DRAFT DAMAGE ASSESSMENT AND RESTORATION PLAN
and
ENVIRONMENTAL ASSESSMENT
for the
FEBRUARY 2, 2005,
M/V CAPE FLATTERY GROUNDING
at
KALAELOA, BARBERS POINT OAHU

Prepared by:
The Natural Resource Trustees
for the M/V *Cape Flattery* Grounding, Oahu Hawaii

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National Oceanic and Atmospheric Administration

U.S. Department of the Interior
U.S. Fish and Wildlife Service

State of Hawaii
Department of Land and Natural Resources

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1.0 INTRODUCTION: PURPOSE OF AND NEED FOR RESTORATION

1.1 INTRODUCTION

On February 2, 2005, the 555-foot bulk carrier *M/V Cape Flattery* grounded on coral reef habitat outside the entrance channel to Barbers Point Harbor, Oahu, Hawaii (Figure 1). Because of the substantial threat of a discharge of oil into navigable waters, the U.S. Coast Guard (USCG), State of Hawaii and Responsible Parties (RPs) developed a Salvage Operations Oil Spill Contingency Plan as part of an Incident Action Plan to provide direction for the response operations. Over the following days, responders offloaded fuel and cement cargo. Tugs and other vessels attempted to remove the M/V *Cape Flattery* from its grounded position and succeeded on February 11, 2005. Although cement cargo spilled into the water during offloading, no substantial discharge of oil to the environment occurred.

FIGURE 1. MAP SHOWING THE GROUNDING SITE FOR THE M/V CAPE FLATTERY.

On February 11, 2005 a team of biologists from the State of Hawaii Department of Land and Natural Resources (DLNR), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Fish and Wildlife Service (USFWS) (collectively "Trustees" or Natural Resource Trustees) and the RPs began assessment activities, collecting direct physical evidence, photo documentation, area measurements and recording observations to determine whether physical injury to natural resources, including coral reef habitat and its associated community, had occurred as a result of the grounding and response operations. The collective evidence and observations from the these activities confirmed that physical injury to coral reef habitats and resources resulting from *M/V Cape Flattery* stabilization and response activities was widespread (Kenyon 2005, Kolinski 2005a and b, Polaris Applied Sciences, Inc. 2005). The injuries to natural resources in the area included, but were not limited to, pulverized coral, sheared, shattered and overturned corals, scarring and limestone pavement fractures. The Trustees determined that additional actions to quantify and further document injury were necessary.

The Trustees conducted initial injury quantification efforts using geo-referenced towed-diver photo documentation surveys on February 15, 2005, and continued initial quantification efforts between September 6 and November 30, 2005. The Trustees estimated that injuries to habitat and resources occurred across 79,085 square meters (7.91 hectares (ha), 19.5 acres) of coral reef. These areas sustained injuries as a result of the deployment and removal of the ship's anchor and chain; movement of the vessel over nine days; use of tow lines that were not floated (creating a "weed whacker" effect on corals); and movement of Incident-generated rubble.

Six habitat zones sustained injuries as a result of the grounding and response actions. The estimated injuries included the injury and/or loss of over one million corals, ranging in size from the barely visible to linear diameters exceeding 160 cm (62 in); 150,000 macro-invertebrates; and 5,000 square meters (1.23 acres) of crustose coralline algae. The Trustees observed other evidence of ecological loss associated with a large-scale impact. When compared to reference areas, the Trustees found higher levels of native turf and/or macroalgae, indicating successional colonization of physically altered substrate in late 2005 (dives between Sept. 6-Nov. 30, 2005). Average fish numbers tended to be lower at impact sites, with statistically significant displacement evident in the shelf pavement region. All habitat zones in the impact area displayed significantly higher live fragment levels than at similar reference sites.

1.2 PURPOSE AND NEED

The purpose and need for action is to restore the affected area and injured resources impacted by the Incident, and to provide compensatory restoration to compensate for interim losses to the coral ecosystems of Oahu. This Draft Damage Assessment and Restoration Plan and Environmental Assessment (Draft DARP/EA) provides summarized information regarding 1) the environmental consequences of the grounding of the *M/V Cape Flattery* and the subsequent response activities (collectively "the Incident"), including the affected environment, 2) the determination and quantification of natural resource injuries, and 3) proposed natural resource restoration alternatives to address those injuries. This document also serves, in part, as the Trustee agencies' compliance with the National Environmental Policy Act (NEPA) and Title 19, Chapter 343, of the Hawaii Revised Statutes (*see* Chapter 5 for additional information).

1.3 NATURAL RESOURCE TRUSTEES AND AUTHORITIES

The Draft DARP/EA has been prepared by the National Oceanic and Atmospheric Administration (NOAA), on behalf of the U.S. Department of Commerce; with the U.S. Fish and Wildlife Service (USFWS), on behalf of the U.S. Department of the Interior; and Department of Land and Natural Resources (DLNR), on behalf of the State of Hawaii as cooperating agencies

Each of these agencies acts as a Natural Resource Trustee pursuant to the Oil Pollution Act of 1990 (OPA), 33 U.S.C. §§ 2701 *et seq.*), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. § 300.600, Executive Order (EO) 12777, 56 Fed. Reg. 54757 (Oct. 18, 1991) and Haw. Rev. Stat., Title 10, Ch. 128D. As a designated Trustee, each agency is authorized to act on behalf of the public under State and/or federal law to assess and recover natural resource damages and to plan and implement actions to restore natural resources and resource services injured or lost as the result of a discharge, or substantial threat of a discharge, of oil. The Trustees designated NOAA as Lead Administrative Trustee (LAT) (15 C.F.R. § 990.14(a)).

1.4 OVERVIEW OF LEGAL AUTHORITIES

1.4.1 OIL POLLUTION ACT OF 1990 & ITS IMPLEMENTING REGULATIONS

Under OPA, Trustees can recover the cost of: *primary restoration*, which is any action, including natural recovery, that returns injured natural resources and services to baseline; *compensatory restoration*, which is any action taken to compensate for interim losses of natural resources and services that occur from the date of the incident until recovery; and reasonable assessment costs.

OPA defines natural resources to include "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian tribe…." 33 U.S.C. § 2701(20); *see also*15 C.F.R. § 990.30.

As described in the OPA Natural Resource Damages Assessment regulations (OPA regulations), a natural resource damage assessment (NRDA) consists of three phases – preassessment, restoration planning, and restoration implementation.

The preassessment is an information gathering phase, during which the trustees determine whether they have jurisdiction to pursue restoration under OPA, and if so, whether it is appropriate to do so. Specifically, before initiating an NRDA, the trustees must determine that:

- an incident has occurred;
- the incident is not from a public vessel;
- the incident is not from an onshore facility subject to the Trans-Alaska Pipeline Authority Act;
- the incident is not permitted under federal, state or local law; and
- public trust natural resources and/or services[1] may have been injured as a result of the incident.

Id. at § 990.41(a).

If, based on information collected during the preassessment phase, the trustees make a preliminary determination that the conditions listed above are met, they will coordinate with response agencies (*e.g*., the USCG) to determine whether the oil spill response actions will eliminate the injury or the threat of injury to natural resources. If injuries are expected to continue and feasible restoration alternatives exist to address such injuries, the trustees may proceed with the restoration planning phase. Restoration planning also may be necessary if injuries are not expected to continue, but are nevertheless suspected to have resulted in interim losses of natural resources and/or services from the time of the incident until the time the resources recover.

The purpose of the restoration planning phase is to evaluate the potential injuries to natural resources and services and to use that information to determine the need for and scale of associated restoration actions. This phase provides the link between injury and restoration and has two basic components – injury assessment and restoration selection. The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services, thus providing a factual basis for evaluating the need for, type of, and scale of restoration actions. As the injury assessment is completed, the trustees develop a plan for restoring the injured natural resources and services. The trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a draft restoration plan presenting the alternative(s) to the public,

[1] The OPA regulations define natural resource services as "functions performed by a natural resource for the benefit of another natural resource and/or the public." 15 C.F.R. § 990.30. Examples of natural resource services include shelter for other species; food; recreation for humans such as diving or bird viewing.

solicit public comment on the draft restoration plan, and consider those public comments when drafting the final restoration plan.

During the restoration implementation phase, if the trustees and the responsible party (RP) have not already resolved the claim, the trustees will present the final restoration plan (a "demand") to the RP either to implement or to fund the Trustees' estimated costs to implement the restoration plan. The presentment provides the opportunity for settlement without litigation. Should the RP decline to settle, OPA authorizes trustees to bring a civil action against the RP for damages or to file a claim for these costs with the USCG's Oil Spill Liability Trust Fund.

Trustees may settle claims for natural resource damages under OPA at any time during the damage assessment process, provided that the settlement is adequate in the judgment of the trustees to satisfy the goals of OPA. The trustees should give particular consideration to the adequacy of the settlement to restore, replace, rehabilitate, or acquire the equivalent of the injured natural resources and services. Such settlements must be approved by a court as fair, reasonable, and in the public interest. Sums recovered in settlement of such claims, other than reimbursement of trustees' assessment costs, may only be expended in accordance with a restoration plan, which has been made available for public review.

1.4.2 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

While OPA and its implementing regulations provide the underpinnings for the Trustees' proposed restoration actions, another statute plays a critical role – NEPA, 42 U.S.C. §§ 4321, *et seq.* Congress enacted NEPA in 1969 to establish a national policy for the protection of the environment. NEPA requires an assessment of any federal action that may impact the environment. The Act establishes the Council on Environmental Quality (CEQ) to advise the President and to carry out certain other responsibilities relating to the implementation of NEPA by federal agencies. Pursuant to Executive Order 11514, federal agencies are required to comply with NEPA regulations adopted by CEQ. These regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing the environmental documentation necessary to demonstrate compliance with NEPA.

Generally, when it is uncertain whether an action will have a significant effect on the quality of the human environment, federal agencies will begin the NEPA planning process by preparing an Environmental Assessment (EA). The EA may undergo a public review and comment period. Federal agencies may then review the comments and make a determination. Depending on whether an impact is considered significant, the federal agency will either develop an environmental impact statement (EIS) or issue a finding of no significant impact (FONSI).

1.4.3 RELATIONSHIP BETWEEN NRDA AND NEPA

NEPA applies to restoration actions undertaken by federal natural resource trustees. The Natural Resource Trustees for the Incident are integrating the OPA and NEPA processes in this Draft DARP/EA. This integrated process allows the Trustees to meet the public involvement requirements of both statutes concurrently. This integrated process is recommended under 40 C.F.R. § 1500.2(c), which provides that federal agencies should "[i]ntegrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively."

This document serves, in part, as the agencies' compliance with the National Environmental Policy Act (NEPA) and Title 19, Chapter 343, of the Hawaii Revised Statutes (see Section 5 for additional information). This Draft DARP/EA complies with NEPA by 1) describing the purpose and need for restoration action in Chapter 1, "Introduction: Purpose and Need for Restoration"; 2) summarizing the current environmental setting in Chapter 2, "Affected Environment"; 3) identifying alternative actions and analyzing potential effects in Chapter 4, "Restoration Planning"; and 4) addressing the public participation requirements in Chapter 1.5, "Public Participation".

In regard to NEPA compliance for preparation of this Draft DARP/EA, NOAA is the lead federal agency and will coordinate the public input. The public is invited to review and provide comments on the proposed restoration activities and the alternatives considered in this Draft DARP/EA.

1.5 COORDINATION WITH THE RESPONSIBLE PARTY

The OPA regulations direct trustees to invite the RP to participate in the damage assessment and restoration process. Although the RP may contribute to the process in many ways, final authority to make determinations regarding injury and restoration rests solely with the trustees.

In this case, the Trustees and RP started informal cooperative assessment activities on February 11, 2005, when they began collection of direct physical evidence, photo documentation, area measurements and recorded observations, to determine whether physical injury to natural resources, including coral reef habitat and its associated community, had occurred as a result of the grounding and response operations. The trustees conducted an initial injury quantification between September 6 and November 30, 2005. The RPs declined to participate in this initial quantification effort.

In 2005, the trustees implemented emergency restoration activities to avoid irreversible losses and continuing danger to the coral reef benthic community. Although the RPs did not participate in the first round of emergency restoration, they did participate in a second round of emergency restoration, which began on July 6 and ended on July 24, 2006. During this effort, divers reattached an estimated 2000 corals and removed approximately 45 tons of loose reef material.

To facilitate the NRDA for this Incident, the Trustees and the RPs executed the "Cooperative Natural Resource Damage Assessment Agreement for the M/V *Cape Flattery* Incident," effective October, 2005[2] In this MOA, the Trustees and RPs agreed to attempt to perform an expedited assessment of damages in order to minimize assessment costs and to proceed with restoration as soon as possible. The RPs agreed to fund all reasonable costs of assessing injury, destruction or loss of natural resources or the services provided by those resources resulting from the Incident.

Thereafter, the Trustees and the RPs continued to gather and analyze data and to exchange their interpretations of those data. Ultimately, they reached agreement on damages that the Trustees determined to be sufficient to compensate the public for the resources that had been injured as a result of the Incident.

1.6 PUBLIC PARTICIPATION

In March of 2013 the Consent Decree was legally filed in the United States District Court, District of Hawaii. There was a 30 day public comment period between the filing and subsequent review of the consent decree. No comments were received.

Public review of the Draft DARP/EA is an integral component of the restoration planning process. Through the process of public review, the Trustees are seeking public comment on the alternatives being considered to restore injured natural resources or replace services provided by those resources, and on any other aspect of this Draft DARP/EA. When preparing the final restoration plan, the Trustees will review and consider comments received during the public comment period. An additional opportunity for public review will be provided in the event that the Trustees decide to make significant changes to the Draft DARP/EA based on the initial public comments.

Comments received during the public comment period will be considered by the Trustees before finalizing the document. Public review of the Draft Damage Assessment and Restoration Plan and Environmental Assessment is consistent with all state and federal laws and regulations that apply to the natural resource damage assessment process, including Section 1006 of OPA, the regulations for Natural Resource Damage Assessment under OPA (15 C.F.R. Part 990), NEPA (42 U.S.C. §§ 4371*, et seq*.), and the regulations implementing NEPA (40 C.F.R. Part 1500, *et seq*.). The deadline for submitting written comment on the draft DARP/EA is [INSERT DATE].

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[2] Even though the Trustees and RPs began informal cooperative activities shortly after the Incident began, in their June 26, 2008, "Notice of Intent to Conduct Restoration Planning and Notice of Emergency Restoration Activities," the Trustees extended an official invitation to the RPs to continue participation in the damage assessment, restoration planning and restoration implementation efforts.

Comments on the draft Plan should be sent to:

Hawaii Restoration Comments
NOAA Restoration Center
Pacific Islands Regional Office
1601 Kapiolani Blvd, Suite 1110: Room 1117
Honolulu, HI 96814

Or can be emailed to:

HawaiiRestorationComments@noaa.gov

1.7 ADMINISTRATIVE RECORD

The Trustees have compiled an administrative record, which contains documents considered or prepared by the Trustees as they have planned and implemented the NRDA and address restoration and compensation issues and decisions. The administrative record is available online at:

http://www.darrp.noaa.gov/southwest/capeflattery/index.html.

Although the record is still being updated, it presently contains the information that the Trustees relied upon to make the decisions described in the Draft DARP/EA. The administrative record facilitates public participation in the assessment process. This Draft DARP/EA may also be viewed and downloaded at the website mentioned above
Additional information and documents, including public comments received on the Draft DARP/EA, the Final DARP/EA, and restoration planning documents, will be included in the record.

