

CHAPTER 11.

MARINE BIOLOGICAL RESOURCES

11.1 AFFECTED ENVIRONMENT

11.1.1 Definition of Resource

For the purpose of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), marine biological resources are defined as those marine-related organisms (marine flora and fauna), their behaviors, and their interactions with the environment that may be directly or indirectly affected by the proposed action within the established marine region of influence (ROI). The ROI is defined as the nearshore waters of Guam out to the 164 feet (ft) [50-meter {m}] isobath (depth line on a map of the ocean/sea). This includes waters offshore of Finegayan on the west coast, offshore of the Route 15 Lands on the east coast, and all waters of Apra Harbor (Figure 11.1-1 and Figure 11.1-2). The ROI does not include the Marianas Trench Marine National Monument, which was established in January 2009 by Presidential Proclamation, as the proposed action and alternatives would not impact this area.

The environmental analysis focuses on species or areas that are important to the function of the ecosystem, of special societal importance, or are protected under federal, state, commonwealth or territory law or statutes. For the purpose of this EIS/OEIS, marine biological resources have been divided into four major categories: marine flora, invertebrates and associated Essential Fish Habitat (EFH), fish and EFH, special-status species, and non-native species.

11.1.1.1 Marine Flora, Invertebrates and Associated EFH

This chapter provides a description of marine flora and macroinvertebrates (including a brief description of corals, which are addressed further under the EFH section) found within the ROI. Examples include macroalgae (or seaweeds), seagrasses, emergent vegetation (plants that are rooted in the substrate beneath water, but grow tall enough to protrude above water or have leaves that float on the water), gastropods (snails), cephalopods (squid and octopus), crustaceans (lobsters and crabs), and sponges. All these examples are also included within the managed fisheries in the Western Pacific under five fisheries management plans (FMPs): (1) coral reef ecosystems, (2) bottomfish and seamount Groundfish, (3) crustaceans, (4) precious corals, and (5) pelagic species. Each of these FMPs identifies specific management unit species (MUS) for different life stages of the species managed under the respective plan (Western Pacific Regional Fisheries Management Council [WPRFMC] 2005). Essential Fish Habitat is described further below.

11.1.1.2 Essential Fish Habitat

The primary federal laws that make up the regulatory framework for fish and EFH include the Magnuson-Stevens Fishery Conservation and Management Act or Magnuson-Stevens Act (M-SA), Executive Order (EO) 12962, and the Endangered Species Act (ESA). EFH is defined as those waters and substrate necessary to fish (finfish, mollusks, crustaceans and all other forms of marine animal and plant life other than marine reptiles, marine mammals and birds) for spawning, breeding, feeding, or growth to maturity (WPRFMC 2005). EFH for managed fishery resources is designated in the FMPs prepared by the local regional fisheries management council - WPRFMC - and in conjunction with the Guam Division of Aquatic and Wildlife Resources (GDAWR), which manages the fisheries resources in Guam. The

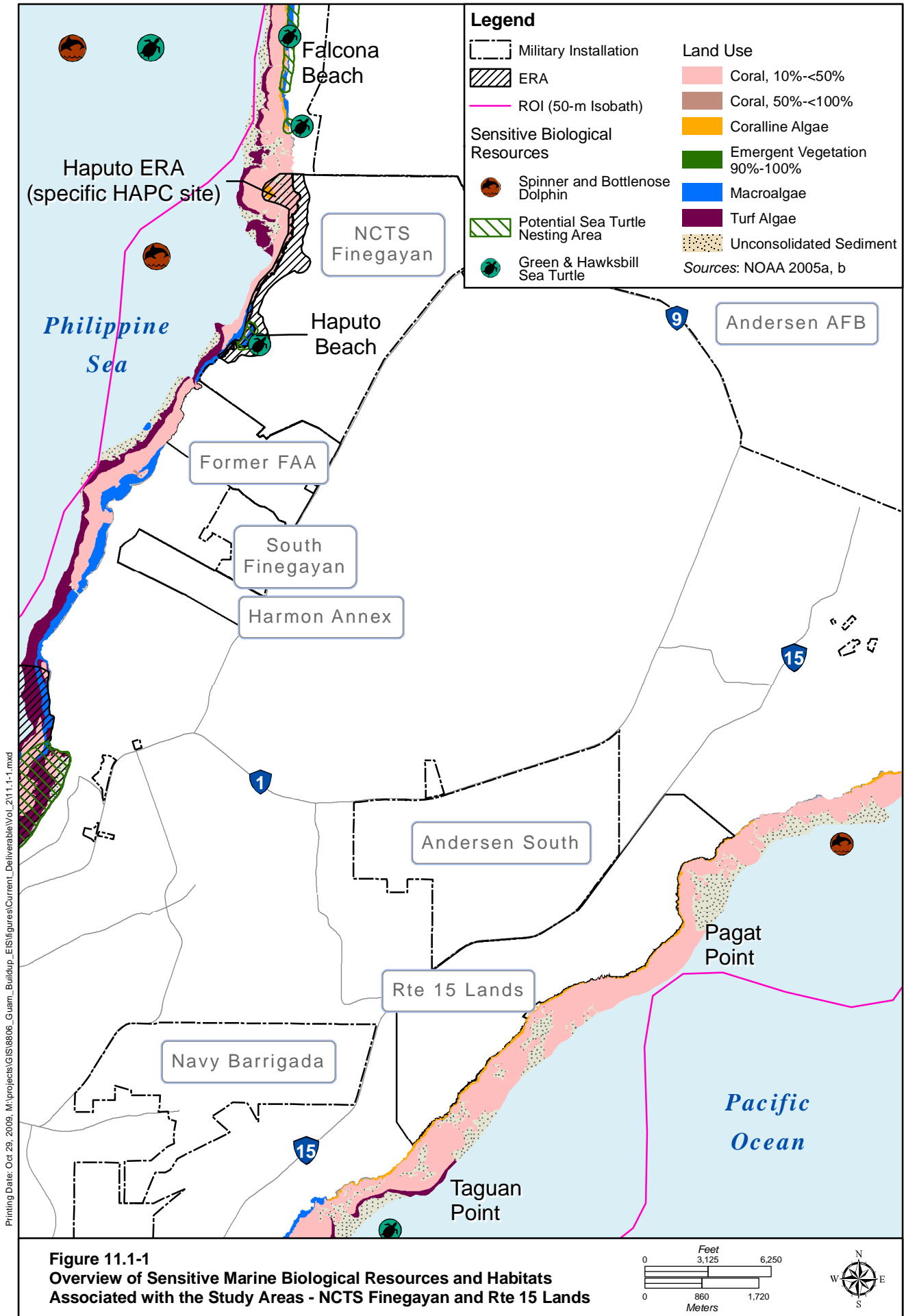
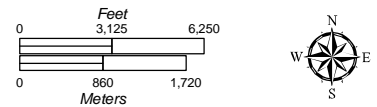
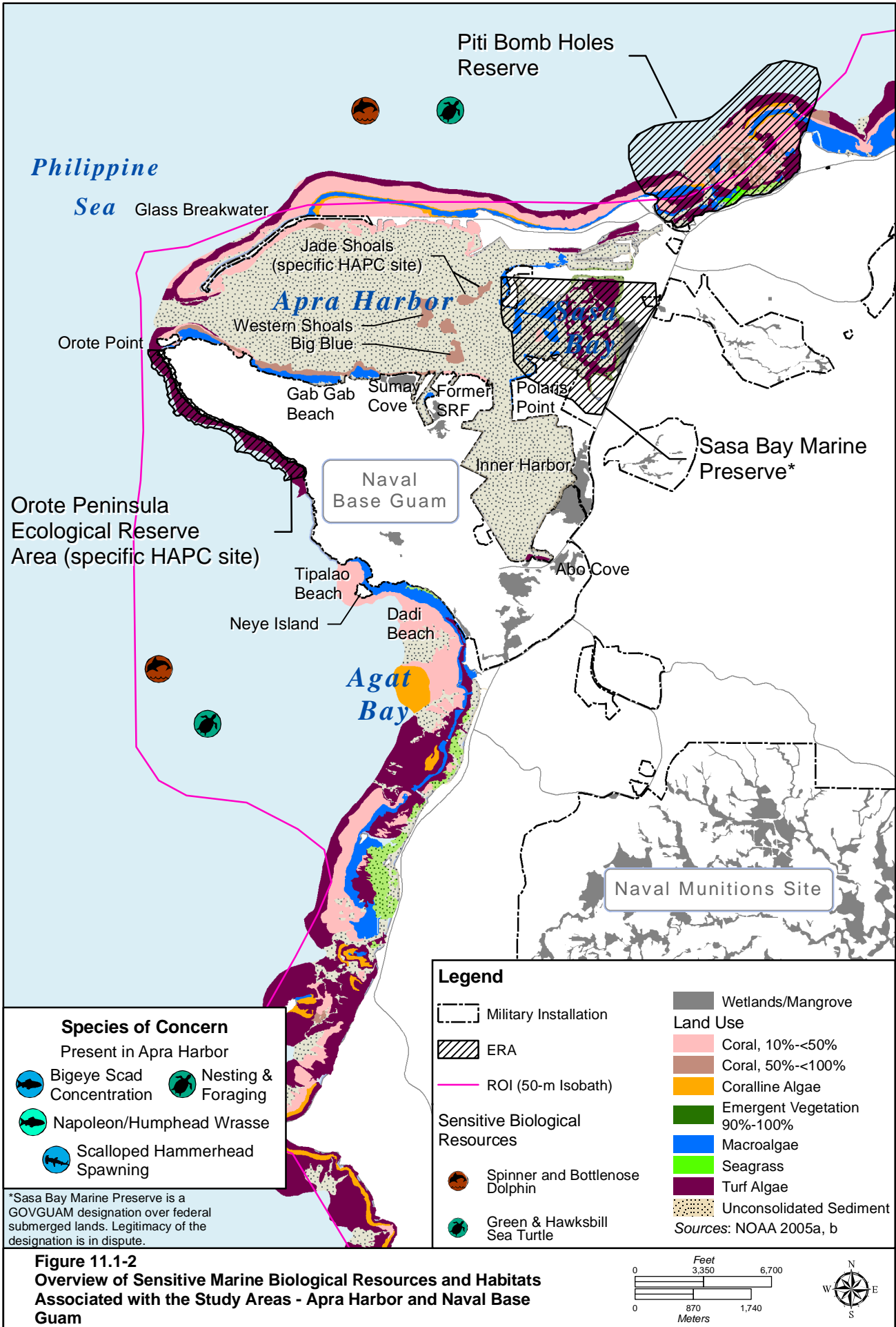


Figure 11.1-1
Overview of Sensitive Marine Biological Resources and Habitats
Associated with the Study Areas - NCTS Finegayan and Rte 15 Lands



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*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.

WPRFMC is currently converting its FMPs to fishery ecosystem plans (FEPs). In other words, changing from species-based management to place-based management for the Pacific Region. The draft FEPs and Preliminary EIS are being reviewed and the Record of Decision for the associated Programmatic EIS is being prepared.

The Navy is consulting with the National Marine Fisheries Service (NMFS) on proposed activities that may adversely affect EFH. There are four steps in the EFH consultation process (NMFS 1999):

1. The federal agency provides a project notification to NMFS of a proposed activity that may adversely affect EFH.
2. The federal agency provides an assessment of the effects on EFH with the project notification. The EFH Assessment (EFHA) prepared as part of this EIS/OEIS includes: (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species by life history stage; (3) the federal agency's views regarding the effects of the proposed action of EFH; and (4) proposed mitigation, if applicable.
3. NMFS provides EFH conservation recommendations to the federal agency. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH and are to be provided to the action agency in a timely manner.
4. The federal agency provides to NMFS a detailed written response, within 30 days of receiving the NMFS EFH conservation recommendations (at least 10 days before final approval of the action for decisions that are rendered in fewer than 30 days).

11.1.1.3 Special-Status Species

For the purpose of this document, special-status species include ESA-listed and candidate species, marine mammals not listed under ESA, species of concern, and Guam-listed species, found in the nearshore marine ROI (Table 11.1-1). Brief species descriptions are located in Section 11.1.4, Guam Regional Environment, and within specific study area sections below. Detailed descriptions of all potentially affected special-status species, including life history information is included in Volume 9, Appendix G.

Table 11.1-1. Special-Status Marine Species Present in the ROI Around Guam

Group	Common Name/Chamorro Name	Status*	
		Federal	Guam
MAMMALS	Common bottlenose dolphin/Toninos/	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E
FISH**	Napoleon wrasse/Tanguisson	SOC	SOGCN
	humphead parrotfish/Atuhong	SOC	SOGCN

Legend: *E = endangered; T = threatened; MMPA = Marine Mammal Protection Act; SOC = NOAA species of concern, SOGCN = Species of Greatest Conservation Need (GDAWR 2006).

** Addressed further under EFH Section.

Sources: NOAA 2005a, NMFS 2009a, USFWS 2009.

ESA-Listed Species, Critical Habitat, and Candidate Species

ESA-listed species are defined as those plant and animal species currently listed by the United States (U.S.) Fish and Wildlife Service (USFWS) under the ESA as threatened, endangered, or proposed as such. Candidate species are plant or animal species for which USFWS or NMFS has on file sufficient

information on biological vulnerability and threats to support a proposal to list them as endangered or threatened under the ESA based on the most recent candidate review (USFWS 2009). The Navy has initiated consultation under Section 7 of the ESA regarding the potential effects of the proposed action on endangered and threatened species within the ROI. All special-status marine species, including threatened and endangered marine species, occurring in the ROI are listed in Table 11.1-1 and discussed in more detail below. There is no critical habitat designation for any marine species on Guam.

Sea Turtles

All sea turtles that occur in the U.S. are listed under the ESA as either threatened or endangered. The threatened green sea turtle and the endangered hawksbill sea turtle are the only ESA-listed species that regularly occur in the nearshore marine ROI. Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources, since they are terrestrial at the nesting stage and are under the jurisdiction of USFWS for consultation purposes.

Species of Concern

Species of Concern are those species about which NMFS has concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA. The goal is to draw proactive attention and conservation action to these species. Two species of fish, the Napoleon wrasse and the humphead parrotfish, are listed as species of concern by NMFS (NMFS 2009a) and are expected to occur in the nearshore marine ROI (refer to Table 11.1-1). These species are discussed in the EFH section of this EIS/OEIS, as they are protected under the Coral Reef Ecosystems MUS (CREMUS) (WPRFMC 2005).

Guam-Listed Species

Guam-listed species are defined as those plant and animal species found in the nearshore marine ROI that are not ESA-listed or Candidate species, but are currently designated by legislative authority in the Territory of Guam as endangered or threatened species. There are no Guam-listed marine species other than those that are also ESA-listed (sea turtles) so these Guam-listed marine species are discussed in the ESA-listed species section of this EIS/OEIS.

Marine Mammals

Marine mammals are discussed in this EIS/OEIS because several species are known to occur or potentially occur in the waters around Guam. The Marine Mammal Protection Act (MMPA) of 1972 makes it illegal to “take” any species of marine mammal. The definition of take refers to the harassing, injuring or killing of any marine mammal, or the possessing of any marine mammal or part of a marine mammal, without authorization. Some marine mammals are listed under the MMPA as strategic. Strategic refers to a stock of marine mammals that is being negatively impacted by human activities and may not be sustainable. When a population or stock has fallen below optimum sustainable levels, it is considered depleted. A stock may be considered depleted when the mortality in multiple units exceeds the Potential Biological Removal identified for the species. All marine mammal species listed under the ESA of 1973 are considered depleted. No ESA-listed marine mammals are anticipated in the ROI (Navy 2005, NOAA 2005a).

The National Defense Authorization Act of Fiscal Year 2004 (Public Law 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 U.S. Code (USC) 1374 (c)(3)]. The National Defense Authorization Act (2004) adopted the definition of “military

activity” as set forth in the Fiscal Year 2003 National Defense Authorization Act (Public Law 107-314). Military training activities on and around Guam (and Commonwealth of the Northern Mariana Islands [CNMI]) constitute military readiness activities as defined in Public Law 107-314 because training activities constitute “training and operations of the armed forces that relate to combat” and constitute “adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use”. For military readiness activities, the relevant definition of harassment is any act that: (1) Injures, or has the significant potential to injure, a marine mammal or marine mammal stock in the wild (“Level A harassment”); or (2) Disturbs, or is likely to disturb, a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered (“Level B harassment”) [16 USC 1362 (18)(B)(i)(ii)].

Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing), if certain findings are made and permits are issued. Permission would be granted by the Secretary for the incidental taking of marine mammals if the taking would have a negligible impact on the species or stock and would not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Marine mammals addressed in this document include all species listed under the MMPA found in the marine ROI. Marine mammals are not well-documented in Micronesia. The first compilation of available information for 19 species of marine mammals from Micronesia was provided by Eldredge (1991) with additional records compiled in 2003 (Eldredge 2003b), which took into account marine mammal distribution and habitat preferences, expanding the list to 32 marine mammal species (29 cetaceans [i.e., whales, dolphins, and porpoises], 2 pinnipeds [i.e., seals and sea lions], and the dugong) with confirmed or possible occurrence in oceanic waters around Guam (Navy 2005).

Based on Appendix B’s figures and supporting text from the Marine Resource Assessment for the Marianas Operating Area (Navy 2005), spinner dolphins and common bottlenose dolphins are the only marine mammals expected to regularly occur within the nearshore marine ROI (164-ft [50-m] isobath) of Guam (see Table 11.1-1).

In general, the main intentions of the three federal acts (ESA, MMPA, and M-SA) listed above are as follows:

- The ESA established protection over and conservation of special-status species and the ecosystems upon which they depend and requires any federal action (authorized, funded, or carried out) to ensure its implementation would not jeopardize the continued existence of the listed species or adversely modify their critical habitat.
- The MMPA established a moratorium on the “taking” (16 USC 1312[13]) of marine mammals in waters or on lands under U.S. jurisdiction.
- The M-SA was designed to protect and conserve important fish/fisheries habitats, including coral reef associated fisheries.

11.1.1.4 Non-Native Species

Non-native species include all marine organisms that have the potential to be introduced from one location or ecosystem to another where it is not native and could potentially cause harm to the receiving ecosystem. This topic is discussed further in Section 11.1.4, and in the subsequent specific study areas.

Most of the relevant site-specific research to date has been within Apra Harbor, so this topic is discussed thoroughly in that section.

11.1.2 Region of Influence

As previously discussed, the marine ROI encompasses all of Apra Harbor, including Sasa Bay and the submerged lands offshore out to the 164-ft (50-m) isobath that may be directly or indirectly impacted by any component of the proposed action. Construction or training activities may impact biological resources due to ground-disturbing activities, in-water construction and/or benthic (bottom) substrate-disturbing activities (dredging), but they may also be impacted through noise, decreased water quality, excess lighting, and other factors.

11.1.3 Study Areas and Survey Methods

For the purposes of this EIS/OEIS, the project area for marine biological resources has been subdivided into three study areas and is assessed for potential impacts from implementation of the proposed action within the nearshore marine ROI. Because of either the location or the nature of the action, some components of the proposed action would have very minimal impact on the marine environment, and therefore no impact assessment is provided. In these cases, a brief explanation of why no assessment is required is provided in those site-specific sections.

Existing conditions and environmental consequences associated with marine biological resources are discussed for the following study areas: Naval Computer and Telecommunications Station (NCTS) Finegayan, Route 15 Range Lands, and Apra Harbor. The other study areas potentially affected by the proposed action do not have marine-related construction and/or land-based construction or training activities that would impact nearshore coastal marine waters.

In addition to existing marine biological resources data for the study areas, project-specific benthic studies and mapping efforts have either been performed for this EIS/OEIS, are ongoing, or are being planned for areas potentially impacted by the proposed action and alternatives (e.g., a 2009 marine benthic survey in the vicinity of the aircraft carrier fairway and turning basin, Outer Apra Harbor). Locations and methods for the survey efforts associated with this EIS/OEIS are provided in detail in the Natural Resources (NR) Survey Report (in progress). Table 11.1-2 lists the specific biological surveys references for this EIS/OEIS.

Table 11.1-2. Summary of Previous and Current Marine Biological Surveys within the Study Areas

<i>Reference</i>	<i>Type of Work</i>	<i>Location</i>
Paulay 1995-1996	Preliminary Non-indigenous Survey - Focusing on Bivalves	Guam
Paulay 1996	Biodiversity and Monitoring Survey of Marine Faunas	Apra Harbor
MRC 1996	Marianas Environmental Impact Statement Marine Environmental Assessment	Guam and Tinian
MRC 1997	Marine Environmental Impact Assessment for Military Training Exercises	Off Tupalao and Dadi Beaches, Guam
Paulay 1998-2000	Introduced Species Survey - Focusing On Hard-bottom Fauna	Guam
Paulay et al. 2000	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Southern Orote Peninsula and North Agat Bay Area
Paulay et al. 2001	Marine Invertebrate Biodiversity: Significant Areas and Introduced Species	Apra Harbor
Amesbury et al. 2001	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Haputo ERA – Offshore NCTS Finegayan
MRC 2002	Maintenance Dredging Rapid Ecological Marine	Inner Apra Harbor

<i>Reference</i>	<i>Type of Work</i>	<i>Location</i>
	Assessment	
Smith 2004a	Reconnaissance Level Observation – Staff Working Paper. in COMNAV Marianas 2006b.	Inner Apra Harbor Entrance Channel
Smith 2004b	Field Report of Supplemental Reconnaissance Level Observations in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
Smith 2004b	Ecological Assessment of the Marine Community in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
MRC 2005a	Marine Resource Assessment in COMNAV Marianas 2006b	Entrance Channel of Inner Apra Harbor
MRC 2005b	Reconnaissance Survey of the Marine Environment, Characterization of the Benthic Habitat in COMNAV Marianas	Outer Apra harbor
Smith 2006	Assessment of Stony Corals	Orote Point to Sumay Cove, Apra Harbor
NOAA 2005c	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report - Oscar Elton Sette	Marianas Archipelago: Island of Guam, Santa Rosa Reef, and Galvez Bank
NOAA 2007	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report – <i>Hi'ialakai</i>	Guam and CNMI (Rota, Aguijan, Tinian, and Saipan)
Smith 2007	Ecological Assessment of Stony Corals and Associated Organisms	Eastern Portion of Apra Harbor
NAVFAC Pacific 2007	Unpublished Cruise Report - Sea Turtle and Cetacean Survey	Mariana Islands
Smith et al. 2008	Marine Biological Survey	Inner Apra Harbor – areas off Sierra, Tango, X-ray, Uniform, Victor Wharves, and Abo Cove.
Smith et al. 2009b [TBP]	Marine Biological Survey	Apra Harbor Cabras Outfall and Polaris Point
Navy 2009b	HEA Remote Sensing Mapping of Coral Communities	Eastern end of Outer Apra Harbor in the vicinity of the CVN channel and turning basin.
Smith et al. 2009a [TBP]	Marine Biological Survey	Navy Main Base - Dadi and Tupalao Beaches
Resource Agency [TBP]	Marine Biological Survey - Spring 2009	Apra Harbor – CVN Fairway

Legend: COMNAV= Commander Navy Region; CVN= Aircraft Carrier-Nuclear; ERA - Ecological Reserve Area.

11.1.4 Guam Regional Environment

Though the focus of this chapter is on marine biological resources within the nearshore ROI, marine ecosystems are also greatly affected by terrestrial inputs (i.e., stormwater runoff, sediments, etc.) and open ocean currents. A brief introduction of the marine geology, environmental habitats, and biological oceanography from the shore to the open ocean is presented for this region, which comprises the Mariana Islands chain.

Marine Geology

The Mariana Islands are volcanic in nature and thus the overall geology reflects this. Coastlines in the study area are generally lined with rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat. Water erosion of rocky coastlines has produced wave-cut cliffs and sea-level benches (volcanic and limestone) and wave-cut notches at the base of the cliffs. Large blocks and boulders often buttress the foot of these steep cliffs in the Marianas. Wave-cut terraces also occur seaward of the cliffs (Navy 2005).

Physical and Biological Oceanography

The North Equatorial Current, which provides the bulk of water passing the Mariana archipelago, is composed primarily of plankton-poor water; however, detailed information on the North Equatorial Current is lacking. Overall, the upper portions of the water column in the western Pacific is nutrient depleted, which greatly limits the presence of organisms associated with primary productivity, such as phytoplankton. Phytoplankton are single-celled organisms that are similar to plants because they photosynthesize using sunlight and chlorophyll. Phytoplankton are at the base of the marine food chain, and are essential to the overall productivity of the ocean. In regions in which the overall nutrient concentrations are low, the phytoplankton communities are dominated by small nanoplankton and picoplankton. This is true for Guam, as phytoplankton communities in the western Pacific are dominated by cyanobacteria (*Synechococcus spp.*), prochlorophytes, haptophytes, and chlorophytes (Higgins and Mackey 2000).

The available studies on plankton (tiny plants [phytoplankton] and animals [zooplankton]) in the neritic zone (also called the sublittoral zone - part of the ocean extending from the low tide mark to the edge of the photic zone) have centered around Apra Harbor and Piti Reef on Guam. In general, abundance of zooplankton is highly variable with respect to location and time (both throughout the day and month to month) (Navy 2005).

Guam tides are semidiurnal with a mean range of 1.6 ft (0.5 m) and diurnal range of 2.3 ft (0.7 m). Extreme predicted tide range is about 3.5 ft (1.1 m). Surface sea temperatures average close to 80 degrees Fahrenheit (°F) year-round (GEPA 2006).

Intertidal Zone

The intertidal zone is the area between low and high tide marks. Approximate tidal ranges on Guam are from -0.6 ft (-0.2 m) at low, low tide to 2.6 ft (0.8 m) at high, high tide (UoG 2009). The intertidal zone of the shoreline can be divided into three subzones: the high-tide zone, the mid-tide zone, and the low-tide zone. In the high-tide zone, benthic organisms are covered by water only during the highest high tides. Organisms in this zone spend the majority of the day exposed to the atmosphere. In the mid-tide zone, benthic organisms spend approximately half of the time submerged. Organisms residing in this zone are exposed during periods of low tides, but are covered with water during all high tides. Organisms in the low-tide zone are submerged most of the time but may be exposed to the air during the lowest of low tides (Navy 2005).

Coral Communities and Reefs of the Mariana Islands

Coral communities and reefs are dynamic and changing ecosystems subject to natural and human induced disturbances. Natural disturbances that affect coral communities and reefs in the Mariana Islands include storm-related damage caused by frequent typhoons; El Niño-Southern Oscillation (ENSO) events (a coupled ocean-atmosphere phenomenon that has global effects); outbreaks of the crown-of-thorns starfish, a predator of corals; freshwater runoff; recurrent earthquakes; and volcanic activity. Human-induced disturbances on reefs in the Mariana Islands result from upland erosion and offshore sedimentation, polluted runoff (input of nutrients), exposure to warm water (global warming and thermal effluents) leading to bleaching, overfishing, anchor damage, tourism-related impacts, ship groundings, and certain military activities (Abraham et al. 2004, Birkeland 1997, Paulay 2003b).

The Mariana nearshore environment is characterized by extensive coral bottom and coral reef areas. There are fewer hard coral reef-building species and genera in the northern compared to the southern Mariana Islands: 159 species and 43 genera hard coral species in the northern islands versus 256 species

and 56 genera in the southern islands (Randall 2003, Abraham et al. 2004). There is also a greater species diversity of fishes and mollusks (invertebrates) on the southern islands than on the northern islands (Birkeland 1997).

In general, the coral reefs of the Marianas have a lower coral diversity compared to other reefs in the northwestern Pacific (e.g., Palau, Philippines, Australian Great Barrier Reef, southern Japan, Marshall Islands) but a higher diversity than the reefs of Hawaii. Corals reported in Guam are typically found on shallow reefs and upper forereefs (< 245 ft [<75 m] water depth), and deeper forereef habitats (> 245 ft [>75 m] water depth) (Randall 2003).

With respect to Guam, most of the northern part of the island's shorelines are karstic and bordered by limestone cliffs. In a few areas, the shorelines consist of volcanic substrates. On windward shores, reefs are narrow and have steep forereefs. Narrow reef flats or shallow fringing reefs (approximately 325 to 3,250 ft [100 to 1,000 m wide]) are characteristic of leeward and more protected coastlines. Reefs also occur in lagoonal habitats in Apra Harbor. Reef organisms also occur on eroded limestone substrates including submerged caves and crevices, and large limestone blocks fallen from shoreline cliffs (Paulay 2003b).

Natural Disturbances

Coral communities and reefs on the eastern, windward side of the islands are exposed to dominant winds, strong wave action, and storms (including typhoons). Corals found above the 100-ft (30-m) isobath on windward coasts are conditioned to withstand heavy wave action and would recover if damaged. Typhoons can cause substantial damage to corals on windward coasts. Corals in this exposed area of the reef typically include encrusting or massive growth forms as well as columnar, platy and branching growth forms. Exposed windward reef fronts are dominated by three growth forms of *Acropora*: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short, nonanastomosing branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

The disruption of the tradewind pattern during ENSO events has caused sea level to drop in the Mariana Islands and exposed shallow corals and other reef organisms over prolonged periods, which has caused mass mortality (Birkeland 1997). Further, ENSO events have produced unusually high seawater temperatures that may have caused coral bleaching. The bleaching of corals has been recorded in the Marianas since 1994, and some bleaching events have caused coral mortality. In 1994, corals were bleached on all reefs of Guam. While the coral families Pocilloporidae and Acroporidae incurred severe bleaching on Guam during the 1994 event, no stony coral mortality was observed.

The chronic outbreaks and predation of crown-of-thorns starfish on corals reefs have also caused coral mortality. In the forereef zone in sheltered areas, massive corals (*Porites* and *Favia*) that are more resistant but not immune to crown-of-thorns starfish have replaced the corals decimated by crown-of-thorns starfish (Navy 2005).

Other sources of coral mortality and degradation are freshwater runoff and seismic and volcanic activity. Freshwater runoff naturally affects reefs during the rainy season (Navy 2005). No areas are reported within the ROI that are particularly affected by natural sedimentation following heavy rainfall, although two rivers discharge into Inner Apra Harbor, which is a highly turbid area. Areas impacted by heavy sediment laden stormwater outside the ROI include the Ugum River watershed (southeast Guam) and the south coast of Guam (Abraham et al. 2004). Coral reefs within the ROI have been impacted by recurrent seismic activity as recent as 1993 in Guam (Birkeland 1997).

Human-Induced Disturbances

The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution (GEPA 2006). The main source and most serious nonpoint, human-induced impacts on marine communities in and around Guam is erosion and high sediment containing runoff (particularly during storm events in the southern areas) due to increased land clearing and construction of coastal roads, housing, and tourism-related facilities (Paulay 2003b, Abraham et al. 2004). Grading or clearing of land by burning results in significant topsoil loss during heavy rain storms leaving more compact soil behind that makes re-vegetation difficult. Runoff of feedlot waste has also been identified as a nonpoint source of pollution needing mitigation. Urban runoff is one of Guam's most critical nonpoint source problems which impacts both groundwater and coastal waters (GEPA 2006). Sedimentation affects both coral cover and diversity. Sedimentation-impacted sites can further be degraded by the compounding effects of overfishing of herbivorous fishes and crown-of-thorns starfish (Abraham et al. 2004). Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam and has a significant anthropogenic (human-induced) impact on corals. See Volume 6, Section 13.2.4 for detailed discussion on nutrient impacts to coral and Volume 2, Section 4.1.1.4 for nearshore water quality discussion.

