EMERGENCY RESTORATION PLAN
AND
ENVIRONMENTAL ASSESSMENT

Pago Pago Harbor
American Samoa

September 1, 1999

Prepared By:
The Government of American Samoa,
The U.S. Department of the Interior, and
The National Oceanic and Atmospheric Administration

Table of Contents

List of Exhibits

1.0 Introduction

Natural resource Trustees are authorized to act on behalf of the public to assess and recover natural resource damages, and to plan and implement actions to restore natural resources and resource services injured or lost as a result of an incident involving the discharge or substantial threat of a discharge of oil under OPA. Trustees are also authorized to restore natural resources and services injured as a result of response actions, such as the planned response action to address the grounded vessels.

This Emergency Restoration Plan/Environmental Assessment (ERP/EA) was prepared to evaluate alternatives for emergency restoration actions under the Oil Pollution Act of 1990 (OPA) necessary to address injuries to natural resources resulting from a planned response action by the United States Coast Guard (USCG). The stated objectives of the USCG response action in American Samoa are to remove oil and oily debris, hazardous and other toxic materials, and keels from nine vessels driven aground on the reefs within Pago Pago Harbor.

1.1 Background

On December 10, 1991, Hurricane "Val" struck and caused widespread damage to the South Pacific Islands of American Samoa. During the storm, nine foreign-owned fishing vessels broke from their moorings and were driven aground on the reefs within Pago Pago Harbor on the island of Tutuila. Seven of the vessels grounded in a group about 100 yards from the village of Leloaloa, while two vessels grounded in the outer harbor on Breakers Point near the village of Aua (Exhibits 1 and 2). The grounded vessels range from 125 to 160 feet and 300 to 350 gross tons. Surveys completed within the past two years found that the wrecks vary dramatically in condition. Some remain upright with their hulls intact, while others have broken up. According to a USCG assessment conducted on December 11, 1991, about 1,500 gallons of oil was discharged into the surrounding waters during the grounding incident (USCG, December 1997).

1.2 Summary of Past Response Efforts

The USCG's immediate response to the 1991 grounding incident included removing an estimated 10,500 gallons of diesel, lube and hydraulic oil from three of the vessels. Rough weather prohibited further oil removal and these actions were stopped, leaving about 18,000 gallons of oil, as well as an undetermined amount of ammonia associated with onboard refrigeration systems, on the vessels (USCG, March 1998).

Following the groundings, the USCG received several reports of sheening and/or small discharges (5 to 10 gallons) of oil from the abandoned vessels. Specific instances were reported to the USCG in February 1997 and on June 5, 1997, June 16, 1997, September 10, 1997, and December 6, 1997 (USCG, December 1997). In addition, the American Samoa Environmental Protection Agency received many additional reports of small discharges from the vessels following the groundings (Sheila Wiegman, American Samoa Environmental Protection Agency, pers. comm., 1999). On or about May 19, 1999, the

USCG determined that the nine vessels "continue to pose a substantial threat to the fragile environment" and that it intended to eliminate the risk of pollutant discharge by removing all ammonia and oil from the vessels (USCG, May 1999).

1.3 Planned USCG Response Actions

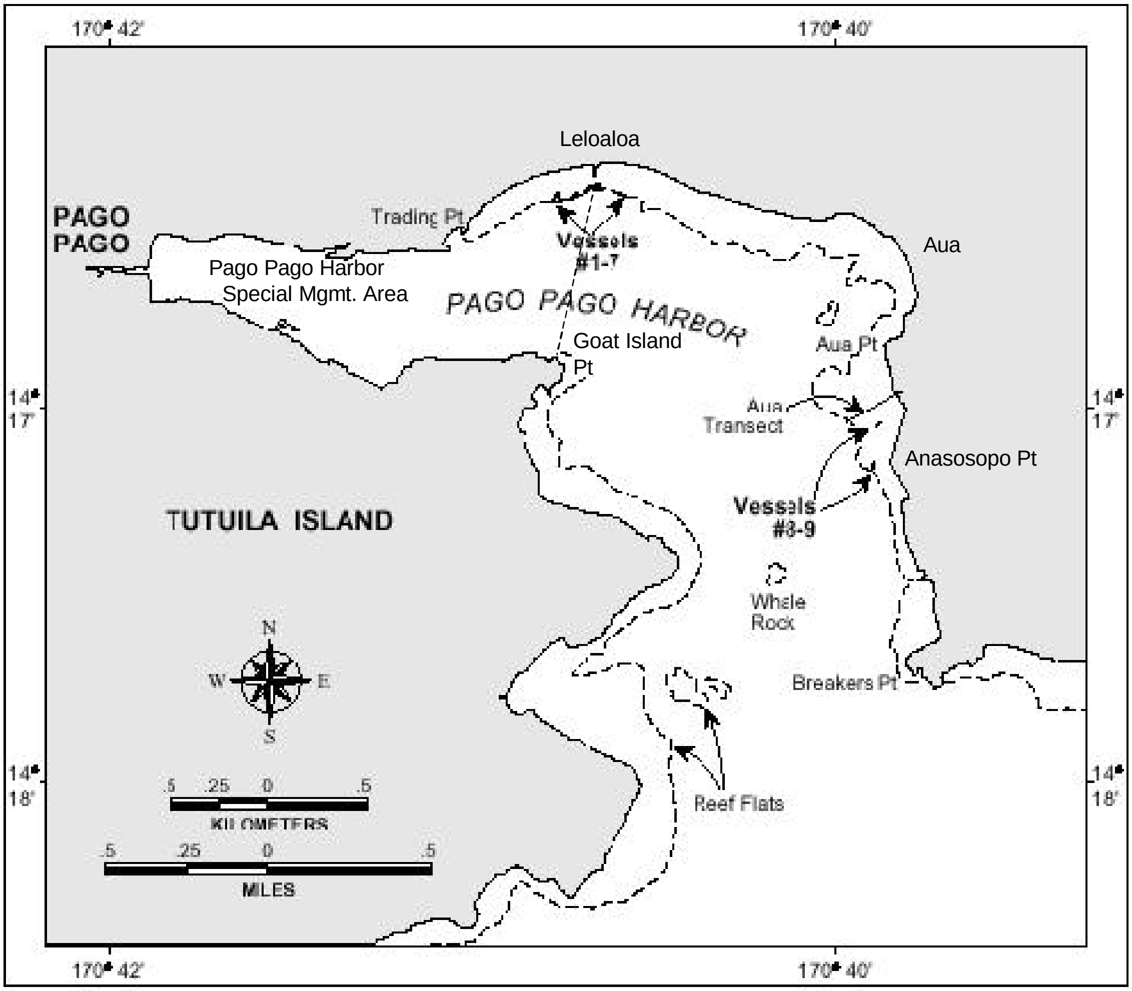
In May 1999, the USCG developed an Incident Action Plan (IAP) entitled "Samoan Longliners Cleanup" (USCG, 1999). This plan proposed to dismantle the vessels to allow access to the tanks and remove all of the hazardous materials, oil and oily debris, other toxic materials, and keels. Specific tasks[1] identified in the IAP included: (1) construction of causeways and rock working platforms to access the clusters of vessels, (2) removal of oil and hazardous materials on the vessels, and (3) removal of the keels to eliminate the remaining toxic materials including zinc and bottom paints. Task 3, "Removal of the Keels," however, was unfunded as of May 28, 1999. The USCG proposed that it would either leave the dismantled vessels in place or, if the hulls become "lively[2]," consider removing the remainder of the vessels.

EXHIBIT 1. Name and Location of the Nine Longline Fishing Vessels Grounded on the Reefs in Pago Pago Harbor, American Samoa.

Vessel Name	Location	Vessel number in USCG IAP
F/V Kwang Myong #58	Off Village of Leloaloa	1
F/V Kwang Myong #63	Off Village of Leloaloa	2
F/V Korbee #7	Off Village of Leloaloa	3
F/V Koram #3	Off Village of Leloaloa	4
F/V Koram #1	Off Village of Leloaloa	5
F/V Kwang Myong #51	Off Village of Leloaloa	6
F/V Kwang Myong #78	Off Village of Leloaloa	7
F/V Yuti #1	Off Village of Aua	8
F/V Amiga #5	Off Village of Aua	9

[1] The USCG IAP refers to specific tasks as "Groups."
[2] The term "lively" is used by the USCG in the IAP.

EXHIBIT 2. Pago Pago Harbor



2.0 Purpose and Need for Action

2.1 Purpose

This ERP/EA was prepared by the natural resource Trustees to quantify injuries caused by a USCG response action and to identify options to restore these injuries. This ERP also serves as an Environmental Assessment (EA) as defined under the National Environmental Policy Act (NEPA). As such, it includes a description of the purpose and need for the action, summarizes the current environmental setting, and identifies action alternatives with their potential environmental consequences.

The scope of this ERP/EA review is to determine the preferred emergency restoration alternative for injuries caused by the USCG response. Thus, this EA evaluates only the actions considered by the Trustees to be necessary to restore natural resource injuries and lost uses from the USCG response actions. Efforts by the USCG to dismantle vessels and remove contaminants are a separate action from the Trustees' restoration efforts.

2.2 Need

The planned USCG response action will result in injuries to natural resources. This ERP/EA is needed to enable the Trustees to restore these injured resources to baseline conditions and ensure that vessel debris caused by the USCG response does not hinder recovery. The Trustees have prepared this plan under their emergency restoration authority (15 C.F.R. 990.26) so that restoration can begin concurrently with the USCG's response efforts. This approach will (1) prevent additional injury associated with rebuilding the causeways for restoration efforts after the USCG completes it response actions, and (2) take advantage of the cost-savings associated with using the causeways constructed for the response action and employing the USCG salvage equipment already deployed to the island (USCG, January 1999).

3.0 Authorities and Legal Requirements

This ERP/EA was prepared in accordance with OPA and its implementing regulations (15 C.F.R. 990 et seq.), as well as the NEPA (42 U.S.C. 4371 et seq.) and its implementing regulations (40 C.F.R. 1500 et seq.). This effort also complies with Executive Order 13089 on Coral Reef Protection signed by President Clinton in June of 1998.

3.1 Overview of Oil Pollution Act

The Department of the Interior (DOI) (in this case represented by the National Park Service), the Governor of American Samoa, and the National Oceanic and Atmospheric Administration (NOAA) are designated natural resource Trustees for this incident under the OPA (33 U.S.C. 2706(b)) and the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. 300.600 et seq.). The NCP, at 40 C.F.R. 600, states:

> (b) The following individuals shall be the designated trustee(s) for general categories of natural resources, including their supporting ecosystems. They are authorized to act pursuant to Section 107(f) of CERCLA, Section 311(f)(5) of the CWA, or Section 1006 of the OPA when there is injury to, destruction of, loss of, or threat to natural resources, including their supporting ecosystems, as a result of a release of a hazardous substance or a discharge of oil. Notwithstanding the other designations in this section, the Secretaries of Commerce and the Interior shall act as trustees of those resources subject to their respective management or control.
>
> (1) Secretary of Commerce. The Secretary of Commerce shall act as trustee for natural resources managed or controlled by DOC and for natural resources managed or controlled by other federal agencies and that are found in, under, or using waters navigable by deep draft vessels, tidally influenced waters, or waters of the contiguous zone, the exclusive economic zone, and the outer continental shelf. However, before the Secretary takes an action with respect to an affected resource under the management or control of another federal agency, he shall, whenever practicable, seek to obtain the concurrence of that other federal agency. Examples of the Secretary's trusteeship include the following natural resources and their supporting ecosystems: marine fishery resources; anadromous fish; endangered species and marine mammals; and the resources of National Marine Sanctuaries and National Estuarine Research Reserves.
>
> (2) Secretary of the Interior. The Secretary of the Interior shall act as trustee for natural resources managed or controlled by the DOI. Examples of the Secretary's trusteeship include the following natural resources and their supporting ecosystems: migratory birds; anadromous fish; endangered species and marine mammals; federally owned minerals; and certain federally managed water resources. The Secretary of the Interior shall also be trustee for those natural resources for which an Indian tribe would otherwise act as trustee in those cases where the United States acts on behalf of the Indian tribe.

The Governor of American Samoa is trustee for all natural resources of American Samoa.

As such, the Trustees are authorized to act on behalf of the public to assess and recover natural resource damages, and to plan and implement actions to restore natural resources and resource services injured or lost as a result of an incident involving the discharge or substantial threat of a discharge of oil under OPA. Trustees are also authorized to restore natural resources and services injured as a result of response actions, such as the planned response action to address the grounded vessels. The natural resource damage assessment regulations under OPA (15 CFR 990) direct Trustees to determine whether "an injury to a natural resource or impairment of a natural resource service has occurred as a result of response actions" (15 CFR 990.51(b)(2)(ii)). Thus, for this assessment, the Trustees are considering only those injuries caused by the construction, use, and removal of causeways and working platforms. Injuries under the hull bottoms are not included as response injuries.

The OPA regulations for damage assessment further provide those Trustees may undertake emergency restoration to minimize continuing injury or prevent future injury from an OPA incident (15 C.F.R. 990.26). OPA in Section 1012(j), "Obligation on Accordance with the Plan," provides:

> (1) IN GENERAL.-- Except as provided in paragraph (2), amounts may be obligated from the Fund for the restoration, rehabilitation, replacement, or acquisition of natural resources only in accordance with a plan adopted under Section 1006(c).
>
> (2) EXCEPTION.-- Paragraph (1) shall not apply in a situation requiring action to avoid irreversible loss of natural resources or to prevent or reduce any continuing danger to natural resources or similar need for emergency action.

However, the Trustees have decided that the circumstances of this natural resource damage assessment are such that the preparation of an ERP/EA would benefit the coordinated response and emergency restoration efforts.

The Trustees' authority under OPA for emergency restoration and natural resource damage assessment and restoration is separate and distinct from USCG authority to respond to oil discharges. Natural resource damages typically consist of the cost of restoring the injured natural resources and services, plus Trustee costs for assessing damages. These damages are to be paid by the person or persons responsible for the spill. If no financially viable responsible party can be identified or if the responsible party refuses to pay, then the Trustees may file a claim with the OSLTF for these damages. The OSLTF was established under OPA as a source of money to pay removal, natural resource damage assessment and restoration, and certain other costs and damages resulting from oil spills or substantial threats of oil spills. The OSLTF is used for costs not paid by a responsible party.

3.2 Coordination Among Natural Resource Trustees

On October 27, 1998, the Governor of American Samoa, the Honorable Tauese P.F. Sunia, wrote to the Under Secretary for NOAA, Dr. James Baker, requesting assistance with removing nine fishing vessels that grounded on the coral reefs in Pago Pago Harbor during a hurricane in 1991. The Governor's letter stated that the vessels continue to leak oil and some are breaking up and causing physical harm to the reefs, as well as a potential safety risk. In response, NOAA's Office of Response and Restoration began to assess the need for emergency restoration under OPA authorities. On May 5, 1999, NOAA invited the government of American Samoa and the U.S. Department of the Interior (DOI) to participate in this effort as co-trustees. Since that time, NOAA has been acting as the Lead Administrative Trustee for this assessment. DOI and the government of American Samoa participated as co-Trustees in developing this ERP/EA.

3.3 Coordination with USCG Response Efforts

Under the OPA regulations, Trustees must notify the Federal On-Scene Coordinator (FOSC) prior to implementation of emergency restoration actions (15 CFR 990.26(b)). Further, the rule requires that any emergency restoration actions must be coordinated through the Trustee Regional Response Team (RRT) member, since the RRT is a part of the National Response System, and must work through the FOSC to ensure adequate coordination.

NOAA's planning for emergency restoration was underway when the USCG announced in May 1999 that it would remove all of the oil and hazardous materials from the vessels to eliminate the risk of further pollutant discharge. Following this USCG decision, NOAA and DOI met with the USCG to ensure a coordinated plan of action. NOAA and DOI indicated they would proceed with emergency restoration concurrently with the USCG response action. Both the response agency and the Trustees agreed to support coordination on USCG response through the RRT.

NOAA reviewed the May 28, 1999, IAP prepared by the USCG to describe its response action. On June 18, 1999, NOAA provided written comments to assist the USCG with understanding the potential for further injuries caused by the response actions. These comments also provided specific recommendations and alternative procedures to minimize potential natural resource impacts during the response action. These comments specifically focused on: (1) physical destruction (crushing) and siltation (smothering/shading) caused by construction, use, removal and re-use of solid rock causeways and working platforms; (2) potential effects of venting ammonia into the water column; (3) potential release of oil or hazardous substances during salvage operations; and (4) the benefits to natural resources associated with keel removal as proposed in the IAP.

On June 28, 1999, the USCG completed a revised IAP. This version provided more details on the proposed response actions and incorporated many of NOAA's comments.

Also on June 28, 1999, a representative from NOAA's Damage Assessment Center (DAC) traveled to the USCG Marine Safety Office in Honolulu, Hawaii, to discuss and coordinate response and damage assessment efforts with the USCG, RRT, and USCG marine salvage contractor (PENCO corp.). Throughout this meeting and several others, as well as a number of phone conversations between NOAA and USCG personnel, including the FOSC, the Trustees indicated that they would attempt to compress their time schedule for natural resource damage assessment efforts to take advantage of cost savings and environmental benefits associated with using the infrastructure developed by the USCG response action for restoration efforts. To facilitate this coordination, representatives from NOAA's DAC and USCG headquarters continued to meet to discuss issues centered on DAC's ability to use USCG contractors and equipment already deployed to the island for restoration efforts determined to be necessary.

3.4 Coordination with the Responsible Parties

The OPA regulations require that known responsible parties be notified and invited to participate in emergency restoration actions, to the extent time permits (15 C.F.R. 990.26(c)). The Trustees did not attempt to locate the responsible parties because previous efforts by the USCG, U.S. Department of State, and U.S. Department of Justice to locate a viable responsible party were unsuccessful. On December 29, 1994, the USCG National Pollution Funds Center concluded that the debtor, Korean Wyonyang Fisheries Co., Ltd, was unable to be located and that the companies that owned the vessels (Korea Wonyang, Korea Tuna Venture S.A., and Koram Fisheries Co.) all went bankrupt on November 25, 1991 (USCG, December 1997). Based on these previous efforts, the Trustees did not attempt further efforts to locate the responsible party(ies), although the USCG continues its efforts to identify potentially responsible parties.

3.5 Coordination with the Public

The OPA regulations also require that Trustees provide notice to the public, to the extent practicable, of planned emergency restoration actions (15 C.F.R. 990.26(d)). Accordingly, the Trustees published a Notice of Intent to Conduct Emergency Restoration Planning in the Federal Register on August 12, 1999. The comment period on this Notice closes on September 13, 1999. As of September 1, 1999, no comments had been received.

3.6 NEPA Compliance

Any restoration of natural resources under OPA must comply with NEPA (42 U.S.C. 4371 et seq.) and its implementing regulations (40 C.F.R. 1500 et seq.). Thus, in compliance with NEPA, this Emergency Restoration Plan also serves as an Environmental Assessment and includes a description of the purpose and need for the action, and summarizes the current environmental setting and action alternatives with their potential environmental consequences. The NEPA review focuses on the restoration component to be completed by Trustees. Alternatives or associated environmental consequences associated with options for removing and disposing of the hazardous materials have been reviewed separately by the USCG under its emergency response authorities.

The Trustees have used information contained in this assessment to make a threshold determination as to whether preparation of an Environmental Impact Statement (EIS) is required prior to the selection of the final restoration action (i.e., whether the proposed action is a major Federal action that may significantly affect the quality of the human environment). Based on the EA integrated in this plan, the Trustees believe the proposed restoration action does not meet the threshold requiring an EIS.

4.0 Affected Environment

American Samoa is an unincorporated Territory of the United States administered by the U.S. Department of the Interior. The Territory consists of a group of small islands in the South Pacific with a total land area of about 76 square miles. It is the only U.S. Territory south of the equator and is located just east of the international dateline (latitude 14 south, 170 longitude). The islands are about 4,100 miles southwest of San Francisco and 2,300 miles southwest of Hawaii.

4.1 Physical Environment

The island of Tutuila is the largest island of the Territory of American Samoa, as well as the center of population. Tutuila is about 18 miles long and six miles wide with a total landmass of 52 square miles. The island is the top of a composite volcano rising three miles from the ocean floor.

Pago Pago Harbor is located on the south-central shoreline of Tutuila Island (Exhibit 2). It is surrounded on three sides by steep, mountainous terrain, with peaks over 1500 feet in elevation. The harbor opens to the south, with an entrance that is about 1 mile wide and over 200 feet deep. Sea swells from the south penetrate into the harbor, with waves of two to four feet commonly breaking on the reef flat in front of the village of Leloaloa.

The mean spring tidal range in Pago Pago Harbor is 3.1 feet. Flood tidal circulation is counter-clockwise, entering the harbor on the eastern shore and exiting along the western shore. Tidal currents across the reef flats along the outer harbor can be strong, reaching two to four knots in non-storm conditions. According to unpublished data provided by the American Samoa Environmental Protection Agency (ASEPA), the harbor has a flushing time of 13-20 days. The harbor has a history of poor water quality due to sedimentation, effluent from two tuna canneries located on the north shore of the inner harbor, chronic oil spills, waste disposal, and heavy metal contamination. Fish advisories are posted in the inner harbor declaring that the fish are toxic and should not be eaten, primarily because of heavy metal contamination (ASEPA, unpubl. data).[3] Recent water quality improvements are related to the relocation of the tuna cannery effluent discharge point in 1992 from the inner harbor to a point near Whale Rock at the harbor entrance.

Much of the intertidal zone in the innermost harbor has been dredged and filled to construct port facilities and roads. The main road is right along the shore for most of the north shoreline and has riprap protection for most of its length. High-tide beaches occur in only a few places. Starting at Trading Point on the north shore and Goat Island Point on the south shore, a reef flat extends from the shoreline to widths of 300-1300 feet. Parts of the reef flat in the inner harbor are exposed during spring low tides, whereas the reef flats along the outer harbor are usually covered by at least one to two feet of water during low tides. The reef crest is slightly higher in elevation, and waves break on the

---

[3] "Inner" Pago Pago Harbor includes that portion that lies west of a line drawn from the causeway at Leloaloa to Goat Island Point. This area is also referred to as the Pago Pago Harbor Special Management Area.

reef crest during low tides. The reef crest edge drops off rapidly into water depths of 60-120 feet.