1.8 SUMMARY OF THE NATURAL RESOURCE DAMAGE CLAIM

The NRDA damage claim for the Incident encompasses primary and compensatory restoration actions for injuries and potential injuries to the following natural resources and services:

- Coral colonies
- Three dimensional reef structure
- Reef habitat
- Marine fish
- Marine Invertebrates
- Marine algal communities

The proposed primary restoration action is natural recovery and monitoring at the site of the Incident with the possibility of adaptive management if natural recovery is not succeeding.

The proposed compensatory restoration action is removal of large quantities of the alien algae *Kappaphycus/Eucheuma* spp. to prevent coral mortality in Kaneohe Bay, Oahu.

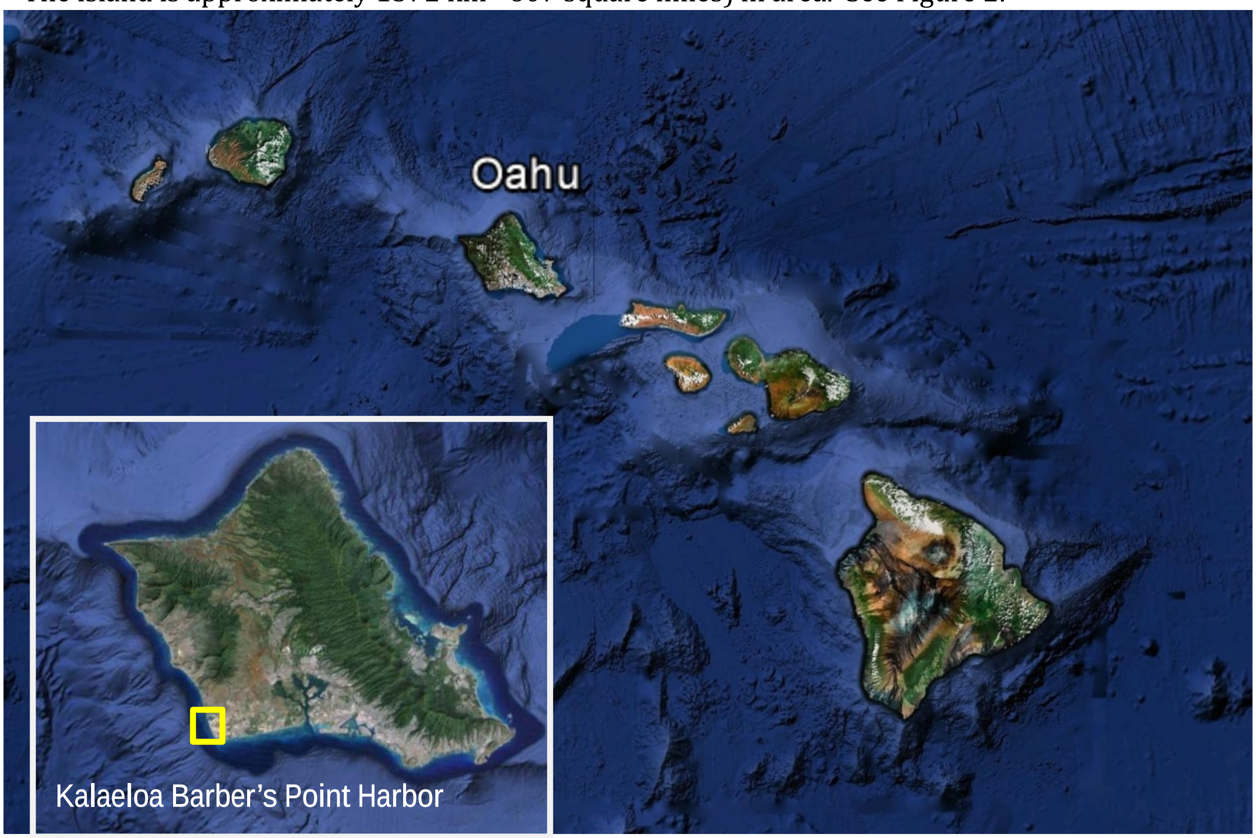
See Chapter Five for a discussion of these restoration actions.

2.0 AFFECTED ENVIRONMENT

The purpose of this section is to provide a general description of the environment, which encompasses the geographic area where the incident occurred and where the Trustees conducted assessment activities related to the incident.

2.1 GENERAL DESCRIPTION

The island of Oahu is located at roughly 21º 18' North Latitude and 158º 04' West Longitude between the islands of Kauai and Molokai along the Main Hawaiian Islands chain. The island is approximately 1572 km^2 (607 square miles) in area. See Figure 2.



As with the definition of ecosystem, the depth to which the shallow reef is defined is subjective. For this Draft DARP/EA, the ecosystem is defined as all waters to a depth of 98 feet. Because reef-building corals have a symbiotic relationship with microalgae that allows them to grow and thrive in the nutrient-poor waters of the tropics, these reefs have a depth limit based on the penetration of sunlight into the water column. Generally, coral reefs grow in water less than 30 m (98 ft.) (Grigg and Epp 1989), although non-reef-building corals are able to grow in much deeper waters (Maragos and Jokiel 1986; Veron 1986). In addition, there is a much better understanding of the shallow reef, as most coral reef assessment and monitoring are done in waters shallower than 30 m. (Maragos *et al*. 2004).

The shallow reef is a dynamic environment, experiencing constant wave surges and powerful winter and summer storms. Tropical storms and hurricanes can generate extreme wave energy that can damage shallow coral reef habitat. These events are the primary natural force in altering and shaping coral reef community structure (Dollar 1982; Dollar and Grigg 2004). They represent potential, but infrequent, natural threats to the shallow coral reef ecosystems of Hawaii. There is a growing concern that global warming and the concurrent acidification of the ocean may cause drastic changes to corals in the coming century (Hoegh-Guldberg 1999). Acidification, caused by increased levels of CO2 in the ocean, inhibits the deposition of calcium carbonate, the primary component of the coral skeleton (Kleypas *et al*. 2006).

The marine reef environment in this area is characterized by a limestone shoreline with an associated wave cut bench. Seaward of this bench, the bottom is characterized by a broad submerged reef platform spanning more than 1220 m (4000 ft.) in width in some areas. This reef platform ranges between 9-15 m (30 to 50 ft.) in depth and gives way to a slope that descends steeply to depths of 18-24 m (60 to 80 ft.) and deeper. In some areas, this slope gives way to ledges and near vertical drop-offs (Bienfang and Brock, 1980). The reef habitat and coral species display distinct zonation patterns with depth and distance from shore.

The shoreline in the area consists of limestone rock that gives way to a wave cut bench in the intertidal zone. This feature is covered with a narrow strip of calcium carbonate beach in some areas with narrow dunes shoreward (AECOS, 1991). This limestone face makes direct access to the ocean difficult but does support recreational angling near the harbor entrance channel. The wave cut bench environment supports several species of algae as well as the black rock boring urchin *Echinometra oblonga*. (AECOS, 1991). The notable higher densities of fleshy algae along this wave cut bench are attributed to high light levels, protection from herbivorous fish (due to the bench's intertidal nature),and increased access to nutrients from groundwater percolating through the porous limestone strata (McDermid, 1988; AECOS, 1991). Fish abundance and diversity are low in this area and consist mostly of members of two families, the Gobiidae and Blennidae (Parry, pers obs).

Directly offshore, the limestone bottom is characterized by surge channels perpendicular to shore, scour holes, and pockets of sand (AECOS, 1991b; Brock 1987). This zone is roughly 2-5 m (6 to 15 ft.) deep and extends 30-90 m (100 to 300 ft.) from shore in places (Bienfang and Brock 1980). This high wave energy habitat zone supports several types of lower growth forms of coral such as *Porites lobata* and thicker forms of branching species like *Pocillopora meandrina* (AECOS, 1991b). Sea urchins such as *Echinometra mathei* (pale rock boring urchin), *E. oblonga*, and *Heterocentrotus mammillatus* (slate pencil urchin) are present, and algae species in the area are fairly numerous and diverse (see Brock, 1987). Due to the relative lack of three dimensional habitat, fish abundance and diversity are low. Representative species include *Abudefduf abdominalis* (sergeant major) and *Cantherhines dumerilii* (barred filefish) as well as others (USFWS, 2007).

Seaward of this low relief inshore area, roughly 90-900 m (300 to 3000 ft.) or more from shore and 5-9 m (15 to 30 ft.) of water, the overall habitat complexity increases. This area is characterized by high vertical relief and high coral cover (Bienfang and Brock, 1980). Large lobate forms of coral such as *Porites lobata* are common with uniquely large colonies being present. Large colonies of *P. lobata* (2-3m (6 to 10 ft.) in diameter) have been reported in this area (AECOS, 1985 & 1991). Other common coral species include *Pocillopora meandrina* as well as various *Montipora sp.* Sea urchins such as *Tripneustes gratilla* (collector urchin), *Echinothrix diadema* (blue black urchin), *Echinometra mathaei* (pale rock boring urchin) and *Echinostrephus aciculatum*((needle spine urchin) also are present. Common fish species found in this area include the surgeonfishes *Acanthurus nigrofuscus* (brown surgeonfish), *Ctenochaetus strigosus* (spotted surgeonfish), as well as the wrasse *Thalassoma duperrey* (saddle wrasse) (AECOS, 1991; USFWS, 2007)

Further offshore, roughly 900-1100m (3000 to 3500 ft.) from land and 9-12 m(30 to 40 ft.) deep, the bottom is characterized by low relief and lower coral cover. The habitat consists of flat hard “table-like” bottom with numerous shallow (2-6 m, 5 to 10 feet) deep rubble filled depressions (AECOS, 1991; Bienfang and Brock, 1980; Kolinski *et al*., 2007). Coral species in the area consist predominantly of *Porites lobata*, which are found at highest densities on the edges of the depressions. *Chelonia mydas* (green sea turtle) are common in the area as are *Stenella longirostris* (Hawaiian spinner dolphin), although the dolphins appear to mostly transit through the area. *Echinometra mathaei* (pale rock boring urchin) are found in the area, and juvenile fishes are concentrated around and within the depressions.

The “table-like” formation gradually slopes offshore to depths of roughly 15 m(50 feet) where coral abundances increase on the edge of a rapidly sloping bottom feature. The top edge of this slope supports higher coral abundances and species than the inshore flat section. Corals in the areas include *Pocillopora meandrina, P. eydouxi, Montipora sp*., as well as *Porites lobata* and others (Kolinski *et al*., 2007). Urchin diversity increases in this zone as well with *Tripneustes gratilla*, *Echinothrix diadema, Echinometra mathaei* and *Echinostrephus aciculatum* all present in the area.

The limestone shelf (which includes all the previously discussed habitats) transitions roughly 4000 feet offshore into ledges and drop-offs that descend steeply to depths of 25 m (80 ft.) or more. The slope terminates at a bottom of sand and scattered rubble with isolated coral and limestone outcrops (Kimmerer and Durbin, 1975). Coral is predominantly *Porites lobata* and *Montipora sp.* Sand areas appear to be fairly heavily colonized by *Halophila decipiens* (seagrass that is a known forage species for Hawaiian Green sea turtles, *Chelonia mydas*; Russell et al. 2003), *Caulerpa sp*. (a green algae), and the non-indigenous algae *Avrainvillea amadelpha* (mud weed) (Kolinski *et al*., 2007). The sand rubble habitat slopes offshore into deeper waters and transitions out of the near shore reef habitat into deeper waters (greater than 30 m, 100 feet).

3.0 INJURY DETERMINATION AND QUANTIFICATION

3.1 DESCRIPTION OF THE GROUNDING AND RESPONSE ACTIVITIES

During the early morning hours of February 2, 2005, the M/V *Cape Flattery* grounded on a coral reef at Barbers Point while attempting to enter the channel to Barbers Point Harbor (Figure 3).

FIGURE 3. Aerial photo showing the M/V *Cape Flattery* hard aground on near shore coral reef. The light colored areas near the vessel are where the reef has been scoured away revealing bare limestone beneath.

The vessel missed the channel and grounded on the reef south of the channel (USCG undated report). Before grounding on the reef shelf, the vessel crossed above the reef slope (about 24-14 m, 80-45 feet deep) and the reef escarpment (17-14 m, 55-45 feet deep) (Kolinski, *et al.* 2007). With a draft of 10.1m (33.2 ft.), the vessel did not strike the vertical faces of the reef slope or the escarpment of the reef. Instead, the M/V *Cape Flattery* grounded on the broad, horizontal platform of the reef shelf, which is less than 14m (45 ft.) deep (Figure 4 & 5). At the time of the grounding, the vessel was laden with 27,000 metric tons of bulk cement powder (USCG incident report).

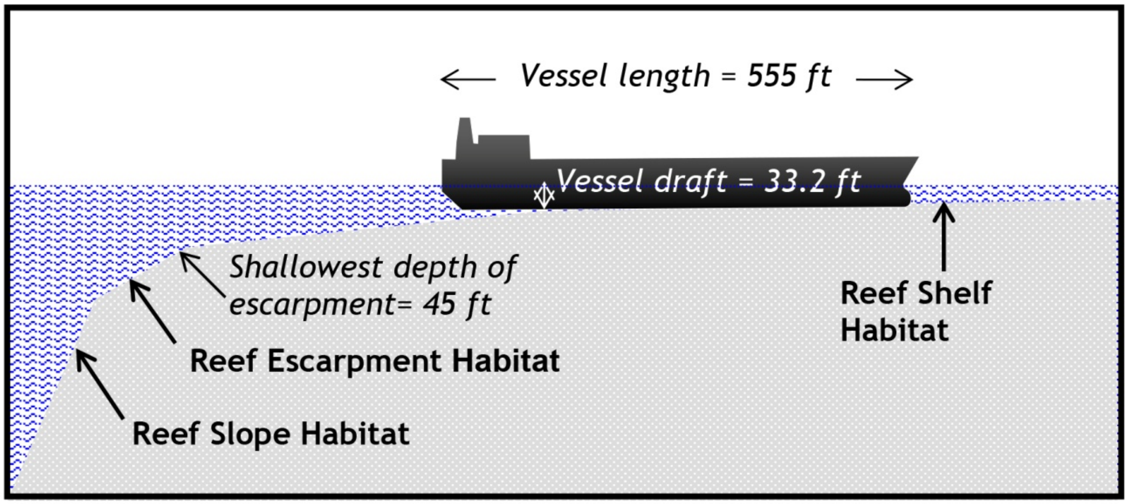


FIGURE 4. Diagram of the reef structure and grounding position of the M/V *Cape Flattery* (*not to scale*).

FIGURE 5. Aerial view of the hull impact (bare limestone) after the M/V *Cape Flattery* was towed off the reef. The light colored areas show the extent of the hull impact. The white object is a 8m (26 ft.) long vessel. The edge of the reef shelf (darker blue) can be seen in the top right corner.

After the grounding, the Trustees observed that the M/V *Cape Flattery* had dropped at least one anchor onto the coral reef. Subsequently, Trustee diver biologists observed that the anchor and anchor chain had injured the reef habitat by crushing and scraping corals (Figure 6).

