FINAL
RESTORATION PLAN
and
ENVIRONMENTAL ASSESSMENT
for the
MAY 14, 1996
CHEVRON PIPELINE OIL SPILL
into
WAIAU STREAM and PEARL HARBOR,
OAHU, HAWAII

***Prepared by*:**
The Natural Resource Trustees
for Pearl Harbor, Oahu, Hawaii

U.S. Department of Defense
U.S. Department of the Navy

U.S. Department of the Interior
U.S. Fish and Wildlife Service
National Park Service
Office of Environmental Policy and Compliance

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

State of Hawaii
Department of Health
Department of Land and Natural Resources

November 1999

FACT SHEET

Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii

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U.S. Fish and Wildlife Service (DOI)
National Oceanic and Atmospheric Administration
Hawaii Department of Health
Hawaii Department of Land and Natural Resources
U.S. Department of the Navy, Commander, Naval Base Pearl Harbor, Hawaii

Abstract: This Final Restoration Plan and Environmental Assessment (Final RP/EA) has been prepared by the State and Federal Natural Resource Trustees to address restoration of natural resources and resource services injured in the Chevron Pipeline Oil Spill of May 14, 1996 into Waiau Stream and Pearl Harbor, Oahu, Hawaii.

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into Waiau Stream and Pearl Harbor, Oahu, Hawaii

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1.0 INTRODUCTION

1.0 INTRODUCTION: PURPOSE OF AND NEED FOR RESTORATION

1.1 PURPOSE

The purpose of this document is to provide summarized information regarding the affected environment, natural resource injury determinations and natural resource restoration projects resulting from the May 14, 1996 Chevron pipeline oil spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii, so that the public may review and provide comments on the planned restoration activities. This document also serves, in part, as the agencies' compliance with the National Environmental Policy Act and the State of Hawaii equivalent (see Section 5 for additional information).

1.2 OVERVIEW

At 1:30 a.m. on May 14, 1996, a Chevron Products Company (Chevron) pipeline ruptured at a thin spot caused by external erosion and began discharging No. 6 bunker fuel oil adjacent to the Hawaiian Electric Company (HECO) Waiau Power Plant in Pearl City, Oahu, Hawaii (Figure 1). The released oil entered the nearby Waiau Stream, flowed downstream and entered East Loch of Pearl Harbor. While in the fresh water of Waiau Stream, the oil remained mostly submerged and then floated to the surface upon entering the denser salt water of Pearl Harbor. In Pearl Harbor, the floating oil initially flowed clockwise down the South Channel. Later that same day, when the winds and current shifted, the oil spread widely around East Loch and began moving down both the South and North Channels and fouling shorelines.

This Chevron pipeline is 22.6 miles long, 8 inches in diameter, and designed to transport heavy black fuel oils at rates as high as 840 gallons per minute from the Chevron Hawaii Refinery at Campbell Industrial Park on the southwest corner of Oahu to delivery points around Honolulu. The pipeline extends from the refinery through Campbell Industrial Park, through the Ewa plain, along the shoreline of Pearl Harbor, along Salt Lake Boulevard, through Camp Catlin military housing, through the airport industrial park, under Keehi Lagoon, through the Sand Island industrial area then through Kapalama to the Chevron Marine Terminal. A takeoff from the pipeline supplies fuel to HECO's Waiau Power Plant (Chevron 1996). The product transfer that resulted in the oil spill was not a transfer to the Waiau Power Plant (Seu 1999).

The pipeline transports both power plant fuel oil and bunker fuel oil for ships. Typically, the oil in the pipeline is heated to reduce its viscosity and facilitate the transportation. The oldest sections of this pipeline were installed in 1958 (Chevron 1996).

The No. 6 fuel oil released was a mixture of three components: two heavy residuum oils and a small amount (less than four percent) of light cycle oil (a component with a boiling range similar to diesel). Once blended together, this No. 6 fuel oil does not readily separate back into its components. The buoyancy of this product is nearly neutral in fresh water and is temperature sensitive. The product will float in fresh water when warmed and will sink when cooled. After its initial release into Waiau Stream and the adjacent marsh area, the product floated on the water surface and created sheens, surface pooling and perimeter staining. As it cooled, the product sank to the marsh bottom and created subsurface pools and mats (Dames and Moore 1997).

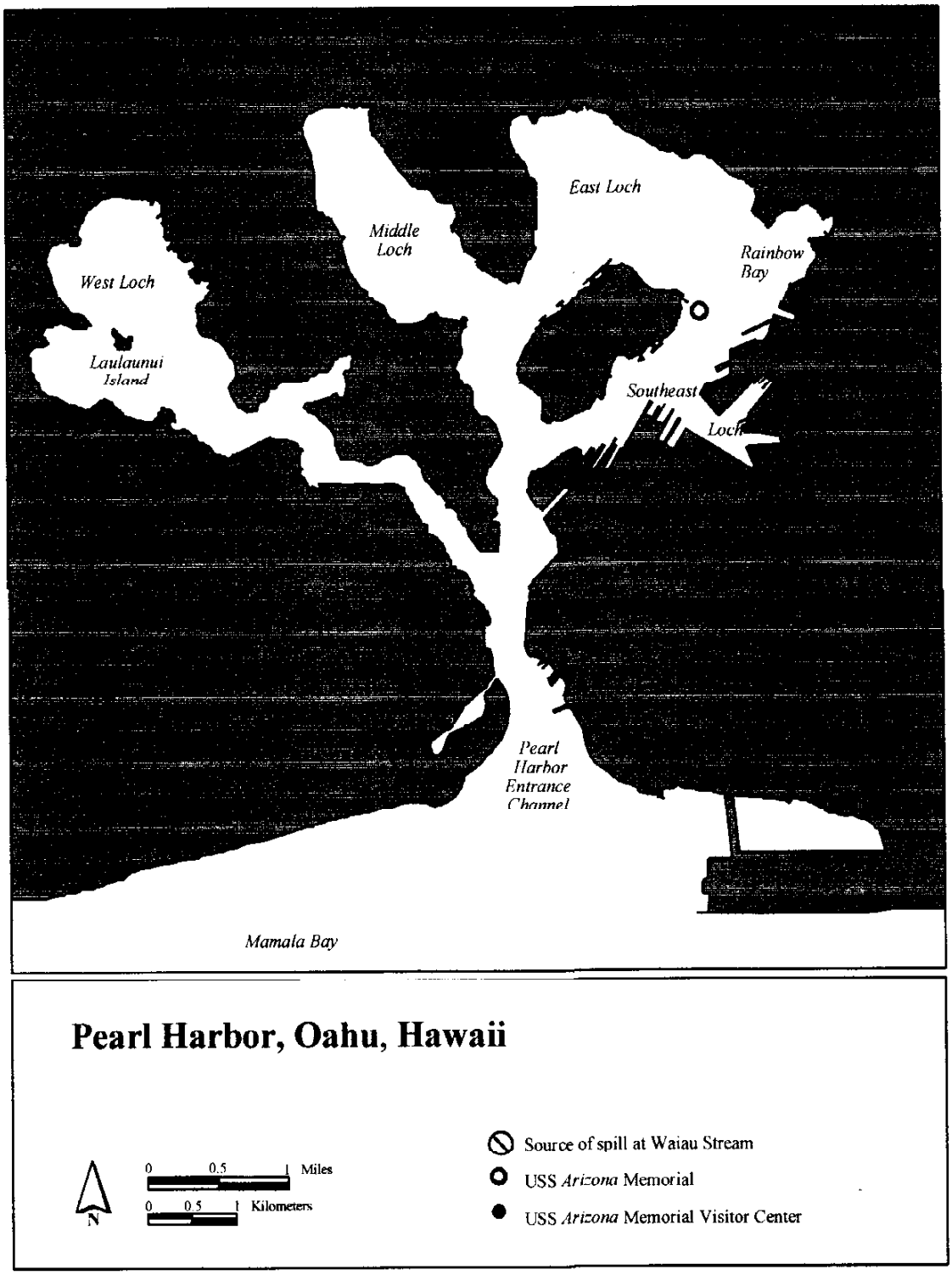

Figure 1. Pearl Harbor, Oahu, Hawaii, showing major land forms and harbor features including the locations of the May 14, 1996 Chevron pipeline oil spill, the USS *Arizona* Memorial and the USS *Arizona* Memorial Visitor Center.