4.1.1 Grounded Vessel Locations

The locations and general condition of the grounded vessels within Pago Pago Harbor are shown in Exhibits 2, 3, 4, 5 and 6. Exhibits 3 and 4 are images from aerial photographs taken in 1994. Exhibit 3 shows the seven vessels grounded in the inner harbor, near the village of Leloaloa. Although the photograph indicates that all seven vessels are stranded on the reef flat, field observations confirm that vessel 3 (the reddish brown vessel third from the left) has broken up and/or edged off the reef flat into deeper water since this photograph was taken.[4] Exhibit 4 shows the two vessels stranded in the outer harbor, approximately one-mile southeast of the seven inner harbor vessels.

Exhibits 5 and 6 are June 1999, photographs taken of the cluster of vessels stranded near the causeway at Leloaloa (Exhibit 5) and Aua (Exhibit 6). These images show the size and current condition of the stranded vessels. Overall, the nine vessels range between 125 and 160 feet in length and 25 to 30 feet in width. The two outer harbor vessels are in the best condition, although they have experienced substantial deterioration since grounding in 1991.

4.2 Biological Environment

The reef flat is the dominant near shore benthic habitat in Pago Pago Harbor. To characterize this environment in its current, or baseline, condition, the Trustees collected site-specific data during a recent visit to Pago Pago and reviewed data from the literature. The information obtained from these efforts is presented in the following sections of this ERP/EA.

4.2.1 Data Collection Methods

The Trustees undertook a rapid assessment to characterize the benthic habitat around the grounded vessels from 29 June to 5 July 1999 to establish baseline conditions prior to initiation of USCG response efforts. Four of the six vessel sites (or clusters) were surveyed (vessels 1-2, 7, 8, and 9). The Trustees did not survey the site around vessel 3 because the vessel is no longer there, although considerable vessel debris remains at the site. The site around vessels 4/5/6 was also not surveyed because a causeway to this site already exists (Exhibit 5).

At each of the four survey areas, the trustees conducted surveys to characterize broad categories of substrate and biota in the path of the proposed causeway and platform areas. Data was collected by running a transect from the shore to the vessel along the proposed causeway corridor, based on the PENCO drawings in the IAP. At vessels 8 and 9, a

[4] The USCG marine salvage contractor, PENCO, assigned each vessel an identification number (1-9) in the Incident Action Plan. The Trustees use the same identification numbers throughout the ERP/EA (see Exhibit 1).

EXHIBIT 3. Aerial Photograph of Seven Inner Harbor Vessels (taken in 1994). The seven vessel total includes two resting against each other at the left end of the vessel distribution (vessels 1 and 2), the reddish/brown vessel (vessel 3) which has since broken up/sunk, three vessels clustered near the end of the Leloaloa causeway (vessels 4, 5, 6) and vessel 7 (sitting almost parallel to the shoreline)

EXHIBIT 4. Aerial Photograph of Two Outer Harbor Vessels (taken in 1994). Vessel 8 is sitting near the middle of the reef flat. The village to the immediate right of this vessel is Aua. Vessel 9 is sitting on the reef crest, near the breaking waves.

EXHIBIT 5. Vessels 4, 5 and 6 (at Leloaloa Causeway) (taken in 1994). The middle of the three vessels (vessel number 5) is featured prominently in the center of the photograph. A portion of vessel number 4 is visible at the right edge of the photograph. The bow of vessel number 6 is visible at the left edge of the photograph.

EXHIBIT 6. Vessel 8 (taken in June 1999), from the shoreline in Aua.

fiberglass tape was weighted down along the transect. Two other fiberglass tapes were weighted down perpendicular to the transect at 6.5 feet (2 m) intervals for a distance of 26.25 feet (8 m) on either side of the transect. Field scientists using snorkel gear made visual estimates of the percent cover of different communities in 10.75 square feet (1 m^2) quadrats along the perpendicular tapes, recording the data directly onto field forms copied on waterproof paper. The field form consisted of grids 1 cm^2 in size in which a code was entered to describe the benthic communities.

Benthic community descriptors included percent cover ranges for coral, *Halimeda*, algal turf, and mixed *Halimeda*/algal turf (Exhibit 7). "Coral" refers to live colonies of a variety of hard coral species living on the reef flat and crest. Corals are associated with numerous ecological and human-use services (Maragos, 1992; Dixon, 1998) related to the physical structure and complex habitat space associated with reefs, and the high biological productivity and diversity associated with coral communities. The "*Halimeda*" descriptor refers to the green calcareous macroalga, *Halimeda opuntia*. Functional services associated with *Halimeda* include habitat structure, high biological productivity, and the production of coarse-grained calcareous sand. The "algal turf" descriptor refers to a mixed variety of algae, including filamentous and coralline forms. Functional services associated with algal turf include high biological productivity, sediment trapping, and nutrient uptake. In addition, coralline forms are important in cementing together (consolidating) loose calcium carbonate and serve as settlement sites for coral recruits (RPI and IEc, 1999). Although coralline algae were not one of the major benthic categories used (because they were less conspicuous), these forms were abundant in the reef flat and crest areas examined (CZA, 1999).

At vessel sites 1-2 and 7, the benthic communities were primarily algal turf. Because of the limited diversity in biota at these two locations, percent cover estimates were made using the same methods, but at wider intervals (16.4 feet on the reef flat and 32.8 feet on the sand/gravel flat).

Figures 1, 2, 3 and 4 present the habitat maps of substrate and biota in the path of the proposed causeways. The figures also show the results of the Trustees characterization of the platforms areas proposed by the USCG, which were surveyed using the same methodology.

The detailed maps of broad community categories cannot capture the full variety of biota on the reef flat. In part to further characterize species abundance and diversity of the different habitats, the Trustees also conducted a quantitative biological assessment during the site visit. Data collected included substrate type, counts of the number of mobile benthic organisms and percent cover estimates of sessile organisms in 1 m^2 quadrats randomly located along the proposed causeways (sample size = 20-30, depending on length) and proposed platforms (sample size = 10). Data from these efforts are integrated into the analysis below and more completely summarized in a provided to the Trustees. (CZA, 1999).

EXHIBIT 7. Community Type Descriptors Used for Habitat Mapping
Sand and Basalt Gravel Coral Rubble and Sand <1% Coral Cover (1 small head <5 inches, sparse young recruits, edges of heads) 1-10% Coral Cover (1 medium head, 5-10 inches) 10-20% Coral Cover (several medium heads/encrusting corals/1 large head >10 in) 20-30% Coral Cover (some medium heads/encrusting corals/ >1 large head) 30-40% Coral Cover (many medium heads/encrusting corals/several large heads) 40-50% Coral Cover (cluster of medium/large heads) >50% Coral Cover (large cluster of medium/large heads)
<1% *Halimeda* Cover 1-10% *Halimeda* Cover 10-20% *Halimeda* Cover
Patchy Algal Turf (typically 30-60% cover) Continuous Algal Turf (>90% cover)
Patchy *Halimeda/*Algal Turf (typically 30-60% cover) Continuous *Halimeda/*Algal Turf (>90% cover)

4.2.2 Results: Inner Harbor Vessels

The inner harbor sites can be characterized as a mix of consolidated reef platform and unconsolidated reef rubble, dominated by algal turf, coralline algal crusts, and *Halimeda*. Corals occur sporadically, mostly on the reef crest. Coral community abundance improves slightly with distance from the shore. The habitats and communities at vessels 1-2 are likely to be representative of those around vessel 3 and the vessels 4/5/6 site, since they are all located west of the existing causeway, which diverts the inflowing tide (with cleaner water) offshore. Vessel 7 has significantly more coral and continuous cover of algal turf, reflecting better water quality to the east of the existing causeway. Reef fish were seldom observed on the reef flats of the inner harbor. Invertebrates, including sea cucumbers, sea urchins and hermit crabs, were rare but occasionally observed.

Figure 1 shows the results of the field mapping effort for the vessels 1-2 site, located in the inner harbor. The benthic habitat around vessels 1-2 is the most degraded of all the areas surveyed during the rapid assessment effort. This stretch of the reef flat is dominated by algal turf and combined *Halimeda*/algal turf communities. *Halimeda opuntia* was the only species named to characterize the habitats, since it is an important habitat component and readily observed in the field. The consolidated reef platform only extends about 130 feet from the vessels; the remaining substrate is loose sand and coral rubble or sand and basaltic gravel (eroded from the shore protection structures). Patchy algal turf dominates the substrate along the transect, and patchy *Halimeda/*algal turf dominate on the platform. *Halimeda* cover reached 10-20 percent in several quadrats on the platform. There are a few patches of 1-10 percent coral coverage on the reef crest closest to the reef edge; live coral (*Pocillopora* and *Porites lutea*) was observed in 21 of the 208 quadrats (10 percent) at the platform and only 5 of the 736 quadrats (<1 percent) sampled along the causeway transect. These abundance estimates for coral, *Halimeda/* algal turf and algal turf communities are consistent with the findings from the quantitative survey in this area. In addition, the quantitative survey found coralline algal crusts to be relatively abundant in sample quadrats (26 percent coverage on the causeway, 20 percent coverage on the platform). Mobile invertebrates were rare.

Figure 2 shows the results of the field mapping effort for vessel 7, also located in the inner harbor. The reef flat extends from the vessel right up to the edge of the riprap. The reef flat has both algal turf and *Halimeda/* algal turf communities on the causeway and platform, with coverage of these communities approaching continuous along the platform. The quantitative survey found similar results; algal turfs covered about 45 percent of sample quadrats in the causeway and platform, while *Halimeda* covered 11 percent and 24 percent of these areas, respectively. Coralline algal crusts coverages in sample quadrats were about 11 percent on the causeway and 15 percent on the platform. Coral (*Pocillopora* and *Leptastrea*) coverage along the platform reached 10-20 percent in some of the quadrats on the reef crest. Overall, live coral was observed in 25 of the 268 quadrats (9 percent) at the platform and 11 of the 576 quadrats (2 percent) sampled along the causeway transect.

4.2.3 Results: Outer Harbor Vessels

The outer harbor reef flats are in better condition than the inner harbor reef flats, likely reflecting the higher water quality in this area. Field observations indicate that the area south of vessel 9 also has a high percentage of live coral cover, and the corals in the outer harbor generally are larger than those seen elsewhere during Trustee field efforts. Reef fish were common on the reef flats of the outer harbor. The most abundant invertebrates were sea cucumbers (about $1/ft^2$) and sea urchins (about $0.35/ft^2$).

Figure 3 shows the results of the field mapping effort for vessel 8, located in the outer harbor. It is the only vessel that is not stranded on the reef crest; rather, it is located about midway between the crest and the shoreline. Most of the area of the causeway is underlain by consolidated and unconsolidated reef rubble. Live corals were observed in nearly every part of the causeway transect, averaging 1-10 percent cover. About midway through the transect, there is a zone of higher coral coverage, with some quadrats having 40-50 percent cover. Coral coverage recorded in the quantitative survey produced similar results, averaging approximately 8 percent in causeway sample quadrats.

The corals closest to the shoreline were small (less than 2-3 inches), whereas the corals closer to the vessel were larger, usually 5-10 inches in size. Overall, nine species of coral were recorded in the causeway area; the three most common species were *Porites lutea*, *Pocillopora sp.*, and *Acropora nana*. With respect to non-coral biota, the quantitative survey found crustose and fleshy coralline algae cover totaling 53 percent in causeway sample quadrats, and algal turf cover of 16 percent.

In the platform area, live corals were observed in every quadrat except for a zone of rubble and debris immediately adjacent to the vessel on the northeast side. Coral cover increased toward the stern, with several quadrats in the 30-40 percent cover range. Overall, coral cover in the area of the platform averaged 1-10 percent. The quantitative survey found a similar, but slightly higher, average coral cover (14 percent) in platform sample quadrats, and observed six species of coral (*Pocillopora* was most abundant, followed by *Porites lutea* and *Leptastrea*). Crustose and flesh coralline algae cover totaled 43 percent of platform sample quadrats; algal turf cover was 23 percent. The mean abundance of mobile invertebrates was 3.3 individuals/m^2; the most abundant was the sea cucumber. Sea urchins, hermit crabs and an octopus were also recorded.

Figure 4 presents the results of the field mapping effort for vessel 9, the southernmost vessel in the outer harbor. For the first 150 feet from the shoreline, the substrate along the causeway transect was mostly unconsolidated rubble with sparse and patchy coral cover. From shore to about half-way along the transect, coral cover averaged <1 percent. Closer to the vessel, the reef flat has more solid reef rock, which is highly irregular, providing more structure to the reef flat. The second half of the causeway transect has the highest amount of coral cover of any of the sites, averaging 10-20 percent. In addition, the corals are larger, with some heads greater than 15 inches across. In the area of the platform, coral cover averaged 1-10 percent along the length of the ship. On the north side of the platform immediately adjacent to the vessel, there is a pile of coral rubble and extensive debris with very sparse coral cover (average <1 percent). The stern section of the platform area could not be mapped because persistent high waves made working on the high, rocky crest dangerous. These results agree with the quantitative surveys at vessel 9, which indicated the presence of the greatest amount of reef rock and the largest number of coral species (seven on the platform and thirteen on the causeway area) of all the sites examined (CZA, 1999). The most abundant species were *Pocillopora sp.*, *Acropora nana*, and *Leptastrea sp*. Similar to the rapid assessment results, live coral was present in 80 percent of the platform quadrats (averaging 5.5 percent cover) and 100 percent of the causeway quadrats (averaging 10.5 percent cover). Crustose coralline algae cover also was high (34 percent along the platform and 40 percent along the causeway), as was algal turf coverage (approximately 25 percent on the platform and causeway).

The rapid assessment and quantitative survey results for the outer harbor sites agree closely with an earlier study conducted at the nearby historical “Aua Transect” in 1995 (Green et al., 1997). The coral community during the Green et al. (1997) study was dominated by *Pocillopora* sp. (55 percent by number of colonies). Individual coral size was relatively small (less than 4 inches in 1995), and percent cover values were typically "low" (probably $\leq$ 10 percent).

4.2.4 Endangered Species

There are two endangered species, one threatened species, and five candidate species listed under the Endangered Species Act within the Territory of American Samoa.

Endangered species include: Humpback whale (*Megaptera novaeangliae*)
Hawksbill turtle (*Eretmochelys imbricata*)

Threatened species include: Green sea turtle (*Chelonia mydas*)

Candidate species include: Sheath-tailed bat (*Emballonura semicaudata*)
Spotless crake (*Porzana tabuensis*)
Many-colored fruit dove (*Ptilinopus perousii*)
Tutuila tree snail (*Eua zebrina*)
Snail (no common name) (*Ostodes strigatus*).

The U.S. Fish and Wildlife Service has also identified 11 "species of concern" (SOC) in American Samoa. These include:

Samoan fruit bat (*Pteropus samoensis*)
Mt. Matafao snail (*Diastole matafaio*)
Snail (no common name) (*Diastole schmeltziana*)
Short Samoan tree snail (*Samoana abbreviata*)
Ofu tree snail (*Samoana thurstoni*)
Snail (no common name) (*Trochomorpha apia*)
Plant (no common name) (*Acaronychia retusa*)
Plant (no common name) (*Elatostema tutilense*)
Plant (no common name) (*Habenaria monogyne*)
Plant (no common name) (*Manikara dissecta*).

Among the 18 species listed (threatened and endangered species and the candidate and SOC species), those that could reasonably be considered at potential risk from the USCG response include the humpback whale; green sea turtle; and hawksbill turtle. Humpback whales have been occasionally sighted in Pago Pago Harbor. Hawksbill turtles appear to be more common around Tutuila Island, while green sea turtles are more commonly sighted at Rose Atoll (Tuato'o-Bartley *et al*. 1993)

4.2.5 Pago Pago Harbor Special Management Area

The American Samoa Coastal Management Program has designated a Pago Pago Harbor Special Management Area, delineated by a line drawn from Goat Island Point to the jetty at Leloaloa, including all land and water resources on the inner harbor side of the American Samoa Highway 001 paralleling the shore around Pago Pago Harbor (Exhibit 2). This Special Management Area is designated under the Administrative Code for the American Samoa Coastal Management Act of 1990 (ASCA § 24.0501 et seq.) defining it as an area that "possesses unique and irreplaceable habitat, products or materials, offers beneficial functions and/or affects the cultural values or quality of life significant to the general population of the Territory and fa'a Samoa (Samoan "way" or culture)." Management objectives for reef resources within Special Management Areas include protecting subsistence, preventing adverse impacts to reefs and corals, and avoiding discharges of petroleum products, siltation, and the destruction of productive habitat.

Six of the grounded vessels are located within the Pago Pago Harbor Special Management Area (vessels 1 through 6). Established management objectives emphasize the importance of Special Management Area resources to American Samoans and reinforce the urgent need to restore any injuries caused to these resources.

4.2.6 The Aua Transect

The Aua Transect is located on the reef flat off the southern edge of the village of Aua, a few hundred yards north of one of the outer harbor vessels (vessel 8). The Transect has been surveyed on three occasions since 1917 and is considered to be of great scientific value. It is the second oldest quantitative coral Transect in the world and the oldest in the Pacific Ocean (Green et al., 1998). This Transect offers one of only a very few worldwide opportunities for the long-term environmental monitoring and study of reef ecosystems. Damage to this Transect would result in an irreplaceable loss.

4.3 Cultural Environment and Human Use

In Samoan culture, the Council of Chiefs within each village is responsible for managing village land, including reefs abutting the village. In rare cases, reef management is presided over by a single individual, the paramount chief of a village. Resource management problems are identified by village members and solutions arrived at through extensive discussions by families and their family chief (matai) and later through discussions held by the Council of Chiefs. Once a consensus is reached about a particular problem, members of the village take active part in implementing the solution.

Samoans fish the reefs year-round and, because reef areas fronting a village are generally controlled by village leaders, local villagers fish primarily in the reef areas adjacent to their own village (Ponwith, 1991). Island-wide, subsistence fishing produced 9.8 pounds of fish per capita in 1991 (Craig et al., 1993) and 14.6 pounds per capita in the four villages fronting the grounded longline fishing boats.[5] However, the annual reef harvest by these villages dropped to 2.7 pounds per capita by 1994, reflecting both reductions in fishing effort and declining catch per unit effort (Saucerman, 1995).

In the last few years, there has been a popular resurgence of interest in the reefs. Healthy eating programs promoting traditional diets have reignited the interest of local people in the reef fishery. While a small percentage fish for commercial purposes, the majority of people fish for their own consumption. Some also fish for entertainment, and consider fishing to be a social event. Many rural villages continue to manage their reefs through enforcement of village rules against inappropriate fishing techniques (e.g., the use of dynamite and poison) and occasionally through the implementation of a two to four month long taboo on reef fishing to promote recovery of the resource. "Tautai o le a'au" or "guardians of the reef" continue to be present among the Samoan people.

Other ocean-based recreation in American Samoa includes snorkeling, scuba diving, sailing, surfing and sport fishing. These pursuits are primarily undertaken by tourists and other non-natives. Access to reef and/or surfing areas, however, is limited by village matais, who may deny permission to use the beaches, particularly on Sundays (for

---

[5] The population of Tutuila is about 45,000 (SYAS, 1996). This includes about 2,300 people who live in four villages along the Pago Pago Harbor where nine grounded longline fishing vessels are located (about 400 people in the villages of Leloaloa and Lepua, and about another 1,900 in the villages of Aua and Anasosopo).

religious reasons). The small Pago Pago Harbor Yacht Club offers on-shore storage for small sailing boats. Pago Pago Harbor and the bay in front of Faga'alu are used by larger sailing boats that anchor at sea.

Historically, tourism was a more significant component of American Samoa's economy than it is today. More than 35,000 tourists visited American Samoa in 1974 (TTF, 1994), compared to an annual average of 6,000 from 1992 to 1996 (SYAS, 1996). Tourism contributes approximately $2 million (TTF, 1994).

The island economy is heavily dependent on the tuna industry. The two tuna canneries on Tutuila employ about one-third of the labor force, and account for more than 95 percent of the island's exports.

5.0 Injury Assessment: Injury Determination and Quantification

There are three predominant habitat types on the coral reef flats evaluated by the Trustees: (1) coral; (2) algal turf; and (3) *Halimeda*/algal turf, as described in Section 4.0. Response actions on the reef flats are expected to affect each of these three types of habitat.

The Injury Assessment phase consists of the injury determination and quantification components. Section 5.1 looks at the likely effects of response actions on the reef flat itself in the injury determination component of the injury assessment. Section 5.2 discusses the quantification component of the injury assessment in two steps. The first is to determine the spatial and temporal extent of the injury to the reef flat resulting from each type of response action that the Trustees determined feasible to quantify at this time. The second step is to determine the spatial and temporal injuries to each of the three habitat types based upon the distribution of each of these habitat types within the impacted area of the reef flat.

The final decision by the USCG on use of trestles versus fill causeways was not yet made at the time of the preparation of this ERP/EA. Therefore, the Injury Assessment provides calculations for two scenarios:

> Scenario 1 assumes that fill causeways are used for vessels 1 through 7 and trestle causeways are used for vessels 8 and 9;
>
> Scenario 2 assumes trestle causeways are used for all vessels, except for vessels 4, 5, and 6, which have an existing fill causeway.

Both scenarios assume use of fill platforms for operation of equipment, as specified in the IAP.

Final selection of one of these scenarios will be made by the USCG during their response action which is not part of the NEPA evaluation by the Trustees.

5.1 Injury Determination

5.1.1 Categories of Injury to the Reef Flat Habitat Resulting from Planned Response Actions

5.1.1.1 Crushing and 100 percent Mortality of Sessile Biota Directly Under the Causeway and Platform Areas of Rock Fill

No attached biota (coral, coralline and fleshy crustose algal, sponges, algal turfs, etc.) will survive temporary burial (for several weeks) by rock fill used to construct platforms and/or causeways. Short-term burial experiments (68 hours or less) caused mortality, partial mortality and/or tissue necrosis in four species of Philippine reef corals, including genera present in Samoa (Wesseling et al., 1999). The rock fill proposed by the USCG will completely kill all attached biota in the footprint of platforms and/or causeways, beginning at the onset of construction activities.