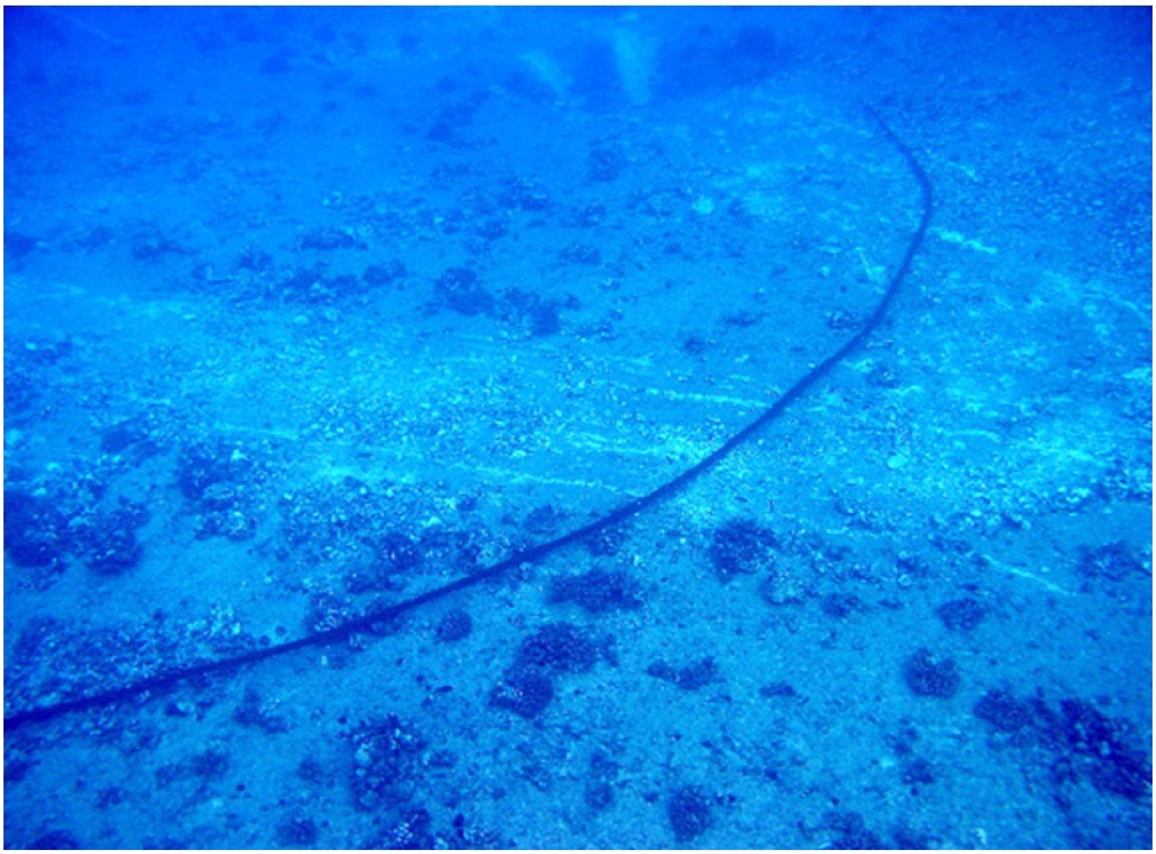


FIGURE 6. A drag scar from the anchor and associated chain that was deployed from the M/V *Cape Flattery* and dragged along the reef. The light colored areas show the injury from the anchor and chain; unaffected coral can be seen to either side of the drag impact.

In attempts to drag the vessel free of the reef, multiple tugboats were connected to the M/V *Cape Flattery* with thick, heavy (multi-ton), steel tow cables that were not floated. When the vessel first grounded, two tugboats attempted to tow the ship off the reef (USCG undated report). After the vessel was partially lightered (Figure 7), three tugboats participated in floating the M/V *Cape Flattery* off the reef (USCG Feb. 11, 2005).

When the tow cables were slack, the tugboats dragged these sunken, heavy, steel cables across the reef habitats, crushing and scraping away corals and other reef biota. In addition, immediately after the M/V *Cape Flattery* was floated free of the reef, the Trustees found freshly excavated areas in the reef habitat that were most likely produced by prop-wash from the tug boats.

FIGURE 7. Aerial photo of the M/V *Cape Flattery* being lightered of its cement powder cargo. Cement can be seen spilling into the ocean.

The efforts to free the vessel rotated and shifted the grounded vessel on the reef shelf habitat. In this process, the heavy steel hull of the 170m (555 ft.) M/V *Cape Flattery* acted as a massive grindstone, crushing and grinding the physical reef structure, corals, and other biota beneath the vessel. The efforts to free the grounded M/V *Cape Flattery* lasted for approximately 9 days.

3.2 PREASSESSMENT APPROACH

There are three pre-conditions set forth in the OPA regulations before restoration planning can proceed:

1) INJURIES HAVE RESULTED, OR ARE LIKELY TO RESULT, FROM THE INCIDENT OR RESPONSE TO THE INCIDENT;

2) RESPONSE ACTIONS HAVE NOT ADEQUATELY ADDRESSED, OR ARE NOT EXPECTED TO ADDRESS, THE INJURIES RESULTING FROM THE INCIDENT; AND

3) FEASIBLE PRIMARY AND/OR COMPENSATORY RESTORATION ACTIONS EXIST TO ADDRESS THE POTENTIAL INJURIES.

The goal of injury preassessment under OPA is to determine the jurisdiction of the Trustees, determine that the incident is not excluded from coverage of the law under another authority and to determine whether resources under trusteeship may have been, or may be, injured as a result of the incident. 15 C.F.R. § 990.40. Injury determination begins with the identification and selection of potential injuries to investigate given the nature and scope of the incident. The large scale of this Incident, coupled with little precise information on where response and recovery operations took place around the vessel, required that the preassessment be relatively comprehensive in nature.

3.3 SUMMARY OF PREASSESSMENT ACTIVITIES

The Trustees and the RP biologists, Polaris Applied Sciences, Inc., began cooperative pre-assessment evaluations on February 11, 2005. They collected direct physical evidence, photo documentation, area measurements and recorded observations, to determine whether physical injury to natural resources, including coral reef habitat and its associated community, had occurred as a result of the grounding and response operations. The collective evidence and observations from the these activities confirmed that physical injury to coral reef habitats and resources resulting from *M/V Cape Flattery* stabilization and response activities was widespread (Kenyon 2005, Kolinski 2005a and b, Polaris Applied Sciences, Inc. 2005). The Trustees conducted initial injury quantification efforts (geo-referenced towed-diver photo documentation surveys) on February 15, 2005 and documented that work (Kenyon 2005). This report discusses the additional preassessment activities and analyses that refine the area estimates and further quantify injury to coral reef habitats and resources.[3] Based on the results of this preassessment work, the Trustees determined that additional actions to quantify and further document injury were necessary.

3.4 ASSESSMENT APPROACH AND RESULTS[4]

[3] For more information, see the Administrative Record at [insert].

[4] For a detailed description of the assessment activities and the results, see the Administrative Record at http://www.darrp.noaa.gov/southwest/capeflattery/pdf/PreAssessmentReport.pdf.

The Trustees conducted assessment activities between September 6 and November 30, 2005.[5]
The Trustees designed the assessment to ascertain gross impacts to major constituents (substrate topography, scleractinian corals, non-coral macroinvertebrates, algae and fish) of the coral reef community in the Incident area, using simple, robust, and cost effective procedures. The data also serve as baseline for defining injury as it relates to natural temporal community trends and for monitoring further site degradation and/or recovery. Relevant information on community structure prior to the grounding was not available. Severe crushing, breakage and displacement of reef habitat and organisms limited the ability to directly assess injury. The Trustees therefore based the assessment on community comparisons between impact and reference habitats. They designated habitat zones to represent fully the variability of the area and the different species assemblages found there (slope, escarpment, shelf pavement, reef depressions, and *Porites* zone).
3.4.1 GENERAL METHODS

The Trustees observed that six habitat zones sustained injury as the result of the grounding of the M/V *Cape Flattery* and the subsequent response activities. Those habitats included the deep rock and seagrass zone, escarpment zone, escarpment top area, shelf pavement zone, reef depressions, and the *Porites* zone (figure X 3)

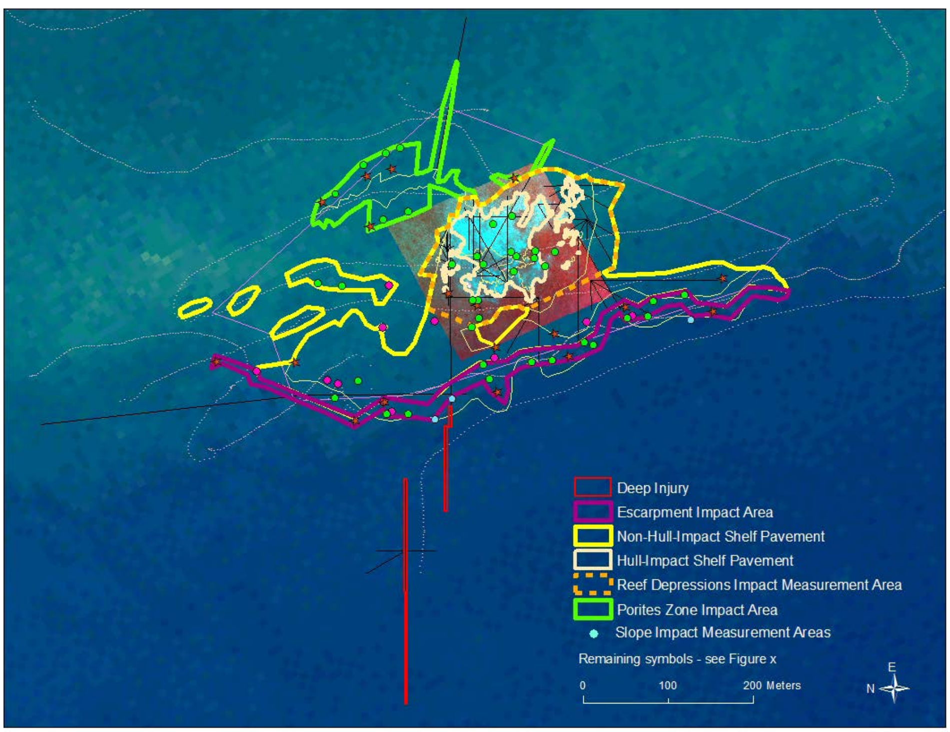


Figure X 3: Area of M/V Cape Flattery incident indicating general habitat zones.

[5] Although the Trustees invited RP representatives to participate in the assessment, they declined.

1. Deep rock and seagrass – Sand, accumulated rock and pavement habitat seaward of the escarpment slope gradually descends from 25 to greater than 37 m (80-120 ft.) depths. The sand areas are heavily colonized by the seagrass *Halophila decipiens*, forage for Hawaiian sea turtles, native algae and non-indigenous algae, *Avrainvillea amadelpha.* The accumulated rock debris supports various live corals and macroinvertebrates. The deployment and removal of the vessel's anchor and chain and the movement of Incident-generated debris injured areas of this habitat.

2. Escarpment slope – This submerged historical shoreline on the north and south of the Barbers Point Harbor channel forms a nearly vertical seaward face of the reef extending from the escarpment top downwards to deep rock and seagrass habitat (approximately 25m deep). The area is characterized by small to mid-sized lobate, encrusting and branching corals, various macroinvertebrates, high coralline crustose, turf, and marcoalgae cover, resident and mobile fishes and caves and crevices used by sharks and sea turtles as resting habitat. The deployment and removal of the vessel's anchor and chain and/or the movement of Incident-generated debris injured areas of this habitat.

3. Escarpment top area – This area includes the escarpment crest, protruding ridges and areas within approximately 20 meters shoreward of the crest at 14-17m (45 to 55 ft.) depths. The area is characterized by heavily colonization by lobate and branching corals, various macroinverterates, fairly high turf, marco- and coralline crustose algae cover and high fish numbers and biomass, relative to the other habitat zones investigated by the Trustees. Towlines, anchor chain, cables and Incident-generated reef debris caused injury to this area.

4. Shelf pavement – The hard reef pavement area slopes gradually from approximately 7 m depth to approximately 14m depth. The corals in this area are characterized by encrusting, lobate and branching species that reach large (greater than 80 cm (32 in.)diameter) sizes. Their distribution is varied. This community also includes green sea turtles, macroinvertebrates, turf and coralline crustose algae cover and a variety of resident and semi-vagile fish. This area sustained injury from the direct impact of the ship's hull, deposition of cement during cargo offloading, and from towlines, anchor chain, cables and Incident-generated reef debris.

5. Reef depressions – Natural depressions of varying sizes and depths are scattered throughout the shelf pavement area. These depressions are resting areas for Hawaiian green turtles and support a variety of other species such as coral, algae, resident and semi-vagile fish and macroinvertebrate. These depressions sustained injury from movement of the vessel's hull, towlines, anchor chain, cables and Incident-generated reef debris and sediment.

6. *Porites* zone – This shoreward extension of the shelf pavement at 8-11 m (25 to 35 ft.) depths, is characterized by large (greater than 160 cm (63 in) diameter) lobate *Porities* coral aggregations, other corals, algae, marcroinvertebrate and

> resident and semi-vagile fish species. This area sustained injuries from towlines and cables during vessel stabilization and response activities.

(Kolinski, *et al.* 2007).

The methods for estimating areas and quantifying injury to natural resources proceeded as follows. The Trustees selected sample sites by drawing multiple points on area photo maps within and outside suspected regions of Incident- related impact and then randomly selecting a set of points for impact and reference area sampling for each habitat zone (with the exception of impact slope sample sites which were fixed). [6] Reference selection included sites north and south of the site of the Incident. The location of injury in the shelf pavement zone was differentiated into hull- and non-hull impact areas for sampling and analyses. The Trustees measured five general categories of coral reef community composition, including topographic complexity, scleractinian corals, non-coral macroinvertebrates, algae, and fish at impact and reference locations.

The Trustees also measured the three dimensional complexity of the bottom (rugosity) along four 10 m (33 ft.) transects at replicate sites in escarpment top, shelf pavement and *Porites* zone habitats. They assessed site numbers and size categories of live coral fragments and attached colonies for individual species along with numbers of individuals of select groups of Mollusca, Crustacea and Echindermata within multiple 10 m^2 (108 ft^2) transects in escarpment slope, top, shelf pavement and *Porites* zones and throughout paired reef depressions at replicate sites. Major coral species were grouped by genus, functional habitat form and growth rate into the following categories: *Montipora* encrusting, *Pocillopora meandrina*/cauliflower, *Pocillopora eydouxi* and *Porites* lobate groups. The Trustees analyzed these categories with statistics being applied to colony size categories of $<$ or $\geq$ 10 cm greatest diameter.

The Trustees grouped and analyzed select species of macroinvertebrates as mobile urchin, boring urchin and guard crab functional groups. They assessed algal cover within three 0.25 m^2 quadrats along established 10 m transects. In reef depressions, they measured two quadrats along the bottom and one on north and south sides of depression walls. Algae were grouped as turf, macro, crustose coralline and invasive species for analyses. They visually surveyed fish numbers and sizes along two 25 m transects at each site (except slope habitat) or throughout individual reef depressions. Fish were grouped by mobility class (Friedlander and Parrish 1998) for analyses.

The Trustees determined separate estimates of injury and loss for corals, macroinvertebrates and coralline crustose algae based on significant differences between reference and impact areas using an α of 0.10 (to account for small sample sizes in a heterogeneous environment) by multiplying the difference in mean densities by estimated area of injury in each habitat zone. Modified injury values and power analysis results were

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[6] The Trustees did not survey the deep rock and seagrass zone for this assessment due to depth related safety and time concerns.

provided when P-values ranged between 0.100 and 0.050. The Trustees further differentiated corals with injury/loss estimates into their original size categories for estimating the length of time needed for coral population recovery.