Estuarine Habitat

Estuarine habitats on Guam, include lagoons, embayments, and river mouths. They occur in areas of tidal intrusion or brackish water, and consist primarily of mangroves and the lower channels of rivers that are inundated by tides ranging from 30 to 35 inches (in) (75 to 90 centimeters [cm]) in amplitude. Nine of Guam's 46 rivers that empty into the ocean have true estuarine habitats with elevated salinity levels extending upstream (Scott 1993). Guam contains numerous relatively shallow lagoons (depths ranging from 3 to 50 ft [1 to 15 m]). The bottoms of the lagoons are mostly sandy and flat or undulatory (wavy in appearance). Coral rubble, coral mounds (patch reefs), seagrass, and algae are found within the lagoons. Coral mounds tend to be more abundant in the outer lagoons and are widely scattered or absent in the inner lagoons (NOAA 2005a, Navy 2005).

Seagrass Beds

Tropical seagrass meadows typically occur in most shallow, sheltered soft-bottomed marine coastlines and estuaries. Barrier reefs protect coastlines, and the lagoon formed between the reef and the mainland is protected from waves, allowing mangrove and seagrass communities to develop. Tropical seagrasses are also important in their interactions with mangroves and coral reefs. Seagrasses trap sediment and slow water movement, causing suspended sediment to fall out. This trapping of sediment benefits coral by reducing sediment loads in the water. All these systems exert a stabilizing effect on the environment, resulting in important physical and biological support for the other communities. Seagrasses are unique amongst flowering plants in that all but one genus can live entirely immersed in seawater. Ten species are reported from Micronesia. Seagrasses provide a sheltered, nutrient-rich habitat for a diverse range of flora and fauna, including higher vertebrates such as dugongs and green sea turtles. A concise summary of the seagrass species found in the western tropical South Pacific is given by Coles and Kuo (1995).

From the fisheries perspective, the fishes and other organisms harvested from the coral reef and associated habitats, such as mangroves, seagrass beds, shallow lagoons, bays, inlets and harbors, and the reef slope beyond the limit of coral reef growth, contribute to the total yield from coral reef-associated fisheries (Navy 2005).

Mangrove Forests

Mangrove forests are a type of wetland located on the border of estuaries and shores protecting them from the open ocean (Scott 1993). They are composed of salt-tolerant trees and other plant species and they provide essential habitat for both marine and terrestrial life. Mangroves possess large roots that spread laterally and consolidate sediments, eventually transforming local mudflats into dry land. Species diversity is usually high in mangroves, and like seagrasses, they can act as a filter to remove sediments before they can be transported onto an adjacent coral reef. The extensive root system and nutrient rich waters found in mangroves make them among the richest of nursery grounds for marine life, including peneaeid shrimps, inshore fish species, and some commercially important crustaceans (Scott 1993, Myers 1999, Navy 2005, WPRFMC 2005).

Mangrove forests are native to the Marianas, though they are only present on the islands of Guam and Saipan, with the mangroves of Guam being the most extensive and diverse, totaling approximately 173 acres (ac) (70 hectares [ha]) (Navy 2005). There are 125.3 ac (51 ha) of mangrove forests on 10 sites within Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of Apra Inner Harbor (Navy 2005). Mangroves/wetlands are discussed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

11.1.4.1 Marine Flora, Invertebrates and Associated EFH

Algae (seaweeds) occupy a wide range of habitats including but not limited to: sandy bottoms of lagoons; shallow, calm fringing reefs; barrier reef coral bottoms; outer reef flats; and the outer reef slope. Coralline algae are of primary importance in constructing algal ridges that are characteristic of exposed Indo-Pacific reefs preventing oceanic waves from eroding coastal areas (WPFMC 2001). Over 237 species of algae or seaweed (blue-green, green, brown, and red) occur on Guam (Lobban and Tsuda 2003). Green, brown, and red algae are commonly harvested for sale at local markets or used as bait for rod and reel fishing on Guam (Navy 2005). Since algae are direct contributors to the well-being and protection of fish species, both as a source of food and protection to larvae and small fish species, algae has a EFH designation and is managed as part of the potentially harvested coral reef taxa (PHCRT) by WPFMC (WPFMC 2005).

Seagrass beds cover approximately 917 ac (371 ha) of reef flats in several coastal bays around Guam (WPFMC 2005). Three species found there include *Halodule uninervis*, *Enhalus acoroides*, and *Halophila minor* (Lobban and Tsuda 2003). These beds are used as foraging grounds by sea turtles and are an important nursery area for a number of economically important reef fish species including but not limited to emperors, scads, wrasses and goatfish (GDAWR 2006).

Sponges in the Marianas have a considerable variation in the distribution and composition among neighboring reefs and islands. Their diversity is greatest, regardless of depth, on coral reefs, in caves and vertical areas not colonized by hard corals. They are also abundant in seagrass beds, mangroves, and other environments, providing residence for a huge variety of animal including crustaceans, annelids and echinoderms among others. Over 120 sponge species have been reported from Guam (and CNMI), have EFH designations, and are managed as part of the PHCRT (WPFMC 2005).

Guam supports biogenic (produced by a living organism) or hermatypic (reef-building) coral reefs. The degree of reef development depends on a number of environmental controls, including the age of the islands, volcanic activity, the availability of favorable substrates and habitats, weathering caused by groundwater discharge, sedimentation and runoff accentuated by the overgrazing of feral animals, and varying levels of exposure to wave action, trade winds, and storms (Navy 2005). Guam is almost entirely surrounded by fringing reefs, is entirely surrounded by forereefs, and has barrier reefs at Apra Harbor

(Luminao Barrier Reef at the western end of Guam) and Cocos Lagoon (southern end of Guam) (Eldredge 2003a, Navy 2005). The fringing reef is interrupted at several locations along the coastline by bays, channels, and areas where the insular shelf is colonized by seagrass. Along the northern coast of the island between Achae Point and the Ritidian Channel, the fringing reef and forereef area transitions from a relatively wide swath of coral (less than 820 ft [250 m] wide) to an area populated by turf algae (approximately 650 to 1,650 ft [200 to 500 m] wide) (NOAA 2005a).

Figures 11.1-1 and 11.1-2 show an overview of sensitive marine biological resources, including benthic habitats associated with the study areas. These habitats are based on National Oceanic and Atmospheric Administration (NOAA) (2005a) Environmental Sensitivity Index (ESI) Mapping, supplemented by the Guam Coastal Atlas (NOAA 2005b) and may include if present:

- Coral Reef and colonized hardbottom, which are broken into two density categories.
 - Lower Density Live Coral Cover (Sparse cover: 10% - <50%).
 - Higher Density Live Coral Cover (Patchy: 50% - <90% and Continuous: 90%-100%).
- Coralline Algae (one category).
 - Sparse (10% - <50%), patchy (50% - 90%), and continuous (90% - 100%) combined.
- Macroalgae, Turf Algae, and Seagrass (one separate category each).
 - All coverage percentages combined (sparse, patchy, and continuous) combined.
- Turf Algae (one category).
 - All coverage percentages (sparse, patchy, and continuous) combined.
- Seagrass (one category).
 - All coverage percentages (sparse, patchy, and continuous) combined.
- Unconsolidated Sediment, usually sand or mud, uncolonized 90-100%

Reefs in the southern half of Guam have always been subject to more naturally-occurring sedimentation than in the northern half of the island because of the lack of surface water associated with the porous limestone substrate and soil type in the north versus the volcanic substrate in the south. Coral cover and diversity are currently higher on reefs located along the northeastern coast of Guam. Historical surveys suggest that diversity was actually higher in the south before anthropogenic impacts severely impacted those reefs (Navy 2005). The NOAA ESI Map (2005a) and Guam Coastal Atlas (NOAA 2005b), produced from surveys of shallow water benthic habitats of Guam show that the overall coral cover around Guam ranges from 10 to 90%. Most of the reefs surrounding Guam have a coral cover ranging from 10 to 50%.

Natural and anthropogenic disturbances affecting the reefs of Guam have caused a significant decline of coral cover and recruitment since the 1960s. Coral cover on many forereef slopes on Guam has decreased from over 50% to less than 25% (Birkeland 1997). There are, however, several reefs of Guam where coral cover remains high, including reefs in Apra Harbor, Agat Bay, Orote Point Ecological Reserve Area (ERA), and Haputo ERA (Navy 2005).

11.1.4.2 Essential Fish Habitat

The 1996 amendments to the M-SA set forth a mandate for NMFS, Regional Fisheries Management Councils, and other federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. To protect EFH in accordance with the law, suitable fishery habitats must be maintained. Guam is within the jurisdiction of the WPRFMC, which has designated the marine waters around Guam as EFH, and adopted a precautionary approach to EFH designation due to the lack of scientific data (COMNAV Marianas 2007a).

EFH for CREMUS covers all the waters and habitats at depths from the sea surface to 328 ft (100 m) extending from the shoreline (including state and territorial lands and waters) to the outer boundary of the exclusive economic zone (EEZ). This broad EFH designation ensures that enough habitat is protected to sustain managed species. In addition to EFH, the WPRFMC also identified Habitat Areas of Particular Concern (HAPC) for CREMUS. Within the EFH, HAPC are specific areas that are essential to the life cycle of important coral reef species. At least one or more of the following criteria established by NMFS must be met for HAPC designation: (1) the ecological function provided by the habitat is important; (2) the habitat is sensitive to human-induced environmental degradation; (3) development activities are, or would be, stressing the habitat type; or (4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth criterion, not established by NMFS, in HAPC designation of areas that are already protected, such as wildlife refuges (WPRFMC 2005).

As described earlier, the WPRFMC currently manages fisheries in the Western Pacific under five FMPs: (1) coral reef ecosystems (2) bottomfish and seamount groundfish, (3) crustaceans, (4) precious corals, and (5) pelagic species. Each of these FMPs identifies areas of EFH and HAPC for different life stages of species managed under the respective plan. There is no designated EFH or HAPC for precious corals or seamount groundfish around Guam, but other designations do apply (COMNAV Marianas 2007a). The preferred alternative in the next FEP amendment would add *Heterocarpus spp.* as a deepwater shrimp MUS.

EFH habitats include mangrove, estuarine, seagrass beds, soft substrate, coral reef/hard substrate, patch reefs, surge zone, deep-slope terraces, and pelagic/open ocean and can be viewed in relation to the species specific life stages in the FEP for Mariana Archipelago (WPRFMC 2005). Specific EFH habitats occurring in waters within the study areas that are described within the text or depicted on figures include the following:

- *Intertidal Zones.* This habitat includes a small margin of seabed existing between the highest and lowest extent of the tides extending around Guam and is present in all ROI.
- *Seagrass Beds.* Seagrass beds occur in patches within Outer and Inner Apra Harbor and other isolated areas around Guam (e.g., Agat Bay).
- *Macroalgae.* Located within most habitats associated with the ROI and around Guam.
- *Mangrove Forests/Wetlands.* These forests are located in the intertidal zone along the coast of Outer and Inner Apra Harbor.
- *Coral Reefs and Colonized Hardbottom.* Coral reefs are located along the coast of the ROI, on shoals (Big Blue Reef, Western Shoals, Middle Shoals, and Jade Shoals) and the coasts of Outer and Inner Apra Harbor.
- *Estuarine Water Column.* Includes the open water areas within Sasa Bay and river mouth areas.
- *Marine Water Column.* Many managed species occur in this habitat and rely on this for development, dispersal, or feeding.
- *Unconsolidated Bottom.* This includes benthic substrates along the coast or within Apra Harbor such as clay and silt, sand, gravel, rubble and boulders.

EFH or HAPC occur in throughout the ROI. The geographic extent of the habitat types varies, but are generally a key portion of each Alternative if discussed.

Table 11.1-3 and Figure 11.1-3 summarize and portray the EFH and HAPC designations for Guam. Each of the FMPs in Table 11.1-3 has an associated figure listed in the right column that illustrate them.

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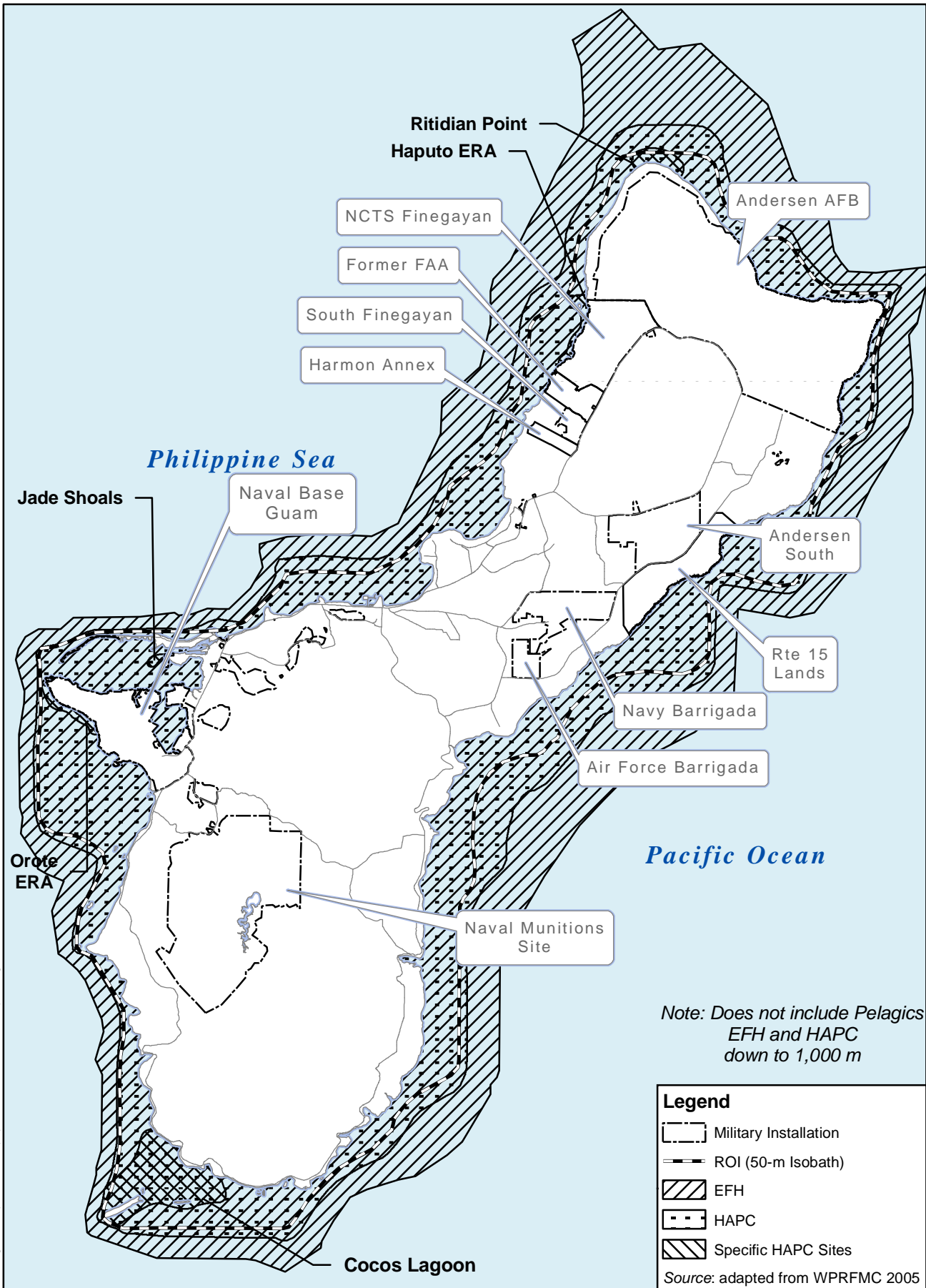


Figure 11.1-3
EFH, HAPC, and Specific HAPC Sites Designated within Guam Waters

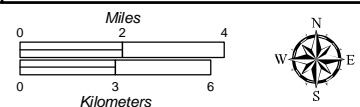


Table 11.1-3. Guam EFH and HAPC

<i>FMP</i>	<i>EFH</i> (<i>Juveniles and Adults</i>)	<i>EFH</i> (<i>Eggs and Larvae</i>)	<i>HAPC</i>	<i>Figure</i>
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 328 ft (100 m)	Water column and benthic substrate to a depth of 328 ft (100 m)	All marine protected areas identified in an FMP, all PRIAs, many specific areas of coral reef habitat (see FMP)	11.1-4
Bottomfish	Bottomfish: Water column and bottom habitat down to 400 m	Bottomfish: Water column down to 1,312 ft (400 m)	Bottomfish: All escarpments and slopes between 130 – 920 ft (40-280 m)	11.1-5
Crustaceans	Bottom habitat from shoreline to a depth of 328 ft (100 m)	Water column down to 490 ft (150 m)	None	11.1-6
Pelagics	Water column down to 3,280 ft (1,000 m)	Water column down to 655 ft (200 m)	Water column above seamounts and banks down to 3,280 ft (1,000 m)	11.1-7

Note: All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.

Source: WPRFMC 2005.

EFH for at least one life stage of a managed species group extends from the shoreline to the outer extent of the EEZ from the surface to a water depth of 3,280 ft (1,000 m) and includes bottom habitat to a depth of 1,312 ft. (400 m).

HAPC within submerged lands around Guam includes seamounts and banks to depths of 3,280 ft (1,000 m), escarpments and slopes between 130 and 920 ft (40 and 280 m), bottom habitat down to depths of 328 ft (100 m) and specific areas around Ritidian Point, Haputo ERA, Jade Shoals in Apra Harbor, and Orote ERA.

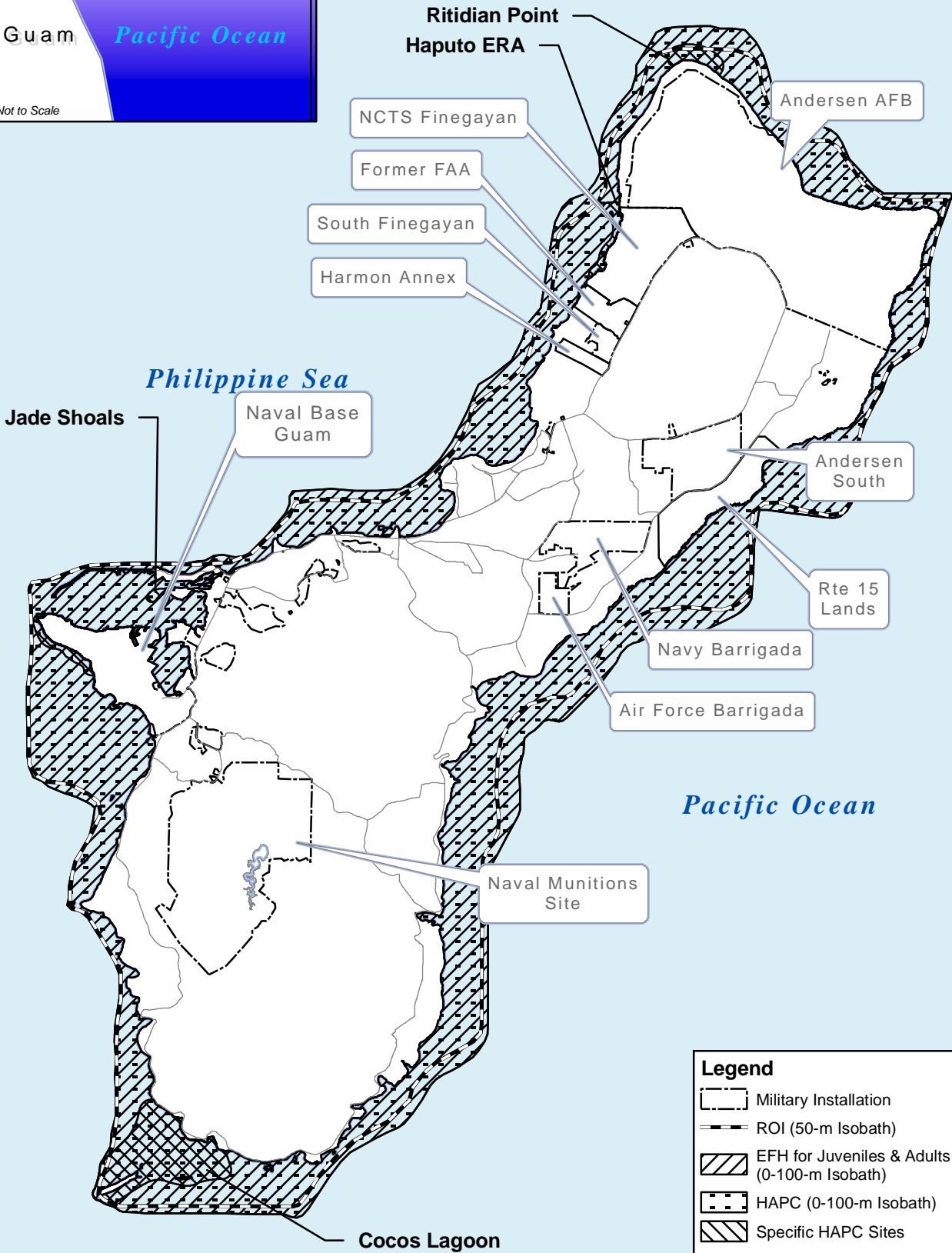
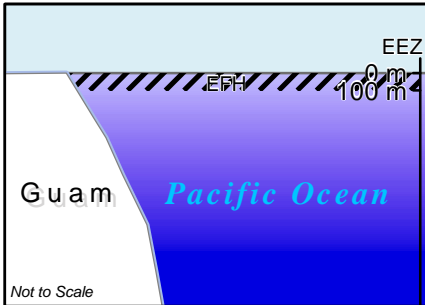
EFH life stage, status, and life history for each of these management units are summarized below. See the FEP for Mariana Archipelago [WPRFMC 2005] for a detailed listing of all FMP MUS.

Coral Reef Ecosystem Management Unit Species (CREMUS)

In designating EFH for CREMUS, the WPRFMC-linked MUS to specific habitat “composites” (e.g., sand, live coral, seagrass beds, mangrove, open ocean) for each life history stage, consistent with the depth of the ecosystem.

For several of the major coral reef associated species, very little is known about the life histories, habitat utilization patterns, food habits, or spawning behavior of most coral reef associated species. For this reason, the WPRFMC, through the CRE-FMP, designated EFH using a two-tiered approach based on the divisions of MUS into the currently harvested coral reef taxa (CHCRT) (this also includes likely targeted species in the near future) and PHCRT categories (WPRFMC 2005).

In the first tier, EFH has been identified for various life stages and juvenile and adult life stages of CHCRT and includes the water column and all benthic substrate to a depth of 328 ft (100 m) from the shoreline to the outer limit of the EEZ (Figure 11.1-4). HAPC for important coral reef species includes all no-take marine protected areas identified in the CRE-FMP, all Pacific remote islands, and numerous other existing marine protected areas, research sites, and coral reef habitats throughout the western Pacific (WPRFMC 2005).

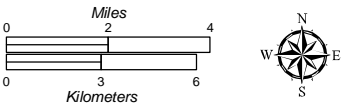


Legend

- Military Installation
- ROI (50-m Isobath)
- EFH for Juveniles & Adults (0-100-m Isobath)
- HAPC (0-100-m Isobath)
- Specific HAPC Sites

Source: adapted from WPRFMC 2005

Figure 11.1-4
EFH and HAPC Designated within Guam Waters for Various Life Stages of CHCRT and PHCRT



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HAPC for all life stages of the CREMUS includes all hardbottom substrate between 0 and 328 ft (100 m) depth in the study area. Five individual HAPC sites (see Figure 11.1-4) have been identified for the island of Guam:

- Jade Shoals, which occurs within Apra Harbor
- Orote Point ERA, which lies immediately outside of Apra Harbor
- Ritidian Point, located in northern Guam, along the shoreline of Andersen AFB
- Haputo ERA, in northwestern Guam along the shoreline of NCTS Finegayan
- Cocos Lagoon, southern Guam

CHCRT include surgeonfishes and unicornfishes, triggerfishes, jacks/scads, sharks soldierfishes and squirrelfishes, flagtails, rudderfishes, wrasses, goatfishes, octopuses, mullets, moray eels, threadfins, bigeyes, parrotfishes, rabbitfishes, tuna/mackerel, barracudas, turban shells, and aquarium species/taxa.

EFH has also been designated for the second tier, PHCRT, and includes literally thousands of species encompassing almost all coral reef flora and fauna. An example of some of these PHCRT MUS/taxa are additional fish MUS/taxa, hard and soft corals, anemones, zooanthids, sponges, hydrozoans, bryozoans, tunicates, feather duster worms, sea cucumbers/urchins, mollusks, sea snails/slugs, other bivalves, other lobsters and crabs, shrimp/mantis, annelids, algae, and live rock (WPFMC 2005).

The two NOAA-designated fish SOC (also MUS under the CHCRT), and two potentially sensitive MUS are briefly described below and in Figure 11.1-4. Factors contributing to their decline and additional information on these species are included in Volume 9, Appendix G.

Napoleon Wrasse

The Napoleon wrasse is the largest species of the Labridae family, with the males exceeding 6 ft (2 m) in length and 420 pounds (lbs) [190 kilograms {kg}] (Sadovy et al. 2003). Females rarely exceed 3 ft (1 m) in length (Choat et al. 2006). This species is slow-growing and long-lived, with delayed reproduction, and consequently, low stock replenishment rates. Individuals become sexually mature at 5 to 7 years old and can live at least 30 years (Choat et al. 2006). Its generation time is expected to be in excess of 10 years. They primarily eat mollusks, fish, sea urchins, crustaceans, and other invertebrates and are one of the few predators of toxic animals such as sea hares, boxfishes and crown-of-thorns starfish (NMFS 2009b).

This species is believed to be uncommon to rare wherever it occurs, and natural densities are never high even in preferred habitats. Once an economically important species in Guam, it is now rarely seen on reefs there, and is infrequently reported on inshore survey catch results.

Humphead Parrotfish

The humphead parrotfish is the largest of all parrotfishes, growing to 4 ft (1.2 m) in length and 100 lbs (46 kg) in weight. This species is slow growing, with delayed reproduction and low replenishment rates, and may live to 40 years of age (NMFS 2009b). Humphead parrotfish primarily eat coral, but also eat benthic algae. The humphead parrotfish has a very wide range, but population sizes have been declining due to overfishing. Additionally, their slow growth and delayed reproduction make them susceptible to stressors (Donaldson and Dulvy 2004). The species has nearly disappeared from Guam's reefs (NMFS 2009b).

Potentially-Sensitive CREMUS in the EFH of Guam

Two other EFH fish species are addressed in this EIS/OEIS: the adult bigeye scad, a CHCRT MUS, is identified in seasonally high concentrations (June – December) at two locations within Apra Harbor; and the scalloped hammerhead shark, a PHCRT MUS, is found during seasonal spawning at one location (NOAA 2005a). Both of these species' locations are in proximity to the proposed action and alternatives within Apra Harbor and are addressed further in that section. Additionally, a “sessile benthic” PHCRT MUS, mainly addressing hard corals (although it includes algae, sponges, hard and soft corals, etc.) within the study area is discussed throughout this EIS/OEIS and in further detail in Volume 4, Chapter 11 (Table 11.1-4).

Table 11.1-4. Sensitive MUS present in the EFH of Guam

Group	Common Name / Chamorro Name	Status*	
		Federal	Guam
Coral Reef Ecosystem - Fishery Management Plan (CRE-FMP)			
Fish MUS	Napoleon wrasse / Tanguisson	CHCRT and SOC	SOGCN
	humphead parrotfish / Atuhong	CHCRT and SOC	SOGCN
	Bigeye scad / Atulai	CHCRT	SOGCN
	Scalloped hammerhead / halu'u (general term)	PHCRT	SOGCN
Sessile Benthic MUS**	Hard coral / cho' cho'	PHCRT	SOGCN

Legend: SOC = NOAA Species of Concern; EFH; SOGCN = Species of Greatest Conservation Need.

Notes: ** includes algae, sponges, hard and soft corals, etc. Only a hard coral example is given for the table and is the main focus of this EIS/OEIS (WPRFMC 2005).

Sources: NOAA 2005a, WPRFMC 2005, GDAWR 2006, USFWS 2009.

Bigeye Scad

The bigeye scad or atulai can be found off the coast of Guam year-round, but is scarce in July and August, which may be due to spawning activities. This species tends to spawn in the pelagic environment in large aggregations. Larvae and juveniles remain offshore for the first several months, then migrate to the nearshore habitat (refer to Figure 11.1-2). Small schools are typically found inshore or in shallow water and occasionally over shallow reefs in turbid water. Large schools of atulai appear seasonally in Guam from August to November in shallow sandy lagoons, bays, and channels (Navy 2005).

This species is an economically important food fish and a small seasonal fishery is present in Guam (WPRFMC 2005). Atulai reach a size of 15 in (38 cm), but are rarely more than 10 in (25 cm) at Guam. On moonless nights, atulai beyond the reef, can be attracted to lights set in the water beneath fishing boats and caught with hook and line. When inshore, atulai are harvested by nets and hook and line during the daytime. Sometimes a large net is set across an entire bay to trap the atulai. A large group of people help close the net and harvest the atulai. Several thousand pounds can be harvested this way. Atulai may also move between islands or island groups since they are not always present near Guam. Little is known of these offshore movements (GDAWR 2009).

Scalloped Hammerhead

Scalloped hammerheads are found in a wide variety of coral reef habitats. They are very active swimmers, occurring in pairs, schools, or solitary, ranging from the surface, surfline, and intertidal region down to at least 900 ft (275 m) (Compagno 1984). Juveniles often occur in schools inhabiting inshore areas such as bays, seagrass beds, and lagoon flats, foraging near the bottom before moving into deeper waters as adults (WPRFMC 2005). As adults they can be found in shallow inshore areas during mating or birthing events (Compagno 1984). The scalloped hammerhead produces an offspring of 15 to 31 pups per litter and utilizes shallow, turbid coastal waters (e.g., Guam's Inner Apra Harbor) as nursery areas (refer to

Figure 11.1-2). The pups may remain in these shallow areas for several months, then venture to coastal waters (Compagno 1984, Myers 1999). The scalloped hammerhead is reported to spawn in January through March outside the Inner Apra Harbor Entrance Channel (NOAA 2005a), although their occurrence is reported as extremely rare (personal communication with Steve Smith, [Navy 2009c]).

Sessile Benthic MUS

In general, the Haputo ERA and Outer Apra Harbor (two of the three study areas addressed in this chapter) are vibrant thriving coral reef communities with a diverse biota of algae, invertebrates and fish. Both locations have well-developed coral reefs containing some of the highest coral cover on Guam (Paulay et al. 1997, Amesbury et al. 2001) (refer to Figures 11.1-1 and 11.1-2). In addition, the Haputo ERA and Jade Shoals of Apra Harbor are identified as Specific HAPC sites, which are defined as “areas that are essential to the life cycle of important coral reef species” (WPFMC 2005). More detailed information regarding the sessile benthic community at these two locations and the sensitivity of the coral reef community is described within the site-specific sections.