For nearly two weeks after the initial pipeline breach, spilled oil continued to be mobilized from Waiau Stream and released into Pearl Harbor. The U.S. Coast Guard (USCG) reported that pockets of residual oil up to 24-inches deep in Waiau Stream and the marsh were warmed by the hot afternoon sun, mobilized to neutral buoyancy in the fresh water and then floated downstream just below the water's surface in basketball-sized "globs." These floating oil globs did not resurface and become readily visible until reaching the denser salt water of Pearl Harbor some 200-feet to 400-feet from the mouth of Waiau Stream. depending on the strength of the ebb tide and the amount of freshwater flow from the stream (USCG 1996j).

An estimated total of 982 barrels (41,244 gallons) of No. 6 fuel oil were released into Waiau Stream, creating pools of submerged oil throughout the lower portion of the 10-acre marsh. The estimated volume of oil reported released was based on information provided by Chevron and calculated by Petrospect, a Chevron contractor (Chevron 1996). The spill created a sheen of floating oil throughout East Loch, covering approximately 2,290 acres of open water during the first six days of the spill event (Gundlach 1997).

This oil spill is referred to in this Final Restoration Plan and Environmental Assessment (Final RP/EA) document as the "Incident." Chevron is the Responsible Party for this Incident and has acknowledged its liability (Chevron 1996, Pai 1996).

As described in more detail in Section 2, immediate impacts of the discharged oil included:

- the closure of Pearl Harbor to navigation and vessel traffic,
- interruption of U.S. Department of the Navy (USN) construction projects around Pearl Harbor,
- suspension of ferry service to Ford Island,
- closure of the USS *Arizona* Memorial Visitor Center (Visitor Center) on the East Loch shore at Halawa Stream,
- suspension of boat trips to the USS *Arizona* Memorial which straddles the sunken hull of the USS *Arizona* in the nearshore waters of East Loch off Ford Island,
- partial closure of the City and County of Honolulu bicycle/jogging path around the perimeter of East Loch, and
- closure of Pearl Harbor to commercial fishing and boating.

Oiling of shorelines and intertidal areas affected freshwater and saltwater wetlands, mangroves, mudflats, rocky shorelines, sandy beaches, riprap, seawalls and piers. These oiled habitats contribute to many recreationally and commercially valuable fish and wildlife species and the prey and forage items for these species. The contamination of the water column and sediments of Waiau Marsh and Pearl Harbor by this oil may have caused impacts to egg, larval, juvenile and adult stages of recreationally and commercially valuable finfish and invertebrates which utilize the Pearl Harbor estuary.

Immediate cleanup measures following the Incident were undertaken at the direction of a Unified Command which included the USCG, the USN, the State of Hawaii Department of Health (DOH) and Chevron. Cleanup measures employed during the response included: high-pressure steam cleaning of affected shorelines: boom placements to exclude, contain and recover oil; skimming

the surface waters of Pearl Harbor to remove the oil; passive collection technologies such as pom-poms and sorbent pads; and chemical cleaning agents to remove oil from USN piers.

Pollution Reports (called "polreps"), prepared by the USCG's Marine Safety Office in Honolulu, summarize and describe the chronology of events in 1996 associated with response and cleanup activities after the Incident. An excerpted chronology of oil spill response actions associated with this oil spill is provided in Appendix A.4.

A variety of traditional mechanical cleanup technologies (*e.g.*, skimming, booming, high pressure washing) were employed during the oil spill response in an effort to mitigate impacts. Certain cleanup measures employed during the response to this Incident contributed to the spill-related injuries affecting the natural resources of Pearl Harbor. Removal of contaminated sediments from wetland areas may have adversely affected the overlying vegetation at the time of removal in addition to causing soil/sediment alterations that will prevent or substantially delay natural recovery by native vegetation.

The shoreline of the USS *Arizona* Memorial Visitor Center suffered injury as a result of the oil spill cleanup technologies employed. The entire Visitor Center was closed to the public from May 15 - 18, 1996. On May 18, Chevron contractors established a shoreline cleanup post on the Visitor Center property near the Remembrance Exhibit. Visitors were restricted from all the shoreline viewing areas of the Visitor Center from May 18 to 22, 1996 while Chevron's cleanup contractors engaged in oil spill response along the shoreline (Petrossian 1997). As many as 53 contracted cleanup workers were working at the Visitor Center at any one time (USCG 1996i).

This 1,200-foot long Visitor Center shoreline, where Halawa Stream meets Pearl Harbor, is an artificially engineered shoreline of irregular riprap consisting of USN construction debris and broken concrete pilings. Mature *naupaka* shrubs (*Scaevola taccada*) cascaded over the shoreline, protecting and sheltering the fill material and soils in and behind the riprapped shoreline from the erosive forces of wave wash and rainfall. The roots of these mature *naupaka* shrubs also acted to hold and stabilize the shoreline soils (Petrossian 1997).

The Visitor Center shoreline was repeatedly oiled from May 14 - 22, 1996, and repeatedly cleaned by Chevron's contractors during this time. The three cleanup technologies, approved by the Unified Command with the assistance of technical advisors, applied at the Visitor Center were (Petrossian 1997):

1. Episodic 1,500-pounds-per-square inch (psi), directed, high pressure washing;
2. Sustained, medium-pressure continuous washing using perforated, 2-inch polyvinyl chloride (PVC) piping hooked up to an on-site fire hydrant; and
3. The placement of sorbent booms and pom-poms along the shoreline, both in front of the riprap in Pearl Harbor and in newly eroded gaps behind the riprap.

Despite these cleanup efforts, this shoreline continued to emit an oil sheen more than a month after the initial release on May 14, 1996 (USCG 1996l).

The repeated, episodic high-pressure washing of this shoreline, the continuous medium-pressure washing of this shoreline, and the abrasive action of the sorbent booms and pom-poms, all acted to destabilize and erode shoreline soils and material filling in the riprap. The protective *naupaka*

shrub sheltering the shoreline was cut away by Chevron contractors because it was oiled. This action exposed the shoreline to the persistently erosive forces of wave action and boat wake wash. Because the Chevron cleanup crews needed unrestricted access to the shoreline, seven separate pathways, each a swath about three feet wide, were cut through the mature *naupaka* shrub barrier to the water's edge (Petrossian 1997).

The USCG did not view the emergency stabilization of the degraded and destabilized Visitor Center shoreline as an oil spill response measure (Whipple 1996). In November 1996, unusually heavy rains on leeward Oahu exacerbated the erosion of the Visitor Center shoreline. Shoreline soils eroded into Pearl Harbor by these rains created potentially unsafe conditions along the shoreline areas for visitors, employees and occasional after-hours fishermen. In November 1996, the National Park Service (NPS) undertook an emergency shoreline stabilization project using sandbags to fill in the eroded areas (Petrossian 1997).

1.3 NATURAL RESOURCE TRUSTEES AND AUTHORITIES

Both federal and State of Hawaii laws establish liability for natural resource damages to compensate the public for the injury, destruction, and loss of such resources and/or their services resulting from oil spills.

This Final RP/EA has been prepared jointly by the U.S. Department of Defense (DOD), represented by the USN; the U.S. Department of the Interior (DOI), represented by the Office of Environmental Policy and Compliance (OEPC), the NPS, and the U.S. Fish and Wildlife Service (USFWS); the U.S. Department of Commerce, represented by the National Oceanic and Atmospheric Administration (NOAA); and the State of Hawaii, represented by the DOH and the Department of Land and Natural Resources (DLNR). Collectively these agencies are referred to as the "Trustees" or "Natural Resource Trustees."