3.4.2 SUMMARY OF INJURY DATA AND RESULTS

The Trustees estimated that over 1 million coral colonies (Table X 83), 150,000 macroinvertebrates (Table X 84) and 5,000 square meters of coralline crustose algae were lost or injured as a result of the grounding of the *M/V Cape Flattery* and the subsequent response activities. Seventy-one percent of corals were larger than 10 cm (4 in.) in greatest diameter. Estimated losses were greatest for *Montipora* encrusting and *Porites* lobate species but occurred in all groups. Other community functional groups tended to support ecological loss associated with a large-scale impact. Levels of turf and/or macroalgae tended to be higher in impact compared to reference areas, which supported observations of successional colonization of physically altered substrate. Analysis of injury in each habitat zone is presented in Kolinski et al. (2007).

Table X 83. Summary of projected loss/injury to coral functional groups by size category across habitat zones. Values in parentheses reflect estimates at α = 0.050 when estimates differ. Table from Kolinski et al. (2007).

	Colony Size Category								
	Small Colonies			Large Colonies					
Species Group	**1 to < 2 cm**	**2 to < 5 cm**	**5 to < 10 cm**	**10 to < 20 cm**	**20 to < 40 cm**	**40 to < 80 cm**	**80 to < 160 cm**	**> 160 cm**	**Total**
Montipora encrusting	70,517	290,157	176,654	106,208	41,051	6,482	626	0	691,694
Pocillopora cauliflower	20,123 (20,303)	50,883 (51,405)	16,545 (16,710)	4,187	8,886	799	0	0	101,423 (102,290)
Pocillopora eydouxi	686	8,196	11,449	9,500	14,740	3,942	1,239	0	49,753
Porites lobate	10,545 (9,618)	84,027 (74,333)	79,651 (72,126)	102,941 (91,811)	30,866 (26,202)	6,527 (5,478)	1,916 (1,886)	164	316,637 (281,618)
Total	101,871 (101,124)	433,263 (424,091)	284,299 (276,939)	222,836 (211,706)	95,543 (90,879)	17,750 (16,701)	3,781 (3,751)	164	1,159,507 (1,125,355)
% of Total	8.79 (8.99)	37.37 (37.69)	24.52 (24.61)	19.22 (18.81)	8.24 (8.08)	1.53 (1.48)	0.33	0.01	

Table X 84. Summary of projected loss/injury of select macro-invertebrate and algae functional groups across habitat zones. Values in parentheses reflect estimates at α = 0.050 when estimates differ. Table from Kolinski et al. (2007).

Functional Group	Macro-Invertebrates	Algae (m^2)
Boring Urchins	107,407	
Mobile Urchins	24,785 (16,511)	
Guard Crabs	21,628 (20,725)	
Coralline Crustose Algae		5,090
Total	153,820 (144,643)	5,090

Injury to scleractinian corals was particularly evident in the hull impact areas of the shelf pavement zone (Figure X 24)

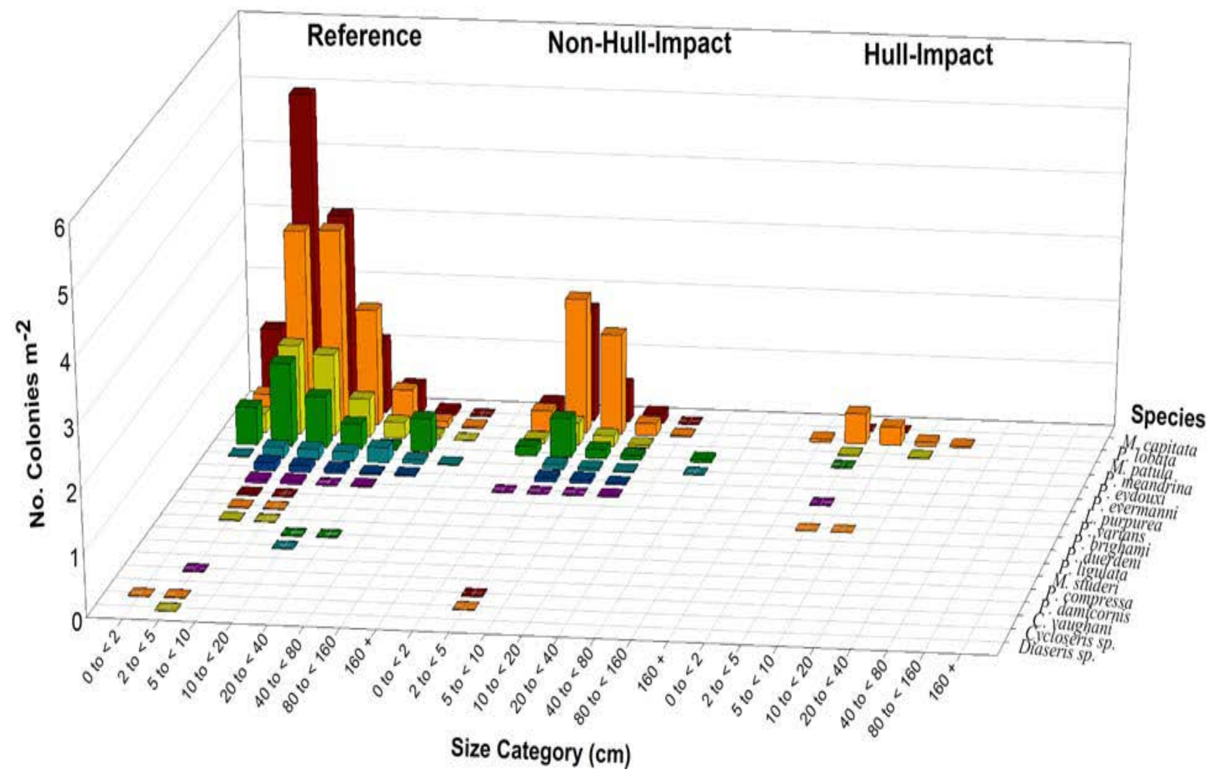

Figure X 24. Coral community composition represented as average number of attached colonies m^{-2} in reference, non-hull impact and hull-impact areas of the shelf pavement zone. Figure from Kolinski et al. (2007)

Average fish numbers tended to be lower at impact sites, with statistically significant displacement evident in the shelf pavement region (Table x 47). The Trustees did not project fish losses in this assessment due to difficulties in discerning levels of fish displacement from actual loss. They did observe dead fish in impacted areas soon after ship removal.

Table X 47. Fish species average abundance (numbers ha-1) at reference (Ref.), non-hull-impact (NHI) and hull-im(HI) sites within the shelf pavement zone. Mob. = mobility class. Table from Kolinski et al. (2007).

Species	Mob.	Ref.	NHI	HI	Species	Mob.	Ref.	NHI	HI
Chromis vanderbilti	R	4038	575	200	*Bodianus bilunulatus*	S2	38	0	0
Thallasoma duperrey	S1	2450	250	0	*Coris gaimard*	S1	38	25	0
Dascyllus albisella	S1	438	0	0	*Zebrasoma flavescens*	S1	38	0	0
Paracirrhites arcatus	R	400	162	0	*Acanthurus olivaceous*	S2	25	0	0
Acanthurus nigrofuscus	S1	362	50	100	*Caracanthus typicus*	R	25	0	0
Plectroglyphidodon johnstonianus	R	350	25	0	*Chromis ovalis*	R	25	0	0
Sufflamen bursa	S1	238	50	200	*Chlorurus sordidus*	S2	25	0	0
Plectroglyphidodon imparipennis	R	225	25	0	*Cirrhitops fasciatus*	R	25	25	0
Canthigaster jactator	S1	188	262	0	*Macropharyngodon geoffroy*	S1	25	0	0
Chaetodon miliaris	S1	188	0	0	*Naso hexacanthus*	S1	25	0	0
Parapeneus multifasciatus	S1	175	125	0	*Ostracion meleagris*	S1	25	0	17
Plagiotremus goslinei	R	138	0	0	*Paracirrhites forsteri*	R	25	0	0
Chaetodon quadrimaculatus	S1	112	0	0	*Echidna nebulosa*	S1	12	0	0
Scarus psittacus	S2	88	50	0	*Gomphosus varius*	S1	12	0	0
Chaetodon ornatissimus	S1	75	0	0	*Canthigaster coronata*	S1	0	25	0
Halichoeres ornatissimus	S1	75	0	0	*Cantherhines dumerilii*	S1	0	25	17
Coris venusta	S1	50	75	100	*Melichthys vidua*	S1	0	0	17
Parapercis schauinslandi	S1	50	100	317	*Naso unicornis*	S2	0	50	67
Pseudocheilinus octotaenia	S1	50	0	0	*Oxycheilinus unifasciatus*	S1	0	0	17
Pseudocheilinus tetrataenia	S1	50	0	0	*Sufflamen fraenatus*	S2	0	62.5	0
Rhinecanthus rectangulus	S1	50	38	267					

All habitat zones in the impact area displayed significantly higher live fragment levels than at similar reference sites (Table x 85). In some of these zones, live fragment data suggested injury had occurred to measured species groups, even though it may not have been resolved through statistical analysis of the attached coral community comparisons.

Table X 85. Summary of live fragment estimates across habitat zones. Values in parentheses reflect estimates at α =0.050 when estimates differ. Table from Kolinski et al. (2007).

	Fragment Size Category							
Species Group	**1 to < 2 cm**	**2 to < 5 cm**	**5 to < 10 cm**	**10 to < 20 cm**	**20 to < 40 cm**	**40 to < 80 cm**	**80 to < 160 cm**	**Total**
Montipora encrusting	2,582	5,749	2,042	158	238	0	0	10,769
Pocillopora cauliflower	1,107	29,012 (29,010)	24,505	4,371	2,757 (2,755)	0	0	61,752 (61,748)
Pocillopora eydouxi	208	5317	4,936	3164	1535	218	0	15,378
Porites lobate	2,845	23,086	17,353	12,060	7,226	3,035	136	65,741
Total	6,742	63,164 (63,162)	48,836	19,753	11,756 (11,754)	3,253	136	153,640 (153,636)
% of Total	4.39	41.11	31.79	12.86	7.65	2.12	0.09	

The Trustees did not assess dead attached corals, which provide habitat. Rugosity measurements incorporated the presence of unconsolidated reef debris, which may ultimately shift to reef depressions and/or down the escarpment slope. The Trustees did not survey communities injured by the anchor and chain in deep rock and seagrass habitats below the escarpment slope or communities at the base of the slope where debris had and will continue to accumulate, in this assessment due to depth, dive time and safety reasons.

In addition, the Trustees did not design the sampling to assess the presence of coral predators at levels useful for applying statistically appropriate comparative analyses. However, measured averages and anecdotal observations suggest larger mean numbers of the coral eating starfish *Acanthaster planci* and *Culcita novaeguinaeae* occurred in impact compared to reference areas in slope and escarpment habitats. The Trustees also observed *Drupella* sp., a coral eating mollusk not measured in this assessment, to be seriously impacting injured and restored Pocilloporid corals in areas disturbed by response efforts. (Kolinski, pers. obs.) Potential latent injury to corals in the impacted community may have occurred as a result of coral predators being attracted by chemical cues released from the injured corals and then feeding on those corals.

Scleractinian corals and crustose coralline algae create and consolidate habitat framework utilized by other sessile and mobile coral reef animals. Herbivorous fish and urchins may facilitate habitat recovery by continuous predation on colonizing fleshy algae, which compete for open space with corals and crustose coralline algae. The Trustees made projections on recovery rates of corals and crustose coralline algae using data from the site and pertinent literature. Recovery levels and rates of the impacted reef will likely depend on the recruitment, growth and activities of multiple coral reef community constituents, including macroinvertebrates and fish.

3.4.3 RECOVERY PROJECTIONS

The Trustees estimated recovery of injury to scleractinian corals for *Montipora* encrusting, *Pocillopora* cauliflower, *P. eydouxi* and *Porites* lobate species groups by individual size categories. Recovery modeling incorporated recruitment and proportional survival rates inferred from attached colony size frequencies in reference areas, measured growth of reference colonies within the Incident area, and projected survival and growth of population structure remaining in the Incident area (Table X 1 Kolinski 2007).

Table X 1. Rates of growth for species injured at Barbers Point, Oahu (*estimate partially derived from values in literature; ** total proportion of species' individuals within a species group as measured in pre-assessment reference transects, see Kolinski et al. 2007).

Species group	Species used to represent growth rate	n	Min. Linear Size (cm)	Max. Linear Size (cm)	Average Growth (cm yr^{-1}) ± S.E.	**Species reference site representation within species group (%)
Montipora encrusting	*M. capitata* and *M. patula*				2.29*	99.9
Pocillopora cauliflower	*P. meandrina*	41	6	40	1.99 ± 0.15	99.6
Pocillopora eydouxi	*P. eydouxi*	20	20	94	4.76 ± 2.05	100
Porites lobate	*P. evermanni* and *P. lobata*	40	8	73	1.76 ± 0.21	99.9

In Hawaii, average growth rates of settlers and young recruits appear reduced compared to those of larger colonies (Kolinski 2004, unpub. data, and see Edmunds 2007). Initial time periods necessary for new settlers to establish and grow were estimated as follows: 6 years for Montipora encrusting to reach an average of 2.5 cm linear diameter; 3 years for *Pocillopora meanadrina* to reach 2.5 cm; 6 years for *Pocillopora eydouxi* to reach 8.1/8.9 cm, and; 5 years for Porites lobate to reach 2.5 cm (see Kolinski 2004 and Grigg and Maragos 1974). Linear growth rates from Table X 1 were applied thereafter and considered constant.

Fundamental assumptions were that average reference population structure adequately reflected spatial and temporal variability inherent in site specific population dynamics, that history, over the long term, would be repetitive, and that parameter estimates would apply, without inhibition, to injured areas. Kolinski (2007) calculated recovery projections for each of the scelatinian coral genera individually. Presented here are examples from Kolinski (2007) for *Montipora* and *Porites*.

Slower growing *Montipora* encrusting Table X 2 and Figure X 1) and *Porites* lobate species groups (table X 5 and Figure X 4) were represented by the largest colonies and displayed the longest projected terminal recovery times (57 and 117 years respectively).

Montipora encrusting
Cumulative recovery and associated time estimates for Montipora encrusting colonies are provided in Table 2 along with reported loss and percentage of total loss for each size category. Recovery projections range from 6 to 57 years for lost colonies based on average sizes within categories (Table 2, Figure 1). Colonies less than 20 cm diameter accounted for over 90 % of projected loss; recovery of these corals is estimated to occur within approximately 11 years. Resource value associated with larger colony sizes may take approximately 57 years to replace.

Table 2. Projections of proportional recovery of estimated Montipora encrusting coral losses by size category (represented by category size averages) (Table from Kolinski 2007).