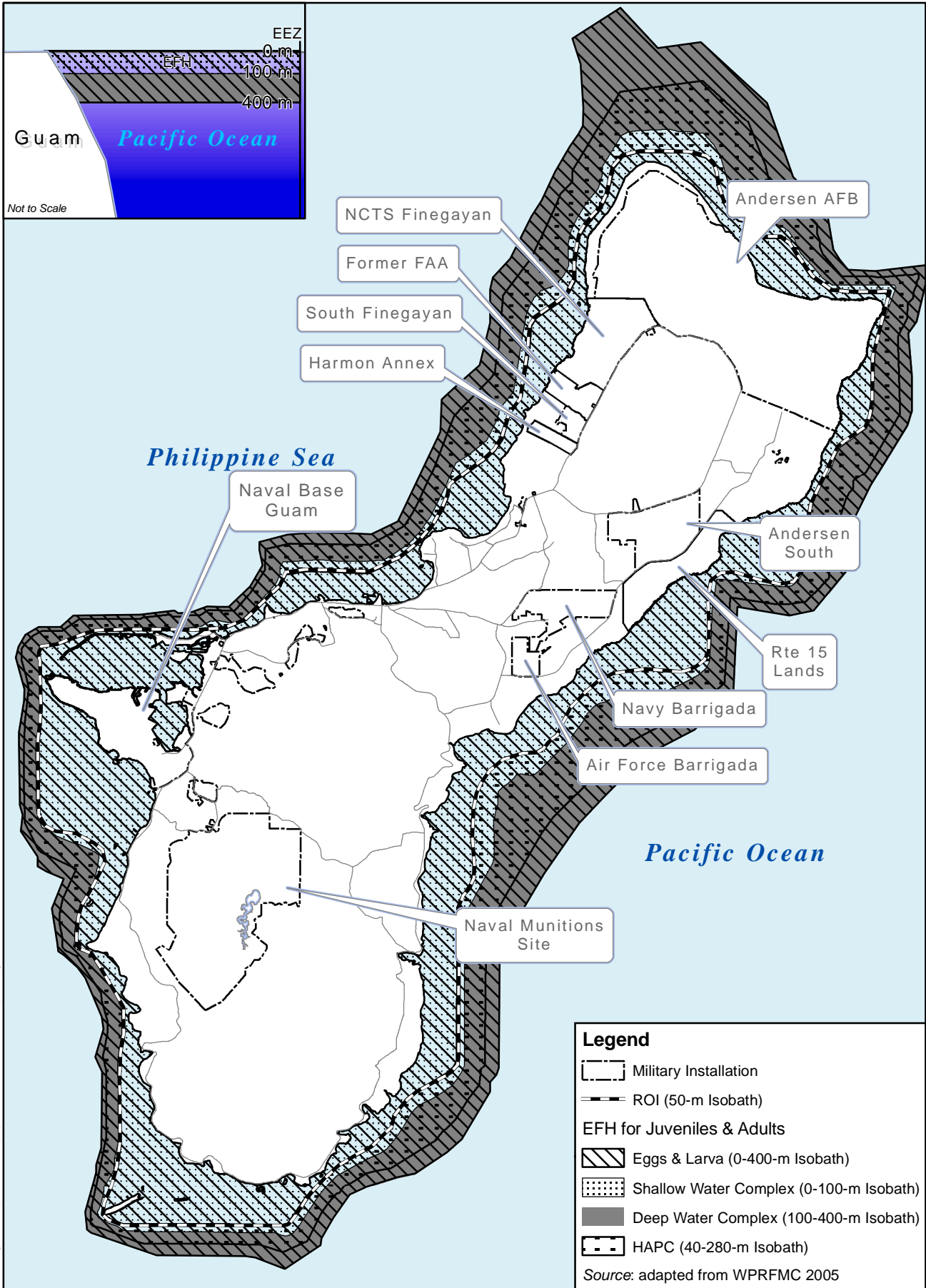
Bottomfish Management Unit Species (BMUS)

EFH for egg and larval life stages includes the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 1,310 ft (400 m) and encompasses both the shallow-water (0 to 328 ft [100 m]) and deep-water complexes (328 to 1310 ft [100 to 400 m]) (COMNAV Marianas 2007a). EFH for juvenile and adult life stages encompasses the water column and all bottom habitat extending from the shoreline to a depth of 1,310 ft (400 m) and includes the shallow-water and deep-water complexes (WPFMC 2005). All life stages of the BMUS have HAPC designated in the ROI that includes all slopes and escarpments between 131 and 920 ft (40 and 280 m) (Figure 11.1-5) (Navy 2005, WPFMC 2005).

There are currently 16 BMUS in the Mariana Archipelago FEP managed by the WPRFMC. In Guam, the BMUS is divided into a shallow-water complex and a deep-water complex based on depth and species composition. The juvenile and adult deep-water complex is outside the ROI, therefore would not be addressed in this document. All species have viable recreational, subsistence, and commercial fisheries with none of the BMUS approaching an overfished condition (WPRFMC 2005).

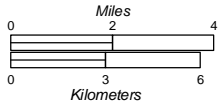
The shallow-water complex is distributed throughout the tropical and subtropical waters of the insular and coral reef-bordered coastal areas of the Pacific Islands (Myers and Donaldson 2003). The proxy used to calculate how much bottomfish habitat is available (comprising the shallow-water and deep-water complexes) is the length of the 100-fathom contour (183-m contour) (index of bottomfish habitat) that surrounds Guam and the CNMI (WPRFMC 2005). Juvenile and adult bottomfish are typically found in habitats characterized by a mixture of sandy bottoms and rocky areas of high structural complexity (WPRFMC 2005). Habitats encompassing the shallow-water complex includes various habitats such as: mangrove swamps; seagrass beds; shallow lagoons; hard, flat coarse sandy bottoms; coral and rocky substrate; sandy inshore reef flats; and deep channels (WPFMC 2005).

Within the shallow-water complex, snappers form large aggregations and groupers/jacks occur in pairs within large aggregations near areas of prominent relief. Spawning coincides with lunar periodicity corresponding with new/full moon events (Amesbury and Myers 2001). Groupers have been shown to undergo small, localized migrations of several kilometers to spawn. Large jacks are highly mobile, wide-ranging predators that inhabit the open waters above the reef or swim in upper levels of the open sea (Navy 2005).



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Figure 11.1-5
EFH Designated within Guam Waters for Egg, Larval, Juvenile, and Adult Life Stages of Bottomfish



Crustacean Management Unit Species (CMUS)

EFH for the larvae life stages is the water column from the shoreline to the outer limit of the EEZ down to a depth of 492 ft (150 m). All bottom habitat from the shoreline to a depth of 328 ft (100 m) is designated as EFH for juveniles and adults (Figure 11.1-6). No HAPC is designated for Guam waters.

Four CMUS, three lobster and one crab are currently in the Mariana Archipelago FEP, specifically, spiny and slipper lobsters, and Kona crab (WPRFMC 2005). There are 839 species of crustaceans in the Marianas and 13 species of spiny lobster that occur in the tropical and subtropical Pacific between 35 degrees North and 35 degrees South (WPRFMC 2005). Of the five species of spiny lobsters that occur within the Marianas, *Panulirus penicillatus* is the most common (Paulay 2003b, WPRFMC 2005).

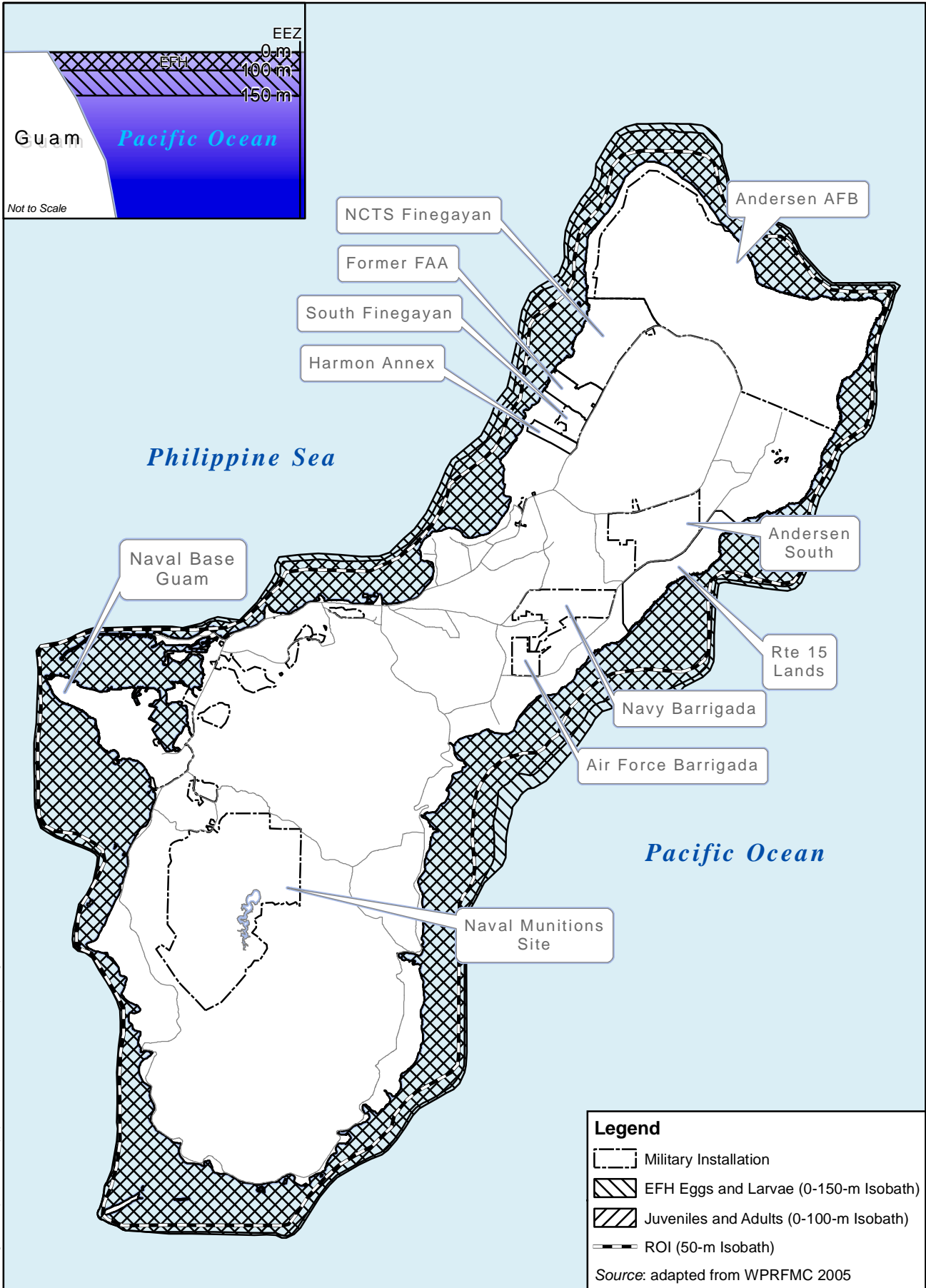
In general, adults of the CMUS prefer sheltered areas with rocky substrates and/or sandy bottoms. There is a lack of published data pertaining to the preferred depth distribution of decapod (invertebrate animal with 10 legs [e.g., lobsters, crabs and shrimp]) larvae and juveniles in this region (WPRFMC 2005). Spiny lobsters are mainly found in windward surf zones of oceanic reefs but some are also found on sheltered reefs (Pitcher 1993). Adult spiny lobsters are typically found on rocky substrate in well-protected areas, such as crevices and under rocks (Holthuis 1991, Pitcher 1993). Some species of spiny lobsters prefer depths less than 33 ft (10 m) while others are found to depths of around 360 ft (110 m) (Holthuis 1991, Pitcher 1993, WPRFMC 2005). Small juvenile spiny lobsters are found only in the same habitat as larger individuals (Pitcher 1993). The depth distribution of the Chinese slipper lobster is 0 to 33 ft (10 m) and some are taken as incidental catch in the spiny lobster fishery (Polovina 1993). Slipper lobsters prefer to live in coral or stone reefs with a sandy bottom (Holthuis 1991).

Decapods exhibit a wide range of feeding behaviors, but most combine nocturnal predation with scavenging; large invertebrates are the typical prey items. Both lobsters and crabs are ovigerous—the females carry fertilized eggs on the outside of their body. The relationships between egg production, larval settlement, and stock recruitment are poorly understood. Spiny lobsters produce eggs in summer and fall. The larvae have a pelagic phase lasting about one year and can be transported up to 2,300 miles (mi) (3,700 kilometers [km]) by prevailing ocean currents (WPRFMC 2005). Spiny lobsters are nocturnal, hiding during the daytime in crevices in rocks and coral reefs. At night, this lobster moves up through the surge channels to forage on the reef crest and reef flat (Pitcher 1993).

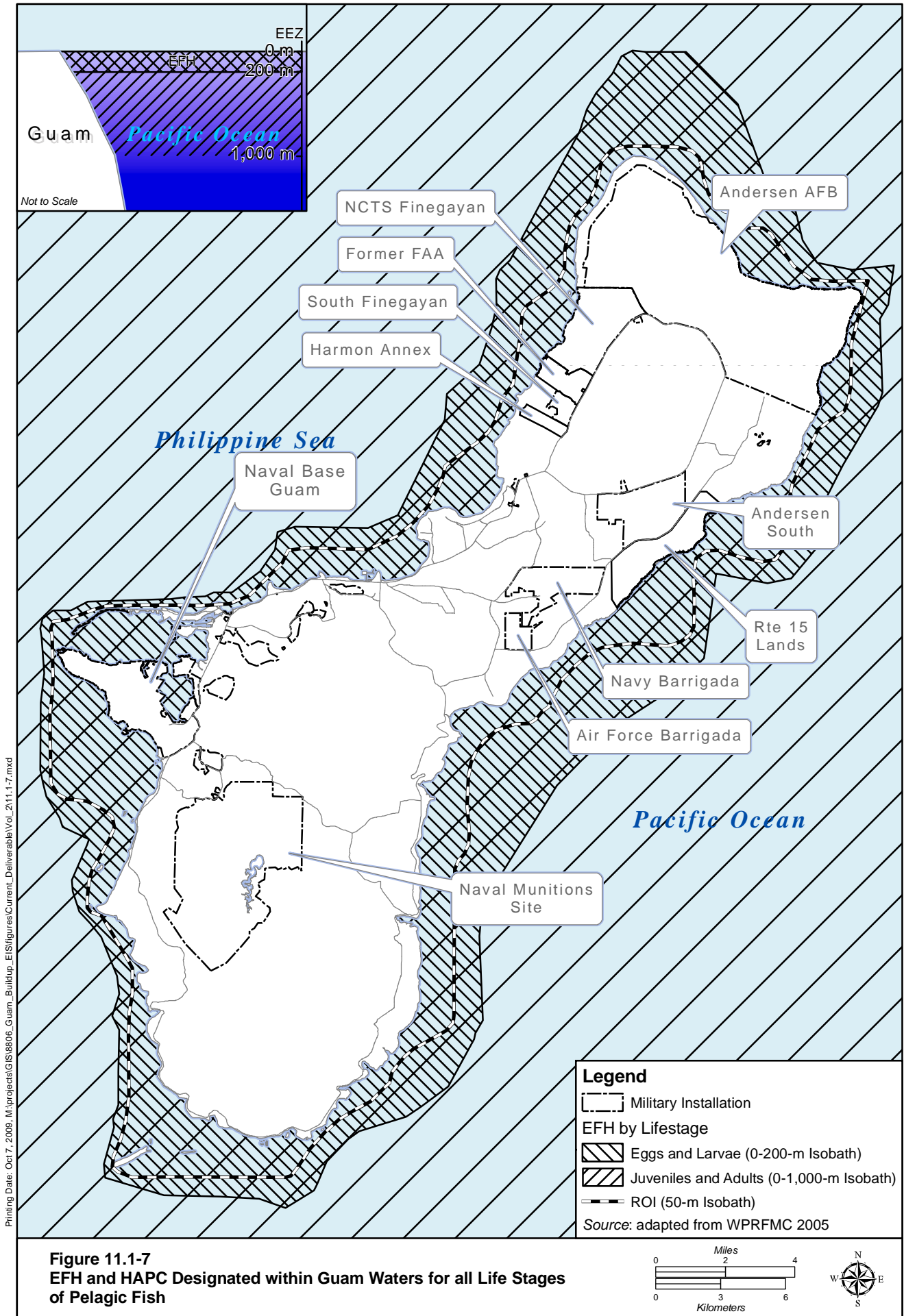
Pelagic Management Unit Species (PMUS)

EFH for the egg and larval stages includes the water column down to a depth of 655 ft (200 m) from the shoreline to the outer limit of the EEZ. EFH for juveniles and adults includes the water column down to a depth of 3,280 (1,000 m) from the shoreline to the outer limit of the EEZ. All life stages of the PMUS have HAPC designated and that includes the entire water column to a depth of 3,280 ft (1,000 m) above all seamounts and banks with summits shallower than 6,560 ft (2,000 m) within the EEZ (Figure 11.1-7) (Navy 2005).

Although certain pelagic MUS are known to occur within the boundary of the Mariana Archipelago FEP, they are currently managed under a separate Pacific Pelagic FEP. Thirty-three species are currently managed as PMUS by the WPRFMC through the FMP for the Pelagic Fisheries of the Western Pacific Region (Navy 2005, WPRFMC 2005). PMUS are divided into the following species complex designations: marketable species, non-marketable species, and sharks. The designation of these complexes is based on the ecological relationships among the species and their preferred habitats (Navy 2005). The marketable species complex has been further divided into temperate and tropical assemblages.



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The temperate species complex includes those PMUS that are found in greater abundance outside tropical waters at higher latitudes (e.g., broadbill swordfish, bigeye tuna, northern bluefin tuna, and albacore tuna) (Navy 2005, WPRFMC 2005).

PMUS are typically found in epipelagic (upper ocean zone or the surface to 720 ft [220 m]) to pelagic (open-ocean zone) waters; however, shark species can be found in inshore benthic, neritic (shallow coastal) to epipelagic, and mesopelagic (intermediate ocean depths) waters. Factors such as gradients in temperature, oxygen, or salinity can affect the suitability of a habitat for pelagic fishes. Skipjack tuna, yellowfin tuna, and Indo-Pacific blue marlin prefer warm surface layers, where the water is well mixed and relatively uniform in temperature. Species such as albacore tuna, bigeye tuna, striped marlin, and broadbill swordfish, prefer cooler temperate waters associated with higher latitudes and greater depths. Certain species, such as broadbill swordfish and bigeye tuna are known to aggregate near the surface at night. However, during the day broadbill swordfish can be found at depths of 2,620 ft (800 m) and bigeye tuna around 900 to 1,800 ft (275 to 550 m). Juvenile albacore tuna generally concentrate above 295 ft (90 m) with adults found in deeper waters (295 to 900 ft [90 to 275 m]) (Navy 2005, WPFMC 2005).

Migration and life history patterns of most PMUS in the Pacific Ocean are poorly understood. Additionally, very little is known about the distribution and habitat requirements of the juvenile lifestages of tuna and billfish prior to recruitment into fisheries. Seasonal movements of cooler-water tunas such as the northern bluefin and albacore are more predictable and better defined than billfish migrations. Tuna and related species tend to move toward the poles during the warmer months and return to the equator during cooler months. Most pelagic species make daily vertical migrations, inhabiting surface waters at night and deeper waters during the day. Spawning of pelagic species generally occurs in tropical waters, but may occur in temperate waters during warmer months (Navy 2005, WPFMC 2005).

Guam Fishery Distribution and Abundance and Composition

Distribution and abundance of fishery species depends greatly on the physical and biological factors associated with the ecosystem, as well as the individual species. Physical parameters include habitat quality variables such as salinity, temperature, dissolved oxygen, and large-scale environmental perturbations (e.g., ENSO). Biological factors affecting distribution are complex and include variables such as population dynamics, predator/prey oscillations, seasonal movements, reproductive/life cycles, and recruitment success. Rarely is one factor responsible for the distribution of a species; usually it is a combination of factors. For example, pelagic species optimize their growth, reproduction and survival by tracking gradients of temperature, oxygen, or salinity (Helfman et al. 1999). Additionally, the spatial distribution of food resources is variable and changes with prevailing physical habitat parameters. Another major component in understanding species distribution is the location of highly productive regions such as frontal zones. These areas concentrate higher trophic-level predators such as tuna and provide visual clues for the location of target species for commercial fisheries (NMFS PIR 2001).

Coral reef communities surrounding Guam are typically uniform and stable year-round. However, there are exceptions, as seasonal variations in pelagic species distributions in the area are understood. Several of the reef fish species (juvenile rabbitfish, juvenile jacks, juvenile goatfish, and bigeye scad) targeted in Guam show strong seasonal fluctuations, usually related to juvenile recruitment (Amesbury et al. 1986).

Fish species composition in Guam is typical of most Indo-Pacific insular, coral reef-bordered coastal areas: 73% of the total number of species belong to 20 families (Myers and Donaldson 2003). The geographic location of the study area suggests a more diverse ichthyofauna than areas such as the Hawaiian Islands. However, the recorded species diversity in the Guam/Marianas Islands chain is lower than that of the Hawaiian archipelago. Actual diversity may be higher and the recorded diversity may be

an artifact of insufficient sampling (Paulay 2003b). However, many other factors, such as larval recruitment and frequent natural disturbances, have dramatic impacts on species diversity. Myers and Donaldson (2003) noted the occurrence of 1,019 fish species (epipelagic and demersal species found to 655 ft [200 m]) in the Mariana Islands. Inshore species are composed primarily of widespread Indo-Pacific species (58%) with the remainder consisting of circumtropical species (3.6%) and nearly equal numbers of species with widespread distributions primarily to the west, south, and east of the islands. Ten species of inshore and epipelagic fishes are currently considered endemic to the Marianas. However, this number is probably too high due to the observations of transient species in the area.

11.1.4.3 Special-Status Species

As noted in Section 11.1.1.3, this section includes USFWS ESA-listed and candidate species and marine mammals not listed under ESA. NMFS species of concern are addressed under EFH CHCRT.

The threatened green sea turtle and the endangered hawksbill sea turtle are the only two ESA-listed species that are anticipated to be in the nearshore marine environment and adjacent beaches. The Navy, in cooperation with USFWS and GDAWR, monitors for sea turtle nesting on Navy land throughout the sea turtle nesting season (April – July for the green sea turtle and January – March for the hawksbill sea turtle) (Navy 2005, COMNAV Marianas 2008). There is no critical habitat designation for any marine species on Guam.

The spinner dolphin and common bottlenose dolphin are the only two marine mammals anticipated in the nearshore (<164-ft [50-m] isobaths) ROI for the study areas (Navy 2005). Table 11.1-5 identifies the special-status species that are addressed in this EIS/OEIS.

Table 11.1-5. Special-Status Species for Guam

Group	Common Name/Chamorro Name	Status*	
		Federal	Guam
MAMMALS	Common bottlenose dolphin/Toninos	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E

Legend: *E = endangered; SOGCN = Species of Greatest Conservation Need; T = threatened.

Sources: Navy 2005, GDAWR 2006, USFWS 2009, NMFS 2009a.

The special status species are briefly described below. Information about these species, including status, habitat preferences, distribution, behavior and life history, can be found in Volume 9, Appendix G.

Green Sea Turtle

The green sea turtle is by far the most abundant sea turtle found around Guam; aerial surveys by GDAWR indicate a year-round resident population. The green sea turtle occurrences are listed as “concentrated” and the hawksbill as “expected” in nearshore waters of Guam. The green sea turtle is ESA-listed as threatened and is the largest of the hard-shelled turtles, with adults commonly exceeding 39 in (100 cm) in carapace length and 220 lbs (100 kg) in weight. As hatchlings, they are only about 2 in (50 cm) long and weigh less than 1 ounce (25 grams [g]). Adult carapaces range in color from solid black to gray, yellow, green and brown in muted to conspicuous patterns (Navy 2005, WPFMC 2005).

Late juveniles and adults feed primarily on seagrass and macroalgae of the genera *Codium*, *Amansia*, *Pterocladia*, *Ulva*, *Gelidium*, *Acanthophora*, and *Hypnea*, and other reef-associated organisms in nearshore waters and within harbors and lagoons. Early juveniles are omnivorous and feed on a variety of algae, invertebrates, and small fishes (COMNAV Marianas 2007a).

Hawksbill Sea Turtle

The hawksbill turtle is a small to medium-sized sea turtle. Adults range between 25 and 35 in (65 and 90 cm) in carapace length and typically weigh around 176 lbs (80 kg.). Hawksbill sea turtles are distinguished from other sea turtles by their hawk-like beaks, posteriorly (near the back) overlapping carapace scutes (bony plates), and two pairs of claws on their flippers. The carapace of this species is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown (Navy 2005, WPFMC 2005).

The hawksbill sea turtle is far less abundant than the green sea turtle, and as a result, debate exists on its occurrence (rare versus regular) within the ROI. There are however, historic reports of hawksbill nesting activity on beaches in northern and central (Apra Harbor) Guam (Navy 2005).

Upon recruitment to benthic feeding habitats, hawksbills are known to become omnivores and feed on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items such as crustaceans and jellyfish. Older juveniles and adults are more specialized and feed primarily on sponges. Sponges comprise as much as 95% of their diet in some locations (Navy 2005, WPFMC 2005).

Common Bottlenose Dolphin

There are no occurrence records for this species in the Marianas, but this is within the known distribution range for the species. Bottlenose dolphins are expected to occur from the coastline to the 6,550-ft (2,000-m) isobaths (Navy 2005).

Bottlenose dolphins are medium-sized, relatively robust dolphins that vary in color from light gray to charcoal. The common bottlenose species *Tursiops* is named for its short, stocky snout. There is striking regional variation in body size; adult body length ranges from 6.2 to 12.4 ft. (1.9 to 3.8 m). They can be found in groups of two to 15 individuals, although groups (pods) of up to 100 or more have been reported (Navy 2005).

Common bottlenose dolphins are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp using a wide variety of feeding strategies. Near the shore, these species prey predominantly on coastal fish and cephalopods (Navy 2005).

Spinner Dolphin

The spinner dolphin is expected to regularly occur all around Guam, except Apra Harbor, where there are few occurrences of this species. Spinner dolphins are behaviorally sensitive and avoid areas with much anthropogenic usage (Navy 2005).

Spinner dolphins are a slender species that have a very long, slender beak. Adults can reach 7.8 ft. (2.4 m) in length and generally have a dark eye-to-flipper stripe and dark lips and beak tip. They typically have a three-part color pattern (dark gray cape, light gray sides, and white belly) (Navy 2005).

Spinner dolphins residing around islands and atolls rest during the daytime hours in shallow, wind-sheltered nearshore waters and forage over deep waters at night. They feed primarily on small mesopelagic (intermediate ocean depths of 328 to 3,280 ft. [100 to 1000 m]) fishes, squids, and shrimps, diving to at least 655 to 984 ft. (200 to 300 m). Group sizes around Guam range from one to 120 individuals, with most groups consisting of less than 30 individuals (Navy 2005).

11.1.4.4 Non-Native Species

Marine organisms, pathogens, or pollutants may be taken up with ship ballast water (or attached to vessel hulls) and be transferred to a different location or ecosystem and cause harm to the receiving ecosystem.

These organisms and pollutants are in greater concentration within 3 nm of the coast (COMNAV Marianas 2007a).

Guam is the administrative and economic hub of Micronesia, hosts one of the largest and expanding U.S. military bases in the Pacific, and lies at the crossroads among Pacific islands, the U.S., and Asia. Although terrestrial introductions, exemplified by the brown treesnake, have received much attention, marine introductions have been little studied until five major marine biodiversity surveys were performed on Guam in the mid-1990s to 2001 (Paulay et al. 2002).. Approximately 5,500 non-native species were recorded in these surveys, of which most remain restricted to Apra Harbor (Paulay et al. 2002). According to the Global Invasive Species Database (GISD), nine marine and 12 estuarine marine invasive alien species (IAS) have been identified associated with Guam habitats (GISD 2009). The database print out can be viewed in Appendix G. Paulay et al. (2002) describes 85 nonindigenous species (mainly sessile organisms [75%]) with Apra Harbor (see Outer Apra Harbor non-native species section).

In general, these marine studies have documented a diverse assemblage of marine species, dominated by sessile organisms, which have been transported to Guam by humans. The main potential sources of nonindigenous species to Guam are purposeful introductions for fisheries and agriculture together with species that inadvertently arrived with such seed stock and hull and ballast transport with shipping traffic. The nature and extent of purposeful introductions of marine species is relatively well-documented because they have been carried out largely by government agencies (Eldredge 1994), although accidental introductions of species hitchhiking on purposeful introductions (such as the parasitic gastropod *Tathrella iredalei* on tridacnines [giant clams]) have occurred. Most of the marine invasive species survey work, although limited, has been conducted in Apra Harbor and is discussed in that section.

Marine IAS are poorly addressed in most national frameworks, although they are now considered as great a problem as terrestrial IAS. Information on marine IAS is needed as scientists are only just beginning to look at the issue in depth. Management of invasive marine species (IMS) is non-existent in the Austral-Pacific Region. Level of awareness is very low and there are no legal and institutional structures in place to effectively address the issue (IAS 2002).

In the South Pacific Regional Environment Programme's (SPREP) draft Regional Strategy on Invasive Species, prepared in 1999, it was decided to address IMS separately. This was due to two main reasons: IAS participants were not fully aware of the issues (most coming from the traditional quarantine and terrestrial invasive species backgrounds) and IMS issues were seen as sufficiently different to invasive terrestrial species issues to warrant separate treatment.

The ballast water situation in Pacific Island countries and territories (PICTS) needs further analysis. Most PICTS do not know if they are acting as exporters and/or importers of marine IAS in ballast water. PICTS need to assess the risks they face and the risks they may pose to other countries. Australia's experience of tackling the incursion and eradication of Black Striped mussel (*Mytilopsis* sp.) in the Northern Territory was discussed in the IAS Workshop (2002). The competent authorities used pre-existing powers to implement mandatory inspection of all yachts arriving in specific ports in the Northern Territory. As the mussel had not reoccurred in Darwin, the inspection regime does demonstrate that it is possible to prevent marine IAS incursions, provided that there is political willingness to bear the cost of the prevention mechanisms. In this case, the prevention was cost-effective: the Northern Territory pearl industry is worth Aus \$50 million per year and could have been severely affected by the IAS.

As reported by *Managing Marine Protected Areas: A TOOLKIT for the Western Indian Ocean, Alien invasive species, sheet K5*, many Marine Protected Areas (MPAs) are located adjacent to ports and

shipping lanes, or to sites that would eventually become ports. These MPA's are at risk from non-native species carried on the hull of yachts and fishing boats, as has been discovered in Guam.

Managing Natural Resource Pathways

In natural resource management work, equipment and organisms are often moved from one location to another. The specific equipment or organism being moved is called the target. Targets could include animals for relocation or stocking for recreation, equipment such as dredging equipment, ships, bulldozers and backhoes, sampling gear such as nets or traps, and even people. Transporting targets provide potential vectors for the spread of non-target species that could potentially invade new habitats. Non-target species are the plants, animals, diseases, pathogens and parasites that are not intended to be moved (HACCP-NRM 2009).