Each of these agencies acts as a Natural Resource Trustee pursuant to the Oil Pollution Act of 1990 (OPA) (33 USC 2701 *et seq.*), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300.600), for natural resources injured by the incident. Executive Order (EO) 12777 designates the federal Trustees for oil spills while the Governor of Hawaii designates the State Trustees for oil spills in Hawaii. 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 of oil. The Trustees designated the USN, represented by the Commander, Naval Base, Pearl Harbor (now known as Commander, Navy Region Hawaii), as the Lead Administrative Trustee (LAT) [15 CFR 990.14(a)].

Additionally, the Park System Resources Protection Act (Public Law 101-337) (104 Stat. 379, 16 USC 19jj) requires the Secretary of the Interior to assess damages to "Park System resources" and authorizes recovery from responsible parties whose actions caused the destruction, loss, or injury. This law provides for any monies thus recovered by the NPS to be used for response costs, damage assessments, restoration, and replacement of injured NPS resources. Double recovery of natural resource damages is prohibited.

restoration actions. This Phase provides the link between injury and restoration and has two basic components: (1) injury assessment, and (2) 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 being completed, the Trustees develop a plan for restoring the injured natural resources and services.

During the Restoration Planning Phase, 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,
- solicit public comment on the Draft Restoration Plan, and
- incorporate comments into a Final Restoration Plan.

During the Restoration Implementation Phase, the Final Restoration Plan is presented to the Responsible Parties to implement or to fund the Trustees' costs for assessing damages and implementing the Restoration Plan, thus providing the opportunity for settlement of damage claims without litigation. Should the Responsible Parties decline to settle a claim, OPA authorizes Trustees to bring a civil action against Responsible Parties for damages or to seek reimbursement from the Oil Spill Liability Trust Fund.

1.5 COORDINATION WITH THE RESPONSIBLE PARTY

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

To facilitate the undertaking of a NRDA related to this Incident, Chevron and the Trustees, shortly after the spill, agreed to expedite the determination and quantification phases of the assessment process to save time and money and to focus on restoration. Although an expedited procedure such as this avoids a potentially lengthy assessment process, it also requires the Trustees and the Responsible Party to accept a level of uncertainty concerning the nature and extent of injuries.

On July 26, 1996, the Trustees executed a Memorandum of Agreement with Chevron (Chevron/Trustee MOA) specifically pertaining to the Incident. In this MOA, the Trustees and Chevron agreed to attempt to perform an expedited assessment of damages in order to minimize assessment costs and proceed with restoration of injured resources and services as soon as possible. Chevron agreed to reimburse the Trustees for the costs of these damage assessment and restoration planning activities up to certain specified funding ceilings.

Even though the Chevron/Trustee MOA had been executed shortly after the oil spill, in their October 19, 1997, "Notice of Intent to Conduct Restoration Planning," the Trustees extended an official invitation to Chevron to continue participation in the damage assessment, restoration planning and restoration implementation efforts (USDOD *et al.* 1997). The Trustees have produced documents that have been shared with Chevron in an attempt to present known or potential injuries or losses of natural resources and services and to identify candidate assessment

strategies. Coordination between the Trustees and Chevron helped to reduce duplication of studies, increase the cost-effectiveness of the assessment process, increase sharing of information, and decrease the likelihood of litigation. The Trustees sought input from Chevron and considered such information, when provided, throughout the NRDA process.

1.6 PUBLIC PARTICIPATION

Public review of the Draft RP/EA is considered an integral component to the restoration planning process. Through the public review process, the Trustees sought public comment on the analyses used to define and quantify natural resource injuries and the methods and the projects being proposed to restore injured natural resources or replace lost resource services. The Draft RP/EA provided the public with current information about the nature and extent of the natural resource injuries identified and the restoration alternatives evaluated.

Following a public notice (Honolulu Advertiser 1999), the Draft RP/EA was made available to the public for a comment period from April 12, 1999 through June 1, 1999. The Draft RP/EA was made available to the public in three ways: in electronic form for viewing and downloading on the world wide web on DOI and NOAA web pages, as part of the publicly-available Administrative Record, and in hardcopy form by request. In addition, a Public Meeting was held at 7:00 PM on May 17, 1999 at the *USS Arizona* Memorial Visitor Center auditorium in Honolulu, Hawaii to present the Draft RP/EA to the public and invite public comment.

Public review of the Draft RP/EA is consistent with all federal and state laws and regulations that apply to the NRDA process, including Section 1006 of OPA, the OPA regulations, the National Environmental Policy Act (NEPA), as amended (42 USC 4371 *et seq.*), and its implementing regulations (40 CFR Parts 1500-1508). Comments received during the public comment period were considered by the Trustees in preparing the Final RP/EA.

During this 51-day long public comment period, the Trustees received five written comments. These comments and the Trustees' responses to these comments are provided in Appendix A.1.

During the Public Meeting on the evening of May 17, 1999, 39 attendees registered by providing information on a "Sign-in Form." These Public Meeting "Sign-In Forms" are provided in Appendix A.2. One attendee at this Public Meeting provided verbal comments and this commentor's "Speaker Sign-In Form" is provided in Appendix A.2. A summary of this speaker's comments, as recorded during the Public Meeting, are provided in Appendix A.2.

After an analysis of the public comments on the Draft RP/EA, the Trustees determined that the Restoration Plan could be adopted as a final Plan without modifications to the proposed projects. The Adoption Resolution is provided at Appendix A.7. A Finding of No Significant Impact (FONSI) determination was made by each of the Trustee agencies. Copies are provided at Appendix A.8

1.7 ADMINISTRATIVE RECORD

The Trustees have compiled an Administrative Record which contains documents considered by the Trustees as they have planned and implemented the NRDA and addressed restoration and compensation issues and decisions. The Administrative Record is available for public review at the public repositories listed below. An index of documents that are part of the Administrative Record is provided in Appendix A.6 of this Final RP/EA.

The Administrative Record facilitates public participation in the NRDA process and will be available for use in future administrative or judicial reviews of the Trustees' actions to the extent provided by federal or State law. Additional information and documents, including public comments received on the Draft RP/EA, the Final RP/EA and other related restoration planning documents will become a part of the Administrative Record and will be submitted to the repositories upon their completion.

The documents comprising the Administrative Record can be viewed at the following public locations:

State of Hawaii, Department of Health
Hazard Evaluation and Emergency Response Office
919 Ala Moana Boulevard, Suite 206
Honolulu, HI 96814
(808) 586-4249
open to the public: Monday - Friday: 7:45 am - 4:30 pm

and

City and County of Honolulu
Pearl City Public Library
1138 Waimano Home Road
Pearl City, HI 96782
(808) 453-6566
open to the public: Monday, Tuesday, Thursday: 10:00 am - 8:00 pm
Wednesday, Saturday, Sunday: 10:00 am - 5:00 pm;
Friday: 1:00 pm - 5:00 pm

1.8 SUMMARY OF THE NATURAL RESOURCE DAMAGE CLAIM

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

- intertidal habitat,
- water column habitat,
- subtidal habitat,
- freshwater marsh habitat, and
- lost human use.

The proposed compensatory restoration actions seek to:

- enhance wetlands and wetland services to compensate for injuries to freshwater marsh and intertidal habitats,
- open vegetated shoreline areas to compensate for injuries to water column and subtidal habitats, and
- improve visitor services at the USS *Arizona* Memorial to compensate for the loss and diminishment of human use services resulting from injuries associated with natural resources.

