Endangered Species Act – Section 7 Consultation

Biological Opinion

Action Agency:	Department of Homeland Security, Federal Emergency Management Agency (FEMA)
Activity:	FEMA funding, under Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, for projects to repair infrastructure damage on Tutuila, American Samoa that resulted from the Presidentially-declared Earthquake, Tsunami, and Flooding disaster (FEMA-1859-DR-AS) of September 2009.
Consulting Agency:	National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division
NMFS File No. (PCTS):	I/PIR/2010/00153
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Acronyms

ANF	Annual Nesting Females
BMP	Best Management Practices
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
cm	Centimeter
dB	Decibel
DMWR	Department of Marine and Wildlife Resources, American Samoa Government
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FAO	Food and Agricultural Organization of the United Nations
FEMA	Federal Emergency Management Agency, Department of Homeland Security
FR	Federal Register
ft	Foot
GBR	Great Barrier Reef (Australia)
Hz	Hertz (a measurement of frequency equivalent to cycles per second)
ITS	Incidental Take Statement
km	Kilometer
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
NA	Nesting Aggregation
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service (also NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
PIRO	Pacific Islands Regional Office
PRD	Protected Resources Division
PTS	Permanent Threshold Shift
RL	Received Level (Sound intensity received at a particular distance from the source)
rms	Root-Mean-Square
SL	Source Level (Sound intensity as measured at 1 m from the source)
SPL	Sound Pressure Level
TTS	Temporary Threshold Shift
US	United States
USFWS	US Fish and Wildlife Service

1 Introduction

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each Federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. To "jeopardize the continued existence" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). A Federal agency is required to consult formally with the National Marine Fisheries Service (NMFS) for marine species or their designated critical habitat or with the United States Fish and Wildlife Service (USFWS) for terrestrial and freshwater species or their designated critical habitat when that agency's action "may affect" an ESA-listed species. Federal agencies are exempt from the requirement for formal consultation if they have received from NMFS or USFWS written concurrence with a determination that an action "may affect, but is not likely to adversely affect" ESA-listed species or their designated critical habitat (see ESA Section 7 Implementing Regulations; 50 CFR 402).

This document represents NMFS' biological opinion (Opinion) of the effects on marine species protected under the ESA that may result from FEMA's funding for projects to repair infrastructure damaged on Tutuila Earthquake, Tsunami, and Flooding disaster of September 2009. This Opinion is based on: the review of FEMA's eight separate requests for informal consultation for the funding of infrastructure repair projects on Tutuila Island; recovery plans for U.S. Pacific populations of listed sea turtles; published and unpublished scientific information on the biology and ecology of threatened and endangered marine species, as well as of other species of concern in the action area; monitoring reports and research in the region; biological opinions on similar actions; and relevant scientific and gray literature (see Literature Cited).

2 Consultation History

FEMA first contacted NMFS Pacific Islands Regional Office (PIRO) Protected Resources Division (PRD) via electronic mail (e-mail) on October 27, 2009, to request a species list for the American Samoa Archipelago, and to establish direct communication between our two offices. PRD responded on November 17, 2009. We provided a link to the archipelagic-based species lists on our website, and further explained that we expect that green and hawksbill turtles and humpback whales were the species most likely to be encountered in nearshore waters around American Samoa.

Between January 14th and 28th, 2010, PRD received a total of eight requests for informal consultation for shoreline infrastructure repair projects in Pago Pago and Fagasa Bays, on Tutuila Island. All eight requests concluded that the proposed projects were not likely to adversely affect green turtles, hawksbill turtles, and humpback whales. On January 28, 2010, PRD requested an overview to describe all expected FEMA projects for this disaster. A phone conversation was held the following day between NMFS PRD and FEMA to discuss FEMA's total action. PRD informed FEMA on January 29, 2010, that NMFS concurred with FEMA's determination for humpback whales, but we did not concur that the actions are not likely to adversely affect green and hawksbill turtles. PRD also requested additional information concerning the planned pile driving. The requested additional information arrived on February 5, 2010, and a formal consultation was initiated on that date for green and hawksbill turtles, resulting in this Opinion.

In addition to green turtles, hawksbill turtles, and humpback whales, ESA-listed species under NMFS jurisdiction in the American Samoa Archipelago also include blue, fin, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles. However, FEMA made no references to any of these species in their consultation requests or other communications, and NMFS did not specifically discuss those animals with FEMA. As such NMFS independently determined that those species too may be affected by the proposed action. However, NMFS determined that humpback, blue, fin, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles, are not likely to be adversely affected by the proposed action (NMFS 2010c).

3 Description of the Proposed Action and Action Area

The proposed action is described in FEMA's consultation request letters. In summary, FEMA intends to provide funding to the American Samoa Government for seven projects along the shoreline within Pago Pago Bay, and one in Fagasa Bay. Work is expected to begin as soon as all permitting has been completed, likely during the first or second quarter of calendar year 2010, and will be completed based on the expected time to completion described below.

<u>Pago Pago Bay</u>

1. PW # 45 - Seawall Repair behind the Department of Marine and Wildlife Resources (DMWR) Offices: Operating from shore and from a barge, heavy equipment will cut-off and remove the upper 6 ft of the steel sheet pilings along 78 ft the existing seawall. New sheet pilings will be driven next to the existing pilings down to about 30 ft below the mudline. A section of concrete, about 78 ft long and 8 ft wide will be removed to facilitate replacement of lost fill then the concrete will be replaced. Four 8-hour days of pile driving are expected, and the over-all project is expected to take about 2 weeks to complete (FEMA 2010a).

2. PW # 59 Seawall Repair bordering Fagatogo Square: Heavy equipment will be operated from shore to rebuild 300 ft of an existing rock seawall and replace a concrete sidewalk. The repaired seawall will consist of two layers of 100 to 200 pound (lb) rocks, over-laid by a single layer of 1,700 to 2,500 lb rocks. A 10 ft long section of 24 inch diameter plastic storm drain will be replaced in the seawall, and about 180 ft of 4 ft wide concrete sidewalk will be replaced. The project is expected to take about 2 weeks to complete (FEMA 2010b).

3. PW # 110 - Boat ramp repair: Heavy equipment will be operated from the shore to remove and replace an existing boat ramp and repair an adjacent retaining wall at the west end of Pago Pago Bay. The work includes use of heavy equipment to drive 18 steel H-pilings to construct a 34 ft by 34 ft cofferdam of H-piles and timbers, then de-watering the ramp area. The ramp area would be re-graded and a new concrete ramp will be poured in-place. The damaged retaining wall will be formed-in and concrete poured to repair damaged areas. One 8-hour day of pile driving is expected, and the over-all project is expected to take about 1 week to complete (FEMA 2010c).

4. BLWG004 - Pier Seawall and Parking Lot Repair: Operating from shore and from a barge, heavy equipment will drive 34 steel H-pilings 3 ft immediately seaward of the face, and 2 ft off

each side of an existing seawall. Pre-cast concrete slabs will be installed between, and held in place by, the H-piles. 299 ft of new seawall will be created around the damaged original. Concrete decking will be cut and removed as needed to allow for tie-back installation and replacement of lost fill. This includes about 100 ft of collapsed concrete parking lot slab. An excavator will also place 100 to 200 lb rocks against and seaward of the lower 3 ft of the new seawall. Three 8-hour days of pile driving are expected, and the over-all project is expected to take about 3 weeks to complete (FEMA 2010e).

5. TEMG010 - Main Lift Dock Repair: Heavy equipment will be operated from shore and from a barge to drive 14 steel H-pilings to replace about 75 ft of collapsed seawall. Pre-cast concrete slabs will be installed between, and held in place by, the outer H-piles. Tie-backs and replacement fill will be installed behind the seawall. A section of lost riprap wall about 16 ft long and 12-ft high will be replaced outside the wall, and a replacement concrete slab about 75 ft long by 16 ft wide will be poured. Two 8-hour days of pile driving are expected, and the over-all project is expected to take about 2 to 3 weeks to complete (FEMA 2010f).

6. TEMG011 - Main Dock Repair: Heavy equipment will be operated from shore and from a barge to remove and replace about 70 ft of concrete decking and abutment, repair and possibly re-set 12 concrete pilings, and repair 5 concrete beams. Platforms will be constructed to prevent debris from entering the water, and sections of damaged concrete abutment, beams, pilings, and decking will be removed. Forms will be set and the structural components repaired with new concrete. The 5 damaged 12- by 12-inch concrete piles may have to be driven to reset them in the substrate. The over-all project is expected to take about 8 weeks to complete, including one 8-hour day of pile driving (FEMA 2010g).

7. TEMG013 - 3000T Dock repair: Heavy equipment with a clam-shell style bucket will be operated from shore to remove and replace interlocking stacked concrete beams to reconstruct about 50 ft of seawall that has collapsed into Pago Pago Bay. A continuous concrete cap will be poured in-place on top of the new seawall. The project is expected to take about 1 week to complete (FEMA 2010h).

