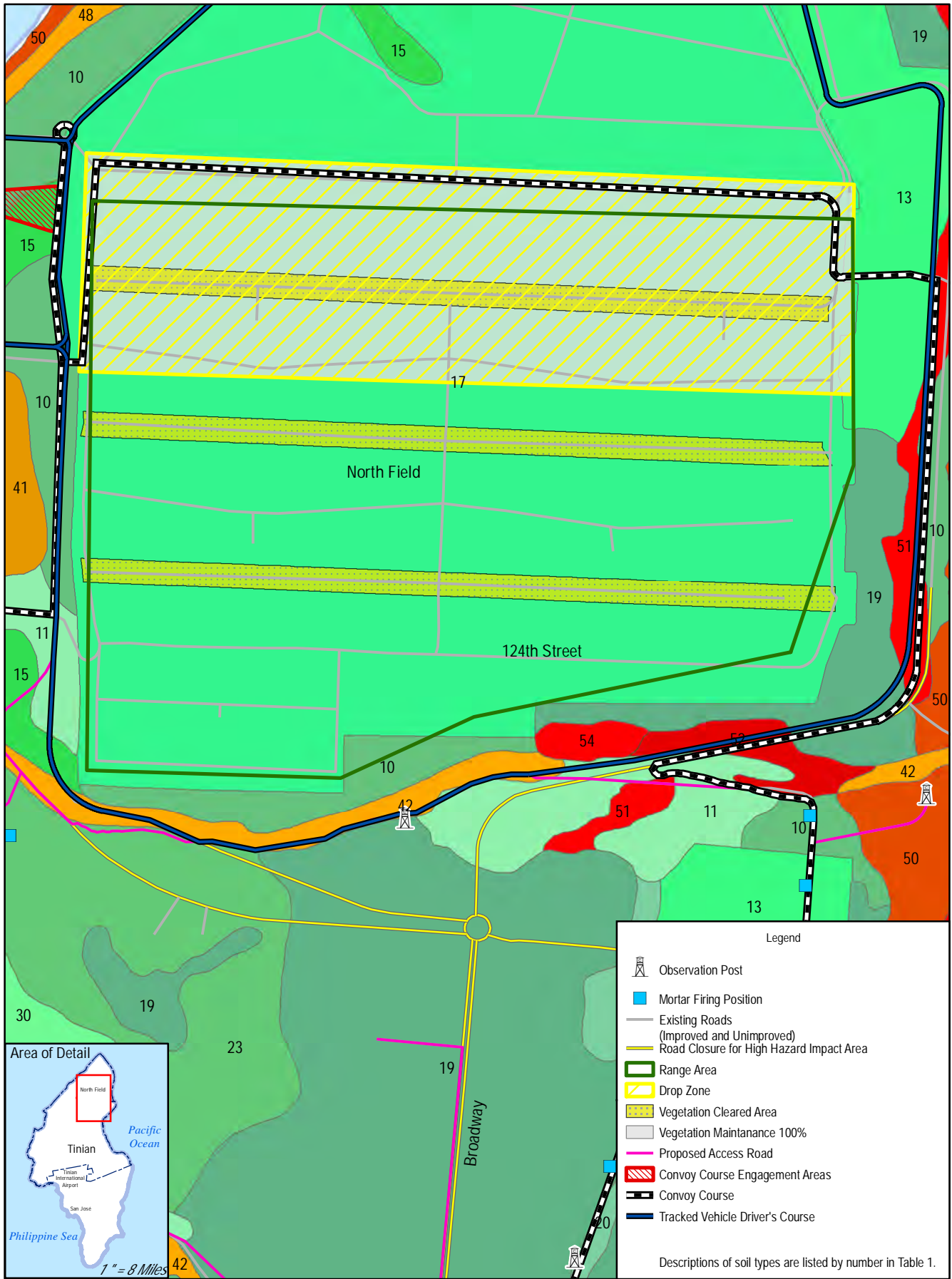


Figure 24
Tinian Alternative 3 Range Complex D:
Soils Map

NORTH
Source: NAVFAC PAC 2013

1.2.2.7 Military Lease Area-wide Training Assets: All Alternatives

Military Lease Area-wide training assets for all alternatives consist of: (1) 4 Landing Zones, (2) 8 Range Control Observation Posts, (3) 6 Surface Radar sites, (4) 12 Field Artillery Indirect Firing Range firing points, (5) a Tracked Vehicle Drivers’ Course, (6) fences, and (7) a Tactical Amphibious Landing Beach at Unai Chulu. These features are common to all action alternatives.

1.2.2.7.1 Ground Disturbance

Ground disturbance for the training facilities and assets within Military Lease Area total 202 acres (81 hectares) of 100% ground disturbance and are presented in [Table 36](#) and depicted in [Figure 25](#). The fences require 0% ground disturbance. It should also be noted that the 3 acres (1 hectare) associated with the Tactical Amphibious Landing at Unai Chulu includes 2 acres (1 hectare) of in water disturbance and 1 acre of on beach disturbance. During the construction phase only, there would be two laydown areas with a total of 1 acre (0.4 hectare) that would be 100% ground disturbed.

Table 36. Tinian Military Lease Area-wide Training Assets: All Alternatives Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbance</i>
Landing Zones*	13	5	100
Range Control Observation Posts**	0.17	0.07	100
Surface Radar Sites***	0.9	0.4	100
Field Artillery Indirect Firing Range Firing Points	85	34	100
Tracked Vehicle Drivers’ Course	100	40	100
Tactical Amphibious Landing Beach - Unai Chulu	3	1	100
Total	202	81	100%

Notes: *Landing Zones: 3.31 acres each multiplied by 4. The Landing Zone associated with the Base Camp is included in the total Base Camp ground disturbance.

**Range Control Observation Posts: 0.03 acre each multiplied by 3, other 5 in HHIA.

***Surface Radar Sites: 0.15 acre each multiplied by 6.

1.2.2.7.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities and assets located within the Military Lease Area during operations total 200 acres (80 hectares) of 100% vegetation maintenance and 36 acres (15 hectares) of 75% vegetation maintenance. The results are presented in [Table 37](#) below and depicted in [Figure 25](#). The fences require 75% vegetation maintenance during operations. It should also be noted that the Field Artillery Indirect Firing Range Firing Points in the Southeastern portion of the MLA have overlapping areas of vegetation clearance. Lastly, the 1 acre (0.4 hectares) of 100% vegetation maintenance associated with the Tactical Amphibious Beach Landing at Unai Chulu would only occur during the construction phase. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation.

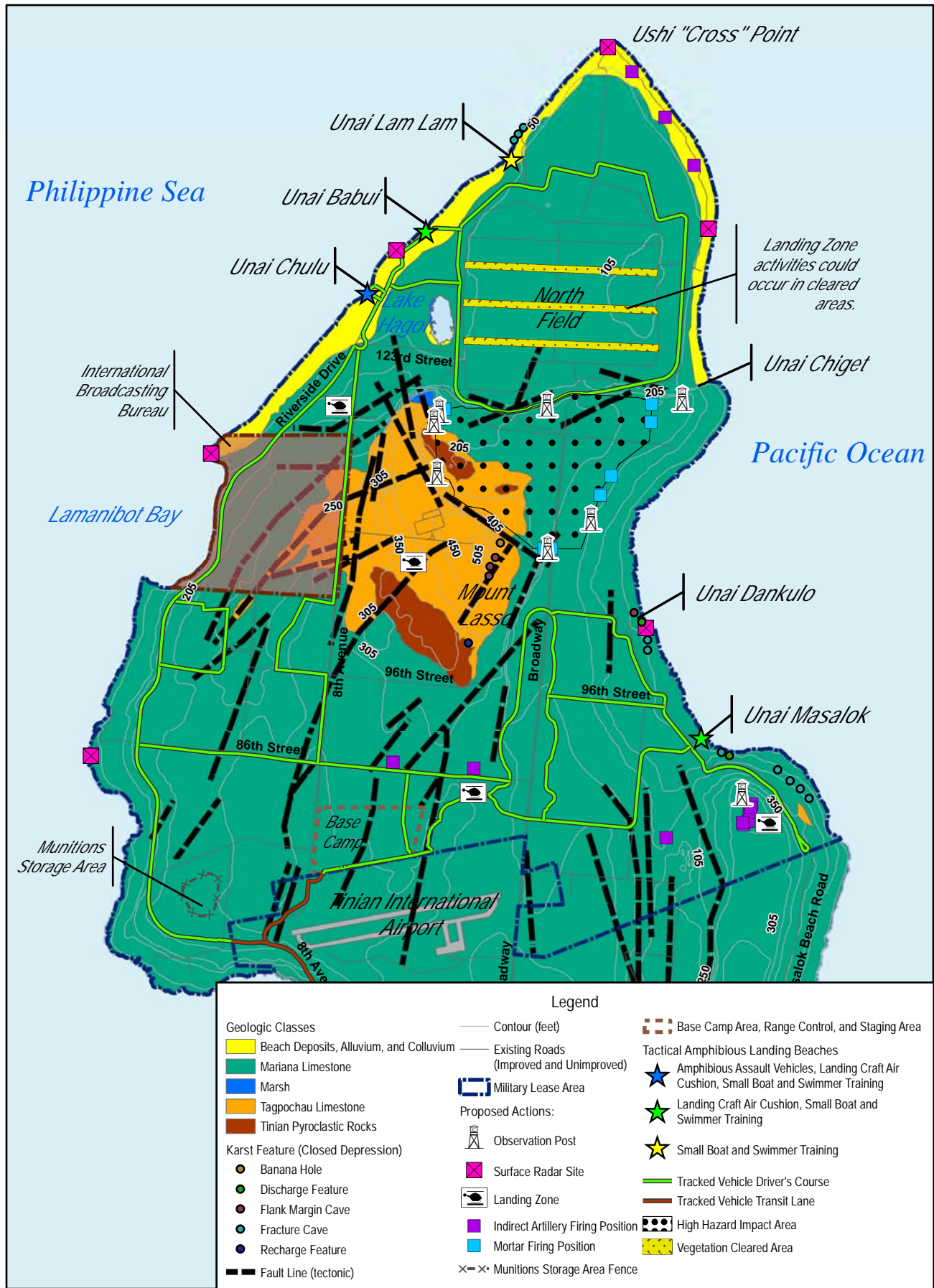


Figure 25
Tinian All Action Alternatives Military Lease
Area-Wide Training Assets: Topographic and Geologic Map



Table 37. Tinian Military Lease Area-wide Training Assets: All Alternatives Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Landing Zones*	13	5	100
Range Control Observation Posts**	0.17	0.07	100
Surface Radar Sites***	0.9	0.4	100
Field Artillery Indirect Firing Range Firing Points	85	34	100
Tracked Vehicle Drivers' Course	100	40	100
Fences	36	15	75
Tactical Amphibious Landing Beach - Unai Chulu (Construction Phase Only)	1	0.4	100
Totals	200	80	100%
	36	15	75%

Notes: *Landing Zones: 3.31 acres each multiplied by 4. The Landing Zone associated with the Base Camp is included in the total Base Camp ground disturbance.

**Range Control Observation Posts: 0.03 acre each multiplied by 3, other 5 in HHIA.

***Surface Radar Sites: 0.15 acre each multiplied by 6.

Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.7.3 Elevation and Slope

Within the proposed Military Lease Area-wide training assets, general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in Tables [38](#), [39](#), [40](#), [41](#) and are displayed topographically in [Figure 25](#).

Table 38. Tinian Military Lease Area-wide Training Assets: All Alternatives Landing Zones Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
LZ 1 Southeastern	350 feet (107 meters)	<1%	West to East
LZ 2 Southern central	255 feet (78 meters)	2%	West to East
LZ 3 Southwestern	235 feet (72 meters)	<1%	West to East
LZ 4 Central	385 feet (117 meters)	<1%	West to East

Table 39. Tinian Military Lease Area-wide Training Assets: All Alternatives Range Control Observation Posts Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
OPA	205 feet (62 meters)	3%	West to East
OPB	5 feet (1.5 meters)	8%	West to East
OPC	35 feet (11 meters)	16%	West to East
OPD	10 feet (3 meters)	22%	West to East
OPE	20 feet (6 meters)	18%	West to East
OPF	5 feet (1.5 meters)	1%	West to East
OPG	35 feet (11 meters)	18%	West to East
OPH	175 feet (53 meters)	3%	East to West

Note: OP = Observation Point

Table 40. Tinian Military Lease Area-wide Training Assets: All Alternatives Field Artillery Indirect Firing Range Firing Point Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
FR1	155 to 160 feet (47 to 49 meters)	1%	East to West
FR2	353 to 357 feet (108 to 109 meters)	1%	East to West
FR3	368 to 373 feet (112 to 114 meters)	1%	East to West
FR4	360 to 369 feet (110 to 113 meters)	1%	East to West
FR5	359 to 367 feet (110 to 112 meters)	1%	East to West
FR6	49 to 84 feet (15 to 26 meters)	5%	East to West
FR7	42 to 70 feet (13 to 21 meters)	4%	East to West
FR8	44.9 to 66.3 feet (13.7 to 20.2 meters)	3%	East to West
FR9	257to 269 feet (78 to 82 meters)	2%	West to East
FR10	267 to 282 feet (81 to 86 meters)	2%	West to East
FR11	49 to 84 feet (15 to 26 meters)	5%	East to West
FR12	42 to 70 feet (13 to 21 meters)	4%	East to West

Note: FR = Firing Points. Labeled from North to South; East=E, Central=C and W=West.

