Photograph by Kevin Foster, USFWS

FINAL
FISH AND WILDLIFE COORDINATION ACT REPORT

LELOALOA SHORELINE PROTECTION PROJECT
ISLAND OF TUTUILA
AMERICAN SAMOA

AUGUST 2005

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
PN-05-279

AUG 3 2005

Lieutenant Colonel David E. Anderson
Honolulu District Engineer
U.S. Army Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858

Dear Lieutenant Colonel Anderson:

The U.S. Fish and Wildlife Service (Service) has prepared a Final Fish and Wildlife Coordination Act (FWCA) Report for the Leloaloa Shoreline Protection Project, Island of Tutuila, American Samoa. This report has been prepared in accordance with the requirements of section 2(b) of the FWCA of 1934 [16 USC 661 *et seq*; 48 Stat. 401], as amended. The purpose of the report is to document the existing fish and wildlife resources at the proposed project site and to insure that fish and wildlife conservation receives equal consideration with other proposed project objectives as required under the FWCA. The report includes an assessment of the significant fish and wildlife resources at the proposed project site, an evaluation of potential impacts associated with the proposed project design alternatives, and recommendations for fish and wildlife mitigation measures.

The Service appreciates the opportunity to coordinate with the U.S. Army Corps of Engineers on the proposed project. If you have any questions regarding this report, please contact Marine Ecologist Kevin Foster by telephone at (808) 792-9420.

Sincerely,

Patrick Leonard
Field Supervisor

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LELOALOA SHORELINE STABILIZATION PROJECT
ISLAND OF TUTUILA
AMERICAN SAMOA

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AUGUST 2005

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INTRODUCTION

Authority, Purpose and Scope

This is the U.S. Fish and Wildlife Service's (Service) final report on plans by the U.S. Army Corps of Engineers (Corps) to implement a shoreline protection project at Leloaloa village on the island of Tutuila, Territory of American Samoa. This report has been prepared under the authority of the Fish and Wildlife Coordination Act of 1934 [16 U.S.C. 661 et seq.; 48 Stat. 401], as amended (FWCA), and other authorities mandating Department of the Interior concern for environmental values. This report is also consistent with the National Environmental Policy Act of 1969 [42 U.S.C. 4321 et seq.; 83 Stat. 852], as amended (NEPA). The purpose of this report is to document the existing fish and wildlife resources at the proposed project site and to ensure that fish and wildlife conservation receives equal consideration with other proposed project objectives as required under the FWCA. The report includes an assessment of the significant fish and wildlife resources at the proposed project site, an evaluation of potential impacts associated with the proposed project design alternatives, and recommendations for fish and wildlife mitigation measures.

The proposed project was authorized as a Small Beach Protection project under Section 103 of the Rivers and Harbors Act of 1962, as amended. The project is also consistent with Section 103 of the Flood Control Act of 1962, as amended. The estimated project cost of $1.7 million (2001 cost) for the proposed shoreline armoring includes the cost for construction, plans and specifications, engineering during construction, supervision and administration and real estate acquisition. The Honolulu Engineer District recommends proceeding into the cost-shared Feasibility Phase and, in accordance with Section 1156 of the Water Resources Development Act of 1986, waiving the American Samoa Government's cost-share requirements up to $200,000.

The purpose of the proposed project is to provide shoreline protection for the Route 1 coastal road at Leloaloa village, located along the northern shoreline of Pago Pago Harbor. Route 1 is the major road that connects the eastern and western human populations of Tutuila Island. At Leloaloa village, the road is on a narrow strip of land between steep mountains to the north and Pago Pago Harbor to the south. Construction of Route 1 at Leloaloa has significantly altered natural processes that would otherwise allow for natural expansion and contraction of coastal habitat. Numerous houses and community buildings exist landward of the road. Steep mountain slopes begin immediately behind the residential community and continue precipitiously to an elevation of nearly two thousand feet. The proposed project site is adjacent to and west of the Lepua shoreline that was armored in the early 1990s.

Oceanic swells and tidal activity have undermined the existing road embankment at Leloaloa village. Large swells travel unimpeded through the mouth of Pago Pago Harbor and break across the fringing reef, particularly at higher tides. As a result, erosion along the entire length of the village's coastal road has transformed the gradually sloping and vegetated shoreline into a nearly vertical wall of barren soil and rock, denuded of coastal vegetation. Therefore, shoreline hardening has been proposed as a measure to ensure the protection and viability of Route 1 as a major thoroughfare and to stabilize the Leloaloa shoreline from further erosion.

Coordination with Federal and Territorial Resource Agencies

Service biologists have discussed the proposed project with staff of the National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (USEPA), American Samoa Department of Marine and Wildlife Resources (DMWR), American Samoa Environmental Protection Agency (ASEPA), and American Samoa Coastal Management Program (ASCMP). Concerns relative to the protection and conservation of important fish and wildlife resources at Pago Pago Harbor expressed by these agencies were incorporated into this report. Copies of this report are being provided to all of these agencies.

Prior Fish and Wildlife Meetings, Studies and Reports

August 2003 - The Service participated in a planning meeting with the Corps and NMFS to discuss the proposed project. The Corps requested that the Service evaluate the potential project site at Leloaloa village.

September 2003 – The Service submitted a Planning Aid Letter with a Scope of Work and budget to conduct a FWCA investigation for the proposed project.

October 2003 – Service staff met with DMWR staff and ASEPA staff to discuss Service plans to conduct the FWCA investigation at Leloaloa.

October 2003 – Service staff conducted FWCA field investigations at the Leloaloa site.

December 2003 – The Service participated in telephone meetings with the Director of DMWR and ASEPA staff concerning potential actions that could serve as compensatory mitigation for unavoidable impacts to fish and wildlife resources as a result of the proposed project.

December 2003 – The Service released the Draft FWCA 2(b) report for review and comment.

February 2004 – The Service and Corps discussed the Draft FWCA 2(b) report and exchanged information.

January 2005 – The Service and Corps agreed to finalize the FWCA 2(b) report for the proposed project.

DESCRIPTION OF THE PROJECT AREA

The Samoa Archipelago is located in the south Pacific Ocean, approximately 4,345 kilometers (km) southwest of the State of Hawaii (Figure 1). The archipelago is about 480 km in length. The archipelago is politically divided into the Territory of American Samoa, an unincorporated territory of the U. S., and the nation of Samoa. American Samoa is comprised of five high islands (Tutuila, Aunu'u, and the Manu'a Islands [Ofu, Olosega, and Ta'u], and two atolls (Rose Atoll and Swains Island). The proposed project area at Pago Pago Harbor is located at 14° 16' South Latitude and 170° 42' West Longitude (Goldin 2002).

Tutuila is approximately 140 km^2 in area. The island is comprised of the remnants of five emergent volcanoes and two submerged volcanoes. The highest elevation on Tutuila is Matafao Peak at 714 meters (m). A drowned barrier reef encircles the island at the 200-m depth contour.

The seasons in American Samoa include tropical dry and wet periods. From June through September, relatively cool and dry conditions prevail throughout Tutuila. From October through May, warm and wet conditions are normal. During the dry season, the average temperature is 27° Celsius (C), and average rainfall is about 15 centimeters (cm) per month. During the wet season, average temperature is about 28° C, and rainfall averages about 33 cm per month (Craig 2002).

Trade winds usually come from the east-northeast and average between 16 and 32 km/hour quadrant. American Samoa has been visited by many hurricanes that primarily originate northwest of the islands. Recent hurricanes that exhibited significant destructive force include Esau (1981), Tusi (1987), Ofa (1990), and Val (1991), and Heta (2004).

Pago Pago Harbor is divided into an inner harbor (maximum depth 30 m) and outer harbor (maximum depth 60 m) (Figure 2). The inner harbor has undergone major alterations that destroyed as much as 95 percent of its original coral reefs by dredging and filling activities (IUCN/UNEP 1988). Pago Pago Harbor has served as a deep-water port for the U.S. Navy since 1872. The tuna canning industry has operated in the inner harbor, due west of Leloaloa village, since 1954. Cannery operations discharged industrial waste within the harbor until 1990. Poor mixing and circulation combined with spilled fuel, pesticides, heavy metals, and sedimentation in runoff have degraded the harbor's water quality (IUCN/UNEP 1988). However, cannery outfalls were moved to the outer harbor in 1992, and this has contributed to improved water quality conditions. Flushing time for the inner harbor is about 13 to 20 days (Green *et. al.*, 1997).

Coral Reef Resources

Marine communities in American Samoa are comprised of thousands of plants and animals that are part of the greater coral-reef ecosystem, which includes areas that may be dominated by live coral colonies, coralline algae, seagrass, macro-algae, and sand. Coral reefs are unique in that they are geological structures built by living communities. Coral polyps deposit calcium carbonate skeletons and grow upward as they continue to deposit new skeletal material from below. Many other organisms also deposit skeletons or shells on the reef. When corals or these other organisms die, their skeletal remains become part of the reef framework largely as a result of the cementing action of coralline algae. New corals settle on top of dead ones to continue the overall growth of the reef. Thus, the reef can be viewed as a thick framework of calcium carbonate rock covered with a fragile, thin veneer of life. The reef surface and underlying framework form an important complex of holes, tunnels, and elevated projections that provide a wide range of shelter, foraging, and reproductive habitats for numerous species of fishes, invertebrates, and other organisms.

The most ubiquitous type of coral reef at Tutuila island is the fringing reef (Figure 3). Fringing reefs are geologically young structures that extend a modest distance from the shoreline and

represent the general growth pattern of the coral community around high islands. The fringing reefs around Tutuila are relatively high-energy environments that have evolved to support complex communities of plants and animals. The fringing reefs that occur within deep embayed environments, such as Pago Pago Harbor, are generally low-energy environments that often support unique species assemblages.

Tutuila's fringing reefs are important because they provide extensive habitat that supports a wide variety of ecological functions. From a biological perspective, these functions include nesting and recruitment, foraging, resting, and sheltering from predators for highly diverse assemblages of species, including the federally listed threatened green sea turtle (*Chelonia mydas*) and endangered hawksbill sea turtle (*Eretmochelys imbricata*). Maintenance of coral reef habitats that support these ecological functions is dependent on protecting the thin, top layer of living coral, which requires clean, well-oxygenated, tropical seawater for maximum health. Although corals are fragile and can be broken by storm waves, healthy reefs can continually heal themselves from wave damage and other natural impacts.

Healthy fringing reefs provide other ecological functions by acting as buffers for island shorelines from oceanic swells and storm events. Wave energy is reduced and dispersed over the reef flat, protecting shorelines from erosion. This protection typically helps support upland areas for human inhabitants and a wide variety of native terrestrial organisms, including coastal vegetation, land snails and other invertebrates, sea turtles and other reptiles, sea birds, shore birds, and bats.

Other ecological functions provided by healthy fringing reefs include the maintenance of intact marine communities in the near shore environment that interact with pelagic or terrestrial species through complex predator, prey, or symbiotic relationships common in tropical ecosystems. Also, healthy coral reef resources directly benefit the residents of American Samoa by supporting human activities such as subsistence harvest/fishing, recreational activities, tourism, and cultural practices.

Coral distribution is limited by numerous factors, such as alteration of habitat, sedimentation, water quality, water temperature, predator outbreaks, and hurricanes. Dredging can destroy coral tissue and entire coral colonies by direct contact. Sediment that becomes suspended in the water column may settle on coral polyps and smother them. Suspended sediment may also abrade polyps and planktonic larvae and render them non-viable. Pago Pago Harbor and the shoreline at many places on Tutuila have been altered to various degrees during construction activities related to harbors, boat ramps, shoreline revetments, and coastal roads.