Fagasa Bay

8. PW # 79 - Boat Ramp Repair at Fagasa: Heavy equipment will be operated from the shore to remove and replace an existing boat ramp and at the village of Fagasa at the south end of Fagasa Bay. The work includes use of heavy equipment to drive 20 steel H-pilings to construct a 24 ft by 24 ft cofferdam of H-piles and timbers, then de-watering the ramp area. The ramp area would be re-graded, debris and displaced boulders will be removed, and a new concrete ramp will be poured in-place. One 8-hour day of pile driving is expected, and the over-all project is expected to take about 1 week to complete (FEMA 2010d).

Interrelated/Interdependent Actions

The proposed action is the funding of projects to repair and restore shoreline infrastructure to pre-existing conditions. As such, NMFS expects no interrelated or interdependent actions to result from the proposed action that would not have been undertaken had the infrastructure not been damaged by the disaster.

Action Area
The action area for the FEMA-funded projects is limited to the marine waters around the Island of Tututila, American Samoa (Figure 2). For all work, other than pile driving, the action area is estimated to be the in-water areas of Pago Pago and Fagasa Bays within a 50-meter radius arc around those activities, and the down-current extent of any plumes that may result from mobilized sediments or discharges of wastes or toxic chemicals such as fuels and/or lubricants associated with the machinery used for this activity. However, during the proposed pile driving, the action area is extended seaward up to 25 km from Pago Pago and Fagasa Bays to include the waters that may be ensonified by pile-driving noise capable of eliciting behavioral modification in ESA-listed marine species.

4 Status of the Species

NMFS has determined that humpback, blue, fin, sei, and sperm whales, as well as leatherback, loggerhead and olive ridley sea turtles, are not likely to be adversely affected by the proposed action (NMFS 2010c). The proposed action is likely to adversely affect green and hawksbill turtles (Table 1), and these two species are the subject of this Opinion.

Table 1. ESA-listed marine species that may be affected by proposed action.

Species	Scientific Name	ESA Status	Listed	Federal Register
Species not likely to be adversely affected by the proposed action.				
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Humpback Whale	*Megaptera novaeangliae*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/02/1970	35 FR 8491
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	07/28/1978	43 FR 32800
Olive Ridley Sea Turtle	*Lepidochelys olivacea*			
Nesting aggregations on west coast of Mexico		Endangered	07/28/1978	43 FR 32800
All other Olive Ridley Sea Turtles		Threatened	07/28/1978	43 FR 32800
Species likely to be adversely affected by the proposed action.				
Green Sea Turtle	*Chelonia mydas*			
Nesting aggregations in Florida and Mexico		Endangered	07/28/1978	43 FR 32800
All other Green Sea Turtles		Threatened	07/28/1978	43 FR 32800
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	07/28/1978	43 FR 32800

This section presents biological or ecological information for green and hawksbill sea turtles affected by the proposed action relevant to formulating the Opinion. Subsections 4.1 and 4.2 provide species-specific descriptions of distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts, and other relevant information (USFWS & NMFS 1998). Factors affecting those species within the action area are described in more detail in the Environmental Baseline (Section 5). No critical habitat has been designated for either of these species in the Pacific Ocean. Therefore, this project will have no effect on designated critical habitat under NMFS jurisdiction.

4.1 Green Sea Turtles

Green turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea, as described in the most recent green turtle 5-year status review (NMFS & USFWS 2007a). As shown above in Table 1, in 1978, all green turtles were listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. Following are descriptions of the distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, and major conservation efforts for the green sea turtle.

4.1.1. Distribution and Abundance

Globally, most green sea turtle nesting populations declined substantially during the 20th century. Conservation efforts over the past 25 years or more appear to have had some positive results, as indicated below. However, threats and impacts persist for many green sea turtle populations (NMFS & USFWS 2007a). Following are brief descriptions of distribution and abundance of green turtles in the three major ocean basins, with more detail provided for Oceania in the Pacific Basin where the action area is located.

Indian Ocean

There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually. Based on a review of 32 index sites, declines in green turtle nesting were evident for many of the Indian Ocean index sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island index site in the western Indian Ocean showed evidence of increased nesting (NMFS & USFWS 2007a).

Atlantic Ocean

The 5-year status review for the species identified eight geographic areas considered to be primary sites for green sea turtle nesting in the Atlantic/Caribbean and reviewed the trend in nest count data for each (NMFS and USFWS 2007a). These include: (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagos Archipelago (Guinea-Bissau). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site. All sites in the central and western Atlantic showed increased nesting with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic. However, other sites support lower levels of nesting and contribute a much smaller proportion to the total number of green turtles in the Atlantic. By far, the most important nesting concentration for green turtles in the western Atlantic is in Tortuguero, Costa Rica. Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggest nesting by 17,402- 37,290 females per year (NMFS and USFWS 2007a).

Pacific Ocean

Green turtles occur in the eastern, central, and western Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998a). Nesting is known to occur at hundreds of sites throughout the Pacific, with major nesting occurring in Indonesia, Malaysia, the Philippines, Australia, Micronesia, Hawaii, New

Caledonia, Mexico, the Galapagos Islands, and other sites (NMFS & USFWS 2007a). Conservation efforts over the past 25 years or more appear to have had some positive results. Chaloupka et. al. (2008a) report that green sea turtle index rookeries at the Ogasawara Islands (southern Japan), Raine Island (northern Great Barrier Reef), Hawaii, and Heron Island (southern Great Barrier Reef) have shown significant increases in nester or nest abundance.

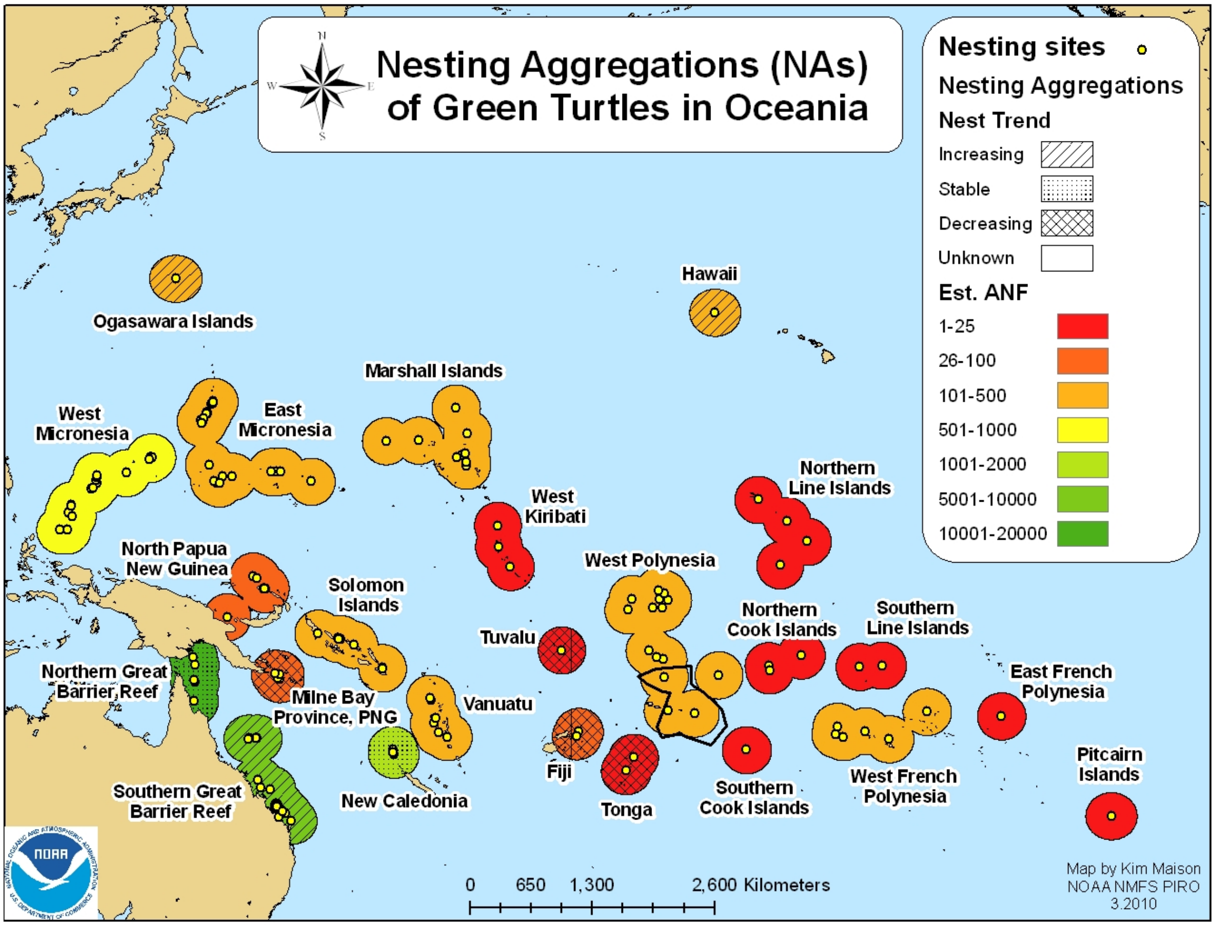

Figure 1. Green turtle nesting aggregations in Oceania (American Samoa EEZ shown in black outline; “Est. ANF” = estimated annual nesting females).