Table 41. Tinian Military Lease Area-wide Training Assets: All Alternatives Tracked Vehicle Drivers' Course Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>	<i>Direction</i>
Segment A Western Perimeter Road	70 to 208 feet (21 to 64 meters)	2%	North to South
Segment B Western "U-shaped" Interior Pass Road	159 to 279 feet (48 to 85 meters)	2%	NA
Segment C Western Center Road Running North and South	76 to 293 feet (23 to 89 meters)	1%	North to South
Segment D Southern Road Running West to East	184 to 309 feet (56 to 94 meters)	1%	West to East
Segment E Southern "U-shaped" Road with Extension to West	240 to 301 feet (73 to 92 meters)	0.4%	NA
Segment F Eastern Loop Road Through Range Complex B	192 to 281 feet (59 to 86 meters)	0.4%	NA
Segment G Southeastern Corner Road	75 to 278 feet (23 to 85 meters)	2%	East to West
Segment H Southeastern Perimeter Road	68 to 318 feet (21 to 97 meters)	2%	South to North
Segment I Southeastern Connector Road from Center of Range Complex B Loop to Center of Southeastern Perimeter Road	82 to 229 feet (25 to 70 meters)	3%	East to West
Segment J Northwestern Corner Road Access to Range Complex D Loop	19 to 56 feet (6 to 17 meters)	0.2%	NA
Segment K Range Complex D Loop	24 to 180 feet (7 to 55 meters)	0.4%	NA

1.2.2.7.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The Military Lease Area-wide training assets conditions are underlain by Beach Deposits, Alluvium, Colluvium, Marsh, Mariana Limestone, and Tagpochau Limestone, shown in the geological map [Figure 25](#).

1.2.2.7.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Among the Military Lease Area-wide training assets, 21 fault lines were identified throughout the Tracked Vehicle Drivers' Course. These features are mapped in [Figure 25](#).

1.2.2.7.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Military Lease Area-wide training assets are shown with their soil characteristics in [Table 42](#) and are mapped in [Figure 26](#).

Table 42. Tinian Military Lease Area-wide Training Assets: All Alternatives Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#15 Chinen-Rock Outcrop Complex	3% to 15% slopes	slow	moderate
#16 Chinen-Rock Outcrop Complex	15% to 30% slopes	medium	severe
#17 Chinen-Urban Land	0% to 5% slopes	slow	slight
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#22 Dandan-Chinen-Pits Complex	5% to 15% slopes	medium	moderate
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.7.7 Prime Farmland Soils

Military Lease Area-wide training assets includes 3 acres (1 hectare) of Dandan-Saipan Clays, 0% to 5% slopes, and 3 acres (1 hectare) of Saipan Clay, 0% to 5% slopes, throughout the center of the Military Lease Area. The locations of these soils are mapped in [Figure 27](#).

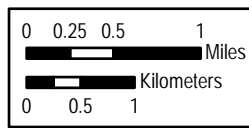
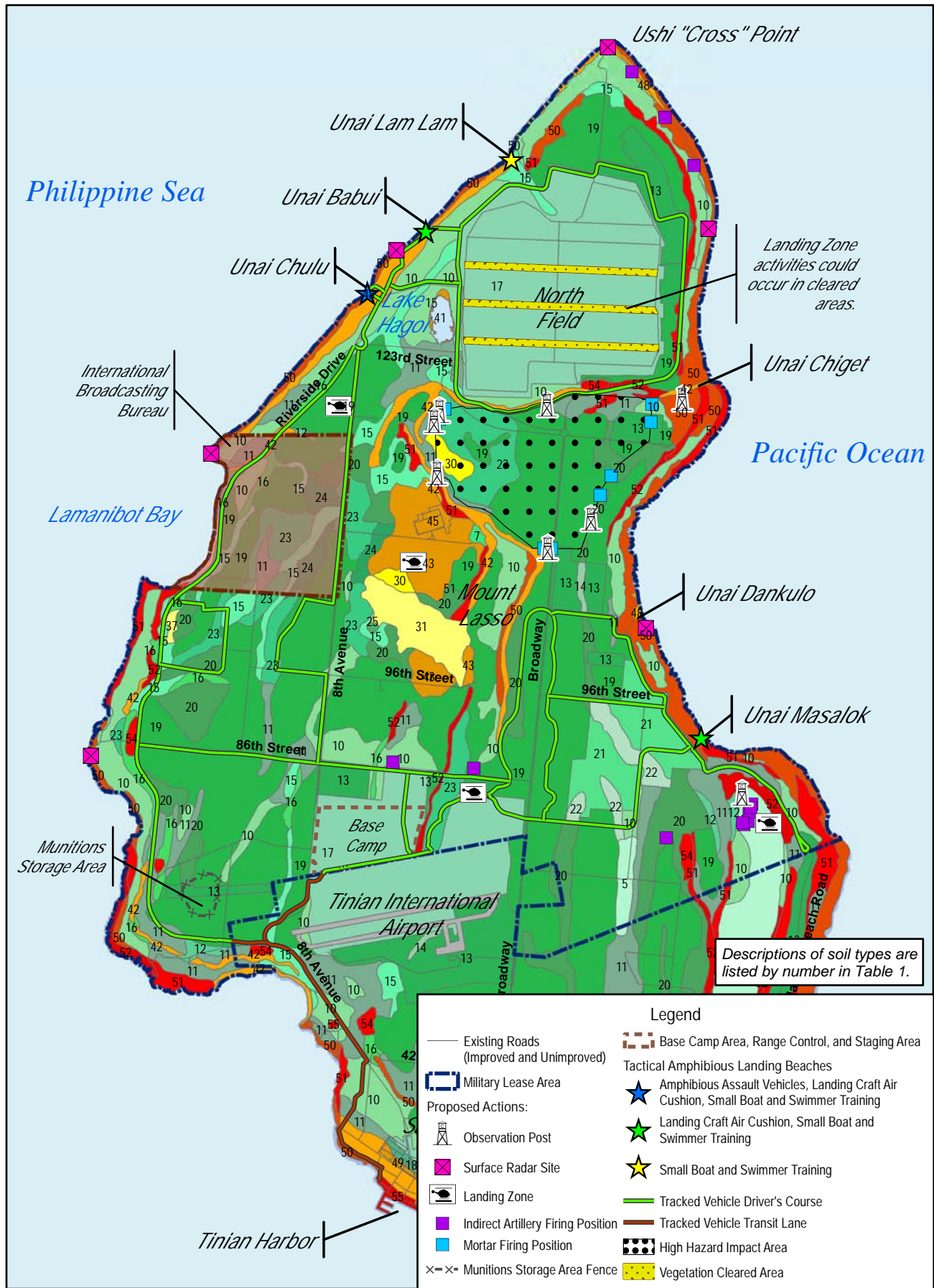


Figure 26
Tinian AII Action Alternatives Military Lease Area-Wide Training Assets: Soils Map



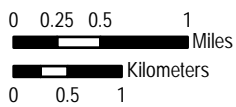
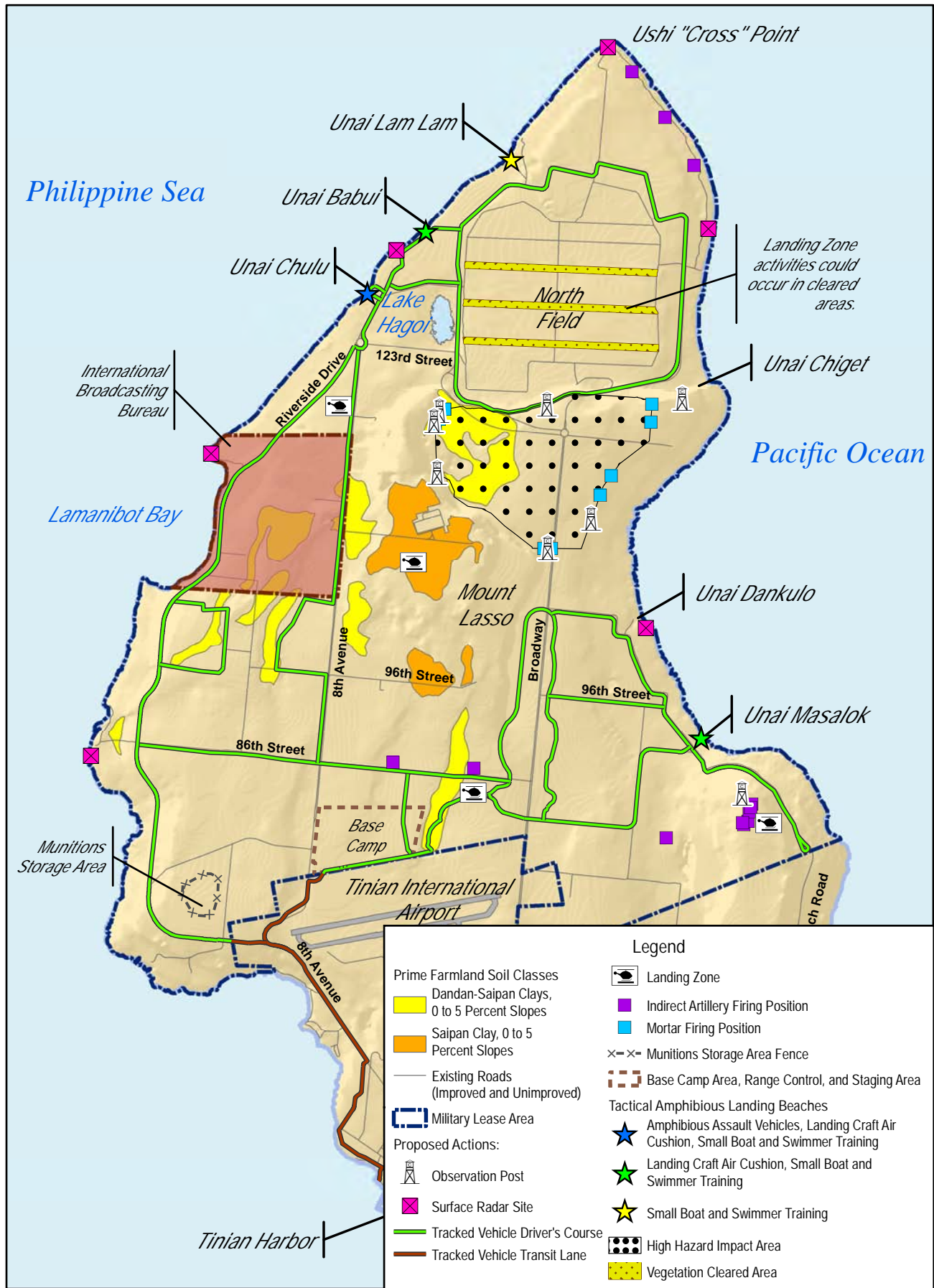


Figure 27
Tinian All Action Alternatives Military Lease
Area-Wide Training Assets: Prime Farmland Soils Map



1.2.2.8 Tinian Convoy Course: Alternative 1

The proposed Tinian Convoy Course for Alternative 1 is comprised of: (1) the Convoy Course and (2) Convoy Course engagement areas.

1.2.2.8.1 Ground Disturbance

Ground disturbance for the training facilities within proposed Convoy Course for Alternative 1 total 97 acres (40 hectares) of 100 % ground disturbance and are presented in [Table 43](#) and depicted in [Figure 28](#).