5.1.1.2 Partial Crushing of Sessile Biota in a Buffer Zone Around the Rock Fill Areas

During transport and placement of the fill, some material will spill onto the reef flat beyond the designed footprint of the structures. Also, waves and storm tides will attack the exposed side(s) of the causeways and platforms, mobilizing some of the rock material. The Trustees have estimated the extent of buffer fill injury using a 5:1 ratio (i.e., five feet of impact for every foot of causeway/platform height), based on information provided by a coastal engineer (David Werren, pers. comm., 1999[6]). This 5:1 ratio includes impacts associated with the sloping sides of the causeway as well as the buffer zone extending beyond the sides. Because the sloping sides of the causeway have already been accounted for in the footprint calculation, the Trustees estimate buffer zone area by subtracting the area underneath causeway sides from the total area calculated using the 5:1 ratio. The design slope of the causeway and platform sides is 1.5:1; therefore, every foot of causeway/platform height increases the footprint by 1.5 feet per side and is associated with a buffer zone of 3.5 feet per side. Using this ratio for the different design elevations, the Trustees calculated buffer zones on each side of the rock fill structures as follows: 17.5 feet for 5 feet elevation; 21 feet for 6 feet elevation; and 24.5 feet for 7 feet elevation. The corals and other biota occupying the reef flat are very fragile and readily crushed. There will be some biota buried and crushed directly adjacent to the fill areas, while areas farther away will experience partial burial, physical breakage, abrasion, sedimentation, etc. Some mortality will occur, as well as damage, disturbance, and stress to the surviving biota. For injury and scaling calculations the Trustees used a 25 percent mortality estimate in the buffer areas, relative to baseline conditions, based on an expert report (RPI and IEc, 1999) provided to the Trustees.

5.1.1.3 Injury to the Reef Flat Substrate During Sediment Placement and Removal

The consolidated rock (biologically built) platform of the reef flat plays a key role, providing a stable substrate as well as living space for different biota. The Trustees expect that there will be some damage to the reef rock, most likely involving the collapse of higher topographic areas and/or fracturing of the consolidated reef framework under the weight of the fill or by the equipment used during fill removal. These types of impacts could substantially reduce the suitability of the area for reef biota and/or limit recolonization and recovery. The Trustees have not attempted to estimate the extent and degree of these injuries at this time.

[6] David Werren, a coastal engineer with Baird & Associates, in Madison, Wisconsin, has extensive expertise in the design and construction of marinas, breakwaters, sediment control structures.

5.1.1.4 Physical Injury to the Reef Flat from Residual Fill Materials Remaining on the Flat After Removal of the Rock Fill Platforms/Causeways

The base fill material will range from 2-12 inches, a size which can be readily mobilized during storms. In the IAP, USCG estimates that 20 percent of the fill material will be "waste," indicating that some loss of fill material to the environment is expected. Once removal of the causeways and platforms is complete, any fill material left on the reef flat will cause injuries in surrounding areas as the material is mobilized during storms. For this reason, rubble removal during vessel groundings on coral reefs is often a key restoration activity. For this injury determination effort, the Trustees have assumed that all of the fill material used for causeway and platform construction will be removed by the USCG as part of the response action, and, at this time, have not quantified these potential injuries.

5.1.1.5 Impacts to Biota Associated with Trestles

The USCG proposes to use grated flat-rack trestles to provide access to vessels 8 and 9, and possibly other vessels. The use of trestles to access work platforms and vessels, while less damaging than rock fill, will still cause injury due to the effects of trestle construction, use, and removal. For example, injuries can be expected as gravel, dust, vehicle oil, and similar material to drop through the grates and into the water.

Another source of injury is shading that will occur from the reduction in the amount of light underneath the trestles. The effects of shading have been widely reported for corals (Connell, 1973; Rogers, 1979; Stimson, 1985; Curtis, 1985; Gittings, et al., 1994), as well as seaweeds and algae (Lobban et al., 1985; Longhurst and Pauly, 1987). The effects of shading on corals include bleaching (loss of zooxanthellae-- microalgae living in symbiosis with the corals), resulting in decreased coral growth, coral tissue death, and complete mortality of colonies (Connell, 1973; Rogers, 1979; Stimson, 1985; Curtis, 1985; Gittings et al., 1993; Harold Hudson, FKNMS, pers. comm.[7]). Bleaching has been observed in corals shaded by vessels for as little as 8-12 days during grounding incidents (Curtis, 1985; Gittings et al., 1993; Harold Hudson, pers. comm.[7]). In one case, corals bleached from eight days of shading recovered over time and no colonies were known to have died (Harold Hudson, pers. comm.[7]). However, following 12 days of shading, some bleached corals displayed tissue death, and mortality of entire colonies was observed (Curtis 1985; Gittings, et al., 1994). In experimental shading studies, coral bleaching, tissue damage, and mortality were observed in cases where: (1) nearly all ambient light was shaded for 3-5 weeks (Rogers, 1979); (2) direct ambient light was reduced by 90 percent over 2-6 months (complete mortality observed) (Connell, 1973); and (3) direct ambient light was reduced by 67-83 percent over 8 months (Stimson, 1985).

The duration of shading by the trestles is likely to be on the order of 4-6 weeks, considering the time needed for trestle construction, pollutant removal, vessel work, and

[7] Harold Hudson is a biologist with NOAA's Florida Keys National Marine Sanctuary Program (FKNMS). He has extensive experience with damage assessment and restoration of coral reefs.

scrap removal. The duration of shading will thus be sufficient to cause injury, including mortality of some corals, depending on the degree of shading. At this time, the degree of light reduction that will be caused by the trestles is not known. Trestles will consist of grated flat racks that will transmit some light (more than that transmitted in the experiments above), although the degree of shading will probably still be considerable, especially relative to the very high levels of light that the corals on the shallow reef flat typically experience.

The extent of shading injury will also be related to the types of corals found in the area. Branching corals, such as those that dominate on the reef flat at Pago Pago Harbor, are typically susceptible to shading injuries (Harold Hudson, pers. comm., 1999[7]). More specifically, *Pocillopora*, which dominate the coral fauna in the impact area, have been described in the literature as highly shade-intolerant, experiencing significantly reduced growth and mortality in shading experiments (Stimson, 1985). The relative size of coral polyps may be related to the degree of injury caused by shading (Rogers, 1979). Corals with small polyps may depend to a greater degree on photosynthesis by zooxanthellae and therefore may be more greatly affected by bleaching, whereas corals with larger polyps can additionally or alternatively feed on zooplankton in the water column if zooxanthellae are lost (Rogers, 1979). Descriptions of *Pocillopora* indicate that this genus has relatively small calyces, and therefore small polyps (Hoover, 1998), and so may be more sensitive to bleaching than other corals.

Considering the types of coral present, it is very likely that significant injury will occur as a result of shading. Similar shading impacts are expected for *Halimeda* and algal turfs as well. *Halimeda distorta*, for example, exhibits a circadian rhythm chloroplast migration that can be significantly altered by changes in lighting. Under normal daily light cycles, the algae undergo photosynthesis for the entire period of the day when light is available, moving its chloroplasts to the surface of its leafy structures just a few hours before dawn. A few hours after sunset, the plant becomes white as it withdraws its chloroplasts away from its leafy surfaces. In an experiment conducted under controlled laboratory conditions, *Halimeda distorta* exposed to continual darkness for seven days did not green for the entire period (Drew et al., 1992). Thus, it is reasonable to expect that shading will cause injury to *Halimeda* on the reefs of Pago Pago Harbor under trestles by inhibiting photosynthesis, a process vital to the growth and survival of the algae.

In summary, the Trustees believe that there will be physical damage to the reef biota and the consolidated reef framework during trestle construction, use, and removal. There will also be injuries as a result of shading. Based on these considerations and an expert report (RPI and IEc, 1999) provided to NOAA, the Trustees used a 50 percent mortality rate for injury determination and scaling calculations in the areas under the causeways for corals, *Halimeda,* and algal turfs.

5.1.1.6 Injuries Associated with High Suspended Sediment Levels Downstream of the Fill Areas

Suspended sediments have rapid and significant impacts to coral reef habitats. Siltation has been shown to kill, sublethally stress, and reduce recruitment of or otherwise injure hard and soft corals, crustose and foliose algae, and other reef flat organisms (Thompson, 1980; Pearson, 1981; Hubbard, 1986; Rogers, 1990; Babcock and Davies, 1991; Kendrick, 1991; Maragos, 1992; Rice and Hunter, 1992; Terrados et al., 1998; Umar et al., 1998; Wesseling et al., 1999). The IAP calls for the use of washed rock fill to minimize the fine grain sizes in the fill material and the use of silt curtains and/or booms to control sediment loss. All of the vessel sites are exposed to strong tidal currents and waves, which could lead to substantial sedimentation-related impacts if the USCG is not successful at limiting the introduction of sediment into the reef flat environment during response activities. The Trustees have not attempted to estimate the extent and degree of these injuries at this time.

5.1.1.7 Other Potential Injuries, Including Impacts From Oil and Chemical Releases and Associated Response Efforts

Documented long-term effects of oil spills on reef corals include mortality, decreases in growth rates and disruption of reproduction (Loya and Rinkevich, 1980; Jackson et al., 1989). More generally, reef flat communities directly contacted by oil have shown immediate mortality with recovery periods for some organisms exceeding five years (NRC, 1985; Garrity and Levings, 1990; Cubit and Connor, 1993; Suchanek, 1993; USFWS 1997). Organisms affected included hard and soft corals, crustose and foliose algae, seagrasses, and mollusks. Releases of other contaminants can have similar, harmful effects. The impacts of spill containment and cleanup efforts can also be substantial. Collateral physical damage from inappropriate or poorly deployed clean up equipment has caused natural resource injury after many oil spills (Houghton et al., 1993). Reef flat organisms are easily killed or dislodged by foot traffic, machinery, mechanical scrubbing, hot water, and other methods commonly used to clean up oil spills (Cubit and Connor, 1993). The Trustees have not attempted to estimate the extent and degree of these injuries at this time.

5.1.1.8 Summary of Injuries to the Reef Flat Habitat

In summary, the reef flat injuries quantified in this analysis include: (1) 100 percent mortality of biota under the footprint of the fill areas; (2) 25 percent mortality of biota in a buffer zone of 17.5-24.5 feet around the fill areas (35 – 49 feet total buffer area); and (3) 50 percent mortality associated with the trestles, including physical damage during trestle construction, use and removal and shading.

To coordinate this emergency restoration effort in a timely manner with the USCG response, the Trustees have not attempted to estimate the degree or extent of other, potentially important injuries. These potential injuries include damage to the reef flat substrate during sediment placement and removal, physical damage to the reef flat from residual fill materials left on the reef flat after removal of the fill platforms and causeways, injuries associated with high suspended sediment levels downstream of the fill areas, and other potential injuries including impacts from oil and chemical releases and associated response efforts. However, if the Trustees later determine that other such injuries are occurring, they may conduct further injury assessments to characterize these injuries and seek additional restoration as appropriate.

5.1.2 Injury to Threatened and Endangered Species

The Trustees believe that the humpback whale that occasionally use the action may be adversely affected in the short term by the proposed action. Noise and disturbance associated with the proposed ERP should cause whales to avoid the area in the vicinity of specific actions, although this avoidance response will probably be a short-term response with no lasting effect of the population numbers, behavior, ecology of the whales. The proposed ERP is designed to change the current environmental baseline by removing the vessels and eliminating the risk of future pollutant discharges. Therefore, activities associated with the proposed ERP are likely to benefit whales that use the action area without adversely affecting them in the long term.

The ERP could adversely affect green and hawksbill sea turtles through: (1) disturbance of shoreline nesting areas through physical disruption from causeway, trestle or platform construction and/or contamination from unintended releases of oil; (2) acute or chronic impacts associated with the release of oil, ammonia, or other contaminants into the water column; (3) degradation of the reef habitat and subsequent reduction in the local forage base of sea turtles. Based on the best scientific and commercial data available on historical nesting patterns of green and hawksbill sea turtles, the Trustees do not believe sea turtles nest in areas that are likely to be adversely affected, either directly or indirectly, by disturbance of shoreline areas caused by activities associated with the ERP.

Activities associated with the ERP could result in oil or hazardous material releases that may adversely affect listed sea turtles. However, the oil or hazardous spill releases began in 1991, when the vessels were grounded, and are part of the baseline conditions for the action area. As discussed in the Introduction (page 5), about 1,500 gallons of oil was discharged in December 1991 after the vessels were grounded. In 1991, the USGC removed an estimated 10,500 gallons of diesel fuel, lubricant, and hydraulic oil from three of the vessels, although an estimated 18,000 gallons of oil and an undetermined amount of ammonia remained on the vessels. Since 1991, the EPA has received reports of small discharges from the vessels. The proposed ERP is designed to change the current environmental baseline by removing all ammonia and oil from the vessels and eliminating the risk of further pollutant discharges. Therefore, activities associated with the proposed ERP are likely to benefit threatened and endangered species in the action area without adversely affecting them.

Finally, activities associated with the proposed ERP are likely to degrade reef habitat and reduce the local forage base of sea turtles (see discussion above). However, the baseline conditions, which include the presence of grounded vessels on the reef that occasionally release oil or hazardous materials, represents a dramatic degradation or this habitat that threatens the forage base of sea turtles. The proposed ERP is designed to change the current environmental baseline by removing the vessels and eliminating the risk of future pollutant discharges. Therefore, activities associated with the proposed ERP are likely to benefit threatened and endangered species in the action area without adversely affecting them. Thus, the Trustees have not included any injuries to threatened and endangered species in this assessment.

5.1.3 Injury to the Pago Pago Harbor Special Management Area

Injuries to specific resources and resource uses in the Pago Pago Harbor Special Management Area caused by the USCG response are considered, determined, and quantified in other sections of this ERP/EA. The Trustees do not claim additional resource injury associated with this area's special designation by the American Samoa Coastal Management Program. However, this designation emphasizes the importance of these resources and the need for complete and prompt restoration.

5.1.4 Injury to the Aua Transect

The Aua Transect is a few hundred yards north of the northernmost of the two outer harbor vessels (vessel 8). Given the predominant counter-clockwise circulation pattern in Pago Pago Harbor, the Transect is generally downstream from vessels 8 and 9 and therefore at risk from any contaminant spills or sedimentation events associated with the USCG response. Because of a variety of uncertainties, including the size and amount of sediment released into the water column during platform construction, the effectiveness of any mitigation efforts, and the completeness of fill removal during platform deconstruction, the likelihood of injury to the Transect cannot be reliably determined or quantified at this time. The value of the Aua Transect derives from the long-term monitoring data from an undisturbed coral community. This value will be lost is the USCG response affects community structure in the area of the Transect.

5.1.5 Cultural/ Human Use Injury

Based on the information in Section 5.2, the causeway and platform footprints (along with buffer zones) are expected to injure about two acres of reef flat. Given the cultural tradition of village use and control of reef area bordering their lands, the Trustees considered impacts of the USCG response on local communities in the vicinity of the vessels. These included: (1) subsistence fishing; (2) reef-based recreation; and (3) visual impairment/losses associated with presence of rusting, deteriorating debris caused by the USCG response left close to shore.

Based on a Pago Pago Harbor marine chart provided by the American Samoa Department of Marine and Wildlife Resources, the Trustees estimated the area of reef flat fronting relevant portions of the villages of Anasosopo, Aua, and Leloaloa is 132 acres.[8] Thus, the

[8] Reef flat area is calculated by counting grid cells from a photocopy of the Pago Pago Harbor marine chart on graph paper. The reef flat area is defined to include grid cells more than 50 percent covered by reef flat

causeway and platform footprint is expected to reduce or eliminate production from a small percentage of the associated reef acreage. This analysis may slightly understate the impact of the construction footprint, as portions of reef areas in Pago Pago Harbor either have been filled in to provide additional land area or dredged to provide fill material for construction in recent years. The Trustees also considered fishing and recreational activities and concluded that the construction footprint will not have a measurable affect on these activities.

The USCG response actions may leave some debris spread out over the reef flats. Thus, the Trustees also considered potential losses associated with visual impairment effects of debris caused by the USCG response. Clearly, the presence of rusting, deteriorating debris detracts from the majestic views afforded by Pago Pago Harbor. Aesthetic values are recognized as an important resource service in numerous pieces of U.S. legislation, including the Coastal Zone Management Act, National Marine Sanctuaries Act, and Clean Air Act. The aesthetic value associated with removal of the grounded vessels in Pago Pago Harbor is difficult to estimate. The Trustees have not attempted to quantify these losses at this time, but believe that debris caused by the USCG response may need to be removed.

5.1.6 Summary of Injuries

A total of eleven potential injury categories are considered in the injury determination component. Section 5.1.1 discusses seven of those potential injury categories to the reef flat habitat:

(1) Crushing and 100 percent mortality of sessile biota directly under the causeway and platform areas of rock fill;
(2) Partial crushing of sessile biota in a buffer zone around the rock fill areas;
(3) Injury to the reef flat substrate during sediment placement and removal;
(4) Injury to the reef flat from residual fill materials remaining on the flat after removal of the rock fill platforms/causeways;
(5) Impacts to biota associated with trestles;
(6) Injuries associated with high suspended sediment levels downstream of the fill areas; and
(7) Other potential injuries, including impacts from oil and chemical releases and associated response actions.

Section 5.1.1.8 concludes that only four of the seven categories will be pursued at this time. Other potential injuries considered but not pursued at this time include: injury to threatened and endangered species (Section 5.1.2); injury to the Pago Pago Special

---

(as represented on the chart) from Trading Pt. (approximately 400 yards west of vessel number 1) to Anasosopo Pt. (the location of the southernmost vessel in the outer harbor). Close to 400 grid cells make up this reef area, with each grid cell representing 1,736 square yards of reef area (based on the chart scale of 421 yards and 10 grid cells per inch). For similar reasons, the Trustees do not believe that the construction footprint will have a measurable affect on fishing or recreation activities of residents of other villages or tourists

Management Area (Section 5.1.3); injury to the Aua Transect (Section 5.1.4); and cultural/human use injury (Section 5.1.5).

5.2 Quantification

5.2.1 Quantification of Biological Injuries to the Reef Flat Habitats

Injury quantification was performed using the methods and approaches presented in NOAA guidance documents on injury assessment (NOAA, 1996) and restoration scaling (NOAA, 1997). Exhibit 8 shows the dimensions for the causeway, platform, buffer zone and vessel footprints at each site. The footnotes describe how the footprint area for each vessel cluster was calculated. Although the Trustees used the heights of the causeways and platforms indicated in the IAP for these calculations, field observations indicate that field conditions will require increased heights, particularly for the outer harbor sites that are subject to substantial wave action (and therefore washover potential). If the causeway height is increased, width will also increase so that the Trustee footprint estimate may be exceeded during removal operations. With respect to causeway length, the Trustees used actual field measurements from the shoreline to the vessels (where available) rather than the estimated lengths included in the IAP. These field measurements were all shorter than corresponding estimates in the IAP, by between nine and 95 feet.

EXHIBIT 8. Dimensions of the Causeways, Platforms, Buffers and Vessel Footprints

	Causeway			Platform			Vessels[10]		
Vessel No.	**Length (ft)**	**Width (ft)**	**Buffer Area (ft^2)**	**Length (ft)**	**Width (ft)**	**Buffer Area (ft^2)**	**Length[8]**	**Width[8]**	**Over-hang**
1-2	322[1]	40[3]	10,666	200[2]	22.5[4]	4,288	150	25	10%
				50[2]	30.5[5]	2,720	150	25	35%
3[9]	--	--	--	--	--	--	--	--	--
4/5/6	370 (already exists)	30.5 (already exists)	--	200[2]	22.5[4]	4,288	150	25	25%
				200[2]	22.5[4]	4,288	150	25	0%
				50[2]	30.5[5]	2,720	150	25	50%
7	468[1]	40[3]	15,750	200[2]	22.5[4]	4,288	150	25	20%
8	251[1]	20 (trestle)	--	200[2]	24[6]	5,208	125	25	0%
				50[2]	19[7]	1,848	--	--	--
9	285[1]	20 (trestle)	--	200[2]	24[6]	4,578	160	30	0%
				50[2]	19[7]	1,848	--	--	--

1 From field survey measurements. Excludes that part of the causeway that will be included in the platform.
2 From IAP specifications.
3 Based on causeway design of 25 ft wide crown, 5 ft height, and 1.5:1 slope on both sides.
4 Based on platform design of 15 ft wide crown, 5 ft height, and 1.5:1 slope on one side.
5 Based on platform design of 20 ft wide crown, 7 ft height, and 1.5:1 slope on one side.
6 Based on platform design of 15 ft wide crown, 6 ft height, and 1.5:1 slope on one side.
7 Based on platform design of 10 ft wide crown, 6 ft height, and 1.5:1 slope on one side.
8 Based on field measurements of the length of vessels 1 and 8, using NOAA aerial photography to estimate the remaining lengths and all widths.
9 Vessel 3 is not included, as the USCG has determined that no causeway will be constructed.
10 The area of the vessel footprint is not included in the injury area

Platform and causeway widths were calculated by adding crown widths (i.e., width needed at the top of the causeway or platform) stated in the IAP to side slope widths generated by the 1.5:1 width to height ratio described in Section 5.1. Footprint areas for platforms and causeways were calculated as rectangles, and do not overlap. The footprint area estimates are conservative, as some platforms and causeways may not be constructed at right angles, leading to slight increases in affected area. Vessel footprint estimates are also based on rectangular areas, which may overstate their actual, tapered footprints. The percent overhang estimate refers to the portion of each vessel that hangs over the reef edge (and therefore is not resting directly on the reef)[9]. This parameter was estimated using field measurements and information from aerial photographs.

Exhibit 9 presents the causeway and platform injury areas calculated from the dimensions in Exhibit 8. The 100 percent mortality area is 42,300 square feet for the causeways and 32,406 square feet for the platforms. For the 25 percent mortality buffer area, the injury area is 26,416 square feet for the causeways and 36,074 square feet for the platforms. The 50 percent mortality area for the causeway area of vessels 8 and 9 is 10,720 square feet.