Water quality is an important consideration for coral reefs. American Samoa coral reefs remain vulnerable to sedimentation and nutrient loading from upland sources as a result of poorly regulated agricultural and human development activities (Green *et al.,* 1997 and Pers. Comm., P. Peshut 2003). Elevated levels of nutrients (*e.g.*, phosphates or nitrates), petroleum products, or polychlorinated byphenyls (PCBs) may have lethal or sub-lethal affects upon coral communities. Sewage and leachate from unlined landfills are primary sources of chemical contamination that may degrade coral reef communities. The ASEPA is evaluating sediments and biota throughout Pago Pago Harbor to determine the relative risk that contaminants may

pose to humans that consume marine organisms taken from the harbor (Pers. Comm., P. Peshut 2003).

Water temperature also affects the viability of coral tissue. Corals may become stressed when water temperatures vary from the optimal range of 25° C to 29° C. In 1994, sea surface temperatures remained elevated for a sustained period that resulted in the largest "coral bleaching" event recorded in American Samoa (Green 2002).

The indigenous crown-of-thorns sea star (*Acanthaster planci*) is a coralivorous echinoderm occasionally observed on American Samoa coral reefs. It is not well understood whether periodic population outbreaks of this species can be attributable to natural or man-made influences. However, it is well-documented that even modest outbreaks may significantly degrade coral reefs in American Samoa (Birkeland and Randall 1979, Zann 1992).

Hurricanes are a rare weather phenomenon in American Samoa, but they can have devastating consequences for coral reefs. Recent hurricanes, such as Ofa (1990) and Val (1991), were responsible for major damage to coral reefs throughout American Samoa (Green 1999). The most recent hurricane (Heta, January 2004) did not result in serious damage to coral reefs (Pers. Comm., P. Peshut 2004).

FISH AND WILDLIFE RESOURCE CONCERNS AND PLANNING OBJECTIVES

The Service's primary concerns for the proposed project include potential impacts to endangered species and other fish and wildlife resources and their habitats from filling in the marine environment. Specific Service planning objectives are to maintain and enhance the existing significant habitat values at the proposed project site by (1) obtaining basic biological data for the proposed project site, (2) evaluating and analyzing the impacts of proposed-project alternatives on fish and wildlife resources and their habitats, (3) identifying the proposed-project alternative least damaging to fish and wildlife resources, and (4) recommending mitigation measures as a result of project-related negative impacts to fish and wildlife resources that include: avoidance of unnecessary impacts; minimization of unavoidable impacts, and compensation for unavoidable negative impacts consistent with the FWCA and the Service's Mitigation Policy.

Under the authority of the Endangered Species Act (ESA), the Department of the Interior (DOI) and the Department of Commerce (DOC) share responsibility for the conservation, protection and recovery of federally-listed endangered and threatened species. Authority to conduct consultations has been delegated by the Secretary of the Interior to the Director of the Service and by the Secretary of Commerce to the Assistant Administrator for Fisheries of NMFS. Section 7(a)(2) of the ESA requires Federal agencies, in consultation with and with the assistance of the Service or NMFS, to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitats. The Biological Opinion is the document that states the opinion of the Service or NMFS as to whether the Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

The Service's Mitigation Policy (Service 1981) outlines internal guidance for evaluating impacts affecting fish and wildlife resources. The Mitigation Policy complements the Service's participation under the NEPA and the FWCA. The Service's Mitigation Policy was formulated with the intent of protecting and conserving the most important fish and wildlife resources while facilitating balanced development of this nation's natural resources. The policy focuses primarily on habitat values and identifies four resource categories and mitigation guidelines. The resources categories are the following:

a. Resource Category 1: Habitat to be impacted is of high value for the evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section.

b. Resource Category 2: Habitat to be impacted is of high value for the evaluation species and is relatively scarce or becoming scarce on a national basis in the ecoregion section.

c. Resource Category 3: Habitat to be impacted is of high to medium value for the evaluation species and is relatively abundant on a national basis.

d. Resource Category 4: Habitat to be impacted is of medium to low value for the evaluation species.

The coral reef ecosystem fronting the project site at Leloaloa comprises the habitat of major concern. Although corals are very small and sensitive organisms, healthy coral colonies are fundamentally important in providing the basic foundation for habitat that supports diverse communities of other highly specialized marine organisms. Corals contribute the bulk of the calcareous raw materials that form and maintain the basic structural framework of the reef. Coral colonies add significantly to the submarine topographic relief in which a large number of fish and invertebrate species find shelter and food. Coral polyps themselves are an important food source for some fishes and other marine life. The institutional significance of U.S. coral reefs has been established through their designation as Special Aquatic Sites [40 CFR Part 230 §230.44/FR v.45n.249] and as a Federal Trust Resource [Executive Order (E.O.) 13089 on Coral Reef Protection]. Such sites possess special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values and contribute to the general overall environmental health or vitality of an entire ecosystem of a region.

Coral reefs are relatively scarce on a national basis and are currently in a world-wide state of decline (Crosby *et al.* 1995; U.S. Coral Reef Task Force 2000). In American Samoa, some coral reefs are subjected to relatively frequent adverse impacts, and the extent of healthy and productive coral reefs may be declining on a local basis (Birkeland *et al.*, in prep, Green 2002, Fisk and Birkeland 2002). The Service considers the coral reef habitats within Pago Pago Harbor to be Resource Category 2 habitats. The Service's resource goal for Category 2 habitat is no net loss of in-kind habitat values. Under this designation, the Service will recommend ways to mitigate losses, through measures to avoid or minimize significant adverse impacts. If losses are unavoidable, measures to immediately rectify, reduce, or eliminate losses over time

by the replacement of in-kind habitat values will be recommended for incorporation into the project as necessary compensation.

Corals, algae, invertebrates, seagrass, and reef fishes have been selected as the evaluation species for the reef habitats that may be affected by the proposed project. Selection of a diverse assemblage of organisms offers an evaluation at the community level to assess a site's relative contribution to the overall coral reef resources that occur within Pago Pago Harbor.

EVALUATION METHODOLOGY

Marine Biological Assessment

In 2003, the Service conducted a marine biological assessment of the shallow reef environment within Pago Pago Harbor fronting Leloaloa to evaluate potential impacts to fish and wildlife resources based on the proposed project design criteria. Observations of the distribution and relative abundance of reef fishes, corals, other macro-invertebrates, and algae were compiled. Global Positioning System (GPS) data were collected to identify the location of each survey transect.

Service ecologists Kevin Foster and Gordon Smith conducted the marine survey work for this project on February 25-27 and October 15-16, 2003. Mr. Foster collected benthic substrate, coral, macro-invertebrate, and marine plant data at all survey transects. Mr. Smith collected reef fish data at all survey transects. All marine survey work was conducted between 9:00 am and 5:00 pm. Mr. Foster provided all photographs that appear in this report.

Two complementary survey techniques were used at each station: (a) a quantitative benthic substrate transect and (b) a semi-quantitative Rapid Ecological Assessment (REA). Transect data on benthic habitat were obtained along a 25-m tape measure. Data were collected at points every .25 m on the tape. The type of substrate directly beneath each point was recorded on underwater paper for later transcription. Non-biological substrate types included mud, rubble/rock, sand, and consolidated calcareous pavement. Biological substrate types included coral, coralline algae, macro-algae, seagrass, and sponge.

Data from a total of 6 transects were collected to characterize the marine community at the Leloaloa survey station. Survey transects were conducted in an east to west orientation, parallel to the shoreline. All survey transects were oriented along the 1m depth contour on the reef flat.

The REA was used to characterize species and habitat conditions at each station. The technique consisted of timed 15-minute scuba dives by biologists to survey fishes, corals, other macro-invertebrates, algae, and seagrass. All dive operations were conducted from shore.

During each REA survey dive, biologists swam over the area immediately surrounding the transect tape in a meandering fashion with a minimum amount of backtracking. Species observations were recorded on underwater paper for later transcription. Emphasis was given to identifying conspicuous, diurnally active species. As a result, small, cryptic, and nocturnally active species are under-represented in these data.

Species observed during the REAs are ranked as being Dominant, Abundant, Common, Occasional, or Rare. These categories are defined as follows: Dominant (D) = the species constitutes a majority in abundance or substrate coverage (50+% of total) or is very conspicuous throughout the survey area; Abundant (A) = the species contributes substantial abundance or coverage (25+% of total) or is very numerous in the survey area (*e.g.*, 15+ individuals of a fish species) or is dominant within parts of the survey area; Common (C) = the species is present as several or more individuals (*e.g.*, 5-14 individuals of a fish species) or as a few larger colonies or is conspicuous in only one or a few parts of the survey area; Occasional (O)= the species is uncommon or present only as a few individuals (*e.g.*, 2-4 individuals for fish species) or as a few large colonies, but not contributing substantially to abundance or substrate coverage anywhere within the survey area; and Rare (R) = the species is present on the basis of only one individual (*e.g.*, fishes) or colony seen within the survey area.

Divers located the 1-m depth contours at each survey transect station with a hand-held fathometer. GPS data were collected while over each survey transect. After these data were collected, both the fathometer and GPS unit were secured in dry bags attached to a floating dive flag. Divers towed the float while conducting each survey.

Ecological Functions

Coral reef ecosystems in Pago Pago Harbor exhibit a variety of ecological functions, which are described in this report. Each ecological function provides a relative contribution toward the maintenance or protection of individual species or groups of species and their habitats. Observations of ecological functions were made at the 1-m-depth contour and along the shoreline (for migratory birds only), and values were assigned to each potential function. A value was assigned to an ecological function when it was either directly observed or evidence suggested that it could be supported at some point within the survey area. For example, if evidence of the function was not observed, it received a value of zero. If evidence of the function was observed, it received a value of one.

DESCRIPTION OF FISH AND WILDLIFE RESOURCES

The complete results of this FWCA investigation are contained in this report (Tables 1-7). Benthic substrate data are presented in Table 1 and Appendix 1. Species lists of reef fishes, corals, other macro-invertebrates, and marine plants are presented in Tables 2-5. GPS data were collected for each transect and are presented in Table 6. Results for the evaluation of ecological functions are presented in Table 7. Photos of the proposed project site appear in Appendices 3 and 4.

Existing Conditions at the Leloaloa Site

Terrestrial

Tuna canneries are located immediately west of the proposed project site. A small peninsula to the east of the site, locally known as the Leloaloa Breakwater, extends into the harbor. The development of residential communities in this area has resulted in significant alterations of the native terrestrial environment. Non-native domestic dogs (*Canis familiaris*), cats (*Felis catus*),

black rats (*Rattus rattus*), Norway rats (*Rattus norvegicus*), Polynesian rats (*Rattus exulans*), house mice (*Mus musculus*), pigs (*Sus scrofa*) and chickens (*Gallus gallus*) are the primary terrestrial animals that occur within the vicinity of the site. Several trees were recorded along Route 1 in the vicinity of the site, and these include the coconut (*Cocos nucifera*), hibiscus (*Hibiscus tiliaceus*) and milo (*Thespesa populnea*). Also, DMWR biologists report occasional observations of migratory birds, including wandering tattlers (*Heteroscelus incanus*), sanderlings (*Calidris alba*), ruddy turnstones (*Arenaria interpres*), and Pacific golden-plovers (*Pluvialis fulva*). These species may be observed foraging along the shoreline at Leloaloa.

Marine

The proposed project area includes a reef flat that extends about 150 m seaward of the shoreline and ranges from one to two meters in depth. This area is considered a high-energy environment since oceanic swells roll through the harbor entrance unimpeded before reaching the fringing reef and shoreline. The reef flat supports a diverse community of marine plants and animals.