Table 43. Tinian Convoy Course: Alternative 1 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbance</i>
Convoy Course	66	27	100
Convoy Course Engagement Areas	31	13	100
Total	97	40	100%

1.2.2.8.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities and assets located within the proposed Convoy Course for Alternative 1 during operations total 66 acres (27 hectares) of 100% vegetation maintenance and 31 acres (13 hectares) of 75% vegetation maintenance. These results are presented in [Table 44](#) and mapped in [Figure 28](#). The Convoy Course engagement areas (i.e., the area of engagement with the target objective) would have 75% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation.

Table 44. Tinian Convoy Course: Alternative 1 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Convoy Course	66	27	100
Convoy Course Engagement Areas	31	13	75
Totals	66	27	100%
	31	13	75%

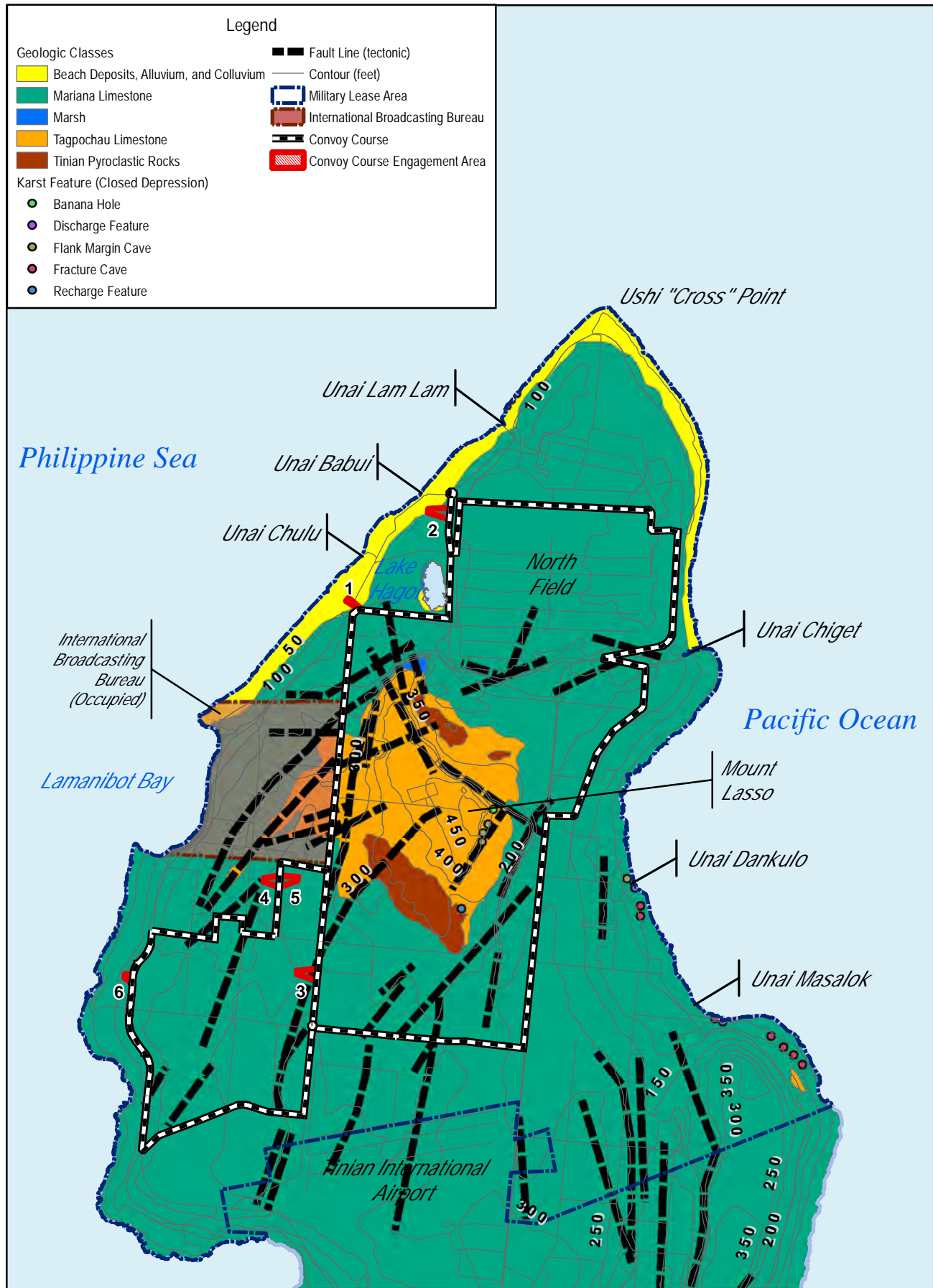
Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.8.3 Elevation and Slope

Within the proposed Convoy Course for Alternative 1, general elevation and an average slope for the Convoy Course was determined using USGS GIS data. The results of this assessment are provided in [Table 45](#) and are topographically shown in [Figure 28](#).

Table 45. Tinian Convoy Course: Alternative 1 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Convoy Course	18.70 to 313.65 feet (5.7 to 95.6 meters)	0.3%



0 0.5 1 2 Miles
 0 0.5 1 2 Kilometers

Figure 28
Tinian Alternative 1 Convoy Course
Topographic and Geologic Map

NORTH

1.2.2.8.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Convoy Course for Alternative 1 area is underlain by Mariana Limestone and Tagpochau Limestone, shown in the geological map [Figure 28](#).

1.2.2.8.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Fourteen faults were identified - throughout the Convoy Course for Alternative 1. Features are shown in [Figure 28](#).

1.2.2.8.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Convoy Course (Alternative 1) are shown with their soil characteristics in [Table 46](#) and are mapped in [Figure 29](#).

Table 46. Tinian Convoy Course: Alternative 1 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
#15 Chinen-Rock Outcrop Complex	3% to 15% slopes	slow	moderate
#17 Chinen-Urban Land	0% to 5% slopes	slow	slight
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe
#54 Quarry	NA	NA	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.8.7 Prime Farmland Soils

The proposed Convoy Course and engagement areas for Alternative 1, includes 1 acre (0.4 hectares) of Dandan-Saipan Clays, 0% to 5% slopes along the Western portion of the Convoy Course Western engagement area for Alternative 1. The locations of these soils are mapped in [Figure 30](#).

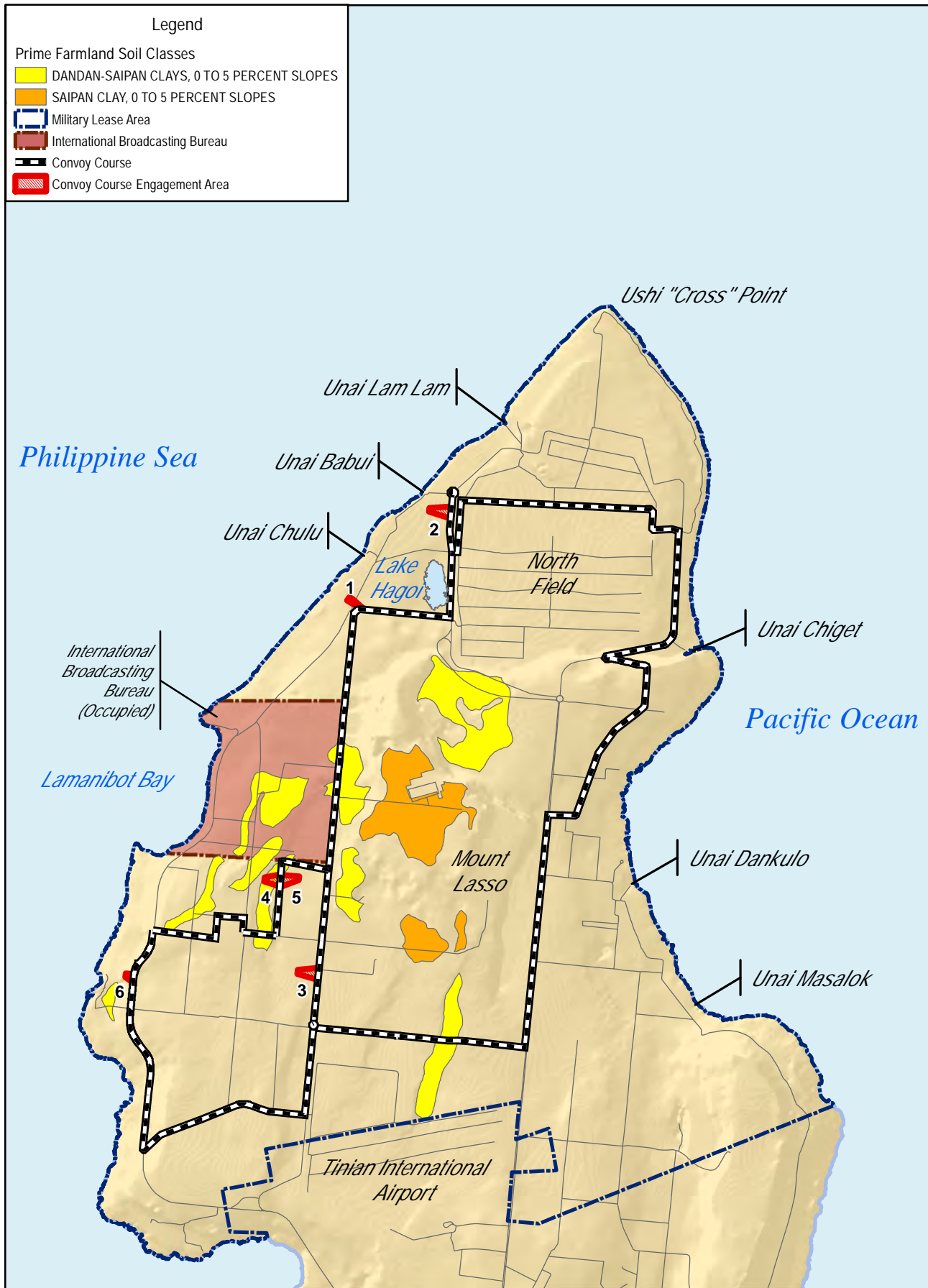


0 0.5 1 2 Miles
 0 0.5 1 2 Kilometers

Figure 29
 Tinian Alternative 1 Convoy Course
 Soils Map

NORTH

F-65



0 0.5 1 2 Miles
 0 0.5 1 2 Kilometers

Figure 30
 Tinian Alternative 1 Convoy Course
 Prime Farmland Soils Map

NORTH

1.2.2.9 Convoy Course: Tinian Alternatives 2 and 3

The proposed Convoy Course for Alternatives 2 and 3 is comprised of: (1) the Convoy Course and (2) the Convoy Course Engagement Areas.

1.2.2.9.1 Ground Disturbance

Ground disturbance for the training facilities and assets within proposed Convoy Course for Alternatives 2 and 3 totals 143 acres (58 hectares) of 100% ground disturbance and is presented in [Table 47](#) and depicted in [Figure 31](#).

Table 47. Tinian Convoy Course: Alternatives 2 and 3 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbed</i>
Convoy Course	62	25	100
Convoy Course Engagement Areas	81	33	100
Total	143	58	100%

1.2.2.9.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities and assets located within the proposed Convoy Course for Alternatives 2 and 3 during operations totals 62 acres (25 hectares) of 100% vegetation maintenance and 81 acres (33 hectares) of 75% vegetation maintenance. These results are presented in [Table 48](#) and mapped in [Figure 31](#). The engagement areas (i.e., the area of engagement with the target objective) would have 75% vegetation maintenance. Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation.

Table 48. Tinian Convoy Course: Alternatives 2 and 3 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Convoy Course	62	25	100
Convoy Live-Fire Engagement Areas	81	33	75
Totals	62	25	100%
	81	33	75%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix.

1.2.2.9.3 Elevation and Slope

Within the proposed Convoy Course for Alternatives 2 and 3, general elevation and an average slope for the Convoy Course was determined using USGS GIS data. The results of this assessment are provided in [Table 49](#) and are topographically shown in [Figure 31](#).

Table 49. Tinian Convoy Course: Alternatives 2 and 3 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Convoy Course	18.70 to 313.65 feet (5.7 to 95.6 meters)	1%

1.2.2.9.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Convoy Course area is underlain by Mariana Limestone and Tagpochau Limestone as shown in [Figure 31](#).