EXHIBIT 9. Causeway and Platform Injury Areas

Vessel	Causeway (fill)		Causeway (trestle)	Platform	
	Footprint (ft^2)	Buffer (ft^2)	Footprint (ft^2)	Footprint (ft^2)	Buffer (ft^2)*
1-2	12,880	10,666	6,440		7,008
3	--	--	--	--	--
4/5/6	--	--	--	10,525	11,296
7	18,700	15,750	9,340	4,500	4,288
8	5,020	--	5,020	5,750	7,056
9	5,700	--	5,700	5,606	6,426
TOTAL	42,300	26,416	26,500	32,406	36,074

Note: Mortality in the causeway and platform footprint is assumed to be 100 percent if fill is used and 50 percent if trestles are used. Mortality in the buffer zones is assumed to be 25 percent. According to the IAP, the USCG will not construct a platform for vessel 3 or a causeway for vessels 4/5/6, which are serviced by an existing causeway. In addition, the USCG will use trestle causeways for vessels 8 and 9, which do not have an associated buffer zone. To the extent USCG decides to use trestles for other causeways, associated buffer zones will be eliminated as well.
* The buffer areas shown include small portions of overlap with causeways. The Trustees have accounted for this overlap in their injury calculations.

Based on the habitat maps in Figures 1 through 4, the reef flat along the proposed causeways and platforms was divided into sub-habitats and the mean cover of community types estimated. The area of reef flat habitat affected by construction of the causeways and platforms (including buffer zones) was then calculated, using previously described assumptions about percent mortality in footprint and buffer zones.[10] Finally, the Trustees

9 The area of the vessel footprint is not included in the injury area.

10 As described previously, the platform and causeway areas do not overlap. The Trustees also have accounted for overlap associated with buffer zones. If platform buffer zones overlapped with causeway footprints (or vice-versa), the Trustees used the footprint 100 percent kill estimates for fill causeways or the 50 percent kill estimates for trestle causeways to calculate injury in the overlap area. If platform and causeway buffer zones overlapped, the Trustees assume 25 percent kill in the overlap area. Although this

estimated the recovery period for each community injury based on a review of relevant scientific literature. These analyses are described in more detail in the following sections of this report.

5.2.1.1 Recovery from Physical Crushing and Shading

For areas where coral is a major component of the reef flat community (vessels 8 and 9), recovery time following injury is estimated to be 10 years. A wide body of literature indicates that recovery time-periods for corals can range from as little as a few years to hundreds of years, depending on the intensity, spatial extent, duration, and type of impact or disturbance, as well as the type of coral community involved (Endean, 1976; Pearson, 1981; Done, 1988; Johnson and Preece, 1992; Connell et al., 1997).[11] As used in this section, the term "coral community" refers to the entire assemblage of plants and animals associated with this community, not just the corals. The recovery time-period focuses on corals, since they are the major structural component of the community, and take the longest time to recover. Organisms that recover more quickly than the corals (e.g., filamentous algae) are assumed to be "captured" as part of the process of recovery over time, where concomitant decreases in interim injuries are observed each year as recovery proceeds.

For substantial, acute, localized impacts, such as those that will be caused by the temporary fill structures, estimates and observations of recovery times in the literature range from 3 to more than 20 years. Where these impacts do not significantly alter the physical environment in a long-term or permanent manner, coral communities can frequently recover within 10 years post-impact (Endean, 1976; Connell et al., 1997). With respect to coral community injuries caused by the USCG response, a ten year estimate of recovery time assumes that the physical environment in temporary fill areas is not drastically altered (i.e., the consolidated framework of the reef flat is not broken up by the placement of fill, the weight of fill and equipment, or by fill removal activities, and the majority of waste fill material and new rubble (created as a result of crushing) will be removed at the completion of the response).

Assuming no significant alteration of the reef substrate, a 10-year recovery-time also is reasonable considering the type of coral community present on-site prior to construction activities. Opportunistic, fast-growing coral species, low percent cover, and small colony size would indicate that a coral community is relatively "young" in terms of age or stage of succession. Recovery following disturbance in such areas should occur relatively quickly, as compared to areas with more mature coral development (Endean, 1976; Pearson, 1974; Grigg and Maragos, 1974; Done, 1988; McManus et al., 1997). The coral reef flat communities in the outer harbor of Pago Pago are dominated by *Pocillopora*, with relatively low percent cover, and small individual colony size (Green et al., 1997, CZA, 1999, and this report). *Pocillopora* are widely recognized as "opportunistic" or "colonizer" species, which often dominate coral communities that are relatively "young,"

---

latter assumption may be conservative, the amount of buffer overlap area is small.

[11] References in major review and synthesis papers were also consulted separately, as were several other recent publications. Overall, more than 50 papers were reviewed on the topic of recovery time.

recently disturbed, or in an early stage of succession (Connell, 1973; Grigg and Maragos 1974; Pearson, 1981; Sakai and Yamazato, 1984; Alino et al., 1985).

In 1995, coral colony sizes in the outer harbor were mostly less than 10 cm for *Pocillopora* (and other corals) (Green et al., 1997). Green et al. (1997) suggested that the corals observed were new recruits to the area following hurricane disturbances in 1990 and 1991. This would place the relative "age" of the coral community that developed after the hurricanes at roughly 4-5 years. Assuming a lag in initial recruitment and an annual growth rate of about 2 cm per year for young *Pocillopora* and other reef flat corals (Done et al., 1988), colony size in 1995 would be less than 10 cm, as observed. Extrapolating this to 1999, 8-9 years following the hurricanes, the size of most individual coral colonies should be 16 cm or less. This agrees well with estimates of 15 cm for average colony sizes reported by recent observations (Harold Hudson, pers. comm.[7]). Thus the "age" of the coral community in 1999 would be roughly 8-9 years. Assuming that the fill activities will set impacted portions of the coral community back to zero (100 percent injury), and that some amount of time will be necessary for disturbed areas to stabilize and for initial recruitment to occur (1 year) (Pearson, 1981), recovery time should be approximately 10 years. Again, this generally agrees with recovery times suggested in the literature.

If the reef structure is substantially changed and/or fill material and rubble is left on the reef flat, recovery might be delayed by another ten years or more (making recovery time 20+ years), due to depressions in or de-stabilization of the consolidated reef flat framework, and/or the storm-mobilization of waste fill and construction-generated rubble. Depressions in the reef framework would collect sediment and rubble, and coral and other sessile biota recruited to the surfaces of unstable materials (e.g., fill, rubble) would be less likely to persist following mobilization. Coral and other sessile biota living on solid substrates would be damaged and killed by storm-mobilized material. These factors would set back the recovery process significantly. Estimates of an additional ten years or more (20+ years total) for recovery are reasonable, under these conditions (Endean, 1976; Connell et al., 1997).

Data obtained from the track made by vessel 8 as it was washed across the reef flat (CZA, 1999) also support estimates of a longer recovery time for coral communities when the reef substrate is damaged. The vessel track was clearly visible from the reef crest to the current location of the vessel, as the reef flat under the track was approximately 0.5 to 1 meter deeper than surrounding, undamaged areas. Random samples taken from 0 to 60 meters seaward in the vessel track indicate that this area differed in several respects from all other areas monitored. Unconsolidated rubble covered more than half the substrate (approximately 53 percent). Sand was at least two to four times more abundant (covering approximately 33 percent of the substrate) than in other areas. There was little stable hard bottom (approximately 13 percent total coverage of reef rock, consolidated rubble, and attached coral). The surface of the reef along the track appeared to have been partially crushed, and unstable, shifting substrata appear likely to continue to collect in the track.

Although more than eight years have elapsed since the vessel grounding, only two species of coral were found in vessel track quadrats, at very low coverages. *Pocillopora* had a mean cover of one percent, and a small fraction of this cover (approximately 10 percent) was loose or "drift" coral rather than anchored colonies. *Leptastrea* was found in only one quadrat, and its overall coverage was less than one percent. Non-coral components of the community are further along in the recovery process. Algae was relatively abundant (61 percent total cover), mainly on unconsolidated rubble. Crustose crusts were most common (22 percent cover), followed by mixed algal turfs (21.6 percent cover) and fleshy crustose algae (14.8 percent cover). While this partial recovery is encouraging, it is clear that full recovery of this area will take longer than ten years. Therefore, the Trustee use of a ten-year recovery time is conservative, as it is based on the assumption that the reef flat substrate will not be substantially altered by the response activity.

For inner harbor sites, where coral growth is much less abundant, recovery times were estimated based on other important components of the reef flat community. Recovery times were based on either: (1) recovery estimates for the calcareous macroalga *Halimeda opuntia*, or (2) recovery estimates for the algal turf assemblage. Where *Halimeda* was predominant, or where it occurred in combination with algal turfs, recovery estimates for *Halimeda* were applied. Where algal turfs were predominant and *Halimeda* largely absent, algal turf recovery times were used. In some cases, individual fill areas were divided up, part being assessed using *Halimeda* recovery times, part using algal turf recovery times, depending on their relative abundances in specific areas.

Literature references concerning recovery times for *Halimeda* and general algal turf assemblages were much less abundant than those for coral recovery. However, some information was available, particularly where the recovery or development of these types of biota were observed during the process of coral reef recovery (or lack thereof). Studies on the colonization of artificial substrates were also informative concerning the development time for algal communities. Recovery times for *Halimeda*, an important natural producer of calcareous sediment, were typically slower than those reported for many other types of macroalgae. Recovery times on the order of 2-5 years were estimated from the literature (Stoddart, 1969; Liddell and Ohlhorst, 1992; Cubit and Connor, 1993). To ensure complete recovery of these communities, the Trustees used a five-year recovery time for *Halimeda* in relevant injury quantification and restoration scaling analyses. Recovery times for the algal turf assemblage were estimated to be one year (Endean, 1976; Borowitzka et al., 1978; Walsh, 1983; Liddell and Ohlhorst, 1992; Cubit and Connor, 1993). Although extensive algal turf assemblages will likely be observed very quickly after fill impacts occur (within weeks), a series of successional changes in algal turf species should progress over time, taking approximately one year to arrive at an assemblage that is more or less mature and consistent with baseline assemblages.

A summary of injury and recovery time assumptions used by the Trustees for each habitat type is provided in Exhibit 10. The information supporting these assumptions is provided in preceding sections of this report.

EXHIBIT 10. Summary of Injury and Recovery Times by Habitat Type				
Habitat Type	**Fill Area Mortality**	**Fill Area Buffer Mortality**	**Trestle-related Mortality**	**Recovery Time**
Coral	100%	25%	50%	10 years
Halimeda/Algal Turf	100%	25%	50%	5 years
Algal turf	100%	25%	50%	1 year

5.2.1.2 Calculations of Habitat Loss from USCG Response Actions

For each vessel or vessel cluster, the habitat loss due to the three categories of injury (fill, fill buffer, and trestle) was calculated taking into account the recovery periods for each habitat type. Because the final decision on use of trestles versus fill causeways has not been made, calculations were made for both options for each vessel/vessel cluster, except for vessels 8 and 9. The IAP indicates that the trestle causeways will be used for these vessels.

Exhibit 11 provides a summary of the habitat losses resulting from the USCG response, expressed in square feet-years, for each vessel/vessel cluster. The calculation involves summing the total square feet of habitat loss for each year until full recovery occurs, using a linear recovery function. The habitat losses are discounted over time, using an annual discount rate of 3 percent [12]. The habitat types listed in the exhibit are the same as those used in the habitat maps made for each vessel/vessel cluster (see Section 4.0). *Halimeda*/algal turf, algal turf, and coral are short descriptors for the complex benthic habitats they represent. In assigning recovery curves, the Trustees used the biota that had the longest recovery rate. That is, for the *Halimeda*/algal turf habitat, the 5-year recovery period for *Halimeda* was used. Scenario 1 assumes that fill causeways are used for vessels 1-7 and trestle causeways are used for vessels 8 and 9. Scenario 2 assumes the trestle causeways are used for all vessels, except for vessels 4/5/6 that have an existing fill causeway (which is not included in the injury area calculations). Both scenarios assume fill platforms.

For all of the habitat loss calculations, the Trustees calculated the area (in square feet) of each habitat under the footprint and buffer zone for the platforms and causeways. The habitat mapping results were used to calculate the percent of each habitat associated with each platform and causeway. Where more than one platform was specified in the IAP (such as a 50-ft section around the bow, which was also at a different elevation), both platforms are listed and calculated separately. The Trustees calculated the habitat loss as a result of using fill for both the causeway and platforms separately for each habitat type (e.g., *Halimeda*, algal turf, and coral). Similar, separate calculations are made for the fill footprint and the buffer zones. Finally, the habitat loss from trestle construction is calculated for the causeway and fill for the platforms, again by habitat type and for both the fill footprint and buffer zones.[13]

[12] The 3 percent discount rate is based on NOAA guidelines for natural resource damage assessment (NOAA, 1999).

[13] The Trustees did not calculate coral injury for bow platform and six feet of the main platform for vessel 9 because the substrate in these areas was primarily coral rubble.

EXHIBIT 11. Habitat Loss Resulting from USCG Response Actions (in 1999 square feet-years)			
Vessel Number	**Habitat Type**	**Scenario 1***	**Scenario 2***
1-2	*Halimeda*/Algal Turf	18,219	17,981
	Algal Turf	2,782	583
3	--	--	--
4/5/6	*Halimeda*/Algal Turf	31,217	31,217
	Algal Turf	0	0
7	*Halimeda*/Algal Turf	30,015	12,515
	Algal Turf	7,801	2,442
8	Coral	44,028	44,028
9	Coral	38,765	38,765
Totals	*Halimeda*/Algal Turf	79,451	61,713
	Algal Turf	10,583	3,025
	Coral	82,793	82,793
* Scenario 1 assumes that fill causeways are used for vessels 1-7 and trestle causeways are used for vessels 8 and 9. Scenario 2 assumes the trestle causeways are used for all vessels, except for vessels 4/5/6 which have an existing fill causeway. Both scenarios assume fill platforms.			

6.0 Emergency Restoration Alternatives Including Proposed Action

Under the OPA, the Trustees share a common responsibility to provide for expeditious restoration, replacement, rehabilitation or acquisition of equivalent resources or services when injuries to natural resources occur, including those that result from response actions (15 CFR 990.51). The Trustees' objective in developing this ERP/EA is to determine the preferred emergency restoration for injuries caused by the USCG response. Five Restoration alternatives are considered below, including the "no-action" alternative.

The goal of restoration under the Oil Pollution Act of 1990 (OPA) is to make the environment and public whole for injuries to natural resources and services resulting from the planned response actions for Pago Pago Harbor. To plan restoration for injuries resulting from the planned response actions, the Trustees consider possible restoration actions for each injury and determine whether restoration can and should be implemented. The Trustees then consider the type and scale of restoration that can best compensate for lost natural resources and/or services during the recovery period.

Restoration alternatives must be scaled to ensure that their size appropriately reflects the magnitude of injuries. Where feasible, the Trustees employ a resource-to-resource scaling methodology. Under this approach, the Trustees determine the scale of restoration actions that will provide natural resources and/or services of the same type and quality and of comparable value to those lost. Here, equivalency is obtained between the resources and/or services lost and those to be provided through restoration.

If a reasonable range of alternatives providing natural resources and/or services of the same type and quality and comparable value to those lost cannot be identified, other restoration actions may be considered. These other restoration actions must, in the judgment of the Trustees, provide services of comparable type and quality as those lost. When restoration provides resources or services not of comparable value as those injured, the Trustees must determine the appropriate trade-off between the injured resources and those provided by restoration.

The scaling calculations set forth in Section 7.0 are based on straightforward methods combined with available data and the best professional judgment of the Trustees. More precise scaling calculations often are not possible due both to incomplete knowledge of the relevant physical and biological processes, and uncertainties about important project-specific scaling parameters. Out of necessity, the calculations use simplifying assumptions while seeking to fairly estimate the magnitude of restoration required as compensation for injuries. Where necessary data are limited or unavailable, creating uncertainty in the true value for required inputs to the scaling calculations, the Trustees use conservative assumptions that will help ensure that the amount of restoration is sufficient.

The Trustees believe that more complex scaling calculations would be difficult and expensive to undertake and would not significantly improve the accuracy of the scaling results in this case. Specific scaling assumptions and calculations are described in Section 7.0.

Once a reasonable range of restoration alternatives is developed, the OPA regulations (CFR Section 990.54) require the Trustees to identify preferred restoration alternatives based on certain criteria. The following criteria, presented in the order given in the regulations, were used:

- The cost to carry out the alternative;
- The extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
- The likelihood of success of each alternative;
- The extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;
- The extent to which each alternative benefits more than one natural resource and/or service; and
- The effect of each alternative on public health and safety.

The regulations leave it up to the Trustees to consider how to prioritize the criteria, and allow additional criteria to be used. The key criterion for the Trustees is the second in the list, since it is the criterion that most clearly indicates whether the goal of making the public whole is met. Based on an evaluation of a number of factors, including the criteria listed above, the Trustees selected preferred restoration alternatives for restoration of injured natural resources and/or services. Information supporting the Trustees' selection of restoration alternatives is provided throughout this ERP/EA.

6.1. Alternative 1: Status Quo (No Action)

NEPA requires evaluation of the no-action alternative, which is also an option that can be selected under OPA. Under this alternative, the Trustees would rely on natural recovery and take no direct action to restore injured natural resources or compensate for lost natural resource services pending environmental recovery. While natural recovery would occur over varying time scales for the various injured resources, the interim losses suffered would not be compensated for under the no-action alternative. Selecting the “no action” alternative would leave the injuries described in Section 5.0 unaddressed, leading to continuing decline of the reef flat. The no-action alternative also would involve leaving vessel debris caused by the USCG response in place indefinitely. The amount of material that would be left is not quantified in the IAP, but could be a substantial source of continuing injuries.

The no-action alternative would do nothing to address the resources injured by the response action as discussed in Section 5.0. Further, a no-action alternative that leaves debris caused by the USCG response on the reefs may result in greater injuries as hull fragments: (1) crush, smother, and shade reef organisms, (2) increase micro-nutrient loads on the reef flat as the hulls deteriorate in seawater, (3) travel down to the fore reef slope where the cannery effluent pipeline is located, and (4) impair visibility, possibly resulting in a loss of the vista and recreational opportunities of the reef.

As the vessel remains deteriorate over time, hull material will fragment and likely be transported across the reef flat by storm tides and waves. Fragments may cause crushing, smothering, and/or shading of reef organisms, as discussed in Section 5.0. Recovery of areas of reef flat near vessel remains may also be slowed or arrested by nutrient loads contributed by the deterioration of metal in seawater. Iron has been shown to be a limiting nutrient for growth of phytoplankton and algae in oceanic waters (Martin and Fitzwater 1988). Data from the wreckage of a similar vessel on nearby Rose Atoll suggest that leaving sections of the vessel in place following spill response may have slowed reef recovery. Iron from the vessel likely contributed to the fertilization of foliose algae occupying areas of the reef previously covered by corals, coralline algae and other reef-building organisms, thereby limiting recolonization (USFWS, 1997).

The vessel remains may also attract curious onlookers, particularly children swimming and playing in the area. Walking across the reef flat can cause significant ecological harm; algal turfs and corals are damaged and may die back as a result of human trampling (Liddle and Kay, 1987; Maragos, 1992; Cubit and Connor, 1993; Brosnan and Crumrine, 1994; Keough and Quinn, 1998). Physical damage from trampling will also slow recruitment and recovery. Although beyond the scope of this analysis, vessel remains may pose a significant health risk to children and other participants in recreational activities.

Finally, the movement of vessel remains/debris may pose a risk to the cannery outfall located along the reef slope. The plastic pipeline, jointly operated by Starkist Samoa, Inc., and VCS Samoa Packing Company, extends approximately 1.5 miles from the cannery locations on the north shore of the inner harbor to a depth of approximately 176 feet, where it discharges treated effluent into the outer harbor off the coast of Anasosopo Point. Near the village of Leloaloa, the pipeline runs close to the top of the reef slope, at a depth ranging between 48 and 60 feet. In the outer harbor, the pipeline lies at the base of the reef slope, at a depth of about 176 feet. The seven inner harbor vessels are between 200 and 500 feet from the pipeline. Most, if not all, of the intervening distance is along the reef slope, which is relatively steep (approximately 8° to 17° decline). While it is difficult to assess the probability that portions of the vessel remains will generate sufficient force to break or cut into the pipeline, the environmental consequences of a pipeline rupture and subsequent release of effluent into the relatively shallow inner harbor are potentially serious. Contaminants present in the effluent may include suspended solids, phosphorous, nitrogen, ammonia and heavy metals.

Given the discussion above, the Trustees have rejected the no-action alternative from further review.

6.2 Alternative 2: Direct Restoration of Injured Areas

This alternative involves three components:

1) Careful and complete removal of all fill materials remaining from the solid platform and causeway areas following the USCG response: Removing loose fill material will prevent injuries from crushing and smothering as the leftover material is mobilized by water currents and hinder successful coral recruitment. Removal of every piece of fill material, however, is not feasible or cost-effective and the Trustees expect that this component would be integrated with the USCG response actions, to the extent practicable.

2) Fill troughs and gouges in the reef structure caused by the USCG response with stable materials: Natural recovery in areas where the reef structure ids damaged (e.g. platform and causeway construction with solid fill or trestles) would be expected to take hundreds of years (if at all), during which period no significant recovery would be expected to occur. However, the use of concrete to mimic the natural structure, and thus significantly accelerate recovery, has been demonstrated to be effective at a number of sites in southern Florida and the Florida Keys. Using concrete to provide solid, stable substrate for coral recovery is also supported by the scientific literature (Hudson and Diaz, 1988; Maragos, 1992; Pearson, 1981) as well as the best professional judgement of trustee experts.

3) Transplant coral from the solid fill platform areas of vessels 8 and 9. Given a stable substrate, transplanting coral colonies is a viable, proven method of restoring coral habitat (Harriot and Fisk, 1988; NOAA, 1995(a)). Thus, prior to the USCG response action, the Trustees propose to remove coral from the platform areas of vessels 8 and 9 and place them in a nursery site. Following the USCG response action, the corals will be returned from the nursery site to the platform area.