	Size Category Average (cm)						
Year	**2.5**	**7.5**	**15**	**30**	**60**	**120**	**All Sizes**
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2		0.04					0.01
3			0.13				0.03
5	1.00		0.16				0.03
6							0.56
7				0.01			0.56
8		1.00					0.80
10				0.16			0.81
11			1.00				0.94
12				0.19			0.94
13					0.03		0.94
18				1.00			0.99
20					0.05		0.99
23					0.27		0.99
25					0.30		0.99
26						0.02	0.99
31					1.00		0.999
39						0.06	0.999
46						0.08	0.999
49						0.34	0.999
51						0.37	0.999
57						1.00	1.00
Initial Loss	360,674	176,654	106,208	41,051	6,482	626	691,695
% of Total	52.14	25.54	15.35	5.93	0.94	0.09	100

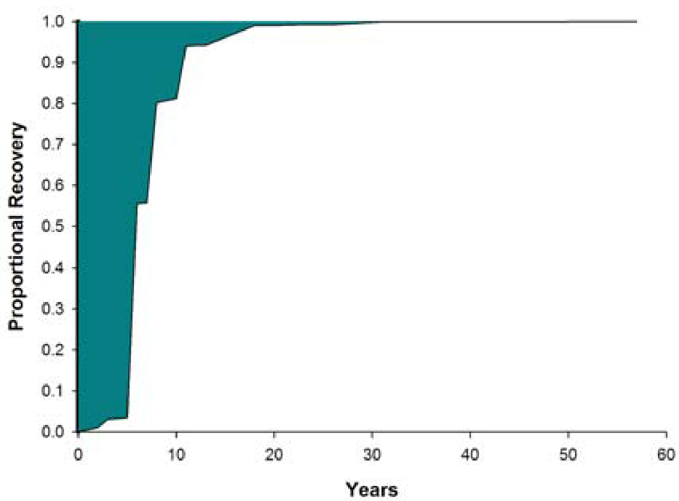

Figure X 1. Projections of recovery of *Montipora* encrusting colony losses. Recovery of all size classes is expected to require 57 years. Figure from Kolinski (2007).

Porites lobate

Recovery projections, estimated loss and percentage of total loss for *Porites* lobate colonies are provided in Table X 5 and Figure X 4. Estimated recovery ranges from 5 to 117 years for the lost colonies based on average size within categories. Colonies less than 20 cm diameter accounted for nearly 90 % of projected loss; recovery of these corals is estimated to occur within approximately 12 years. Resource value associated with larger colony sizes may take approximately 117 years to replace.

Table X 5. Projections of proportional recovery of estimated Porites lobate coral losses by size category (represented by category size averages). Table from Kolinski (2007).

	Size Category Average (cm)							
Year	**2.5**	**7.5**	**15**	**30**	**60**	**120**	**200**	**All Sizes**
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3		0.02						0.01
4			0.47					0.16
5	1.00							0.46
7			0.48					0.46
8		1.00						0.71
9				0.01				0.71
12			1.00					0.88
13				0.55				0.93
16				0.56				0.93
17					0.002			0.93
21				1.00				0.97
26					0.01			0.97
30					0.56			0.98
33					0.56			0.98
34						-0.01		0.98
38					1.00			0.99
45							0.02	0.99
51						-0.02		0.99
60						-0.01		0.99
64						0.51		0.996
67						0.47		0.996
72						1.00		0.999
80							-0.01	0.999
97							-0.02	0.999
105							-0.02	0.999
109							0.38	0.9996
112							0.30	0.9996
117							1.00	1.00
Initial Loss	83,951	72,126	91,811	26,202	5,478	1,886	164	281,618
% of Total	29.81	25.61	32.60	9.30	1.95	0.67	0.06	100

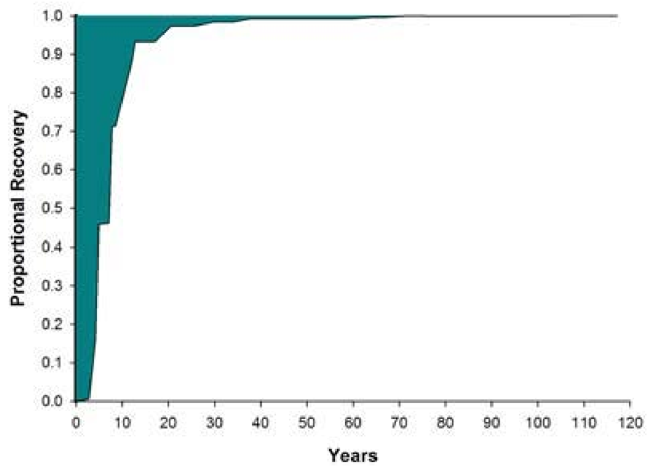

Figure X 4. Projections of proportional recovery of estimated *Porites* encrusting colony losses. Figure from Kolinski (2007).

The Trustees projected that the smaller, faster growing *Pocillopora eydouxi* and Pocillopora cauliflower colonies will recover much sooner, and were very similar to each other in terminal recovery time estimates (both in 23 years).

Approximately 99% of lost coral abundance (smaller and/or faster growing corals) may be replaced within 21 years (Figure x 5). However, resource value associate with the largest colonies will take much longer to replace -up to 117 years. These rates of recovery are not inconsistent with previous projections for Hawaiian reefs.

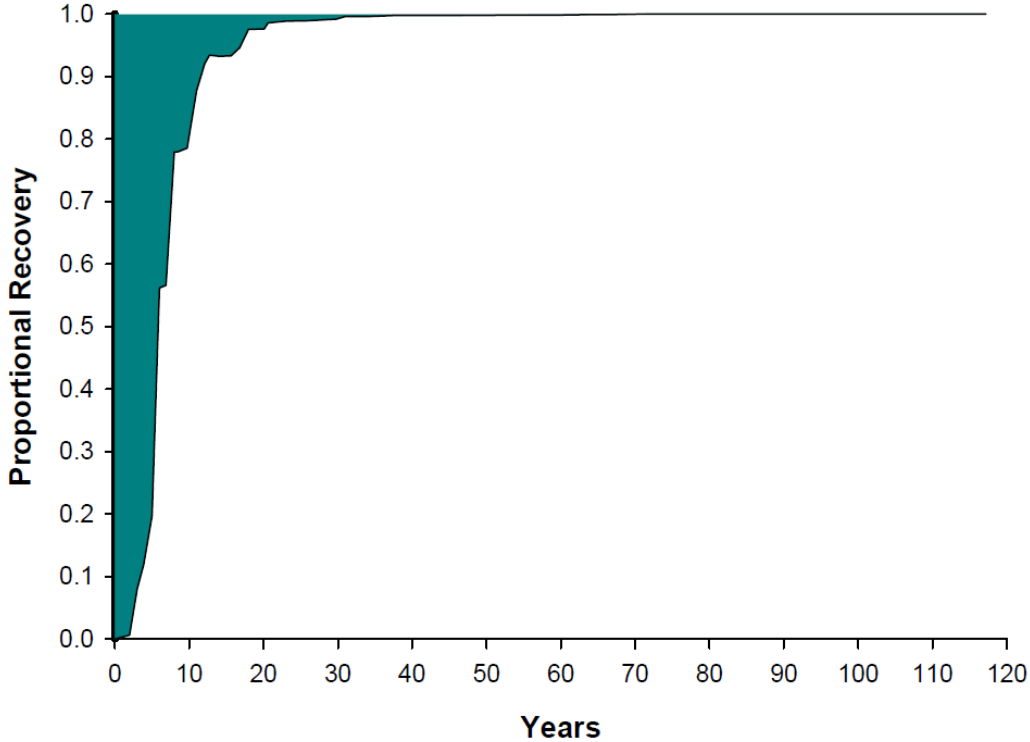

Figure 5. Projection of proportional recovery of coral colony losses within the M/V Cape Flattery incident area. Figure from Kolinski (2007).

The Trustees used the above recovery projections as a guide to scale appropriate restoration projects to recover ecosystem functions for the suite of coral species and size class categories injured during the Incident. For a full accounting of injury to specific coral species and size class categories and projected recovery times, see http://www.darrp.noaa.gov/southwest/capeflattery/pdf/RecoveryProjections.pdf.

4.0 RESTORATION PLANNING

4.1 RESTORATION STRATEGY AND PROPOSED ACTION

The goal of the Oil Pollution Act is to "make the environment and the public whole for injuries to natural resources and services resulting from an incident involving discharge or substantial threat of a discharge of oil…." 15 C.F.R. § 990.10. To achieve this goal, OPA authorizes trustees, after an oil spill or response action to the threat of an oil discharge, to conduct restoration planning to restore, rehabilitate, replace, or acquire the equivalent of injured natural resources resulting from the spill and/or response actions. The OPA regulations direct that this goal be achieved by returning injured natural resources to their baseline condition, but for the incident, and by compensating for any interim losses of natural resources and services during the period of recovery to baseline. Specifically, the preferred restoration alternatives in this Draft DARP/EA are designed to restore injured natural resources and services resulting from the February 2, 2005 grounding of the M/V *Cape Flattery* off of Kalaeloa, Barbers Point and the subsequent response activities.

The OPA regulations designate restoration actions as either "primary" or "compensatory". Primary restoration is action(s) taken to return injured natural resources and services to baseline on an accelerated time frame -- that is faster than what would occur naturally. The OPA regulations require that trustees consider natural recovery as an alternative under primary restoration. Some of the conditions under which natural recovery would be considered a preferred alternative would be 1) active primary restoration is infeasible, 2) active primary restoration is not cost-effective, and 3) injured natural resources will recover to baseline at a reasonable rate without human intervention. Alternative primary restoration activities can range from natural recovery with monitoring, to actions that prevent interference with natural recovery, to more intensive actions expected to return injured natural resources and services to baseline faster and/or with greater certainty than natural recovery.

Compensatory restoration is/are action(s) taken to address the interim losses of natural resources and/or services between the time of injury and recovery to baseline. The type and scale of compensatory restoration can depend on the nature of the primary restoration action(s) and the timeline and scope of recovery of injured resources to baseline. When identifying compensatory restoration alternatives, trustees must first consider actions that provide resources and/or services of the same type and quality and of comparable value as those that were lost. If a reasonable range of alternative compensatory actions cannot provide resources and/or services of the same type, quality, and comparable value as those lost, then trustees can consider actions that will provide resources and/or services of comparable type and quality.

Reasonable compensatory restoration alternatives must be "scaled" so that the size or quantity of the proposed project reflects the magnitude of the injuries. The OPA regulations discuss two scaling approaches -- the service-to-service (or resource-to-resource) approach and the valuation approach. The former approach (hereafter referred to as service-to-service) is a simplification of the valuation approach and is used when the injured and replacement resources and services are of the same type, quality, and comparable value. The service-to-service approach is similar to an in-kind trading approach that requires no explicit valuation. Under this approach, the scaling analysis simplifies to selecting the scale of a restoration action for which the present discounted quantity of replacement services equals the present discounted quantity of services lost due to the injury. The habitat version of the approach, habitat equivalency analysis, has been applied in a number of damage assessment cases. For an overview of habitat equivalency analysis, see NOAA (2000).

If the trustees determine that the first approach is not appropriate, they will use the second approach and determine the amount of natural resources and/or services that must be provided to produce the same value lost to the public. The trustees must explicitly measure the value of the interim losses from the injured natural resources and/or services and then calculate the value of gains from the proposed restoration actions. Scaling then requires adjusting the size of restoration project(s) to ensure that the value of restoration gains equals the value of the interim losses. Responsible parties are liable for the cost of implementing the restoration action that would generate the equivalent value. The value-to-cost variant of the valuation approach may be employed when valuation of the lost services is practicable but valuation of the replacement natural resources and services cannot be performed within a reasonable time frame or at a reasonable cost. With this approach, the restoration is scaled by equating the cost of the restoration plan to the value (in dollar terms) of losses due to the injury.

4.1.1 PROPOSED ACTION

The Trustees propose to develop and implement restoration alternatives based on the service-to-service scaling method. Only compensatory restoration alternatives are being pursued as a preferred alternative. When developing the restoration alternatives included in this Draft DARP/EA, the Trustees relied on known methodologies previously applied to other incidents or to related natural resource recovery activities and projected costs and outcomes related to those situations. Specific project details may require additional refinements or adjustments to reflect changing conditions or factors. In addition, restoration projects and design may also change to reflect public comments and further Trustee analysis.

4.2 EVALUATION CRITERIA

The OPA regulations require that Trustees develop a reasonable range of primary and compensatory restoration alternatives and then identify the preferred alternatives based on the six criteria listed in the regulations:

1. Cost to carry out the alternative action,
2. 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,
3. Likelihood of success of each alternative,
4. 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,
5. Extent to which each alternative benefits more than one natural resource and/or service, and
6. Effect of each alternative on public health and safety.

Id. at § 990.54(a). In addition, the Trustees considered several other factors including:

1. Cost effectiveness (rather than just overall total costs),
2. Nexus to geographic location of the injury,
3. Opportunities to collaborate with other entities involved in restoration projects, and
4. Compliance with applicable federal and state laws and policies.

As mentioned in Chapter 1, NEPA applies to actions taken by federal agencies. To reduce transaction costs and avoid delays in restoration, the OPA regulations encourage the trustees to conduct the NEPA process concurrently with the development of the draft restoration plan. As well, NEPA also encourages federal agencies to integrate the requirements of NEPA with other agency planning procedures so that the processes can run concurrently, rather than consecutively. To comply with the requirements of NEPA, the Trustees considered the effects of each preferred alternative on the quality of the human environment. NEPA's implementing regulations direct federal agencies to evaluate the potential significance of proposed actions by considering both context and intensity. For the actions proposed in this Draft DARP/EA, the appropriate context for considering potential significance of the action is local, as opposed to national or worldwide.

With respect to evaluating the intensity of the impacts in the proposed action, the NEPA regulations and NOAA's Administrative Order 216-6 require consideration of the following factors:

1. Likely impacts of the proposed projects,
2. Likely effects of the projects on public health and safety,
3. Unique characteristics of the geographic area in which the projects are to be implemented,
4. Controversial aspects of the project or its likely effects on the human environment,
5. Degree to which possible effects of implementing the project are highly uncertain or involve unknown risks,
6. Precedential effect of the project on future actions that may significantly affect the human environment,
7. Possible significance of cumulative impacts from implementing this and other similar projects,

8. Effects of the project on National Historic Places, or likely impacts to significant cultural, scientific or historic resources,
9. Degree to which the project may adversely affect endangered or threatened species or their critical habitat,
10. Likely violations of environmental protection laws,
11. Unique characteristics of the geographic area,
12. Degree to which endangered or threatened species, or their critical habitat as defined under the Endangered Species Act of 1973, are adversely affected,
13. Whether a violation of federal, state, or local law for environmental protection is threatened, and
14. Whether a federal action may result in the introduction or spread of a nonindigenous species.

40 C.F.R. § 1508.27.

4.3 EVALUATION OF NO ACTION ALTERNATIVE

NEPA requires the trustees to consider a "no action" alternative, and the OPA regulations require that a "natural recovery" option is evaluated. Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services. In lieu of direct action, the Trustees would rely on natural processes of recruitment and growth for recovery of the injured natural resources including, but not limited to, corals, algae, fishes, sessile invertebrates and coralline algae. There are several advantages to natural recovery as primary restoration. The principle advantages would be simplicity of implementation and no cost. Because an injured area or species is expected to recover naturally, it would make sense to, in essence, "let nature take its course".

The Trustees have determined that natural recovery with monitoring would be appropriate as a primary restoration alternative for injuries to coral reef resources at the injury site. While natural recovery would occur over varying time scales for various injured resources and categories, the public would not be compensated for the interim losses under the no action alternative. OPA clearly establishes trustee authority to seek compensation for interim losses pending recovery of the injured natural resources. Such compensation would not occur under a no action alternative.

Natural resource losses were, and continue to be, incurred by the public during this period of recovery from the grounding event and technically feasible alternatives exist to compensate for these interim losses within a reasonable cost framework. Therefore, a no action alternative (natural recovery) would have to be coupled with compensatory restoration actions to fully restore lost interim services.