2.0 ENVIRONMENT

2.0 AFFECTED ENVIRONMENT

2.1 PHYSICAL AND BIOLOGICAL ENVIRONMENT

Pearl Harbor is a coastal plain estuary located between the Koolau and Waianae Mountain ranges on south-central Oahu. The harbor is the largest landlocked estuary in Hawaii and has about 8 square miles of surface water with an average depth of 28 feet and about 36 linear miles of shoreline. Pearl Harbor is divided into three main embayments called lochs (East Loch, Middle Loch and West Loch) and one smaller loch (Southeast Loch) which are remnants of drowned river valleys that join at a narrow main channel connecting the harbor with the open ocean (Coles *et al.* 1997). Waipio Peninsula lies between West and Middle Lochs while Pearl City Peninsula separates Middle Loch from East Loch. Two islands punctuate the waters of Pearl Harbor: Ford Island in East Loch and the smaller Laulaunui Island in West Loch (Figure 1).

The harbor is relatively isolated from oceanic water circulation and the water exchange between the harbor and open ocean is relatively slow. Residence time of water within the harbor has been estimated at about six days maximum for bottom water and one to three days for surface water. Surface water circulation is primarily offshore and driven by the prevailing northeast trade winds, while weak tidal ebb and flood flows of 0.15 - 0.3 meters per second (m/sec) control the movement of bottom water in and out of the narrow harbor opening (Grovhoug 1992).

Water temperature in the harbor varies annually from 23 to 29 degrees Centigrade (°C), and salinities have ranged from 10 to 37 parts per thousand (ppT) with a mean harbor-wide salinity of 33 ppT. Salinity is highly influenced by surface water and groundwater runoff, especially at the upper reaches of the three main lochs. Warming of the surface water and freshwater discharge contribute to the development of a pronounced vertical stratification of harbor waters which in turn promotes differing current conditions between surface and bottom and a relative isolation between surface and bottom water masses (Coles *et al.* 1997).

Eight streams presently discharge into Pearl Harbor draining approximately 109 square miles of watershed. Six of these streams are perennial: Waikele, Waiawa, Waiau, Waimalu, Kalanao and Halawa. Two of the eight streams are intermittent: Honouliuli and Aiea. The perennial streams originate in the windward Koolau Mountain range and constantly bring fresh water into the Pearl Harbor estuary.

Groundwater also discharges into Pearl Harbor along the shore and in stream channels below seawater or stream water level. Five large springs along the upper loch shorelines, collectively known as the Pearl Harbor Springs, input additional fresh water into the system (Coles *et al.* 1997). The Pearl Harbor Aquifer probably has the broadest and thickest caprock in Hawaii. However, there are numerous areas where basaltic rock outcrops extend to the surface without caprock cover. In most of these areas, the basaltic rock is sufficiently weathered to serve as a caprock. In other areas, such as those adjacent to stream channels, the basaltic rock is exposed at elevations below 6.1 m. These large springs exist at these points. The largest measurable groundwater flow, estimated at between 78,000 cubic meters to 852,000 cubic meters per day, occurs at the springs (SSFM and Belt Collins 1997).

The waters of Pearl Harbor are relatively turbid from stream runoff coupled with other sources of sediment which has resulted in thick deposits of fine silt on the bottom throughout most of the lochs. Stream input of sediments has been estimated to exceed 96,000 tons annually and maintenance dredging of about nine million cubic yards has been required by the USN on four- to five-year cycles. Relative turbidity measurements indicated by Secchi disk readings in 1990 averaged only 2.5 m harbor-wide resulting from the high loading of suspended sediments and organic material produced by eutrophic conditions (Grovhoug 1992).

A variety and range of shoreline types comprise the 36 miles of linear shoreline in Pearl Harbor. The most extensive shoreline type, found predominantly throughout East Loch, Ford Island, the end of the Waipio Peninsula and the harbor entrance, is sheltered rocky/constructed seawall shoreline. The second most extensive shoreline type is wetlands, which are considered to be the most sensitive shoreline type to oil spills. These wetland shorelines are found intermittently in the upper reaches of the three main lochs. Isolated areas of fine-grained sand beaches are found sporadically along the three main lochs and on Ford Island (RPI 1986).

Vegetation along the shoreline is dominated by red mangroves (*Rhizophora mangle*) at the heads of the three main lochs forming dense, nearly impenetrable growths of bushes and trees up to 10 m high. The red mangrove is an exotic, salt-tolerant species which probably began colonizing the harbor shorelines not long after it was introduced to Molokai in 1902. Pickleweed (*Batis maritima*), first reported in Hawaii in 1859, now forms low and thickly-growing communities along certain muddy shorelines in Pearl Harbor which are periodically flooded by salt water (Wagner *et al.* 1990). Elsewhere along the harbor shoreline, the dominant vegetation is cultivated exotic grasses, trees and plants in populated areas and *kiawe* trees (*Prosopis pallida*) along the channels (Coles *et al.* 1997).

The habitat of Pearl Harbor has been an environment of shifting characteristics, both physical and biological, since humans arrived in the area. Native Hawaiians used the harbor and its shorelines for extensive fish cultivation and harvesting in unique walled fishponds. Middle 19th century agricultural development on the surrounding plains increased the rate of sediment-laden runoff into the harbor. The 1911 completion of the entrance channel allowed deep draft vessels to enter the harbor, increasing the rate of exotic species introduction. The development of the harbor and surrounding lands as a USN ship repair and resupply complex, coupled with an increase in residential development and expansive sugar cane production, yielded construction-hardened shorelines and a period in which the harbor received uncontrolled runoff and waste disposal (Coles *et al.* 1997).

The inner harbor benthic community is depicted by four zones: sand-rubble, algal-mud, channel wall and channel floor mud-silt. Naturally occurring sedimentation greatly influences the constituents of the benthic community. Stony corals are present but not widely or generally observed because they are sensitive to high sediment loads. Predominant marine biota in the area include the sea cucumber (*Ophiodesoma spectabilis*), which is common to areas where organic particulate input is high; benthic algae; sponges; sabellid (or feather duster) worms; serpulid tube worms; and various benthic shrimps and crabs (SSFM and Belt Collins 1997).

Many reports describe the abundance of fish and shellfish resources inhabiting Pearl Harbor. The harbor region served as a major Hawaiian population center in the early years and supported numerous and extensive constructed fish ponds. Many of the walled fish ponds remained intact

until the 1930s. By 1972, the number of existing fish ponds had decreased to four. However, an extensive survey of the harbor's marine biota revealed a relatively diverse and abundant estuarine marine ecosystem during a period of significant contaminant loading into the harbor (Evans *et al.* 1974). Abundant fish and invertebrate communities continue to flourish into the present (Grovhoug 1992, Coles *et al.* 1997).

Some 24 percent of the inshore fishes from Hawaii are endemic. This is the highest percentage of endemism for warm-water marine fishes worldwide. These endemic fishes in Hawaii are often the most common members of their genera (Randall 1996).

Recent biological investigations of Pearl Harbor observed a total of 434 species or higher taxa including 36 algae, 1 spermatophyte, 338 invertebrates and 59 fish. Ninety-six species (*i.e.*, 22 percent) are considered to be introduced or cryptogenic. The areas of highest species richness were in the entrance channel to Pearl Harbor and in Rainbow Bay at the northeast head of East Loch where the number of taxa was around 150. Lowest species richness occurred in the areas of highest sedimentation and turbidity at the head of West Loch where fewer than 50 taxa occurred. Based on species composition, three types of biological communities can be delineated in the harbor: one associated with the relatively oceanic conditions in channel areas, one with the highly turbid West Loch sedimentary environment, and one with conditions prevailing throughout the rest of the harbor (Coles *et al.* 1997).

Since the beginning of this century, Pearl Harbor has been at the center of USN operations in the Pacific. The Pearl Harbor Naval Complex has served to support industrial, berthing and maintenance activities for the U.S. Pacific fleet. On October 14, 1992, the Pearl Harbor Naval Complex was placed on the National Priorities List (NPL) of the nation's most contaminated hazardous waste sites (USEPA 1992). As part of a long-term program to restore the environment at its facilities, the USN is conducting an investigation of marine life and contaminants that are present in sediments of Pearl Harbor. This investigation will provide data to evaluate the potential threat from contaminants to human health and the marine environment and to identify areas that may require remediation or cleanup. In 1998, the DOH issued a notice advising that marine life taken from Pearl Harbor not be consumed (DOH 1998).