Based on NOAA's experience and expertise with coral transplanting, it is expected that transplanting coral will reduce mortality in the platform area of vessels 8 and 9 from 100 percent to 50 percent. Based on the coral densities in these platform areas (see Section 5.0; Figures 3 and 4), about 500 coral heads will be transported. Exhibit 12 presents the habitat loss calculations for coral under both a no transplant and transplant scenario.

The Trustees considered efforts to transplant algal turf and *Halimeda* expected to be injured by the USCG response actions, but have determined that this is not feasible based on the short recovery times for these habitat communities and biological uncertainties regarding survival rates.

EXHIBIT 12. Habitat Loss Resulting from USCG Response Actions Without and With Coral Transplanting (in 1999 square feet-years)		
Vessel Number	Without Coral Transplanting[1]	With Coral Transplanting[2]
8	44,028	30,783
9	38,765	28,040
Totals	82,793	58,823

[1] from Exhibit 11
[2] based on 50 percent mortality in platform fill area

6.3 Alternative 3: Complete Vessel Removal With Reef Stabilization

The IAP calls for partial removal of the vessels to access and remove oil and toxic materials that pose environmental threats. The remaining parts of the vessels will be left in place. Exhibit 11 estimates that waiting for natural recovery of the reef flat after the planned response actions will result, solely for those injuries selected for quantification in Section 5.1.1, in:

> Scenario 1 (fill causeways for vessels 1-7; trestle causeways for vessels 8 and 9), a total loss of 79,451 square feet-years for *Halimeda*/algal turf; 10,583 square feet-years for algal turf, and 82,793 square feet-years for coral;
>
> Scenario 2, (trestle causeways for all vessels except vessels 4/5/6), a total loss of 67,713 square feet-years for *Halimeda*/algal turf, 3,025 square feet-years for algal turf, and 82,793 square feet-years for coral.

The Trustees evaluated complete vessel removal as a restoration alternative for the resources injured during the USCG response. Complete vessel removal will involve the same kinds of action to be conducted during the response. The same methods and equipment will be used for removal and disposal of vessels. This alternative will be cost-effective and presents a low risk of collateral injury if conducted at the same time as the response. Injuries caused by removal of the vessels will result from construction of causeways and platforms to access the vessels, which will already be incurred as a result of response activities. Complete vessel removal will provide the benefit of a coordinated plan of action, where emergency response and restoration activities can be performed using the same infrastructure, process and permitting.

Removing the remaining possibly unstable hulls, without considering any additional debris that may be caused by the planned response action, creates the benefits, shown in Exhibit 13, of 127,844 square feet-years for *Halimeda/*algal turf, 10,011 square feet-years for algal turf, and 57,260 square feet-years for coral. These benefits associated with complete hull removal are intended to offset the injuries caused by the planned response actions.

Once the vessels have been removed, it may be necessary to stabilize the substrate under the footprint of the vessels to speed recovery of the habitat, particularly at vessels 8 and 9, which contain more extensive coral communities. During the field surveys conducted in June/July 1999, the Trustees observed that there was a pile of coral rubble in front of both vessels, indicating that they have caused some damage to the underlying reef platform. Evaluation of the condition of the reef communities in the track from vessel 8 (see Section 5.0) suggests that complete recovery will take longer than ten years. Several reports have estimated that reef recovery under such conditions will be very slow or will not occur at all (Curtis, 1985; Smith, 1985; Hudson and Diaz, 1988; NOAA, 1995(a), Gittings et al., 1994; Harold Hudson, pers. comm. 1999[7]).

As a result of these concerns, the Trustees have included rubble removal and reef substrate stabilization as part of the vessel removal alternative. This work involves manual rubble removal by divers. Reef stabilization will be accomplished using prefabricated concrete modules, secured together and to the substrate. The design and placement methods are based on Trustee experience with previous restoration projects for coral reef vessel groundings (e.g., M/V Wellwood, M/V Miss Beholden (NOAA, 1995(a)) and M/V Alec Owen Maitland (NOAA, 1995(b)).

This emergency restoration alternative will promote recovery of approximately 9,200 square feet of reef flat currently beneath the grounded vessels. However, there is some potential for additional natural resource injury resulting from complete vessel removal. If the vessels are firmly wedged into the reef platform, complete removal of the hulls might cause additional injury to the solid reef platform. If this is the case, the Trustees will use an alternate approach that involves cutting the hull down level with the substrate. Under the complete hull removal alternatives, the Trustees will make this determination in the field for each vessel based on the specific circumstances encountered.

Overall, the Trustees consider the additional environmental risk of complete vessel removal to be minimal since the USCG response will include extensive work on the vessels. The time spent completing vessel removal will add to the time that rock fill material and trestles will be in place on the reef flat. The longer the fill material is in place, the greater the risk of erosion and sediment loss during a storm. For the trestles, although a longer duration of shading causes greater injury to corals, the initial response action (lasting at least 2-4 weeks) likely will cause the majority of coral injury. Major coral injuries have resulted from shading episodes of as little as 2-3 weeks (Curtis, 1985; Rogers, 1979; Gittings et al., 1994). Finally, larger volumes of scrap steel will have to be handled, transported, and processed. Overall, the Trustees believe that the incremental injury caused by complete vessel removal will be small relative to that caused during the initial response action and the benefits provided by the restored reef, including the avoidance of future injuries associated with permanently leaving vessel pieces on the reef flat.

6.4 Alternative 4: Complete Vessel Removal Without Reef Stabilization

This restoration alternative involves complete vessel removal, as described in the alternative identified in Section 6.3, without performing stabilization of the reef underlying vessels 8 and 9. The restoration benefit of this alternative is that vessel removal will allow the area under the vessels to recovery naturally. However, to the extent that the reef substrate has been damaged by the presence of the grounded vessels since 1991, recovery may be slowed or prohibited (Curtis, 1985; Smith, 1985; Hudson and Diaz, 1988; NOAA, 1995(a); Gittings et al., 1994; Harold Hudson, pers. comm. 1999[7]).

During field surveys conducted in June/July 1999, the Trustees observed a pile of coral rubble in front of vessels 8 and 9, indicating that they have caused some damage to the underlying reef platform. If the reef structure is substantially changed and/or fill material and rubble left on the reef flat, recovery could take twenty years or longer due to depressions in or de-stabilization of the consolidated reef flat framework and/or the storm-mobilization of waste fill and construction-generated rubble (Endean, 1976; Connell, 1997). Depressions in the reef framework would collect sediment and rubble and coral and other sessile biota recruited to the surfaces of unstable materials (e.g., fill, and rubble) would be less likely to persist following mobilization. Coral and other sessile biota living on solid substrates would be damaged and killed by storm-mobilized material. These factors would set back the recovery process significantly.

Because the reef substrate underlying vessels 8 and 9 is likely to be injured, delaying and/or preventing recovery of reef communities injured by the USCG response, the Trustees have rejected this alternative from further review.

6.5 Alternative 5: Offshore Artificial Reef Augmentation

Taema Bank, located at the mouth of Pago Pago Harbor, is a relatively flat or low undulating surface at depths between 40 and 50 feet (USACE, 1980). Several derelict vessels were sunk in this area several years ago to provide productive habitat for a variety of biota, including commercially valuable fish (John Naughton, pers. comm., 1999[14]). Overall, more than 120 species of fish have been recorded in this area (USACE, 1980). Coral was also present on Taema Bank historically, although the area experienced a heavy infestation of the crown-of-thorns starfish (*Acanthaster planci*) in 1977 and 1978.

Under this emergency restoration alternative, the Trustees would expand this artificial reef with the scrap and vessel debris from the grounded vessels. By disposing of vessel debris at this offshore site, it is possible to augment the existing artificial reef. Resulting increases in productivity could be credited against response-related injuries. The Trustees, however, are unable to quantify the potential benefits (if any) of this restoration alternative with available data. No biota surveys of the disposal site have been taken since the vessels were sunk, leaving the Trustees without enough information to estimate the specific types of biota that would benefit or the increase in productivity associated with this potential restoration action. In addition, salvage operations will produce vessel pieces and debris, which will be more susceptible to storm or current-induced movement than intact vessel structures, potentially limiting their habitat value. Finally, the vessel remains and debris would need to meet applicable contaminant standards for ocean disposal. Existing data are insufficient to evaluate how much of the vessel remains and

[14] John Naughton is the NOAA Regional Response Team Representative for the Western Pacific Region.

debris might be affected by this limitation. For these reasons, the Trustees have rejected this restoration alternative from further review.

6.6 Alternative 6: Sediment Controls in the Pago Pago Watershed

Sedimentation is a water quality problem in Pago Pago Harbor. As stated in Craig et al. (1995);

> after every heavy rainfall, chocolate-colored plumes of sediment are flushed out of the streams and onto the coral reefs. Poor urban and agricultural land-use practices are presumably the sources of this sediment. There is ample evidence in the literature to indicate that such high levels of sedimentation adversely impact coral growth, survival and recruitment.

Injuries to coral, *Halimeda*/algal turf, and algal turf communities potentially could be restored through the implementation of sediment control measures, including erosion controls, improved waste management practices, and similar efforts to limit the introduction of sediment into the reef flat environment. Although sediment control would undoubtedly be beneficial, existing data are insufficient to determine the scale of sediment control projects needed to offset the injuries caused by the USCG response actions. Specifically, the area of coral, *Halimeda*/algal turf, algal turf, or other biota restored per unit of sediment reduction cannot be reliably estimated given the complex interactions between the timing and amount of sediment contributed from other sources, local circulation patterns, and the presence of other environmental and anthropogenic stressors limiting biota growth and survival. For this reason, the Trustees have rejected this restoration alternative from further review.

6.7 Alternative 7: Validation the Aua Transect

The Aua Transect is an underwater survey line that has been monitored on several occasions since 1917 (Green et al., 1997). It is the oldest quantitative coral transect in the Pacific, and second oldest in the world, making it of great international scientific value. The Transect has also been used to describe the changed that have occurred to the coral reefs in Pago Pago Harbor during this past century.

The Aua Transect is very close to and just north (or, more importantly, down current) of vessels 8 and 9. For this survey line to maintain its great scientific value, any degradation resulting from the USCG response actions must be quantified. Thus, the Trustees must determine the extent of change by forces other than natural causes to validate the transect for future monitoring efforts. If scientists know the extent of this external interference with the transect, they may still gather valuable information.

The Trustee propose two quantitative surveys (one before and one following the USCG response) of the Aua Transects. These efforts will reestablish baseline conditions for future survey efforts and maintain the scientific value and integrity of the Aua Transect.

6.8 Selection of the Preferred Emergency Restoration Alternative

The Trustees' goal for this emergency restoration action is to conduct feasible restoration using the best available techniques to accelerate recovery of the resources injured by the USCG response, and to prevent additional injury from debris caused by the USCG response. Based on the selection criteria presented in Section 6.0 and the evaluation of restoration alternatives provided above, the Trustees have selected a three-part restoration approach. The three parts are: (1) direct restoration of injured areas, (2) complete vessel removal with reef stabilization, and (3) validation of the Aua Transect.

7.0 Scaling Benefits from Vessel Removal

Exhibit 13 shows the calculated habitat credit resulting from vessel removal for each vessel/vessel cluster, by habitat. The area of reef underneath each vessel was estimated by multiplying vessel length, width, a 0.33 correction factor to account for the area of vessel bottom actually in contact with the reef platform and a factor correcting for the percent of the vessel overhanging the reef edge (Exhibit 8). The recovery rates for each habitat were the same used in the habitat loss analysis. A discount rate of 3 percent (NOAA, 1999) was used to account for the timing of restoration benefit. The credit for the restoration actions are calculated for a period of 50 years into the future. Although the restored reef flat may continue generating benefits beyond 50 years, the Trustees have not estimated or incorporated reductions in service flows associated with hurricanes, *Acanthaster planci* invasions, or man-made perturbations, which could reduce the benefits during this time. In fact, Samoan reefs have suffered many major impacts in the last two decades, including three severe hurricanes (Tusi, Ofa and Val in 1987, 1990 and 1991, respectively), several major *Acanthaster planci* outbreaks, and a mass coral bleaching event.

Exhibit 13. Habitat Credit Resulting from Vessel Removal (in 1999 square feet-years)

Vessel Number	Habitat Type	Credit for Vessel Removal
1-2	*Halimeda*/Algal Turf	46,203
	Algal Turf	not calculated
3	*Halimeda*/Algal Turf	not calculated
	Algal Turf	not calculated
4/5/6	*Halimeda*/Algal Turf	67,068
	Algal Turf	not calculated
7	*Halimeda*/Algal Turf	14,573
	Algal Turf	10,011
8	Coral	22,579
9	Coral	34,681
Totals	*Halimeda*/Algal Turf	127,844
	Algal Turf	10,011
	Coral	57,260

The Trustees have not calculated a credit for vessel 3[15], since it is broken up and there is no information available on the area covered by the vessel pieces. In addition, no credit is calculated for algal turf habitat for vessels 1 through 6 because the combined *Halimeda*/algal turf habitat dominates the platform areas at these vessels. Vessel 7 is the

[15] The Trustees have not attempted to quantify the benefit of removing the debris associated with vessel 3. However, as discussed in other sections of this report, debris left on the reef flat will cause continuing natural resource injuries when it is mobilized by water currents. For this reason, the Trustees are pursuing removal of vessel 3 debris to offset: (1) injuries to coral in excess of the restoration benefit (25,553 square-feet-years without coral transplant and 1,563 square-feet-years with coral transplant (see Exhibit 14)) and (2) a portion of other injuries not quantified in this analyses (e.g. sedimentation impacts).

only site where algal turf is the dominant benthic habitat type in the area covered by the platform. Coral is the dominant habitat type at vessels 8 and 9. Details on the scaling parameters and calculations are provided in Appendix A.

Exhibit 14 shows the net difference for each vessel/vessel cluster, by habitat type, and by USCG removal action scenario. The "net difference" shown in Exhibit 14 is the relationship between the losses estimated by Scenarios 1 and 2 and the benefits, or credits, expected from the selected restoration alternative. A negative number in the "net difference" column indicates that the losses are expected to be greater than the benefits expected from the selected restoration alternative. Similarly, a positive number if the "net difference" column indicates that the losses are expected to be less than the benefits expected from the selected restoration alternative. Consistent with Exhibit 11, Scenario 1 assumes that fill causeways are used for vessels 1-7 and trestle causeways are used for vessels 8 and 9. Scenario 2 assumes the trestle causeways are used for all vessels, except for vessels 4/5/6 which have an existing fill causeway. Both scenarios assume fill platforms because the USCG maintains that solid work platforms must be provided for operation of heavy equipment.

EXHIBIT 14. Habitat Loss from USCG Response and Gain from Complete Vessel Removal (in 1999 square feet-years)

Vessel Number	Habitat Type	Scenario 1[1] Loss	Scenario 2[1] Loss	Vessel Removal Credit	Net Difference (Credit-Loss) Scen.1	Scen.2
1-2	*Halimeda*/Algal Turf	18,219	17,981	46,203	27,984	28,222
	Algal Turf	2,782	583	0	-2,782	-583
3	--	--	--	--	--	--
4/5/6	*Halimeda*/Algal Turf	31,217	31,217	67,068	35,851	35,851
	Algal Turf	0	0	0	0	0
7	*Halimeda*/Algal Turf	30,015	12,515	14,573	-15,442	2,058
		7,801	2,442	10,011	2,210	7,569
8	Coral/ no transplant	44,028	44,028	22,579	-21,449	-21,449
	Coral/ with transplant	30,783	30,783	22,579	-8,204	-8,204
9	Coral/no transplant	38,765	38,765	34,681	-4,084	-4,084
	Coral/ with transplant	28,040	28,040	34,681	6,641	6,641
Totals	*Halimeda*/Algal Turf	79,451	61,713	127,844	48,393	66,131
	Algal Turf	10,583	3,025	10,011	-572	6,986
	Coral/ no transplant	82,793	82,793	52,260	-25,533	-25,533
	Coral/ with transplant	58,823	58,823	57,260	-1,563	-1,563

[1] Scenario 1 assumes that fill causeways are used for vessels 1-7 and trestle causeways are used for vessels 8 and 9. Scenario 2 assumes the trestle causeways are used for all vessels, except for vessels 4/5/6 which have an existing fill causeway. Both scenarios assume fill platforms.

8.0 Project Costs for the Preferred Emergency Restoration Alternative

As stated in Section 6.8, the Trustees' preferred emergency restoration alternative includes: (1) direct restoration of injured areas, (2) complete vessel removal with reef stabilization, and (3) validation of the Aua Transect. Costs to implement these actions, as well as long-term monitoring costs to evaluate the effectiveness of restoration, are detailed below.

8.1 Direct Restoration of Injured Areas Costs

As described in Section 6.2, this initiative has three components: (1) careful and complete removal of all fill materials remaining from the solid platform and causeway areas following the USCG response; (2) filling troughs and gouges in the reef structure caused by the USCG response with stable materials, and (3) transplanting of coral from the solid fill platform areas of vessels 8 and 9 to suitable nursery areas prior to the USCG response and returning these transplants to the injured area following the response action. The Trustees will attempt to coordinate items 1 and 2, to the maximum extent practicable, with the USCG response action and, therefore, do not anticipate that funds will be required for these items beyond what is projected in the Trustee oversight costs identified below. For item 3, transplanting of corals, the trustees estimate that the costs will be $65,020 (Exhibit 15).

Exhibit 15. Costs for Direct Restoration of Injured Areas			
		Rate	**Amount**
Labor (hours)	600		$ 39,000
Travel Airfare (trips)	6	$ 2,700	$ 16,200
Per Diem (days)	60	$ 126	$ 7,560
Rental Car (days)	20	$ 38	$ 760
Other Direct Costs			$ 1,500
Total			$ 65,020

8.2 Vessel Removal Costs

The Trustees solicited a workplan from the USCG response contractor (PENCO) to obtain an estimate of the cost of implementing the preferred emergency restoration alternative. The estimated cost per is $3,480,795 (Appendix B). Additional costs of disposing of the scrap and/or vessel debris are estimated at $500,000. These are "fair-weather costs that allow no provision for down-time due to foul weather. During weather delays, the contractor will charge about two-thirds of the daily rate for operational days. These costs are also based on using the USCG-deployed equipment and causeways, as constructed by the USCG contractor.

8.3 Reef Stabilization Costs

The cost information provided in Exhibit 16 is based on recent personal communications (July 1999) with experts experienced in coral reef restoration following vessel groundings; specifically, Harold Hudson with the Florida Keys National Marine Sanctuary[7] and Ron Coddington, Team Land Development, Inc.[16]

EXHIBIT 16. Cost for Reef Stabilization	
Cost Element	**Total Cost**
Rubble Removal	
Diver costs (654 hours @ $40 per hour)	$26,160
Equipment costs	$30,000
Construction of Reef Module "Blocks"	
Design, materials, labor, construction (41 modules @ $4,000 per module)	$164,000
Kevlar cable and attachment hardware	$5,000
Shipping	$50,000
Technical Design and Oversight Team	
Personnel (3 workers, 4 days prep, 20 days on-site @ $500 per day per worker)	$36,000
Travel Expenses ($9,000 airfare, $126 per diem per day)	$17,000
Module Placement Costs	$280,000
TOTAL	$608,160

Following removal of vessels 8 and 9, a diver survey will be needed to determine and map the spatial extent of substrate damage in the footprint of the groundings. The degree of fracturing of the consolidated reef framework and the amount of rubble generated will need to be determined. Following assessment activities, estimates concerning the amount of rubble to be removed and the exact specifications for concrete reef modules can be made.

The estimated costs associated with substrate stabilization are summarized in Exhibit 16. The Trustees estimate that it will take a diver approximately 3 hours to clear 12 square feet of rubble. Based on vessel footprints of 1,031 square feet and 1,584 square feet, 654 diver-hours will be needed. Using estimated (mainland US) diver rates of approximately $40/hour, dive labor costs would total $26,160 for rubble removal. Equipment costs are expected to be minor, assuming that local and USCG contractor equipment already on-scene will be available to support this task. Estimated equipment costs are $30,000.

To approximate reef module design and the cost of reef stabilization, the Trustees assume that the entire vessel footprint estimated in the scaling calculations will need to be stabilized (vessels 8 and 9 only). This is a worst-case estimate, since the entire area of vessel footprints may not need stabilization. The Trustees estimate that the vertical depressions formed by the vessels will be 0.5 m deep on average, with some areas as deep as 1-2 m. The basic design for reef modules will 3 x 2 x 1 m (length x width x height) “blocks” constructed of pre-cast concrete with steel reinforcement. A veneer of

[16] Ron Coddington, President, Team Land Development, Inc., Pompano Beach, Florida, has worked on reef restoration projects with NOAA, including engineering and constructing prefabricated concrete reef modules and planning and implementing the placement of these materials on-site.

roughened limestone rock may be used on the upper surfaces of the blocks to enhance the establishment of sessile biota, including corals. The weight of each block will be roughly 25,000 lbs. Modifications to block dimensions can be made, although single blocks will each weigh at least 6000-8000 lbs. to reduce mobilization during hurricanes.

Where possible, blocks should be anchored to the reef framework. Blocks will be anchored using number 316L grade stainless steel all-thread rods with epoxy encapsulation, or comparable materials. Blocks would also be attached together, using the rods described above, or using Kevlar cables, clips, and kremps. Kevlar cable may be preferred due to easier manipulation during block placement. Blocks should be placed so that their upper surface is flush with the grade of the surrounding reef flat or crest, and so that edges of the blocks are aligned in an overlapping fashion. This will also reduce mobilization during storms. Reef blocks tied together in groups of at least eight (200,000 lbs. per group), placed flush with the reef grade and overlapped, should be relatively stable during severe storms, anchored by their own weight even if they cannot be secured to the reef framework.