As described, natural resource management work often creates open pathways that could spread non-native species to unique and critical habitats for already endangered species. Next to habitat loss, non-native species are natural resource management's biggest challenge. On February 3, 1999, EO 13112 was signed establishing the National Invasive Species Council. The EO requires that a Council of Departments dealing with non-native species be created and directs agencies to prevent the spread of non-native species in their work, but few management tools exist to implement this directive. Hazard Analysis and Critical Control Points (HACCP) planning has been modified from the food industry for natural resource work. Around the world, industry uses the HACCP planning tools to avoid product contamination. In natural resource pathways, "hitchhiking" species are considered contaminants. HACCP's comprehensive planning identifies these species and the risk of contamination while documenting the best management practices (BMPs) used to prevent and remove hitchhikers. HACCP planning is an international standard (ASTM E2590-08) for reducing or eliminating the spread of unwanted species during specific processes or practices or in materials or products. HACCP planning focuses attention on critical control points where non-target species can be removed. Documenting risks and methods used to remove non-target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits. A standard guide for conducting a HACCP evaluation is provided at the website included with the reference (HACCP-NRM 2009).

Navy Policy and Ballast Water Management

If it is necessary for a surface ship to load ballast water in an area that is either potentially polluted or within 3 nm from the shore, it is Navy policy for the ship to pump the ballast water out when outside an area 12 nm from shore and twice rinse the ballast tank(s) with clean sea water prior to the next entry within 12 nm of shore. Surface ships perform a ballast exchange twice in clean water, even if the ballast water was pumped out before exiting the polluted waters or 3 nm limit, as residual water remaining in a tank after emptying it may still contain unwanted organisms that could be transferred during the next ballasting evolution (Navy 2003).

This policy is based on the U.S. Coast Guard's (USCG) "Ballast Water Management for Control for Nonindigenous Species in Waters of the U.S." (33 Code of Federal Regulations [CFR] §151 Subpart D), which is applicable to all foreign and U.S. vessels, equipped with ballast tanks that enter a U.S. port. The USGC's published guidelines are based on guidelines developed by the Marine Environmental Protection Committee of the International Maritime Organization for the control of ship ballast water to prevent the introduction of unwanted aquatic organisms and pathogens. In addition, the Navy, in cooperation with U.S. Environmental Protection Agency (USEPA), fully complies with the Uniform National Discharge Standards. These Standards regulate discharges incidental to normal operations and apply to the ocean

water out to 12 nm. All vessels are required to maintain a ballast water management plan that is vessel-specific. The Vessel Master is responsible for understanding and executing the management plan (COMNAV Marianas 2007a).

11.1.5 North

11.1.5.1 Andersen Air Force Base (AFB)

Baseline marine biology information for the Andersen AFB study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.5.2 Finegayan

The following specific study area information is provided in addition to that presented in Section 11.1.4, Guam Regional Environment.

The northwest coast of Guam is steep and karstic, with limited marginal reef development. The coast faces west/northwest and thus it is relatively sheltered, with usually low to moderate wave impact and weak currents. Relatively narrow reef flats are developed along the northern portion of this coast, south to Falcona Beach, and again south of Ague Point. The central section of the northwest coast is largely devoid of reef flats, bounded mostly by narrow, supratidal (pertaining to the shore area immediately above the high-tide level) benches, or by rock faces lacking any reef protection.

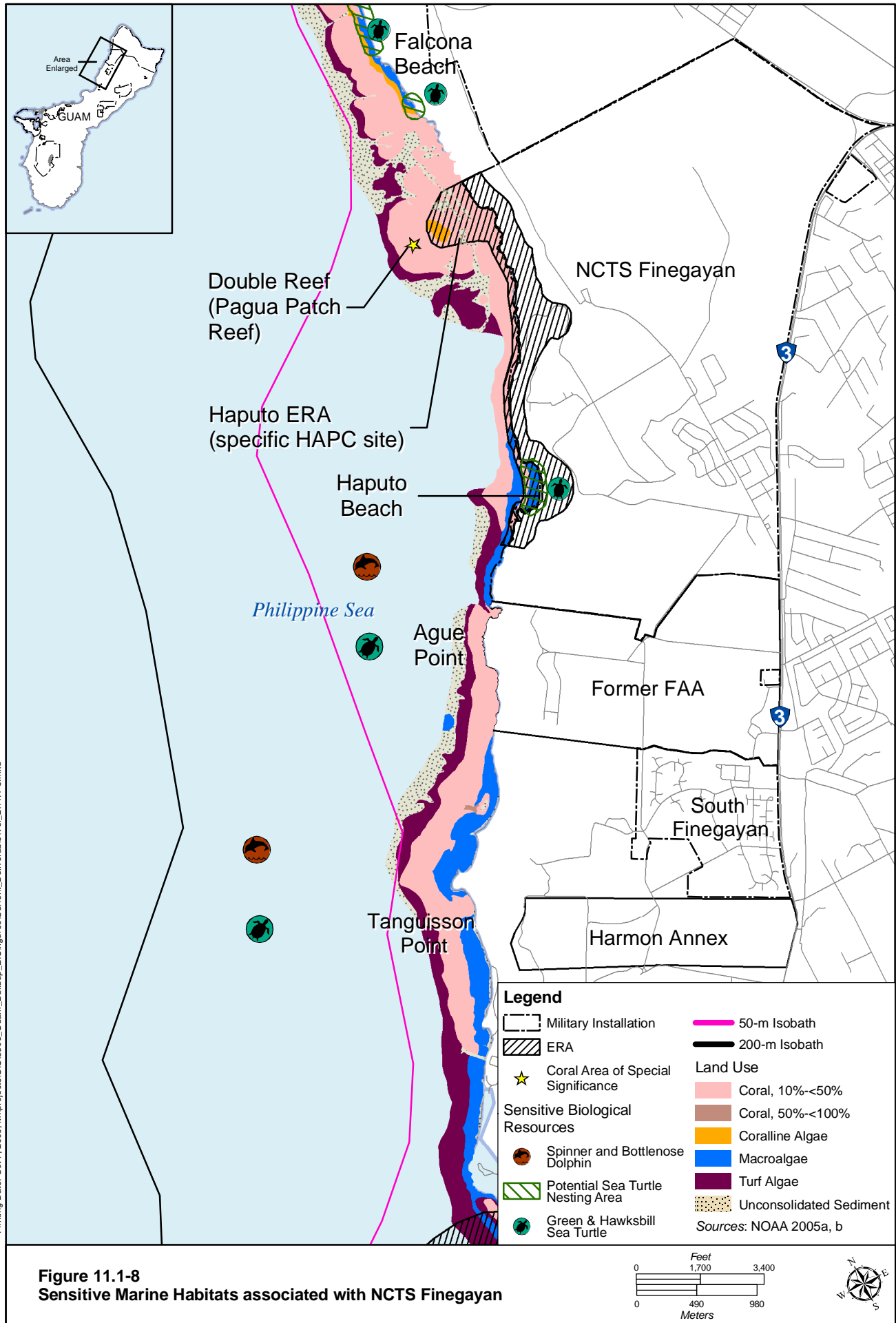
Marine Flora, Invertebrates and Associated EFH

Off-shore habitat includes fringing, patch, submerged and barrier reefs, and offshore banks (COMNAV Marianas 2007a). Macroalgae lines the southern portion of the coast from Harmon Annex north to Haputo Beach; turf algae fringes the outer portions of the coral reef in the same area. The majority of the coral reef ecosystems offshore of Finegayan are included in the Haputo ERA, which extends offshore on Navy land to a depth of 121 ft (37 m) (Navy 2005). There are two small, localized reef flats (flat reef, usually exposed at low tide) located outside the ERA off Haputo Beach and inshore of Pugua Patch Reef or Double Reef, which is considered a coral area of special significance (COMNAV Marianas 2007a, NOAA 2005a). Double Reef is the most striking offshore feature along the entire northwest coast of Guam. It is an incipient (just beginning) barrier reef that breaks the surface (Amesbury et al. 2001). Double Reef, is one of Guam's few remaining examples of a healthy leeward fringing reef community and enhances this area as a nursery for species of subsistence and commercial fishery value (Navy 2005) (Figure 11.1-8).

Essential Fish Habitat

EFH-designated habitat areas for Finegayan would be the same as those described in Section 11.1.4. EFH in the Mariana Archipelago is defined for bottomfish, pelagic, crustaceans, and coral reef ecosystems (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off Finegayan are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 Federal Register (FR) 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished.

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Double Reef, an area noteworthy for its unusually high coral cover and coral diversity, lies on a shelf that extends considerably further from the coast than adjacent areas of forereef of Finegayan. The area around Double Reef is highly heterogeneous (varied), both because of topographic variation created by reef growth and the erosive action of the large freshwater aquifer discharge in the area, and because the bulk of Double Reef creates sufficient shelter in its lee to host a distinct backreef community. Otherwise, the fore reef of northwest Guam shows relatively little variation in macrohabitat, although fine-scale variation in benthic communities is widespread (Amesbury et al. 2001).

Coral cover around most of Guam is <20%, but in the Double Reef area it averages 46%. High coral cover on Guam is largely associated with reefs dominated by the weedy coral *Porites rus*. Such high cover *P. rus* reefs dominate Apra Harbor, and occur locally at a number of other locations around the island. Although *P. rus* dominated the reef tract immediately to the south of Double Reef, it was rare elsewhere. The high coral cover of the area is typical throughout, and not only of this locally *P. rus* dominated section (Amesbury et al. 2001).

Another noteworthy area is the reef front off Haputo Beach, where unusually large colonies of faviid and mussid corals dominate very high coral cover. No other site on Guam has been reported where such large coral heads, other than *Porites*, dominate cover. The lee of Double Reef supports highly heterogeneous coral communities, with patches of unusual corals (Amesbury et al. 2001).

Coral diversity of the area is very high, with approximately 60% of the known coral fauna of Guam encountered during a limited survey on this short reef section (Amesbury et al. 2001). In contrast to the great abundance and diversity of corals, the local fish fauna was depauperate (lacking species variety and not fully grown), of low population density, and had especially few fishes belonging to taxa targeted by fisheries. All these factors indicate that overfishing is a serious problem in the area. The Haputo ERA had considerably lower fish diversity and lesser abundance of large fish than the Orote-Agat reef section surveyed earlier (Paulay et al. 2000). Some of the differences between these areas are clearly the result of very different habitats. The southern Orote coast is washed by relatively strong currents that bring abundant food for fishes and also provides greater structural complexity with its dropoffs and giant boulder fields. Nevertheless, the low abundance of large fish in the Haputo ERA is striking (Amesbury et al. 2001).

There are six main macrohabitats supporting corals in the Haputo ERA within the 3 to 60 ft (1 to 18 m) water depth range: exposed benches, protected reef flats, Double Reef Top, the back reef, the shallow fore reef, and the deep fore reef. Macrohabitats on the fore reef 3 to 60 ft (1 to 18 m) in depth support more diverse assemblages of corals, macroinvertebrates, and fish than the three shallow macrohabitats. Corals, however, have the greatest diversity in shallow water on Double Reef. Coral cover ranged from 37 to 64% in the Haputo ERA. Coral cover is higher along transects taken at an 26 ft (8 m) depth compared to those taken at 50 ft (15 m), and coral species with the highest coverage in the Haputo ERA include *Porites* (deep area), *Montipora* (shallow area), and *Leptastrea* (Amesbury et al. 2001).

Specific macro- and micro-habitats are noteworthy for the diversity of unusual species they harbor. The reef front of Haputo Bay and the lee of Double Reef have already been mentioned for their striking coral communities. The back reef at Double Reef also holds a diverse cryptofauna (hidden or not easily detected). The caverns, fissures and frequently associated freshwater seeps along the steep portion of the coast from the north end of Haputo to Pugua Point are also noteworthy, they hold numerous species not previously seen on Guam, some of which may be endemic. These include crabs associated with freshwater seeps, sponges associated with the caverns, and likely numerous other species of cryptofauna (Amesbury et al. 2001).

Haputo ERA

The Haputo ERA, a specific EFH HAPC site, was established by the Chief of Naval Operations on March 15, 1984, as one of several mitigation measures implemented by the Navy to obtain approval from federal and Government of Guam (GovGuam) agencies for the construction of a munitions wharf (Kilo Wharf) at Adotgan Point in outer Apra Harbor, Guam. The ERA is 252 ac (102 ha) in area and consists of a terrestrial and marine unit. The 72-ac (29-ha) marine unit originates at the mean lower low water (MLLW) line and extends to the edge of the outer coral reef line to a depth of 120 ft (37 m) (refer to Figure 11.1-8).

Amesbury et al. (2001) documented 21% of the known marine fauna of Guam, approximately 4,500 species, within the Haputo ERA. These organisms consisted of 154 species of corals, 583 species of other macroinvertebrates (>0.4 in [1 cm]), and 204 species of fish. The 154 coral species found in the Haputo ERA correspond to approximately 60% of the coral species known on Guam, and the 204 fish species, 22% of the fish known on Guam. The marine unit of the Haputo ERA is therefore an area of relatively high biodiversity, yet because of overfishing, the fish in the ERA are not very diverse or abundant.

Shallow splash pools found on the exposed benches support low diversities of corals, fishes, and cryptic organisms. Shoreward of the benches and at the base of the cliffs are erosional notches created by wave action on the rock face where habitat-specific species of limpets, chitons, slugs, and shore crabs can be found. The seaward edge of the benches is a steep subtidal face typically burrowed by echinoids that supports corals, macroinvertebrates and fishes. A freshwater seep microhabitat associated with this area had three species not encountered elsewhere within the study area: the barnacle *Balanus eburneus* and two grapsid crabs. The crabs are likely undescribed and endemic to the Marianas (Amesbury et al. 2001).

Two narrow, protected reef flats off Haputo Beach and shoreward of Double Reef are intertidal habitats supporting numerous species that are found only in sheltered reef flat or shallow lagoon habitats, such as the coral *Pavona divaricata*, several species of hermit crabs and crabs, sea slugs, and sea cucumbers that can withstand the rigors of an exposed habitat. Corals and fishes are more common and diverse at the seaward margin of these reef flats (Amesbury et al. 2001).

The shallow forereef substrate within the Haputo ERA includes a steep reef front and gently sloping forereef starting at a water depth of 13 to 26 ft (4 to 8 m). Numerous cuts and channels normal to the shoreline run through the fore reef and create abundant structural complexity and increased biodiversity. Coral and macroinvertebrate diversity peaked at this macrohabitat, with 54 and 116 species, respectively. Three new sponge species that had not been seen elsewhere on Guam were also identified in this macrohabitat (*Neofibularia hartmani*, “yellow tough sponge,” and “puff sponge”) (Amesbury et al. 2001). Branching corals (*Acropora*, *Pocillopora*) dominate the 3 to 10-ft (1 to 3-m) depth range on the fore reef. Coral composition within the 13 to 30-ft (4 to 9-m) depth range varies within the Haputo ERA, including several areas dominated by encrusting species of *Montipora* while other areas are dominated by the massive *Porites*. The cryptofauna of the rubble fields is highly diverse and includes several species (*xanthid* crab *Atergatis granulatus*, the flatworm *Pseudoceros bimarginatus* and the hermit crab *Pylopaguropsis kiejii*). The ahermatypic coral, *Dendrophyllia gracilis*, a rare coral species on Guam, was observed in one of the small caverns (Amesbury et al. 2001).

The two fish species of concern (and CHCRT MUS), the napoleon wrasse and humphead parrotfish, may be found offshore of Finegayan associated with the Haputo ERA; however, these two species were not identified in biodiversity checklist surveys (Amesbury et al. 2001).

The ESA-listed green sea turtle utilizes the Haputo Beach as nesting habitat (NOAA 2005a, Navy 2005). The Haputo ERA is popular with the public for hiking, wildlife viewing, crabbing, fishing, and beach-combing.

Special-Status Species

The threatened green sea turtle nests on beaches in the area and can be anticipated in nearshore waters. The endangered hawksbill sea turtle has been recorded nesting near Achae point (north of this area) and as far south as Falcona Beach, and could be expected in the coastal waters. No other marine ESA-listed species are known to frequent the area (Navy 2005, COMNAV Marianas 2008).

Spinner dolphins occur in relatively high concentrations (pod sizes of ~100) and bottlenose dolphins are identified as present in the coastal waters (Navy 2005, NOAA 2005a) (refer to Figure 11.1-8).

Non-Native Species

Only 23% of the nonindigenous species recognized by Guam have been found in natural habitats outside Apra Harbor: six introduced and 14 cryptogenic species. These include three purposeful introductions: two brackish-water fish species and the gastropod *Trochus niloticus*. This gastropod species is now abundant around Guam and is the basis of a local fishery. Fifty percent of the nonindigenous species that have been encountered outside Apra Harbor are ascidians (sea squirts), none of which are abundant. Cryptic hydroids (related to jellyfish, sea anemones and corals) common outside Apra Harbor include *Pennaria disticha* and *Thyroscyphus fruticosus* (Paulay et al. 2002).

Non-invasive species information is lacking for this specific study area.

11.1.5.3 Non-DoD Land

Baseline marine biology information for the Non-DoD Land study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.5.4 Off Base Roadways

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

Marine biological resources considered in the analysis of the proposed roadway improvement projects include (1) Marine Flora, Invertebrates and Associated EFH, (2) Essential Fish Habitat, (3) special-status species, and (4) invasive species. These resource definitions are analyzed within areas where the construction and use of proposed road projects could directly or indirectly affect marine resources. Figure 4.1-6 in Volume 4, Chapter 4.1.2.4 presents a map of the surface waters and affected watersheds in each region of the proposed roadway projects that discharge to coastal areas.

The proposed roadway projects in the North Region include pavement strengthening and road widening, as well as access point construction for facilitating access to Finegayan and Andersen AFB. None of the proposed roadway improvement projects within the North Region are located near or are anticipated to affect marine biological resources; therefore, no affected environment component pertains to marine biological resources within this region associated with the proposed roadway improvements projects.

Because of the high permeability of the limestone substrate, no perennial streams exist on the northern end of the island. Runoff from roadways usually sheet flows off the pavement to grassy swales or flat strips of grass, and the runoff from the roadway is generally filtered prior to its conveyance to offsite drainages. Volume 4, Chapter 4, Water Resources provides a detailed description of the surface water resource environment that would be impacted by the proposed roadway improvement projects.

11.1.6 Central

11.1.6.1 Andersen South

Baseline marine biology information for the Andersen South study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.2 Barrigada

Baseline marine biology information for the Barrigada study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.3 Non-DoD Land

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. The proposed training activities associated with Route 15 Range Lands does not contain any surface water resources (refer to Volume 4, Figure 4.1-2). Impervious areas on the Route 15 parcel amount to 71 ac (28.73 ha), or 3.5% of the total Route 15 project area of 2,031 ac (822 ha). The Route 15 Range Lands may include increased access to the shoreline areas by foot and boat, and the presence of range surface danger zones (SDZs) that extend over the coastal waters. Therefore, this study area has been analyzed for potential threat to the resources below, especially special-status species that may occur in waters off-shore.

Marine Flora, Invertebrates and Associated EFH

The coastline off the Route 15 Range Lands consists of exposed rocky shores and an intertidal bench providing habitat for many intertidal invertebrate species including octopus, sea cucumbers, swimming crabs, slipper and spiny lobsters. Little evidence of marine flora (seagrasses, macro algae, or turf algae) is seen in the area (NOAA 2005a).

Coral communities and reefs are exposed to dominant trade winds, strong wave action, and storms (including typhoons). From Pagat Point south to Taguan Point coral reef and colonized hard bottom (live coral 10 to 50%) are present seaward of the exposed wave-cut platforms. Corals found above the 100-ft (30-m) isobath in this area typically include encrusting or massive growth forms of corals as well as columnar, platy and branching growth forms conditioned to withstand heavy wave action and would recover if damaged (Navy 2005).

Exposed windward reef fronts are dominated by three growth forms of *Acropora*: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

Essential Fish Habitat

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off Route 15 are used for commercial, recreational or subsistence fishing has not been determined.

Site-specific information is limited for this study area (Pagat Point); however, general fish and abundance would be similar to those described in Section 11.1.4, and include a host of juvenile and adult fish and invertebrate MUS with year round residence.

Special-Status Species

There are no reported sea turtle nesting beaches or foraging areas in this vicinity based on NOAA (2005a) mapping; however, green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters. The nearest reported nesting beach from Pagat Point is located south of Pago Bay, approximately 5 mi (8 km) away. The nearest potential foraging area appears to begin at Tanguan Point approximately 2 mi (3 km) south.

There are no regularly reported marine mammals offshore of this study area, however spinner dolphins (pod sizes ~80) are reported in association with the Pati Point reserve and south past Anao Point, approximately 2 mi (3 km) north of Pagat Point (NOAA 2005a). Their range could be expected to extend south to the offshore waters of the study area. As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam. The bathymetry off this coast transitions rapidly through the island-arc margin toward the trench system (Navy 2005). The 655-ft (200-m) isobath is within 1 mi (1.6 km) of the shoreline just southeast of Pagat Point. Consequently, the marine mammals that normally inhabit oceanic waters may be present closer to the shoreline off Pagat Point. These additional species are identified on Figure 11.1-9.

Non-Native Species

Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that this coastline has seen minimal impact from non-native species due to the distance from Apra Harbor; however, data are limited.

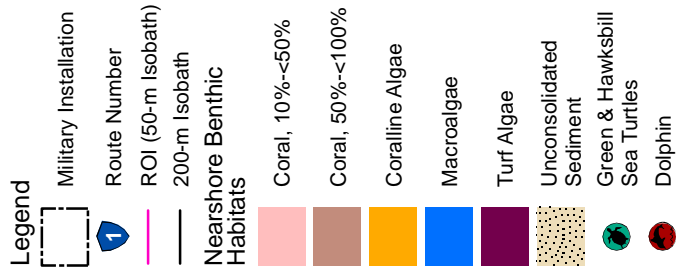
Piti/Nimitz Hill

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. Baseline marine biology information for the Piti/Nimitz Hill study area was analyzed commensurate with the land-based road construction projects (e.g., bridge replacement) along Route 1, which may affect the nearshore marine environment (see Section 11.1.6.4 for details). There is no in-water or land-based training activities proposed that would affect the marine environment.

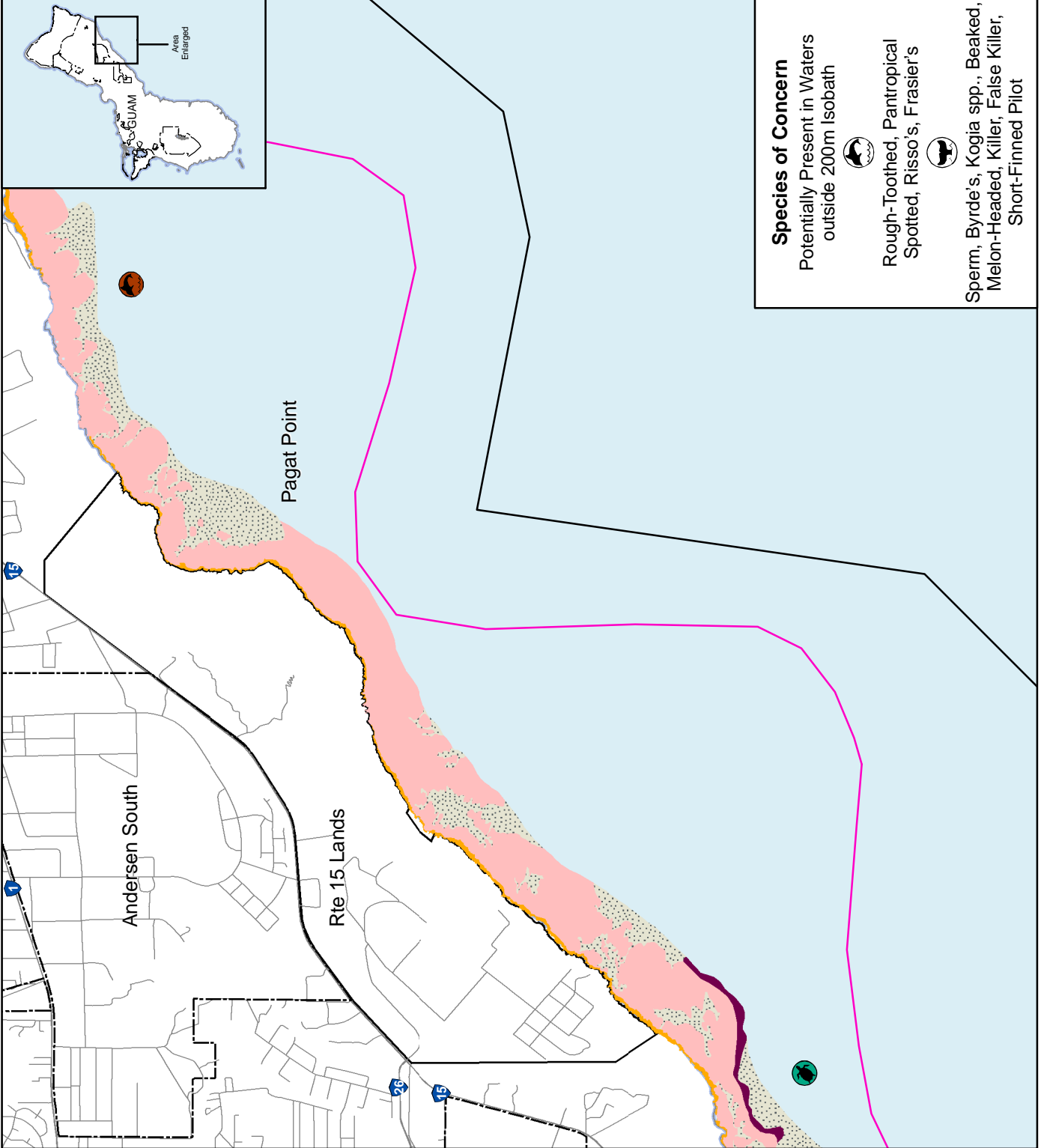
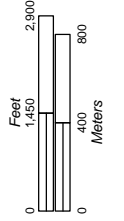
Marine Flora, Invertebrates and Associated EFH

The three embayments (Piti, Asan and Agana Bay) along this coastline have similar benthic habitats consisting of a nearshore unconsolidated sediment (sandy, uncolonized 90-100%) intermixed with rubble, seagrass, macroalgae and coral as you continue offshore. The coral communities are approximately 1,650 ft (500 m) from the Fonte and Agana Rivers where bridge replacement projects would be occurring (NOAA 2005b). These areas, including the Piti Bay MPA provide habitat for intertidal invertebrate species including octopus, sea cucumbers, swimming crabs, giant clams, and spiny lobsters (NOAA 2005a).

Figure 11.1-9
 Sensitive Marine
 Biological Resource
 and Habitats
 associated with
 Rte 15 Range Lands



Sources: NOAA 2005a, b



Species of Concern
 Potentially Present in Waters
 outside 200m Isobath

- Rough-Toothed, Pantropical Spotted, Risso's, Fraser's
- Sperm, Byrde's, Kogia spp., Beaked, Melon-Headed, Killer, False Killer, Short-Finned Pilot

Essential Fish Habitat

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-3 through Figure 11.1-7). The extent to which the coastal waters off this area are used for commercial, recreational or subsistence fishing has not been determined.

General fish and abundance would be similar to those described in Section 11.1.4, and include a host of juvenile and adult fish and invertebrate MUS with year round residence. High concentrations of fish species noted include juvenile rabbitfish (April and May), adult bigeye scad (June – December), giant manta rays (January - December). The humphead parrotfish is reported within Piti Bay MPA (NOAA 2005a, and Figure 11.1-10).

Special-Status Species

There are no reported sea turtle nesting beaches. Green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters and the seagrass beds provide potential foraging habitat (NOAA 2005a and Figure 11.1-10).

Spinner dolphins (pod sizes ~80-100) may be present in coastal waters (NOAA 2005a). As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam.

Non-Native Species

Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that Piti Bay has seen additional influence from non-native species due to the canal connecting the power plant near the commercial port at Apra Harbor to Piti Bay; however, data are limited.

11.1.6.4 Off Base Roadways

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

The central region covers a relatively large area of the island that encompasses two different hydrologic regimes – the northern broad sloping limestone plateau in the north area and the southern mountainous region composed of eroded volcanic formations in the south area. Descriptions of potentially affected coastal water resources have therefore been split into the northern and southern parts of the central region. Roadway projects located in the north central area include improvements along Routes 1, 8, 8A, 10, 15, 16, 26, and 27. Roadway projects in the south central area include improvements to several bridges along Route 1 along the west side of the island.

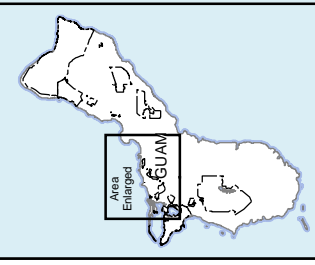
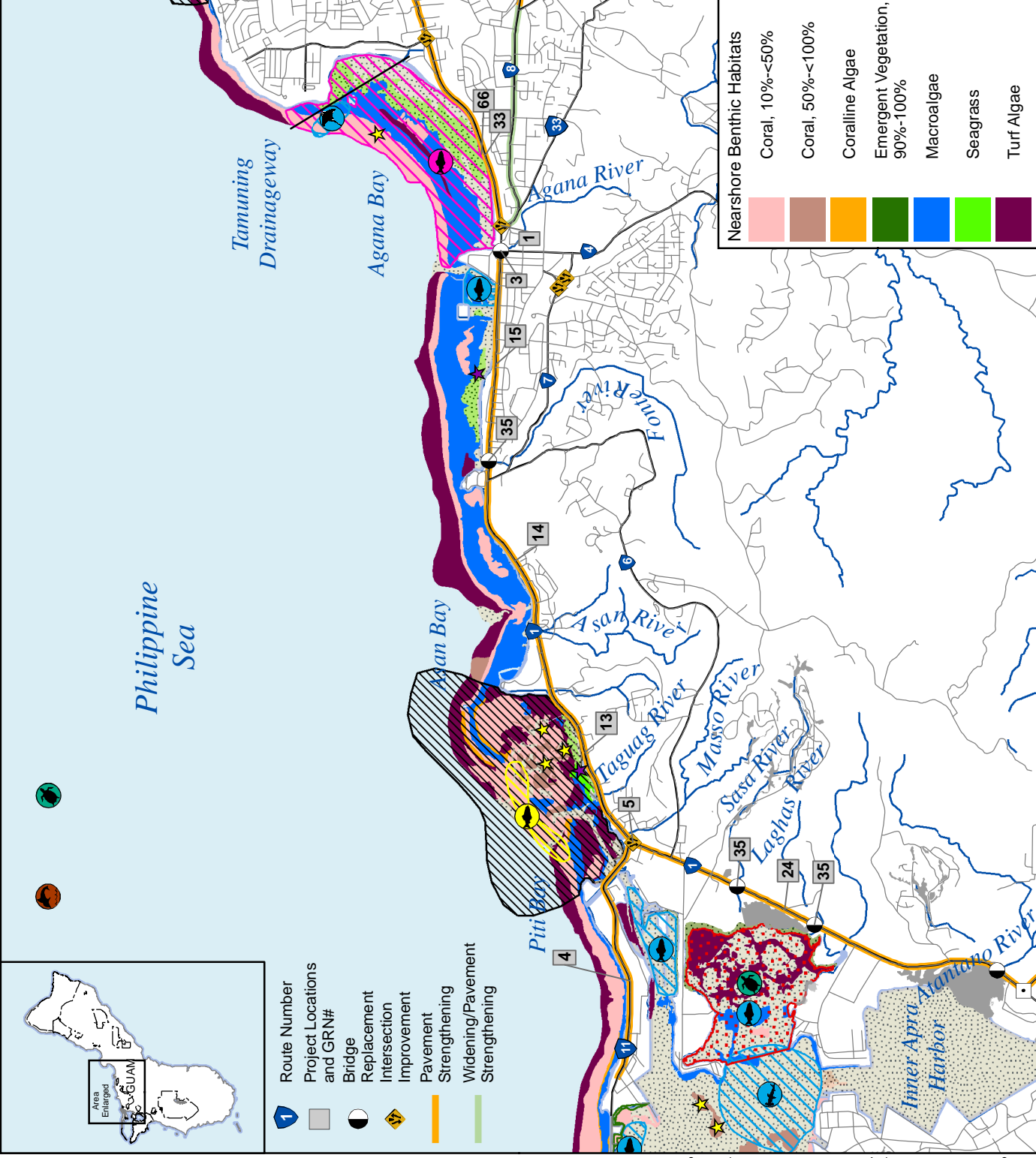
Specifically, roadway projects in the Central Region include pavement strengthening, road widening, intersection improvements, and bridge replacements (on Route 1), as well the rerouting of Route 15. The proposed new location of Route 15 would redirect the road onto Department of Defense (DoD) property (Andersen South) so that the public road would not be within any firing range danger zones. These projects include: (1) pavement strengthening between Asan River and Route 11 along Route 1; (2) pavement strengthening between Asan River and Route 6 along Route 1; (3) pavement strengthening between Route 6 and Route 4 along Route 1; (4) pavement strengthening between Route 6 and Route 4 along Route 1; and (5) the replacement of bridges over the Atantano, Laguas, Agana, Sasa, and Fonte rivers.