During the last century a wide variety of human activities has been concentrated along the shoreline and within the upland drainage basins that empty into the harbor. These activities include the industrial and operational activities of the USN, private industrial operations, extensive sugarcane and pineapple agriculture, golf courses, extensive residential development, and other municipal, commercial and urban activities. An estimated 5,000 acres of harbor sediments may have received contaminants from multiple sources. These sediments act as an ultimate sink or repository for many of the contaminants entering the harbor (Grovhoug 1992).

2.2 ENDANGERED AND THREATENED SPECIES

The shoreline, estuarine and freshwater areas associated with Pearl Harbor are known habitat for four species of endemic waterbirds which are listed by both federal government and by the State of Hawaii as endangered species: the Hawaiian moorhen (*Gallinula chloropus sandvicensis*) (= *`alae `ula*), the Hawaiian coot (*Fulica americana alai*) (= *`alae ke`oke`o*), the Hawaiian duck (*Anas*

wyvilliana) (= *koloa maoli*) and the Hawaiian stilt (*Himantopus mexicanus knudseni*) (= *ae`o*) [Haw. Rev. Stat. Ch. 12 (1998), USFWS 1998a, 50 CFR Part 17].

Population levels of these endangered waterbirds have been severely reduced primarily because of the loss of wetland habitat. Other threats to these species include predation by introduced mammals, invasion of wetlands by alien plants and fish, hybridization, disease, and possibly environmental contaminants (USFWS 1998a). The secretive nature of the Hawaiian moorhen, which inhabits the islands of Kauai and Oahu, prevents adequate censusing and estimation of population numbers; however, "small numbers" are reported from Pearl Harbor. The state-wide population of the Hawaiian coot is estimated to range between 2,000 - 4,000 birds with 80 percent of these birds found on Kauai, Oahu and Maui. An estimated 300 wild Hawaiian ducks remain on the Island of Oahu. An estimated 1,200 - 1,600 Hawaiian stilts exist throughout the main Hawaiian Islands. Forty to sixty percent of this state-wide Hawaiian stilt population can be found on Oahu with Pearl Harbor supporting a portion of this population (USFWS 1998a). Approximately 50 of these Hawaiian stilt are resident at Chevron's Hawaii Refinery in Campbell Industrial Park on the southwestern corner of Oahu (Foster 1996).

Two additional species of birds, listed as threatened or endangered by the State of Hawaii, but not listed by the federal government, are found in the vicinity of Pearl Harbor. These two species include the state-threatened white tern (*Gygis alba rothschildi*) (= *manu o kū*), a diminutive, arboreal-nesting seabird which can be seen around Pearl Harbor, and the state-endangered Hawaiian owl (*Asio flammeus sandwichensis*) (= *pueo*), an endemic race of the crepuscular, ground-nesting shorteared owl) [Haw. Rev. Stat. Ch. 12 (1998)].

The federally- and state-listed threatened Pacific green sea turtle (*Chelonia mydas agassizi*) (=*honu*), which feeds on sea grasses and algae (= *limu*) in Mamala Bay, has been regularly reported in Pearl Harbor (Naughton pers. comm.). At least one Pacific green sea turtle has been regularly observed in and around the sunken hull of the USS *Arizona* and is thought to be resident in that location (Adams pers. comm.). On March 21, 1998, federally-listed endangered humpback whales (*Megaptera novaeangliae*) (= *kohola*), specifically an adult and a calf, were observed within Pearl Harbor. This use of Pearl Harbor by humpback whales is considered an unusual event.

A large number of federally-listed and state-listed threatened and endangered plants are found in the State of Hawaii, including 272 taxa of endangered plants and 10 taxa of threatened plants. Of these plants, 115 taxa of endangered plants and 2 taxa of threatened plants are found on the Island of Oahu (USFWS 1998b). An unknown number of these threatened and endangered plants from Oahu may be associated with the terrestrial and shoreline areas of Pearl Harbor.

2.3 HISTORIC AND CULTURAL RESOURCES

Pearl Harbor is recognized worldwide as one of the most dramatic historic sites in the United States due to the crucial role played by Naval Base Pearl Harbor in the nation's defense from the beginning of the century to the present. Because of the Japanese attack on the Naval Base on December 7, 1941, and the resulting American casualties, coupled with its role throughout the remainder of World War II, Pearl Harbor today is widely held in near reverential, patriotic esteem.

In 1964, the U.S. Naval Base Pearl Harbor was declared a National Historic Landmark (NHL) by the Secretary of the Interior and was placed on the National Register of Historic Places in 1966. The boundary of the NHL area was officially defined in 1974 and includes both upland areas and surface waters. Upland areas included within the NHL boundary include Naval Magazine Lualualei, the Waipio Peninsula, the Pearl City Peninsula, Ford Island, Naval Station Pearl Harbor, Submarine Base Pearl Harbor, Naval Supply Center Pearl Harbor and Naval Shipyard Pearl Harbor. Surface water areas included within the NHL boundary include West Loch, Middle Loch, East Loch and the Mamala Bay entrance to Pearl Harbor on the south shore of Oahu (Helbert Hastert & Fee 1992).

Within the NHL boundary there are also several activities and related facilities of particular historic and cultural importance. Perhaps the most famous of these is the USS *Arizona* Memorial, which spans the submerged USS *Arizona*, off Ford Island and the associated Visitor Center on the shoreline of East Loch. The Visitor Center was completed in 1980 and attracts 1.4 million visitors annually. The USS *Utah* and its memorial are located on the northwest side of Ford Island. Both of these ships are designated NHLs. The USS *Nevada* Memorial is located near Hospital Point.

The NPS operates the USS *Arizona* Memorial under an agreement with the USN (NPS 1983). The specific purposes of the USS *Arizona* Memorial are:

- to preserve and interpret the tangible historical resources associated with the December 7, 1941 attack on Pearl Harbor,
- to interpret the historical events which led up to and which were a direct result of the December 7, 1941 attack, and
- to preserve and interpret the intangible historical values -- the memories, attitudes and traditions -- of those individuals who were present at or had intimate first-hand knowledge of the historic events which took place on December 7, 1941.

These purposes are to be carried out by the NPS for the benefit of visitors in an atmosphere of safety and relative comfort. Of primary importance in this mission is the sunken remains of the USS *Arizona*, which serves as the final resting place for the battleship's sailors and marines killed during the attack, and the distinctive concrete memorial which straddles the USS *Arizona*.

Immediately to the north of the Visitor Center is the *Bowfin* Park operated by the non-profit Pacific Fleet Submarine Memorial Association. This facility, which was completed in 1988, includes the Pacific Submarine Memorial Association Museum maintained by Naval Station Pearl Harbor and the USS *Bowfin*, a World War II vintage submarine listed on the National Register of Historic Places. The *Bowfin* Park attracts 200,000 visitors annually (Helbert Hastert & Fee 1992).

Also located in the waters off Ford Island are the mooring quays for ships berthed in the harbor during the attack on December 7, 1941. These structures are not listed as historic landmarks but their historic significance has gained increased attention in recent years (Helbert Hastert & Fee 1992).

The Oki`oki`lepe Fishpond, located along the shoreline at the confluence of West Loch and East Loch at Naval Magazine Lualualei, is listed on the National Register of Historic Places. Paaiau

Fishpond, located along the shoreline near the McGrew Point housing area in East Loch, is also within the NHL boundary, but has not been evaluated for inclusion on the National Register of Historic Places (Helbert Hastert & Fee 1992). Perhaps as many as 23 other late-19th century coastal fish ponds existed or are suspected to have existed along the margins of Pearl Harbor within the landmark boundary (SHPO, undated).