Based on vessel footprints of 1,031 square feet (vessel 8) and 1,584 square feet (vessel 9), approximately 16 blocks will be needed for vessel 8, and 25 for vessel 9 (41 total). Approximately 5,000 feet of cable would be needed to secure the blocks together. Based on U.S. costs for design, materials, and labor, construction of each reef block should be approximately $4,000; 41 modules would cost $164,000. The cost of the Kevlar cable and associated hardware would be approximately $5,000. The total cost for materials and block construction (but not placement and securing of the modules) would be $169,000.

The use of an expert 3-person technical design and placement team (reef designer, coastal engineer, and construction diver) will be required for this project. The design and placement team will travel on-site and oversee construction of the modules and their placement by the USCG, using local materials, labor, and equipment. Costs for this team, including travel expenses for an estimated 20 days and personnel rates of $500/person/day, total approximately $53,000. Based on these figures, total costs for rubble removal, module construction, and an expert team to oversee the project are estimated to be $278,252.

For budgeting purposes, the reef experts suggest that placement costs are often of the same order of magnitude as module construction/preparation costs. Based on this rough rule of thumb, the Trustees estimate that an additional $280,000 may be required to complete placement. Thus, total reef stabilization costs are estimated at $608,160. To the extent that only partial stabilization of the restored reef is necessary, costs for this project component may be substantially reduced.

8.4 Validation of the Aua Transect Costs

Validation of the Aua Transect requires two surveys, one prior to and one following the USCG response action. A chief scientist and two marine biologists will be required for each survey. Costs of these efforts are $69,840 (Exhibit 17).

Exhibit 17. Costs to Validate the Aua Transect

		Rate	Amount
Labor (hours)	680	$ 65	$ 44,200
Airfare (trips)	6	$ 2,700	$ 16,200
Per Diem (days)	60	$ 126	$ 7,560
Rental Car (days)	10	$ 38	$ 380
Misc. Supplies			$ 1,500
Total			$ 69,840

8.5 Trustee Oversight Costs

The Trustees will require one person on-site at all times during the restoration to coordinate with the USCG response effort and direct the contractor work needed to implement the emergency restoration. It is assumed that the coordinated response and restoration action will last for 160 days. In addition, the trustees plan to obtain expert assistance in marine salvage from the US Navy, or from an appropriate contractor. The trustee salvage experts will personally inspect the site and provide recommendations and continuing support to ensure the most effective, safe, and efficient conduct of complete vessel removal. The entire operation will be supported by NOAA's Damage Assessment Center in Silver Spring, MD. This support will involve oversight and direction of field operations, coordination with appropriate scientific expertise when needed for operation decisions, and development of requisite contracts and interagency agreements, as well as coordination with American Samoa and DOI. NOAA will also develop and maintain an administrative record of the emergency record of the emergency restoration action, including documentation of all significant operational decisions and records of all costs incurred to implement the actions.

Trustee costs to oversee the emergency restoration action of complete vessel removal with reef stabilization are detailed in Exhibit 18. Total estimated costs for the on-scene restoration coordinator, marine salvage support, and general trustee oversight for both the complete vessel removal and reef stabilization actions total $325,035.

Exhibit 18. Trustee Oversight Costs				
On-Scene Restoration Coordinator		**Rate**	**Amount**	
Labor (hours)	1232	$ 60	$ 73,920	
Travel Airfare (trips)	3	$ 2,700	$ 8,100	
Per Diem (days)	158	$ 126	$ 19,908	
Rental Car (days)	149	$ 38	$ 5,662	
Other Direct Costs:			$ 2,200	
Total				**$109,790**
Marine Salvage Support				
Labor (hours)	420	$ 97	$ 40,740	
Travel Airfare (trips)	2	$ 2,700	$ 5,400	
Per Diem (days)	20	$ 126	$ 2,520	
Rental Car (days)	7	$ 38	$ 266	
Other Direct Costs			$ 500	
Total				**$ 49,426**
NOAA Oversight[3]				
Labor (hours)				
Project Management	636		$ 62,703	
Scientific Support	140		$ 21,420	
Administration and Contract Management	580		$ 44,080	
Travel Airfare (trips)	6	$ 2,700	$ 16,200	
Per Diem (days)	60	$ 126	$ 7,560	
Rental Car (days)	42	$ 38	$ 1,596	
Other Direct Costs			$ 4,000	
Total				**$157,559**
DOI Oversight[3]				
Project Manager (hours)	80		$ 5,600	**$ 5,600**
American Samoa Oversight[3]				
Project Manager (hours)	120		$ 6,000	**$ 6,000**
TOTAL TRUSTEE OVERSIGHT COSTS				**$328,375**

[1]The on-scene restoration coordinator will monitor and direct the restoration effort.
[2]The marine salvage support will work with the on-scene restoration coordinator and the project manager to identify ways to improve efficiency and effectiveness of salvage operations.
[3] Includes oversight for complete vessel removal with reef stabilization.

8.6 Long-Term Monitoring Costs

Long-term monitoring of the emergency restoration will allow the Trustees to evaluate the projects and determine if mid-course corrections are needed. The monitoring program developed by the Trustees involves a principal investigator and assistant biologist each making four trips (years 1, 3, 5, and 10) following completion of the response and restoration efforts. Total costs for this monitoring are detailed in Exhibit 19.

Exhibit 19. Costs to Monitor the Preferred Emergency Restoration Strategy

		Rate	Amount
Labor (hours)	880		$ 52,800
Airfare (trips)	8	$ 2,700	$ 21,600
Per Diem (days)	80	$ 126	$ 10,080
Rental Car (Days)	80	$ 38	$ 3,040
Total			$ 87,520

8.7 Summary of Total Costs to Implement Preferred Emergency Restoration Alternative

A summary table of the costs described above to implement the preferred emergency restoration alternative is provided below (Exhibit 20). A 25 percent contingency cost was added based on the inherent uncertainties in knowing the extent of salvaging that will be required as emergency restoration following the USCG response action. The total cost is $6,424,638.

Exhibit 20. Summary of Costs to Implement the Preferred Emergency Restoration Strategy

Direct Restoration of Injured Areas	$ 65,020
Vessel Removal Costs	$ 3,480,795
Scrap/ Debris Disposal	$ 500,000
Substrate Stabilization	$ 608,160
Validating the Aua Transect	$ 69,840
Long-Term Monitoring	$ 87,520
Trustee Oversight	$ 328,375
Subtotal	$ 5,139,710
Contingency (25%)	$ 1,284,928
TOTAL	$ 6,424,638

9.0 Management of the Emergency Restoration

NOAA will serve as the Lead Administrative Trustee in conducting the Pago Pago emergency restoration project. Co-trustees American Samoa and DOI will share in this responsibility by participating in making determinations and decisions relevant to the progress and direction of the emergency restoration, and by providing assistance requested by NOAA to the extent allowed by funding, staffing, and other constraints.

As Lead Administrative Trustee, NOAA will perform the following functions:

- Coordination with officials in DOI and American Samoa on progress, issues, and joint decisions related to the damage assessment and emergency restoration;
- Coordination of the emergency restoration action with USCG response operations;
- Coordination with the National Pollution Funds Center on developments that would substantially affect the cost of the emergency restoration;
- Direction and management of vessel removal, substrate stabilization, and Aua Transect monitoring activities;
- Development and maintenance of any contracts or memoranda of agreement needed to implement the emergency restoration;
- Development of an administrative record to document all significant developments, determinations and decisions made by the Trustees during the implementation of the emergency restoration;
- Documentation of all costs incurred to implement the emergency restoration.

The Trustees are seeking that the National Pollution Funds Center (NPFC) authorize expenditures from the Oil Spill Liability Trust Fund (OSLTF) sufficient to implement the emergency restoration actions described in this document. The Chief of NOAA's Damage Assessment Center will be the accountable official within NOAA for implementing the emergency restoration. The Chief of the Damage Assessment Center will, therefore, be responsible for using the funding authorization to accomplish complete vessel removal with substrate stabilization and Aua Transect validation as proposed in this plan. All expenditures will be made in a manner consistent with the financial controls and administrative procedures established by NOAA.

The Trustees, through NOAA, will document in the administrative record any developments or decisions that substantially affect the level of funding necessary to implement the emergency restoration. Any use of the contingency funds portion of the emergency restoration budget will be fully documented. When the emergency restoration is completed, any unused funding authority will be returned to the OSLTF. In the event that the spending authority provided by the NPFC is insufficient to accomplish the emergency restoration, the Trustees will make a supplemental claim to the OSLTF for future adjudication by the NPFC.

10.0 Conclusions

The proposed action is a natural resource Trustee action to address injuries to the reefs in Pago Pago Harbor resulting from the Coast Guard response action to remove oil and hazardous material from the nine grounded fishing vessels.

Through this ERP/EA, the natural resource Trustees have determined that complete vessel removal is needed to address injuries to trust resources resulting from USCG response actions. By proceeding with this project, the people of American Samoa and the nation will benefit from the restoration of injured reef communities and prevention of future injuries.

Consistent with OPA and NEPA requirements, the Trustees have evaluated five emergency restoration alternatives: no-action; direct restoration of injured areas; complete vessel removal with reef stabilization; complete vessel removal without reef stabilization; offshore artificial reef augmentation; sediment controls in Pago Pago watershed; and validating the Aua Transect. These alternatives are described and analyzed in the preceding sections of this document. The results of the Trustee evaluation indicate that the no-action alternative is not appropriate given the anticipated response-related injuries documented in Section 5.0. The Trustees' authority to seek compensation for interim losses pending environmental recovery is clearly set forth in OPA, and can not be addressed through the no-action alternative. Restoration of this resource is particularly important given the special management designation assigned by the American Samoa Coastal Management Program to the harbor area west of the Leloaloa causeway (which encompasses five of the grounded vessels), the water quality improvement in the area, the cultural value of the habitat to the Samoan "guardians of the reef", the renewed interest in fishing in this area, and the national recognition of coral reefs as a valued natural resource as embodied in Presidential Order 13089. In addition, as described in Section 6.0, a decision to take no-action at this time will cause future injuries from debris caused by the USCG response.

In contrast, the complete vessel removal with reef stabilization alternative meets all of the emergency restoration requirements. It is needed to minimize continuing injury to the reef flat, it is feasible and likely to succeed, and it is cost-effective given the fact that removal personnel, equipment, and infrastructure are already in place at the site. The costs of this alternative would escalate substantially (by at least 50%) if not undertaken in conjunction with USCG response actions.

Overall, the results of the injury quantification and scaling analyses indicate that complete vessel removal/substrate stabilization project over compensates for quantified injuries to *Halimeda/*algal turf communities, but under compensates for quantified coral injuries. The net difference for algal turf injuries depends on the scenario, but is much smaller than the difference for the other two communities. It is important to recognize that these analyses only quantify a subset of the total injuries that will be caused by the USCG response (i.e., causeway and platform footprints and associated buffer zones). Total injuries, including sedimentation impacts, physical damage to the reef structure, incomplete removal of rubble and other impacts described in Sections 4.0 and 5.0, may be substantially greater. As a result, the Trustees conclude that direct restoration of injured areas and complete vessel removal with reef stabilization, coordinated with USCG response actions, is the preferred action as emergency action.

11.0 References

Alino, P.M., P. Viva Banzon, H.T. Yap, E.D. Gomez, J.T. Morales, and R.P. Bayoneto, 1985. Recovery and recolonization on a damaged backreef area at Cangaluyan Island Proceedings of the Fifth International Coral Reef Congress, Vol. 4, Tahiti, pp. 279-284.

Babcock, R.C. and P. Davies, 1991. Effects of sedimentation on settlement of *Acropora millepora*. Coral Reefs 9: 205-208.

Borowitzka, M.A., A.W.D. Larkum, and L.J. Borowitzka, 1978. A preliminary study of algal turf communities of a shallow coral reef lagoon using an artificial substratum. Aquatic Botany, Vol. 5, pp. 365-381.

Brosnan, D.M. and L.L. Crumrine, 1994. Effects of human trampling on marine rocky shore communities. Journal of Experimental Marine Biology and Ecology 177: 79-97.

CZA, 1999. Samoa Longliners Cleanup: Potential natural resource injury to substrate and biota of Pago Pago reef flats. Report prepared for NOAA Damage Assessment Center, Silver Spring, MD., Coastal Zone Analysis, 26 pp.

Connell, J.H., 1973. Population ecology of reef-building corals. Biology and Geology of Coral Reefs, Volume II: Biology 1. O.A. Jones and R. Endean (eds.) Academic Press, New York, NY, pp. 205-245.

Connell, J.H., T.P. Hughes, and C.C. Wallace, 1997. A 30-year study of coral abundance, recruitment, and disturbance at several scales in space and time. Ecological Monographs, Vol. 67, No. 4, pp. 461-488.

Craig, P., A. Green and S. Saucerman, 1995. Coral Reef Troubles in American Samoa. Department of Marine and Wildlife Resources, Pago Pago, American Samoa. SPC Fisheries Newsletter #72 - January/March 1995.

Craig, P.,B. Ponwith, F. Aitaoto and D. Hamm, 1993. The Commercial, Subsistence, and Recreational Fisheries of American Samoa. Marine Fisheries Review, 55(2), 1993.

Cubit, J. and J.L. Connor, 1993. Effects of the 1986 BahÌa las Minas oil spill on reef flat communities. Proceedings of the 1993 Oil Spill Conference: 329-334.

Curtis, C., 1985. Investigating reef recovery following a freighter grounding the in the Key Largo National Marine Sanctuary. Proceedings of the Fifth International Coral Reef Congress, Vol. 6, Tahiti, pp. 471-476.

Dixon, J.A., 1998. Economic values of coral reefs: what are the issues? Coral Reefs: Challenges and Opportunities for Sustainable Management, Proceedings of an Associated Event of the Fifth Annual World Bank Conference on Environmentally and Socially Sustainable Development. M.A. Hatziolos, A.J. Hooten, M. Fodor (eds.). The World Bank, Washington, DC.,pp. 157-162.

Done, T.J. 1988. Simulation of recovery of pre-disturbance size structure in populations of Porites sp. damaged by the crown thorns starfish *Acanthaster planci*. Marine Biology, Vol. 100, pp. 51-61.

Done, T.J., K. Osborne, and K.F. Navin, 1988. Recovery of corals post-Acanthaster: progress and prospects. Proceedings of the 6th International Coral Reef Symposium, Vol. 2, Australia, pp. 137-142.

Drew, E.A. and K.M. Abel, 1992. Studies on *Halimeda* IV. An endogenous rhythm of chloroplast migration in the siphonous green alga, *H. distorta*. Journal of Interdisciplinary Cycle Res 23(2): 128-135.

Endean, R., 1976. Destruction and recovery of coral reef communities. Biology and Geology of Coral Reefs, Volume III: Biology 2. O.A. Jones and R. Endean (eds.) Academic Press, New York, NY, pp. 215-254.

Garrity, S.D. and S.C. Levings, 1990. Effects of an oil spill on the gastropods of a tropical intertidal reef flat. Marine Environmental Research: 30: 119-153.

Gittings, S.R., T.J. Bright, and D.K. Hagman, 1994. The M/V Wellwood and other large vessel groundings: coral reef damage and recovery. Proceedings of the Colloquium on Global Aspects of Coral Reefs: Health, Hazards, and History, 1993, Robert N. Ginsburg (compiler), Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Fla., pp. 174-180.

Green, A.L., C.E. Birkeland, R.H. Randall, B.D. Smith, and S. Wilkins, 1997. 78 years of coral reef degradation in Pago Pago Harbor: a quantitative record. Proceedings of the 8th Coral Reef Symposium, Vol. 2, pp. 1883-1888.

Grigg, R.W. and J.E. Maragos, 1974. Recolonization of hermatypic corals on submerged lava flows in Hawaii. Ecology, Vol. 55, pp. 387-395.

Harriot, V.J. and D.A. Fisk, 1988. Coral Transplantation as a reef management option. Proceedings of the 6th Intl. Coral Reef Symp., Vol. 2.

Hoover, J.P., 1998. Hawaii's sea creatures, a guide to Hawaii's marine invertebrates. Mutual Publishing, Honolulu, Hawaii, 366 pp. Hudson, J.H. and R. Diaz. 1988. Damage survey and restoration of M/V Wellwood grounding site, Molasses Reef, Key Largo National Marine Sanctuary, Florida. Proceedings of the 6th International Coral Reef Symposium, Vol. 2, Australia, pp. 231-236.

Houghton, J.P., A.K. Fukuyama, D.C. Lees, W.B. Driskell, G. Shigenaka, and A.J. Mearns, 1993. Impacts on intertidal epibiota: *Exxon Valdez* spill and subsequent cleanup. Proceedings of the 1993 Oil Spill Conference: 293-300.

Hubbard, D.K., 1986. Sedimentation as a control of reef development: St. Croix, U.S.V.I. Coral Reefs 5: 117-125.

Hudson, J.H. and R. Diaz, 1988. Damage survey and restoration of M/V Wellwood grounding site, Molasses Reef, Key Largo National Marine Sanctuary, Florida. Proceedings of the 6th International Coral Reef Symposium 2: 231-236.

Johnson, C.R. and A.L. Preece, 1992. Damage, scale and recovery in model coral communities, the importance of system state. Proceedings of the Seventh International Coral Reef Symposium, Vol. 1, Guam, pp. 606-615.

Kendrick, G.A., 1991. Recruitment of coralline crusts and filamentous turf algae in the Galapagos archipelago: effects of simulated scour, erosion and accretion. Journal of Experimental Marine Biology and Ecology 147: 47-63.

Keough, M.J. and G.P. Quinn, 1998. Effects of periodic disturbances from trampling on rocky intertidal algal beds. Ecological Applications 8: 141-161.

Liddle, W.D. and S.L. Ohlhorst, 1992. Ten years of disturbance and change on a Jamaican fringing reef. Proceedings of the Seventh International Coral Reef Symposium, Guam, Vol. 1, pp. 144-150.

Liddle, M.J. and A.M. Kay, 1987. Resistance, survival and recovery of trampled corals on the Great Barrier Reef. Biological Conservation, Vol. 42, Elsevier Applied Science Publishers Ltd., England, pp. 1-18.

Lobban, C.S., P.J. Harrison and M.J. Duncan, 1985. The physiological ecology of seaweeds. Cambridge University Press, Cambridge.

Longhurst, A.R. and D. Pauly, 1987. Ecology of tropical oceans. Academic Press, Inc. New York.

Loya, Y. and B. Rinkevich, 1980. Effects of oil pollution on coral reef communities. Marine Ecology Progress Series 1: 77-80.

Maragos, J.E., 1992. Restoring coral reefs with emphasis on Pacific reefs. Chapter 5, Restoring the Nation's Marine Environment. G.W Thayer (ed.). Maryland Sea Grant, College Park, Md., pp. 141-221.

Martin, J.F. and S.E. Fitzwater, 1988. Iron deficiency limits phytoplankton growth in the northeast Pacific subarctic. Nature 331: 341-343.

McManus, J.W., R.B. Reyes, Jr., and G.L. Nañola, Jr., 1997. Effects of some destructive fishing methods on coral cover and potential rates of recovery. Environmental Management, Vol. 21, No. 1, pp. 69-78.

NOAA, 1995(a). Natural resource damage assessment M/V Miss Beholden grounding site, Western Sambo Reef, FKNMS, March 13, 1993. 26 pp. plus appendices, National

Oceanic and Atmospheric Administration.

NOAA, 1995(b). Coral reef restoration of the M/V Alec Owen Mairland and the M/V Elpis gorunding sites. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D.D.

NOAA, 1996. Injury Assessment: Guidance Document for Natural Resource Damage Assessment Under the Oil Pollution Act of 1990, Damage Assessment and Restoration Program, National Oceanic and Atmospheric Administration.

NOAA, 1997. Scaling compensatory restoration actions: Guidance document for natural resource damage assessment under the Oil Pollution Act of 1990, Damage Assessment and Restoration Program, National Oceanic and Atmospheric Administration.

NOAA. 1999, Discounting and the treatment of uncertainty in natural resource damage assessment, Technical Paper 99-1. Damage Assessment and Restoration Program, National Oceanic and Atmospheric Administration.

NRC, 1985. Oil in the sea: Inputs, fates and effects. Steering Committee for the Petroleum in the Marine Environment Update, Board on Ocean Science and Policy. National Academy Press, Washington D. C.

Pearson, R.G., 1974. Recolonization of Hermatypic corals of reefs damaged by Acanthaster. Proceedings of the Second International Coral Reef Symposium, Vol. 2, Great Barrier Reef Committee, Brisbane, pp. 207-215.

Pearson, R.G., 1981. Recovery and recolonization of coral reefs. Marine Ecology Progress Series, Vol. 4, pp. 105-122.

Ponwith, B., 1991. The Shoreline Fishery of American Samoa: A 12-Year Comparison. Department of Marine and Wildlife Resources, DMWR Biological Report Series, No. 2.

Rice, S.A. and C.L. Hunter, 1992. Effects of suspended sediments and burial on scleractinian corals from west central Florida. Bulletin of Marine Science 51: 429-442.

Rogers, C.S., 1979. The effect of shading on coral reef structure and function. J. Exp. Mar. Biol. Ecol., Vol. 41, Elsevier/North-Holland Biomedical Press, pp. 269-288.

Rogers, C.S., 1990. Responses of coral reef organisms to sedimentation. Marine Ecology Progress Series 62: 185-202.

RPI and IEc, 1999. Pago Pago Rapid Assessment: Characterization of Affected Environment, Injury and Restoration Alternatives. Prepared for NOAA Damage Assessment Center by Research Planning, Inc. and Industrial Economics, Inc.

Saki, K. and K. Yamazato, 1984. Coral recruitment to artificially denuded natural substrates on an Okinawan reef flat. Galaxea 3: 57-69.

Saucerman, S., 1995. The Inshore Fishery of American Samoa, 1991 to 1994. Department of Marine and Wildlife Resources, DMWR Biological Report Series, No. 77.

Smith, S.R. 1985. Reef damage and recovery after ship groundings on Bermuda. Proceedings of the Fifth International Coral Reef Congress, Vol. 6, Tahiti, pp. 407-502.

Stimson, J. 1985. The effect of shading by the table coral Acropora hyacinthus on understory corals. Ecology 66(1), Ecological Society of America, pp. 40-53.