Figure 11.1-10
 Sensitive Marine
 Biological Resources
 and Habitats Associated
 with the Proposed
 Road Projects in the Apra
 Harbor Region
 and Central Region
 Study Areas

- Legend**
- Stream
 - Coral Area of Special Significance
 - Sea Grass Area of Special Significance
 - ERA
 - Spinner Dolphin
 - Potential Sea Turtle Nesting Area
 - ESA-listed Species & EFH MUS High Concentration Area
 - Green & Hawksbill Sea Turtles
 - Giant Manta High Concentration
 - Burmphead Parrotfish (Jan-Dec)
 - Bigeye Scad Adult High Concentration (Jun-Dec)
 - Rabbit Fish Juvenile High Concentration (Apr-May)
 - Scalloped Hammerhead Spawning (Jan-Mar)
 - Mangrove/Wetland
 - Unconsolidated Sediment

Sources: NOAA 2005a, b

Feet: 0, 2,800, 5,600
 Meters: 0, 750, 1,500



- Route Number
- Project Locations and GRN#
- Bridge
- Replacement
- Intersection Improvement
- Pavement Strengthening
- Widening/Pavement Strengthening

- Nearshore Benthic Habitats**
- Coral, 10% < 50%
 - Coral, 50% < 100%
 - Coralline Algae
 - Emergent Vegetation, 90% < 100%
 - Macroalgae
 - Seagrass
 - Turf Algae

The north central region has similar characteristics to those of the North Region, with few streams and several sinks. In general, new development in this area is required to treat surface water generated from impervious surfaces by utilizing BMP treatment schemes, such as oil water separators and detention basins that allow pollutants and settleable solids to be separated and settle out prior to entering a storm drainage system, to protect surface, ground and coastal waters. Other roadways in this area are curbed and convey concentrated flow to low points in the roads that connect directly to some of the sinks located in the vicinity. There are no coastal resources or coastal barriers near the roadway projects in the north central area.

Proposed Guam Road Network (GRN) projects within the southern part of the central region are generally on the west side of the island characterized by eroded volcanic formations with streams that are short with steep gradients and drainage areas of less than 3 mi² (777 ha) each. These streams are generally deeply channeled within the volcanic slopes that outlet into shallow fringing coral reefs at the mouths of the streams. Route 1 is located very close to the mouths of several of these streams that outlet into several bays connected to the Philippine Sea or Apra Harbor in the Piti/Nimitz and Apra Harbor areas.

Figure 11.1-10 identifies road projects locations and GRN# (see Volume 6, Section 13.2.6 for GRN# details), including bridge replacements over streams, with respect to sensitive marine biological resources in the nearshore environment. The streams and outlets include: (1) the Agana River that outlets into Agana Bay; (2) the Fonte River that outlets into Hagatna Bay; (3) the Asan River with two tributaries that outlet into Asan Bay; (4) the Matgue, Taguag, and Masso Rivers that outlet into Piti Bay; (5) the Sasa, Laguas, and Aguada Rivers that outlet into the Sasa Bay Marine Preserve; and (6) the Atantano and Apalacha Rivers that outlets into the Apra Inner Harbor. See Volume 4, Chapter 4.1.3.4 for the field investigation descriptions of issues with the nine bridges and figures/photos associated with these structures. Erosion along the upstream side of these bridges is common and contributes to downstream sedimentation that is a continual issue along the shoreline. Sediments have been found to contain heavy metals, such as copper and zinc, in Agana (Hagatna) Bay.

There are no areas subject to the Coastal Barrier Act near the roadway projects in this area. Coastal resources within this area include (1) Agana Bay, located at the outlet of the Agana River and Tamuning Drainageway; (2) Asan Bay, located at the outlet of the Asan River; and (3) Piti Bay, located at the outlet of the Masso and Taguag Rivers. These areas are within the Coastal Zone Management Program (GEPA 2000) and fall under Section 309 of the CZMA, which evaluates and regulates dredging activities within the harbors and bays of Guam.

As shown in Figure 11.1-10, Route 1 parallels the coastline from Apra Harbor northward to Agana Bay. Along this section of roadway, several locations are designated within Federal Emergency Management Agency (FEMA) Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or riprap slope protection (See Volume 4, Figure 4.1-23 and 4.1-24).

11.1.7 Apra Harbor

11.1.7.1 Harbor

Apra Harbor, located along Guam's southwestern coast, is the largest and busiest U.S. deepwater port (>100 ft [33 m] deep) in the Western Pacific and Micronesia. Orote Peninsula borders most of the southern boundary of the outer harbor while the Glass Breakwater and Cabras Island form the northern borders.

The Glass Breakwater was constructed in 1944 of 2 million cubic yards (1.5 million cubic meters [m³]) of soil and coral extracted from adjacent Cabras Island. This totally altered the barrier reef system by restricting the exchange of water between Apra Harbor and the open ocean. With an average height of approximately 15 ft (4.6 m) above mean sea level, it is the largest artificial substrate in the Marianas (COMNAV Marianas 2007a). In addition, fill operations that developed Dry Dock Island, Polaris Point and artificial shorelines of the northeastern and southeastern boundaries also altered the lagoon (Paulay et al. 1997).

For the purposes of this EIS/OEIS Apra Harbor was divided into two study areas: Outer Apra Harbor (including Sasa Bay), and Inner Apra Harbor. The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment.

Outer Apra Harbor and Sasa Bay

In spite of the alterations to the harbor since the liberation of Guam during World War II, the outer harbor "...holds a vibrant and thriving marine community, including well-developed reefs with some of the highest coral cover on Guam, and a diverse biota of algae, invertebrates and fish. In this regard the harbor is unlike most other major ports, which tend to become greatly degraded for marine life" (Paulay et al. 1997). In addition, the outer harbor supports diverse populations of macro-invertebrates, finfish and moderate numbers of the threatened green sea turtle (COMNAV Marianas 2006b).

Outer Apra Harbor contains the port operations for both the Navy and civilian commercial port, which is currently operated by the GovGuam. In addition, the outer harbor has fringing and patch reefs with some of the highest percentages of coral cover on the island, and these reefs are important recreational sites for residents and tourists alike. The Port Authority of Guam maintains the Commercial Port of Guam facilities on Cabras Island. Much of the remainder of the outer harbor contains both port and recreational facilities owned by the Navy. The outer harbor supports well developed reefs, with diverse populations of algae, macro-invertebrates, fish and moderate to high numbers of the threatened green sea turtle (Paulay et al. 1997) (Figure 11.1-11).

Sasa Bay, located in the eastern portion of the outer harbor, is a shallow estuarine lagoon containing patchy corals and an extensive mangrove habitat. Sasa Bay's waters are generally extremely turbid because of rivers emptying fine sediments into the bay. The bottom substrate is mostly fine muds to rocky and sandy habitats (Scott 1993). GovGuam has set aside over 10% of Guam's coastline in five marine preserves, one of which is Sasa Bay. The Sasa Bay Marine Preserve Area (1.2 mi² [311 ha]) extends from Dry Dock Island to Polaris Point and ends at the public right of way bordering Marine Corps Drive (Route 1). Route 18 runs along its northern end while the road to Polaris Point borders its southern end. Although the southern portion of Sasa Bay is within the Navy's submerged lands, the Navy does not recognize its preserve status (COMNAV Marianas 2007a) (see Figure 11.1-11).

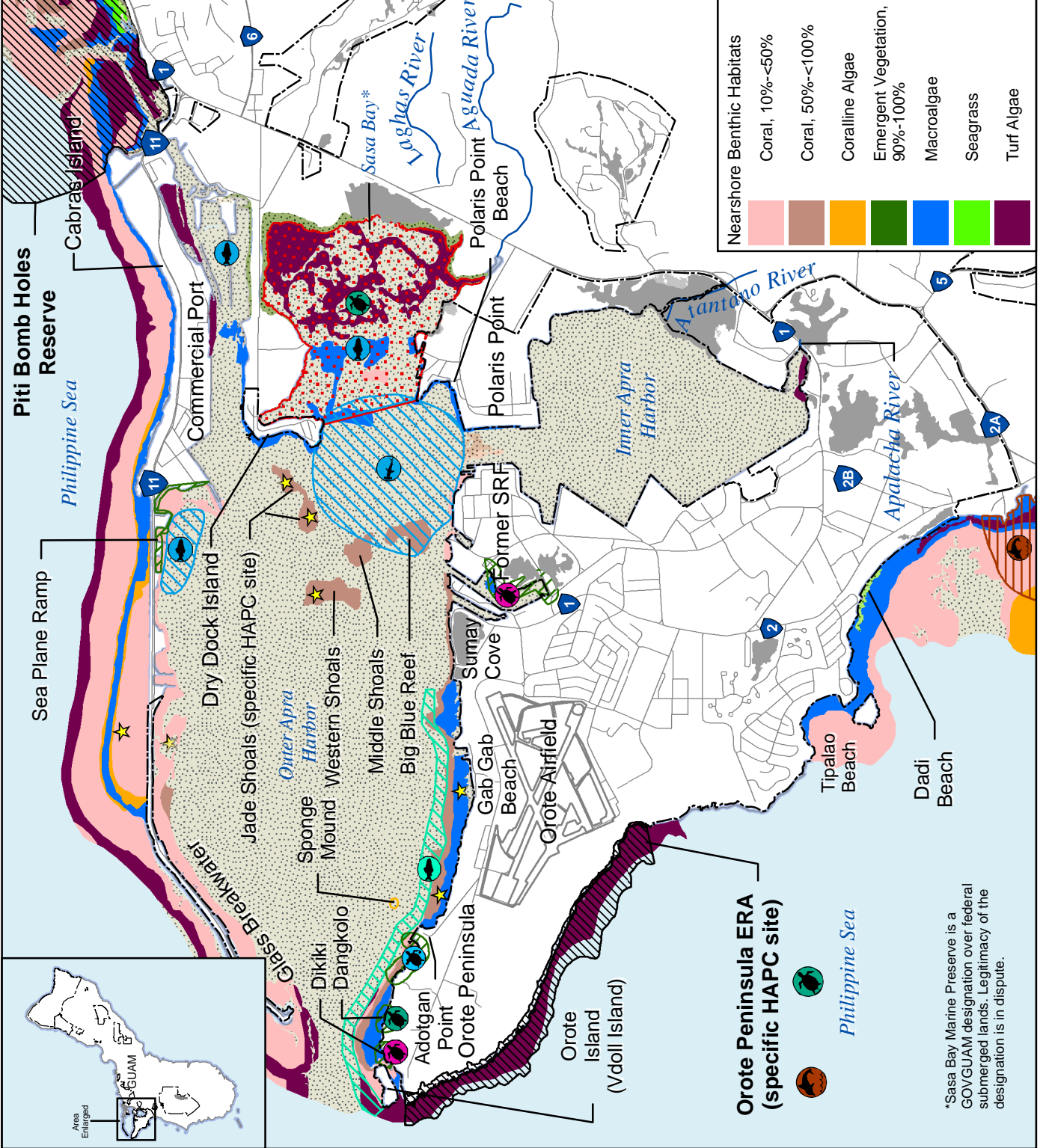
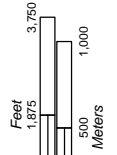
Sasa Bay contains a large, diverse mangrove habitat, one of few such habitats on Guam. Mangroves are typically found in estuaries or shores protected from the open ocean throughout the tropical and subtropical regions of the world (Scott 1993). They are composed of salt-tolerant woody trees and shrubs and other plant species and provide habitat for both marine and terrestrial life. Species diversity tends to be high in functioning mangroves. Mangrove habitats, like seagrass beds, can also act as water filters by removing sediments and nutrients from waters that flow through them. When mangroves are not functioning properly, sediments and nutrients flow into and can damage fragile coral reef ecosystems (Scott 1993). This may account for the limited coral habitat (4.5 ac [2 ha]) in Sasa Bay. Two rivers, the Sasa and Aguada Rivers, dump large quantities of sediment-laden water into the bay, which lowers visibility and overwhelms most corals (GDAWR 2006).

Figure 11.1-11
 Sensitive Marine
 Biological Resources
 and Habitats
 associated with
 Apra Harbor

Legend

- Military Installation
- Coral Area of Special Significance
- ERA
- Sensitive Biological Resources**
- Spinner Dolphin
- Potential Sea Turtle Nesting Area
- ESA-listed Species & EFH MUS High Concentration Area
- Green & Hawksbill Sea Turtles
- Green Sea Turtle Nesting (Apr-Jul)
- Hawksbill Sea Turtle Nesting (Jan-Mar)
- Bigeye Scad Adult High Concentration (Jun-Dec)
- Napoleon Wrasse
- Scalloped Hammerhead Spawning (Jan-Mar)
- Mangrove/Wetland
- Unconsolidated Sediment

Sources: NOAA 2005a, b



There are 125.3 ac (50.7 ha) of mangrove forests on 10 sites on Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of the Inner Apra Harbor. There are four mangrove areas near Abo Cove at the southern tip of the Inner Apra Harbor, two mangrove sites near Dry Dock Island, two more sites near Polaris Point and one mangrove area along the southern shore of Apra Harbor (Navy 2005 (see Figure 11.1-11)).

Sasa Bay is also a loafing and feeding habitat for migratory shore birds and is visited by foraging green sea turtles and hawksbill sea turtles, both of which are ESA-listed species and reported in high concentrations (NOAA 2005a). Estuarine areas like Sasa Bay are particularly important to both the native land hermit crabs and coconut crabs, both of which begin life in the sea. Adult females return to the sea to lay eggs. After a planktonic larval stage, small crabs emerge from the ocean to live on land (COMNAV Marianas 2001).

Estuarine communities (e.g., mangroves/wetlands) are described further under the Essential Fish Habitat section below, and Volume 2, Chapter 10, Terrestrial Biological Resources.

A detailed descriptive tour of Outer Apra Harbor benthic habitats can be found in Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary. The descriptive tour begins with the Glass Breakwater on the north, continuing to the south in the area from Orote Point to the Entrance Channel of Inner Apra Harbor, and finally to the mounds and shoals (e.g., Big Blue Reef, Middle Shoals, and Western and Jade Shoals) located throughout the lagoon (Navy 2005).

Marine Flora, Invertebrates and Associated EFH

Outer Apra Harbor provides habitats for unique and diverse coral reef ecosystems and floral communities. For example, most of the sponges and ascidians found in Apra Harbor, 48 species of sponges and 52 species of ascidians, are unique to Apra Harbor, and many are indigenous native to Guam. Indigenous (native) species generally occupy natural substrates while introduced and cryptogenic species generally occupy artificial substrata (e.g., wharf walls, concrete revetments, moorings, and navigational buoys). Some of the species (one sponge and 16 ascidians) were introduced via ship traffic (Paulay et al. 1997). Macroalgae species are dominant around the perimeter of Outer Apra Harbor, but are present on the shoal areas. These species are discussed further under special-status species as potential foraging habitat.

Essential Fish Habitat

EFH-designated habitat areas for Outer Apra Harbor are the same as those described in Section 11.1.4, Guam Regional Environment (refer to Figure 11.1-3 through Figure 11.1-7). Accordingly, all of Apra Harbor has been designated an EFH, including Sasa Bay on its eastern edge. Jade Shoals, approximately 4,692 ft (1,430 m) north of the entrance channel, is a Specific HAPC Site. The extent to which Apra Harbor and coastal waters outside the harbor are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 FR 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished (COMNAV Marianas 2007b) (see Figure 11.1-11).

In Apra Harbor, the commercial port area contains the highest levels of zooplankton with copepods dominating. Other organisms in the harbor include finfish larvae, decapod zoeae (free-swimming larvae), and pteropods (ocean gastropod mollusk) (Navy 2005).

Along the southern boundary of Apra Harbor between Orote Point and Gab Gab Beach, including areas east and west of Kilo Wharf, coral cover on fringing reefs is high (Smith 2004b, NOAA 2005a) as described in detail in the Apra Harbor Benthic Habitat Summary in Volume 9, Appendix G. The areas

adjacent to Kilo Wharf are close to 100% coral cover, consisting mainly of *P. rus* (>90% of the cover) and other stony corals including *P. lichen*, *P. lobata*, *Platygyra pini*, *Leptoseris* spp., *Lobophyllia corymbosa*, and *Acanthastrea echinata*. Reefs located further in the harbor (excluding the Inner Apra Harbor) have been severely impacted by freshwater runoff, siltation, and polluted discharges (Smith 2004b, Navy 2005).

Sasa Bay and the mangroves provide refuge for high concentrations of many species, and serve as nursery grounds for jacks, barracudas, snappers, and groupers, as well as numerous burrowing invertebrates including bivalves, small crabs and worms.

NOAA (2005a) identifies two sensitive fin fish MUS: the adult bigeye scad, in seasonally high (June – December) at two locations within Apra Harbor; and the scalloped hammerhead, which occurs during seasonal spawning (January – March) at one location extending from the entrance channel to the western edge of Big Blue reef, north to Jade Shoals (a HAPC), and easterly into Sasa Bay (refer to Figure 11.1-11). The hammerhead spawning is reported to be extremely rare (personal communications with Steve Smith, [Navy 2009c]). In addition, the shoal areas, which contain numerous CREMUS including high live coral coverage (50% to <100%) and coral areas of special significance, fringe the navigational channel bend and fairway for the approach into Inner Apra Harbor. The six coral areas of special significance within Outer Apra Harbor, were designated by NOAA resource experts as those areas that should be highly prioritized for protection following spills due to various reasons (e.g., species diversity, abundance of soft coral species, high percent cover, sensitive habitat for fish/invertebrates, having structure-building potential that may lead to high diversity/high coral cover in the future, etc.) (NOAA 2005a).

Special-Status Species

In general, the threatened green sea turtle is frequently sighted in Apra Harbor, while the endangered hawksbill sea turtle has been recorded occasionally. The green and hawksbill sea turtles are the only special-status species reported in Apra Harbor.

Sea turtles have been observed to nest during all months of the year on Guam, however the peak of nesting activity occurs from April to July. Sea turtles nesting activity has been reported from three Apra Harbor locations: Adotgan Dangkolo (Dangkolo) (green sea turtles), Adotgan Dikiki (Dikiki) (hawksbill sea turtle), and Kilo Wharf (green sea turtle) (COMNAV Marianas 2008). Historic records of sea turtle nesting include a hawksbill reported at a beach near Sumay Cove in 1997 and a general report of nesting at a beach near the Sea Plane Ramp (COMNAV Marianas 2007b) (refer to Figure 11.1-11). No activity has occurred at these areas since this reported event (COMNAV Marianas 2008, Navy 2009b). In general, turtles nest and hatch at night. They cue in on natural light to orient toward the ocean; however the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings into orienting away from the open ocean (COMNAV Marianas 2007b).

During Smith (2007) survey dives in the eastern Apra Harbor area, no hawksbill turtles were observed. Nine green sea turtles were observed, five of which were on Big Blue Reef. All turtles sighted were between 15 to 23 in (40 to 60 cm) in length, with no visible fibropapilloma tumors or other signs of injury. Balazs et al. (1987) identified ten genera of algae that he considered preferred forage for green sea turtles in Hawaii. Although algal surveys were not conducted, Smith (2007) suggests that more potential sea turtle resting habitat and preferred algal forage species were present on Big Blue Reef and the Fairway areas, where most turtle sightings occurred. Preferred forage genera observed included: Chlorophyta (green algae), *Dictyosphaeria* and *Ulva*; Phaeophyta (brown algae) *Sargassum*; Rhodophyta (red algae) *Gracillaria*, *Jania*, *Hypnea*, *Acanthophora* and *Laurencia*. Green sea turtles are probably

opportunistic feeders; however, within preferred food items listed above, three specific species (*dictyospheria versluisii*, *Sargassum obtusifolium* and *Acanthophora specifera*) have been reported from Guam (Lobban and Tsuda 2003) and were tentatively field identified on Big Blue Reef west and the Fairway Shoals. During the observation periods, none of the algae listed above were abundant at any of the study sites.

Spinner and common bottlenose dolphins are not expected to regularly occur within Apra Harbor (Navy 2005, NOAA 2005a). However, according to Roy Brown (personal communication, September 2007), spinner dolphins are noted on a rare, but somewhat regular basis within Apra Harbor. Brown runs dolphin tours throughout Guam's waters and estimates that spinner dolphins are seen up to four times a year within the outer harbor, as they enter the harbor in a small group for a few hours and then exit (COMNAV Marianas 2007a).

Critical Habitat

There is no critical habitat designation for any marine species on Guam.

Non-Native Species

Guam, particularly Apra Harbor, has been invaded by numerous nonindigenous species. However the spread and impact of the nonindigenous species to outside areas on Guam have been relatively limited. These species are relatively rare on natural reef bottoms, but abundant on artificial substrata (Paulay et al. 2002).

Opportunities for ballast transport of nonindigenous species has been fairly limited, and hull transport appears to have been the predominant avenue of invasion identified in Apra Harbor. A study of the fauna associated with two dry docks hauled from Hawaii and the preponderance of sessile organisms supports this conclusion (Paulay et al. 2002).

Paulay et al. (2002) recognized 85 nonindigenous species on Guam (see Volume 9, Appendix G). Forty-one species can be categorized as introduced and 44 as cryptogenic (unknown origin). Fourteen percent represent purposeful introductions, the rest accidental. Sessile organisms comprise 76% of the total and 86% among accidental introductions. Sessile nonindigenous species include numerous sponges, hydroids, anemones, bivalves, barnacles, bryozoans, and ascidians. Over half of these nonindigenous species (46) were restricted to artificial substrata (e.g., moorings, wharf structural supports, etc.).

Paulay et al. (2002) noted the lack of spreading to areas outside the harbor of well-established species in Apra Harbor, such as the Caribbean barnacle and the sponge *Ianthella basta*. The differences between invasion and impact on Guam and those in other locations (e.g., Pearl Harbor) is associated with several factors: shipping traffic is lower; Apra Harbor's reefs are still relatively intact with a diverse community, and therefore resistance to invasion by nonindigenous communities is higher. This was also observed by Lambert (2002), who found nonindigenous ascidians were extremely abundant on artificial surfaces in harbors and marinas around the world, however they rarely colonized adjacent natural benthic ecosystems. She also noted, along with Paulay et al. (2002), the specific confinement of nonindigenous ascidians to Apra Harbor without significant colonization on the outside reefs. This is quite different from other harbors and marinas around the world (e.g., Pearl Harbor, San Francisco Bay), where coastal areas have been invaded by nonindigenous species (Paulay et al. 2002, Lambert 2002).

Inner Apra Harbor

Inner Apra Harbor is a natural embayment formed by tectonic activity along the Cabras Fault, separating the volcanic Tenjo Block in central Guam from the limestone Orote Block immediately to the west. Two

ivers, the Apalacha and Atantano, drain the volcanic mountain land to the east of Apra Harbor and discharge into the inner harbor waters (Randall and Holloman 1974).

Although naturally formed, Inner Apra Harbor was dredged in the 1940s and used exclusively by the Navy. The only portion of the inner harbor remaining unchanged is the mangrove area at the mouth of the Atantano River (Smith et al. 2008). Inner Apra Harbor is approached through the Inner Apra Harbor entrance channel between Polaris Point and the former Ship Repair Facility (SRF), which allows entrance by vessels with a maximum draft of 33 ft (10 m). The eastern side of the entrance channel extends for approximately 1,804 ft (550 m) while the western side extends approximately 1,312 ft (400 m). The width of the entrance channel is 984 ft (300 m). The bottom of the inner or southern portion of the entrance channel is comparable to the floor of the inner harbor and is composed of fine calcareous sand. Moving seaward in a northerly direction the channel sediments become increasingly coarse, rock outcrops appear and hard corals become more common (COMNAV Marianas 2007b).

Inner Apra Harbor was dredged to a maximum depth of approximately 36 ft (11 m) in the 1940s. More recent maintenance dredging in 1978 and 2004 has maintained the original dredged depths that allow for safe navigation by seagoing vessels. Primarily because of the original and continued dredging, Inner Apra Harbor is dramatically different from Outer Apra Harbor. While Outer Apra Harbor supports a diverse community of corals, algae, fish and other organisms, Inner Apra Harbor is relatively devoid of marine life (COMNAV Marianas 2006b).

Marine Flora, Invertebrates and Associated EFH

The floor of Inner Apra Harbor is composed predominantly of sticky, fine sand and silty/muddy-type sediment that is easily resuspended (Smith et al. 2008). Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel. The closest area to the Inner Apra Harbor where corals occur on the seafloor is in the outer reaches of the entrance channel of the Inner Apra Harbor as described above. In this area corals present include *P. rus* and *P. cylindrica* (Navy 2005). Corals, both soft and hard, algae and most other sessile organisms require hard substrata on which to attach. The lack of hard substrata on the floor of the inner harbor may explain the lack of these groups (COMNAV Marianas 2006b). For further detail on the Inner Apra Harbor Entrance Channel habitat, please see Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary.

Although the fine silty sediment bottom of the inner harbor contains little life other than burrowing organisms, corals and other sessile fouling organisms are found growing on the upper half of vertical hard surfaces such as metallic sheet piles and concrete walls. Randall and Holloman (1974) reported living *Pocillopora* and *Porites* corals on the wharf and dock structures in the inner harbor. Paulay et al. (1996) found that artificial surfaces in the inner harbor supported diverse fouling communities, including both indigenous and introduced species. They noted the presence of *Porites convexa*, known in Guam from only a few locations. They also remarked on the abundance of the hammer oyster on wharf faces in Inner Apra Harbor. Three species of hard corals are dominant on these vertical surfaces: *Porites rus*, *P. lutea* and *Pocillopora damicornis*, all of which are common on Guam's reefs. These vertical surfaces act like artificial reefs and provide the hard substrata needed for attachment (COMNAV Marianas 2006b). These coral species were also found encrusting rocks and concrete debris, in addition to sheet pilings (Navy 2005).

A 2008 marine benthic survey of Inner Apra Harbor recorded 70 benthic taxa. Twenty eight of these species were corals and related organisms. Species richness was highest at X-ray Wharf, where eight

species occurred on the transect; only four species occurred at the other wharves and Abo Cove. Few corals were present on the inner harbor floor transects, and only small colonies of *Porites lutea* were observed on scattered pieces of debris and old pilings that provided the only hard substrata available for larval attachment. Thirty species of solitary macroinvertebrates were encountered; all were suspension feeders but three, those being detritus feeders. The greatest diversity was found at Victor Wharf, where bivalve mollusks and ascidians dominated in terms of diversity and density. These numbers, along with average species richness were low compared to results of similar surveys in other areas (Smith et al. 2008).

The most 'natural' site (Abo Cove) is significantly less taxon-rich than the wharf sites due to its mostly flat sediment-covered bottom and highly turbid conditions. Large specimens of *Caulerpa verticillata*, a green alga that copes well with increased sedimentation levels and low salinity, were found in Abo Cove, probably a result of relatively low herbivore pressure. The distribution of the seagrass species *Halophila japonica* also seems to be restricted to Abo Cove (Smith et al. 2008).

The benthic assemblages of the wharves contain interesting but very different taxa from Abo Cove. For example, the very abundant *Celleporaria sibogae* and the rather uncommon *Lichenopora* sp. are most likely new bryozoan records for Guam, although this group has been virtually unstudied in the region (Paulay 2003a).

Corals represent the majority of biotic assemblages at Abo Cove, while the wharves predominantly include encrusting macroalgae and sponges (Smith et al. 2008) (Figure 11.1-12).

Essential Fish Habitat

EFH-designated habitat areas in Inner Apra Harbor are described in Section 11.1.7.1, Outer Apra Harbor. All of Apra Harbor is considered EFH; however, neither Inner Apra Harbor nor the entrance channel are cited as being significant from an EFH perspective (COMNAV Marianas 2006b).

Finfishes, although present, are not abundant and are represented by only three families: Pomacentridae (damselfishes), Chaetodontidae (butterflyfishes), and Carangidae (jacks). The waters of the inner harbor are highly turbid with some areas having a visibility of less than a few feet. High turbidity in the inner harbor makes surveying fish difficult, and also decreases the amount of sunlight available to algae and corals (COMNAV Marianas 2006b). Smith et al. (2008) made limited qualitative assessments of habitat utilization by fish in the turbid waters. Overall, man-made structures (i.e., wharves provided relatively considerable habitat for a diverse array of fishes compared to the reef at Abo Cove or the harbor floor offshore from the wharves. Benthic species, such as cardinalfishes, damselfishes, and gobies favored corals, debris, sand, and soft corals, and the wharf wall and pilings. Species that were active swimmers, such as butterflyfishes, emperors, snappers, surgeonfishes, sweetlips, trevallys and jacks, etc., were found in the water column directly adjacent to the wharves.

On the reef at Abo Cove, cardinalfishes were observed with corals or rock, gobies with sand, mullet with rubble or sand, and a snapper was observed in the sand community. Visibility was very poor during this survey and it is expected that other species present along the wharf transects would be present as well, particularly at high tide. The harbor floor transects also were surveyed under conditions of poor visibility, but burrowing gobies associated with the fine sand were observed.