Benthic substrate data are presented in Table 1 and Appendix 1. A total of 26 species of reef fishes (Table 2), 8 species of corals (Table 3), 16 species of benthic macro-invertebrates (Table 4), and 9 species of marine plants (Table 5) were observed and recorded. Although green sea turtles and hawksbill sea turtles are known to exist in Pago Pago Harbor, these species were not observed during the Leloaloa site surveys. It is likely, however, that green and hawksbill sea turtles forage at Leloaloa.

Survey Transect 1: The reef substrate at a depth of 1 m consisted of rock and rubble (58%), coralline algae (19%), macro-algae (19%), and sand (4%). Reef fish species included cardinalfishes (*Apogon novemfasciatus*); goatfishes (*Parupeneus cyclostomus*); butterflyfishes (*Chaetodon citrinellus*); damselfishes (*Chromis margaritifer*, *Chrysiptera brownrigii*, and *Pomacentrus vaiuli*); gobies (*Amblygobius sphynx*); and surgeonfishes (*Acanthurus nigrofuscus*, *A. triostegus*, and *Ctenochaetus strigosus*). Coral species observed at this site included *Pocillopora damicornis*, *Porites lobata* and *P. lutea*. Observations of macro-invertebrates included a sponge (*Callyspongia* sp); sea snails (*Conus ebraeus*); and sea urchins (*Echinothrix diadema* and *Echinometra mathaei*). Marine plants observed at this location included red algae (*Halymenia durvillei*, *Hydrolithon onkodes,* and *Peyssonnelia boergesenii*), green algae (*Bryopsis pennata*, *Caulerpa serrulata*, *Chlorodesmis fastigiata*, and *Halimeda minima*), and an unidentified turf alga.

Survey Transect 2: The reef substrate at a depth of 1 m consisted of rock and rubble (54%), coralline algae (17%), macro-algae (17%), consolidated calcareous pavement (11%), and coral (1%). Reef fish species included squirrelfishes (*Myripristis murdjan*); butterflyfishes (*Chaetodon auriga* and *C. citrinellus*); damselfishes (*Abdefduf sexfasciatus*, *Chromis margaritifer, Chrysiptera brownrigii*, *C. cyanea*, and *Pomacentrus vaiuli*); wrasses (*Thalassoma hardwickii*); surgeonfishes (*Acanthurus nigrofuscus* and *Ctenochaetus strigosus*); triggerfishes (*Rhinecanthus aculeatus*); and puffers (*Canthigaster solandri*). Coral species observed at this site included *Pocillopora damicornis*, *P. verrucosa,* and *Porites lutea.* Observations of macro-invertebrates included a sponge (*Dysidea* sp); a sea snail (*Cypraea moneta*, *Conus lividus*, and *Elysia ornata*); and a sea urchin (*Echinostrephus* sp). Marine plants observed at this location included red algae (*Halymenia durvillei* and *Peyssonnelia*

boergesenii), green algae (*Bryopsis pennata*, *Caulerpa serrulata*, *Chlorodesmis fastigiata*, and *Halimeda minima*), and an unidentified turf alga.

Survey Transect 3: The shallow reef benthic substrate at a depth of 1 m consisted of rock and rubble (68 %), coralline algae (22%), macro-algae (8%), coral (1%), and sand (1%). Reef fish species included cardinalfishes (*Apogon novemfasciatus*); butterflyfishes (*Chaetodon citrinellus*); damselfishes (*Chrysiptera brownrigii* and *Pomacentrus vaiuli*); surgeonfishes (*Acanthurus nigricauda*, *A. nigrofuscus*, *A. pyroferus*, *Ctenochaetus strigosus*, and *Zebrasoma flavescens*); and triggerfishes (*Rhinecanthus aculeatus*). Coral species observed at this site included *Pocillopora damicornis*, *Porites lobata*, and *P. lutea*. Observations of macro-invertebrates included sea snails and oysters (*Cypraea moneta*, *Conus lividus*, *C. ebraeus*, *Elysia ornata*, and *Pedum spondyloideum*); and a sea urchin (*Echinothrix diadema*). Marine plants observed at this location included red algae (*Peyssonnelia boergesenii*), green algae (*Bryopsis pennata*, *Chlorodesmis fastigiata, Halimeda opuntia*, and *H. minima*), and an unidentified turf alga.

Survey Transect 4: The shallow reef benthic substrate at a depth of 1 m consisted of coralline algae (40%), macro-algae (28%), rock and rubble (18%), sand (13%), and coral (1%). Reef fish species included cardinalfishes (*Apogon novemfasciatus*); butterflyfishes (*Chaetodon auriga*); damselfishes (*Chrysiptera brownrigii* and *Pomacentrus vaiuli*); gobies (*Amblygobius phalaena*); surgeonfishes (*Acanthurus nigrofuscus*, *A. triostegus*, and *Ctenochaetus strigosus*); triggerfishes (*Rhinecanthus aculeatus*); and puffers (*Canthigaster solandri*). Coral species observed at this site included *Pocillopora damicornis*, *P. danae*, *P. verrucosa*, *Porites lobata*, and *P. lutea*. Observations of macro-invertebrates included sea snails (*Strombus* sp, *Conus flavidus*, *C. lividus*, and *Elysia ornata*) and a sea urchin (*Echinostrephus sp*). Marine plants observed at this location included red algae (*Hydrolithon onkodes* and *Peyssonnelia boergesenii*), green algae (*Bryopsis pennata*, *Caulerpa racemosa*, *Chlorodesmis fastigiata, Halimeda opuntia*, and *H. minima*), and an unidentified turf alga.

Survey Transect 5: The shallow reef benthic substrate at a depth of 1 m consisted of consolidated calcareous pavement (34%), macro-algae (29%), sand (17%), rock and rubble (8%), coralline algae (7%), and coral (5%). Reef fish species included goatfishes (*Parupeneus cyclostomus*); damselfishes (*Chrysiptera brownrigii*); and surgeonfishes (*Acanthurus triostegus* and *Zebrasoma flavescens*). Coral species observed at this site included *Pocillopora damicornis*, *Favia speciosa*, *Favia* sp, *Porites lobata*, *P. lutea*, and *P. rus*. Observations of macro-invertebrates included a sponge (*Agelas* sp); marine worms (*Spirobranchus giganteus*); sea snails (*Strombus* sp, *Conus lividus*, and *Elysia ornata*); and a sea squirt (*Didemnum molle*). Marine plants observed at this location included red algae (*Hydrolithon onkodes* and *Peyssonnelia boergesenii*), green algae (*Bryopsis pennata*, *Caulerpa racemosa*, *C. taxifolia*, *Chlorodesmis fastigiata, Halimeda opuntia* and *H. minima*), and an unidentified turf alga.

Survey Transect 6: The shallow reef benthic substrate at a depth of 1 m consisted of rock and rubble (38%), coralline algae (21%), macro-algae (19%), sand (13%), consolidated calcareous pavement (8%), and sponges (1%). Reef fish species included snappers (*Lutjanus fulvus*); goatfishes (*Parupeneus cyclostomus*); butterflyfishes (*Chaetodon citrinellus* and *C. vagabundus*); damselfishes (*Abdefduf sexfasciatus*, *Chrysiptera brownrigii*, *Pomacentrus vaiuli*,

and *Stegastes nigricans*); rabbitfishes (*Siganus argenteus*); surgeonfishes (*Acanthurus lineatus* and *A. nigrofuscus*); triggerfishes (*Rhinecanthus aculeatus*); and puffers (*Canthigaster solandri*). Coral species observed at this site included *Pocillopora danae*, *Porites lobata*, and *P. lutea*. Observations of macro-invertebrates included a sponge (*Dysidea* sp); sea snails and oysters (*Conus lividus*, *Elysia ornata*, and *Pedum spondyloideum*); a sea urchin (*Echinostrephus sp*); and a sea cucumber (*Holothuria atra*). Marine plants observed at this location included red algae (*Hydrolithon onkodes* and *Peyssonnelia boergesenii*), green algae (*Bryopsis pennata*, *Caulerpa taxifolia*, *Chlorodesmis fastigiata*, and *Halimeda minima*), and an unidentified turf alga.

Ecological functions supported by the fringing coral reef community at Leloaloa (Table 7) include provision of significant shoreline protection; foraging habitat for protected sea turtles; habitat for general marine species recruitment, foraging, resting, and sheltering from predators; foraging habitat for migratory birds (Marine Habitat); foraging habitat for migratory birds (Coastal Habitat); a significant source of coral and coralline algae for potential re-colonization of inner Pago Pago Harbor; and resources that support human activities such as subsistence harvest, recreation fishing, and diving for residents and tourists.

Future Without the Project:

Construction of Route 1 along the water's edge at Leloaloa has significantly altered the effects of natural processes that would otherwise allow for the dynamic expansion and contraction of coastal habitat. Construction of static structures, such as roads, buildings and residential communities in close proximity to the shoreline have incrementally degraded the performance of the ecological functions (*e.g.*, wave energy buffer and forage habitat for migratory birds) once associated with this habitat. Currently, the Leloaloa shoreline is particularly vulnerable to oceanic swells, which have undermined the road-hardened embankment and threatened the future integrity of the road.

Without the project, it is likely that large sections of Route 1 at Leloaloa would eventually erode into the harbor and threaten safe passage for the community members and others. Also, rubble and coastal sediments would continue to erode from shore and accumulate on the adjacent reef. Surge energy may roll these materials around on the reef, degrading existing coral communities and disrupting the successful establishment of new recruits among corals and other important marine organisms.

DESCRIPTION OF ALTERNATIVES EVALUATED

Proposed Action

The proposed action is meant to address a site-specific problem (*i.e.*, coastal erosion). Therefore, alternative sites to implement this action have not been considered. The proposed project involves construction of a rock revetment along the shoreline at Leloaloa village for a distance of about 720 m (Appendix 4a). The rock revetment would consist of a layer (0.9 m thick) of fitted armor stones that would be laid on top of a layer (0.7 m thick) of smaller diameter stones. About 5,000 yards^3 of armor stones (907 to 1,360 kilograms each) and about

5,900 yards^3 of underlayer material (9 to 45 kilograms each) would be used to construct the revetment. Plastic filter cloth would be laid under the structure to prevent migration of the underlying sand and soil. The crest elevation of the revetment would be set at 3.05 m above Mean Sea Level, with a seaward side slope of 1 vertical to 1.5 horizontal. The approximate width of the revetment, measured from crest to toe, is about 9.6 m Appendix 5b). The total area of fill is estimated to be approximately 6,912 m^2 (about 0.69 hectares or 1.71 acres).

No Action Alternative

No activities would be undertaken to address shoreline erosion or protect the Route 1 coastal road at Leloaloa.

PROJECT IMPACTS

Habitat

Approximately 1,800 m^2 would be directly lost due to the placement of backfill landward of the proposed revetment. Approximately 6,912 m^2 (about 0.69 hectares) of coastal and shallow marine habitat would be directly lost due to installation of the revetment on the reef flat.

Terrestrial Ecological Functions

Project-related coastal hardening will result in the permanent loss of existing terrestrial habitat where certain vegetated areas of the shoreline embankment serve as foraging habitat for migratory birds. In addition, the existing intertidal habitat that also provides foraging resources for migratory birds at Leloaloa will be permanently lost.

Marine Ecological Functions

The proposed activity will result in the permanent loss of shallow marine habitat that supports coralline algae, corals, and macro-algae. Coralline algae offer settlement opportunities for coral larvae and stabilize or cement physical reef structures. Coral colonies provide food, shelter and recruitment opportunities for a wide variety of vertebrate and invertebrate species. Certain species of macro-algae serve as food items for sea turtles. Therefore, adverse impacts to coral, coralline algae, and macro-algae may lead to the degradation of the reef and its potential to support certain existing functions such as the provision of foraging habitat for sea turtles; maintenance of coral reef replenishment; provision of habitat for general marine species recruitment, foraging, nesting, and sheltering from predators, as well as foraging habitat for migratory birds. It is not anticipated that longshore currents would be affected by the proposed project.