4.4. EVALUATION OF PRIMARY RESTORATION ALTERNATIVES

4.4.1. PREFERRED PRIMARY RESTORATION ALTERNATIVE 1: MONITORED NATURAL RECOVERY WITH THE POSSIBILITY OF ADAPTIVE MANAGEMENT

Project Description:

This proposed alternative provides primary restoration for injury to corals, other benthic macro-invertebrates, and crustose coralline algae using natural recovery of resources to return to baseline conditions*.* Unlike the no action alternative discussed in subsection 4.3 above, this alternative includes monitoring with the possibility of adaptive management should the injured natural resources fail to meet expected recovery projections. Because of limited opportunities for restoring large established coral communities at the incident site, the monitored natural recovery alternative is the best one for primary restoration.

Approximately 99 % of the injury to coral resources (smaller and/or faster growing corals) due to the grounding and response activities is expected to recover naturally to pre-incident conditions within 21 years (Kolinski, 2005, 2007). These rates of recovery are within expected values based on previously published coral growth rates and parameters (Grigg and Maragos 1974, Grigg 1995, Holthus et al. 1986, Dollar and Tribble 2003, Connell 1997, Hughes and Connell 1999), .

While the Trustees anticipate relying on natural recovery for much of the primary restoration of the injury caused by the M/V *Cape Flattery* grounding and response actions, they intend to monitor natural recovery of the coral reef communities at the impact site to determine if recovery is progressing to the baseline conditions as they have projected (see discussion below). The Trustees will develop and implement an adequate biological monitoring program to determine whether affected coral reef communities meet anticipated recovery goals at the M/V *Cape Flattery* vessel grounding site. Both qualitative and quantitative data will be collected. [7] Several surveys will be conducted over a 10-11 year time period. Coupled with the information already collected by the Trustees, this time frame will provide data for a twenty-year time period from the date of the vessel grounding – likely adequate time to gauge resource recovery.

The Trustees continue to be concerned that the ecological disturbances caused by the M/V *Cape Flattery* grounding and subsequent response actions could result in the injured reef community undergoing a "phase shift" into another type of biological community, such as

[7] *See* Appendix One for more information concerning the types of data to be collected.

one dominated by algae to the exclusion of corals. If monitoring discloses that natural recovery is not progressing as projected, the Trustees will examine the feasibility of active primary restoration actions and may reallocate funds and effort from the compensatory restoration project.

Restoration Objective:

The goal of the monitored natural recovery alternative is to allow the injury site to continue its natural recovery progression back to baseline conditions or pre-incident levels of coral species, size classes, and abundances.

Probability of Success:

The probability of success is high. All current information collected by the Trustees suggests that natural recovery is occurring as predicted. There is a possible concern (however remote) that the ecological disturbances caused by the Incident could result in the injured reef community undergoing a "phase shift" into another type of biological community, such as one dominated by algae to the exclusion of corals. The probability of this occurring appears low as all indications to this point show that the incident site is recovering normally back to baseline conditions.

Performance Criteria and Monitoring:

The performance criteria for this alternative are that natural recruitment and growth of coral resources at the incident site continue to follow predicted recovery models and that the site is recovered to 99% of pre-incident conditions within 21 years. The Trustees intend to monitor natural recovery of the coral reef communities at the incident site to confirm that recovery is progressing acceptably toward baseline conditions throughout the recovery period.

If monitoring discloses that natural recovery is not progressing as projected, the Trustees will evaluate adaptive management activities in the nature of primary restoration at the M/V *Cape Flattery* vessel grounding site. If they determine that active primary restoration actions are feasible, the Trustees may reallocate funds and effort from the compensatory restoration project.

Environmental and Socio-Economic Impacts:

Because this alternative is based on monitoring the site and allowing the resources to naturally recover, there are essentially no environmental or socio-economic impacts.

4.4.2 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVES

The Trustees considered a number of alternatives for primary restoration of the M/V *Cape Flattery* grounding site. They evaluated these alternatives using the standards delineated in OPA regulation (1) the cost of the alternative, (2) the extent to which the project is expected to return the resource and services to baseline, (3) the likelihood of success, (4) the probability of preventing future injury, (5) the benefit to other resources, and (6) the effects on public health and safety. The Trustees did not select the following alternatives as the preferred restoration methods because of feasibility and cost benefit concerns. The non-preferred alternatives are listed below with their associated explanations and concerns.

4.4.2.1 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 2: AIDS TO NAVIGATION

Because the area around Barbers Point/Ko'olina is a fairly high traffic area, there is the chance that future groundings or incidents may occur. One alternative considered by the Trustees was to place specific Aids to Navigation (AToN) at this and other sites around the Hawaiian Islands to help prevent future incidents, thereby preventing future injury to natural resources. The Trustees determined that this alternative was not preferred in this matter for a number of reasons. The costs for putting out and maintaining a system of AToN would be too high with little tangible benefits to natural resources.

The additional benefits to navigation, given the systems currently in place around Hawaii and those available on individual vessels, are minimal. In addition, there are questions as to how this alternative would be scaled to future injuries that might be avoided, due to lack of injury information on past incidents that could be projected for these potential future incidents. There are no satisfactory methods for determining how much injury to coral and other natural resources would be avoided by establishing a system of AToN. Without an effective method for scaling the benefits of this project, there are no satisfactory ways to ensure that the public would be fully and justifiably compensated for natural resource losses. Given these questions, the Trustees did not evaluate this alternative further.

4.4.2.2 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 3: NATURAL RESOURCE EXCLUSION ZONE

Another idea considered by the Trustees was to designate an exclusion area in the form of a natural reserve around the Porites zone. Because the Porites zone includes some areas of fairly high coral cover consisting of exceptionally large *Porites lobata* colonies the Trustees considered a project to exclude potentially injurious human activities in this area. There are a number of problems inherent in this alternative.

There are not enough commercial and/or recreational activities occurring within the proposed exclusion zone to quantify what if any potential impacts might be avoided.

There are questions as to how this alternative would be scaled to future injuries that would be avoided. Like the AToN non-preferred alternative discussed above, there are no satisfactory methods for determining how much injury to coral and other natural resources would be avoided by using this method. Without an effective method for scaling the benefits of this alternative, there are no satisfactory ways to ensure that the public would be fully compensated for natural resource losses if the Trustees selected this alternative. Given these issues, the Trustees did not further evaluate this alternative.

4.4.2.3 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 4: RECONSTRUCTION OF THREE DIMENSIONAL HABITAT STRUCTURE

The loss of three dimensional habitat structure (coral colonies and natural terrain) has an impact on fishes, invertebrates and other species in the injury area. Reconstructing some of this three dimensional habitat would provide refuge areas for fishes and invertebrates and could possibly help increase re-colonization rates of coral into the injury area. Some reconstruction of lost three dimensional habitat occurred at the injury site during emergency restoration activities, including re-attaching surviving coral colonies. While this alternative is attractive, the Trustees rejected it for several reasons. The level and pace of possible increased coral recruitment and recovery (above and beyond the natural rates) of the area are not known and may not provide adequate resource compensation. Because the area has been undergoing natural recovery for several years, adding structures to the bottom would result in an initial injury to corals that have naturally colonized to the area, diminishing the initial recovery credits and essentially resetting the recovery curve. Additionally, for determining added benefits, the degree that these structures will result in net increased populations of fishes and invertebrates rather than just attract these species from other areas is also not known (the production versus attraction debate).

4.4.2.4 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 5: ALIEN INVASIVE ALGAE CONTROL AND REMOVAL

The presence of alien and invasive algae at and near the injury site is well known(Brostoff, 1989, USFWS 2002). In particular, the alien alga *Avrainvillea amadelpha* is known to exist along the west coast of Oahu as well as in other areas such as Maunalua Bay on the south east side of the island. At the injury site the primary question is whether, because of the cleared benthic substrate as a result of the Incident, *A. amadelpha* will progress from its presently pervasive condition to an invasive state by beginning to form large mats that fully occlude or cover the bottom. The Trustees have not yet observed this invasive condition although the density of *A. amadelpha* varies across the injury site. Also, it is unknown what level of impact *A. amadelpha* has on coral recovery at the injury site. In a pervasive condition, the effects of *A. amadelpha* are not well understood. In its invasive state, *A. amadelpha* likely inhibits coral recruitment as it can completely cover the bottom preventing settlement. Because of these uncertainties, the Trustees are unable to scale adequately restoration benefits in terms of enhanced coral recruitment for this alternative. Moreover, there is currently no accepted methodology for effective removal of this algal species at the injury site. If subsequent monitoring at the injury site reveals a progression to an invasive state, or if the Trustees learn more about the effects on coral recruitment of *A. amadelpha* in its present state, the Trustees may reconsider this alternative as part of preferred primary restoration alternative 1 -- monitored natural recovery with the possibility of adaptive management.

4.4.2.5 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 6: REPLANTING OF LOST NATIVE SEAGRASS, HALOPHILA HAWAIIANA

Some native Hawaiian seagrass (*Halophila hawaiiana*) was injured as the anchor from the *M/V Cape Flattery* was dragged offshore during the recovery. Because *H. hawaiiana* is a native seagrass and is known forage for green sea turtles (*Chelonia mydas*), the Trustees gave some consideration to restoring this resource. A number of issues led the Trustees not to select this alternative. The extent and severity of the injury was minimal. During the assessment, the Trustees observed that the seagrass was beginning to recover as evidenced by re-growth of material back into the anchor drag scar. Given the limited geographic scope of the injury, the observations of rapid initial recovery, the Trustees determined that the small amount of required compensation would not be worth the relatively large expense of a recovery project.

4.4.2.6 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 7: TRANSPLANTING DESIRABLE ALGAE TO GROUNDING SCAR

Transplanting desirable algae species into the grounding scar would help restore lost benthic species such as mobile and sessile invertebrates and algae. The algae would provide habitat for benthic biota as well as forage for herbivorous fish species. While this alternative is attractive, there is no way to scale directly for lost fish and invertebrates as the Trustees inferred the injury to these groups from their work on the lost coral colonies. Additionally, there is also some concern that transplanted algae might just become forage for green sea turtles, which are prevalent in the area. If that occurred, there would not be any benefit to the benthic species. Therefore, the Trustees rejected this alternative.

4.4.2.7 NON-PREFERRED PRIMARY RESTORATION ALTERNATIVE 8: ENHANCEMENT OF CORAL RECOVERY WITH A CORAL NURSERY

The Trustees seriously considered a project to establish a land-based coral nursery and transplantation facility that would produce modules encrusted with live coral and serve as a base of operations for transplantation efforts. The modules would be encrusted with live coral by propagation and isogenic colony fusion during a nursery phase that would last up to one year. The modules would be designed so that they could be rapidly deployed and secured directly to the substrate and/or to larger artificial structures. The nursery's primary focus would be the *Porites* species, as they are slow to recover naturally, long-lived, tolerant of manipulation, and their growth form contributes to topological complexity. While this alternative is appealing, there are a number of reasons why it is not a preferred alternative. There is no known source area to obtain enough donor material to proceed with this project. The project replaces only *Porites* sp. corals with an encrusted concrete structure, and it is not known whether this approach will replace the same type of services as a real coral colony. There are logistical issues related to moving the concrete blocks that are covered with a thin layer of coral and attaching them to the bottom that have not been fully resolved. The failure rate of the attachment mechanisms is not known. And finally, the costs for this project are quite high compared to the potential restoration benefits/credits. As a result, the coral nursery is not a preferred alternative.

4.5 EVALUATION OF COMPENSATORY RESTORATION PROJECTS

4.5.1 PREFERRED COMPENSATORY RESTORATION PROJECT 1: CORAL RESCUE IN KANEOHE BAY

This proposed alternative provides compensatory restoration for injury to corals, other benthic macro-invertebrates, crustose coralline algae, and fishes caused by the M/*V Cape Flattery* incident (Kolinski, *et al*. 2007). Because of limited opportunities for gaining large amounts of coral restoration credits from projects at the incident site, off-site restoration projects remain necessary to ensure that the public is fully compensated for injuries at the incident site. This proposed alternative will prevent ongoing loss of corals at another Oahu site, Kane'ohe Bay, which is located on the eastern side of Oahu. In Kane'ohe Bay, the invasive alien algae *Kappaphycus/Eucheuma* spp. is overgrowing, smothering, and killing otherwise healthy corals and other sessile biota. The introduction of alien algae in the bay has caused a phase shift to change the bay from a coral dominated system to a non-native algal dominated system. Controlling the algae in the bay has the potential to save many species and size categories of established coral colonies and to address injury to the other biota.

This alternative will protect existing, well-established corals and other sessile reef biota by removing invasive alien algae using manual mechanical removal methods, supplemented by subsequent biological controls. Initial removal will be achieved by using an underwater vacuum device known as the "Super Sucker" to increase the efficiency of divers in manually removing large masses of alien algae that threaten existing stands of corals. The Super Sucker consists of a 13' x 25' (~ 4m x 7.6m) covered barge equipped with a 40 hp Venturi pump that draws water and algae from the reef through a hose controlled by a pair of SCUBA divers positioned on the reef. Both loose and attached alien algae are lifted off the reef substratum by divers and placed into the intake of the suction hose of the Super Sucker. The suction in the device is low and steady, and as a result rarely pulls in other items. The suction does, however, easily entrain algal fragments. Water and algae are pumped onto the barge via Venturi-driven suction and are deposited intact on a table with a mesh bottom that allows the water to drain off, while retaining algae and other marine life on the table. Alien algae is sorted from any minor amounts of incidental by-catch and placed in mesh bags. While experience with this system has shown there to be very little to no by-catch, the sorting process allows for control and oversight of the material being removed from the bay.

Restoration Objective:

The overall goal of the Coral Rescue project is to prevent coral losses by removing alien algae. This project will directly compensate for the coral injury resulting from the grounding incident by increasing the amount of ecological services provided by coral around the Oahu coast (Kolinski, *et al*. 2008). The ecological services provided by the corals include habitat and forage for fish and invertebrates, among others. The proposed restoration site within Kaneohe Bay is shown in Figure XX and is known as the Marker 12 reef.