Figure 11.1-12

**Inner Apra Harbor
Transect Surveys
and Percent
Biotic Coverages**

Legend

- Military Installation
- Stream
- Wetlands/Mangrove
- Transect Line
- Green Sea Turtle Sighting
- Unconsolidated Sediment

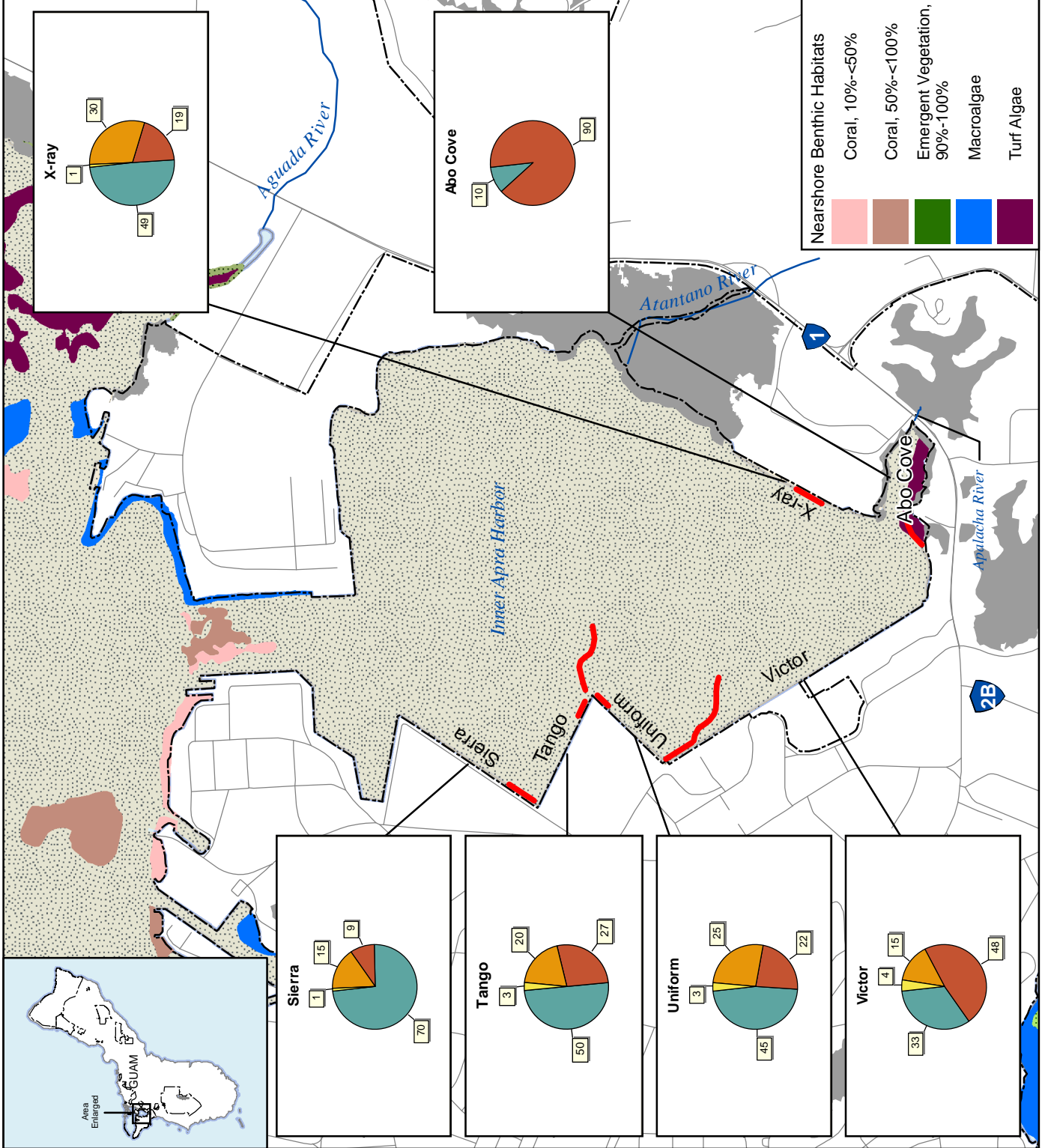
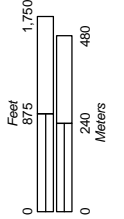
Pie Chart, % Biotic Coverages

- Sponges
- Algae
- Cnidaria
- Other

**Approximate Total
Benthic Biotic Coverage**

- Sierra 66%
- Tango 74%
- Uniform 63%
- Victor 66%
- Abo Cove 25%
- X-ray 63%

Source: Earth Tech 2008



Special-Status Species

No marine mammals are expected in Inner Apra Harbor and sea turtles are not expected on a regular basis, and considerably less frequent and in smaller numbers than in Outer Apra Harbor. A green turtle was observed on a recent marine benthic survey of Inner Apra Harbor (Smith et al. 2008) in waters between Abo Cove and the southern end of Victor Wharf, most likely foraging at the seagrass bed in Abo Cove. The individual observed was small (18 to 36 in [50 to 100 cm] carapace length). Considering the sponge community and other soft body invertebrates present on the wharves, the hawksbill sea turtle could also forage at this site, however are not of preferred species. No sea turtle nesting habitats have been identified and because of the fine-grained, muddy composition of the shoreline of Inner Apra Harbor, the beaches at this study area are not considered potential nesting sites for threatened and endangered sea turtles known to occur in Apra Harbor. The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex, and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. Aside from the recent green sea turtle observation (identified above) no other observations have been reported and no density information is available for Apra Harbor. However, if sea turtles are present within Inner Apra Harbor during construction activity, the proposed and associated underwater noise has the potential to affect the ESA-listed species by temporarily altering their behavior (i.e. changing their swimming, resting or feeding patterns).

There have been limited studies on green sea turtle hearing capabilities, but the available data suggests a hearing in the moderately low frequency range, and have relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999, Ketten and Bartol 1995). NOAA (2005 [pp 3-88 and 3-89]) identifies sea turtle hearing sensitivity, and includes the following information. The range of maximum sensitivity for sea turtles is 100 to 800 Hz, with an upper limit of about 2,000 Hz. Hearing below 80 Hz is less sensitive but still potentially usable to the animal (Lenhardt 1994). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz. They possess an overall hearing range of approximately 100 to 1,000 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 μ Pa-m (Lenhardt 1994).

TEI (2006) gathered unpublished data on hearing thresholds for green sea turtles from an Office of Naval Research hearing threshold study at the New England Aquarium and combined this data with other information (Ruggero and Temchin 2002) to present the hearing thresholds in Table 11.1-6. These data show similar results as above and provides the best available estimates for green sea turtle. The hearing bandwidth was relatively narrow, 50 to 1,000 Hz with maximum sensitivity around 200 Hz. And these animals have very high hearing thresholds at over 100 dB re 1 μ Pa in low frequencies where construction sound is concentrated.

Table 11.1-6. Hearing Thresholds and Bandwidth for Sea Turtles

<i>Hearing Bandwidth 1/3 Octave Band (Hz)</i>	<i>Hearing Threshold Sea Turtle (dB re 1 μPa)</i>
50	149
63	142
80	131
100	119
125	118
160	117
200	115
250	119
315	123
400	130
500	136
630	144
800	154
1,000	166

Source: TEI 2006, NEA 2005, and Ruggero and Temchin 2002.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Due to the distances of Adotgan Point, Kilo Wharf and the historic Seaplane Ramp nesting areas from the proposed action under Alternative 1, it is unlikely that any nesting-related activities would be affected by the action alternatives, including night work and the associated lights and noise. The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during nighttime construction operations. However, as mentioned previously, this site has not been active since a reported hawksbill nesting event in 1997.

Non-Native Species

Non-native species information for Inner Apra Harbor would be similar as described in Section 11.1.6.1. In general, nonindigenous species are abundant on artificial substrata (e.g., moorings, steel pile wharf supports).

11.1.7.2 Naval Base Guam

The LCAC/AAV laydown area, which includes amphibious operations facility and marine ramp, is proposed for construction on Polaris Point. The benthic community associated with the AAV's marine ramp would be the same as described under the Inner Apra Harbor section above (i.e. the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily resuspended. Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

11.1.7.3 Off Base Roadways

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

Roadway projects in the Apra Harbor region include pavement strengthening and intersection improvements and bridge replacements (on Route 1). Figure 11.1-13 shows representative photographs along Route 11 to the commercial port that are areas of proposed road improvement projects adjacent to marine environments within the Apra Harbor region study area. These projects include (1) rehabilitation of Route 11 from the commercial port to the Route 1 intersection, and (2) pavement strengthening along Route 1 from the intersection with Route 11 and Route 2A. Figure 11.1-10 shows the roadway projects, including bridge replacement locations, that may affect sensitive marine biological resources and habitats associated with the downstream or adjacent nearshore environment.



Left: View from Route 11 to northeast. **Right:** Cooling water canal (Approximately 5 ac (2 ha) with rip rap lining the sides. This canal connects the power plant near the Commercial Port along Route 11 to Piti Bay and the Philippine Sea.

Figure 11.1-13. Photographs of Marine Environmental Features along Route 11 (Commercial Port)

11.1.8 South

11.1.8.1 Naval Munitions Site

Baseline information for the areas in and adjacent to Naval Munitions Site (NMS) was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.2 Non-DoD Land

Baseline information for the areas in and adjacent to potential access road options A, B, and C was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.3 Off Base Roadways

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

Roadway projects in the southern portion of Guam include pavement strengthening and roadway modifications. None of the proposed roadway improvement projects within the South Region includes in-water construction, dredging, or land-based construction projects that would affect streams and/or marine biological resources; therefore, marine biological resources were not evaluated.

11.2 ENVIRONMENTAL CONSEQUENCES

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

11.2.1 Approach to Analysis

11.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to marine biological resources was based on federal laws and regulations including the ESA, MMPA, M-SA, Section 404(b)(1) of the CWA, and EO 13089, *Coral Reef Protection*. Significant marine biological resources include all special-status species including species that are ESA-listed as threatened and endangered or candidates for listing under ESA, species protected under the MMPA, or species with designated EFH or HAPC established under the M-SA. The M-SA defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. 'Substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities. 'Necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem, and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (16 USC 1801 et seq.). Additionally, at least one or more of the following criteria established by the NMFS must be met for HAPC designation: 1) the ecological function provided by the habitat is important; 2) the habitat is sensitive to human-induced environmental degradation; 3) development activities are, or will be, stressing the habitat type; or 4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth HAPC criterion, not established by NMFS, that includes areas that are already protected, such as Overlay Refuges (WPRFMC 2005). Section 404(b)(1) Guidelines (Guidelines) of the CWA is in essence a Memorandum of Agreement (MOA) between the USEPA and U.S. Department of the Army (Army), to articulate policies and procedures to be used in the determination of the type and level of mitigation necessary to demonstrate CWA compliance. The MOA is specifically limited to the Section 404 regulatory program and does not change substantive Section 404 guidance. The MOA expresses the intent of the Army and USEPA to implement the objective of the CWA to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, including special aquatic sites (SAS). SAS are those sites identified in 40 CFR 230, Subpart E (i.e., sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes). They are geographic areas, large or small, possessing special ecological characteristics of

productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region.

In general, the main intentions of the three federal acts listed above are as follows:

- The ESA establishes protection over and conservation of threatened and endangered species and the ecosystems upon which they depend, and requires any action that is authorized, funded, or carried out by a federal entity to ensure its implementation would not jeopardize the continued existence of listed species or adversely modify critical habitat.
- The MMPA was established to protect marine mammals by prohibiting take of marine mammals without authorization in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.
- The M-SA requires NMFS and regional fishery management councils to minimize, to the extent practicable, adverse effects to EFH caused by fishing activities. The M-SA also requires federal agencies to consult with NMFS about actions that could damage EFH.
- The CWA Guidelines set forth a goal of restoring and maintaining existing aquatic resources, including SAS (i.e. coral reefs, wetlands etc.).

The ESA, MMPA, and M-SA require that NMFS and/or USFWS be consulted when a proposed federal action may adversely affect an ESA-listed species, a marine mammal, EFH or HAPC. In addition, while all habitats are important to consider, ‘coral reef ecosystems’ are perhaps the most important habitats and the analysis of this SAS is included under EFH. As a note, EO 13089 also mandates preservation and protection of U.S. coral reef ecosystems that are defined as “... those species, habitats and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction and control of the U.S.”.

The CWA guidelines and the subsequent MOA requires the EPA and Army to implement the objectives of the CWA. For dredging activities, the U.S. Army Corps of Engineers (USACE) first makes a determination that potential impacts have been avoided to the maximum extent practicable (striving to avoid adverse impacts); remaining impacts would be mitigated the extent appropriate and practicable by requiring steps to reduce impacts; and finally, compensate for aquatic resource values. This sequence is considered satisfied where the proposed mitigation is in accordance with specific provisions of a USACE and USEPA approved comprehensive plan that ensures compliance with the compensation requirements of the Guidelines Determination of Significance.

Best Management Practices and Protective Measures

The implementation of appropriate resource agency (USFWS/NOAA/NMFS) BMPs, construction and industrial permit BMPs, Navy Low Impact Development (LID) concept plans and Industrial Management Practices (IMPs), USACE permit conditions, and general maritime measures in place by the military and USCG is assumed for each resource and anticipated to reduce any construction- and operation-related impacts to marine biological resources. With respect to possible construction impacts on the nearshore marine environment, the implementation and management of such plans would reduce/eliminate any construction-related stormwater runoff into the nearshore environment. The LID concept plan would support master planning activities, and through these joint efforts, a sustainable development strategy would be implemented where pre-construction site hydrology would be equal or nearly equal to post-construction hydrology. Stormwater would be treated for pollutants prior to discharge to the porous ground surface. Other avoidance and minimization measures employed during operations, including the

use of “green bullets” composed of non-toxic alloys and periodic benthic cleanup, would be used to decrease potential impacts.

General maritime protective measures in place by the military (which may apply to ranges with SDZs overwater) include lookouts trained to sight marine mammals or sea turtles. Specific duties include the following (U.S. Fleet Forces 2007):

- All commanding officers, executive officers, lookouts, and officers of the deck (or range) complete the NMFS-approved Navy Marine Species Awareness Training, which is a DVD-based instructional course. All bridge (or range) watchstanders/lookouts would complete both parts one and two of the Marine Species Awareness Training; part two is optional for other personnel. This training addresses the lookout’s role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.
- Navy lookouts undertake extensive training in order to qualify as a watchstander in accordance with the *Lookout Training Handbook* (NAVEDTRA 12968-B).
- Lookout training includes on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).
- Lookouts are trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

The *Environmental Handbook for Trainers* further states the following:

- Survey the area after each exercise for any harmful objects, abandoned wire, netting and other debris that poses a danger to people and wildlife.

A detailed listing of BMPs is provided in Volume 2, Chapter 4, Water Resources, and in Volume 7 of this EIS/OEIS.

11.2.1.2 Determination of Significance

This section analyzes the potential for impacts to marine biological resources from implementation of the action alternatives and the no-action alternative. Factors considered in the analysis of potential impacts to marine biological resources include: (1) importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; (2) proportion of the resource that would be affected relative to its occurrence in the region; (3) sensitivity of the resource to proposed activities; and (4) duration of ecological ramifications. The factors used to assess significance of the effects to marine biological resources include the extent or degree that implementation of an alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community. The following significance criteria were used to assess the impacts of implementing the alternatives:

- The extent, if any, that the action would diminish suitable habitat for a special-status species or permanently lessen designated EFH or HAPC for the sustainment of managed fisheries.
- The extent, if any, that the action would disrupt the normal behavior patterns or habitat of a federally listed species, and substantially impede the Navy’s ability to either avoid jeopardy or conserve and recover the species.

- The extent, if any, that the action would diminish population sizes or distribution of special-status species or designated EFH or HAPC.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any special-status species or result in the destruction or adverse modification of habitat of such species or designated EFH or HAPC.
- The extent, if any, that the action would permanently lessen physical and ecological habitat qualities that special-status species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would result in a substantial loss or degradation of habitat or ecosystem functions (natural features and processes) essential to the persistence of native flora or fauna populations.
- The extent, if any, that the action would be inconsistent with the goals of the Navy's Integrated Natural Resources Management Plan (INRMP).

The MMPA generally defines harassment as Level A or Level B, and these levels are defined uniquely for acts of military readiness such as the proposed action. Public Law 108-136 (2004) amended the MMPA definition of Level A and Level B harassment for military readiness events, which applies to this action.

- Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild.
- Level B harassment is now defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behaviors are abandoned or significantly altered." Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may cause Level B harassment.

ESA specifically requires agencies not to "jeopardize" the continued existence of any ESA-listed species, or destroy or adversely modify habitat critical to any ESA-listed species. Under Section 7, "jeopardize" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution. Section 9 of the ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.

Effects determination for EFH are either "no adverse effect on essential fish habitat" or "may adversely affect essential fish habitat" (WPRFMC 2005). Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity EFH. Adverse effects to EFH require further consultation if they are determined to be permanent versus temporary (NMFS 1999). To help identify Navy activities falling within the adverse effect definition, the Navy has determined that temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 FR 2354) were used as guidance for this determination, as they highlight activities with impacts that are more than minimal and not temporary in nature, opposed to those activities resulting in inconsequential changes to habitat. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (67 FR 2354). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (67 FR 2354). Whether an impact is minimal would depend on a number of factors (Navy 2009a):

- The intensity of the impact at the specific site being affected

- The spatial extent of the impact relative to the availability of the habitat type affected
- The sensitivity/vulnerability of the habitat to the impact
- The habitat functions that may be altered by the impact (e.g., shelter from predators)
- The timing of the impact relative to when the species or life stage needs the habitat

The analysis of potential impacts to marine biological resources considers direct, indirect, and cumulative impacts (refer to Volume 7 of this EIS/OEIS for the cumulative impacts analysis). The *Council on Environmental Quality (CEQ), Section 1508.08 Effects*, defines direct impacts as those caused by the action and occur at the same time and place, while indirect impacts occur later in time or farther removed in distance, but are still reasonably foreseeable. Direct impacts may include: the removal of coral and coral reef habitat, the “taking” of special-status species, increased noise, decreased water quality, lighting impacts resulting from construction or operation activities. Indirect impacts, for the purposes of this evaluation, may include any sedimentation/siltation of coral reef ecosystems resulting from construction or operational activities (i.e., dredging, resuspension of sediment via propeller wash), recreational activities in the vicinity of the resource that may lead to impacts to special-status species and EFH.

If marine biological or aquatic resources could be significantly impacted by proposed project activities, potential impacts may be reduced or offset through implementation of appropriate BMPs and/or mitigation measures. "Significantly" as used in NEPA Per (per 43 FR 56003, November 29, 1978; 44 FR 874, January 3, 1979) requires considerations of both context and intensity:

- Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
- Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the Habitat Equivalency Analysis (HEA) Volume 9. These communities are not considered to be coral reef (per USACE definition of what constitutes a coral reef), and therefore are not subject to compensatory mitigation.

11.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to marine biological resources that could be impacted by the proposed action. As part of the analysis, concerns relating to marine biological resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. A general account of these comments includes the following:

- Potential impacts on the Apra Harbor marine environment from CVN berthing, fully documenting impacts from dredging (acreage and ecosystem characteristics of affected area, depth of dredging operations, duration of affects)
- Potential impacts to endangered species (including nesting habitats), species of concern, and federal trust species such as corals and marine mammals
- Potential impacts from military expansion from all project sites on the marine resources, including removal or disturbance of the marine habitat
- Impacts to culturally significant marine-related areas for subsistence fishing and beliefs

- Increased “high impact” recreational use that would damage the ecosystem and impact fish habitat (e.g., Sasa Bay Marine Reserve)
- Increased land runoff impacting beaches and marine life (erosion and sediment stress)
- Increased anthropogenic factors impacting the coral reef ecosystem and concerns about the education and training that would be provided for newly arriving military personnel and their dependants regarding reef protection
- Mitigation measures and non-structural alternatives to avoid and minimize impacts to coral reefs

11.2.2 Alternative 1

11.2.2.1 North

Andersen AFB

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would occur from construction or operations.

Finegayan

Construction

Construction of the main cantonment, family housing, and community support facilities would take place at Finegayan under Alternative 1. The main cantonment land use functions include bachelor housing, supply warehouses, maintenance facilities, various headquarters and administrative support facilities, community support functions (e.g., retail, education, recreation, medical, day care, etc.), some training areas, and open space.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permit BMPs and IMPs discussed in Section 11.2.1.1. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Potential impacts to species with FMP would be addressed accordingly under Essential Fish Habitat.

Essential Fish Habitat. No direct impact on these resources are expected with the implementation and management of appropriate construction permit BMPs and IMPs. These resources would not be appreciably modified from existing conditions by indirect impacts. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. However, an increase in recreational use of Haputo ERA may be seen through such activities as dive boat tours. Indirect impacts would not be significant, and there would be no adverse effect to EFH. Alternative 1 would result in less than significant impacts to fish and EFH.

Special-Status Species. No direct impact on this resource is expected with the implementation and management of appropriate construction permits BMPs and IMPs.

This resource would not be appreciably modified from existing conditions by indirect impacts. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of

Alternative 1. Green sea turtles may be minimally, but not adversely affected; therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-native species. There would be no direct impact to this resource. No in-water construction, dredging, or training activities are proposed in the marine environment; therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased boating-related recreational activities (e.g., personnel boats and dive tours) associated with construction personnel which has the potential for transport of non-native species to and from other locations within the Mariana Islands chain. This increase above existing conditions is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and IMPs and existing Navy and USCG policies as discussed in the existing conditions section. Therefore, Alternative 1 would result in a less than significant impact regarding non-native species introduction.

Operation

Potential operations effects of implementing the proposed action in the Finegayan area would occur in the Haputo ERA. Because the Haputo shore area is relatively accessible, many of the marine biological resources discussed in this chapter may be adversely affected by indirect, long-term recreational activities due to the substantial increase of people potentially using Haputo ERA and coastal waters as a result of the proposed action (Figure 11.2-1). Recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing) may result in indirect loss of Haputo ERA habitat. This is a significant impact that can be mitigated through the implementation of mitigation measures such as natural resource educational training and public outreach, controlled access (a short video and access pass required before entry), informational documents (i.e., preparation of a *Military Environmental Handbook*, distribution of natural resource educational materials to dive boat operators); multiple designated mooring areas offshore; and increased efforts toward ERA enforcement (starting with Haputo) of “no take” and other ESA, MMPA, and EFH policies.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial stormwater pollution prevention plans and BMPs as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. No direct impact on these resources is expected with the implementation and management of appropriate industrial permits and BMPs for the reasons provided above.

Considering the dramatic increase of operations-related (military) personnel and their dependents working and living at Finegayan (see Volume 2, Section 2.1), an increased usage of Haputo ERA and adjacent coastal waters for recreational activities is expected. This increased usage has the potential for long-term reduction of the quality and/or quantity of CREMUS (specifically coral) (Table 11.2-1). The WPRFMC FEP for the Mariana Archipelago (2005) identifies “fishing related and non-fishing related impacts that may adversely affect EFH,” in Sections 6.4 and 6.5, respectively, of this FEP. One or more of these impacts described may apply to this study area. Alternative 1 may adversely affect EFH. Though implementation and enforcement of appropriate BMPs and mitigation measures would reduce effects, Alternative 1 would result in significant impacts to fish and EFH. These impacts are mitigable to less

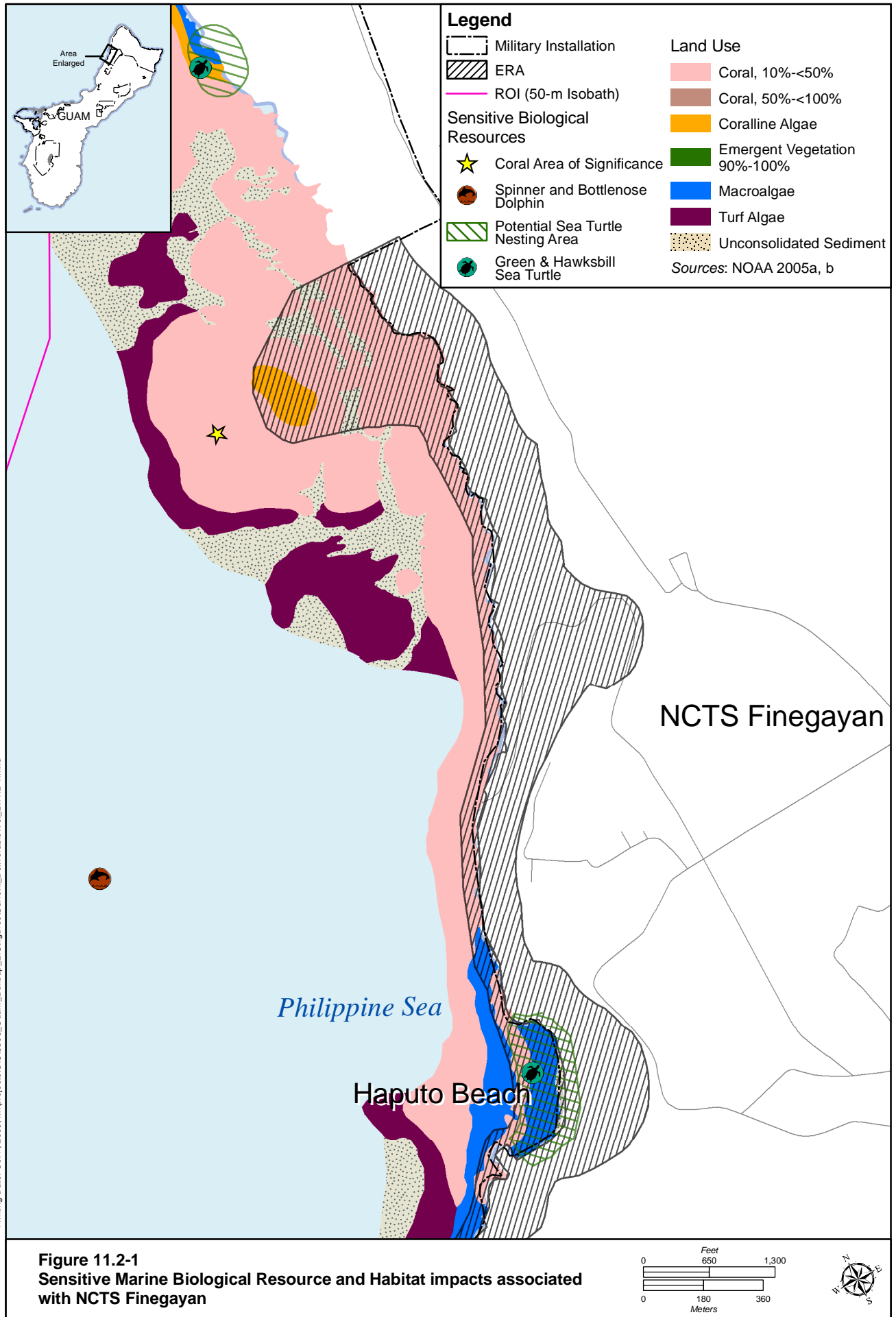


Figure 11.2-1
Sensitive Marine Biological Resource and Habitat impacts associated with NCTS Finegayan

than significant through implementation and management of mitigation measures described in Volume 7.

Table 11.2-1 identifies the potential effects associated with fish and EFH.

Table 11.2-1. EFH Areas Associated with Finegayan and Potential Effects

<i>EFH Habitat Description</i>	<i>Area of Occurrence</i>	<i>Associated Activity</i>	<i>Effect</i>
Coral and Coral Reef Ecosystems	Haputo ERA, including Double Reef, coral reef ecosystem outside ERA, including off-shore of Haputo Beach	Increased recreational activity	Potential long-term reduction in the quality and/or quantity of EFH through long-term, periodic and localized degradation.
Marine Water Column	Haputo ERA and coral reef ecosystem outside ERA	Increased recreational activity	Direct, long-term, periodic and localized.
Intertidal Zones	NCTS Finegayan Coastline	Increased recreational activity	Direct, long-term, periodic and localized.

Special-Status Species. No direct impact on this resource is expected with the implementation and management of appropriate industrial permits and BMPs described above and in Volume 7.

There may be long-term, indirect adverse impacts on this resource due to the considerable increase of operational personnel and their dependents using the Haputo ERA and adjacent coastal waters for recreational activities. Increased dive boat operations have the potential for increased turtle and marine mammal harassment and strikes, impacting special-status species. Considering the mobility of sea turtles and dolphins in the water, and the protective measures anticipated to be in place (i.e., by dive boat operators and Navy), these increased recreational activities would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Thus, sea turtles may be affected, but are not likely to be adversely affected with the implementation Alternative 1 actions. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Therefore, Alternative 1 would result in less than significant impacts to special-status species.

Sea turtle nesting areas may be affected by one or more jeopardizing actions as described under Sections 7 and 9 of the ESA. Implementation and enforcement of appropriate mitigation measures would reduce impacts, possibly from significant to less than significant with the possibility of a beneficial effects outcome compared with existing conditions. These potential impacts to nesting sea turtles are addressed further under Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-Native Species

There would be no direct impact to this resource. No in-water operation or training activities are proposed in the marine environment, therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased boating-related recreational activities (e.g., personnel boats and dive tours) associated with operation-based personnel which have the potential for transport of non-native species to and from other locations within the Mariana Islands chain. This increase above existing conditions is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and existing Navy and USCG policies as discussed in the existing conditions section. Therefore, Alternative 1 would result in a less than significant impacts regarding non-native species introductions.

Non-DoD Land

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would result from the proposed action.

11.2.2.2 Central

Andersen South

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would result from either construction or operations associated with the proposed action.

Non-DoD Land

Construction

As described in Section 2.3.1 Alternatives Development, Volume 2, to minimize the non-DoD land required, planning density assumptions were re-evaluated. There are two alternatives for the Route 15 Range Lands firing range complex:

- Alternative A. All ranges would be on the plateau area of the Route 15 lands. This training option would require realignment of Route 15 to accommodate the machine gun range. Land available for other land uses at Andersen South would be reduced (refer to Figure 2.3-6).
- Alternative B. The machine gun range would be sited in the valley and all other ranges would be sited on the plateau area of the Route 15 Range Lands. There would be no realignment of Route 15, no impact to available land at Andersen South, and would not require more land acquisition or long term leasing than training Alternative A (refer to Figure 2.3-7).

The impacts described below would be similar for either Alternative A or B.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, and the minimal runoff from the limestone landscape. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be short-term and localized, negligible indirect impacts to fish and EFH due to the increase of construction personnel and their dependents using the adjacent coastal waters for recreational activities. The potential for long-term reduction of the quality and/or quantity of CREMUS (specifically corals) of the EFH does not exist for the following reasons: the shoreline is exposed to dominant winds, wave action and storms and is not readily accessible by land or boat; and the construction project is not as large as other areas (e.g., NCTS Finegayan). As a result, no adverse indirect effects are expected to EFH, therefore impacts would be less than significant from Alternative 1 proposed actions.

Special-Status Species. A less than significant indirect impact to this resource is expected from construction-related recreational activities for similar reasons as described above in EFH. Additionally, special-status species are not as common on this coast compared to others around Guam and there are no sea turtle nesting areas (see operation description below for elaboration). No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of

Alternative 1. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA, thus sea turtles would not be adversely affected. Therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-native species. There would be no direct impact to this resource. No in-water construction, dredging, or training activities are proposed in the marine environment. Increased boating-related activities associated with construction personnel have the potential for transport of non-native species to and from other locations within the Mariana Islands chain; however, the access to this rough water coast is difficult. Therefore no major direct or indirect conduit exists for introduction of non-native species into the marine environment.

Any potential introduction/transport of non-native species would be lessened or even prevented through appropriate BMPs and existing Navy and USCG ballast water policies and the DoD-funded Biosecurity Risk Assessment and Management Plan, as discussed in the existing conditions section. Consequently, Alternative 1 would result in a less than significant impact regarding introduction of non-native species.