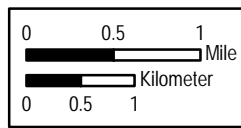
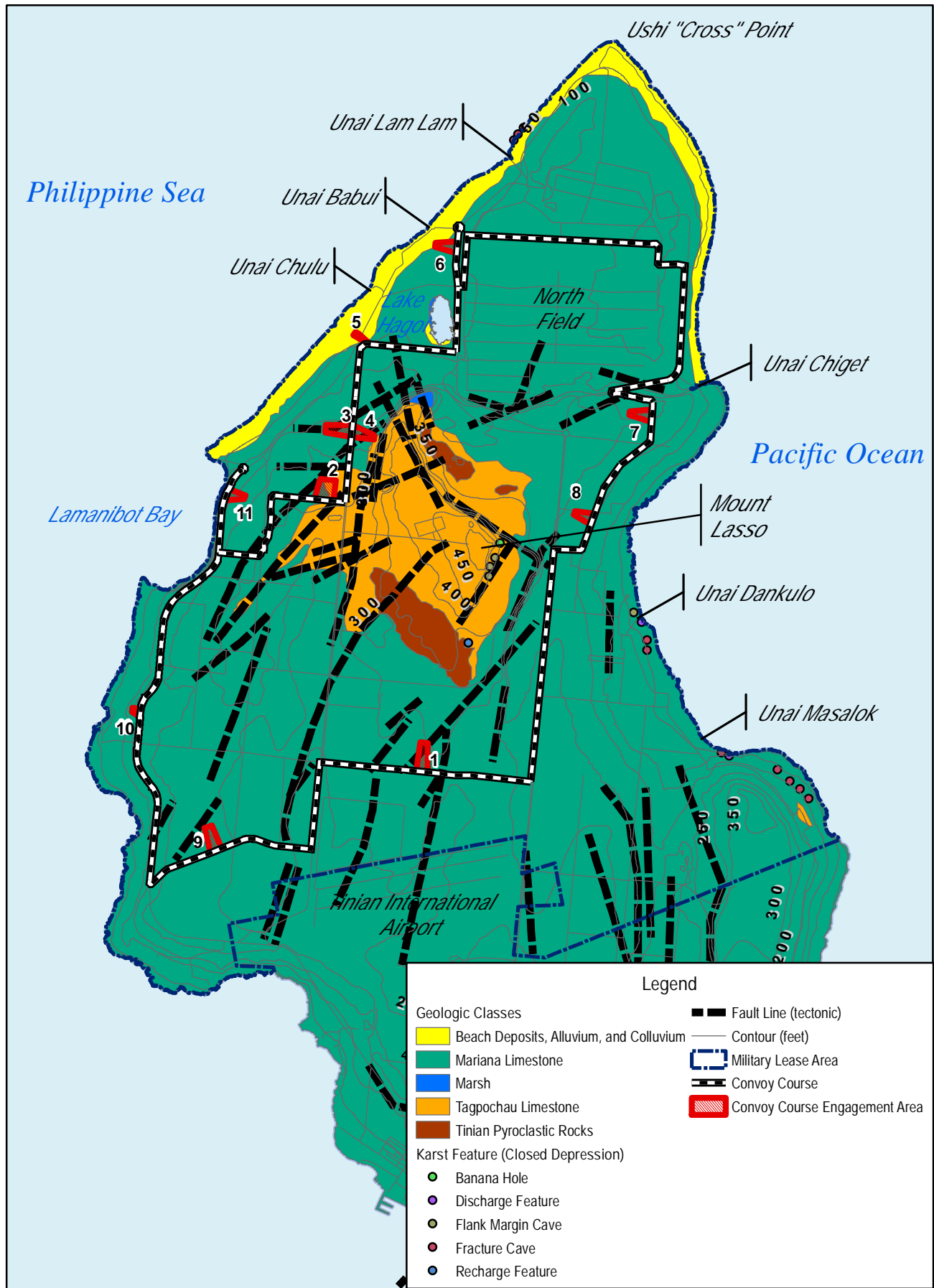


Figure 31
Tinian Alternatives 2 and 3 Convoy Course
Topographic and Geologic Map



1.2.2.9.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Fourteen faults were identified – throughout the Convoy Course for Alternatives 2 and 3. Features are shown in [Figure 31](#).

1.2.2.9.6 Soil Classification

Soil classes across Tinian were identified by the U.S. Department of Agriculture Soil Conservation Service in 1985 (Young 1989). Soils found within the proposed Convoy Course for Alternatives 2 and 3 are shown with their soil characteristics in [Table 50](#) and are mapped in [Figure 32](#).

Table 50. Tinian Convoy Course: Alternatives 2 and 3 Soil Classification

<i>Description*</i>	<i>Slope</i>	<i>Runoff Rate</i>	<i>Erodibility</i>
#10 Chinen Clay Loam	0% to 5% slopes	slow	slight
#11 Chinen Clay Loam	5% to 15% slopes	medium	moderate
#13 Chinen very gravelly sandy loam	0% to 5% slopes	slow	slight
#15 Chinen-Rock Outcrop Complex	3% to 15% slopes	slow	moderate
#17 Chinen-Urban Land	0% to 5% slopes	slow	slight
#16 Chinen-Rock Outcrop Complex	15% to 30% slopes	medium	severe
#19 Dandan-Chinen Complex	0% to 5% slopes	slow	slight
#20 Dandan-Chinen Complex	5% to 15% slopes	medium	moderate
#23 Dandan-Saipan Clays	0% to 5% slopes	slow	slight
#42 Rock Outcrop-Takpochao Complex	60% to 99% slopes	rapid	severe
#52 Takpochao-Rock Outcrop Complex	30% to 60% slopes	very rapid	NA
#54 Quarry	NA	NA	NA

Note: * Descriptions of soil types by number are further discussed in [Table 1](#) at the beginning of this Appendix.

1.2.2.9.7 Prime Farmland Soils

Convoy Course (Alternatives 2 and 3), includes 1 acre (0.4 hectares) of Dandan-Saipan Clays, 0% to 5% slopes, along the Western Convoy Course Engagement Area for Alternatives 2 and 3. The locations of these soils are shown in [Figure 33](#).