Stoddart, D. R. (1969).
Post-hurricane changes on the British Honduras reefs and cays: re-survey of 1965. Atoll Res. Bull. 131: 1-25

Suchanek, T. H., 1993. Oil impacts on marine invertebrate populations and communities. American Zoologist 33: 510-523.

SYAS, 1996. American Samoa Statistical Yearbook, 1996.

Terrados, J., C.M. Duarte, M.D. Fortes, J. Borum, N.S.R. Agawin, S. Bach, U. Thampanya, L. Kamp-Neilsen, W.J. Kentworthy, O. Gertz-Hansen and J.E. Vermat, 1998. Changes in community structure and biomass of seagrass communities along gradients of siltation in SE Asia. Estuarine, Coastal and Shelf Science 46: 757-768.

Thompson, J.H., 1980. Effects of drilling mud on seven species of reef-building corals as measured in field and laboratory. Report to the U.S. Geological Survey, Department of Oceanography, Texas A&M University, College Station, TX.

TTF, 1994. Tourism Task Force, Report to the Governor. 5-Year Tourism Action Plan. October, 1994.

Tuato'o-Bartley, T.E. Morrell, and P. Craig, 1993. Status of sea turtles in American Somoa in 1991. Pacific Science. 47(3): 215-221.

Umar, M.J., L.J. McCook and I.R. Price, 1998. Effects of sediment deposition on the seaweed *Sargassum* on a fringing coral reef. Coral Reefs 17: 169-177

USACE, 1980. American Samoa Coral Reef Inventory (ASCRI Project). Prepared under US Army Corps of Engineers Pacific Ocean Division, Contract No. DACW84-79-C-0022 for American Samoa Government Development Planning Office. Version: Aug-80

USCG, December 1997. Executive summary and chronology of Coast Guard efforts involving the nine longline vessels grounded in Pago Pago Harbor. United States Coast Guard Report.

USCG, March 1998. Proposed course of action for mitigation of the pollution threat from longliners in American Samoa, FPN-147011. United States Coast Guard Report.

USCG, May 1999. Request for RRT/DoD emergency assistance for the American Samoa grounded longliner project. United States Coast Guard Report

USCG, January 1999. American Samoa Grounded Longliner Update. United States Coast Guard Report.

USCG, 1999. Incident Action Plan: Samoa Longliner Clean Up. United States Coast Guard, May – June 1999.

USFWS, 1997. The impact of a ship grounding and associated fuel spill at Rose Atoll National Wildlife Refuge, American Samoa. U. S. Fish and Wildlife Service, Pacific Islands Office, Honolulu, Hawaii.

Walsh, W., 1983. Stability of a coral reef fish community following a catastrophic storm. Coral Reefs, 2:49-63.

Wesseling, I., A.J. Uychiaoco, P.M. Alino, T. Aurin and J.E. Vermaat, 1999. Damage and recovery of four Philippine corals from short-term sediment burial. Marine Ecology Progress Series 176: 11-15.

12.0 Figures

13.0 List of Appendices

APPENDIX A -- Detailed Restoration Scaling Inputs

Exhibit A-1 provides additional information concerning the inputs used in the scaling analysis for the complete vessel removal restoration alternative. Summary information from the restoration scaling analysis is provided in Section 7.0 of the Emergency Restoration Plan. The parameters included in the table below are the key inputs used in this analysis.

The first section of the table provides the area of injury under the two injury scenarios. Scenario 1 assumes that fill causeways are used for vessels 1-7 and trestle causeways are used for vessels 8 and 9. Scenario 2 assumes the trestle causeways are used for all vessels, except for vessels 4/5/6, which have an existing fill causeway. Both scenarios assume fill platforms. These area estimates are based on the length and width of the causeways and platforms (Exhibit 8), the length and width of associated buffer areas (see Section 5.1 for a description of these calculations), and the detailed habitat maps that identify the coverage of different reef communities (i.e., *Halimeda*/algal turf, *Halimeda*, and coral - see Figures 1, 2, 3 and 4).

The areas provided in the table include adjustments needed to eliminate overlap between platform footprints, causeway footprints, and associated buffer areas. Where causeway and platform footprints overlapped, the Trustee calculations ensure that overlap area is only included once in the injury estimate. Causeway and platform footprints do not overlap in the Trustee calculations. Where causeway buffer and footprint buffer areas overlapped, the Trustees assumed 25 percent service reduction in the overlap area (the same service reduction used for non-overlapping areas).

The area of benefit from vessel removal is based on the footprint of each grounded vessel and the reef community types expected after restoration. The length and width of each vessel is provided in Exhibit 8. Some of the vessels overhang the reef edge. The amount of overhang (based on field observations and aerial photography) is also estimated in Exhibit 8. The area of reef that will be restored by vessel removal is calculated using the following equation:

Reef Area Restored = Vessel Width * Vessel Length * (1 - percent overhang) * 0.33

The 0.33 adjustment factor corrects for the fact that the vessel width provided in Exhibit 8 is the maximum boat width; vessel widths decrease towards the bow and stern. The type of reef community expected after restoration is based on the types of reef communities observed by Trustee field teams in the areas surrounding the vessels (see Figures 1, 2, 3 and 4).

With regard to other scaling parameters, the "current" year used for presentation of discounted injury and restoration scaling results is 1999. Restoration also is assumed to begin in 1999. The basis for the percent service loss and recovery time estimates for each habitat type is described in Sections 5.1 and 5.2. The basis for the assumption of 50 years of service production from restored reef is described in Section 8.0. The average annual percent service loss for each habitat type is used in the Habitat Equivalency Analysis calculations. Finally, the real discount rate used in the scaling analysis is 3 percent.

Exhibit A-1 PARAMENTERS FOR PAGO PAGO RESTORATION SCALING ANALYSIS			
Area of Injury			
Scenario 1			
	Halimeda/Algal Turf	50,425	
	Algal Turf	32,232	
	Coral	27,851	
Scenario 2			
	Halimeda/Algal Turf	40,465	
	Algal Turf	11,091	
	Coral	27,851	
Area of Benefit from Vessel Removal			
	Halimeda/Algal Turf	5,308	
	Algal Turf	385	
	Coral	2,615	
Other Scaling Parameters			
	Current Year	1999	
	Year Recovery Begins	1999	
	Percent of Original Services Lost		
		Footprint	100%
		Footprint with coral transplant	75%
		Buffer	25%
		Trestle	50%
	Recovery Time of Injured Resources		
		Halimeda/Algal Turf	5 years
		Algal Turf	1 year
		Coral	10 years
	Years of Service Production Expected from Removal of Vessels	50 years	
	Real discount rate	3%	

Exhibits A-2 through A-6 provide additional information underlying the habitat area of injury summaries in Exhibit A-1 broken down by each vessel group. The information in these exhibits is based on the data obtained from the rapid response mapping effort, which is presented graphically in Figures 1, 2, 3 and 4. It is important to note that these figures are not a graphical description of the exact locations and sizes of the causeways and platforms. They represent the areas that were surveyed to determine the habitat types in the locations of the platforms and causeways. These Some habitat types are listed more than once for a particular vessel cluster; this reflects the fact that in some cases, the platform is comprised of multiple sections with different lengths, widths and/or orientation (see the USCG IAP for more detail). Habitat cover estimates were made individually for each platform section, and summed to develop estimates for the entire platform (and associated buffers). Overlap between causeway and platform footprint and buffer areas is accounted for in the table, as described in Section 5.2 and in the footnotes of each exhibit. Finally, the sand/rubble/cobble habitat type identified and estimated as part of the mapping effort is included in the table for completeness, although the Trustees do not claim injury to this type of habitat from the USCG response effort in this Emergency Restoration Plan.

Exhibit A-2:

Calculations for Vessels 1 and 2:

This vessel group will consist of two platforms and one causeway. The first platform is 200 ft. by 22.5 ft. with a 17.5 ft. buffer (on three sides). The second platform is 50 ft. by 30.5 ft. with a 24.5 ft. buffer (on two sides). The section of the fill causeway that doesn't overlap with the platform is 322 ft. by 40 ft. (on two sides) with a 17.5 ft. buffer and a trestle causeway is 322 ft. by 20 ft with no buffer. Due to the uncertainty of the exact placement of the causeways and platforms, the areas of overlap between fill areas, trestles, and buffers are uncertain. It is assumed that there is no buffer on the side of the platforms next the vessels and conservative assumptions of overlap areas have been made to prevent double counting. For purposes of calculating the benefits of vessel removal, it is assumed that the habitat under Vessels 1 and 2 is 100% *Halimeda*/Algal Turf.

Platform:[1]
  Footprint (2 sections):
    Halimeda/Algal Turf: 4,500 sq. ft. -- (200 ft. x 22.5 ft.)
    Halimeda/Algal Turf: 1,525 sq. ft. -- (50 ft. x 30.5 ft.)
  Buffer (2 sections):[2,3]
Halimeda/Algal Turf: 3,588 sq. ft. -- (200 ft. x 17.5 ft.) + 2 x (22.5 ft. x 17.5 ft.) – (40ft. x 17.5 ft.)
    Halimeda/Algal Turf: 1,972 sq. ft. -- (50 ft. x 24.5 ft.) + (30.5 ft. x 24.5 ft.)

Causeway (Fill):
  Footprint:[4]
    Halimeda/Algal Turf: 131 sq. ft. -- ((1/98) x 322 ft.) x 40 ft.
    Sand/Rubble/Cobble: 8,083 sq. ft. -- ((61.5/98) x 322 ft.) x 40 ft.
    Algal Turf: 4,666 sq. ft. -- ((35.5/98) x 322 ft.) x 40 ft.
  Buffer:[4,5]
    Halimeda/Algal Turf: 0 sq. ft
    Sand/Rubble/Cobble: 7073 sq. ft. -- 2 x ((61.5/98) x 322 ft.) x 17.5 ft.
    Algal Turf: 3,593 sq. ft. -- 2 x (((35.5/98) x 322 ft.)-14 ft.) x 17.5 ft.

Causeway (Trestle):
  Footprint:
    Halimeda/Algal Turf: 66 sq. ft. -- ((1/98) x 322 ft.) x 20 ft.[4]
    Sand/Rubble/Cobble: 4,041 sq. ft. -- ((61.5/98) x 322 ft.) x 20 ft.[4]
    Algal Turf: 2,333 sq. ft. -- ((35.5/98) x 322 ft.) x 20 ft.[4]

Totals:[5]
  Case 1:
    Halimeda/Algal Turf: 11,716 sq. ft.
    Sand/Rubble/Cobble: 15,155 sq. ft.
    Algal Turf: 8,258 sq. ft.
  Case 2:
    Halimeda/Algal Turf: 11,650 sq. ft.
    Sand/Rubble/Cobble: 4,041 sq. ft.

Algal Turf: 2,333 sq. ft.

[1] The platforms and platform buffers of the vessel group 1/2 are dominated by 100% *Halimeda*/Algal Turf.
[2] To account for the area where the buffer from the 200 ft. long platform and causeway overlap, 700 sq. ft. (40 ft. x 17.5 ft.) have been subtracted from the buffer area. If a trestle causeway is used instead of a fill causeway, the buffer area will be underestimated. This provides an approximate but conservative estimate of the overlap area.
[3] Because the exact placement, shape, and size of the platforms are uncertain, a buffer on one side of the 50 ft. long platform has been excluded from the calculation. This provides a conservative estimate of the buffer area from the 50 ft. long platform.
[4] Of the 98-meter length of the causeway and associated buffers (322 ft.), 1 meter is estimated to be dominated by *Halimeda*/Algal Turf, 61.5 meters are estimated to be dominated by Sand/Rubble/Cobble and 35.5 meters are estimated to be dominated by Algal Turf.
[5] To account for the area where the buffer from the platform overlaps with the buffer from the causeway, the segment of the causeway buffer dominated by *Halimeda*/Algal Turf and 14 ft. of the segment dominated by Algal Turf have been subtracted out of the area estimates. This provides an approximate but conservative estimate of the affected habitat area.
[6] Due to rounding, the sum of individual habitat areas may not equal the total areas.

Exhibit A-3:
Calculations for Vessels 4/5/6

This vessel group will consist of three platforms. A causeway already exists at this location. The first platform is 200 ft. by 22.5 ft. with a 17.5 ft. buffer (on two sides). The second platform is 200 ft. by 22.5 ft. with a 17.5 ft. buffer (on three sides) and the third platform is 50 ft. by 30.5 ft. with a 24.5 ft. buffer (on two sides). Due to the uncertainty of the exact placement of the causeways and platforms, the areas of overlap between fill areas, trestles, and buffers are uncertain. It is assumed that there is no buffer on the side of the platforms next the vessels and conservative assumptions of overlap areas have been made to prevent double counting. For purposes of calculating the benefits of vessel removal, it is assumed that the habitat under Vessels 4, 5, and 6 is 100% *Halimeda*/Algal Turf.

Platform:[1]
  Footprint (3 sections):
    Halimeda/Algal Turf: 4,500 sq. ft. -- 200 ft. x 22.5 ft.
    Halimeda/Algal Turf: 4,500 sq. ft. -- 200 ft. x 22.5 ft.
    Halimeda/Algal Turf: 1525 sq. ft. -- 50 ft. x 30.5 ft.
  Buffer (3 sections):[2,3]
    Halimeda/Algal Turf: 3,360 sq. ft. -- (200 ft. x 17.5 ft.) + (22.5 ft. x 17.5 ft.) – (30.5 ft. x 17.5 ft.)
    Halimeda/Algal Turf: 4,288 sq. ft. -- (200 ft. x 17.5 ft.) + 2 x (22.5 ft. x 17.5ft.)
    Halimeda/Algal Turf: 1,972 sq. ft. -- (50 ft. x 24.5 ft.) + (30.5 ft. x 24.5 ft.)

Causeway:[4] 0 sq. ft.

Totals:[5,6]
  Case 1 and 2:
    Halimeda/Algal Turf: 20,145

[1] The platforms and platform buffers of the vessel group 4/5/6 are dominated by 100% *Halimeda*/Algal Turf.
[2] To account for the area where the buffer from the platform overlaps with the existing causeway, 534 sq. ft. (30.5 ft. x 17.5 ft.) have been subtracted from the buffer area. This provides an approximate but conservative estimate of the overlap area.
[3] Because the exact placement, shape, and size of the platforms are uncertain, a buffer on one side of the 200 ft. long platform and a buffer on one side of the 50 ft. long platform have been excluded from the calculation. This provides a conservative estimate of the buffer area from the 50 ft. long platform.
[4] The causeway to the vessel group 4/5/6 already exists, although it's likely to be enlarged during response actions.
[5] An additional causeway will not be built, therefore, the total area of Case 1 and Case 2 are the same.
[6] Due to rounding, the sum of individual habitat areas may not equal the total areas.

Exhibit A-4:
Calculations for Vessel 7

This vessel group will consist of one platform and one causeway. The platform is 200 ft. by 22.5 ft. with a 17.5 ft. buffer (on three sides). The section of a fill causeway that doesn't overlap with the platform is 467.5 ft. by 40 ft. with a 17.5 ft. buffer (on two sides) and a trestle causeway is estimated to be 467 ft. by 20 ft with no buffer. Due to the uncertainty of the exact placement of the causeways and platforms, the areas of overlap between fill areas, trestles, and buffers are uncertain. It is assumed that there is no buffer on the side of the platforms next the vessels and conservative assumptions of overlap areas have been made to prevent double counting. For purposes of calculating the benefits of vessel removal, it is assumed that the habitat under Vessel 7 is 22/36 *Halimeda*/Algal Turf and 14/36 Algal Turf, which is the same percentage of the coverage of the platform.

Platform:
Footprint: [1]
Halimeda/Algal Turf: 2,750 sq. ft. -- ((22/36) x 200 ft.) x 22.5 ft.
Algal Turf: 1,750 sq. ft. -- ((14/36) x 200 ft.) x 22.5 ft.
Buffer: [1,2,3]
Halimeda/Algal Turf: 2,105 sq. ft. -- ((22/36) x 200 ft. x 17.5 ft.) + (22.5 ft. x 17.5 ft.) - (40ft. x 17.5 ft.) x (22/36)
Algal Turf: 1,483 sq. ft. -- ((14/36) x 200 ft. x 17.5 ft.) + (22.5 ft. x *17.5 ft.) - (40ft. x 17.5 ft.) x (14/36)

Causeway (Fill):
Footprint: [4]
Halimeda/Algal Turf: 7,638 sq. ft. -- ((58/142) x 467.5 ft.) x 40 ft.
Algal Turf: 11,062 sq. ft. -- ((84/142) x 467.5 ft.) x 40 ft.
Buffer: [4,5]
Halimeda/Algal Turf: 6,071 sq. ft. -- 2 x (((58/142) x 467.5 ft.)-17.5 ft.) x 17.5ft.
Algal Turf: 9,679 sq. ft. -- 2 x ((84/142) x 467.5 ft.) x 17.5 ft.

Causeway (Trestle):
Footprint: [4]
Halimeda/Algal Turf: 3,815 sq. ft. -- ((58/142)x467 ft.)x20 ft.
Algal Turf: 5,525 sq. ft. -- ((84/142)x467 ft.) x 20 ft.

Totals: [6]
Case 1:
Halimeda/Algal Turf: 18,564 sq. ft.
Algal Turf: 23,974 sq. ft.
Case 2:
Halimeda/Algal Turf: 8,670 sq. ft.
Algal Turf: 8,758 sq. ft.

[1] Of the 36 meters length of the platform that was examined, 22 meters are estimated to be dominated by *Halimeda*/Algal Turf and 14 meters dominated by Algal Turf.
[2] To account for the area where the buffer from the platform overlaps with the causeway, 700 sq. ft. (40 ft. x 17.5 ft.) have been subtracted from the buffer area. Of this, 22/36 is estimated to be dominated by *Halimeda*/Algal Turf and 14 meters is estimated to be dominated by Algal Turf. This provides an approximate but conservative estimate of the overlap area.
[3] The platform's buffer is assumed to be dominated by Algal Turf on one side and *Halimeda*/Algal Turf on the other.
[4] Of the 142 meter length of the causeway and associated buffers (467.5 ft.), 58 meters are estimated to be dominated by *Halimeda*/Algal Turf and 84 meters are estimated to be dominated by Algal Turf.
[5] To account for the area where the buffer from the platform overlaps with the buffer from the causeway, 17.5 ft. of the segment dominated by *Halimeda*/Algal Turf have been subtracted out of the area estimates. This provides an approximate but conservative estimate of the overlap area.
[6] Due to rounding, the sum of individual habitat areas may not equal the total areas.

Exhibit A-5:
Calculation for Vessel 8

This vessel group will consist of two platforms and one trestle causeway. The first platform is 200 ft. by 24 ft. with a 21 ft. buffer (on three sides). The second platform is 50 ft. by 19 ft. with a 21 ft. buffer (on two sides). The section of a trestle causeway that doesn't overlap with the platform is 251 ft. by 20 ft. with no buffer. Due to the uncertainty of the exact placement of the causeways and platforms, the areas of overlap between fill areas, trestles, and buffers are uncertain. It is assumed that there is no buffer on the side of the platforms next the vessels and conservative assumptions of overlap areas have been made to prevent double counting. For purposes of calculating the benefits of vessel removal, it is assumed that the habitat under Vessel 8 is 100% Coral.

Platform:[1]
  Footprint (2 sections):
    Coral: 4,800 sq. ft. -- 200 ft. x 24 ft.
    Coral: 950 sq. ft. -- 50 ft x 19 ft.
Buffer (2 sections):[2,3]
    Coral: 4,788 sq. ft. -- (200 ft. x 21 ft.) + 2 x (24 ft. x 21 ft.) - (20 ft. x 21 ft.)
    Coral: 1,449 sq. ft. -- (50 ft. x 21 ft.) + (19 ft. x 21 ft.)

Causeway (Trestle):
  Footprint:[4]
    Coral: 4,495 sq. ft. -- ((68.5/76.5) x 251 ft.) x 20 ft.
    Sand/Rubble/Cobble 525 sq. ft. -- ((8/76.5) x 251 ft. x 20 ft.
Totals:[5]
  Case 1 and Case 2:
    Coral: 16,482 sq. ft.
    Sand/Rubble/Cobble 525 sq. ft.

1 The platforms and platform buffers of vessel 8 are dominated by 100% coral.
2 To account for the area where the buffer from the platform overlaps with the causeway, 504 sq. ft. (20 ft. x 21 ft.) have been subtracted from the buffer area. This provides an approximate but conservative estimate of the overlap area.
3 Because the exact placement, shape and size, of the platforms are uncertain, a buffer on one side of the 50 ft. long platform has been excluded from the calculation. This provides a conservative estimate of the buffer area from the 50 ft. long platform.
4 Of the 76.5 meter length of the causeway (251 ft.), 68.5 meters are estimated to be dominated by Coral and 8 meters are estimated to be dominated by sand/rubble/coral.
5 Due to rounding, the sum of individual habitat areas may not equal the total areas.

Exhibit A-6:
Calculation for Vessel 9

This vessel group will consist of two platforms and one trestle causeway. The first platform is 200 ft. by 24 ft. with a 21 ft. buffer (on two sides). The second platform is 50 ft. by 19 ft. with a 21 ft. buffer (on two sides). The section of a trestle causeway that doesn't overlap with the platform is 285 ft. by 20 ft. with no buffer. Due to the uncertainty of the exact placement of the causeways and platforms, the areas of overlap between fill areas, trestles, and buffers are uncertain. It is assumed that there is no buffer on the side of the platforms next the vessels and conservative assumptions of overlap areas have been made to prevent double counting. For purposes of calculating the benefits of vessel removal, it is assumed that the habitat under Vessel 9 is 100% Coral.

Platform:
Footprint (2 sections): [1,2]
Coral: 4,656 sq. ft. -- 194 ft. x 24 ft.
Sand/Rubble/Cobble: 950 sq. ft. -- 50 ft. x 19 ft.
Buffer (2 sections): [3,4]
Coral: 4,158 sq. ft. = (194 ft. x 21 ft.) + (24 ft. x 21 ft.) - (20 ft. x 21 ft.)
Sand/Rubble/Cobble: = 1,449 sq. ft. = (50 ft. x 21 ft.) + (19 ft. x 21 ft.)