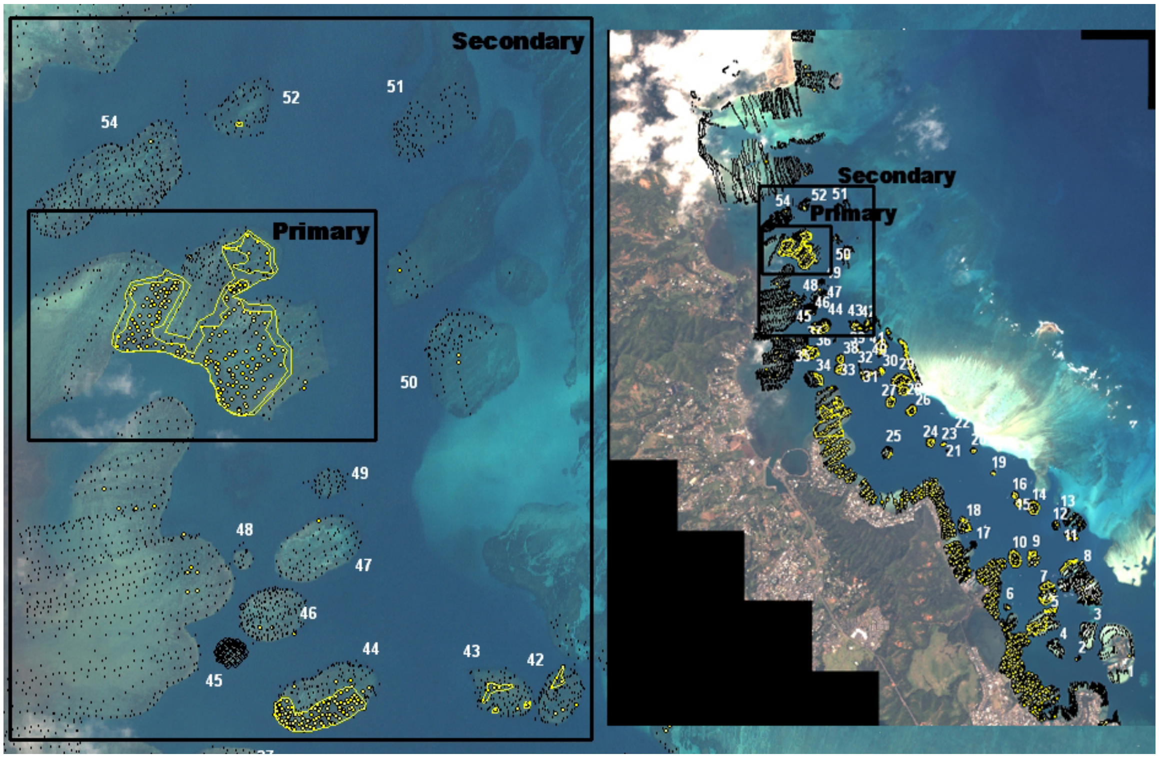

FIGURE XX. Map showing the location of Marker 12 reef (Primary) within Kaneohe Bay, Oahu.-

Probability of Success:

The probability of preventing alien algae from overgrowing established coral colonies in Kane'ohe Bay with this alternative is extremely high. The State of Hawaii Division of Aquatic Resources, in conjunction with The Nature Conservancy, has been successfully conducting this activity for a number of years. The removal criteria necessary for this project are within established removal rates for existing projects of this nature.

The probability of successfully rearing and transplanting sea urchins to the restored areas for bio-control efforts is also high. Mass cultivation and transplantation of this sea urchin has been successful in Okinawa and elsewhere. Currently the State of Hawaii Division of Aquatic Resources is operating an active culture program for *T. gratilla* at the Anuenue Fisheries Research Center. This program could provide urchins for this project as available.

Figures 6 and 7 illustrate the success of the combined mechanical algae removal and sea urchin outplanting to suppress alien algae overgrowth on Reefs 26 and 27. Figure 8 shows the current situation on Reef 28 where no algae control efforts have been conducted. The combination of mechanical (supersucker) and sea urchin outplanting are effectively

suppressing algal regrowth over these patch reefs. Figure 26 indicates that continued outplanting of sea urchins may be required to maintain an effective population of sea urchins.
The patch reefs 26, 27 and 28 in Kaneohe Bay are shown in Figure 9, with an index map of Oahu showing their location in Kaneohe Bay.

Performance Criteria and Monitoring:

In order for the restoration project to be successful, algae has to be prevented from spreading further than its current extent. Based on previous surveys, this containment of the spread of algae can be obtained with clearance rates (area cleared of algae per time) of 0.7 m/h in densely colonized areas and up to 1.4 m/h in sparsely colonized areas. Removal rates have ranged from 115 to 3600 kg algae per work day. The rate of algae clearance from the proposed restoration site in Kaneohe Bay is expected to be between 2.7 and 5.7 ha/year. The expected time to clean the restoration site one time of the current 15 ha of algae is 4.1 years plus or minus 1.5 years.

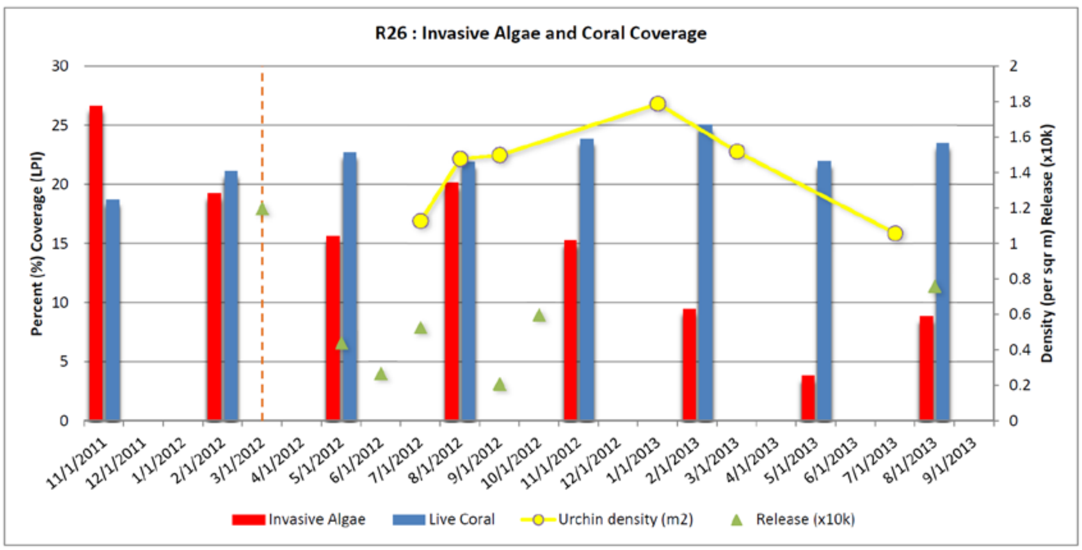

Figure 6: Reef 26. Invasive Algae and Live Coral coverage calculated using database of Line Point Intercept (LPI) over 14-25m transects. Urchin density calculated using reef wide non-randomized sampling. Urchin Release numbers relate to actual counts from nursery to site (as indicated on right y axis 1=10,000 urchins). Dashed vertical line represents date of final mechanical removal event. This reef has been stocked with urchins for the longest period. (Pers.com. Jonathan Blodgett, HI DLNR Div. Aquatic Resources)

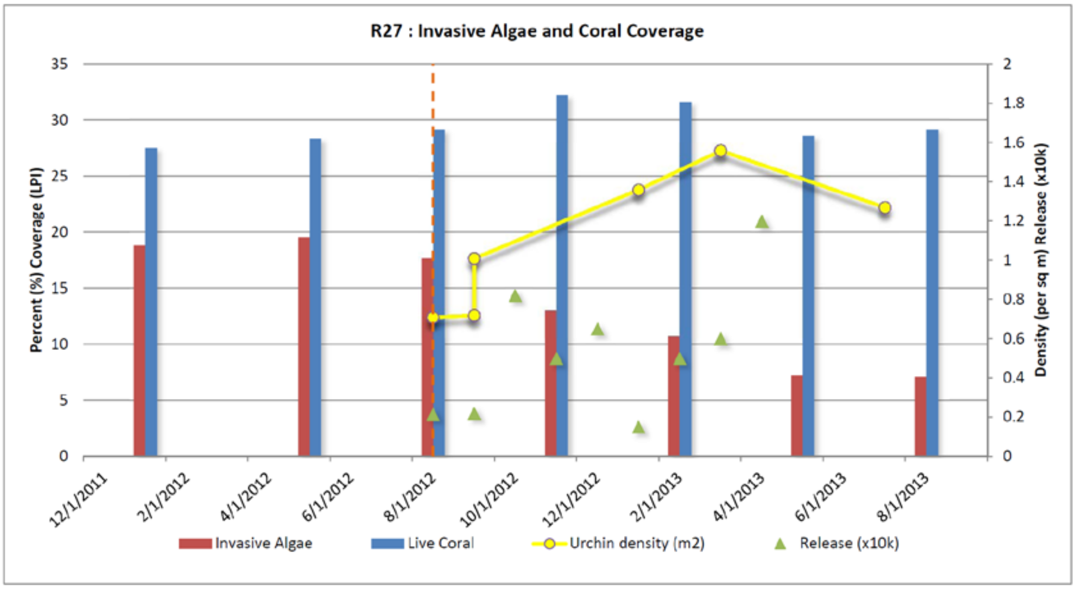

Figure 7: Reef 27. Invasive Algae and Live Coral coverage calculated using database of Line Point Intercept (LPI) over 13-25m transects. Urchin density calculated using reef wide non-randomized sampling. Urchin Release numbers relate to actual counts from nursery to site (as indicated on right y axis 1=10,000 urchins). Dashed vertical line represents date of final mechanical removal event. (Pers.com. Jonathan Blodgett, HI DLNR Div. Aquatic Resources)

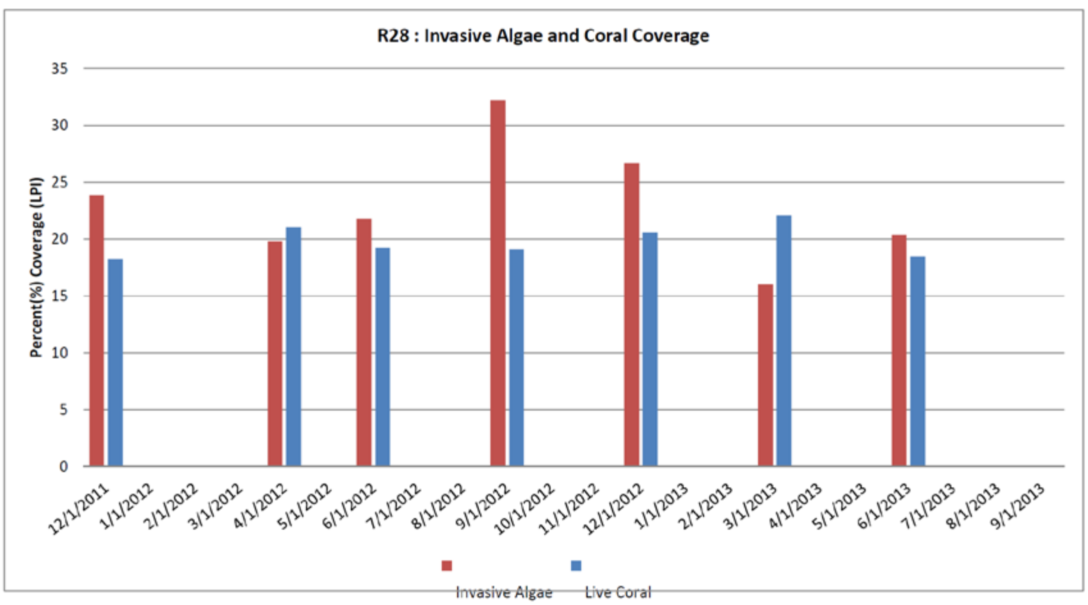

Figure 8: Reef 28. Invasive Algae and Live Coral coverage calculated using database of Line Point Intercept (LPI) over 18-25m transects. Reef 28 set as control, no manipulation has occurred. The most recent data (September 2013) is not available for analysis at this time. (Pers.com. Jonathan Blodgett, HI DLNR Div. Aquatic Resources)

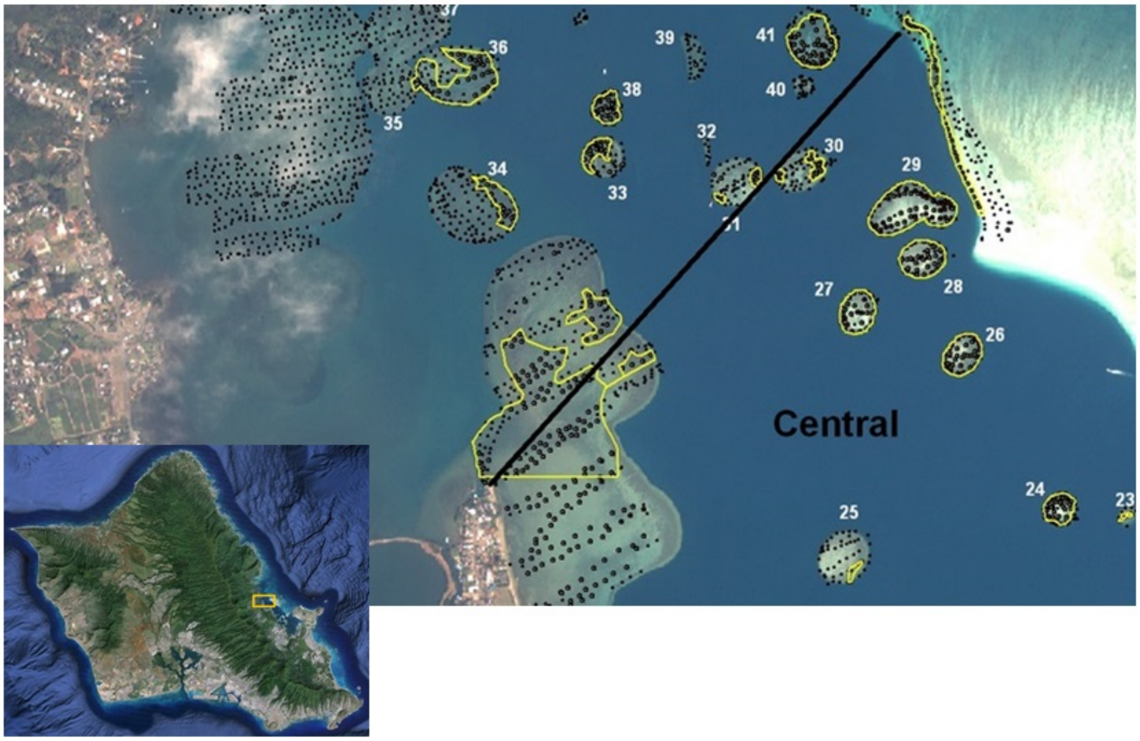

Figure 9: Map of central Kaneohe Bay showing locations of Patch reefs 26, 27, and 28 where Supersucker activities have been monitored plus inset map of Oahu to show location of Kaneohe Bay activities.

Algal re-growth is assumed to be variable, so the regular collection of data on current algal distributions and the changes in algal density over time will be used to adaptively manage Super Sucker activities. Staff will monitor the removal sites approximately six times per year, recording the relative abundance and spatial distribution of alien algae. Even with urchin outplanting, some level of algal regrowth following mechanical removal is anticipated. As a result, the Super Sucker will return to re-clear an area if accumulation of algal biomass is recorded. Monitoring over the reef area including coral species and sizes will also take place to confirm that anticipated coral credits are being gained as predicted.

Environmental and Socio-Economic Impacts:

The potential negative environmental impacts of conducting this project are less than equivalently sized recreational activities in the area (Kaneohe Bay is a heavily used recreational area). The State of Hawaii has developed protocols for anchoring the barge that minimize any impacts to the environment. The State has also developed work protocols that allow the algae removal teams to operate with minimal potential impacts to the environment.

The alien algae that is removed during this project is donated to local farmers in the area who use it to fertilize their farms. This collaboration between local farmers and the State removal effort has a two-fold effect. First, it provides local farmers with a free, natural source of fertilizer that is less susceptible to run-off than commercial fertilizer (and hence less likely to end up back in the ocean). Second, the farmers see increased profitability because they are spending less to produce their crops. *Kappaphycus/Eucheuma species ``die quickly in low salinity water, insuring that runoff from taro fields will not infect offshore areas near stream runoff (Sulu et al 2004).*

Because the Super Sucker takes in sea water as it collects the algae and returns it back to the ocean, it technically creates a "discharge" under Section 404 of the Clean Water Act. The State of Hawaii Division of Aquatic Resources has collaborated with the State Department of Health to certify that the "discharge" is not in violation of the law.