2.4 NATIONAL WILDLIFE REFUGE RESOURCES

The Pearl Harbor National Wildlife Refuge (Refuge) was established on October 17, 1976 along the shoreline of Pearl Harbor and is divided into two discrete geographic units totaling 61 acres. The 24.5-acre Waiawa Unit of the Refuge is on the western shore of the Pearl City Peninsula at the upper reach of Middle Loch and is composed of two constructed impoundment ponds with manmade islands for bird nesting. Surface water in this Unit is pumped into the ponds from a nearby spring-fed, freshwater stream and eventually empties into adjacent Pearl Harbor. The 36.5-acre Honouliuli Unit of Refuge is on the western shoreline of West Loch and is composed of two constructed impoundment ponds with manmade bird nesting islands. Surface water in this Unit is pumped into the impoundments from an onsite freshwater well and eventually empties into Pearl Harbor (USFWS, undated).

The USN owns the land comprising the two units of the Refuge. The Refuge is managed by the USFWS under a 1972 "Use Agreement" with the USN (USN and USBSFW 1972). This Agreement is in effect indefinitely but the USN may terminate or suspend the Agreement at any time for the following reasons: (1) during a national emergency declared by the President or Congress, or (2) in the event that the land ceases to be used for the specified purposes (USFWS, undated).

These two units of the Refuge serve as feeding, foraging, loafing and nesting habitat for the four species of federal and state endangered endemic waterbirds and 25 other species of federally protected migratory birds including shorebirds and waterbirds. The three management goals for this Refuge are:

1. To support the recovery and perpetuation of federally-listed endangered and threatened species especially endangered Hawaiian waterbirds;
2. To provide adequate water quality to maximize habitat size and value for migrant, endangered and resident waterbirds; and
3. To provide opportunities for quality wildlife-dependent recreation, education and research to enhance public appreciation, understanding and enjoyment of Refuge wildlife and habitats.

Public access to the Refuge is authorized only by a Special Use Permit (SUP) from the USFWS (USFWS, undated).

2.5 HUMAN USE SERVICES

The human use services in, on and around the margins of Pearl Harbor can be considered in four broad categories: tourism, recreation, fisheries and Navy Operations.

2.5.1 Tourism

The USS *Arizona* Memorial, located on the Naval Base Pearl Harbor and operated by the NPS in cooperation with the USN, is considered to be the single most heavily visited tourist attraction on the Island of Oahu. This Memorial interprets the diplomatic and military history of the December 7, 1941 Japanese attack on Pearl Harbor that marked the entrance of the United States into World War II. The USS *Arizona* Memorial consists of a Visitor Center (containing theaters, a museum, a gift shop, a Remembrance Exhibit, public viewing area of Pearl Harbor and other interpretative exhibits) on the shoreline of East Loch and a memorial structure which is situated over the sunken hull of the USS *Arizona* off the east shore of Ford Island. The USS *Arizona* is the final resting place for most of the ship's 1,177 crewmen who lost their lives during the Japanese attack and visits to the Memorial evoke powerful emotional responses from both domestic and international visitors. Approximately 4,000 visitors visited the Memorial each day during the month of May, 1996 (Billings pers. comm.).

The *Bowfin* Park and Pacific Submarine Museum are located adjacent to the Visitor Center on the shoreline of East Loch. The *Bowfin* Park is maintained as a memorial to the 52 U.S. Navy submarines and the 3,505 submariners lost during World War II. The Pacific Submarine Museum interprets the U.S. submarine campaign during World War II and depicts the history of the U.S. submarine service up to the present day. The USS *Bowfin*, a restored World War II era submarine, is permanently docked at the museum and is open for interpreted public tours. The *Bowfin* Museum received approximately 400 visitors a day during the month of May, 1996 (Billings pers. comm.).

Water-borne tours of Pearl Harbor are offered to the public aboard the cruise ship *Star of Honolulu*. The *Star of Honolulu*, a 232-foot, 1,500-passenger capacity vessel, provides scenic and historic tour cruises of Pearl Harbor under a permit from the USN.

2.5.2 Recreation

The City and County of Honolulu owns and maintains a public park called Blaisdell Park (also known as Pearl Harbor Park) along the shoreline of East Loch immediately west of Waimalu Stream. This park provides both open space and public shoreline access to Pearl Harbor for a wide range of public recreational activities including fishing, bird watching, picnicking, bicycling and games.

A paved, public bicycle/jogging path, maintained by the City and County of Honolulu's Department of Public Works along a former railroad right-of-way around the perimeter of East Loch of Pearl Harbor, extends from Halawa Stream westward for approximately five miles to Waipio Point Access Road. This bicycle/jogging path is heavily used by joggers, walkers, skaters and bicyclists. This path bisects HECO property at the Waiau Power Plant along a Navy right-of-way and passes within several feet of the location of the pipeline breach next to Waiau Stream.

The Rainbow Marina is located along the shoreline of Aiea Bay in East Loch of Pearl Harbor. This marina is owned by Naval Station Pearl Harbor, operated by the Naval Station Morale, Welfare and Recreation Department, and provides 88 berths for boats belonging to USN personnel and

dependents. Recreational activities offered by the marina include sailboat rentals, sailing lessons and youth sailing lessons.

Other general recreational activities that take place along the shorelines and margins of Pearl Harbor include recreational beach use, beach combing and bird watching.

2.5.3 Fisheries

Quiet waters in the upper regions of all three major Pearl Harbor lochs provide suitable habitat for the commercially important, endemic Hawaiian anchovy (*Encrasicholina purpurea*) (= *nehu*), a species used as a baitfish in the offshore skipjack tuna (*Katsuwonus pelamis*) (= *aku*) fishery. This native anchovy is the most important baitfish resource in Hawaii and Pearl Harbor provides a major baitfish harvesting region (Naughton pers. comm., Oishi pers. comm.). The USN issues permits for insured commercial *aku* boats to collect baitfish from certain regions of Pearl Harbor.

The Marquesan (or goldspot) sardine (*Herklotsichthys quadrimaculatus*) was brought to Hawaii from the Marquesas Islands between 1955 and 1959 as a baitfish for tuna and became established, although never abundant, in Pearl Harbor (Randall 1996). Marquesan sardines are sometimes caught incidentally as part of the commercial Hawaiian anchovy fishery in Pearl Harbor (Oishi pers. comm.).

Except for the commercial baitfish fishery in Pearl Harbor, general access to Pearl Harbor for recreational fishing is restricted and generally discouraged by the USN. However, a persistent but limited subsistence, artisanal and recreational fishery by the public exists on the shorelines and around the margins of Pearl Harbor for both finfish and crustaceans. The finfish are typically caught using rod and reel and cast net and the crustaceans are caught using nets. Finfish species caught in this fishery include: striped mullet (*Mugil cephalus*) (= *ʻama ʻama*), Hawaiian flagtail (*Kuhlia sandvicensis*) (= *āholehole*), surgeonfish (*Acanthuridae* spp.), jacks (= *ulua* and *papio*), goatfish (= *weke*) and tilapia (*Tilapia* spp.). Crustaceans caught in this fishery include the mangrove (or Samoan) crab (*Scylla serrata*), the white crab (*Portunus sanguinolentus*) (= *kuahonu*) and the slipper lobster (*Scyllarides squammosus*) (= *ula papapa*) (Oishi pers. comm.).

2.5.4 Navy Operations

The overriding and dominant human use of Pearl Harbor is USN operations associated with the Pearl Harbor Naval Complex. The Pearl Harbor Naval Base is the USN's largest and most strategic island base in the Pacific. It extends over more than 12,600 acres of land and water and serves as the headquarters for more than 70 commands including the U.S. Pacific Fleet Commander. The Pearl Harbor Naval Complex is home for more than 18,000 sailors, 15 surface ships and 22 submarines.

The USN offers services to transiting Pacific fleet units as well as many ships of friendly allied navies when they visit Pearl Harbor. During a major fleet exercise such as "Rim of the Pacific" (RIMPAC), logistical support is provided to as many as 75 ships from 20 different nations. Such an exercise, RIMPAC 96, was underway at Pearl Harbor when the Incident occurred.