Also, construction-related activities will mobilize sediments that may migrate, settle on, and smother corals, coralline algae, and macro-algae. Corals are particularly vulnerable to suspended sediments, which may inhibit successful reproduction and settlement of larvae, lacerate larval tissue, and result in other lethal affects. The suspension of sediments during project construction activities may result in the temporary degradation of water quality, which

may reduce the ability of the coral reef ecosystem to support certain functions such as foraging by sea turtles; coral replenishment; and general marine species recruitment, foraging, nesting, and sheltering from predators. However, we believe that construction of the rock revetment would help stabilize the remaining existing embankment and prevent further erosion and deposition of coastal sediments into the marine environment. A reduction of sediment inputs should help improve water quality conditions and promote the colonization of the remediated habitat by coral reef organisms. Also, the rock revetment may create interstitial spaces that could be colonized by limited numbers of fish, invertebrates, and algae.

Coastal vegetation planted adjacent to and along the entire length of the rock revetment (720 m), within, the narrow corridor between Route 1 and the crest of the rock revetment, would allow for an area, about 2 m in width, to serve as vegetated habitat for migratory birds. The approximate area that may be re-vegetated would be about 1,440 m^2 (about 0.14 hectares or 0.35 acres).

In summary, we anticipate that coastal and coral reef resources and associated ecological functions would be lost or diminished as a result of project-related construction activities. However, adverse impacts to terrestrial resources are not expected to be significant. In addition, the control of sediment inputs through construction of the shoreline revetment may help improve water quality conditions, which could help promote colonization of adjacent coral reef habitat by various types of marine organisms and help stabilize the coral reef community beyond the footprint of the revetment.

FISH AND WILDLIFE SERVICE RECOMMENDATIONS

The Service shares jurisdiction with the NMFS over federally listed threatened green sea turtles and endangered hawksbill sea turtles. The Service has lead jurisdiction over these species when they are on shore, and the NMFS has lead jurisdiction over these species when they are in the sea. Based on information from the American Samoa DMWR, sea turtles are not currently known to nest at the proposed project site. Nevertheless, the Service is concerned that potential impacts to these species may occur during project construction activities. Therefore, the Service recommends that any NMFS recommendations for the protection and conservation of sea turtles near Leloaloa be made an integral part of the project.

The Service is concerned that some terrestrial and marine habitat would be permanently lost and that certain ecological functions would be permanently lost and temporarily degraded during construction activities. However, we recognize that implementation of the project may result in a positive benefit for the coral reef community fronting the proposed project site. Recent Corps guidance (RGL 02-2) provides a structured compensatory mitigation process that is intended to produce mitigation actions that more accurately replace permanently lost coral reef resources from project-related impacts. The basic premise of compensatory mitigation in the Clean Water Act is that the resource functions and values lost from project-related impacts are replaced. A strategy to compensate for these losses includes: (1) Documentation of Anticipated Area of Impact; (2) Assessment of Resources Anticipated to be Impacted; (3) Correlation Between Anticipated Impacts and Compensatory Mitigation; (4) Scientific Monitoring of Compensatory Mitigation; (5) Establishment of Performance Standards/Evaluation Criteria; and (6)

Determination of the Effectiveness of Implemented Compensatory Mitigation (Service 2003). The first two components, "Documentation of Anticipated Area of Impact" and "Assessment of Resources Anticipated to be Impacted" have already been addressed in this report. Components 3-6 will be addressed in the following discussion on recommended mitigation activities to compensate for the loss of habitat (6,912 m^2 or 0.69 hectares or 1.71 acres) of terrestrial and marine habitat) and ecological functions at Leloaloa.

Based on the existing need for the proposed project and on the anticipated project-related impacts, we support the construction of a rock revetment to stabilize the Leloaloa shoreline. We recommend development of a compensatory mitigation plan that includes an appropriate monitoring plan and performance standards, including appropriate contingency planning, should the proposed measures fail to achieve expected results to offset the anticipated unavoidable impacts to fish and wildlife resources by the proposed project. Also, we recommend that the mitigation plan be finalized prior to implementation of project construction activities.

In addition, we recommend that a post-construction assessment of the marine environment in the vicinity of the Leloaloa shoreline protection project be conducted. The marine assessment should evaluate the coral reef community in the vicinity of the proposed project to ensure that the rock revetment installation-related impacts to the coral reef community do not exceed the level of impacts anticipated during the planning phase of this project. The marine assessment should be conducted one week after completion of project installation activities and prior to completion of implemented compensatory mitigation activities. In addition, we recommend development of a compensatory mitigation plan to offset anticipated unavoidable impacts to fish and wildlife resources by the proposed project. We also recommend that all plans to avoid, minimize or compensate for project-related impacts be finalized prior to implementation of project construction activities.

COMPENSATORY MITIGATION

The Service is unaware of any single activity that may adequately compensate for the degradation and loss of coral reef ecological functions as a result of the proposed project. However, the combined effects of multiple mitigation activities implemented at appropriate scales may replace these losses. We recommend coordination of mitigation activities with the DMWR, ASEPA, and us. More specifically, we recommend that the following features be incorporated into the compensatory mitigation plan.

We recognize that implementation of the proposed project would restore some of the site's marine ecological functions since the rock revetment is intended to stabilize the shoreline and prevent further erosion. Control of sediment inputs to the marine environment may help restore functions such as the provision of foraging habitat for sea turtles; a source of coral and coralline algal replenishment; habitat for general marine species recruitment, foraging, nesting and sheltering from predators; and foraging habitat for migratory birds. Also, the rock revetment will create interstitial spaces that may be colonized by certain fish, invertebrate, and algae species.

However, the Service does not anticipate that stabilizing the bank alone will adequately offset the functions and values of the existing conditions given the permanent loss of 8,712 m^2 (about 0.87 hectares or 2.15 acres) of coastal terrestrial and shallow marine habitats. Therefore, we recommend that the following features be incorporated into the mitigation plan:

(1) **Coastal Vegetation**: Integrate native coastal vegetation into the design of the rock revetment to benefit some shoreline functions, such as shade and shelter for migratory birds. We highly recommend incorporation of the indigenous coastal shrub, *Scaevola taccada*, as a feature that could be designed for the margin area between the revetment crest and the roadway.

(2) **Revetment Slope**: Model and design the revetment, prior to construction, with sufficient slope to reduce significant back-wash wave energy from being projected in a seaward direction onto the reef flat. Reduction of back-wash wave energy may minimize transporting rubble from the shallows and forming deposits on the mid reef flat that may scour and degrade coral, coralline algae, or macro-algae.

(3) **Marine Debris**: Remove debris and discarded materials (*e.g*, batteries, bottles, and tires) to contribute to the improvement of water quality and a reduction of potential substrate scouring, which may promote re-colonization by coral reef organisms.

(4) **Outreach**: Implement a community public education campaign and post signage to help elevate public awareness of coral reef conservation and reduce trash discards into the marine environment, which may contribute to improved water quality conditions that promote reef growth.

Correlation Between Anticipated Impacts and Compensatory Mitigation

(1) **Coastal Vegetation**: Incorporation of coastal vegetation into the design of the rock revetment would help stabilize the shoreline and restore some foraging habitat for migratory birds. Stabilization of coastal topsoils will help reduce sediment input to the marine environment and promote the growth of forage resources for sea turtles and help improve water quality conditions to support coral reef replenishment and general marine species recruitment, foraging, nesting, and sheltering from predators.

(2) **Revetment Slope**: A rock revetment that is modeled and designed to have a slope that sufficient to significantly reduce wave energy from transporting rubble and rocks onto the mid-reef flat and potentially scouring coral communities would help reduce scouring and promote the growth of forage resources for sea turtles and migratory birds. Such a revetment design would help maintain a source of recruits for coral and coralline algal replenishment, as well as habitat for general marine species recruitment, foraging, nesting, and sheltering from predators.

(3) **Marine Debris**: Removal of reef debris would help promote re-colonization of marine habitat by coral reef organisms in areas currently occupied by the debris. Ecological functions that would benefit by the removal activity include the improvement of foraging

habitat for sea turtles; a source of coral reef replenishment; habitat for general marine species recruitment, foraging, nesting and sheltering from predators; and foraging habitat for migratory birds.

Significant sources of debris (*e.g.*, tires and bottles) and rubble (*i.e.*, stones and boulders) that occur on the reef flat, seaward of the shoreline for a distance of 20 m and along the entire length of the proposed rock revetment (720 m) should be removed. The approximate area of the debris field is 14,400 m^2 (about 1.44 hectares). However, the Service expects that only a portion of this area will receive benefits as a result of debris removal.

(4) **Outreach**: Elevation of community member awareness of coral reef resources and the hazards of discarding trash in the marine environment would help result in reduced discards. Less trash in the shallows may promote expansion of coral reef communities that support sea turtle foraging and coral reef replenishment of habitat for general marine species recruitment, foraging, nesting and sheltering from predators.

Scientific Monitoring of Compensatory Mitigation

The Service recommends that valid scientific methods be used to monitor compensatory mitigation actions. Data from before and after resource surveys should indicate that a balanced community of indigenous coral reef species has been maintained and that it is reasonable to conclude that the area is able to support existing ecological functions.

(1) **Coastal Vegetation**: Assessments should be conducted at intervals of 1,3 and 5 years for up to five years, to ensure that native coastal vegetation (*Scaevola taccada*) have been successfully planted and established along the length of the revetment and that ecological functions (*e.g.*, habitat for migratory birds) has been maintained.

(2) **Revetment Slope**: An Assessment should be conducted to determine whether the rock revetment was constructed with a slope sufficient to minimize significant back-wash wave energy from projecting onto the reef.

(3) **Marine Debris**: An Assessment of the marine habitat, where marine debris removal activities have been carried out, should be conducted to ensure that significant deposits of debris (*e.g.*, tires, batteries, and bottles) and stones or boulders have been removed from the reef.

(4) **Outreach**: A public education campaign concerning the conservation of coral reef resources and their ecological functions for the Pago Pago Harbor community should be conducted. Interviews should be designed to measure the effectiveness of the awareness campaign. Measurement activities, such as before and after surveys, should report whether the public education campaign had a positive affect on influencing community members to reduce discarding trash into the marine environment. A report of these activities should be delivered to DMWR, ASEPA, ASCMP, NMFS and us within three months after completion of the campaign.

Performance Standards/Evaluation Criteria for Compensatory Mitigation

(1) 100 percent of the proposed vegetation area adjacent to the revetment (1,440 m^2 or 0.14 hectares) is occupied by *Scaevola taccada*.
(2) Deposits of rock and rubble on the reef do not exceed existing levels, as identified in Table 1, one year from completion of project construction-related activities.
(3) No significant evidence of debris (*e.g.*, tires, batteries, and bottles) and deposits of stones or boulders exist within the defined 14,400 m^2 (about 1.44 hectares) debris field area after removal activities are completed.
(4) At least 100 members of the Leloalaoa community attend the public awareness event. The public education campaign ensures that at least 80 percent of participants feel disposal of debris in the marine environment negatively affects coral reef resources. The public education project is completed prior to implementation of the proposed project.

Effectiveness of Implemented Compensatory Mitigation

The Service believes that anticipated project-related impacts to coral reef organisms, habitat and ecological functions from implementation of the proposed project will be adequately compensated if: (1) recommended mitigation activities (1,2,3 and 4) are successfully implemented; and (2) the performance standards are successfully met and reported within one month from the time the Leloloa shoreline stabilization project is completed.