Based on the best information currently available, about 18,000 to 38,000 green turtles nest annually in Oceania (NMFS 2010d). However, about 90% of nesting takes place among two Australian nesting aggregations (Northern GBR and Southern GBR which includes the Coral Sea Platform), with over half of all the nesting occurring on a single island; Raine Island in the Northern GBR (Chaloupka et al. 2008a, Limpus 2009). Nesting trends appear stable at Raine Island, and are increasing at Heron Island in the Southern GBR, as well as at Chichi-jima in the Ogasawara Islands (Chaloupka et al. 2008a). However, these trends do not necessarily correlate with a stable or increasing total number of turtles because of low nesting success and hatchling production at Raine Island, where the majority of nesting for Oceania occurs (Limpus et al. 2003; Limpus 2009; Hamann et al. 2009). Also, nesting aggregations (NAs) with small numbers of nesting females, like those throughout the islands and atolls of central and south Pacific, may be of greater importance than their proportional numbers indicate. Many of these NAs are geographically isolated, and likely harbor unique genetic diversity, which may be lost if these small NAs or their components become extirpated (Avise & Bowen 1994).

Sub-adult and adult green turtles occur in low abundance in nearshore waters around the islands of American Samoa. No population trend data are available, but anecdotal information suggests major declines over the last 50 years (Tuato'o-Bartley et al 1993, Utzurrum 2002). Genetics samples have been collected from stranded or foraging green turtles around Tutuila. To date, 4 samples have been analyzed: 2 samples from stranded green turtles in Pago Pago Harbor had a haplotype known from nesting green turtles in American Samoa, Yap, and the Marshall Islands. However, since many green turtle nesting aggregations in the Pacific still have not been sampled, it is possible that this haplotype occurs at more than these three sites. In addition, 2 samples have been analyzed from foraging green turtles at Fagaalu, but the haplotype is of unknown nesting origin (Peter Dutton, SWFSC, pers. comm.).

4.1.2. Life History Characteristics Affecting Vulnerability to the Proposed Action

Following hatching from their natal beaches, green turtle life history is characterized by early development in the oceanic (pelagic) zone followed by development in coastal areas where post-recruitment juveniles and adults forage in shallow coastal areas, primarily on algae and seagrass. Upon maturation, adult greens typically undertake long migrations between their resident foraging grounds and their natal nesting areas. Between 1971 and 1996, 46 adult female greens were flipper tagged after they nested at Rose Atoll. Three were recaptured, two in Fiji, and one in Vanuatu (Balazs et al. 1994). Between 1993 and 1995 seven post-nesting green turtles were satellite tagged at Rose Atoll. Most migrated 1,600 km to foraging areas in Fiji, and one migrated to French Polynesia (Craig et al. 2004). Of 513 greens tagged in French Polynesia between 1972 and 1991, six were recovered in Fiji, three in Vanuatu, two in New Caledonia, and one each were recovered at Wallis Island, Tonga, and the Cook Islands. The high number of foragers found in Fiji is likely due to Fiji's abundant, shallow seagrass and algae habitats (Craig et al. 2004).

Based on the description of the proposed action, high intensity noise, due to pile driving, is the stressor with the greatest potential to impact green turtles. Research into turtle hearing is limited, but available information suggests that they are low frequency specialists, with greens thought to be most acoustically sensitive between 200 and 700 Hz (Ridgway et al, 1969). Because the hearing range of green turtles overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that greens can hear and respond to pile driving noise. Based on green turtle life history characteristics, adults and juveniles foraging in nearshore habitats, as well as adults in nearshore waters for breeding and nesting are the most vulnerable to exposure to excessive noise levels. Because green turtles found around Tutuila migrate widely between their preferred forage and nesting areas, the proposed action may affect green turtles from multiple NAs across a broad area of the south and western Pacific (Figure 1).

4.1.3 Threat to the Species

Global threats to green turtles are described in the 5-year review (NMFS & USFWS 2007a). The major threats to the species are alteration of nesting and foraging habitat, fishing bycatch, and direct harvest, which are briefly described below. Climate change also appears to be a growing threat to this species, and is also mentioned below.

Destruction and alteration of green turtle nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. Under natural conditions, beaches can move landward or seaward with fluctuations in sea level. However, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Beach armoring is typically done to protect the coastal development from erosion during storms, but armoring blocks turtle nesting and often leads to beach loss. Coastal development also increases artificial lighting, which may disorient emerging hatchlings, causing them to crawl inland towards the lights instead of seaward. Coastal development also improves beach access for humans, resulting in more vehicular and foot traffic on beaches, causing compaction of nests and thereby reducing emergence success. Adult green turtles are primarily herbivores that forage on seagrass and algae in shallow nearshore areas and coral reefs. Contamination from effluent discharges and runoff has degraded these habitats, and invasive species may reduce native algae species preferred by green turtles (NMFS & USFWS 2007a).

Green turtles are susceptible to fisheries bycatch, particularly in nearshore artisanal fisheries. These fisheries use a vast diversity of gears, including long-lining, drift gillnets, set-nets, pound-nets, trawls, and others. Despite operating in the areas with the greatest density of adult green turtles, artisanal fisheries are typically the least regulated of all fisheries (NMFS & USFWS 2007a). Industrial fisheries also interact with green turtles, especially juveniles, like in the Hawaii-based deep-set and American Samoa longline fisheries. Harvest of green turtles for their meat, shells, and eggs has been a major factor in the past declines of green turtles. Globally, harvest of adults and eggs is reduced from previous levels, but still exists and continues to be a major factor in some parts of the species' range. This includes both legal and illegal harvests of adults and eggs in most of the NAs described above.

Green turtles are probably already being affected by anthropogenic climate change. The global mean temperature has risen 0.76°C over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (NMFS & USFWS 2007a). Warmer temperatures within the nest chamber produce females while cooler ones produce males. As global temperatures increase, so will sand temperatures, which in turn will alter the thermal regime of incubating nests and alter natural sex ratios within hatchling cohorts, likely toward a larger proportion of females. Sea level rose approximately 15 cm during the 20th century (Baker et al. 2006) and further increases are expected, resulting in inundation of nesting beaches. Although beaches can move with fluctuations in sea level under natural conditions, extensive shoreline hardening (e.g., seawalls) inhibits this natural process. Erosion due to increased typhoon frequency and extreme temperatures are documented and known to cause high nest mortality. The effects of rising sea level and storm damage are amplified on small low-profile islands and atolls across the Pacific. These islands are prone to significant inundation due to relatively small increases in sea level, as well as increased inundation and erosion due to storm surge. Climate change may also have an indirect effect of on green turtles through reduced ocean productivity during warmer years.

4.1.4 Conservation of the Species

Green turtles nesting in the U.S. have benefited from both State and Federal laws passed in the early 1970s banning the harvest of turtles and their eggs. Protection and management activities since 1974 throughout the Hawaiian Archipelago and habitat protection at the French Frigate Shoals nesting area since the 1950's have resulted in increased population trends of both nesting and foraging turtles (Balazs and Chaloupka 2004). Elsewhere, the protection of nesting beaches against large-scale egg harvest appears to have reversed some downward nesting trends. Using long-term data sets, encouraging trends in green turtle nester or nest abundance over the past 25 years has become apparent in at least six locations including Hawaii, Australia, Japan, Costa Rica and Florida (Chaloupka et al. 2008a).

Efforts to reduce fisheries bycatch, such as the improvements made in the Hawaii-based longline fishery since the 1990s, has reduced green turtle interactions (NMFS & USFWS 2007a). Internationally, the conservation and recovery of green turtles is facilitated by a number of regulatory mechanisms at international, regional, national and local levels, such as the FAO Technical Consultation on Sea Turtle-Fishery Interactions, the Inter-American Convention for the Protection and Conservation of Sea Turtles, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and others. As a result of these designations and agreements, many of the intentional impacts on sea turtles have been reduced: harvest of eggs and adults have been slowed at several nesting areas through nesting beach conservation efforts and an increasing number of community-based initiatives are in place to slow the take of turtles in foraging areas (Gilman et al. 2007b; NMFS & USFWS 2007a).