Pearl Harbor itself and the area immediately outside the entrance channel into the Harbor is described as the Pearl Harbor Naval Defensive Sea Area. The Defensive Sea Area was established by EO 8143 (May 26, 1939) during peacetime to provide control of waters and submerged lands abutting active military installations. Control of the submerged lands and waters, including the entrance channel and approaches to Pearl Harbor, remains with the United States rather than with the State of Hawaii (33 USC 475, 32 CFR 765.5). Entry control over Pearl Harbor has been delegated to the Commander, Navy Region Hawaii.

3.0 INJURY

3.0 INJURY DETERMINATION AND QUANTIFICATION

3.1 SUMMARY OF PREASSESSMENT ACTIVITIES

Three threshold requirements identified in OPA must be met before Restoration Planning can proceed:

1. Injuries have resulted, or are likely to result, from 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.

All of the information collected during the Preassessment Phase for the Incident was collected by the Trustees and Chevron prior to August, 1996. This information satisfies the three criteria listed above and confirms the need for restoration planning to address spill impacts.

3.1.1 General Description of Impacts

Immediate public impacts from the discharged oil included:

- the closure of Pearl Harbor to vessel traffic.
- the partial closure of the City and County of Honolulu's bicycle/jogging path around East Loch in the vicinity of the Waiau Power Plant,
- suspension of ferry service to Ford Island,
- the closure of the Visitor Center and associated boat trips to the Memorial, and
- the closure of the Harbor to recreational and commercial fishing and boating.

Oiling of shorelines and intertidal areas affected freshwater and saltwater wetlands, mudflats, and sandy beaches. These oiled habitats contribute to many recreationally and commercially valuable fish and wildlife species. Other shoreline types, including riprap, seawalls and piers, were also oiled. Introduction of oil into the water column and sediments may have exacerbated the extant pollution problems in Pearl Harbor.

Cleanup of shorelines accelerated the destabilization of existing shoreline protection at the Visitor Center and may have impacted other habitats that required intensive and/or repeated aggressive cleanings. Removal of contaminated sediments from wetland areas may not only have adversely affected the overlying vegetation at the time of removal but also caused soil/sediment alterations that will prevent or substantially delay natural recovery by native vegetation.

A more detailed discussion is provided below on specific assessments undertaken for the following natural resource categories: air resources, surface waters, wildlife and marine/estuarine biota.

3.1.2 Air Resources

Samples taken and analyzed by Chevron and the NPS at the Visitor Center indicate that the air resource was not affected with respect to public health and/or natural resources (Chevron 1996, Robichaux 1996).

The NPS undertook an air sampling investigation at the Visitor Center for a period of three to six days after the Incident because of concerns about the health and welfare of NPS employees, volunteers and visitors, particularly the elderly, who might potentially be exposed to the volatile fractions evaporating from the spilled oil. NPS employees working at the Visitor Center on the morning of May 14, 1996 reported smelling strong petroleum odors and experienced nausea and vomiting after exposure to the fumes-laden ambient air (Billings pers. comm.).

Four outdoor, ambient air sampling stations were established at the Visitor Center: two along the Halawa Stream shoreline, one along the Pearl Harbor shoreline next to the former Ford Island ferry dock, and one on the sidewalk immediately outside the theater building. Air samples collected on May 17 and 18, 1996 were analyzed for total petroleum hydrocarbons (TPH) and benzene only. Samples collected on May 20, 1996 were analyzed only for hydrogen sulfide. No detectable concentrations of TPH, benzene or hydrogen sulfide were measured at the specified analytical detection limits during this limited air sampling at the Visitor Center during a period of three to six days after the oil spill. Table 1 details the results of this air sampling event.

Table 1. Ambient air sampling results for TPH, benzene and hydrogen sulfide at four outdoor monitoring stations established at the USS *Arizona* Memorial Visitor Center on May 17, 18 and 20, 1996 (Robichaux 1996).

analyte	date sample collected	number of air samples collected	analytical detection limit	analyses results
total petroleum hydrocarbons (TPH)	5/17/96 5/18/96	4 7	100 μg^1 100 μg^1	not detected[3] not detected[4]
benzene	5/17/96 5/18/96	4 7	1.0 μg^1 1.0 μg^1	not detected[5] not detected[6]
hydrogen sulfide	5/20/96	4	ppb[2] by volume	not detected

[1] measured as mass absorbed by sampling device at 1 liter of air per minute of sample time (in micrograms).
[2] ppb = parts per billion.
[3] sample time = 25 - 28 minutes.
[4] sample time = 16 - 23 minutes.
[5] sample time = 25 - 28 minutes.
[6] sample time = 16 - 23 minutes.

Warm ambient weather conditions during the day on May 14, 1996 acted to volatilize a fraction of the spilled oil creating a widely detected "odor problem" around Pearl Harbor especially within the Naval Complex and in Pearl City (Kakesako and Barayuga 1996). The Hawaii Department of

Health advised the public that the spilled oil did not present an immediate public health threat except for these odors (Kakesako *et al.* 1996).

3.1.3 Surface Waters

Two specific studies of surface water impacts resulting from the Incident were undertaken. The Trustees independently contracted an analysis of certain aerial photoimagery taken during the first day of the spill event and the Trustees, in cooperation with the Chevron, contracted for an investigation of the extent of oil coverage on the surface waters of Pearl Harbor during the first six days of the spill event.

The aerial imagery study of the surface waters of Pearl Harbor used multispectral imagery taken late in the afternoon on May 14, 1996, the first day of the spill. These images were taken with an airborne multispectral camera system that features four narrow spectral bands that can be selected for specific environmental applications. A total of 220 aerial, multispectral images along 12 different flight lines across Pearl Harbor were collected. Of these, five specific geographic areas of Harbor shoreline were selected for detailed analysis to demonstrate the extent of oil coverage and oil spill shoreline impacts. These five geographic areas included:

- Hospital Point to Waipio Point;
- the shoreline immediately to the north of Hospital Point;
- the shoreline at the Visitor Center, including the USS *Bowfin* and *Bowfin* Park (Photo 1);
- the USS *Arizona* Memorial, the sunken remains of the USS *Arizona* and the east coast of Ford Island; and
- the shoreline adjacent to the HECO Power Plant, including the source location of the oil spill.

The imagery was obtained in four narrow bands at wavelengths of 450, 550 , 650, and 770 nanometers (nm) at approximately 0.6 meters/pixel under cloud cover shadow in the later afternoon after 5:00 p.m. Hawaii Standard Time (HST) on the first day of the oil spill. Processing of these images distinctly shows regions of oil, oil sheen and coastal impacts (TerraSystems 1997). A summary of these selected images is provided in Table 2.

These images demonstrate the broad distribution of the spilled oil on the surface waters of East Loch of Pearl Harbor extending from the upper reaches of East Loch south to Waipio Point on the Waipio Peninsula at the Pearl Harbor entrance channel during the first day of the spill on May 14, 1996. These aerial images also demonstrate the limited success of protective booms which were deployed to provide protection from the spilled oil to the USS *Arizona* Memorial, the sunken remains of the USS *Arizona* and the mouth of Halawa Stream (TerraSystems 1997).

In the second surface water study the Trustees, in cooperation with Chevron, contracted an investigation of the areal extent oil coverage on the surface waters of Pearl Harbor based on analyses of aerial imagery and video overflights. This analysis used digital data entry regarding oil slick position into a Geographic Information System (GIS) application called "Spatial Analyst."