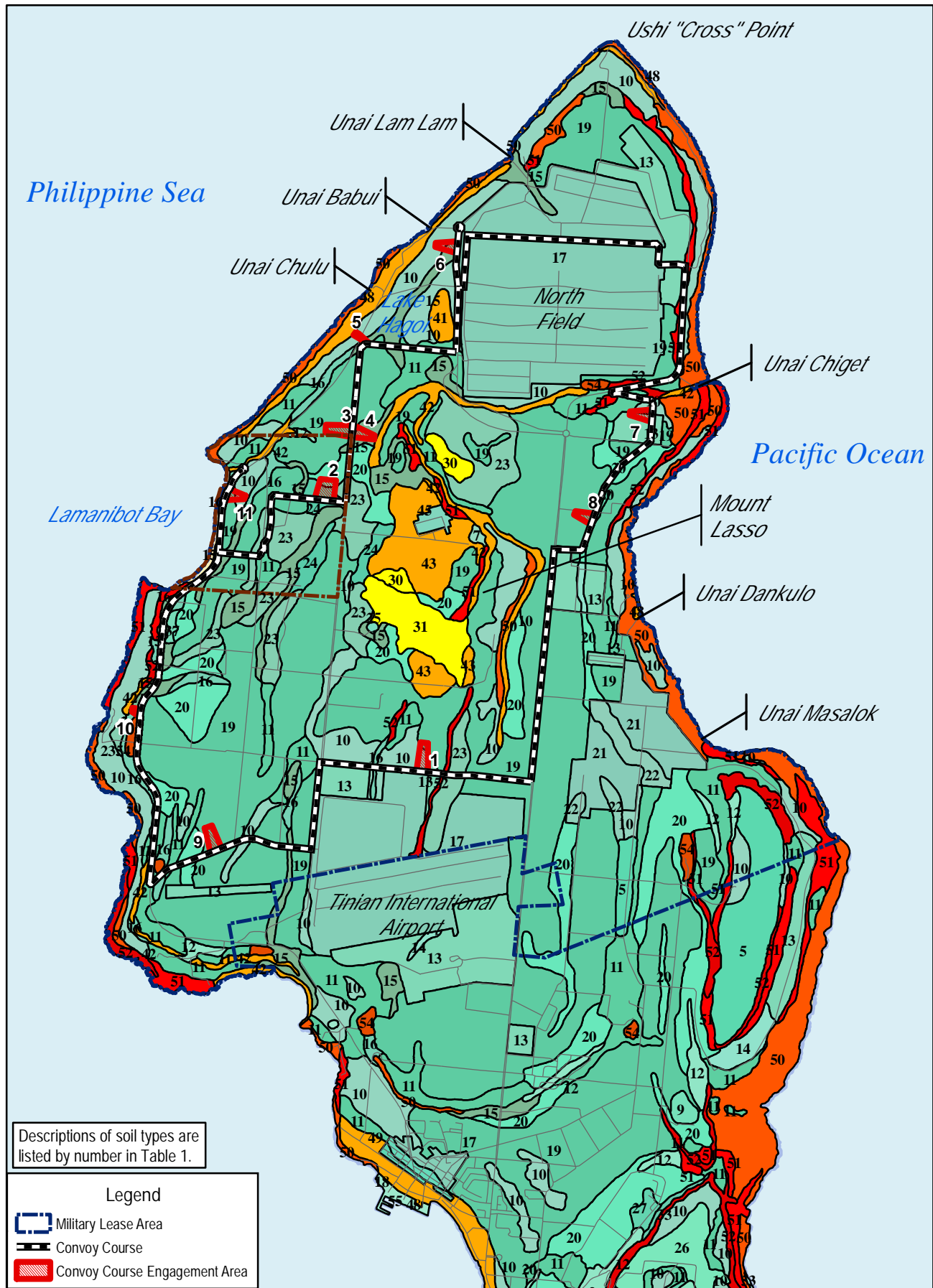


Figure 32
Tinian Alternatives 2 and 3 Convoy Course
Soils Map

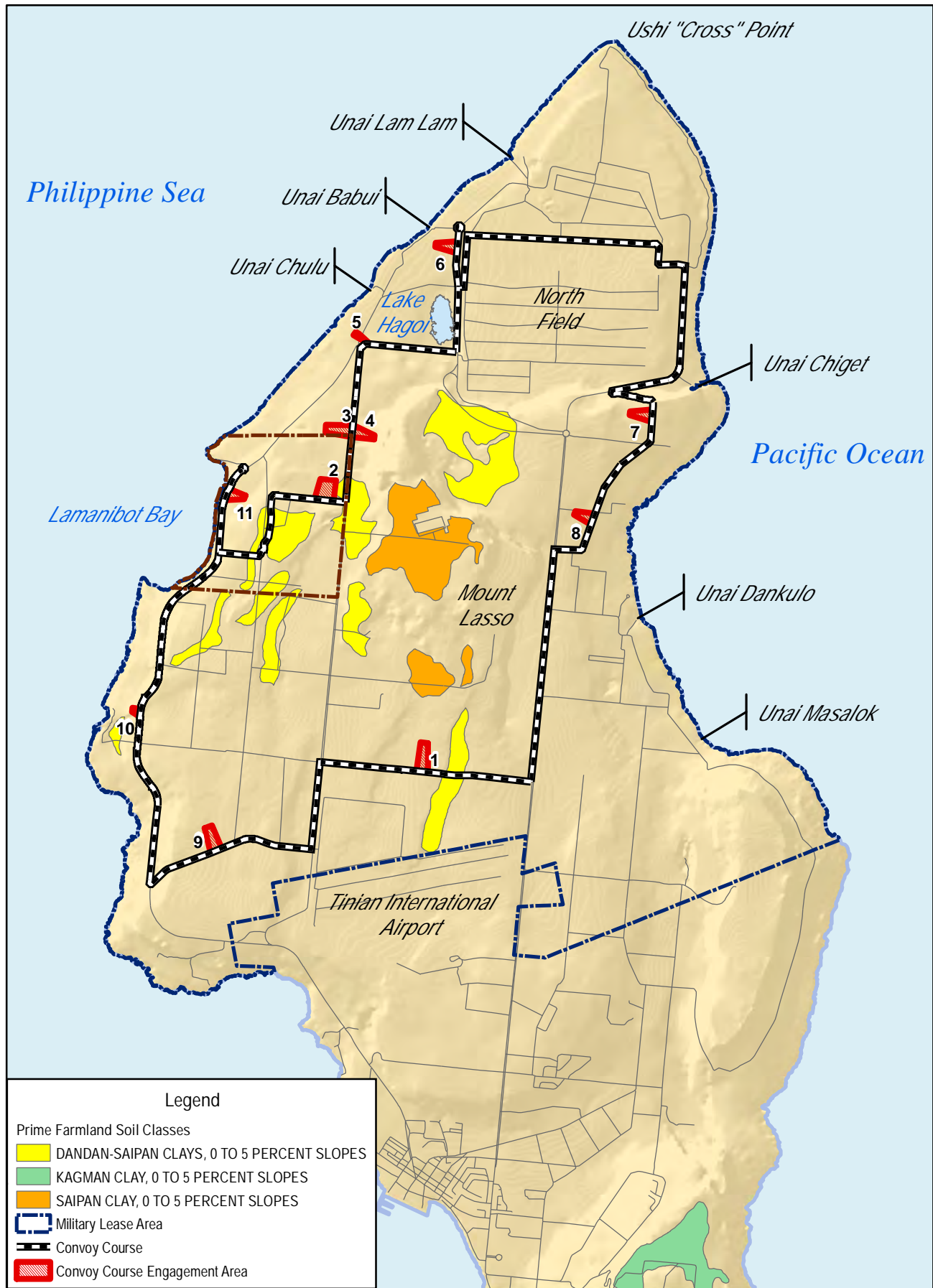


Figure 33
Tinian Alternatives 2 and 3 Convoy Course
Prime Farmland Soils Map

1.3 PAGAN AFFECTED ENVIRONMENT

The impact analysis for Pagan includes an analysis of the support facilities and infrastructure ([Section 1.3.1](#)) and training facilities ([Section 1.3.2](#)). A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology and geologic hazards, soil classifications, and location of any Prime Farmland soil units within each proposed facility is shown. Few in depth soil studies are available for Pagan therefore discussion is limited compared with the more extensively studied soils on Tinian. To maintain RTA operations, vegetation control would be required and undertaken by Range Control personnel. The degree of management varies depending on the requirements for each individual training facility. For example, accommodating line-of-sight, fire control, and equipment laydowns are factors dictating the degree of proposed vegetation maintenance. The following briefly describes how proposed vegetation maintenance would be conducted. Maintenance is defined that all the vegetation is maintained at a height not to exceed approximately 6 inches (15 centimeters) above the ground throughout the entire area identified. This description of proposed vegetation management is referenced throughout the following sections.

1.3.1 Support Facilities and Infrastructure

Common to all Pagan (action) alternatives are improvements to the expeditionary airfield; construction of an expeditionary base camp and bivouac area; and construction and improvements to military training trails. A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology, and geologic hazards within the proposed facility follows for support facilities and infrastructure.

1.3.1.1 Pagan Support Facilities: All Pagan Alternatives

The proposed Pagan support facilities consist of: (1) an Expeditionary Base Camp including a bivouac area, (2) an Airfield (including parking, turnaround aprons, refueling, ammo staging and overrun), (3) an Airfield Clear Zone, (4) Military Training Trails, (5) Forward Arming and Refueling Point (FARP), Hot Cargo and MSA Routes, (6) Unpaved Access Roads and (7) a Munitions Storage Area. These support facilities are common for all Pagan alternatives.

1.3.1.1.1 Ground Disturbance

Ground disturbance for the proposed Pagan support facilities total 164.3 acres (67 hectares) of 100% ground disturbance and are presented in [Table 51](#) and are depicted in [Figure 34](#) and [Figure 35](#). The airfield clear zone would require 0% ground disturbance.

Table 51. Pagan Support Facilities: All Alternatives Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Disturbed</i>
Expeditionary Base Camp	42	17	100
Airfield (including parking, turnaround aprons, refueling, ammo staging, and overrun)	41	17	100
Military Training Trails	37	15	100
FARP, Hot Cargo and MSA Routes	7	3	100
Unpaved Access Roads	2.3	1	100
Munitions Storage Area	35	14	100
Total	164.3	67	100%

1.3.1.1.2 Vegetation Maintenance:

Vegetation maintenance areas for the proposed Pagan support facilities during operations total 623.3 acres (252 hectares) of 100% vegetation maintenance and is presented in [Table 52](#) and mapped in [Figure 34](#) and [Figure 35](#). Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation.

Table 52. Pagan Support Facilities: All Alternatives Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Expeditionary Base Camp	42	17	100
Airfield (including parking, turnaround aprons, refueling, ammo staging and overrun)	41	17	100
Airfield Clear Zone	484	196	100
Military Training Trails	37	15	100
FARP, Hot Cargo and MSA Routes	7	3	100
Unpaved Access Roads	2.3	1	100
Munitions Storage Area	30	12	100
Total	643.3	261	100%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix and in the beginning of this section, [Section 1.3](#).

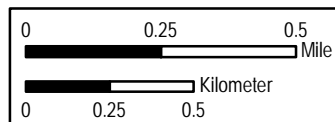
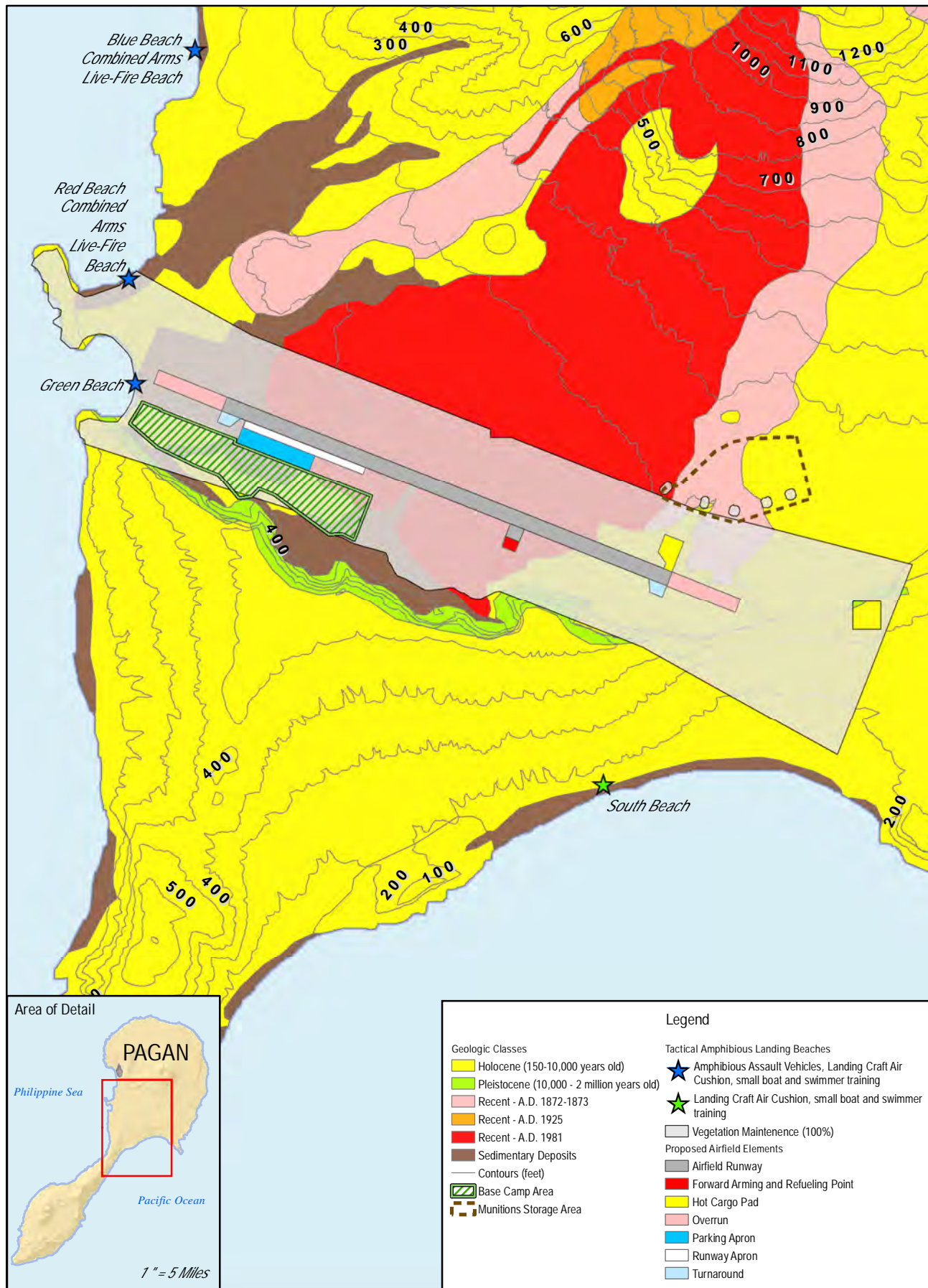
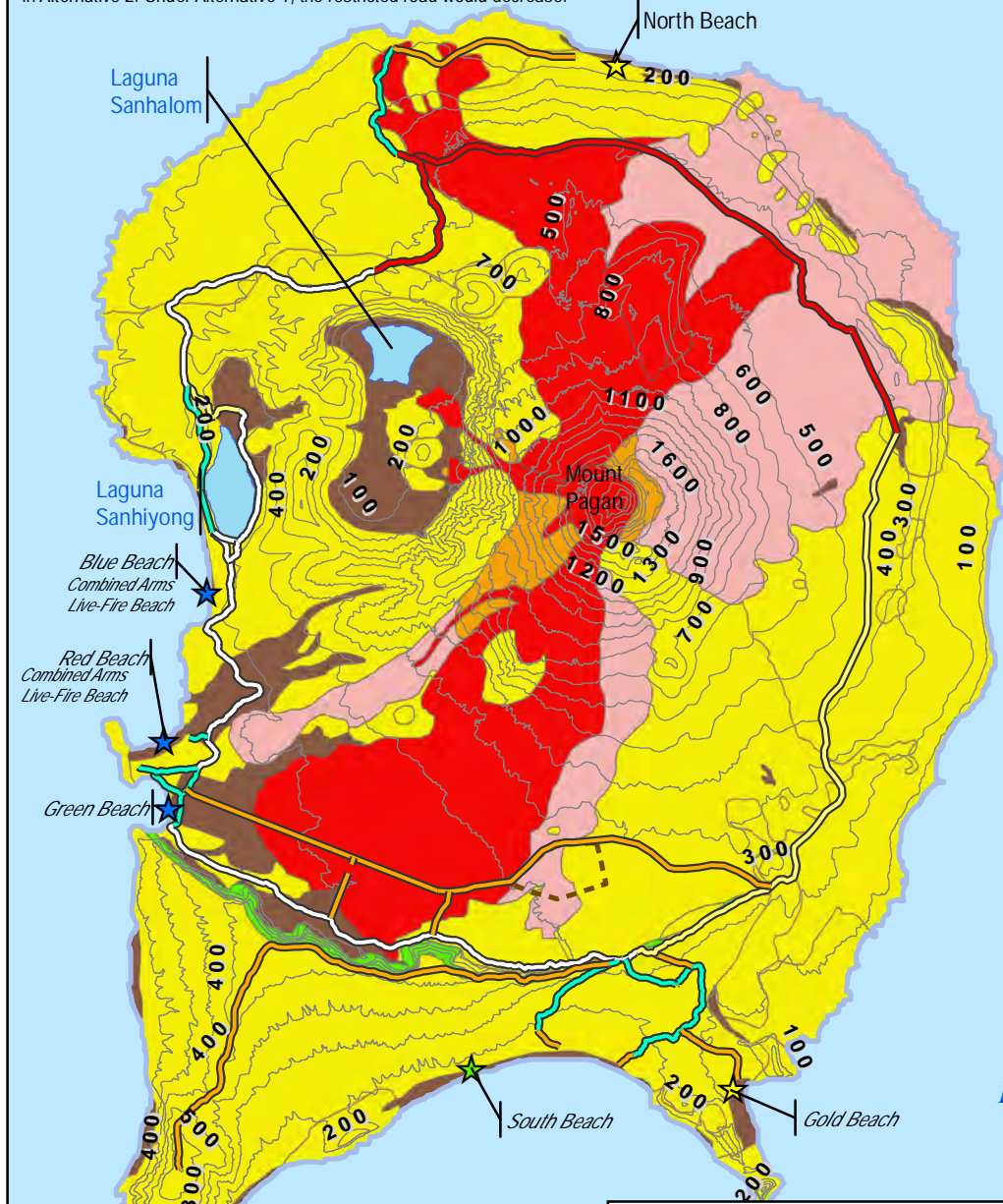


Figure 34 Pagan All Action Alternatives
Bivouac Area, Munitions Storage, and
Airfield Improvements Topographic and Geologic Map



*The High Hazard Impact Area Restricted Access Road represents the section of road restricted by the High Hazard Impact Area in Alternative 2. Under Alternative 1, the restricted road would decrease.