4.2 Hawksbill Sea Turtles

Hawksbill turtles are distributed circumglobally, and can be found in the Pacific, Indian, and Atlantic Oceans, but not in the Mediterranean Sea, as described in the most recent hawksbill turtle 5-year status review (NMFS & USFWS 2007b). As shown above in Table 1, in 1978, all hawksbill turtles are listed as endangered under the ESA. Hawksbills are the most tropical sea turtle species, ranging from approximately 30°N latitude to 30°S latitude. They are closely associated with coral reefs and other hardbottom habitats, but they are also found in other habitats including inlets, bays, and coastal lagoons. There are only five remaining nesting aggregations with more than 1,000 females nesting annually. These nesting aggregations are in the Seychelles, Mexico, Indonesia, and two in Australia. There has been a global population decline of over 80 percent during the last three generations. Hawksbills face many of the same threats affecting green sea turtles. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions (NMFS and USFWS 2007b). Following are descriptions of the distribution and abundance, life history characteristics (especially those affecting vulnerability to the proposed action), threats to the species, major conservation efforts for the hawksbill sea turtle.

4.2.1 Distribution and Abundance

Globally, most of the important hawksbill sea turtle nesting populations declined substantially during the 20th century. Following are brief descriptions of distribution and abundance of hawksbill turtles in the three major ocean basins, with more detail provided for Oceania in the Pacific Basin where the action area is located.

Atlantic Ocean

In the western Atlantic, the largest hawksbill nesting population occurs on the Yucatán Peninsula of Mexico. Within the U.S., nesting occurs in Puerto Rico, the U.S. Virgin Islands, and along the southeast coast of Florida. Outside the U.S., nesting also occurs in Antigua, Barbados, Costa Rica, Cuba, and Jamaica. At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (NMFS and USFWS 2007b).

Indian Ocean

Of the approximately 83 nesting rookeries have been identified for hawksbill sea turtles, 31 occur in the Indian Ocean. Many of those nesting areas are relatively small hosting 100 or fewer nesting females annually. However, some nesting rookeries in Madagascar, Iran, and Western Australia may have as many as 1,000 to 2,000 nesting females annually. Based on the number of nesting females the population trends at the 31 nesting rookeries over the recent past (last 20 years) have remained stable in two locations, declined at five, and are unknown for 24. Historically (20 to 100 years ago), populations trends at these nesting rookeries have been in decline at 17 sites and are unknown for 14 (NMFS and USFWS 2007b).

Pacific Ocean

Hawksbill turtles nest broadly in the Pacific, including on the islands and mainland of Southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea, the Solomon Islands, and Australia, with the largest nesting concentration occurring on remote islands in the Great Barrier Reef (GBR) area. However, along the eastern Pacific Rim where nesting was common in the 1930s, hawksbills are now rare or absent (NMFS and USFWS 2007b). Unlike green turtles, hawksbills are solitary nesters, hampering data collection on nesting female numbers, thus all nesting numbers cited below are rough estimates. Hawksbill nesting information is available for eight locations within Oceania: GBR, Papua New Guinea, Solomon Islands, Vanuatu, Fiji, Micronesia (Federated States of Micronesia and Palau), the Samoan Islands (Western Samoa and American Samoa), and the Mariana Islands. Hawksbill nesting may occur elsewhere within the range of this population, but little to no information is available, and nesting activity at those sites is thought to be very low. Based on the best information currently available, about 5,400 to 6,100 hawksbill turtles nest annually in Oceania, and the overall trend is downward (NMFS & USFWS 2007b).

Sub-adult and adult hawksbill turtles occur in low abundance in nearshore waters around the islands of American Samoa. However, they are the most common sea turtle species in the nearshore waters around Tutuila (NMFS & USFWS 2007b), and low level nesting has been confirmed at several sites on that island (Tagarino et al. 2008). Fewer than 30 hawksbills are estimated to nest annually in the Samoan Archipelago, and the nesting trend is declining (NMFS & USFWS 2007b).

4.2.2 Life History Characteristics Affecting Vulnerability to the Proposed Action

As with green turtles, hawksbills hatch at their natal beaches, spend the first several years developing in the pelagic zone, and eventually recruit to nearshore habitats where they grow to adulthood. At about 35 cm carapace length, juveniles recruit to nearshore foraging areas where they begin feeding on sponges, other benthic invertebrates, and algae. Upon maturation, adult hawksbills undertake long migrations between their resident foraging grounds and their natal nesting areas (NMFS & USFWS 2007b). Two post-nesting hawksbills were fitted with satellite tags on Tutuila; one migrated several hundred km to Western Samoa, and the other migrated more than 1,000 km to the Cook Islands (Tagarino et al. 2008). Post-nesting hawksbills on the GBR are reported to migrate more than 2,000 km (Miller et al. 1998).

Based on the description of the proposed action, high intensity noise, due to pile driving, is the stressor with the greatest potential to impact hawksbill turtles. Research into turtle hearing is limited, and no specific information is available for hawksbills. However, available information suggests that they are low frequency specialists. As described above, green turtles are thought to be most acoustically sensitive between 200 and 700 Hz (Ridgway et al, 1969). Loggerhead (*Caretta carreta*) hearing is very similar to that of greens, being most sensitive between 250 and 1,000 Hz (Bartol et al. 1999). Based on the similarity in hearing between greens and loggerheads, NMFS considers it likely that hawksbill hearing is also similarly specialized for low frequencies. Because the hearing range of these turtles overlaps with the expected frequency range of the pile driving signals, NMFS considers it likely that hawksbills can hear, and respond to pile driving noise. Based on hawksbill turtle life history characteristics, adults and juveniles foraging in nearshore habitats, as well as adults in nearshore waters for breeding and nesting are the most vulnerable to exposure to excessive noise levels. Because the hawksbill turtles found around Tutuila are likely to migrate widely between their preferred forage and nesting areas, the proposed action may affect hawksbills from multiple NAs across a broad area of the south and western Pacific (Figure 1).

4.2.3 Threats to the Species

Global threats to hawksbill turtles are described in the 5-year review. As with green turtles, alteration of nesting and foraging habitat as well as direct harvest are considered the major threats to the species, and climate change also appears to be a growing threat.

As described for green turtles (Section 4.1.3), destruction and alteration of hawksbill nesting and foraging habitats is occurring throughout the species' global range, especially through coastal development, beach armoring, beachfront lighting, vehicular/ pedestrian traffic, invasive species, and pollution from discharges and runoff. The adverse impacts of these stressors described for greens, are virtually the same for hawksbills (NMFS & USFWS 2007b), so they are not repeated here. Although hawksbills interact with some fisheries, their bycatch rates are much lower than for the other sea turtle species, particularly with industrial fisheries.

Harvest of hawksbill shells and eggs continues to be a major threat. Due to the beauty of their shells, hawksbill adults may be harvested more heavily than other sea turtle species. Despite protections under CITES, the "tortoiseshell" trade continues in many areas. As with other sea turtle species, egg harvest continues unabated in parts of the Pacific, including Southeast Asia, Melanesia, and Polynesia (NMFS & USFWS 2007b).

4.2.4 Conservation of the Species

Numerous conservation programs are being implemented around the world to protect nesting habitat and reduce harvesting and fisheries bycatch of all sea turtle species, and numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (Section 5.2.4 above). Many of these programs likely benefit hawksbills, and some sub-populations in the Insular Caribbean appear to be increasing. However, hawksbills continue to decline rapidly in the Pacific and Indian Ocean areas (NMFS & USFWS 2007b).

5 Environmental Baseline

The environmental baseline for a biological opinion includes: past and present impacts of all State, Federal, or private actions and activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone Section 7 consultation; and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The Consultation Handbook further clarifies that the environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area (USFWS & NMFS 1998). The purpose of describing the environmental baseline in this manner within a biological opinion is to provide the context for the effects of the proposed action on the listed species. The past and present impacts of human and natural factors leading to the status of green and hawksbill sea turtles within the action area include direct take, coastal development, fishing interactions, pollution, climate change, vessel strikes, and entanglement in marine debris. As described in Section 3 above, the action area for this consultation is the marine waters within 25 km of Pago Pago and Fagasa Bays on Tutuila Island.