Operations

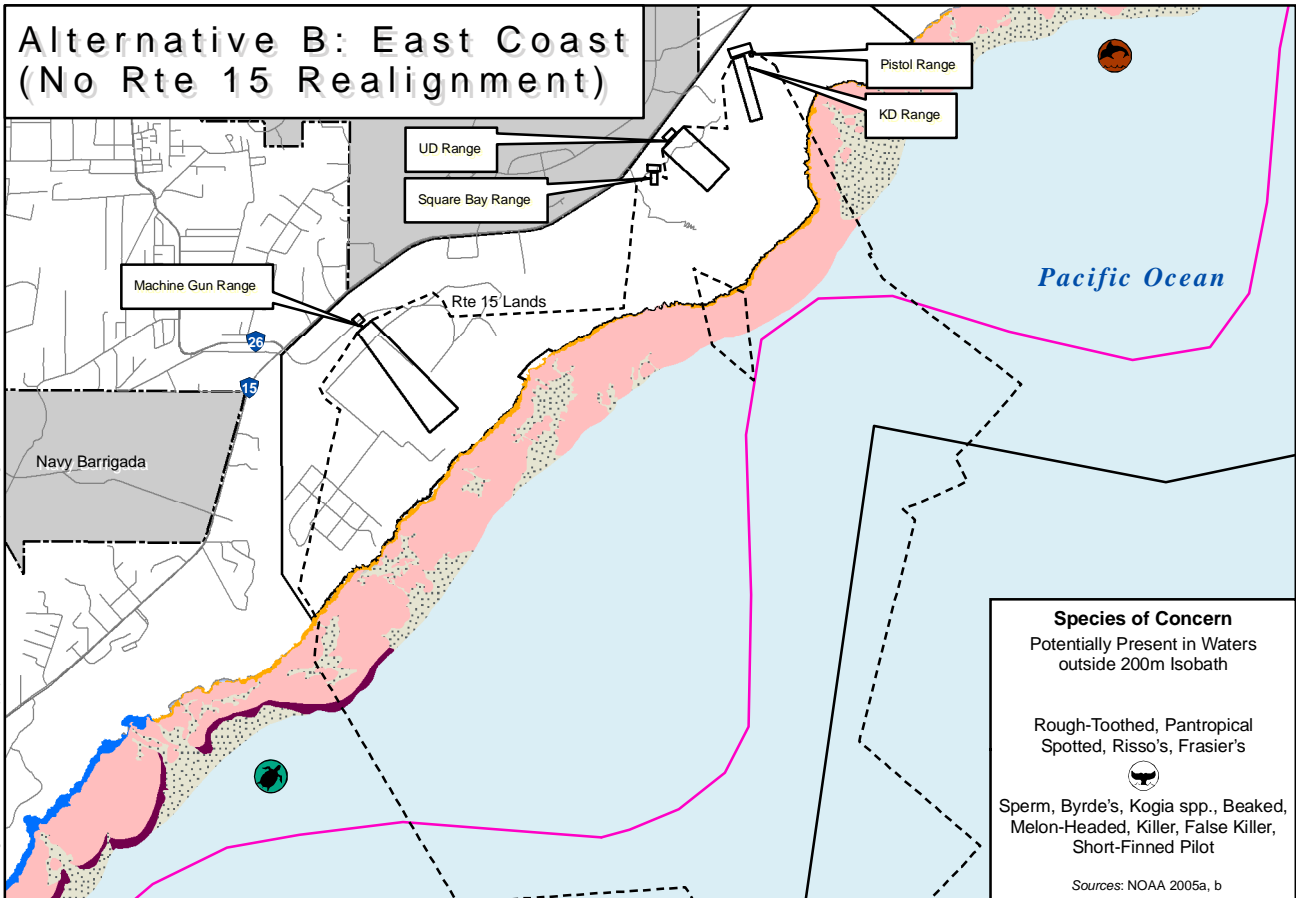
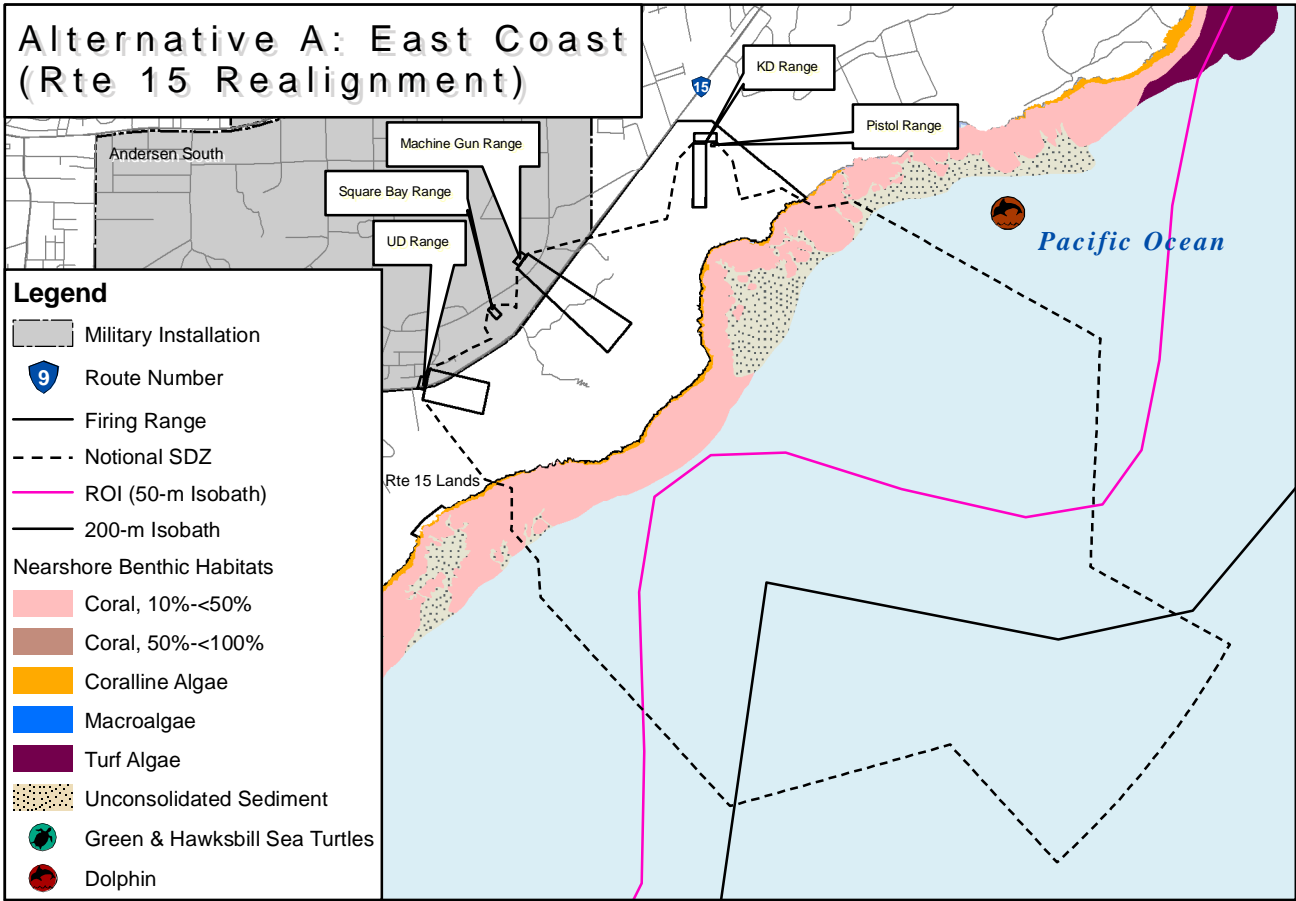
Because the Route 15 Range Lands shore area is not readily accessible (compared to the Haputo ERA), marine biological resources would be minimally impacted by indirect, long-term recreational activities from increased personnel using the coastal waters (Figure 11.2-2). Increased recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing), may occur and result in indirect loss of habitat offshore if not properly mitigated. Range activities, specifically the SDZs, are analyzed for potential impacts on marine mammals in the offshore waters in the following *Special-Status Species* subsection below.

Marine Flora, Invertebrates and Associated EFH. These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial permits and BMPs as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be no direct impact on these resources as described above.

There would be minimal indirect impacts to EFH from recreational activities of operations personnel and their dependents. Impact assessment reasoning is similar as that as described above under *Construction*. Additionally, there would be a beneficial impact to nearshore communities due to limited and controlled access at the coastline during training operations.

There would be long-term, localized accumulation of small arms (.50 cal and MK19 TP) expended materials in the benthic habitat from the firing range operations. There would be limited potential for ingestion (Navy 2009a). Avoidance and minimization measures (see Section 11.2.1.1), including the use of “green bullets” and periodic benthic cleanup, would be employed to decrease potential impacts. The “green bullets” are composed of non-toxic alloys and would not contaminate the surrounding areas or marine benthic habitat if munitions land in the water or were ingested. Therefore, no adverse affects to EFH would occur, and Alternative 1 would result in less than significant impacts to fish and EFH.



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Figure 11.2-2
Sensitive Marine Biological Resource and Habitat impacts associated with Rte 15 Range Lands, Guam

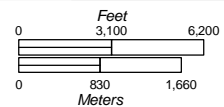


Table 11.2-2 includes information on the EFH types present in the study area and potential effects.

Table 11.2-2. EFH Areas Associated with Route 15 Range Lands and Potential Effects

<i>EFH Habitat Description</i>	<i>Area of Occurrence</i>	<i>Associated Activity</i>	<i>Potential Effect</i>
Coral and Coral Reefs	Pagat Point, live coral coverage area (10% -<50%).	Increased indirect recreational activities	Potential for less than significant reduction in the quality and/or quantity through long-term, periodic and localized degradation offset by limited access during training activities and mitigation.
Intertidal Zone	Route 15 Lands Coastline	Increased recreational activity and range fire w/in SDZ	No Effect
Benthic Habitat	Pagat Point	Range Activities	Minimal effect from inert expended munitions build up on the bottom.

Special-Status Species. There would be a less than significant direct impact to special-status species from range operations based on the assessment below.

Figure 11.2-2 identifies the special-status species potentially present in coastal waters (Navy 2005), and depicts the surface danger zones SDZs for the training area. The potential for range training activities to lead to Level B harassment as defined by the MMPA (Section 11.2.1.2), or impact the ESA-listed sea turtle would be negligible for the following reasons.

Special-status species, although potentially present within the ROI and offshore, are not common (NOAA 2005a). NOAA (2005a) does not list either of these special-status species (dolphins or sea turtles) as notably present within these coastal waters.

General maritime measures and range operations in place by the military include lookouts to keep vessels out of the SDZs and trained personnel to sight marine mammals or sea turtles. It is also anticipated that preventative measures would be developed by the military for activities at Route 15 Range Lands (among other areas) and would be described in Range and Training Regulations, Standing Operating Procedures for Range Control and revised Navy INRMPs. Actions described in these documents are standard operating procedures that would be used in the future for all activities being analyzed in this EIS/OEIS. Activities at the Route 15 Range Lands on Guam would use up to .50 caliber and MK19 TP, which are essentially inert, so there would be no explosive projectiles involved. All projectiles would be contained within the range footprint by bullet traps or backstops, with the exception of ricochets, which by statistical analysis could escape the range but would be contained within the SDZs.

Although the SDZs extend off the cliff and over the water (refer to Figure 11.2-2), all anticipated rounds would impact and be contained within the range. However, as these waters support visits by the special-status species and potential impacts may include direct strike or debris ingestion, estimates of the annual level of munitions and those that statistically may land in the water from the Route 15 Range Land are provided in Table 11.2-3. As only smaller munitions (in effect, .50 caliber) would be used, this would pose an even lower magnitude of risk to special-status species.

Table 11.2-3. Annual Use of Proposed Outdoor Ranges on Guam under All Alternatives

Range	Weapon	Ammunition Type	Hours of Use	Typical Daily Use			Monthly Use	Annual Number Rounds
				Days/Yr ^(a)	Rounds Day	Night		
Rifle KD	Rifle	5.56 mm		225	15,000	0	Jan - Dec	3,375,000
Pistol	M9	9 mm		225	7,000	3,000	Jan - Dec	2,250,000
Square Bay	Rifle	5.56 mm		225	4,523	2,227	Jan - Dec	1,518,750
	Pistol	9 mm		225	3,769	1,856	Jan - Dec	1,265,625
UD	Rifle	5.56 mm		225	12,750	2,250	Jan - Dec	3,375,000
Machine Gun	Machine Gun	.50 cal		225	640,000	0	Jan - Dec	144,000,000
	Machine Gun	7.62 mm		225	512,000	0	Jan - Dec	115,200,000
	MK 19 Grenade Machine Gun	40 mm		225	112,000	0	Jan - Dec	25,200,000
Hand Grenade	M67 Fragmentation	N/A		48 or 225	96	0	Jan - Dec	4,608 or 21,600
Demolition	N/A	TNT (\leq 20 lb)		36 or 48	360	0	Jan - Dec	N/A
Total								296,184,375^(b)

Legend: cal = caliber; mm = millimeters; N/A = not applicable; KD= Known Distance; UD= Unknown Distance.

Notes: ^(a)Hand grenade and demolition ranges would be used approximately 4 days/ month; all other ranges would be used 5 days/week, 45 weeks/year.

^(b)Total is for small arms only and does not include use of demolition or hand grenade ranges.

Conservative munitions strike probability, as described below for the spinner dolphin, would be significantly less than ($< 2.3 \times 10^{-8}$), hence negligible. Other larger marine mammal species present outside the 655-ft (200-m) isobath are less common and include only a small representative portion of the SDZ and ocean surface area.

MUNITIONS STRIKE PROBABILITY. An analysis was conducted using Army (1995) methodology to examine the probability of direct strikes to special-status species and the resultant total number of potential strikes based on the annual number of munitions that may land in the water and the density of dolphins within SDZ areas identified off the Route 15 Range Lands. The probability of a direct strike was determined by first calculating the area of the potential strike surface (approximately 13,107,199 m²) and multiplying it by the total number of rounds that may enter the water (~75%). The area of the potential strike surface is a dolphins dorsal surface area multiplied by the species density in that location and at the surface based on year-round average estimates. The estimate of bottlenose dolphin surface area was calculated (a more conservative estimate than the smaller and more common spinner dolphin and considerable greater than a sea turtle) as 15,339 square ft [ft²] (1.425 square meters {(m²)}) (or the average length of 9.35 ft times 2.85 m) times the average body width of 1.6 ft [0.5 m]). The total annual number of small arms rounds at the Route 15 Range Lands is 296,184,375. The total number of rounds that may land in the SDZ and Pacific Ocean, based on a .001% (conservative) non-containment of munitions, is approximately 3,000 annually. Probabilities of a direct strike were calculated for the spinner dolphins for the area off Route 15 Range Lands.

The likelihood of a direct strike would be negligible and an analysis was not conducted for other special-status species as the probability of a direct strike would be less. Due to the low probability of projectiles strike and the implementation of preventative measures (observers, etc.), there would be a very low probability that projectiles would come in contact with a marine mammal or sea turtle. An even less likely scenario would be an injury to an animal given that the velocity of the projectile would have significantly

decreased due to the distance from the range. Additionally, due to the inert quality of the munitions, there would be negligible ingestion effects to special-status species.

Table 11.2-4 lists the probabilities of direct impact to spinner dolphins from munitions that may land in the water.

Table 11.2-4. Potential for Direct Strike of Munitions on Marine Mammals from the Route 15 Land Range – Alternative 1

<i>Species</i>	<i>Species Density</i>	<i>Probability of Direct Strike</i>	<i>Annual Estimate of Dolphin Potentially Impacted by Direct Strike</i>
Spinner Dolphin	1.43 m ²	2.3 X 10 ⁻⁸	Significantly less than 2.3 X 10 ⁻⁸

This conservative analysis assumes that a dolphin would be present on the surface within the SDZ 100% of the time and confirms that the risk of the probability of direct strike is very low. The annual estimates would be substantially lower due to the low to moderate occurrence of marine mammals (and sea turtles) within the ROI (NOAA 2005a) and that they would be below the surface for a percentage of the time.

Indirect impacts to special-status species would be similar to those described in the *Construction* section. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native species. Impacts to this resource would be similar as described in the *Construction* section. Alternative 1 would result in no impacts regarding the introduction of non-native species.

Barrigada

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would occur as a result of construction and operations associated with the proposed action.

Piti/Nimitz Hill

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment, therefore, no impacts to marine biological resources would occur as a result of construction and operations associated with the proposed action.

Apra Harbor

Project activities occurring in Apra Harbor may negatively impact marine or estuarine organisms or habitats. The embarkation operations would support amphibious transportation of Guam-based Marines to and transiting amphibious forces for potential contingency, humanitarian efforts, and exercise operations in the Pacific Theater. The Navy’s Amphibious Ready Groups and the Marine Expeditionary Units (MEU) are transient forces that have traditionally come to Guam for port visits and training. These and other amphibious task force visits would occur more frequently with the relocation. The MEU embarkation ships currently come into port four times per year. This frequency would increase under Alternative 1. The escort ships for the MEU are the same types of ships that would support the CVN (refer to Volume 4 of this EIS/OEIS for an assessment of CVN impacts). Typically, there would be three

ships carrying amphibious vessels and four combatant ships that escort the amphibious ships. Transport of Marines and supplies between Guam and the CNMI would likely occur via High Speed Vessels (HSVs). The HSVs would be homeported in Guam and are a new type of vessel for Apra Harbor.

There are general purpose Navy wharves in Inner Apra Harbor that the amphibious task force currently uses. The proposed increase in the number of amphibious task force visits, the class of ships that would be homeported, and the utilities that would be needed would require a new embarkation area for loading and unloading of ships and a new amphibious vehicle laydown area. There would be four waterfront facility projects to support the proposed action.

Vessel operations within Apra Harbor would be expected to increase proportionally to support increased embarkation training activities under the proposed action.

Construction dredging, including tug and scow transport of dredged materials, and pier rehabilitation associated with Alternative 1 would be limited to areas of Inner Apra Harbor that have been previously dredged. These operations and construction-related projects were addressed to assess potential disturbances to marine biological resources including flora and invertebrates, fish and EFH, special-status species and non-native species. The activities addressed include: embarkation and support ship berthing (embarkation operations, HSV berthing, escort ship berthing); Amphibious Vehicle Laydown Area and ramps construction, new USCG ship berthing, construction-related projects; and the increased small boat, HSV, and escort ship traffic within Apra Harbor. Documents from a variety of sources including Navy, NOAA NMFS, and individual scientific investigators are referenced for analysis of potential impacts to marine biological resources.

Outer Apra Harbor

Construction

Marine Flora, Invertebrates and Associated EFH. This resource would not be appreciably modified from existing conditions. Impacts to this resource would be short-term and minor from Alternative 1 actions. Impact assessment reasoning is similar to that described below in Fish and EFH. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact on these resources. Table 11.2-5 includes information on the EFH types present in the study area and potential effects.

Table 11.2-5. EFH Areas Associated with Outer Apra Harbor and Potential Effects

<i>EFH Habitat Description</i>	<i>Area of Occurrence</i>	<i>Associated Activity</i>	<i>Potential Effect</i>
Coral and Coral Reef Ecosystems	Shoal, Sasa Bay, and Entrance Channel Areas	Increased sediment resuspension and vessel traffic	Temporary and episodic minor behavioral responses to fish MUS and impact to coral polyp spawning survival.
Marine Water Column	Apra Harbor and Turning Basin	Increased vessel traffic	Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Water Column	Sasa Bay	Increased vessel traffic	Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Benthic Habitat	Sasa Bay	Increased vessel traffic and sediment resuspension	Temp. and episodic disturbances
Submerged Aquatic Vegetation	Sasa Bay	Increased vessel traffic	No effect

There may be minor impacts to this study area from Inner Apra Harbor dredging-related sedimentation during receding tidal actions carrying the sediment plume toward the Entrance Channel and Outer Apra Harbor. The turbidity levels are not expected to increase above existing conditions in Outer Apra Harbor with the implementation USACE permit BMP conditions (i.e., silt curtains). Short-term behavioral responses to noise are expected from finfish during dredging operations, which may temporarily inhibit entrance to Inner Apra Harbor. This temporary impact is less than significant.

It is estimated that a tug and scow would make one round trip/day for 6 to 8 months for dredged material disposal. See Volume 2, Chapter 14, Marine Transportation for detailed description. The vessels would adhere to the channel centerline, use the existing Outer Apra Harbor navigational channel to the ocean dredged disposal site, and return to Inner Apra Harbor. This increase of vessel movements would result in short-term and localized disturbances to the water column and organisms living in or on the shallow portions of the benthic substrate due to propeller wash and resuspension of sediments. Short-term behavioral and/or physiological responses to finfish (e.g., swimming away and increased heart rate) would result; however, such responses would not be expected to compromise the general health or condition of individual fish. The seasonal spawning of scalloped hammerhead sharks, although reported to be extremely rare (personal communication with Steve Smith, [Navy 2009c]), may also be temporarily disturbed by increased vessel traffic if in the area. EFH for this PHCRT species would not likely be adversely affected with appropriate NMFS BMPs being implemented (Volume 7). The probability of collisions between vessels and adult fish, which could result in injury, would be extremely low due this highly mobile life stage and slow moving vessels within the navigational channel and shipping lanes in the ROI (Navy 2009a).

There is no evidence that underwater noise negatively affects marine invertebrates (COMNAV Marianas 2007b).

The EFH of planktonic eggs and larvae of all species as identified in the Coral Reef, Bottomfish, Pelagic Fish, and Crustacean FMPs could be directly impacted by increased vessel movement. These life stages typically are weak swimming forms and are carried about by local currents. Based on wind and current measurements (SEI 2008) planktonic larvae of many species most likely never leave the confines of the harbor. Some recruitment to Apra Harbor may occur from eggs and larvae being carried into the harbor by local currents as well as by active recruitment (swimming into) by juveniles. The relative contributions from each of these sources of larvae are unknown, although recruits from outside Apra Harbor must pass through the relatively narrow entrance channel (relative to the volume of Apra Harbor), which would reduce the opportunity for eggs and larvae to passively enter the harbor. Thus the probability of their presence in the vicinity of the Alternative 1 action area is small (COMNAV Marianas 2007b). Although the eggs and larvae of these FMP species in the upper portions of the water column associated with the Alternative 1 actions (including previously identified turbidity plume limits) could be displaced, injured, or killed by vessel and propeller movements, no measurable effects on fish recruitment would occur because the number of eggs and larvae exposed to vessel movements would be low relative to total biomass within the ROI (Navy 2009a). Based on the small coverage areas, these impacts would be negligible, therefore no adverse impacts to EFH are anticipated.

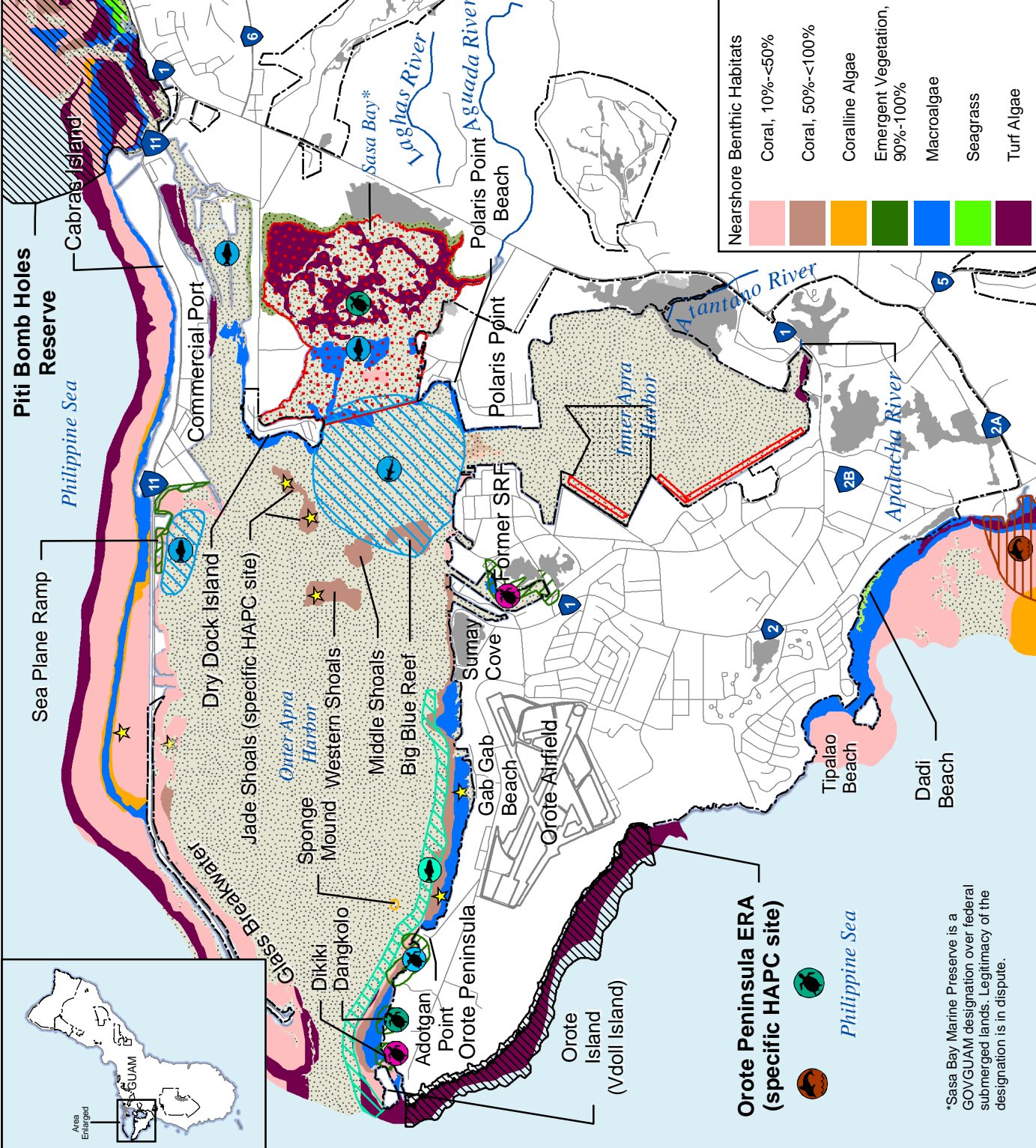
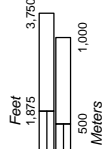
Figure 11.2-3 (used together with Table 11.2-6) identifies sensitive months (and areas) for certain species in Apra Harbor.

Figure 11.2-3
Sensitive Marine
Biological Resources
and Habitats
Impacts associated
with Apra Harbor

Legend

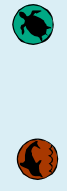
- Military Installation
- Project Area
- Dredge Area
- Coral Area of Special Significance
- ERA
- Sensitive Biological Resources**
- Spinner Dolphin
- Potential Sea Turtle Nesting Area
- ESA-listed Species & EFH MUS High Concentration Area
- Green & Hawkswill Sea Turtles
- Green Sea Turtle Nesting (Apr-Jul)
- Hawksbill Sea Turtle Nesting (Jan-Mar)
- Bigeye Scad Adult High Concentration (Jun-Dec)
- Napoleon Wrasse
- Scalloped Hammerhead Spawning (Jan-Mar)
- Mangrove/Wetland
- Unconsolidated Sediment

Sources: NOAA 2005a, b



- Nearshore Benthic Habitats**
- Coral, 10% < 50%
 - Coral, 50% < 100%
 - Coralline Algae
 - Emergent Vegetation, 90% < 100%
 - Macroalgae
 - Seagrass
 - Turf Algae

Orote Peninsula ERA
(specific HAPC site)



Philippine Sea

*Sasa Bay Marine Preserve is a GOV/GUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.

Table 11.2-6. Sensitive Months for Certain Species within Apra Harbor

<i>Species</i>	<i>Status</i>	<i>Location</i>	<i>Months</i>
Green Sea Turtle	ESA-listed, Threatened	see Figure 11.2-3	Nesting: Jan – Mar
Hawksbill Sea Turtle	ESA-listed, Endangered	see Figure 11.2-3	Nesting: Apr – Jul
Green and Hawksbill Sea Turtles	ESA-listed	see Figure 11.2-3	Foraging: Jan – Dec
Adult Bigeye Scad	EFH species	see Figure 11.2-3	Jun – Dec
Scalloped Hammerhead	EFH species	CVN turning basin - see Figure 11.2-3	Spawning: Jan – Mar
Juvenile Fish ¹	EFH	Sasa Bay and other nearshore environments	Nursery: Jan – Dec
Hard Corals	EFH-PHCRT	All of Outer Apra Harbor	Full Moon Spawning: (July-Aug)

Note: ¹includes barracudas, emperors, goatfishes, groupers, mullets, parrotfishes, puffers, snappers, surgeonfishes, wrasses, and small-toothed whiptails.

The EFHA for Outer Apra Harbor found that the increase of construction-related vessel movements could result in:

- Short-term, periodic, and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from propeller wash
- Short-term, periodic, and localized increase in benthic sedimentation
- Short-term, periodic, and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
- Seasonal disturbances to spawning coral reef and scalloped hammerhead sharks respectively

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of the EFH does not exist; therefore, there would be no adverse effects on EFH with the implementation of Alternative 1, and less than significant impacts to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. Indirect effects from sedimentation plumes would be similar as described under fish and EFH above. Turbidity levels are not anticipated to exceed existing conditions in Outer Apra Harbor.

Many of the ongoing and proposed actions within the ROI involve marine navigation of various types of surface ships and boats (vessels). The increased vessel movements through the Outer Apra Harbor navigational channel associated with the ocean disposal of dredged materials has the potential to affect sea turtles by disturbing or directly striking individual animals.

The implementation of NOAA-NMFS recommended BMPs and existing Navy maritime policies (see Volume 7 and Section 11.2.2.5 in association with Table 11.2-6 and Figure 11.2-3) is anticipated to continue to reduce potential vessel interactions and impacts to sea turtles.

Construction-related vessel movements would be short-term, localized and slow-moving (see Volume 2, Chapter 14, Marine Transportation). The ability of sea turtles to detect slow approaching vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology. If their response to oncoming vessels does not induce a sea turtle to flee the area of vessel movement, the behavioral response may induce confusion, thereby increasing the possibility of a collision. Boat strikes in general are from small fast moving boats (Navy 2009a). There have been no vessel strikes on sea turtles since the Navy has been operating within Apra Harbor (Navy 2009d).

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1.

The short-term and periodic impacts associated with Alternative 1 actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native Species. Potential impacts to the marine habitat from non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) are a genuine threat as described in the Affected Environment, Section 11.1. Any potential introduction/transport of non-native species from one area to another may be lessened or even prevented through appropriate implementation and management of BMPs and existing USCG and Navy policies (see Volume 7).

The Navy would prepare a Regional Biosecurity Plan with Risk Analysis with the overall goal to identify terrestrial and marine biosecurity risks associated with DoD build-up and training activities on Guam and the CNMI posed by transportation and commerce to and within the Micronesia and Hawaii, and to document prevention, control and treatment measures that can be incorporated by civilian and military operations. Volume 7 includes a more detailed description of the BioSecurity Risk Assessment and Management Plan. Therefore, Alternative 1 would result in less than significant impacts regarding the introduction of non-native species.

Operations

Marine Flora, Invertebrates and Associated EFH. Effects on this resource would not appreciably modify existing conditions, although an increase in ship traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column, in or on the sediments due to propeller wash and resuspension of sediments. There is no evidence that underwater noise negatively affects marine invertebrates.