If Performance Standards and Evaluation Criteria for activities (1, 2, 3 and 4) are not successfully implemented, the Service recommends setting aside marine habitat of similar composition to the project area as conservation areas to benefit coral reef organisms and functions, in perpetuity, to compensate for habitat and ecological functions permanently lost as a result of this project. Extractive activities, such as fishing or harvesting of marine resources will not be authorized inside the conservation district. We recommend that an area roughly 14,000 m^2 (about 1.4 hectares or 3.46 acres) be set aside for this purpose and that its implementation be coordinated with DMWR and us.

AVOIDANCE AND MINIMIZATION OF IMPACTS

Best Management Practices: The Service recommends that the following measures to minimize the degradation of the coastal water quality and impacts to fish and wildlife resources and habitats be incorporated into the project:

a. No construction materials will be stockpiled in the marine environment.
b. Underlayer fills for the rock revetment will be protected from erosion with large stones as soon after placement as practicable;
c. All construction-related materials will be placed or stored in ways to avoid or minimize disturbance to the reef;
d. All construction-related materials will be cleaned free of pollutants prior to construction;
e. No contamination (trash or debris disposal, or introduction of alien species etc) of the coastal and marine environment will result from construction activities;

f. A contingency plan to control the accidental spills of petroleum products at the construction site will be developed. Absorbent pads, containment booms and skimmers will be stored on-site to facilitate the clean-up of petroleum spills;

g. Turbidity and siltation from construction and debris removal will be minimized and confined to the immediate vicinity of the construction and removal through the use of effective silt containment devices and the curtailment of construction and debris removal during adverse sea conditions or severe weather;

h. No debris extracted from harbor sediments will be stockpiled in the marine environment;

i. All debris removed from the harbor will be disposed of at a site that is approved by the American Samoa Government and acceptable to the NMFS, EPA, and us; and

j. Project construction activities will occur during non-coral spawning periods. In American Samoa, coral spawning season is approximately October through December (Mundy and Green 1999). Therefore, we recommend that project construction-related activities occur between January and September to avoid impacts to coral larvae and recruitment-related processes.

SUMMARY OF FISH AND WILDLIFE SERVICE POSITION

The coastal shoreline and fringing coral reef habitat at Leloaloa has been identified as the habitat of major concern for the proposed project because their contributions to support migratory bird and coral reef organisms (*e.g.*, reef fish, coral, macroinvertebrates, algae, and sea turtles). The institutional significance of U.S. coral reefs has been established through their designation as Special Aquatic Sites [40 CFR Part 230 §230.44/FR v.45n.249] and as a Federal Trust Resource [Executive Order (E.O.) 13089 on Coral Reef Protection]. To various degrees, the fringing coral reefs throughout Pago Pago Harbor provide habitat that promote specialized ecological functions that include species recruitment, foraging, nesting, and sheltering from predators and habitat for the federally listed green and hawksbill sea turtles. Fringing coral reefs provide other ecological functions that include shoreline protection from oceanic swells and storm events; significant contributions of larvae/juveniles to promote species replenishment; maintenance of prey items for federally protected migratory birds; and provisions of a resource base to support human activities such as subsistence harvest/fishing, recreational activities, tourism, and cultural practices.

The Service is concerned that the fringing coral reef community at Leloaloa will be negatively impacted due to implementation of the proposed project. Recent Corps guidance (RGL 02-2) provides a structured process to ensure that adequate compensatory mitigation will offset project-related impacts to coral reef resources. The Service recommends that the project proponent develop a compensatory mitigation plan that addresses potential impacts to ecological functions identified in this report. To assist in the development of this plan, the Service has provided a set of activities that could be implemented to minimize adverse impacts and compensate for lost habitat and ecological functions as a result of the proposed project.

From a resource conservation perspective, implementation of the proposed rock revetment project at Leloaloa would result in more beneficial impacts to fish and wildlife resources than

the No-action alternative, which will likely result in greater long-term adverse impacts to fringing coral reef resources. Therefore, we support implementation of the proposed project provided that our recommendations to avoid, minimize and compensate for impacts to fish and wildlife resources, included in this report, are incorporated into and made part of the project. Any requested changes to the proposed project plan or these recommendations will require additional coordination with the Service.

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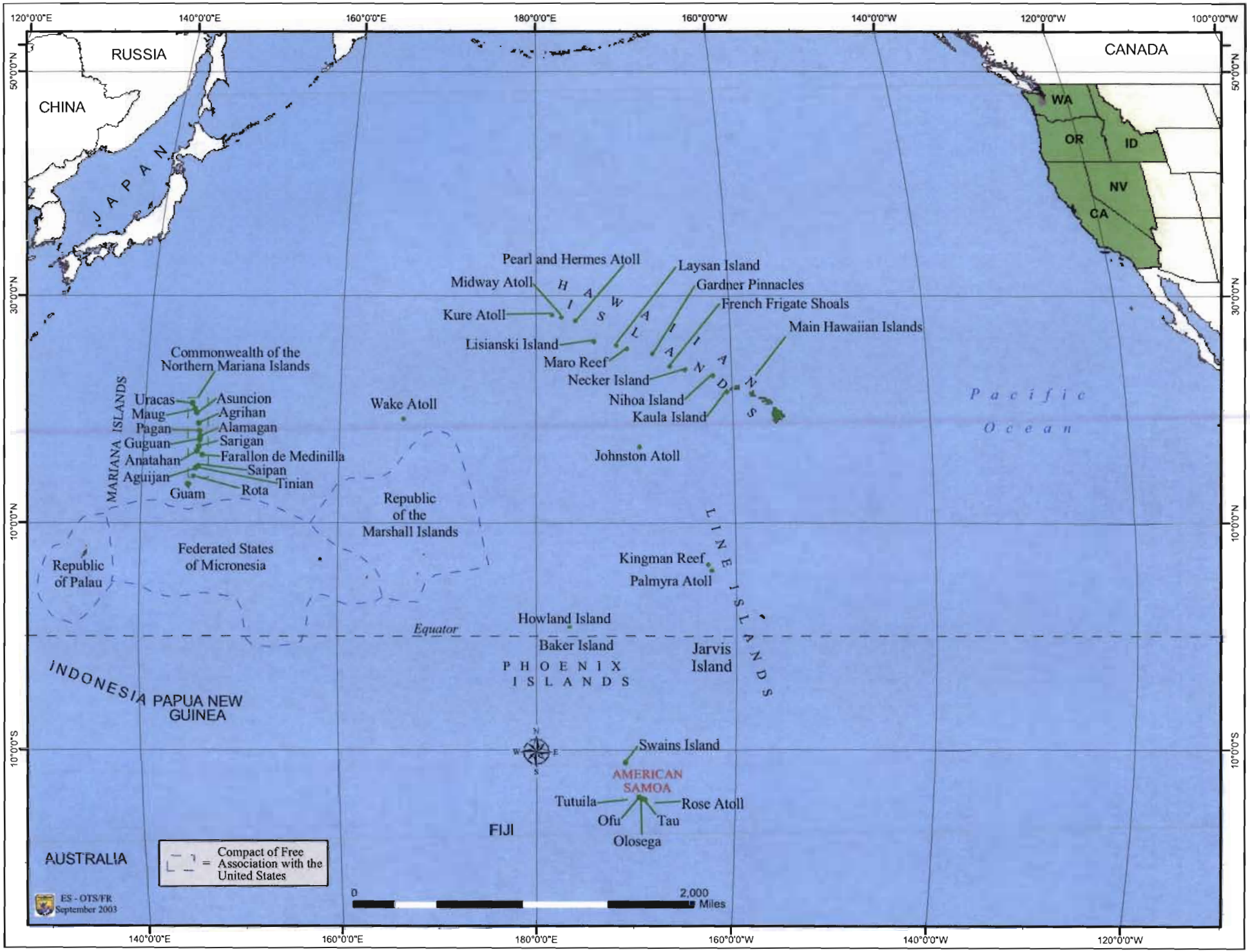