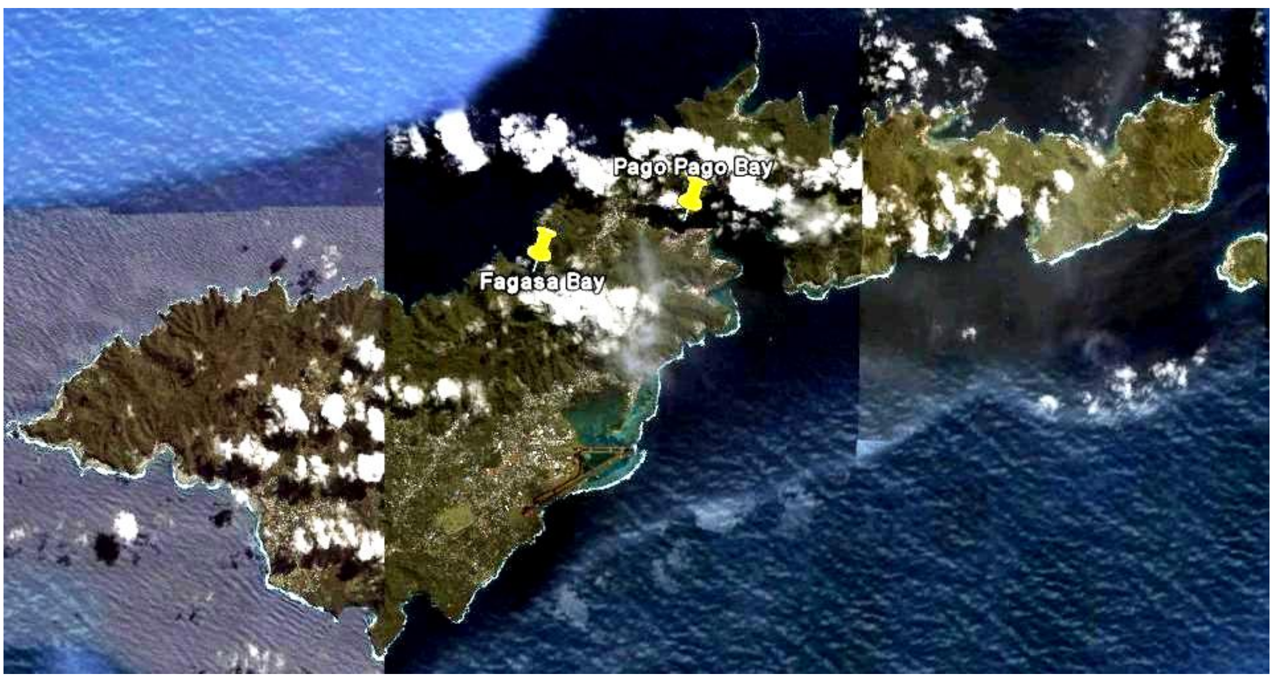

Figure 2. Action areas on Tutuila, affected by the proposed projects.

Tutuila is a steep volcanic island with limited coastal areas suitable for human habitation or agriculture. The island’s area is less than 142 km^2, with less than 20 km^2 of arable land, all of which is located along the shoreline. The island's population has grown from 32,000 in 1980, to over 65,000 in 2009, and is projected to double again in the next 30 years. Pago Pago Bay is a natural deep-water harbor, which has been heavily impacted by shoreline development, particularly along the inner (western) half of the bay, where very little natural reef remains.

Nearshore fisheries in American Samoa consists primarily of subsistence fishing, using hook-and-line (handlines or rod-and-reel), free diving, gillnetting, gleaning, and throw netting (Craig et al. 1993). Nearshore fisheries may sometimes result in entanglement and drowning of green turtles. Gillnets are the most problematic for turtles, because they are left untended, and entangled animals usually drown. Hook-and-line fishing from shore or boats also hooks or entangles green turtles, although the chance of survival is higher than if caught in a gillnet. In a study of “stranded” green turtles in Hawaii (stranded turtles are injured, sick, or dead turtles found on shore), the most common known cause of stranding was the tumor-forming disease, fibropapillomatosis (28%) followed by hook-and-line fishing gear-induced trauma (7%) and gillnet fishing gear-induced trauma (5%) (Chaloupka et al. 2008b). However, most turtles drowned in fishing gear probably sink rather than stranding, making it very difficult to estimate the total number of green turtles killed annually by nearshore fishing interactions, even in Hawaii where green turtles are much better monitored and studied than in American Samoa (NMFS 2008).

In American Samoa, sea turtles are killed by collisions, both with boats when turtles surface, and with cars when adult females are searching for nesting sites. In Hawaii, the total number of green turtles killed annually during the period 1998-2007 by boat collisions was estimated at 25 – 50 turtles, based on stranding data (NMFS 2008). Boats and green turtles are both less dense in American Samoa nearshore waters than in Hawaiian nearshore waters, thus the number of green turtles killed annually by boat collisions is likely much less than 25 turtles. Because roads in American Samoa typically run adjacent to beaches, adult females searching for nesting sites sometimes crawl onto the roadway where they may be run over, such as a large hawksbill female that was killed by a vehicle in late 2008 (Samoa News 2008). However, most green turtle nesting in American Samoa is on the uninhabited Rose Atoll, thus mortality from vehicle collisions is not a major source of mortality for green turtles in American Samoa.

Other impacts to the green turtle environmental baseline within the action area include climate change, marine debris, harvest, and contaminants. Climate change may be affecting the pelagic green turtle habitat within the action area. Marine debris may cause entanglement and possibly drowning, whereas ingested trash may cause intestinal blockage and death. The streams and coastlines of Tutuila are among the most littered within the U.S. Direct harvest of green turtles is likely still occurring in American Samoa (NMFS & USFWS 2007a). Pago Pago Harbor is heavily contaminated because of industrial and sewage effluents, which may be impacting green turtles.

During the 4 year period from Oct-04 to Sep-08, the American Samoa Department of Marine and Wildlife Resources (DMWR) recorded 15 green turtles stranded on Tutuila measuring 46-85 cm CCL, 6 of which were dead. Of the 4 green turtles that were necropsied, 2 had plastic and aluminum in their guts (Tagarino et al. 2008). However, because DMWR’s new turtle stranding program still has little data, and many turtles within the action area that are dead or dying from the above human impacts do not strand in American Samoa, it is not possible to estimate the number of green turtle mortalities resulting from climate change, marine debris, harvest, and contaminants in the past few years in the action area.

6 Effects of the Action

In this section of a biological opinion, NMFS assesses the probable effects of the proposed action on threatened and endangered species. Effects of the Action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline. Indirect effects are those that are likely to occur later in time (50 CFR 402.02). The effects of the action are considered within the context of the Status of Listed Species and Environmental Baseline sections of this Opinion to determine if the proposed action can be expected to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination.

Approach. NMFS determines the effects of the action using a sequence of steps. The first step identifies stressors (or benefits) associated with the proposed action with regard to listed species. The second step identifies the magnitude of stressors (e.g., how many individuals of a listed species will be exposed to the stressors; *exposure analysis*). In this step of our analysis, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to a proposed action's effects, and the populations or subpopulations those individuals represent. The third step describes how the exposed individuals are likely to respond to these stressors (e.g., the mortality rate of exposed individuals; *response analysis*).

The final step in determining the effects of the action is establishing the risks those responses pose to listed resources (*risk analysis*). The risk analysis is different for listed species and designated critical habitat. However, the action area does not include proposed or designated critical habitat, thus it is not considered in this opinion. Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (probability of extinction or probability of persistence) of listed species depends on the viability of their populations. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species and the populations that comprise them, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individuals risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individual's "fitness," which are changes in an individual's growth, survival, annual reproductive success, or lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable responses to an Action's effects on the environment (which we identify during our response analyses) are likely to have consequences for the individual's fitness.

When individual listed plants or animals are expected to experience reductions in fitness, we would expect those reductions to also reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent. Reductions in one or more of these variables (or one of the variables we derive from them) is a *necessary* condition for reductions in a population's viability, which is itself a *necessary* condition for reductions in a species' viability. On the other hand, when listed plants or animals exposed to an Action's effects are *not* expected to experience reductions in fitness, we would not expect the Action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise. If we conclude that listed plants or animals are *not* likely to experience reductions in their fitness, we would conclude our assessment.

If, however, we conclude that listed plants or animals are likely to experience reductions in their fitness, our assessment tries to determine if those fitness reductions are likely to be sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In this step of our analyses, we use the population's base condition (established in the 'Status of Listed Species' and 'Environmental Baseline' sections of this opinion) as our point of reference. Finally, our assessment tries to determine if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise.

6.1 Stressors

Potential stressors that may occur due to the proposed action include: exposure to elevated noise levels; collision with vessels; disturbance from human activity and equipment operation; exposure to wastes and discharges; and loss of forage or resting habitat.

<u>Exposure to elevated noise levels</u>. Exposure to high intensity noises may adversely affect sea turtles. Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. In extreme cases, exposure to very high levels of sound can cause soft tissue injuries that may directly result in fatality. Exposure to lower levels may cause injury in the form of permanent hearing damage, also referred to as permanent threshold shift (PTS). Exposure to even lower levels may cause behavioral effects that range from temporarily reduced sensitivity also referred to as temporary threshold shifts (TTS), to temporarily masked communications and/or acoustic environmental cues, and areal avoidance.