4.5.2 NON-PREFERRED COMPENSATORY RESTORATION PROJECTS

4.5.2.1 NON-PREFERRED COMPENSATORY RESTORATION ALTERNATIVE 1: REEF WARNING BUOYS

This alternative consists of using surface marker buoys to identify high coral concentrations that may be susceptible to vessel groundings or other disturbances, and that should be avoided. The Trustees had a number of concerns about this alternative. One is that marking off areas of high coral concentrations might actually attract and focus ocean activities such as snorkeling, SCUBA diving, and fishing in those areas, which could increase the risk of impacts to the corals. Another is that marker buoys require a large amount of upkeep and maintenance and would most likely be subject to vandalism and theft. A final concern with this alternative is that there is no reliable way to scale the coral colony years gained (or protected from future losses) from this activity.

4.5.2.2 NON-PREFERRED COMPENSATORY RESTORATION ALTERNATIVE 2: DAY USE MOORINGS

This alternative consists of using surface moorings in areas of high coral concentrations that may be susceptible to anchor impacts from vessels visiting the area. The Trustees have the same concerns about this alternative as the reef warning buoy alternative discussed above – 1) There if very little if any anchoring occurring in the area, 2) the moorings in areas of high coral concentrations might actually attract and focus ocean activities such as snorkeling, SCUBA diving, and fishing in those areas and could increase the risk of impacts to the corals; 3) the moorings would require a large amount of upkeep and maintenance and would most likely be subject to vandalism and theft; and 4) there is no reliable way to scale the coral colony years gained (or protected from future losses) from this activity.

4.5.2.3 NON-PREFERRED COMPENSATORY RESTORATION ALTERNATIVE 3: PROVIDING CURRENT METERS AND COMMUNICATION EQUIPMENT TO BARBERS POINT HARBOR.

Because of the strong shifting currents in the area and the difficulties in communication, which may have contributed to the Flattery grounding, the Trustees discussed an alternative that would provide additional information for vessels entering and leaving the harbor. The alternative would provide real time current information to the harbor master and harbor pilots and could potentially help prevent groundings in the future. However, there is no way to verify the possible effects or outcomes of this alternative and no way to scale possible restoration benefits.

4.5.2.4 NON-PREFERRED COMPENSATORY RESTORATION ALTERNATIVE 4: CAPACITY BUILDING FOR FUTURE GROUNDINGS

The Trustees considered an alternative that would increase response capacity for ship groundings. Building response capacity of local agencies may enhance the timing and effectiveness of measures to reduce impacts to natural resources from future groundings. One aspect of capacity building would be to open a dialog by holding an international workshop on coral restoration in Hawaii. Using the information from this workshop, the Trustees would design a formalized toolbox of techniques for ship grounding response and coral restoration in Hawaii. In addition to formalized techniques for coral restoration, the Trustees would fund and train a Coral Reef Rapid Response Team, which would be used for future vessel groundings and coral injury incidents. While the Trustees agreed that this type of capacity building is much needed in Hawaii, there is no way to scale the restoration benefits and recovery of lost coral colony years, in part because no one can be sure how many groundings will occur in the future and whether those groundings will impact the same types of resources injured by the M/V *Cape Flattery* Incident.

4.5.2.5 NON-PREFERRED COMPENSATORY RESTORATION ALTERNATIVE 5: CONTROL OF RUN-OFF FROM CAMPBELL INDUSTRIAL PARK.

Control of runoff and sedimentation from nearby Campbell Industrial Park was considered. Building sediment control structures such as sediment traps and basins as well as addressing the channelized streams in the area could reduce runoff and sedimentation, which can impact coral reefs and other resources. The costs of such workwould be prohibitively high. Additionally there is no adequate way to measure the possible impacts from the runoff in the Campbell Industrial Park area nor is there a way to scale the subsequent restoration benefits of reducing the runoff.

4.5.2.6 NON-PREFERRED COMPENSATORY RESTORATION PROJECT 7: RESTORING ORPHAN VESSEL GROUNDING SITES

In this project, compensatory restoration would be gained at orphan vessel grounding sites primarily by preventing ongoing injury to intact corals that are threatened by coral debris generated by the grounding incident. This activity would only be pursued where no viable responsible party exists (hence the term "orphan") to do the necessary restoration at such grounding sites. Some additional restoration credit may be gained for re-attaching intact loose colonies when appropriate. Coral debris, including blocks of coral rock, that are dislodged by vessel groundings can be moved by wave action and can crush, bury, or abrade intact corals surrounding the grounding site. The same basic restoration process described here could also be applied to reef habitats that are threatened by similar injury-causing factors, such as loose derelict fishing gear and other debris. However, experience in Hawaii indicates that the injuries created by so-called orphan vessels are too small in scope and too infrequent to create enough restoration credits to be cost effective for the M/V *Cape Flattery* injury. As a result, the Trustees rejected this alternative.

4.6 RESTORATION MANAGEMENT OUTLINE

4.6.1 BUDGET

The Trustees and the RPs settled the claim for natural resource damages in 2012 for $7,500,000. The U.S. District Court in Honolulu approved the consent decree containing the terms of that settlement on April 27, 2013. The Trustees calculated their claim in this case by scaling the preferred restoration alternatives to match (as closely as possible) the loss of natural resources and services that occurred from the grounding and subsequent response actions as well as accounting for agency past assessment costs and for future costs to oversee implementation of the restoration.

The consent decree reimbursed costs incurred by the state and federal trustees to conduct the emergency restoration actions, triage of injured corals, injury assessment, restoration planning, and other related actions. Those costs totaled $1,618,820. The remainder, $5,881,180, is for restoration, enhancement and protection of coral reef habitat and associated resources.

The Trustees are proposing the following allocation of restoration funds among three components:

<u>Oversight = $381,180</u>

These are essentially overhead costs for processing, planning, and reviewing the restoration actions.

<u>Monitoring</u> = $500,000

These costs are for monitoring the natural recovery of the injury site.

<u>Restoration</u> = $5,000,000

The costs for implementation of the preferred compensatory restoration project.

4.6.2 ADAPTIVE PROJECT MANAGEMENT

The Trustees will review the preferred primary and compensatory restoration projects every two years to determine whether the selected projects are meeting expected goals. If natural recovery of corals at the grounding site is not occurring as expected, and if a method exists to address the cause of reduced recovery, then the Trustees may shift funds from the compensatory restoration project to activities at the grounding site. If the compensatory restoration project fails to yield sufficient coral restoration credits to compensate for coral loss at the incident site, the Trustees will meet to determine a more appropriate compensatory project.

The bi-annual review and possible reallocation of resources will be conducted by the Trustees through a Trustee Oversight Committee composed of duly appointed staff from the NOAA Restoration Center, the FWS Ecological Services Office, and the State of Hawaii Division of Aquatic Resources.

5.0 COORDINATION WITH OTHER PROGRAMS, PLANS, AND REGULATORY AUTHORITIES

5.1 OVERVIEW

Two major federal laws guiding the restoration of the injured resources and services from the M/V *Cape Flattery* incident are OPA and NEPA. OPA and its natural resource damage assessment regulations provide the basic framework for natural resource damage assessment and restoration. NEPA, as a procedural law, sets forth a specific process of impact analysis and public review. In addition, the Trustees must comply with other applicable laws, regulations and policies at the federal, state and local levels. The potentially relevant laws, regulations and policies are set forth below. The listing below is not necessary exclusive as there may be other laws, regulations or policies with which the Trustees will need to comply.

In addition to laws and regulations, the Trustees must consider relevant environmental programs that are ongoing or planned for in the affected environment. By coordinating restoration with other relevant programs and plans, the Trustees can enhance the overall effort to improve the near shore coral reef environment of Hawaii.

As noted previously, the Trustees elected to combine the restoration plan required under OPA with the environmental review processes required under NEPA. This will enable the Trustees to implement restoration more rapidly than had these processes been undertaken sequentially.

5.2 KEY STATUTES, REGULATIONS AND POLICIES

<u>Oil Pollution Act of 1990 (OPA), 33 U.S.C. §§ 2701, *et seq*.; 15 C.F.R. Part 990</u>

OPA establishes a liability regime for oil spills which injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. Federal and state agencies and Indian tribes act as Trustees on behalf of the public to assess the injuries, scale restoration to compensate for those injuries and implement restoration. Section 1006(e)(1) of OPA,33 U.S.C. § 2706 (e)(1), requires the President, acting through the Under Secretary of Commerce for Oceans and Atmosphere (NOAA), to promulgate regulations for the assessment of natural resource damages resulting from a discharge or substantial threat of a discharge of oil. Assessments are intended to provide the basis for restoring, replacing, rehabilitating, and acquiring the equivalent of injured natural resources and services.

The OPA regulations provide a framework for conducting sound natural resource damage assessments that achieve restoration. The process emphasizes both public involvement and participation by the responsible party(ies). The Trustees have followed the regulations in this assessment.

Hawaii Environmental Response Law, Title 10, chapter 128D, Hawaii Revised Statutes

The State of Hawaii response law addresses the release or threatened release of any hazardous substance, including oil, into the environment. It creates an environmental response fund which can be used to pay for, among other things, costs of removal actions and costs incurred to restore, rehabilitate, replace or acquire the equivalent of any natural resources injured, destroyed or lost as the result of a release of a hazardous substance. The statute further provides that there shall be no double recovery for natural resource damages. The statute states that upon the request of the Department of Health, the attorney general will recover such costs from the responsible parties. The State of Hawaii Department of Health has promulgated regulations to address the cleanup of releases of hazardous substances. The federal and state Trustees have participated in cooperative injury assessment and restoration planning activities so as to avoid the possibility of any double recovery.

National Environmental Policy Act (NEPA), as amended, 42 U.S.C. §§ 4321, *et seq*. 40 C.F.R. Parts 1500-1508

Congress enacted NEPA in 1969 to establish a national policy for the protection of the environment. NEPA applies to federal agency actions that affect the human environment. NEPA established the Council on Environmental Quality (CEQ) to advise the President and to carry out certain other responsibilities relating to implementation of NEPA by federal agencies. Pursuant to Presidential Executive Order 11514, federal agencies are obligated to comply with the NEPA regulations adopted by the CEQ. These regulations outline the responsibilities of federal agencies under NEPA and provide specific procedures for preparing environmental documentation to comply with NEPA.

The Trustees have integrated this restoration plan with the NEPA process to comply, in part, with those requirements. This integrated process is recommended under §1500.2 "(c) Integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently rather than consecutively.".

Hawaii Environmental Impact Statements, Title 19, Chapter 343, Hawaii Revised Statutes

In this chapter, Hawaii has established a system of environmental review to ensure that environmental concerns are given appropriate consideration in decision making along with economic and technical considerations. The statute provides for public review and opportunity for comments on a range of activities such as proposed use of state or county lands or proposed use within the shoreline area. The statute notes that when an action is subject both to this chapter and NEPA, the state agencies "shall cooperate with federal agencies to the fullest extent possible to reduce duplication between federal and state requirements." This cooperation would include concurrent public review.

The Trustees will integrate the federal and state environmental review requirements as they proceed with restoration planning and implementation.

Coastal Zone Management Act (CZMA), 16 U.S.C. §§ 1451, *et seq*., 15 C.F.R. Part 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 the states with federally-approved coastal management programs. The State of Hawaii has a federally-approved program. 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.

To the extent that the CZMA applies, the Trustees will seek the concurrence of the State of Hawaii that their preferred projects are consistent to the maximum extent practicable with the enforceable policies of the state coastal program.

Endangered Species Act (ESA), 16 U.S.C. §§ 1531, *et seq*., 50 C.F.R. Parts 17, 222, 224

The ESA directs all federal agencies to conserve federally listed endangered and threatened species and their habitats, and encourages such agencies to utilize their authorities to further these purposes. Under the Act, the NOAA Fisheries and the USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these two agencies to minimize the effects of federal actions on endangered and threatened species. The federal Trustees have determined that implementing the proposed restoration would not be likely to adversely affect any listed species, and conducted an informal section 7 consultation. A concurrence with this determination was received from the Pacific Islands Regional Office (PIRO) Protected Species Division.

Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. §§ 1801 *et seq*.

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requires federal fishery management plans to describe the habitat essential to the fish being managed and describe threats to that habitat from both fishing and non-fishing activities. In addition, in order to protect this Essential Fish Habitat (EFH), federal agencies are required to consult with the National Marine Fisheries Service (NMFS) on activities that may adversely affect EFH. The Trustees determined that implementing the proposed restoration would not adversely affect any designated EFH, and initiated an EFH consultation with the PIRO Habitat Conservation Division, and will have them completed prior to implementation.

Hawaii Conservation of Aquatic Life, Wildlife, and Land Plants, Title 12, Chapter 195D

Recognizing that many species of flora and fauna unique to Hawaii have become extinct or are threatened with extinction, the state established procedures to classify species as locally endangered or threatened. The statue directs the DLNR to determine what conservation measures are necessary to ensure the continued ability of species to sustain themselves.

Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. §§ 661, *et seq*.

The FWCA requires that federal agencies consult with the USFWS, NMFS, 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.

In the case of restoration actions under this Draft DARP/EA, the fact that the three consulting agencies for the FWCA (*i.e.,* USFWS, NMFS, DLNR) are represented by the Trustees means that FWCA compliance will be inherent in the Trustee decision making process.

Executive Order (EO) 13089 Coral Reef Protection

On June 11, 1998, President Clinton issued EO 13089, Coral Reef Protection, to address impacts to coral reefs. Section 2 of that EO states that federal agency actions that may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. Given that this Draft DARP/EA is designed to restore injured coral and coral reef habitat, compliance with EO 13089 is inherent within the project.

APPENDIX ONE

Monitoring of Natural Recovery as Primary Restoration
for the M/V *Cape Flattery* Impact Site

<u>Basic methods</u>

Priority information needed from a natural recovery monitoring program at the Cape Flattery vessel grounding site. Monitoring will be focused directly on recovery of the coral reef community most heavily impacted by the vessel hull and surrounding coral reefs injured from anchors, anchor chains, and tow cables. Reference sites will be selected from adjacent un-impacted areas. Factors used to select appropriate reference sites include similarity to the impact sites by depth, topography and substrate/community type.

Types of surveys. The monitoring areas will be qualitatively and quantitatively surveyed. Quantitative surveys will be used to address specific questions of resource recovery concerning coral recruitment, growth rates and species composition. Qualitative surveys will be designed to gauge general ecosystem parameters and to detect unanticipated changes in the reef community. *See* below for a description of data to be collected.

Layout of survey locations. The anticipated survey methodology will include permanent plots/transects marked by fixed stakes or other permanent markers. In order to efficiently cover all habitats and sub-habitats, the survey design will use a stratified random design.

Data to be recorded. Both quantitative and qualitative data will be collected. The quantitative surveys will include surveying the following biota using similar methodology used during the trustees' injury pre-assessment surveys. These metrics include:

- Corals: species, sizes, counts within fixed areas (i.e., to produce records of population densities);
- Algae: percent cover of species and species groupings;
- Fish: counts by species and/or by other groupings (family or functional categories);
- Mobile invertebrates (counts by species or genera in fixed areas to give population densities).

The qualitative data collected will include the following activities:

- A one-day qualitative reconnaissance/inspection of the impact site by the 4-member biologist team to detect and record any unexpected phenomena related to the injury (conducted during the quantitative surveys).
- Monitoring of changes in the substratum to track trends in substrate condition (*e.g.,* erosion, build-up of fragmenting substrate, dispersion of fragments).
- Mapping of the area to detect the presence, relative abundance, and distribution of alien algae in the impact and reference sites.

The results of each survey will be analyzed and a written report will be provided to the Trustee Oversight Committee.

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