Figure 1. Territory of American Samoa in relation to other U.S. Pacific Islands

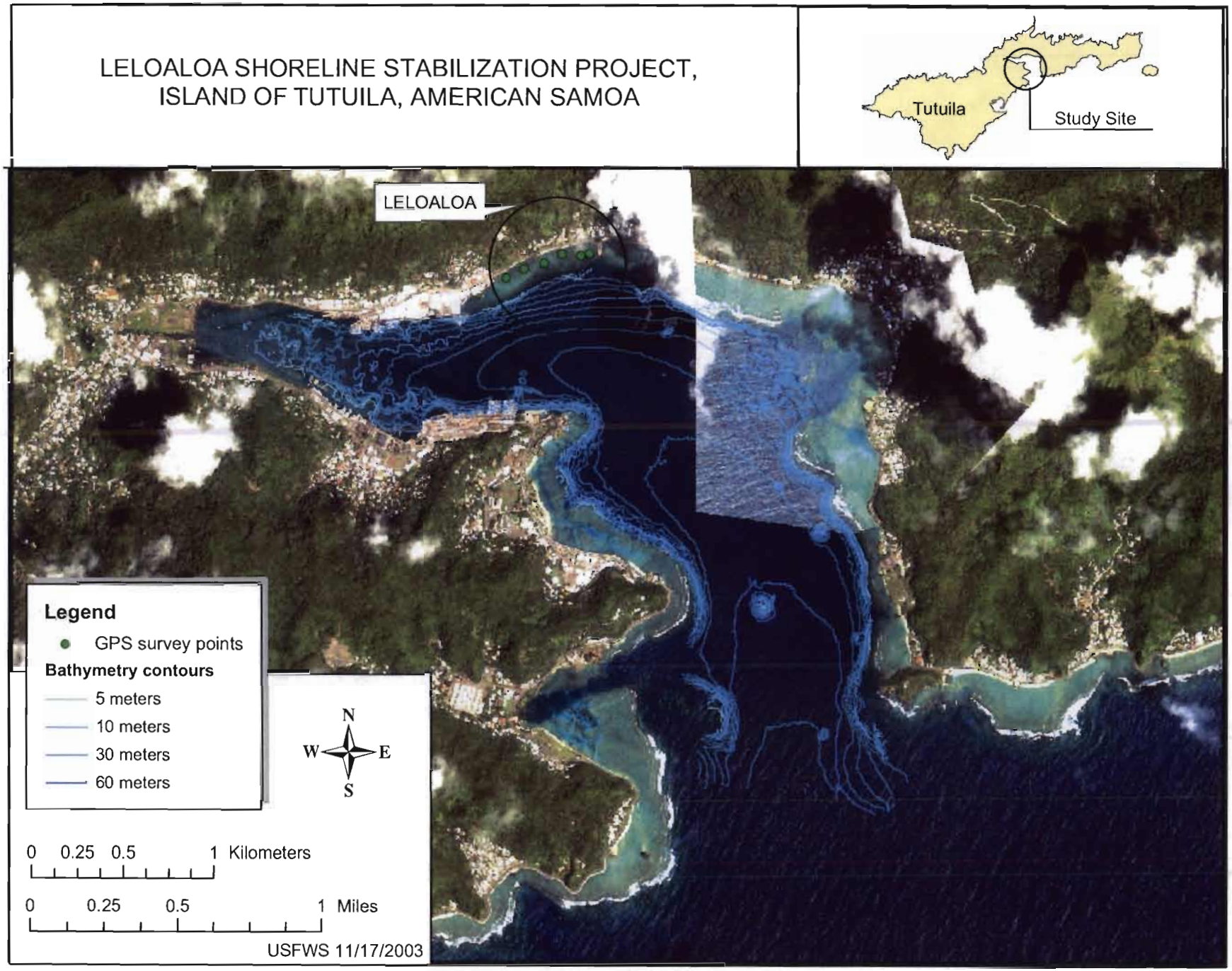


Figure 2. Pago Pago Harbor, Island of Tutuila, American Samoa

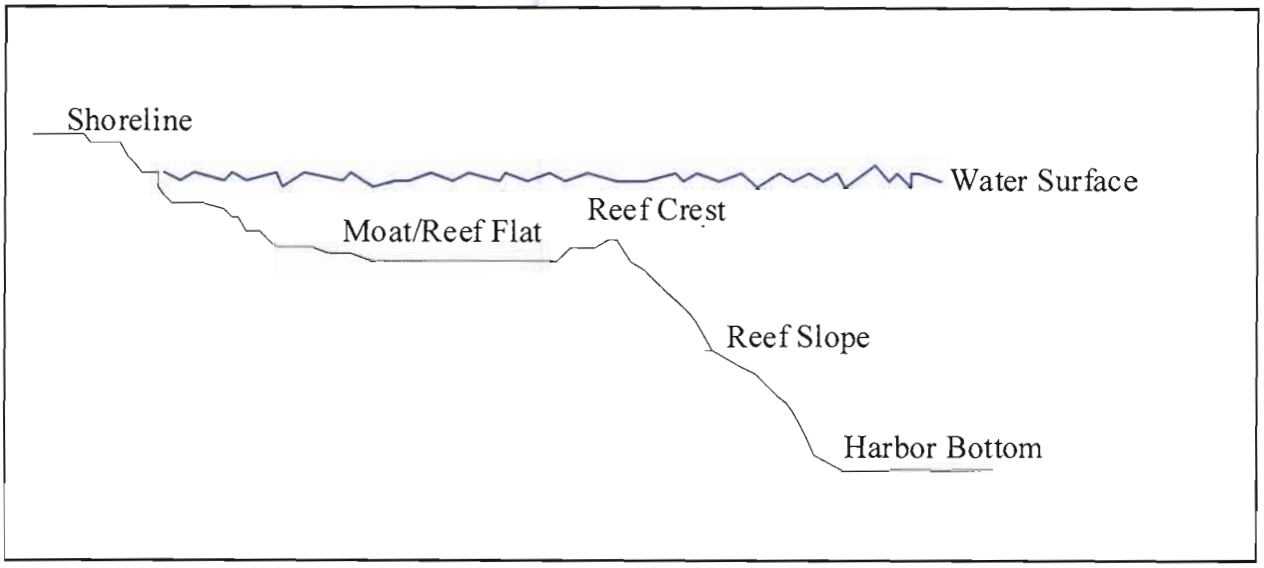


Figure 3. Stylized fringing coral reef habitat profile, Pago Pago Harbor, American Samoa

Table 1. Summary of substrate analyses conducted at six shallow (1 meter depth) survey transects fronting Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data represent percent cover.

TRANSECT	SUBSTRATE TYPE									
	Coral	Coralline Algae	Macro Algae	Sea Grass	Rock & Rubble	Pavement	Sponge	Mud	Sand	Total
S1	0	19	19	0	58	0	0	0	4	100
S2	1	17	17	0	54	11	0	0	0	100
S3	1	22	8	0	68	0	0	0	1	100
S4	1	40	28	0	18	0	0	0	13	100
S5	5	7	29	0	8	34	0	0	17	100
S6	0	21	19	0	38	8	1	0	13	100

Table 2. Marine fish species observed at six shallow (1 meter depth) survey transects fronting Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. (D = dominant; A = abundant; C = common;O = occasional; R = rare)*

FAMILY	SURVEY (S) TRANSECTS					
Genus/species	S-1	S-2	S-3	S-4	S-5	S-6
HOLOCENTRIDAE (Squirrelfishes)						
Myripristis murdjan		R				
APOGONIDAE (Cardinalfishes)						
Apogon novemfasciatus	R		O	O		
LUTJANIDAE (Snappers)						
Lutjanus fulvus						O
MULLIDAE (Goatfishes)						
Parupeneus cyclostomus	R				R	R
CHAETODONTIDAE (Butterflyfishes)						
Chaetodon auriga		O		R		
C. citrinellus	C	C	O			R
C. vagabundus						O
POMACENTRIDAE (Damselfishes)						
Abudefduf sexfasciatus		R				O
Chromis margaritifer	O	O				
Chrysiptera brownrigii	A	A	C	C	O	O
C. cyanea		O				
Pomacentrus vaiuli	O	O	O	O		R
Stegastes nigricans						R
LABRIDAE (Wrasses)						
Thalassoma hardwickii		O				
GOBIIDAE (Gobies)						
Amblygobius phalaena				O		
A. sphynx	R					
SIGANIDAE (Rabbitfishes)						
Siganus argenteus						R
ACANTHURIDAE (Surgeonfishes)						
Acanthurus lineatus						R
A. nigricauda			R			
A. nigrofuscus	O	O	O	O		C
A. pyroferus			R			
A. triostegus	O			C	C	
Ctenochaetus strigosus	O	O	C	O		
Zebrasoma flavescens			R		O	
BALISTIDAE (Triggerfishes)						
Rhinecanthus aculeatus		R	C	C		C
TETRAODONTIDAE (Puffers)						
Canthigaster solandri		R		O		O
Total Families per Survey Transect =	6	7	5	7	3	8
Total Species per Survey Transect =	10	13	10	10	4	13

Total Fish Species For All Survey Transects = 26

* = see text for additional explanation

Table 3. Coral species observed at six shallow (1 meter depth) survey transects fronting Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. (D = dominant; A = abundant; C=common; O = occasional; R = rare)*

FAMILY	SURVEY (S) TRANSECTS					
Genus/Species	S-1	S-2	S-3	S-4	S-5	S-6
POCILLOPORIDAE						
Pocillopora damicornis	O	O	O	O	O	
P. danae				O		O
P. verrucosa		R		O		
FAVIIDAE						
Favia speciosa					O	
F. sp (encrusting juv.)					O	
PORITIDAE						
Porites lobata	R		O	O	O	O
P. lutea	O	O	O	O	O	O
P. rus					O	
Total Families per Survey Transect:	2	2	2	2	3	2
Total Species per Survey Transect:	3	3	3	5	6	3

Total Species For All Survey Transects = 8

* = see text for additional explanation

Table 4. Macroinvertebrate species observed at six shallow (1 meter depth) transects fronting Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003.
(D = dominant; A = abundant; C=common; O = occasional; R = rare)*

FAMILY	SURVEY (S) TRANSECTS					
Genus/Species	S-1	S-2	S-3	S-4	S-5	S-6
CALLYSPONGIIDAE						
Callyspongia sp	R					
DYSIDEIDAE						
Dysidea sp		O				O
AGELASIDAE						
Agelas sp					O	
SERPULIDAE						
Spirobranchus giganteus					O	
STROMBACEA						
Strombus sp				R	R	
CYPRAEIDAE						
Cypraea moneta		O	R			
CONIDAE						
Conus flavidus				R		
Conus lividus		R	O	C	O	C
Conus ebraeus	R		O			
ELYSIIDAE						
Elysia ornata		C	O	O	C	C
PECTINIDAE						
Pedum spondyloideum			O			C
DIADEMATIDAE						
Echinothrix diadema	O		C			
ECHINOMETRIDAE						
Echinometra mathaei	O					
Echinostrephus sp		C		O		O
HOLOTHURIIDAE						
Holothuria atra						O
DIDEMNIDAE						
Didemnum molle					O	
Total Families per Survey Transect:	4	5	5	4	6	6
Total Species per Survey Transect:	4	5	6	5	6	6

Total Species For All Survey Transects = 16

* = see text for additional explanation

Table 5. Marine plant species observed at six shallow (1 meter depth) survey transects fronting Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003.
(D = dominant; A = abundant; C = common; O = occasional; R = rare)*

PHYLUM FAMILY *Genus/Species*	SURVEY (S) TRANSECTS S-1	S-2	S-3	S-4	S-5	S-6
RHODOPHYTA (Red Algae)						
HALYMENIACEAE						
Halymenia durvillei	R	O				
CORALLINACEAE						
Hydrolithon onkodes	O			C	C	A
PEYSSONNELIACEAE						
Peyssonnelia boergesenii	O	C	A	C	A	A
CHLOROPHYTA (Green Algae)						
BRYOPSIDACEAE						
Bryopsis pennata	C	O	A	A	C	C
CAULERPACEAE						
Caulerpa racemosa				C		
C. serrulata	C	R				
C. taxifolia					C	C
CODIACEAE						
Chlorodesmis fastigiata	O	O	A	C	C	C
HALIMEDACEAE						
Halimeda opuntia			C	C		
H. minima	O	C	C	O	O	C
Unidentified turf alga	O	O	C	C	O	C
Total Families per Survey Transect:	8	7	5	7	7	7
Total Species per Survey Transect:	8	7	6	8	7	7

Total Species For All Survey Transects = 11

* = see text for additional explanation

Table 6. Global Position System data for six survey transects, Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003.

Survey Transect Number	Date	Latitude	Longitude
Survey Transect 1	14-Oct-03	S 14 degrees 16.109'	W 170 degrees 40.763'
Survey Transect 2	14-Oct-03	S 14 degrees 16.116'	W 170 degrees 40.789
Survey Transect 3	15-Oct-03	S 14 degrees 16.111'	W 170 degrees 40.847'
Survey Transect 4	15-Oct-03	S 14 degrees 16.138'	W 170 degrees 40.900'
Survey Transect 5	16-Oct-03	S 14 degrees 16.156'	W 170 degrees 40.962'
Survey Transect 6	16-Oct-03	S 14 degrees 16.181'	W 170 degrees 41.016'

NOTE: DATUM = WGS 84

Table 7. Evaluation of some of the ecological functions identified at six survey transects Leloaloa, Pago Pago Harbor, American Samoa, October 5-16, 2003. Values for Ecological Functions = 0 (no value); 1 (low value); 2 (moderate value); or 3 (high or signficant value).*

Ecological Functions	SURVEY (S) TRANSECTS S1	S2	S3	S4	S5	S6
Shoreline Protection	1	1	1	1	1	1
Foraging Habitat for Sea Turtles	1	1	1	1	1	1
Habitat for general marine species recruitment, foraging, resting, and sheltering from predators	1	1	1	1	1	1
Foraging Habitat for Migratory Birds (Marine Habitat)	1	1	1	1	1	1
Forage Habitat for Migratory Birds (Coastal Habitat)	1	1	1	1	1	1
Coral Reef Replenishment/Connectivity	1	1	1	1	1	1
Human Activities	1	1	1	1	1	1
Total values per survey station =	7	7	7	7	7	7

* = see text for additional explanation

APPENDIX 1

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 1**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	0	3	0	1	0	0	0	0
2	0	0	0	0	4	0	0	0	0
3	0	0	1	0	3	0	0	0	0
4	0	0	0	0	4	0	0	0	0
5	0	1	0	0	1	0	0	0	2
6	0	0	0	0	4	0	0	0	0
7	0	2	0	0	2	0	0	0	0
8	0	1	0	0	3	0	0	0	0
9	0	0	0	0	3	0	0	0	1
10	0	1	0	0	3	0	0	0	0
11	0	0	0	0	4	0	0	0	0
12	0	1	2	0	0	0	0	0	1
13	0	0	1	0	3	0	0	0	0
14	0	0	4	0	0	0	0	0	0
15	0	2	0	0	2	0	0	0	0
16	0	2	0	0	2	0	0	0	0
17	0	2	2	0	0	0	0	0	0
18	0	0	0	0	4	0	0	0	0
19	0	3	0	0	1	0	0	0	0
20	0	2	0	0	2	0	0	0	0
21	0	0	0	0	4	0	0	0	0
22	0	0	2	0	2	0	0	0	0
23	0	1	2	0	1	0	0	0	0
24	0	1	0	0	3	0	0	0	0
25	0	0	2	0	2	0	0	0	0
Mean	0	0.76	0.76	0	2.32	0	0	0	0.16
SD	0	0.90686	1.1412	0	1.3182	0	0	0	0.463