Geologic Classes		Legend	
	Holocene (150 - 10,000 years old)		High Hazard Impact Area
	Pleistocene (10,000 - 2 million years old)		Restricted Access Military Training Trail
	Recent - A.D. 1872-1873		Primary Perimeter Military Training Trail (Existing Trail)
	Recent - A.D. 1925		Primary Perimeter Military Training Trail (No Existing Trail)
	Recent - A.D. 1981		Other Potential Military Trail (Existing Trail)
	Sedimentary Deposits		Other Potential Military Trail (No Existing Trail)
	Contours (feet)	Tactical Amphibious Landing Beaches	
	Munitions Storage Area		Amphibious Assault Vehicles, Landing Craft Air Cushion, small boat and swimmer training
			Landing Craft Air Cushion, small boat and swimmer training
			Small boat and swimmer training

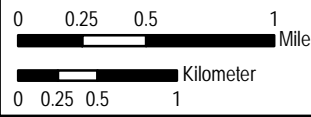


Figure 35 Proposed Pagan Combined Level RTA
Access Road and Trail Improvements: All Action Alternatives
Topographic and Geologic Map



1.3.1.1.3 Elevation and Slope

Within the proposed Pagan support facilities, general elevation and a slope class for the facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 53](#) and are topographically shown in [Figure 34](#) and [Figure 35](#).

Table 53. Pagan Support Facilities: All Alternatives Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Expeditionary Base Camp and Airfield	0 to 200 feet (0 to 61 meters)	0-5% 31+% (on western point)
HHIA and Restricted Access Military Training Trail	300 to 400 feet (91 to 122 meters)	6-15% (western portion) 16-30% (eastern portion)
Primary Perimeter Military Training Trail (existing trail)	200 to 400 feet (61 to 122 meters)	0-5% (sentral portion) 31+% (northern and southern portions)
Primary Perimeter Military Training Trail (no existing trail)	200 to 400 feet (61 to 122 meters)	6-15% (southern portion) 16-30% (northern portion)
Other Potential Military Training Trail (existing trail)	0 to 250 feet (0 to 76 meters)	6-15% (southeastern portion) 0-5% (southwestern portion) 31+% (northern portion)
Other Potential Military Training Trail (no existing trail)	300 to 400 feet (91 to 122 meters)	6-15% (northern portion) 0-5% (central portion) 16-30% (southern portion)

1.3.1.1.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The geological conditions for proposed Pagan support facilities are shown in [Table 54](#) and in [Figure 34](#) and [Figure 35](#).

Table 54. Pagan Support Facilities: All Alternatives Elevation and Slope

<i>Description</i>	<i>Geology of Area</i>
Expeditionary Base Camp/Bivouac Area and Airfield	Sedimentary Deposits and Holocene (150-10,000 years old)
HHIA Restricted Access Military Training Trail	Recent-A.D. 1981, recent-A.D. 1872-1873 and Holocene (150-10,000 years old) volcanic deposits
Primary Perimeter Military Training Trail (existing trail)	Sedimentary deposits and Holocene (150-10,000 years old) volcanic deposits
Primary Perimeter Military Training Trail (no existing trail)	Sedimentary deposits and Holocene (150-10,000 years old) volcanic deposits
Other Potential Military Training Trail (existing trail)	Recent-A.D. 1981, Holocene (150-10,000 years old) volcanic deposits, and Pleistocene (10,000-2 million years old) volcanic deposits
Other Potential Military Training Trail (no existing trail)	Holocene (150-10,000 years old) volcanic deposits, recent-A.D. 1981 volcanic deposits, and sedimentary deposits

1.3.1.1.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Pagan support facilities have nothing published on geological hazards but there is a potential for tsunami inundation for the expeditionary base camp, bivouac area, and airfield since the area is low-lying. Possibility of seismic activity, volcanic eruptions, and landslides exists. Features are shown in the geological map [Figure 34](#) and [Figure 35](#).

1.3.2 Training Facilities

Common to all Pagan (action) alternatives are the construction of training facilities: (1) North Range Complex and South Range Complex. A summary of the acreage, ground disturbance, anticipated vegetation maintenance, elevation and slope, geology, and geologic hazards within the proposed facility follows for the training facilities.

1.3.2.1 Pagan North Range Complex: Alternative 1

The proposed Pagan North Range Complex for Alternative 1 consists of: (1) a northern HHIA, (2) 8 northern High Hazard Impact Target Areas, (3) a southern HHIA, (4) a southern High Hazard Impact Target Area, (5) 11 Landing Zones, (6) 11 Field Artillery Indirect Firing Positions, (7) a Field Artillery Direct Firing Position, (8) 6 Mortar Positions, and (9) a Dedicated Live-fire Maneuver Area.

1.3.2.1.1 Ground Disturbance

Ground disturbance associated with the training facilities within the proposed Pagan North Range Complex (Alternative 1) totals 600 acres (243 hectares) of 100% ground disturbance and is presented in [Table 55](#) and depicted in [Figure 36](#). The northern HHIA totals 4,192 acres (1,587 hectares) over barren lava field and the southern HHIA totals 376 acres (150 hectares) and both would require 0% ground disturbance. The Dedicated Live-fire Maneuver Area totals 3,921 acres (1,587 hectares) and would also require 0% ground disturbance. Only target areas would require 100% ground disturbance during operations.

Table 55. Pagan North Range Complex: Alternative 1 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Dedicated Live-fire Maneuver Area	3,921	1,587	0
North HHIA	4,192	1,725	0
North High Hazard Impact Target Areas (inside HHIA)	320	130	100
South HHIA	376	150	0
South High Hazard Impact Target Area (inside HHIA)	64	26	100
Landing Zones*	36	15	100
Field Artillery Indirect Firing Positions**	110	12	100
Field Artillery Direct Firing Position	10	4	100
Mortar Positions	60	24	100
Total	600	243	100%

Notes: *11 Landing Zones each is 3.3 acres (1.3 hectares) = 36.3 acres (14.7 hectares).

**11 Indirect Firing Positions each is 10 acres (4 hectares) = 110 acres (45 hectares).

***6 Mortar Positions each is 10 acres (4 hectares) = 60 acres (24 hectares).

Terrain Flight Maneuver Area Range located over the island

*The High Hazard Impact Area Restricted Access Road represents the section of road restricted by the High Hazard Impact Area in Alternative 2. Under Alternative 1, the restricted road would decrease.

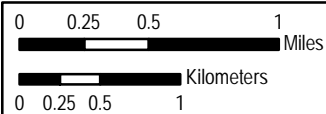
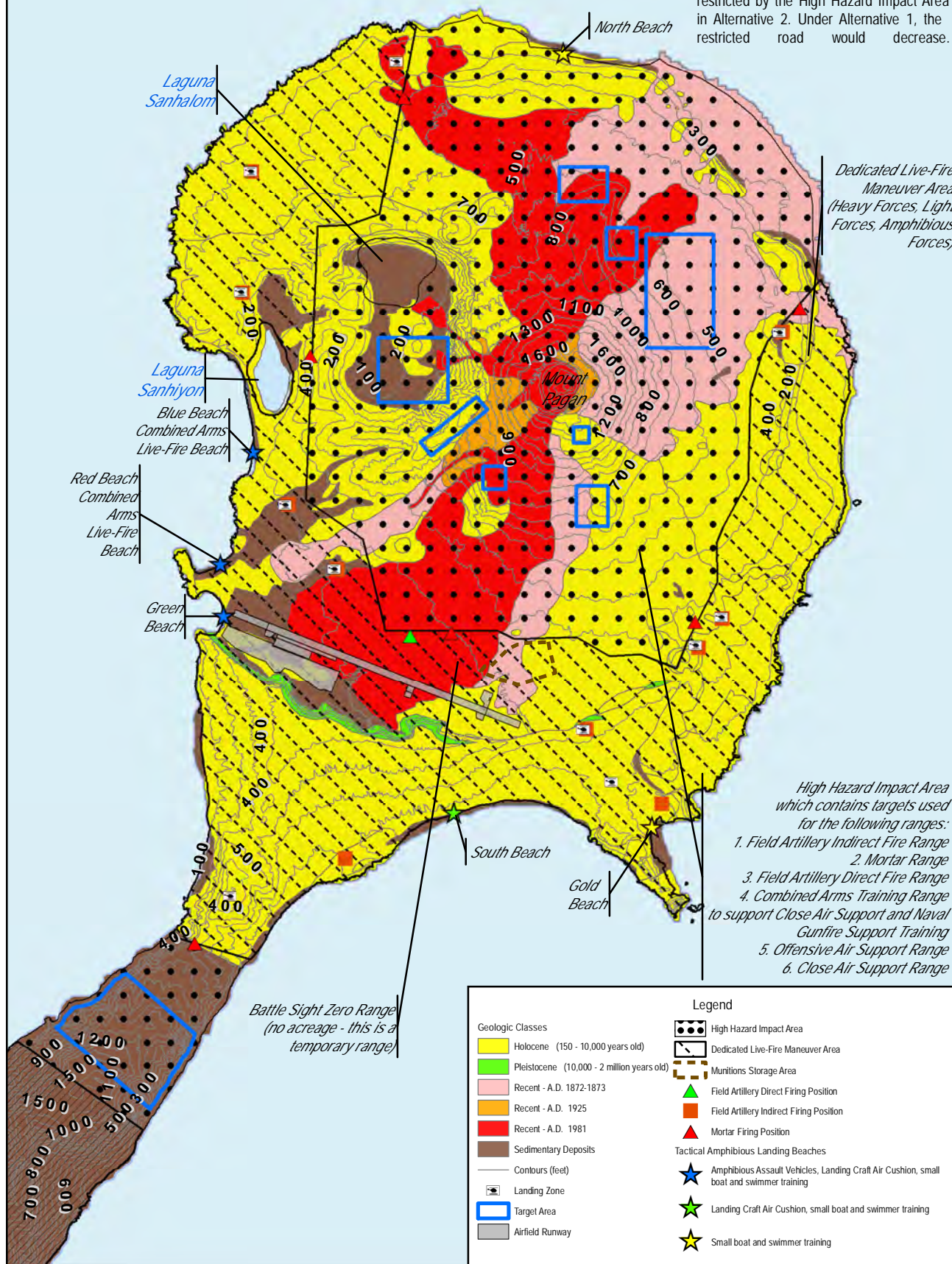


Figure 36 Pagan Alternative 1
North Range Complex
Topographic and Geologic Map



1.3.2.1.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Pagan North Range Complex (Alternative 1) during operations totals 600 acres (243 hectares) of 100% vegetation maintenance and is presented in [Table 56](#) and mapped in [Figure 36](#). The northern HHIA totals 4,192 acres (1,725 hectares) over a barren lava field and would require 0% vegetation maintenance. The Dedicated Live-fire Maneuver Area totals 3,921 acres (1,587 hectares) and would also require 0% vegetation maintenance. The target areas would require 100% vegetation maintenance during operations. Target placement for the HHIA is anticipated to be located in areas largely devoid of vegetation (i.e., a lava flow). Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation within the target areas when needed.

Table 56. Pagan North Range Complex: Alternative 1 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Dedicated Live-fire Maneuver Area	3,921	1,587	0
North HHIA	4,192	1,725	0
North High Hazard Impact Target Areas (inside HHIA)	320	130	100
South HHIA	376	150	0
South High Hazard Impact Target Area (inside HHIA)	64	26	100
Landing Zones*	36	15	100
Field Artillery Indirect Firing Positions**	110	12	100
Field Artillery Direct Firing Position	10	4	100
Mortar Positions	60	24	100
Total	600	243	100%

Notes: *11 Landing Zones each is 3.3 acres (1.3 hectares) = 36.3 acres (14.7 hectares).

**11 Indirect Firing Positions each is 10 acres (4 hectares) = 110 acres (45 hectares).

***6 Mortar Positions each is 10 acres (4 hectares) = 60 acres (24 hectares).

Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix and in the beginning of this section, [Section 1.3](#).

1.3.2.1.3 Elevation and Slope

Within the proposed Pagan North Range Complex (Alternative 1), general elevation and slope class for each of the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 57](#) and are topographically shown in [Figure 36](#).