Causeway (Trestle):
Footprint: [5]
Coral: 2,555 sq. ft. -- ((39/87) x 285 ft.) x 20 ft.
Coral/Sand/Rubble/Cobble: 2,883 sq. ft. -- ((44/87) x 285 ft.) x 20 ft.
Sand/Rubble/Cobble: 262 sq. ft. -- ((4/87) x 285 ft.) x 20 ft.

Totals:[6]
Case 1 and Case 2:
Coral: 11,369 sq. ft.
Sand/Rubble/Cobble: 2,661 sq. ft.
Coral/Sand/Rubble/Cobble: 2,883 sq. ft.

[1] The 200 ft. long platform and associated platform buffers of vessel 9 is dominated by 100% Coral for 194 feet and Sand/Rubble/Coral for the other 6 feet. The 6 feet of Sand/Rubble/Coral from this platform have been excluded in the calculations.

[2] The second 50 ft. long platform and its associated buffers are dominated by 100% Sand/Rubble/Cobble.

[3] To account for the area where the buffer from the platform overlaps with the causeway, 420 sq. ft. (20 ft. x 21 ft.) have been subtracted from the buffer area. This provides an approximate but conservative estimate of the overlap area.

[4] Because the exact placement, shape and size of the platforms are uncertain, a buffer on one side of the 50 ft. long platform has been excluded from the calculation. This provides a conservative estimate of the buffer area from the 50 ft. long platform.

[5] Of the 87 meter length of the causeway (285 ft.), 39 meters are estimated to be dominated by Coral, 44 meters are estimated to be dominated by Coral/Sand/Rubble/Cobble and 4 meters are estimated to be dominated by Sand/Rubble/Cobble

[6] Due to rounding, the sum of individual habitat areas may not equal the total areas.

Appendix B. Scanned copy of PENCO Cost Proposal for Complete Vessel Removal

August 7, 1999

PENCO

PACIFIC ENVIRONMENTAL
CORPORATION

65 N. Nimitz Hwy., Pier 14
Honolulu HI 96817

Phone (808) 545-5195
Fox (808) 538-1703

Protecting Pacific Area Ecosystems

August 7, 1999

NOAA
N/ORR3
Attn: Bob Ransom
1305 East-West Highway
Silver Spring, MD 20910-3281

Subject: Estimate for removal of the superstructure(s) of 9 individual vessels located in the shore-break, on the reef in American Samoa.

Mr. Bob Ransom:

Pacific Environmental Corporation is pleased to offer you the following estimate for the above mentioned work. This estimate is based on our present assessment of the vessels and the varied conditions that they may be left in upon completion of the USCG portion of the work. We provide the following estimated time and cost(s), see spreadsheets, for the complete removal of the vessel(s). The following is a listing of each vessel and our estimate of the number of days for each. Our estimate is based on "fair weather" conditions.

	Vessel Name	Est. days	Est Subtotal
#1	Diang Myong 958	6 days	$232,053.00
#2	Lyang Myong #63	12 days	$464,106.00
#3	Korbee #7	18 days	$696,159.00
#4	Koram#1	12 days	$464,106.00
#5	Koram #3	6 days	$232,053.00
#6	Lyang Hyong #56	12 days	$464,106.00
#7	Kyang Myong #72	12 days	$464,106.00
#8	Yuti #1	6 days	$232,053.00
#9	Amiga #5	6 days	S232,053.00

Estimated Total: S3,480,795.00

Estimate Subtotal is based on 5 days of the "daily straight time estimate cost" and 1 day of the "over-time estimate cost" sheets (attached), for every 6 days estimated. Should you have any questions please call me at 011 (694) 258-2480. I appreciate the patience that you have already shown with regard to obtaining this estimate.

Sincerely

Frank A. Knight
Pacific Area Manager

Appendix C. Compliance with Key Statutes, Regulations, and Policies

Oil Pollution Act of 1990 (OPA), 33 USC 2701, *et seq.*, 15 CFR Part 990

OPA establishes a liability regime for oil spills that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. OPA provides a framework for conducting sound natural resource damage assessments that achieve restoration. This framework is detailed in the natural resource damage assessment regulations at 15 CFR Part 990. The Trustees have followed the regulations in this assessment.

National Environmental Policy Act (NEPA), 42 USC 4321, *et seq.*, 40 CFR Parts 1500-1508

An Environmental Assessment (EA) has been prepared for the Pago Pago Harbor Restoration Project. A Finding of No Significant Impact (FONSI) was signed on by the Trustees. The document evaluated the effects of the vessel removal with substrate stabilization for compensation from the planned response actions for Pago Pago Harbor.

Clean Water Act (CWA), 33 USC 1251, *et seq.*

The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the disposal of dredged or fill material into navigable waters. The Army Corps of Engineers (Corps) administers the program. In general, restoration projects, which move significant amounts of material into or out of waters or wetlands -- for example, hydrologic restoration of marshes -- require 404 permits. Under section 401 of the CWA, restoration projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. No permit will be required for the selected vessel removal with substrate stabilization.

Rivers and Harbors Act, 33 U.S.C. §§ 401, *et seq.*

The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the Corps with authority to regulate discharges of fill and other materials into such waters. Restoration actions that require Section 404 Clean Water Act permits are likely also to require permits under Section 10 of the Rivers and Harbors Act. However, a single permit usually serves for both. Therefore, the Trustees can ensure compliance with the Rivers and Harbors Act through the same mechanism.

Coastal Zone Management Act (CZMA), 16 USC 1451, *et seq.*, 15 CFR 923

The goal of the CZMA is to preserve, protect, develop and, where possible, restore and enhance the nation's coastal resources. The federal government provides grants to states with federally-approved coastal management programs. Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no federal license or permit may be granted without giving the state the opportunity to concur that the project is consistent with the state's coastal policies. The regulations outline the consistency procedures. The selected restoration project will be consistent with the American Samoa CZMA program.

Endangered Species Act (ESA), 16 USC 1531, *et. seq.*, 50 CFR Parts 17, 222, 224

The ESA directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authorities to further these purposes. Under the Act, the Department of Commerce through NOAA and the Department of the Interior through the US&FWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these departments to minimize the effects of federal actions on endangered and threatened species. The selected restoration project is expected to have no adverse impacts on threatened or endangered species and is expected to develop habitat enhancements beneficial to supporting ecosystems for threatened and endangered species, including, but not limited to brown pelicans and piping plovers. Consultation has been completed for the Pago Pago Harbor Restoration Project.

Fish and Wildlife Conservation Act, 16 USC 2901, *et seq.*

The selected restoration project will encourage the conservation of non-game fish and wildlife.

Fish and Wildlife Coordination Act (FWCA), 16 USC 661, *et seq.*

The FWCA requires that federal agencies consult with the U.S. Fish and Wildlife Services, the National Marine Fisheries Service, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license or review requirements. The selected restoration project will have a positive effect on fish and wildlife resources. Coordination has taken place between NOAA National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson-Stevens Act), 16 USC 1801 *et seq.*

The Magnuson-Stevens Act provides for the conservation and management of the Nation's fishery resources within the Exclusive Economic Zone (from the seaward boundary of every state to 200 miles from that baseline). The management goal is to achieve and maintain the optimum yield from each fishery. The Magnuson-Stevens also established a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, Federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized funded, or undertaken by such agency that may adversely affect any EFH.

The proposed restoration activity, under OPA, is being undertaken to make the environment and the public whole for injuries to natural resources and natural resource services by returning injured natural resources and natural resource services to their pre-spill, or baseline condition and compensating for interim losses of natural resources. While the overall goal is to restore and enhance the injured habitat, some restoration activities may convert one habitat to another and must be considered as a potential adverse impact to EFH and analyzed appropriately.

The areas in which the coral reef restoration is planned (coral transplant and coral substrate stabilization) have been identified as EFH for species managed by the Western Pacific Regional Fishery Management Council. During the development of specific restoration project details as the preferred alternative, the Trustees evaluated for EFH to ensure that project implementation will comply with the EFH provisions of the applicable Fishery Management Plans under the jurisdiction of the Western Pacific Regional Fishery Management Council and, if necessary, consult with the National Marine Fisheries Service (Southwest Region).

Marine Mammal Protection Act, 16 USC 1361 *et seq.*

The Marine Mammal Protection Act provides for long-term management and research programs for marine mammals. It places a moratorium on the talking and importing of marine mammals and marine mammal products, with limited exceptions. The Department of Commerce is responsible for whales, porpoise, seals, and sea lions. The Department of the Interior is responsible for all other marine mammals. The selected restoration project will not have an adverse effect on marine mammals. Consultation has been completed for the Pago Pago Harbor Restoration Project.

Migratory Bird Conservation Act, 126 USC 715 *et seq.*

The selected restoration project will have no adverse affect on migratory birds that are likely to benefit from the Pago Pago Harbor Restoration Project.

Archeological Resources Protection Act, 16 USC 470 *et seq*.

American Samoa was consulted on the Pago Pago Harbor Restoration Project. American Samoa reported no known cultural resources in the area and no known cites or properties listed on or eligible for listing on the National Register of Historic Places.

Executive Order 13089 - Coral Reef Protection

On June 11, 1998, President Clinton issued Executive Order 12898, Coral; Reef Protection. This Executive Order requires each federal agency whose actions may affect U.S. coral reef ecosystems to: identify their actions that may affect U.S. coral reef ecosystems; utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and, to the extent permitted by law, ensure that any such actions they authorize fund, or carry out will not degrade the conditions of such ecosystems. The Trustees have determined that the selected restoration project will, in fact, help the recovery of the coral reef in American Samoa.

EXECUTIVE ORDER 11990 - PROTECTION OF WETLANDS

On May 24, 1977, President Carter issued Executive Order 11990, Protection of Wetlands. This Executive Order requires each federal agency to take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: acquiring, managing, and disposing of federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land us, including but not limited to water and related land resources planning, regulating, and licensing activities. The Trustees have concluded that the selected restoration project will meet the goals of this executive order.

EXECUTIVE ORDER 12962 - RECREATIONAL FISHERIES

On July 7, 1995, President Clinton issued Executive Order 12962, Recreational Fisheries. This Executive Order requires each agency, to the extent permitted by law and where practicable, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities. The Trustees have concluded that the selected restoration project will meet these goals.

EXECUTIVE ORDER 12898 - ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. This Executive Order requires each federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low income populations. EPA and the Council on Environmental Quality (CEQ) have emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations. The Trustees have concluded that there are no low income or ethnic minority communities that would be adversely affected by the selected restoration project.

Executive Order Number 11514 (34 FR 8693) - Protection and Enhancement of Environmental Quality

An Environmental Assessment has been prepared and environmental coordination is taking place as required by NEPA.

EXECUTIVE ORDER NUMBER 12962 (60 FR 30769) - RECREATIONAL FISHERIES

The selected restoration project will help ensure the protection of recreational fisheries and the services they provide.

Appendix D. Administrative Record Index

I. Authorities
   A. Statutes
      1. Oil Pollution Act of 1990
      2. Coastal Management Program, American Samoa, 24.0501, et seq.
   B. Regulations
      1. Interim Claims Regulations
      2. Natural Resource Damage Assessment Regulations
      3. American Samoa Coastal Management Program Admin. Code, July 7, 1997
   C. Guidance
      1. Claims Guidance
      2. Guidance on Natural Resource Damage Claims
   D. Executive Order
      1. E.O. 13089, 63 FR 32701 (June 11, 1998)

II. Preassessment Phase
   A. Coordination with Response
      1. Nall, Roger, Pacific Environmental Corporation, Letter to USCG, MSO Office, Hawaii, Subject: Recollection of events in response to a threat of an Oil Spill in American Samoa in December 1991, 5/22/97
      2. Dreiu, M.D., Coast Guard Pacific Strike Team, Memo to Commanding Officer, USCG, MSO Hawaii, Subject: American Samoa Longliner Project (PST 13-97), 10/27/97
      3. Evans, Mary, and Nir Barnea, NOAA HAZMAT, to Sharon Christopherson, NOAA HAZMAT, Subject: Ammonia trajectory prediction for Pago Pago Harbor, American Samoa, 9/25/97
      4. Pacific Environmental Corp., Site Specific Health and Safety Plan for the Samoa Longliners Clean Up, July 1999
      5. Pollution Reports (POLREP), USCG
         a) Dec. 91, #1
         b) Dec. 91, #2
         c) Dec. 91, #3
         d) Dec. 91, #4
         e) Dec. 91, #5
         f) Dec. 91, #6
         g) Dec. 91, #7
         h) Mar. 97, #1
         i) Jul. 97, #2
         j) Sep. 97, #3
         k) Oct. 97, #4
         l) Mar. 98
         m) Jan. 99
         n) May 99
         o) Jun. 99, #1
         p) Jun. 99, #2
         q) Jun 99, #3

r) Jun. 99, #4
s) Jun. 99, #5
t) Jun. 99, #6
u) Jun. 99, #7
v) Jun. 99, #8
w) Jun. 99, #9
x) Jun. 99, #10
y) Jun. 99, #11

6. Tausaga, Togipa, American Samoa Environmental Protection Agency, Letter to USCG Captain of the Port, Honolulu, HI, Subject: Information about grounded longline fishing vessels in Pago Pago Harbor, 10/1/97
7. American Samoa, U.S. Army Corps of Engineers, Application for Emergency Department of the Army Permit to Remove Oil and Ammonia from Nine Longline Fishing Vessels, Pago Pago Harbor, American Samoa, 6/1/99
8. Naughton, John J., NOAA Oceania Regional Response Team Representative, Letter to USCG, Honolulu, HI, Subject: Comments on USCG IAP, 6/18/99
9. Karnella, Charles, NOAA National Marine Fisheries, Pacific Islands Area Office, Letter to District Engineer, U.S. Army Corps of Engineers, Subject: Emergency Department of Army Permit, 6/8/99

B. Coordination with Trustees

1. Kennedy, David M., NOAA Office of Response and Restoration, Letter to Sunia, Honorable Tauese P.F.. Governor of American Samoa, Subject: Emergency Restoration, 5/5/99
2. Kennedy, David M., NOAA Office of Response and Restoration, Letter to Matthew Millenbach, U.S. Department of the Interior, Subject: Emergency Restoration, 5/5/99
3. Sunia, Honorable Tauese P.F.. Governor of American Samoa, Letter to David Kennedy, NOAA Office of Response and Restoration, Subject: Emergency Restoration, 5/13/99
4. Millenbach, Matthew N., U.S. Department of the Interior, NRDAR Program Manager, Letter to David Kennedy, NOAA Office of Response and Restoration, Subject: Emergency Restoration, 5/12/99

C. Public Participation

1. Notice of Intent to Conduct Emergency Restoration Planning

III. Injury Assessment

A. Literature

1. Craig, P., B. Ponwith, F. Aitaoto, and D.Hamm, 1993. The Commercial, Subsistence, and Recreational Fisheries of American Samoa, *Marine Fisheries Review*, 55(2), 1993, pp. 109-116
2. McConnaughey, DMWR, for WPFMC Pelagics Plan Team, American Samoa: Analysis of Tournament Catches, 1993, pp. A-26-A-38
3. American Samoa Government, Important Health Advisory for Pago Pago Harbor, 10/11/91
4. Tuato'o-Bartley, T.E. Morrell, and P. Craig, 1993. Status of Sea

Turtles in American Samoa in 1991, *Pacific Science,* Vol 47, No. 3, pp. 215-221.
5. Grant, G.S., P. Craig, and G.H. Balazs, Notes on Juvenile Hawksbill and Green Turtles in American Samoa
6. Tourism Task Force, American Samoa, *Report to Governor: Background*
7. Connell, J.H., T.P. Hugues, and C.C. Wallace, 1997. A 30-Year Study of Coral Abundance, Recruitment, and Disturbance at Several Scales in Space and Time, *Ecological Monographs*, 67(4), pp. 461-488
8. Green, A., Status of the Coral Reefs of the Samoan Archipelago, July 1996
9. Green, A.L., C.E. Birkeland, R.H. Randall, B. Smith, and S. Wilkens, Department of Marine and Wildlife Resources, *75 Years of Coral Reef Degradation in Pago Pago Harbor: A Quantitative Record*, Appendix 1
10. Mundy. *A Quantitative Survey of the Corals of American Samoa*, a report prepared for Department of Marine and Wildlife Resources, American Samoa Government, January 1996
11. Mayor, A.G, *Structure and Ecology of Samoan Reefs,* Papers of the Department of Marine Biology
12. Government of American Samoa, Department of Public Works, *Wastewater Facilities Plan for American Samoa*, prepared by CH2M Hill, Inc., February 1976
13. American Samoa Environmental Protection Agency and Coastal Zone Management Program, *American Samoa Watershed Protection Plan*, Draft prepared by Pedersen Planning Consultants, September 1998
14. The IUCN Conservation Monitoring Center and United National Environment Programme, American Samoa, *Coral Reefs of the World - Volume 3: Central and Western Pacific,* 1988
15. Gittings, S.R., T.J. Bright, and B.S. Holland, Five Years of Coral Recovery Following a Freighter Grounding in the Florida Keys, *Diving for Science,* 1990
16. Gittings, S.R., T.J. Bright, A. Choi, and R.R. Barnett, The Recovery Process in a Mechanically Damaged Coral Reef Community: Recruitment and Growth, *Proceedings of the 6th International Coral Reef Symposium,* Australia, 1988, Vol. 2, pp. 225-230
17. Dennis, D., and T.J. Bright, The Impact of a Ship Grounding on the Reef Fish Assemblage at Molasses Reef, Key Largo National Marine Sanctuary, Florida, *Proceedings of the 6th International Coral Reef Symposium,* Australia, 1988, Vol. 2, pp. 213-218
18. Maragos, J.E., and C.W. Cook, Jr., The 1991-1992 Rapid Ecological Assessment of Palaus Coral Reefs, *Coral Reefs* (1995) 14:237-252
19. Dodge, R.E., A.H. Kap, S.C. Wyers, H.R. Frith, T.D. Sleeter, and S.R. Smith, The Effect of Dispersed Oil on the Calcification Rate of the Reef Building Coral *Diploria Strigosa*, *Proceedings of the Fifth International Coral Reef Congress,* Tahiti, 1985, Vol. 6, pp. 453-457
20. Maney, E.J., Jr., J. Ayers, K.P. Sebens, and J.D. Witman, Quantitative

Techniques for Underwater Video Photography, *Diving for Science*, 1990, pp. 255-265
21. Kuchler, D.A., R.T. Bina, and D. van R. Claasen, Status of High-Technology Remote Sensing for Mapping and Monitoring Coral Reef Environments, *Proceedings of the 6th International Coral Reef Symposium*, Australia, 1988, Vol. 1, pp. 97-101
22. Miller, Steven L., and Dione W. Swanson, ACoral Community Rapid Assessment,@ *Florida Keys National Marine Sanctuary Zone Performance Report - Year 1*
23. Tomkins, P.A., D.K. Bass, D.A.J. Ryan, and H. Sweatman, Video Identification of Benthic Organisms: How Accurate is It? Australian Institute of Marine Science
24. Hudson, J.H., and R. Diaz, Damage Survey and Restoration of M/V Wellwood Grounding Site, Molasses Reef, Key Largo National Marine Sanctuary, Florida, *Proceedings of the 6th International Coral Reef Symposium,* Australia, 1988, Vol. 2, pp. 231-236
25. Fujita, R.M.., M.S. Epstein, Thomas J. Goreau, and Kristina Gjerde, A Guide to Protecting Coral Reefs, Environmental Defense Fund, November 1992
26. Threats to Coral Reefs, March 1, 1999
27. U.S. Environmental Protection Agency, Development of Biological Criteria for Coral Reef Assessment: References, March 23, 1999
28. Receiving Water Quality Monitoring Report, Pago Pago Harbor, American Samoa, March 1996 Sampling, Prepared for StarKist Samoa, NPDES Permit AS0000019 and VCS Samoa Packing NPDES Permit AS0000027, by CH2M Hill and GDC, March 6, 1997
29. Saucerman, S., Department of Marine and Wildlife Resources (DMWR), American Samoa, The Inshore Fishery of American Samoa, 1991-1994,@ *DMWR Biological Report Series, No. 77,* 1995
30. Ponwith, B.J., Department of Marine and Wildlife Resources (DMWR), American Samoa, The Shoreline Fishery of American Samoa: A 12-Year Comparison, *DMWR Biological Report Series, No. 2,* 1991

B. Contractor Reports

IV. Restoration Planning

14.0 Preparers

The following individuals participated in the development of this DARP/EA:

Jim Hoff, NOAA Damage Assessment Center
Linda Burlington, NOAA Office of General Counsel
Curtis Carlson, NOAA Damage Assessment Center
Lelei Peau, American Samoa, Department of Commerce
Sheila Wiegman, American Samao, Environmental Protection Agency
Rick Dawson, U.S. Department of the Interior, National Park Service
Nick Pula, U.S. Department of the Interior, Office of Insular Affairs

15.0 Finding of No Significant Impact

Having reviewed this environmental assessment relative to the proposed emergency restoration action in Pago Pago, American Samoa, I have determined that there will be no significant impacts from the proposed action. Accordingly, preparation of an environmental impact statement on these issues is not required by Section 102 (2)(c) of the National Environmental Policy Act or it's implementing regulations.

Ted I. Lillestolen Date
Deputy Assistant Administrator for
Ocean Services and Coastal Zone Management

Having reviewed this environmental assessment relative to the proposed emergency restoration action in Pago Pago, American Samoa, I have determined that there will be no significant impacts from the proposed action. Accordingly, preparation of an environmental impact statement on these issues is not required by Section 102 (2)(c) of the National Environmental Policy Act or it's implementing regulations.

Mike Soukup   Date
Associate Director for Natural Resource
  Stewardship and Science
National Park Service
U.S. Department of the Interior

Having reviewed this environmental assessment relative to the proposed emergency restoration action in Pago Pago, American Samoa, I have determined that there will be no significant impacts from the proposed action. Accordingly, preparation of an environmental impact statement on these issues is not required by Section 102 (2)(c) of the National Environmental Policy Act or it's implementing regulations.

____

Governor Date
American Samoa Government