<u>Collision with vessels</u>: Sea turtles must surface to breathe, and they are known to rest or bask at the surface. Therefore, when at or near the surface, they are at risk of being struck by vessels or their propellers as the vessels transit to and from the project site. Potential injuries and their severity will depend on the speed of the vessel, the part of the vessel that strikes the animal, and the body part impacted. Injuries from boat strikes may include bruising, broken bones or carapaces, and lacerations. The recovery plan for green sea turtles indicates that boat collision is

a major threat around the MHI. Although not identified as a significant risk for either species in American Samoa, the recovery plans for both turtle species suggest that the incidence of collision is expected to increase as vessel size, speed, and traffic density increases, or as animal density increases (NMFS & USFWS 1998a & b).

Existing information about sea turtle sensory biology suggests that sea turtles rely more heavily on visual cues, rather than auditory, to initiate threat avoidance. Research also suggests that sea turtles can not be expected to consistently notice and avoid vessels that are traveling faster than 2 knots (kts) (Hazel et al. 2007). Consequently, vessel operators must be responsible to actively watch for and avoid sea turtles, and to adjust their speed based on expected animal density and on lighting and turbidity conditions to allow adequate reaction time to avoid marine animals. Based on the limited number of trips expected, the understanding that vessel operations will be primarily limited to inner Pago Pago Bay, and on the expectation that the vessels will operated in accordance with the NMFS-recommended BMPs for this action (NMFS 2010) that require operators to watch for and avoid protected species, and to operate vessels at reduced speeds NMFS considers the risk of collisions between action-related vessels and green and hawksbill turtles is discountable.

Disturbance from human activity and equipment operation: Exposure to construction activities may startle sea turtles should they encounter them. However, sea turtles typically avoid human activity. Based on this, the most likely effect of this interaction will be a moderate level stress with a moderate to high energy avoidance behavior leading to the animal rapidly leaving the area without injury. Additionally, the applicant will reduce the likelihood of this interaction by watching for and avoiding protected marine life before commencing work and by postponing or halting operations when protected species are within 50 feet of construction activities (NMFS 2010). Based on the above, we expect that disturbances related to this action will be infrequent and non-injurious, resulting in insignificant effects on green and hawksbill turtles.

Exposure to wastes and discharges: Construction wastes may include plastic trash and bags that may be ingested and cause digestive blockage or suffocation, or if large enough, along with discarded sections of ropes and lines, may entangle marine life. Equipment spills and discharges likely consist of hydrocarbon-based chemicals such fuel oils, gasoline, lubricants, hydraulic fluids and other toxicants, which could expose protected species to toxic chemicals. Depending on the chemicals and their concentration, the effects of exposure may range between animals temporarily avoiding an area, to death of the exposed animals.

Local and Federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. Additionally, contractors are required to operate in accordance with the NMFS-recommended BMPs (NMFS 2010). Those BMPs include measures intended to prevent the introduction of wastes and toxicants into the marine environment. Based on the information above, we expect that discharges and spills are unlikely to occur, but will be infrequent, small, and quickly cleaned if they do occur. Therefore, we have determined that exposure to construction wastes and discharges that may result from this action will result in insignificant effects on green and hawksbill turtles.

Loss of forage or resting habitat: Expansion of the marine footprint to create the new seawall proposed under BLWG004 will permanently remove 861 ft^2 of benthic habitat in Pago Pago Bay. However, the sea floor adjacent to the existing seawall is located in the most industrialized part of the island and is highly disturbed. No current surveys are available, but the area is believed to support only sparse macroalgae and sponge growth, and likely provides little or no resting habitat for either species. Thus, the value of this habitat is considered marginal at best. Because the new seawall will provide hard substrate, the area is expected to become re-colonized by algae and sponges from the adjacent areas. Because the lost habitat will be small and of low value, and lost forage resources will be temporary in duration, we expect that habitat loss due to this action will have insignificant effects on green and hawksbill turtles.

Summary of Stressors. Of the five potential stressors, only elevated noise levels are expected to adversely affect sea turtles, as described above. Thus, the exposure-response-risk analyses are limited to this stressor.

6.2 Exposure

This section analyzes the proposed action's potential for exposing green and hawksbill sea turtles to adverse levels of sound energy during pile driving operations in Pago Pago and Fagasa Bays. The analysis is based on the piling types and method of driving in the individual project descriptions (FEMA 2010a, & c-g), the expected substrate and duration of work (FEMA 2010i & j), the expected source levels based on the California Department of Transportation's Compendium of Pile Driving Sound Data (Compendium) (CALTRANS 2007). The exposure analysis is organized as follows:

1: Estimate the in-water source level for each pile driving project.
2: Estimate the ranges where in-water sound energy will fall to current threshold for expected effects.
3: Estimate number of green or hawksbill sea turtles potentially exposed to sound energy at or above the threshold for injury.

6.2.1 Estimate the in-water source level for each pile driving project:

Project PW # 45 involves four 8-hour days of impact pile-driving 78 linear feet of steel sheet pilings. Cumulatively, projects BLWG004, PW # 110, TEMG010, and PW # 79 involve seven 8-hour days of impact driving a total of 86 steel H-pilings. TEMG011 involves one 8-hour day of impact driving to re-set twelve 12-inch concrete pilings.

Acoustics Background. Sound can be measured and quantified in several ways, but the logarithmic decibel (dB) is the most commonly used unit of measure, and sound pressure level (SPL) is a common and convenient term used to describe intensity. In water, sound pressure is typically referenced to a baseline of 1 micropascal (re 1 µPa), vice the 20 µPa baseline used for in-air measurements. Consequently, 26 dB must be added to an in-air measurement to convert to an appropriate in-water value for an identical acoustic source (Bradley and Stern 2008). To assess the potential impact of a sound on marine resources, NMFS often assesses impacts based on the root-mean-square (dB_{rms}) of an acoustic pulse. This is the portion of a pulse that contains 90% of the sound pressure. For brevity, all further references to SPL assume dB_{rms} re 1 µPa, unless specified differently.

Sound Transmission in Water. Transmission loss (attenuation of sound intensity over distance) varies according to several factors in water, such as water depth, bottom type, sea surface condition, salinity, and the amount of suspended solids in the water. Sound energy dissipates through mechanisms such as spreading, scattering, and absorption (Bradley and Stern 2008). Spreading refers to the apparent decrease in sound energy at any given point on the wave front because the sound energy is spread across an increasing area as the wave front radiates outward from the source. In unbounded homogenous water, sound spreads out spherically, loosing as much as 7 dB with each doubling of range. Toward the other end of the spectrum, sound expands cylindrically when vertically bounded such as by the surface and substrate, losing only about 3 dB with each doubling of range. Scattering refers to the sound energy that leaves the wave front when it "bounces" off of a surface or particles in the water. Absorption refers to the energy that is lost through conversion to heat due to fiction. Irregular substrates, rough surface waters, and particulates in the water column increase scattering loss, while soft substrates, such as mud and silt increase absorption loss. Sound typically dissipates more rapidly in shallow, turbid waters over soft substrates (74 FR 18492). The waters of Pago Pago and Fagasa Bays are expected to be poor environments for acoustic propagation because they are shallow, with irregularly shaped bottoms with high levels of silt and mud.

Accurately predicting received noise levels at a given range (isopleth) requires complex equations and detailed information that is rarely available. The equation "RL = SL – 20LogR" is used to calculated spherical spreading loss, and "RL = SL – 10LogR" is used for cylindrical spreading (RL = received level; SL = source level; and R = range in meters). Actual spreading loss is typically somewhere between spherical and cylindrical, with absorption and scattering increasing the loss. Consequently, predictions are often made by estimating transmission loss using an equation with a spreading coefficient between -20 and -10. To account for the acoustic environment expected within the bays, RL = SL – 15LogR was used to calculate estimated transmission loss to estimate ranges to particular isopleths. Outside of the bays, the bottom drops away dramatically and transmission loss likely approaches that of spherical spreading.

Pile Driving Noise. The in-water source level (SL) is the sound energy at 1 m from the source. The SL of impact pile driving is typically high, sometimes in excess of 200 dB (CALTRANS 2007). Frequencies vary according to several factors, including the type of piling and substrate as well as the intensity of impact. Signal analysis of sheet piles indicates a relatively broadband signal with most of the energy between 25 and 4,000 Hz. Concrete piles have a signature with two components; a sound at about 200 Hz, followed by high frequency sound between 1,000 and 3,000 Hz. H-pile signals were described as "…higher frequency content than steel pipe…", with frequencies above 500 Hz to over 1,000 Hz. SPL is also affected by pile type and the substrate (the harder and larger the piling, the louder; the harder the bottom, the louder), as well as the impact energy (the harder the impact, the louder). Measured SPLs for individual pile driving events may vary over time.