Table 57. Pagan North Range Complex: Alternative 1 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
North HHIA	0 to 200 feet (0 to 61 meters)	6-15%
North HHIA Target Areas	200 to 870 feet (61 to 570 meters)	6-15%
South HHIA and Target Area	0 to 200 feet (0 to 61 meters)	16-31+%
Mount Pagan	1870 feet (570 meters)	0-31+%
Field Artillery Indirect Firing Points West	200 feet (61 meters)	0-15%
Field Artillery Indirect Firing Points East	200 feet (61 meters)	0-15%
Field Artillery Indirect Firing Points South	500 feet (152 meters)	0-15%
Field Artillery Direct Firing Point	200 feet (61 meters)	0-15%
Landing Zones	NA	NA
Dedicated Live-fire Maneuver Area Northern Portion	0 to 200 feet (0 to 61 meters)	0-15%

Description	Elevation	Slope
Dedicated Live-fire Maneuver Area Western Central Portion	0 to 400 feet (0 to 122 meters)	0-5% 31+% (West)
Dedicated Live-fire Maneuver Area Southern Portion	0 to 400 feet (0 to 122 meters)	0-5% (North) 6-15%, 16-30% and 31+% (South)
Dedicated Live-fire Maneuver Area Eastern Portion	0 to 400 feet (0 to 122 meters)	16-30%

1.3.2.1.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Pagan North Range Complex (Alternative 1) is underlain by sedimentary deposits, Recent-A.D. 1981 volcanics, Recent-A.D. 1872-1873 volcanics, Recent-A.D. 1925 volcanics, Holocene (150-10,000 years old) volcanics, and Pleistocene 10,000-2 million years old volcanics shown in [Figure 36](#).

1.3.2.1.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. The proposed Pagan North Range Complex (Alternative 1) area has nothing published but there is a potential for tsunami inundation for the Dedicated Live-fire Maneuver Area and the northeastern portion of the HHIA since the areas have low-lying coastal portions. Possibility of seismic activity, volcanic eruptions, and landslides exists. Features are shown in the geological map [Figure 36](#).

1.3.2.2 Pagan South Range Complex: Alternative 1

The proposed Pagan South Range Complex: Alternative 1 consists of: (1) a Non-live-fire Maneuver Area. It does not include a HHIA.

1.3.2.2.1 Ground Disturbance

Ground disturbance for the training facilities within proposed Pagan South Range Complex: Alternative 1 totals 0 acres of 0% ground disturbance and is presented in [Table 58](#) and depicted in [Figure 37](#). The southern HHIA and Non-live-fire Maneuver Area would require 0% ground disturbance.

Table 58. Pagan South Range Complex: Alternative 1 Ground Disturbance

Description	Acres	Hectares	% Ground Disturbance
Non-live fire Maneuver Area	3,146	1,273	0
Total	3,146	1,273	0%

1.3.2.2.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Pagan South Range Complex: Alternative 1 during operations total 3,146 acres (1,273 hectares) of 0% vegetation maintenance and are presented in [Table 59](#) and mapped in [Figure 37](#). The Non-live-fire Maneuver Area would require 0% vegetation maintenance during operations.

Table 59. Pagan South Range Complex: Alternative 1 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Non-live fire Maneuver Area	3,146	1,273	0
Total	3,146	1,273	0%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix and in the beginning of this section, [Section 1.3](#).

1.3.2.2.3 Elevation and Slope

Within the proposed Pagan South Range Complex: Alternative 1, general elevation and slope the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 60](#) and are topographically shown in [Figure 37](#).

Table 60. Pagan South Range Complex: Alternative 1 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Non-live-fire Maneuver Area Northern Portion	0 to 1,700 feet (0 to 518 meters)	31+%
Non-live-fire Maneuver Area Central Portion	0 to 1798 feet (0 to 548 meters)	6-15% and 31+%
Non-live-fire Maneuver Area Southern Portion	0 to 1100 feet (0 to 335.3 meters)	6-15%, 16-30% and 31+%
South Volcano	1,798 feet (548 meters)	31+%

1.3.2.2.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. Pagan South Range Complex (Alternative 1) is underlain by Pre-caldera succession (South Volcano) volcanics, Post-caldera lavas (South Volcano) volcanics, and Holocene (150-10,000 years old) volcanics, shown in [Figure 37](#).

Terrain Flight Maneuver Area
Range located over the island

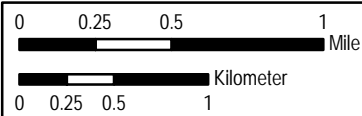
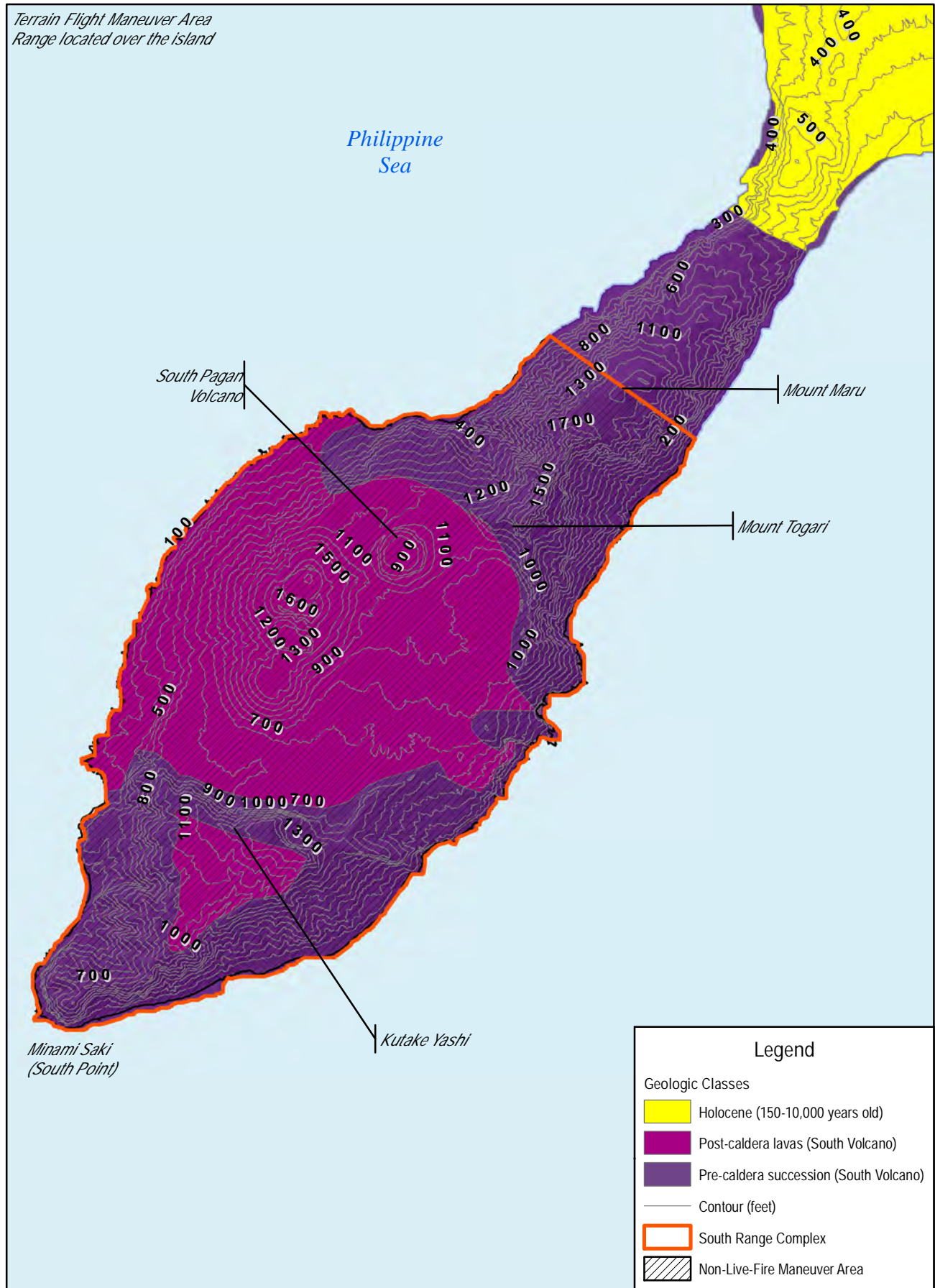


Figure 37 Pagan Alternative 1
South Range Complex
Topographic and Geologic Map



1.3.2.2.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. The area of the proposed South Range Complex: Alternative 1 has nothing published but there is a potential for tsunami inundation in the Non-live-fire Maneuver Area in the low-lying coastal portions. Possibility of seismic activity, volcanic eruptions, and landslides exists. Existing features are shown in [Figure 37](#).

1.3.2.3 Pagan North Range Complex: Alternative 2

The proposed Pagan North Range Complex for Alternative 2 consists of: (1) a northern HHIA, (2) 8 northern High Hazard Impact Target Areas, (3) 13 Landing Zones, (4) a Field Artillery Indirect Firing Range firing position, (5) a Field Artillery Direct Firing Range firing position, (6) 5 Mortar Positions, and (7) a Dedicated Live-fire Maneuver Area.

1.3.2.3.1 Ground Disturbance

Ground disturbance for the training facilities within the proposed Pagan North Range Complex Alternative 2 totals 532 acres (215 hectares) of 100% ground disturbance and is presented in [Table 61](#) and depicted in [Figure 38](#). The HHIA and Dedicated Live-fire Maneuver Area would have 0% ground disturbance while the target areas would require 100% ground disturbance.

Table 61. Pagan North Range Complex: Alternative 2 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Dedicated Live-fire Maneuver Area	5,064	2,049	0
North HHIA	3,424	1,386	0
North High Hazard Impact Target Areas (inside HHIA)	319	130	100
Landing Zones*	43	17	100
Field Artillery Indirect Firing Points**	110	45	100
Field Artillery Direct Firing Point	10	4	100
Mortar Positions**	50	20	100
Total	532	215	100%

Notes: *13 Landing Zones each is 3.3 acres (1.3 hectares) = 43 acres (17.4) hectares.

**11 Indirect Firing Positions each is 10 acres (4 hectares) = 110 acres (45 hectares).

***5 Mortar Positions each is 10 acres (4 hectares) = 50 acres (24 hectares).

1.3.2.3.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Pagan North Range Complex: Alternative 2 during operations totals 532 acres (215 hectares) and is presented in [Table 62](#) and mapped in [Figure 38](#). The HHIA and Dedicated Live-fire Maneuver Area would have 0% vegetation maintenance while the target areas would require 100% vegetation maintenance. Target placement for the HHIA is anticipated to be located in areas large devoid of vegetation (i.e., a lava flow). Ordinary vegetation maintenance methods (e.g., mowing, cutting, herbicides) would be used to manage vegetation when needed.

Terrain Flight Maneuver Area Range located over the island

*The High Hazard Impact Area Restricted Access Road represents the section of road restricted by the High Hazard Impact Area in Alternative 2. Under Alternative 1, the restricted road would decrease.