APPENDIX 1 (continued)

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 2**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	0	2	0	0	2	0	0	0
2	0	2	0	0	1	1	0	0	0
3	0	2	1	0	0	1	0	0	0
4	0	2	0	0	0	2	0	0	0
5	0	0	0	0	2	2	0	0	0
6	0	0	0	0	2	2	0	0	0
7	0	0	0	0	3	1	0	0	0
8	0	0	1	0	3	0	0	0	0
9	0	0	4	0	0	0	0	0	0
10	0	0	0	0	4	0	0	0	0
11	0	0	2	0	2	0	0	0	0
12	0	0	2	0	2	0	0	0	0
13	0	0	0	0	4	0	0	0	0
14	0	0	0	0	4	0	0	0	0
15	0	0	0	0	4	0	0	0	0
16	0	0	0	0	4	0	0	0	0
17	0	1	2	0	1	0	0	0	0
18	0	3	0	0	1	0	0	0	0
19	0	0	0	0	4	0	0	0	0
20	0	0	0	0	4	0	0	0	0
21	0	1	1	0	2	0	0	0	0
22	0	0	0	0	4	0	0	0	0
23	0	1	1	0	2	0	0	0	0
24	1	2	1	0	0	0	0	0	0
25	0	3	0	0	1	0	0	0	0
Mean	0.04	0.68	0.68	0	2.16	0.44	0	0	0
SD	0.196	1.00876	1.0088	0	1.5147	0.752596	0	0	0

APPENDIX 1 (continued)

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 3**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	0	0	0	4	0	0	0	0
2	0	0	1	0	2	0	0	0	1
3	0	0	0	0	4	0	0	0	0
4	0	0	0	0	4	0	0	0	0
5	0	0	2	0	2	0	0	0	0
6	0	0	0	0	4	0	0	0	0
7	0	0	0	0	4	0	0	0	0
8	0	0	0	0	4	0	0	0	0
9	0	0	0	0	4	0	0	0	0
10	0	1	1	0	2	0	0	0	0
11	0	2	0	0	2	0	0	0	0
12	1	1	0	0	2	0	0	0	0
13	0	0	0	0	4	0	0	0	0
14	0	1	0	0	3	0	0	0	0
15	0	0	0	0	4	0	0	0	0
16	0	0	0	0	4	0	0	0	0
17	0	0	0	0	4	0	0	0	0
18	0	1	0	0	3	0	0	0	0
19	0	1	2	0	1	0	0	0	0
20	0	3	0	0	1	0	0	0	0
21	0	2	0	0	2	0	0	0	0
22	0	3	0	0	1	0	0	0	0
23	0	3	0	0	1	0	0	0	0
24	0	1	2	0	1	0	0	0	0
25	0	3	0	0	1	0	0	0	0
Mean	0.04	0.88	0.32	0	2.72	0	0	0	0.04
SD	0.196	1.10707	0.6765	0	1.2496	0	0	0	0.196

APPENDIX 1 (continued)

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 4**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	1	1	0	2	0	0	0	0
2	0	2	1	0	1	0	0	0	0
3	0	0	3	0	1	0	0	0	0
4	0	2	1	0	1	0	0	0	0
5	0	1	3	0	0	0	0	0	0
6	0	3	1	0	0	0	0	0	0
7	0	2	2	0	0	0	0	0	0
8	0	2	1	0	1	0	0	0	0
9	0	2	1	0	1	0	0	0	0
10	0	3	1	0	0	0	0	0	0
11	0	2	2	0	0	0	0	0	0
12	0	1	2	0	1	0	0	0	0
13	0	2	1	0	1	0	0	0	0
14	0	1	2	0	0	0	0	0	1
15	0	1	1	0	0	0	0	0	2
16	0	1	2	0	0	0	0	0	1
17	0	1	1	0	0	0	0	0	2
18	0	4	0	0	0	0	0	0	0
19	0	2	0	0	1	0	0	0	1
20	0	1	0	0	2	0	0	0	1
21	0	1	0	0	2	0	0	0	1
22	0	2	0	0	0	0	0	0	2
23	1	0	2	0	1	0	0	0	0
24	0	2	0	0	1	0	0	0	1
25	0	1	0	0	2	0	0	0	1
Mean	0.04	1.6	1.12	0	0.72	0	0	0	0.52
SD	0.196	0.89443	0.9086	0	0.7222	0	0	0	0.6997

APPENDIX 1 (continued)

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 5**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	0	4	0	0	0	0	0	0
2	0	1	1	0	0	0	0	0	2
3	0	0	1	0	0	0	0	0	3
4	0	1	1	0	2	0	0	0	0
5	0	0	2	0	1	0	0	0	1
6	2	1	1	0	0	0	0	0	0
7	0	0	3	0	0	0	0	0	1
8	0	0	0	0	0	2	0	0	2
9	0	0	2	0	1	0	0	0	1
10	0	0	1	0	2	0	0	0	1
11	0	0	0	0	0	4	0	0	0
12	0	0	0	0	0	4	0	0	0
13	0	0	1	0	0	3	0	0	0
14	0	1	1	0	0	2	0	0	0
15	0	0	2	0	0	2	0	0	0
16	0	0	0	0	2	2	0	0	0
17	1	1	1	0	0	1	0	0	0
18	0	1	1	0	0	1	0	0	1
19	0	0	1	0	0	1	0	0	2
20	0	0	0	0	0	3	0	0	1
21	1	0	0	0	0	2	0	0	1
22	1	0	2	0	0	1	0	0	0
23	0	0	1	0	0	3	0	0	0
24	0	0	2	0	0	2	0	0	0
25	0	1	1	0	0	1	0	0	1
Mean	0.2	0.28	1.16	0	0.32	1.36	0	0	0.68
SD	0.49	0.449	0.9666	0	0.6765	1.29244	0	0	0.8352

APPENDIX 1 (continued)

POINT TRANSECT DATA

Point transect data for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every 0.25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 6**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand
1	0	0	0	0	1	3	0	0	0
2	0	2	1	0	1	0	0	0	0
3	0	0	0	0	2	2	0	0	0
4	0	0	3	0	0	1	0	0	0
5	0	0	1	0	2	1	0	0	0
6	0	1	2	0	0	1	0	0	0
7	0	1	0	0	0	0	0	0	3
8	0	1	0	0	0	0	0	0	3
9	0	0	3	0	0	0	0	0	1
10	0	0	1	0	2	0	0	0	1
11	0	0	0	0	3	0	0	0	1
12	0	2	1	0	1	0	0	0	0
13	0	1	0	0	2	0	0	0	1
14	0	0	0	0	4	0	0	0	0
15	0	0	2	0	2	0	0	0	0
16	0	0	1	0	3	0	0	0	0
17	0	1	2	0	1	0	0	0	0
18	0	4	0	0	0	0	0	0	0
19	0	2	0	0	2	0	0	0	0
20	0	2	0	0	2	0	0	0	0
21	0	2	1	0	0	0	1	0	0
22	0	1	0	0	1	0	0	0	2
23	0	1	0	0	2	0	0	0	1
24	0	0	1	0	3	0	0	0	0
25	0	0	0	0	4	0	0	0	0
Mean	0	0.84	0.76	0	1.52	0.32	0.04	0	0.52
SD	0	1.00717	0.9499	0	1.2368	0.733212	0.196	0	0.8998

APPENDIX 2

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 1**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	0	75	0	25	0	0	0	0	100
2	0	0	0	0	100	0	0	0	0	100
3	0	0	25	0	75	0	0	0	0	100
4	0	0	0	0	100	0	0	0	0	100
5	0	25	0	0	25	0	0	0	50	100
6	0	0	0	0	100	0	0	0	0	100
7	0	50	0	0	50	0	0	0	0	100
8	0	25	0	0	75	0	0	0	0	100
9	0	0	0	0	75	0	0	0	25	100
10	0	25	0	0	75	0	0	0	0	100
11	0	0	0	0	100	0	0	0	0	100
12	0	25	50	0	0	0	0	0	25	100
13	0	0	25	0	75	0	0	0	0	100
14	0	0	100	0	0	0	0	0	0	100
15	0	50	0	0	50	0	0	0	0	100
16	0	50	0	0	50	0	0	0	0	100
17	0	50	50	0	0	0	0	0	0	100
18	0	0	0	0	100	0	0	0	0	100
19	0	75	0	0	25	0	0	0	0	100
20	0	50	0	0	50	0	0	0	0	100
21	0	0	0	0	100	0	0	0	0	100
22	0	0	50	0	50	0	0	0	0	100
23	0	25	50	0	25	0	0	0	0	100
24	0	25	0	0	75	0	0	0	0	100
25	0	0	50	0	50	0	0	0	0	100
Percent Average	0	19	19	0	58	0	0	0	4	100

APPENDIX 2 (continued)

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 2**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	0	50	0	0	50	0	0	0	100
2	0	50	0	0	25	25	0	0	0	100
3	0	50	25	0	0	25	0	0	0	100
4	0	50	0	0	0	50	0	0	0	100
5	0	0	0	0	50	50	0	0	0	100
6	0	0	0	0	50	50	0	0	0	100
7	0	0	0	0	75	25	0	0	0	100
8	0	0	25	0	75	0	0	0	0	100
9	0	0	100	0	0	0	0	0	0	100
10	0	0	0	0	100	0	0	0	0	100
11	0	0	50	0	50	0	0	0	0	100
12	0	0	50	0	50	0	0	0	0	100
13	0	0	0	0	100	0	0	0	0	100
14	0	0	0	0	100	0	0	0	0	100
15	0	0	0	0	100	0	0	0	0	100
16	0	0	0	0	100	0	0	0	0	100
17	0	25	50	0	25	0	0	0	0	100
18	0	75	0	0	25	0	0	0	0	100
19	0	0	0	0	100	0	0	0	0	100
20	0	0	0	0	100	0	0	0	0	100
21	0	25	25	0	50	0	0	0	0	100
22	0	0	0	0	100	0	0	0	0	100
23	0	25	25	0	50	0	0	0	0	100
24	25	50	25	0	0	0	0	0	0	100
25	0	75	0	0	25	0	0	0	0	100
Percent Average	1	17	17	0	54	11	0	0	0	100

APPENDIX 2 (continued)

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 3**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	0	0	0	100	0	0	0	0	100
2	0	0	25	0	50	0	0	0	25	100
3	0	0	0	0	100	0	0	0	0	100
4	0	0	0	0	100	0	0	0	0	100
5	0	0	50	0	50	0	0	0	0	100
6	0	0	0	0	100	0	0	0	0	100
7	0	0	0	0	100	0	0	0	0	100
8	0	0	0	0	100	0	0	0	0	100
9	0	0	0	0	100	0	0	0	0	100
10	0	25	25	0	50	0	0	0	0	100
11	0	50	0	0	50	0	0	0	0	100
12	25	25	0	0	50	0	0	0	0	100
13	0	0	0	0	100	0	0	0	0	100
14	0	25	0	0	75	0	0	0	0	100
15	0	0	0	0	100	0	0	0	0	100
16	0	0	0	0	100	0	0	0	0	100
17	0	0	0	0	100	0	0	0	0	100
18	0	25	0	0	75	0	0	0	0	100
19	0	25	50	0	25	0	0	0	0	100
20	0	75	0	0	25	0	0	0	0	100
21	0	50	0	0	50	0	0	0	0	100
22	0	75	0	0	25	0	0	0	0	100
23	0	75	0	0	25	0	0	0	0	100
24	0	25	50	0	25	0	0	0	0	100
25	0	75	0	0	25	0	0	0	0	100
Percent Average	1	22	8	0	68	0	0	0	1	100