Green and hawksbill sea turtles are the only ESA-listed marine animals expected to occur within Pago Pago and Fagasa Bays where pile driving noise may reach levels capable of causing adverse effects. As described in Section 4, greens and hawksbills are thought to be low frequency specialists, with hearing ranges that overlap with the expected frequency range of the pile driving signals. Thus, NMFS considers it likely that green and hawksbills can hear, and respond to pile driving noise.

6.2.2 Estimate the ranges where in-water sound energy will fall to current thresholds for expected effects:

Neither FEMA nor NMFS has site-specific noise measurements for pile-driving at Tutuila. Consequently, NMFS has referred to the CALTRANS Compendium, under the assumption that sound levels reported in the Compendium will closely approximate sound levels expected for similar pilings, driven in a similar manner in Pago Pago and Fagasa Bays on Tutuila. Based on the Compendium, impact driving steel sheet piles will be the loudest of the three piling types. Back-calculations with measured levels of 189 dB at 10 meters (m) and 194 dB at 5 m suggest a SL of 204 dB (Table 2). Impact driving of 16-inch concrete piles is the smallest piling described in the compendium. Back-calculation from the measured level of 173 dB at 10 m suggests a SL of 188 dB. The proposed action includes driving 12-inch concrete piles, which are smaller and likely less loud than the 16-inchers described above, but for conservatism, this consultation will use the 188 dB value. Back-calculations with measured levels of 158 dB at 90 m and 165 dB at 30 m suggest a SL of 187 dB for impact driving 12-inch steel H-piles.

Table 2. Estimated source levels and ranges to effects threshold isopleths for proposed pile driving types.

Piling	SL	Range to 190 dB	Range to 180 dB	Range to 160 dB	Range to 120 dB
Steel Sheet	204 dB	8 m	40 m	800 m	400,000 m
16-in Concrete	188 dB	N/A	3 m	80 m	32,000 m
12-in Steel H	187 dB	N/A	3 m	60 m	32,000 m

The mouth of Pago Pago Bay is about 5,000 m from the proposed sheet pile driving, where the estimated received sound level drops to 149 dB. The mouth of Fagasa Bay is about 1,000 m from the proposed pile driving, where the estimated received level is 142 dB. As mentioned above, transmission loss outside of the bays is likely to increase because spreading loss is expected increase due the dramatic increase in water depth. Exact calculations are beyond the scope of this consultation, but it is likely that the ranges to the 120 dB isopleth are significantly shorter than shown in Table 2.

Exposure to high intensity noises may adversely affect marine life. Effects vary with the frequency, intensity, and duration of the sound source, and the hearing characteristics of the exposed animal. In extreme cases, exposure to very high levels of sound can cause soft tissue injuries that may directly result in fatality. Exposure to lower levels may cause injury in the form of permanent hearing damage, also referred to as permanent threshold shift (PTS). Exposure to even lower levels may cause behavioral effects that range from temporarily reduced sensitivity also referred to as temporary threshold shifts (TTS), to temporarily masked communications and/or acoustic environmental cues, and areal avoidance. For exposure to sounds in water, ≥ 190 dB and ≥ 180 dB are the thresholds for PTS for pinnipeds and cetaceans, respectively. Exposure to in-water sounds ≥ 160 dB and ≥ 120 dB are the thresholds for TTS and behavioral effects, respectively for all marine mammals.

Currently, no acoustic thresholds have been established for sea turtles. However, existing research available into sea turtle sensory biology suggests that sea turtles are less acoustically sensitive than cetaceans, relying more heavily on visual cues, rather than auditory input (Hazel, et al. 2007, Ridgeway et al. 1969). Thus, application of the marine mammal thresholds is considered conservative for sea turtles. Using the loudest SL (sheet piles), and estimating attenuation based on RL = SL - 15logR, suggests that the 190, 180, 160, and 120 dB isopleths will occur at ranges of 8, 40, 800, and 400,000 meters, respectively, whereas driving the concrete and steel H-piles will have much shorter ranges to the effects thresholds (Table 2, and Figure 3). The estimated received levels fall to 149 and 142 dB at the mouths of Pago Pago and Fagasa Bays, respectively, at which point the spreading loss is expected to increase. Based on the information above, we expect that adverse levels of sound will be restricted to the area within the bays themselves, and that at most, exposure of ESA-listed animals to pile driving noise outside of either bay may result in low levels of temporarily masked communications or acoustic environmental cues, potentially resulting in insignificant behavioral responses that are likely to range between “awareness” of the noise to low level areal avoidance.

6.2.3 Estimate number of green or hawksbill sea turtles potentially exposed to sound energy at or above the threshold for injury:

Available data strongly suggest that in addition to the small number of green and hawksbill sea turtles that may nest on the island, low numbers of both species also reside year-round to rest and forage in nearshore waters, including Pago Pago and Fagasa Bays (Tagarino et al. 2008). However, Current data are insufficient to determine precisely their total numbers, or their density at particular sites around Tutuila. Although the BMPs require that pile driving be postponed or halted when ESA-listed species are within 100 m, NMFS considers it unlikely that turtles will be consistently detectable in the water at ranges much beyond 50 or 60 meters. As described above, 40 m is the range at which potentially injurious levels of sound (PTS) are expected to radiate outward from driving sheet pilings, and 3 m is the range for PTS from the other two piling types. Consequently, NMFS expects that no turtles will be exposed to sound levels at or above 180 dB, but pile driving may expose an undetermined number of turtles to sound levels at or above 160 dB (TTS threshold) out to about 800 m for sheet pilings, and 80 and 60 m for concrete and H-pilings, respectively (Figure 3).

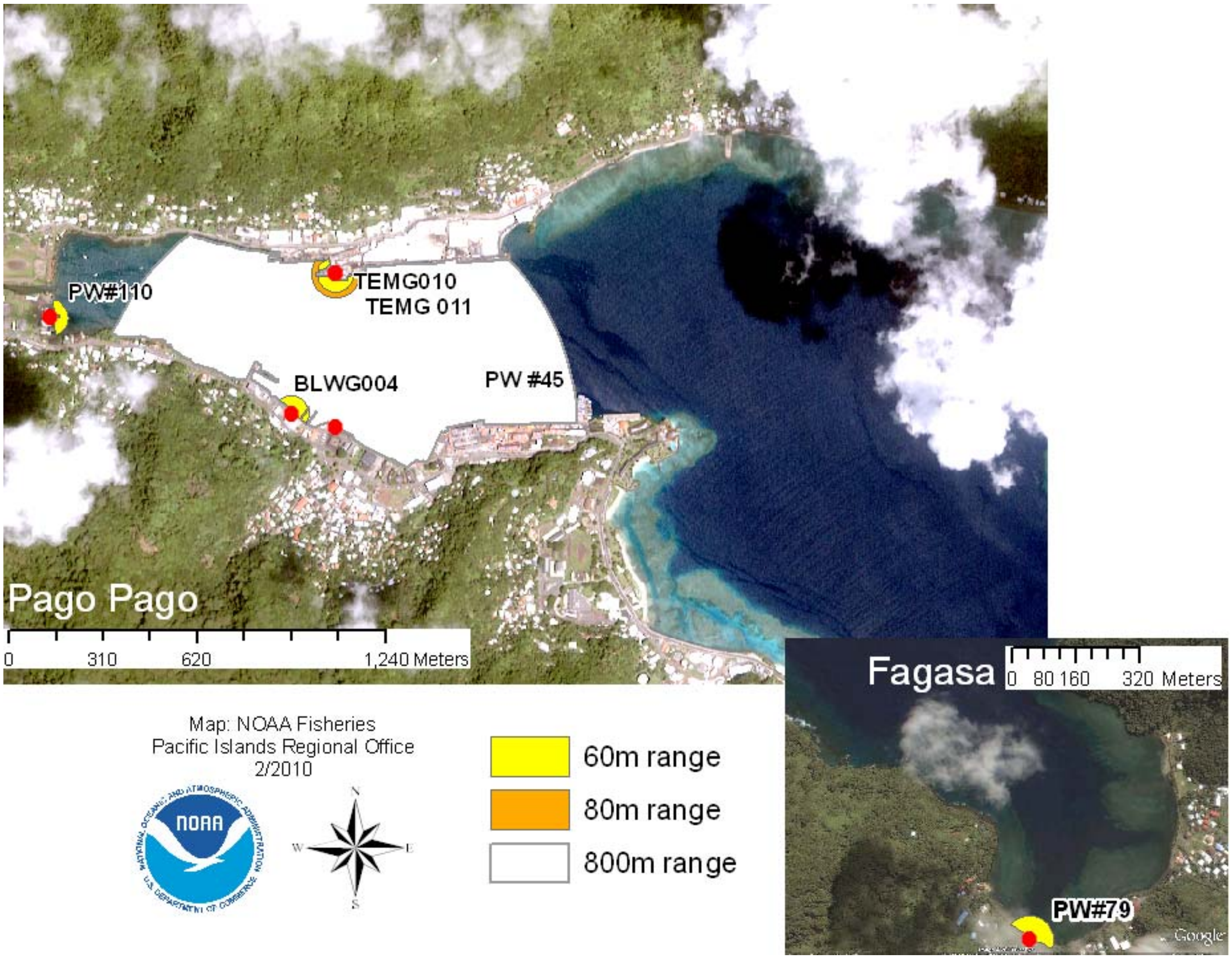

Figure 3. Pago Pago and Fagasa Bays showing the varying ranges to the 160 dB isopleth.