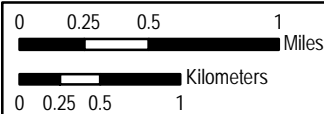
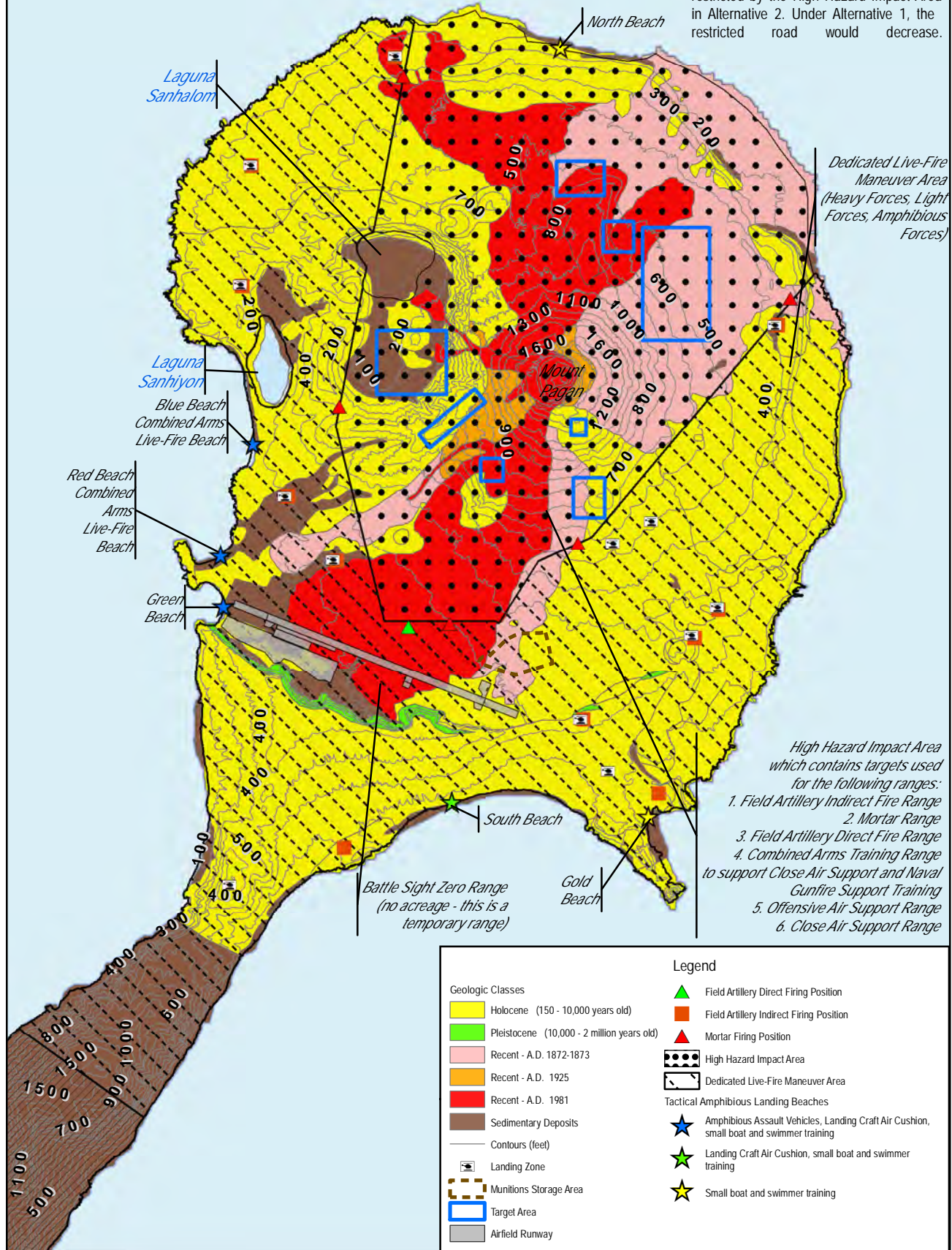


Figure 38 Pagan Alternative 2
North Range Complex
Topographic and Geologic Map



Table 62. Pagan North Range Complex: Alternative 2 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Dedicated Live-fire Maneuver Area	5,064	2,049	0
HHIA	3,424	1,386	0
High Hazard Impact Target Areas (inside HHIA)	319	130	100
Helicopter Landing Zones*	43	17	100
Field Artillery Indirect Firing Points**	110	45	100
Field Artillery Direct Firing Point	10	4	100
Mortar Positions**	50	20	100
Total	532	215	100%

Notes: *13 Landing Zones each is 3.3 acres (1.3 hectares) = 43 acres (17.4) hectares.

**11 Indirect Firing Positions each is 10 acres (4 hectares) = 110 acres (45 hectares).

***5 Mortar Positions each is 10 acres (4 hectares) = 50 acres (24 hectares).

Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix and in the beginning of this section, [Section 1.3](#).

1.3.2.3.3 Elevation and Slope

Within the proposed Pagan North Range Complex (Alternative 2), general elevation and slope for each of the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 63](#) and are topographically shown in [Figure 38](#).

Table 63. Pagan North Range Complex: Alternative 2 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Dedicated Live-fire Maneuver Area Northern Portion	0 to 200 feet (0 to 61 meters)	6-15%
Dedicated Live-fire Maneuver Area Western Central Portion	0 to 400 feet (0 to 122 meters)	0-5% 31+% (West)
Dedicated Live-fire Maneuver Area Southern Portion	0 to 400 feet (0 to 122 meters)	0-5% (North) 6-15%, 16-30% and 31+% (South)
Dedicated Live-fire Maneuver Area Eastern Portion	0 to 400 feet (0 to 122 meters)	16-30%
North HHIA	0 to 200 feet (0 to 61 meters)	6-15%
North High Hazard Impact Target Areas	200 to 1,870 feet (61 to 570 meters)	6-15%
Mount Pagan	1870 feet (570 meters)	31+%
Field Artillery Indirect Fire Range Firing Points	200 feet (61 meters)	0-15%
Field Artillery Direct Fire Range Firing Point	200 feet (61 meters)	0-15%
Helicopter Landing Zones	NA	NA

1.3.2.3.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. Pagan North Range Complex (Alternative 2) area is underlain by sedimentary deposits, Recent-A.D. 1981 volcanics, Recent-A.D. 1872-1873 volcanics, Recent-A.D. 1925 volcanics, Holocene (150-10,000 years old) volcanics, and Pleistocene (10,000-2 million years old) volcanics, as shown in [Figure 38](#).

1.3.2.3.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. Pagan North Range Complex (Alternative 2) area has nothing published but there is a potential for tsunami inundation in the dedicated live-fire maneuver area and in the Northeastern portion of the HHIA because the areas have low-lying coastal portions. Possibility of seismic activity, volcanic eruptions, and landslides exists. Features are shown in [Figure 38](#).

1.3.2.4 Pagan South Range Complex: Alternative 2 (no High Hazard Impact Area)

The proposed Pagan South Range Complex (Alternative 2) consists of: (1) a Non-live-fire Maneuver Area. It does not include a HHIA.

1.3.2.4.1 Ground Disturbance

Ground disturbance for the training facilities within Pagan South Range Complex is a total of 0 acres (0 hectares) and are presented in [Table 64](#) and depicted in [Figure 39](#). The Non-live-fire Maneuver Area would have 0% ground disturbance.

Table 64. Pagan South Range Complex: Alternative 2 Ground Disturbance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Ground Disturbance</i>
Non-live-fire Maneuver Area	4,402	1,781	0
Total	4,402	1,781	0%

1.3.2.4.2 Vegetation Maintenance

Vegetation maintenance areas for the training facilities located within the proposed Pagan South Range Complex (Alternative 2) during operations total 0 acres (0 hectares) and are presented in [Table 65](#) and mapped in [Figure 39](#). The Non-live-fire Maneuver Area would have 0% vegetation maintenance.

Table 65. Pagan South Range Complex: Alternative 2 Vegetation Maintenance

<i>Description</i>	<i>Acres</i>	<i>Hectares</i>	<i>% Vegetation Maintenance</i>
Non-live-fire Maneuver Area	4,402	1,781	0
Total	4,402	1,781	0%

Note: Descriptions of vegetation maintenance are further discussed in [Section 1.2](#) at the beginning of this Appendix and in the beginning of this section, [Section 1.3](#).

Terrain Flight Maneuver Area
Range located over the island

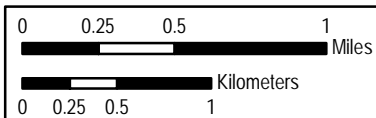
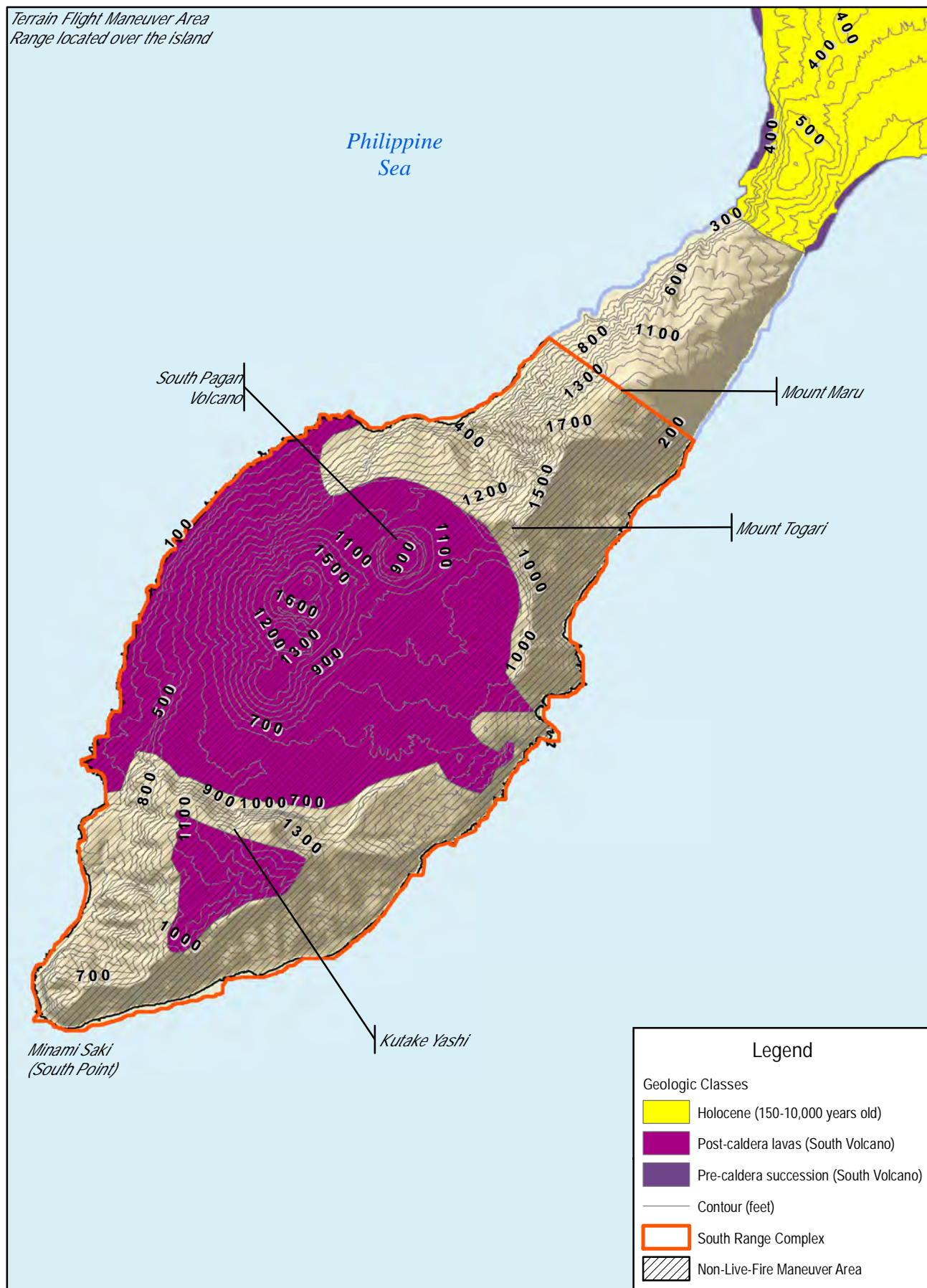


Figure 39 Pagan Alternative 2
South Range Complex
Topographic and Geologic Map



1.3.2.4.3 Elevation and Slope

Within the proposed Pagan South Range Complex (Alternative 2), general elevation and slope for the training facilities was determined using USGS GIS data. The results of this assessment are provided in [Table 66](#) and are topographically shown in [Figure 39](#).

Table 66. Pagan South Range Complex: Alternative 2 Elevation and Slope

<i>Description</i>	<i>Elevation</i>	<i>Slope</i>
Non-live-fire Maneuver Area Northern Portion	0 to 1,700 feet (0 to 518 meters)	16-30 % and 31+%
Non- live-fire Maneuver Area Central Portion	0 to 1,798 feet (0 to 548 meters)	6-15% and 31+%
Non- live-fire Maneuver Area Southern Portion	0 to 1,100 feet (0 to 335 meters)	6-15%, 16-30% and 31+%
South Volcano	1,798 feet (548 meters)	31+%

1.3.2.4.4 Geology

Geological conditions were assessed using U.S. Department of Interior USGS data. The proposed Pagan South Range Complex (Alternative 2) is underlain by Pre-caldera succession (South Volcano) volcanics, Post-caldera lavas (South Volcano), and Holocene (150-10,000 years old) volcanics, as shown in [Figure 39](#).

1.3.2.4.5 Geologic Hazards

Geological hazards were assessed using U.S. Department of Interior USGS data. The area of the proposed South Range Complex (Alternative 2) has nothing published but there is a potential for tsunami inundation in the Non-live-fire Maneuver Area since the areas have low-lying coastal portions. The possibility of seismic activity, volcanic eruptions and landslides exists. Existing features are shown in [Figure 39](#).

2.0 REFERENCES

Young, F. L. (1989). *Soil Survey of the Islands of Aguijan, Rota, Saipan, and Tinian, Commonwealth of the Northern Mariana Islands*. United States Department of Agriculture Soil Conservation Service.

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