APPENDIX 2 (continued)

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 4**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	25	25	0	50	0	0	0	0	100
2	0	50	25	0	25	0	0	0	0	100
3	0	0	75	0	25	0	0	0	0	100
4	0	50	25	0	25	0	0	0	0	100
5	0	25	75	0	0	0	0	0	0	100
6	0	75	25	0	0	0	0	0	0	100
7	0	50	50	0	0	0	0	0	0	100
8	0	50	25	0	25	0	0	0	0	100
9	0	50	25	0	25	0	0	0	0	100
10	0	75	25	0	0	0	0	0	0	100
11	0	50	50	0	0	0	0	0	0	100
12	0	25	50	0	25	0	0	0	0	100
13	0	50	25	0	25	0	0	0	0	100
14	0	25	50	0	0	0	0	0	25	100
15	0	25	25	0	0	0	0	0	50	100
16	0	25	50	0	0	0	0	0	25	100
17	0	25	25	0	0	0	0	0	50	100
18	0	100	0	0	0	0	0	0	0	100
19	0	50	0	0	25	0	0	0	25	100
20	0	25	0	0	50	0	0	0	25	100
21	0	25	0	0	50	0	0	0	25	100
22	0	50	0	0	0	0	0	0	50	100
23	25	0	50	0	25	0	0	0	0	100
24	0	50	0	0	25	0	0	0	25	100
25	0	25	0	0	50	0	0	0	25	100
Percent Average	1	40	28	0	18	0	0	0	13	100

APPENDIX 2 (continued)

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloaloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 5**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	0	100	0	0	0	0	0	0	100
2	0	25	25	0	0	0	0	0	50	100
3	0	0	25	0	0	0	0	0	75	100
4	0	25	25	0	50	0	0	0	0	100
5	0	0	50	0	25	0	0	0	25	100
6	50	25	25	0	0	0	0	0	0	100
7	0	0	75	0	0	0	0	0	25	100
8	0	0	0	0	0	50	0	0	50	100
9	0	0	50	0	25	0	0	0	25	100
10	0	0	25	0	50	0	0	0	25	100
11	0	0	0	0	0	100	0	0	0	100
12	0	0	0	0	0	100	0	0	0	100
13	0	0	25	0	0	75	0	0	0	100
14	0	25	25	0	0	50	0	0	0	100
15	0	0	50	0	0	50	0	0	0	100
16	0	0	0	0	50	50	0	0	0	100
17	25	25	25	0	0	25	0	0	0	100
18	0	25	25	0	0	25	0	0	25	100
19	0	0	25	0	0	25	0	0	50	100
20	0	0	0	0	0	75	0	0	25	100
21	25	0	0	0	0	50	0	0	25	100
22	25	0	50	0	0	25	0	0	0	100
23	0	0	25	0	0	75	0	0	0	100
24	0	0	50	0	0	50	0	0	0	100
25	0	25	25	0	0	25	0	0	25	100
Percent Average	5	7	29	0	8	34	0	0	17	100

APPENDIX 2 (continued)

PERCENT SUBSTRATE COVER

Percent substrate cover for one depth at six survey transect sites at Leloalloa, Pago Pago Harbor, American Samoa, October 15-16, 2003. Data were collected every .25 meter along a 25-meter transect line. Figures indicate number of times a substrate type was recorded.

Site: Leloaloa **Depth: 1 meter** **Transect Number: 6**

Meter	Coral	Coralline Algae	Macro Algae	Sea Grass	Rubble/ Rock	Pavement	Sponge	Mud	Sand	Total
1	0	0	0	0	25	75	0	0	0	100
2	0	50	25	0	25	0	0	0	0	100
3	0	0	0	0	50	50	0	0	0	100
4	0	0	75	0	0	25	0	0	0	100
5	0	0	25	0	50	25	0	0	0	100
6	0	25	50	0	0	25	0	0	0	100
7	0	25	0	0	0	0	0	0	75	100
8	0	25	0	0	0	0	0	0	75	100
9	0	0	75	0	0	0	0	0	25	100
10	0	0	25	0	50	0	0	0	25	100
11	0	0	0	0	75	0	0	0	25	100
12	0	50	25	0	25	0	0	0	0	100
13	0	25	0	0	50	0	0	0	25	100
14	0	0	0	0	100	0	0	0	0	100
15	0	0	50	0	50	0	0	0	0	100
16	0	0	25	0	75	0	0	0	0	100
17	0	25	50	0	25	0	0	0	0	100
18	0	100	0	0	0	0	0	0	0	100
19	0	50	0	0	50	0	0	0	0	100
20	0	50	0	0	50	0	0	0	0	100
21	0	50	25	0	0	0	25	0	0	100
22	0	25	0	0	25	0	0	0	50	100
23	0	25	0	0	50	0	0	0	25	100
24	0	0	25	0	75	0	0	0	0	100
25	0	0	0	0	100	0	0	0	0	100
Percent Average	0	21	19	0	38	8	1	0	13	100

APPENDIX 3. Photo sequence for the project area at Leloaloa, Pago Pago Harbor, American Samoa

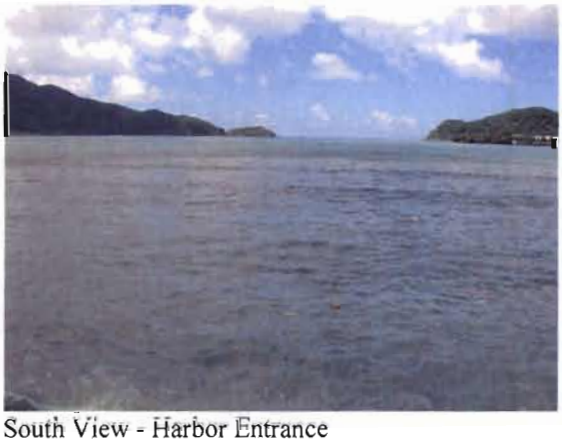
West View - Shoreline

West View - Shoreline

West View - Shoreline

West View - Reef Flat and Shoreline

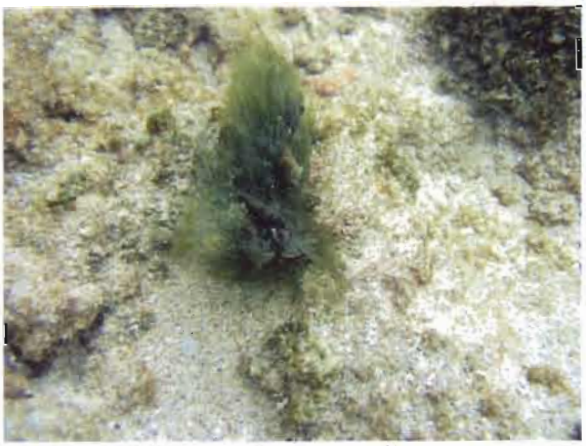
West View - Reef Flat



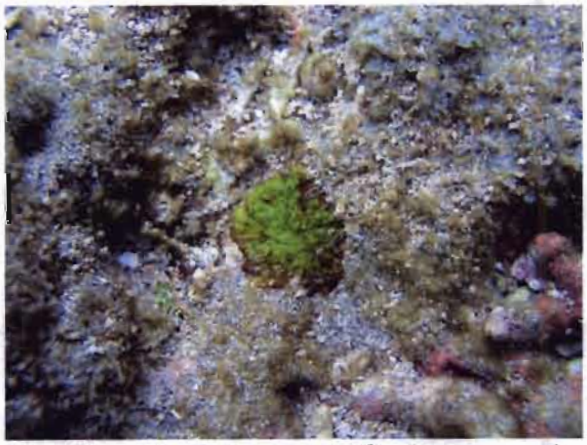
South View - Harbor Entrance

APPENDIX 4. Photo sequence of the fringing reef habitat at Leloaloa, Pago Pago Harbor, American Samoa

Urchin (*Echinometra mathaei*)



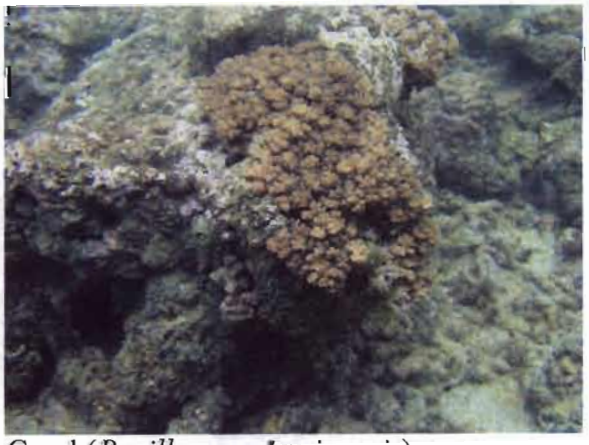
Green alga (*Bryopsis pennata*)



Coralline Algae (*Peyssonnelia boergesenii*)

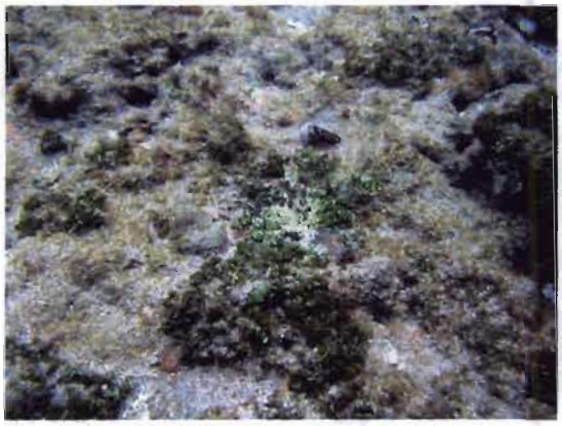
Coral (*Porites lutea*)

Red Alga (*Halymenia* sp)



Coral (*Pocillopora damicornis*)

APPENDIX 4 (continued)

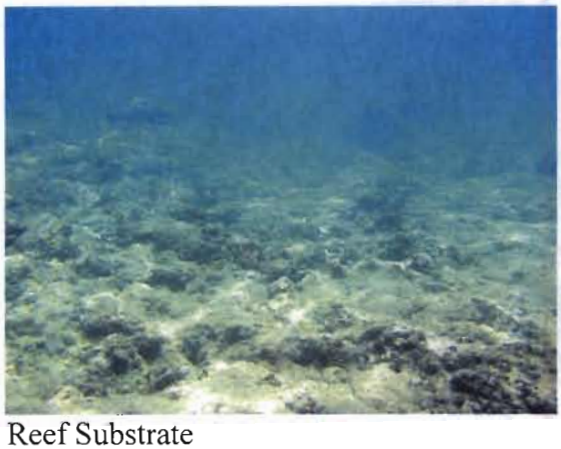


Turf algae

Green alga (*Halimeda opuntia*)

Coral Community

Reef Substrate



Reef Substrate

Coral (*Pocillopora verrucosa*)

APPENDIX 5a. Plan proposed of shoreline revetment, Leloaloa, Pago Pago Harbor, American Samoa (Source: U.S. Army Corps of Engineers, Honolulu District)

APPENDIX 5b. Plan profile of proposed shoreline revetment, Leloaloa, Pago Pago Harbor, American Samoa (U.S. Army Corps of Engineers, Honolulu District)