6.3 Response

The proposed action involves twelve 8-hour days of pile driving: four to drive the sheet piles, seven to drive the H-piles, and one to reset the 12-inch concrete pilings. The probable response to the exposure to pile driving noise due to the proposed action is the Based on this, and on the understanding that the effects thresholds are conservative for sea turtles, NMFS expects that no sea turtles will be injured by this exposure, but an unknown number of turtles may experience temporary behavioral modification in the form of TTS and/or real avoidance outward to the mouths of both bays during pile driving. Areal avoidance may result in the temporary displacement of turtles from the marginal to adequate forage and resting habitats of Pago Pago and Fagasa Bays, outward to adjacent habitats in more open water areas with potentially higher quality forage. This displacement is expected to last 11 days for work in Pago Pago Bay, and one day for Fagasa Bay. Because the numbers of Turtles around Tutuila are considered depressed due mostly to overharvest, NMFS expects that these habitats are likely underutilized, and capable of supporting the temporarily displaced turtles without causing adverse impacts on the turtles that may already be in those areas. Additionally, under normal conditions, the "displaced" turtles likely use some of these adjacent habitats as well as the inner harbors habitats.

6.4 Risk

As shown by the available data used in the exposure and response analyses above, we expect that an undeterminable number of green and/or hawksbill turtles may experience up to 12 days of areal avoidance, with a subset of those turtles potentially experiencing TTS. However, no turtles are expected to be injured or killed by the proposed action. As described above in the Status of Listed Species section, genetic information is inadequate to determine which nesting aggregations within Oceania the affected turtles belong to. Given that the proposed action will be completed within 6 months, the low number of turtles affected, and the expectation that no injury or mortality will result, the risk to the affected nesting aggregations is considered negligible.

6.5 Cumulative Impacts

"Cumulative Impacts" are the additive, synergistic, multiplicative, and/or antagonistic effects that may result from interactions between and among the stressors produced by an action and other pre-existing stressors. More so within Pago Pago Bay than in Fagasa Bay, turtles are routinely exposed to numerous environmental stressors that include elevated noise levels due to harbor activities such as vessel traffic and industrial activities related to the port and the cannery. The turtles are exposed to poor water quality due to runoff and effluents, and are also exposed to frequent close proximity with human activities in an area where such interactions frequently result in the intentional take of turtles. Exposure to the proposed action's pile driving noise may result in a short term increase the stresses experienced by these animals, but that additive stress is expected return to background levels shortly (within hours) after the work stops. Based on this and on the understanding that the pile driving will last a total of 12 days, NMFS expects that cumulative impacts due to the proposed action will be negligible for green and hawksbill turtles.

7 Cumulative Effects

"Cumulative effects," as defined in the ESA implementing regulations, are limited to the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). Cumulative effects, as defined in the ESA, do not include the continuation of actions described under the Environmental Baseline, and future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA. The climate change, fisheries interactions, vessel traffic, and marine debris that are described in the Environmental Baseline section are not only expected to continue, they will likely intensify over time, causing cumulative effects on green and hawksbill sea turtles.

In addition to the reduced ocean productivity due to climate change, sea level rise has been observed. As the sea level rises, inundation of low lying areas could result in the reduction or loss of important nesting habitats, which may adversely impact sea turtle reproductive success over time. The continued growth of the human population in American Samoa, as well as across the rest of the Pacific region, will likely result in increased coastal development, fishing pressure, vessel traffic, and pollution of the marine environment. Impacts may include accelerated degradation or loss of forage, resting, and nesting habitats; increased take in fisheries including intentional harvest of turtles and eggs; increased vessel strikes; and increased entanglement in, and ingestion of, marine debris. Although the extent of these increased stressors is unquantifiable, and the corresponding effects are also unquantifiable, it is clear that unless adequately addressed to reduce their impacts, these vectors of cumulative effect will present increasing challenges to the continued survival of green and hawksbill sea turtles.

8 Integration and Synthesis of Effects

The purpose of this Opinion is to determine if the proposed action is likely to have direct or indirect effects on threatened and endangered species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (50 CFR 402.02), otherwise known as the jeopardy determination. This is done by considering the Effects of the Action within the context of the Status of Listed Species and Environmental Baseline, as described in the Approach section (beginning of Section 7 Effects of the Action): We determine if mortality of individuals of listed species resulting from the proposed action are sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In order to make that determination, we use the population's base condition (established in the Status of Listed Species and Environmental Baseline sections of this Opinion) as the context for the overall effects of the action on the affected populations. Finally, our Opinion determines if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise. The following discussion summarizes the probable risks the proposed action poses to green and hawksbill sea turtles.

As described in the Effects of the Action section, we expect that the proposed action may result in an undeterminable number of green and/or hawksbill turtles experiencing up to 12 days of areal avoidance, with a subset of those turtles potentially experiencing TTS in and around Pago Pago and Fagasa Bays, but no turtles are expected to be injured or killed by the proposed action.

As discussed in the Status of Listed Species and summarized in Figure 1, many of the major green sea turtle nesting aggregations in the Pacific are stable or increasing, while most smaller nesting aggregations are declining, based on the best available information. As discussed in the Environmental Baseline, nearly all sea turtle nesting and foraging areas on Tutuila have been dramatically impacted by coastal development and pollution. Intentional harvest of turtles and eggs continues in some areas, and fisheries interactions and boat collisions are taking turtles. However, because the anticipated impacts of the proposed action will be temporary and are not expected to result in any turtle injury or mortality, or to affect reproductive success, the proposed action is not expected to adversely affect the population dynamics of green or hawksbill sea turtles. To summarize, we do not expect the effects of the proposed action to reduce the reproduction, numbers, or distribution of green or hawksbill sea turtles. Thus, we do not expect the proposed action to reduce the reproduction, numbers, or distribution of the green and hawksbill sea turtle species, as listed under the ESA.

9 Conclusion

The purpose of this Opinion is to determine if the Proposed Action is likely to jeopardize the continued existence of listed species (i.e., jeopardy determination). After reviewing the current status of ESA-listed green and hawksbill sea turtles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' Opinion that the proposed action is not likely to jeopardize the continued existence of green sea turtles or hawksbill sea turtles.

As described above in Section 4, no critical habitat has been designated or proposed for designation for any ESA-listed marine species in the action area or elsewhere in the American Samoa Archipelago. Therefore, the proposed action will have no effect on designated or proposed critical habitat under NMFS jurisdiction.

10 Incidental Take Statement

Section 9 of the ESA and protective regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement (ITS).

Based on the best information available, implementation of the proposed action is expected to adversely affect an undeterminable number of green and hawksbill sea turtles over a period of 12 days, through some level of areal avoidance, with a subset of those turtles experiencing some level of TTS. Although NMFS has determined that the proposed action is likely to adversely affect green and hawksbill sea turtles, we have also determined that the expected impacts will not rise to the level of take because the turtles' expected response to the stressors are expected to cause no measurable harm to those animals. Because no take is expected, no ITS is necessary, nor can an ITS be issued for this action.

11 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or develop information.

The following conservation recommendations are provided pursuant to Section 7(a)(1) of the ESA:

1. FEMA should strongly encourage and support the applicant's use of acoustic attenuation devices, such as bubble curtains, to reduce the acoustic impacts of pile driving on ESA-listed species in their marine habitats.
2. FEMA should strongly encourage and support the applicant's use of in-water acoustic monitoring devices to ensure that acoustic impacts on ESA-listed marine species from pile driving do not exceed expected levels.

3. To improve turtle nesting and nearshore forage habitats, FEMA should encourage the applicants to perform comprehensive debris and trash removal at the project sites and adjacent areas, beyond that of construction-related materials.
4. FEMA should lead or support outreach efforts on Tutuila, such as signage and other educational programs, to improve the public's awareness of the declining trends for sea turtles around Tutuila, including their vulnerability to harvest and habitat loss, and measures that can be taken to reduce impacts.

12 Reinitiation Notice

This concludes formal consultation on FEMA's funding, under Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, for projects to repair infrastructure damage on Tutuila, American Samoa that resulted from the Presidentially-declared Earthquake, Tsunami, and Flooding disaster (FEMA-1859-DR-AS) of September 2009. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of anticipated incidental take is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion;
3. The agency action is subsequently modified in a manner that may affect listed species or critical habitat to an extent, or in a manner not considered in this Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

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