The impact reasoning would be similar to that described under construction activities for increased vessel movement, although less in frequency (approximately four times/year over existing conditions), but longer in duration and increased vessel traffic during those events. Impacts to this resource would be long-term, but episodic and minor compared to existing conditions. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact on these resources. Impacts resulting from the increased MEU embarkation ship movement would be similar to those described in the Construction sections above. Fish in the Apra Harbor channel and associated nearby shoals and nurseries (Sasa Bay) may be disturbed by increased levels of vessel movements by underwater noise or physical disturbance (resuspension of sediment from propeller wash). While fish may exit the immediate area during vessel movement, it is not likely that there would be a permanent effect to the present populations. Impacts on reef fish populations would be short-term, periodic, localized, and would not appreciably change existing conditions. Alternative 1 would result in no adverse effects on EFH. Therefore, Alternative 1 would result in less than significant impacts to fish and EFH.

Implementation of BMPs would reduce any potential impacts of vessel interactions with sensitive EFH MUS. Measures would be implemented by vessels while underway within Apra Harbor and especially while in the vicinity of Sasa Bay, and during sensitive months. Table 11.2-6 above (used in concert with

Figure 11.2-3) identifies these sensitive months (and areas) for respective EFH (and ESA-listed) species in Apra Harbor.

The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements could result in:

- Long-term, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Long-term, periodic and localized minimal increase of turbidity (decreased water quality) in the water column from propeller wash
- Long-term, periodic and localized minimal increase in benthic sedimentation
- Long-term, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from a negligible increased vessel traffic
- Seasonal disturbances to spawning coral reef and scalloped hammerhead sharks

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of the EFH does not exist. Therefore, Alternative 1 would result in no adverse effects on EFH, and less than significant impacts to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. Increased vessel movements associated with MEU embarkation operations have the potential for increased sea turtle strikes enroute to and from Sasa Bay (a high turtle concentration area). Implementation of NOAA/NMFS-recommended BMPs (Volume 7) is anticipated to reduce any potential impacts of vessel interactions with sea turtles to less than significant impacts. These BMPs would be implemented while vessels are underway within Apra Harbor and especially while in the vicinity of Sasa Bay and during nesting season.

General maritime measures in place by the military, including lookouts trained to sight marine mammals or sea turtles, are in use and designed to avoid collisions with protected species. These protective measures are described in detail in Volume 7.

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1.

The long-term, periodic impacts associated with Alternative 1 actions are likely to affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) as described in the Construction section.

Inner Apra Harbor

As described in Volume 4, Chapter 2 Section 2.3.5, four dredged material disposal options are considered in this EIS/OEIS: 100% ocean disposal, 100% upland placement, 100% beneficial reuse, and 15-20% beneficial reuse/75-80% ocean disposal. Beneficial reuse of dredged material is preferred by the Navy and would be evaluated on a case-by-case basis. Potential uses include landfill cover, road base, backfill,

and beach renourishment if suitable. Several local beneficial reuse projects could include fill for shoreline stabilization below the proposed aircraft carrier wharf, fill of berms and backstops at proposed military firing ranges on Guam, and fill for the Port Authority of Guam expansion program.

If upland dredged material disposal is required for any volume of material that does not meet Marine Protection, Research, and Sanctuaries Act Section 103 rules for ocean disposal, the dredged material would be placed at existing permitted sites. Use of these sites is subject to ongoing operational permit conditions that address potential impacts to biological resources, including threatened and endangered species. The Navy would comply with all applicable requirements; therefore, associated biological resource impacts would not be significant.

Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the HEA Volume 9. These communities are not considered to be coral reef (per USACE definition of what constitutes a coral reef), and therefore are not subject to compensatory mitigation.

Construction

Marine Flora, Invertebrates and Associated EFH. There would be a less than significant impact to these resources. Dredging activities planned for Sierra and Tango Wharves would include all areas from -35 to -38 ft (-10 to -11 m) MLLW. The effects on communities that have established themselves on Navy-installed artificial structures are of less concern than establishment on natural surfaces and will not be evaluated for compensatory mitigation. Marine flora communities are limited and occur mainly near Abo Cove. Benthic invertebrates, such as sponges, sea urchins, starfish, and mollusks are poorly represented within Inner Apra Harbor, except for on wharf vertical structures. Representatives of few families were sighted, and none of those groups observed were abundant (COMNAV Marianas 2006b.). Floral and invertebrate communities present on the wharves' vertical support columns or infaunal communities in the soft bottom may be directly impacted in the short-term through removal during wharf structural refurbishing and dredging operations, but are expected to reestablish themselves quickly on the new vertical structures from laterally soft bottom (TEI 2009). Taylor Engineering, Inc. (2009) performed a literature review of effects of beach nourishment, dredging and disposal projects on benthic habitat. The following paragraphs cite the reviewed articles and list the key findings related to benthos effects:

- NOAA Benthic Habitat Mapping. 2007. Applying Benthic Data: *Dredging and Disposal of Marine Sediment*.
 - “Benthic organisms living in shallow water estuarine and nearshore environments are well adapted to frequent physical disturbance”
 - “Tides, currents, waves, and storms cause sediments to be lifted, deposited, or shifted”
 - “The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging”
- Dredging Operations and Environmental Research (DOER). 2005. *Sedimentation: Potential Biological Effects of Dredging Operations in Estuarine and Marine Environments*.
 - “most shallow benthic habitats in estuarine and coastal systems are subject to deposition and resuspension events on daily or even tidal time scales”
 - “Many organisms have physiological or behavioral methods of dealing with sediments that settle on or around them, ranging from avoidance to tolerance of attenuated light and/or anaerobic conditions caused by partial or complete burial”
- Section 404(b) Evaluation, *Pinellas county Florida Beach Erosion Control Project Alternative Sand Source Utilization.*”

- “Fill material will bury some benthic organisms.”
- Most organisms in this turbid environment are adapted for existence in area of considerable substrate movement”
- Re-colonization will occur in most cases within one year following construction”
- Atlantic States Marine Fisheries Commission. 2002. *Review of the Biological and Physical Impacts*.
 - “Studies from 1985-1996 report short-term declines in infaunal abundance, biomass, and taxa richness following beach nourishment, with recovery occurring between 2 and 7 months”
 - “Studies from 1994-2001 reported recolonization of infauna occurred within two weeks”
- U.S. Army Corps of Engineers coastal Engineering Research Center. 1982. *Biological Effects of Beach Restoration with Dredged material on Mid-Atlantic Coasts*.
 - “animals that spend their entire life cycle in the substrate were not seriously impacted by burying from beach nourishment”
 - “nourishment destroyed or drove away the inertial macrofauna; but, based in other regional studies, recovery should occur within one or two seasons (i.e. 3-6 months)

Conclusions of the literature review identified short-term impacts to benthic habitat. Most references listed considered those impacts short-term because the majority of benthic infaunal organisms have the ability to adapt for existence in areas of considerable substrate movement (TEI 2009).

A beneficial long-term impact for the recruitment of marine flora, invertebrates and associated EFH and the ecology of the immediate area is expected with the increased settlement potential of the cleared hard surfaces after dredging and the added aircraft carrier wharf armor rip rap and vertical pilings provide. The development of the pier would provide suitable habitat for species such as benthic invertebrates including sponges, sea urchins, starfish, and mollusks, which are poorly represented within Inner Apra Harbor and the entrance channel areas (COMNAV Marianas 2006).

Those organisms that are not directly subjected to removal or fill, or are motile, could sustain short-term and minimal impacts as a result of transport, suspension and or deposition of dredging-generated sediments. These organisms are accustomed to resuspension of sediment and would adapt to these short-term effects. No coral reef communities have been identified on the harbor bottom in the areas fronting Sierra and Tango Wharves or within Inner Apra Harbor (MRC 2002). The impacts associated with marine flora, invertebrates and associated EFH (either on man-made structures or infaunal communities present in soft bottom habitat) would be short-term and localized based on rapid reestablishment rates (TEI 2009), and are less than significant.

Increased vessels movements during in-water construction and dredging activities would be similar to those described under Outer Apra Harbor Fish and EFH. There would be a short-term and periodic increase in frequency of vessel movement. The impacts associated with marine flora, invertebrates and associated EFH would be short-term, periodic and localized, hence negligible.

Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact to these resources. As described earlier, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the Inner Harbor as described above in the marine flora, invertebrates and

associated EFH discussion. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as a significant spawning or nursery area for either invertebrates or fishes and/or any other FMP species. The effects on communities that have established themselves on Navy-installed artificial structures are of less concern than establishment on natural surfaces and will not be evaluated for compensatory mitigation.

The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that larvae might be present would survive. Therefore, spawning and reproductive activities that may occur within the Inner Harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2006b).

The Navy would comply with USACE permit conditions; therefore re-suspension of sediment would be localized. Long-term water quality would not be significantly changed from these activities; however, removal of some of the very fine sediment in the Inner Harbor would likely have a beneficial effect on the marine community and EFH. The beneficial effects would result from: improved water quality; the removal of fine particulates which are routinely re-suspended and swept into Outer Apra harbor; and the increase in the amount of hard substrate, which would enhance the successful recruitment of stony corals (COMNAV Marianas 2006b).

Table 11.2-7 includes information on the EFH types present in the study area and potential effects.

Table 11.2-7. EFH Areas Associated with Inner Apra Harbor and Potential Effects

<i>EFH Habitat Description</i>	<i>Area of Occurrence</i>	<i>Associated Activity</i>	<i>Effect</i>
Coral Reefs Ecosystem	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	Short-term and periodic behavioral responses from fish
Marine Water Column	Inner Apra Harbor	Dredging and wharf structural refurbishing, increased vessel movement	Short-term and minimal w/ temporary beneficial
Wharf Vertical Substrate	All Wharves	Wharf structural refurbishing	Direct, however short-term and minimal based on quick (2-6 months) reestablishment
Soft Bottom Benthic Habitat	Inner Apra Harbor Wharves and off Polaris Point	Dredging and wharf structural refurbishing, increased vessel movement	Direct, however short-term and minimal based on quick (2-6 months) reestablishment
Submerged Aquatic Vegetation	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	No effect

Species with FMPs may experience minimal, short-term and localized, impacts; fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing-activities cease. Invertebrate communities that have established themselves on Navy-installed wharves or man-made structures would be directly impacted during refurbishing; however, they are anticipated to recolonize quickly after the new wharf is constructed. Though infaunal soft bottom communities would be impacted through dredging removal, these communities are expected to reestablish themselves laterally from other areas in Inner Apra Harbor. Based on this assessment and information provided in other sections, there are no adverse impacts to EFH. Therefore, Alternative 1 would result in a less than significant impact to fish and EFH.

Special-Status Species. The green sea turtle has been observed in Inner Apra Harbor, though with considerably less frequency and in smaller numbers than in Outer Apra Harbor. Thus, the proposed construction action and associated noise has the potential to affect the ESA-listed green sea turtle if present by temporarily changing their swimming or feeding patterns. The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex,

and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. Aside from a recent observation during a survey in Inner Apra Harbor (Smith B.D. et al. 2008) no other observations have been reported. No density information is available for Inner Apra Harbor.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Due to the distances of Adotgan Point, Kilo Wharf and the historic Seaplane Ramp nesting areas from the proposed action under Alternative 1, it is unlikely that any nesting-related activities would be affected by the action alternatives, including night work and the associated lights and noise. The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during nighttime construction operations. However, as mentioned previously, this site has not been active since a reported hawksbill nesting event in 1997.

As identified in the affected environment section, the available data on sea turtle hearing suggest a hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 1995). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 μ Pa-m (Lenhardt 1994).

As described earlier, the ability of sea turtles to detect noise and slow moving vessels via auditory and /or visual cues would be expected based on knowledge of their sensory biology (Navy 2009a). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m]) is well below the 180 dB re 1 μ Pa NMFS guideline to protect all marine species from high sound levels at any point on the frequency spectrum. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.8 m) from in-water construction activities (NMFS 2008c). It is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area.

Tech Environmental (2009) predicted underwater sound levels of pile driving perceived by sea turtles-all species (hearing threshold sound levels – dBht re 1 μ Pa) is 56 (at 500 m), 60 (at 320 m), and 80 (at 30 m). Research shows marine animals avoidance reactions occur for 50% of individuals at 90 dBht re 1 μ Pa, occur for 80% of the individuals at 98 dBht re 1 μ Pa, and occur for the single most sensitive individual at 70 dBht re 1 μ Pa. This threshold for significant behavioral response is consistent with NOAA/NMFS guidelines defining a zone of influence (i.e., annoyance, disturbance). For estimating the zone of injury for marine mammals, a sound pressure level of 130 dBht re 1 μ Pa (i.e. 130 dB above an animal's hearing threshold) is recommended (Nedwell and Howell 2004). Therefore the calculated zone of behavior response for significant avoidance reaction (i.e. distance where dBht = 90 dB re 1 μ Pa and avoidance reaction may occur) to pile driving for sea turtles-all species is <98 ft (<30 m) (Tech Environmental, Inc. 2006). In other words, no injury to any marine animals, including sea turtles, are predicted even if an individual were to approach as close as 30 m to pile driving because all dBht values at this minimum distance are well below.

Sea turtles are highly mobile and capable of leaving or avoiding an area during proposed dredging and in-water construction activities. Dredging and pile driving activities would probably deter green sea turtles from closely approaching the work area, and as a result, the likelihood that a green sea turtle would get

close enough to experience and effects is remote, especially with the silt curtain barriers and mitigation measures in place.

The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this Draft EIS/OEIS. The Navy will continue to research these studies and where appropriate, incorporate and apply methodologies, analysis, and results to the ongoing impact analysis to sea turtles from the proposed action. Applicability of these studies will also be coordinated through consultations with NMFS. The Final EIS/OEIS will contain revised sea turtle impact analysis as developed through the process described above.

The Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and impact minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures are expected to considerably lessen any potential impacts to sea turtles in the area.

In summary, it is anticipated that implementation of Alternative 1 may affect, but is not likely to adversely affect the ESA-listed green sea turtles in Apra Harbor. Table 11.2-6 and Figure 11.2-3 above identify sensitive months (and areas) for respective ESA-listed and FMP MUS in the EFH due to nesting, spawning and/or high concentration. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Section 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies as described in the Affected Environment, Section 11.1.

Operations

Marine Flora, Invertebrates and Associated EFH. There would be a less than significant impact to this resource. Effects on this resource would not differ much from existing conditions, although an increase in ship traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column, in or on the sediments due to propeller wash and resuspension of sediments. There is no evidence that underwater noise negatively affects marine invertebrates.

The impact reasoning would be similar to that described under Outer Apra Harbor operations activities and Inner Apra Harbor construction activities for vessel movements. Although this resource is poorly represented at this study area, impacts would be long-term but episodic and minor compared to existing conditions. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH.

Essential Fish Habitat. There would be a less than significant impact to these resources. As describe earlier in the construction section above, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the Inner Harbor.

Table 11.2-7 includes information on the EFH types present in the study area and potential effects.

Species with FMPs may experience short-term and temporary impacts during vessel movements; however fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing activities cease. Based on this assessment and information provided in other sections, there are no adverse impacts to EFH. Therefore, Alternative 1 would result in a less than significant impact to fish and EFH.

Special-Status Species. There would be a less than significant impact on this resource. The green sea turtle may be expected in Inner Apra Harbor; however, it would occur less frequently and in considerably smaller numbers than in Outer Apra Harbor. As described earlier, sea turtles are expected to be able to detect noise and slow moving vessels via auditory and /or visual cues. Additionally, the Navy would comply with their general maritime measures reducing potential interactions with sea turtles and special-status species in general. Table 11.2-6 (used in concert with Figure 11.2-3) identifies sensitive months (and areas) for respective ESA-listed and EFH species in Apra Harbor.

The long-term but episodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect ESA-listed sea turtles. Alternative 1 would not “jeopardize” or “take” ESA-listed sea turtles as defined under Sections 7 and 9 of ESA. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-Native Species. A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies as described in the Affected Environment, Section 11.1.

Naval Base Guam

Naval Base Guam (Tipalao/Dadi Beaches) study area would now be addressed under a programmatic National Environmental Policy Act (NEPA) document, therefore baseline marine biology information and analysis has been removed from this document.

Construction

Land-based activities associated with the LCAC Laydown Area may impact coastal water quality in the vicinity of Polaris Point within Inner Apra Harbor via storm runoff. Appropriate construction BMPs would be in place to minimize this short-term localized impact to marine biological resources that are well adapted to turbid waters.

The AAV Marine Ramp would disturb soft bottom communities. The benthic community associated with the AAV’s Marine Ramp would be the same as described under the Inner Apra Harbor section above (i.e., the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily re-suspended. Marine biota are not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

There would short-term, localized direct impacts to soft bottom infaunal communities at the area of impact; however it is anticipated that disturbed areas would quickly recover with new infaunal recruitments. Those organisms that are not directly subjected to removal or fill, or are motile, could sustain impacts as a result of transport, suspension and deposition of dredging-generated sediments. See Inner Apra Harbor section above for more a similar and more detailed impact analysis. Impacts would be less than significant.

Operation

The less than significant impacts to marine biological resources associated with the LCAC and AAV operation under Alternative 1 are expected to be similar to those described under Inner Apra Harbor above.

11.2.2.3 South

Baseline marine biology information for this South Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment. There would be no construction or operations impacts resulting from implementation of Alternative 1 in this area.

11.2.2.4 Summary of Alternative 1 Impacts

Significant indirect impacts, mitigated to less than significant indirect impacts, are anticipated on EFH at Haputo ERA, specifically coral and coral reef ecosystem, with an increase of recreational use. All other impacts on marine biological resources are anticipated to be less than significant. Section 11.2.8, Table 11.2-1 describes associated impacts from all alternatives.

11.2.2.5 Summary of Alternative 1 EFH Assessment

The EFHA found that Alternative 1 actions may adversely affect EFH, specifically CRE MUS at Haputo ERA, without the implementation of appropriate mitigation measures. All other Alternative 1 actions would have no adverse effect on EFH and are summarized in Section 11.2.8, Table 11.2-6.

11.2.2.6 Alternative 1 Potential Mitigation Measures

In addition to Volume 2, Recreational Resources, Section 9.2.2.5 and the Terrestrial Biological Resources, Section 10.2.2.5, the following mitigation measure would help reduce impacts to marine biological resources. Potential Mitigation Measures for all Volumes are summarized in Volume 7.

Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Base Orders, educational training (i.e., require watching a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook* and natural resource educational handouts [i.e., to dive boat tours]), or a combination of all.

11.2.3 Alternative 2

11.2.3.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.3.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.3.3 Apra Harbor

Harbor

Alternative 1 is the only proposed wharf improvement alternative.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.3.4 South

Until further notice, impacts from this Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.3.5 Summary of Alternative 2 Impacts

The Alternative 2 impact assessment would be the same as prepared for Alternative 1.

11.2.3.6 Summary of Alternative 2 EFH Assessment

The Alternative 2 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6.

11.2.3.7 Potential Mitigation Measures

Mitigation measures for Alternative 2 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.4 Alternative 3

11.2.4.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.4.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.4.3 Apra Harbor

Harbor

Alternative 1 is the only alternative where the proposed wharf improvement and LCAC/AAV Laydown and Ramp projects are planned.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.4.4 South

Until further notice, impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.4.5 Summary of Alternative 3 Impacts

The Alternative 3 impact assessment would be the same as prepared for Alternative 1.

11.2.4.6 Summary of Alternative 3 EFH Assessment

The Alternative 3 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6

11.2.4.7 Potential Mitigation Measures

Mitigation measures for Alternative 3 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.5 Alternative 8

11.2.5.1 North

Andersen AFB

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Finegayan

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.5.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for Alternative A or B.

11.2.5.3 Apra Harbor

Harbor

Alternative 1 is the only proposed wharf improvement and LCAC/AAV Laydown and Ramp.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.5.4 South

Until further notice, impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.5.5 Summary of Alternative 8 Impacts

The Alternative 8 impact assessment would be the same as prepared for Alternative 1.

11.2.5.6 Summary of Alternative 8 EFH Assessment

The Alternative 8 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-6

11.2.5.7 Potential Mitigation Measures

Mitigation measures for Alternative 8 would be similar to those described under Alternative 1.

11.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the Marine Corps.

The embarkation areas and the LCAC/AAV laydown area, discussed in Section 2.7.5.2, would not be constructed. The USCG would not relocate facilities from Victor Wharf to Oscar and Papa Wharves, and the Military Working Dog Kennel would not be relocated. There eventually would be structural improvements at Victor, Sierra, and Uniform Wharves, including dredging at Sierra and Tango Wharves to maintain existing operations at these wharves.

The no-action alternative does not meet the purpose and need of the proposed action. It serves as a baseline, representative of the “status quo” condition, against which to compare the action alternatives when assessing potential environmental impacts. See Section 2.7.5.2 for the Description of Proposed Action and Alternatives (DOPAA) for this project for more details

11.2.7 Summary of Impacts

Table 11.2-8 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 11.2-9 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 11.2-10 and

11.2-11 summarize the impacts at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives respectively. A summary of potential noise impacts due to Other Training, Airfield, and Waterfront is provided in Table 11.2-12. A text summary follows the summary tables.

Table 11.2-8. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

<i>Main Cantonment Alternative 1 (North)</i>	<i>Main Cantonment Alternative 2 (North)</i>	<i>Main Cantonment Alternative 3 (North/Central)</i>	<i>Main Cantonment Alternative 8 (North/Central)</i>
Construction			
<p>LSI</p> <ul style="list-style-type: none"> • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions. 	<p>LSI</p> <ul style="list-style-type: none"> • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions. 	<p>LSI</p> <ul style="list-style-type: none"> • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions. 	<p>LSI</p> <ul style="list-style-type: none"> • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA may adversely affect EFH, specifically coral and coral reef ecosystem and ESA-listed sea turtles. However, implementation of BMPs and would help to avoid and minimize effects. Therefore, a less than significant impact from Alternative 1 actions.
Operation			
<p>SI-M</p> <ul style="list-style-type: none"> • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary. 	<p>SI-M</p> <ul style="list-style-type: none"> • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary. 	<p>SI-M</p> <ul style="list-style-type: none"> • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary. 	<p>SI-M</p> <ul style="list-style-type: none"> • No direct impacts. Long-term, indirect potentially adverse effects to EFH (coral and coral reef ecosystems) and significant impacts to special-status species from increased recreational activities at Haputo ERA, mitigated to less than significant. See Table 11.2-9 for EFHA summary.

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 11.2-9. Summary of Training Impacts – Firing Range Alternatives

<i>Firing Range Alternative A (Central)</i>	<i>Firing Range Alternative B (Central)</i>
Construction	
LSI <ul style="list-style-type: none"> Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs. 	LSI <ul style="list-style-type: none"> Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs.
Operation	
LSI <ul style="list-style-type: none"> Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to Special-Status Species. Beneficial impacts to marine biological resources may be seen from restricted access to the coastal areas during training activities. 	LSI <ul style="list-style-type: none"> Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to Special-Status Species. Beneficial impacts to marine biological resources may be seen from restricted access to the coastal areas during training activities.

Legend: LSI = Less than significant impact.

Table 11.2-10. Summary of Training Impacts – Ammunition Storage Alternatives

<i>Ammunition Storage Alternative A (South)</i>	<i>Ammunition Storage Alternative B (South)</i>
Construction	
NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. 	NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment. 	NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-11. Summary of Training Impacts – NMS Access Roads Alternatives

<i>Access Road Alternative A (South)</i>	<i>Access Road Alternative B (South)</i>
Construction	
NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. 	NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment. 	NI <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-12. Summary of Other Training, Airfield, and Waterfront Component Impacts

<i>Other Training (North/Central/South)</i>	<i>Airfield (North)</i>	<i>Waterfront (Apra Harbor)</i>
Construction		
<p>NI</p> <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. Environmental effects from roadway construction activities are addressed in Volume 6. 	<p>NI</p> <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. 	<p>LSI</p> <ul style="list-style-type: none"> Less than significant direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during vessel movements (Outer and Inner Apra Harbor), dredging and in-water construction activities of wharves (pile driving) and LCAC and AAV operations area within Inner Apra Harbor. See Table 11.2-9 for EFHA summary. A beneficial mid-term impact to water quality may be seen from the removal of the fine benthic sediment within Inner Apra Harbor. Less than significant direct and indirect impacts (no adverse effects) from increased vessel movements in Apra Harbor. Less than significant impacts from runoff or spills associated with construction-related activities in Apra Harbor Environmental effects from roadway construction activities are addressed in Volume 6.
Operation		
<p>NI</p> <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment. Environmental effects from roadway construction activities are addressed in Volume 6. 	<p>NI</p> <ul style="list-style-type: none"> Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment. 	<p>LSI</p> <ul style="list-style-type: none"> Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality, and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-9 for EFHA summary). Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality and other disturbances to ESA-listed sea turtles, EFH FMP species, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-9 for EFHA summary). Less than significant direct and indirect impacts from increased vessel movements in Apra Harbor. Less than significant impacts from runoff or spills associated with operation-related activities in Apra Harbor

Legend: LSI = Less than significant impact, NI = No impact.

11.2.8 Summary of Essential Fish Habitat Assessment

The Alternative 1 EFHA would be essentially the same for all alternatives. Table 11.2-13 below summarizes this Assessment.

Table 11.2-13. EFHA Summary

Area	Project Activities	Project Specific Impacts
NORTH		
Finegayan	Construction	<p>Increased construction-related personnel and associated recreational activities may adversely affect EFH, specifically CRE MUS at the Haputo ERA. EFHA identified the following indirect and cumulative effects:</p> <ul style="list-style-type: none"> • Minor, short-term and localized disturbance and displacement of motile species. • Adverse, short-term and localized potential effects to EFH. Specifically, potential damage to coral structures and the coral reef ecosystem within Haputo ERA. However, this effect would be mitigable to no adverse effect. <p>There would be no adverse direct effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs.</p> <p>Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs measures as described in Volume 7.</p>
	Operation	<p>Increased operation-related personnel and associated recreational activities may adversely affect EFH at the Haputo ERA. EFHA identified the following indirect and cumulative effects:</p> <ul style="list-style-type: none"> • Temporary and minor localized disturbance and displacement of motile species. • Long-term, localized, potential impacts to EFH. Specifically, potential damage to coral structures and coral reef ecosystems within Haputo ERA may adversely affect EFH. However, this effect is mitigable to no adverse effect. • Potential long-term reduction in the quality and/or quantity of the and EFH through long-term, periodic and localized degradation <p>There would be no adverse direct effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs.</p> <p>Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.</p>
CENTRAL		
Non-DoD Land	Construction	<p>There would be no adverse effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. Increased construction-related personnel and associated recreational activities would not affect EFH as access to this shoreline is limited and there are no dive boat tour spots identified.</p> <p>Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.</p>
	Operation	<p>There would be minimal indirect impacts to EFH from recreational activities of operation-based personnel and their dependants. Effects determination would be similar as that described above under construction. Additionally, beneficial impact to</p>

Area	Project Activities	Project Specific Impacts
		<p>nearshore communities due to limited and controlled access at the coastline during training operations.</p> <p>There would be long-term, localized accumulation of small arms (.50 cal and MK19 TP) expended materials in the benthic habitat from the range operations, however minimal potential for ingestion. Avoidance and minimization measures, including the use of “green bullets” (non-toxic alloys) and periodic benthic clean up would be employed to decrease potential impacts.</p> <p>Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.</p>
APRA HARBOR		
Harbor	Construction	<p>The proposed action would have direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances on EFH FMP species. These impacts would occur during dredging and in-water construction activities of the wharves (i.e. pile driving) and LCAC and AAV operations area associated with Inner Apra Harbor, including dredged spoils tug and scow movements through Outer Apra Harbor to the ocean disposal site.</p> <p>The EFHA for Apra Harbor found that the in-water construction and increase of construction-related vessel movements could result in:</p> <ul style="list-style-type: none"> • Direct, short-term and localized removal of soft bottom habitat and infaunal community during dredging activities, which is anticipated to recovery quickly (2-6 months) due to horizontal reestablishment • Direct, short-term and localized impacts to invertebrates colonized on wharf vertical structures. Invertebrates are anticipated to quickly recolonize post construction. • Short-term, and localized disturbance and displacement of motile species of fish during in-water transit, dredging and pile driving activities. Ramping up methods of pile driving will allow marine species to exit the immediate area • Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from dredging, pile driving, and vessel propeller wash • Short-term, periodic, and localized increase in benthic sedimentation • Seasonal disturbances to potential scalloped hammerhead sharks <p>As describe earlier, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the inner harbor. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as an important spawning or nursery area for either invertebrates or fishes.</p> <p>Based on this assessment, the Navy has determined that these minimal, short-term and localized impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs along with USACE permit conditions as described in Volume 7.</p>
	Operation	<p>The proposed action would have direct, indirect and cumulative impacts from noise, resuspension of sediment, decreased water quality, and other disturbances on EFH FMP species from increased vessel movements in Outer and Inner Apra Harbor.</p> <p>The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements would be a negligible increase, however would result in:</p> <ul style="list-style-type: none"> • Long-term, however, periodic and localized disturbance and displacement of

Area	Project Activities	Project Specific Impacts
		<p>motile species (fish) during in-water transit activities</p> <ul style="list-style-type: none"> • Long-term, however, periodic and localized increase of turbidity (decreased water quality) in the water column from propeller wash • Long-term, however periodic and localized increase in benthic sedimentation • Long-term, however periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic • Seasonal disturbances to potential spawning scalloped hammerhead sharks. <p>Based on this assessment, the Navy has determined that these temporary and/or minimal impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Section 11.2.2.1 and associated Figures (11.1-3 – 11.1-7, 11.1-11 and 11.1-12) and Tables 11.2-5, 11.2-6, and 11.2-7).</p>
Naval Base Guam	Construction	<p>The proposed action would have minimal direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances on EFH FMP species present during land-based and in-water construction activities of the LCAC and AAV operations area associated with Inner Apra Harbor.</p> <p>The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that larvae present would survive. Therefore, spawning and reproductive activities that may occur within the inner harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2006b).</p> <p>Based on this assessment, the Navy has determined that these minimal impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.</p>
	Operation	<p>There would be minimal, short-term and localized impacts to EFH. Effects determination would be similar as that described above under construction.</p>

11.2.9 Summary of Potential Mitigation Measures

In addition to Volume 2, Recreational Resources, Section 9.2.2.5 and the Terrestrial Biological Resources, Section 10.2.2.5, the following mitigation measures (Table 11.2-14) would further reduce impacts to marine biological resources. Potential mitigation measures for all Volumes are summarized in Volume 7.

Table 11.2-14. Summary of Potential Mitigation Measures

Alternative 1	Alternative 2	Alternative 3	Alternative 8
Construction Activities			
<ul style="list-style-type: none"> • Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. 	<ul style="list-style-type: none"> • Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. 	<ul style="list-style-type: none"> • Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. 	<ul style="list-style-type: none"> • Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all.

<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>	<i>Alternative 8</i>
<ul style="list-style-type: none"> Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Increased effort toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.
Operation Activities			
<ul style="list-style-type: none"> Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies. 	<ul style="list-style-type: none"> Marine Biological Resources Education and Training on EFH, along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of <i>Military Environmental/Natural Resource Handbook</i>), or a combination of all. Increased efforts toward ERA enforcement (starting with Haputo) and other ESA, MMPA, and EFH policies.