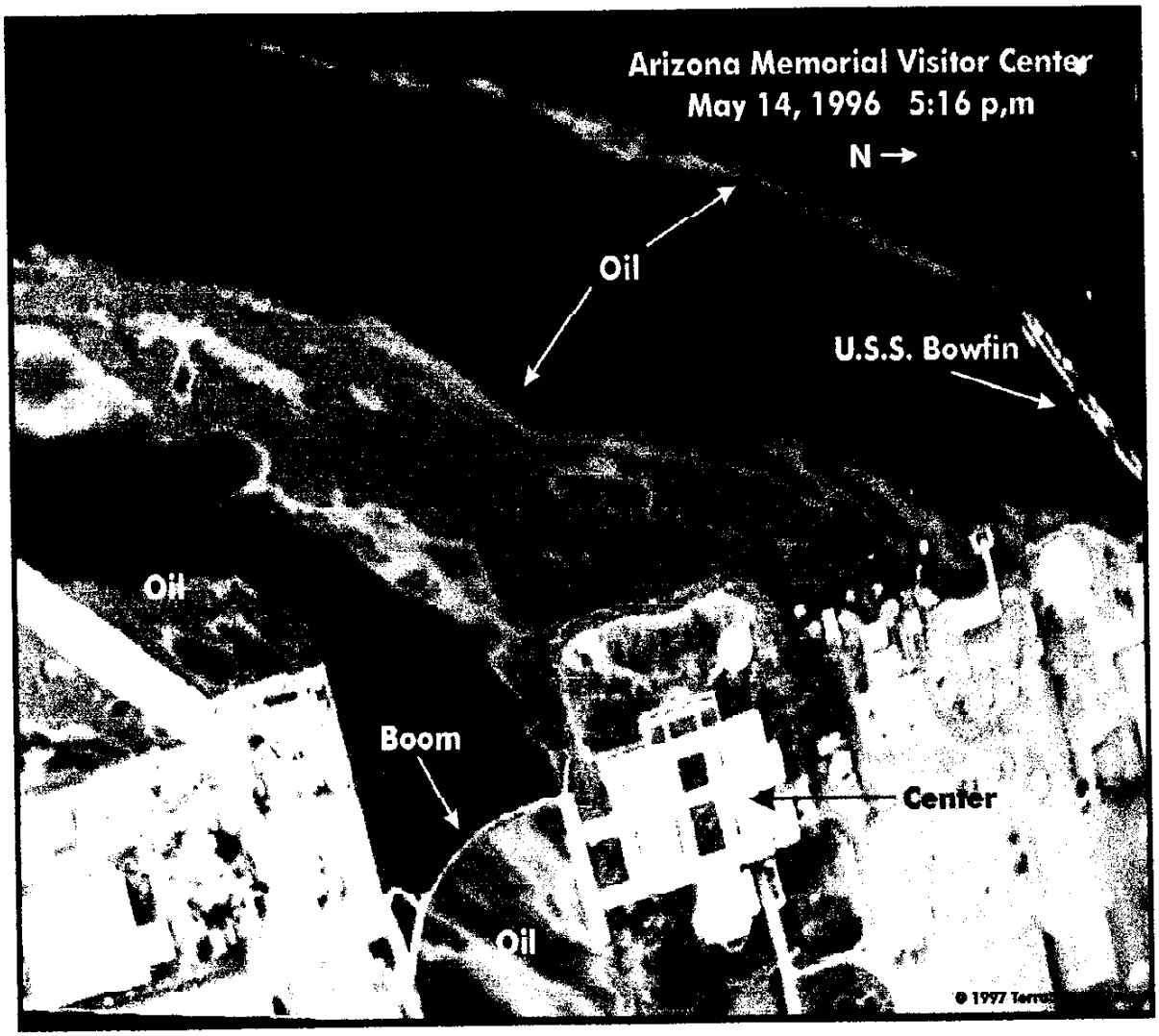

Photo 1. Aerial view of USS *Arizona* Memorial Visitor Center, on the shoreline of East Loch, Pearl Harbor, Oahu, Hawaii on May 14, 1996, 5:16 pm, showing oil on the surface water and shoreline of Pearl Harbor and in the mouth of Halawa Stream (see Section 3.1.3)(Photo courtesy of TerraSystems, Inc.).

Table 2. Summary of selected aerial spectral imagery of surface waters of Pearl Harbor taken on May 14, 1996 (TerraSystems 1997).

location of image	time of day (HST) on May 14, 1996	description of visible oil effects
Hospital Point to Waipio Point	17:04	long bands of oil stretching from Hospital Point to Waipio Point at Pearl Harbor entrance channel
shoreline north of Hospital Point	17:09	a broad band of oil stretching between Ford Island and Hospital Point and shoreline impacts on Ford Island and on the Naval Reservation
USS *Arizona* Memorial Visitor Center shoreline	17:16	a broad swath of oil hitting the entire length of the Visitor Center shoreline, the (now former) Ford Island ferry landing, the USS *Bowfin* and the *Bowfin* Park oil escaping behind a containment boom stretched across the mouth of Halawa Stream from the Visitor Center dock to the USN Pier and impacting the Visitor Center shoreline which the booming strategy intended to protect
USS *Arizona* Memorial and east coast of Ford Island	17:20	a band of oil stretching in a north-south orientation intersecting with the USS *Arizona* Memorial, the emergent turret of the sunken USS *Arizona* remains and the historic mooring quays oil on both sides of the boom deployed to protect the Memorial a band of oil impacting the eastern shoreline of Ford Island
HECO Waiau Power Plant and source of oil spill	~17:10	oil emerging from Waiau Stream. entering East Loch of Pearl Harbor and impacting mangrove-lined shorelines west of Waiau Stream and on the Pearl City Peninsula oil in freshwater marsh

This GIS was then used to calculate total areal coverage of visible oil on the surface waters of Pearl Harbor. The results of this analysis of areal extent of oil coverage of the surface waters of Pearl Harbor is provided in Table 3.

This investigation concluded that over the period of the first six days of the Incident, oil likely covered 2,289.9 acres (9,270,967 m^2) of the surface waters of Pearl Harbor. Oil sheen was directly observed during this period on 1,598.9 acres (6,473,154 m^2). Oil sheen likely affected

Table 3. Calculated areal extent of surface waters in Pearl Harbor demonstrating evidence of oil exposure following the incident, based on GIS Spatial Analyst analyses of multispectral images and video overflights from May 14 - 19, 1996 (Gundlach 1997).

date (1996)	photo or video data source	calculated areal extent (acres and m^2) of oil coverage of surface waters of Pearl Harbor			
		sheen[1]	probable sheen[2]	heavier[3]	probable heavier[4]
May 14	vertical multispectral images from TerraSystems	not calculated	-	16.4 acres 66,219 m^2	-
May 14	TerraSystems high-altitude video overflight taken at 17:00 - 17:30	259.6 acres 1,051,897 m^2	-	18.3 acres 74,083 m^2	-
May 15	unnamed video overflight taken at 12:34 - 12:52	not calculated	-	18.3 acres 74,087 m^2	5.6 acres 22,871 m^2
May 15	Chevron video overflight taken at 17:22 - 17:44	not calculated	not calculated	not calculated	-
May 16	Chevron low-altitude video over-flight taken in late afternoon	1,091.3 acres 4,418,027 m^2	not calculated	not calculated	-
May 17	Chevron video overflight, time of day not specified	363.6 acres 1,472,229 m^2	33.8 acres 136,711 m^2	3.9 acres 116,115 m^2	-
May 19	Chevron video overflight, time of day not specified	371.4 acres 1,503,601 m^2	39.1 acres 158,359 m^2	0.3 acres 1,077 m^2	-
May 14 -19	summary of all video overflights	1,598.9 acres 6,473,154 m^2	55.2 acres 223,283 m^2	64.1 acres 259,326 m^2	5.7 acres 22,871 m^2

[1] characterized as rainbow or silver in color
[2] assumed sheen coverage into/from the out-of-view portion of frame
[3] characterized by darker color
[4] assumed heavier coverage into/from the out-of-view portion of frame

another 690.3 acres (2,794,813 m^2) based on probable transport trajectories and observed shoreline oilings. According to Gundlach (1997), those geographic areas of Pearl Harbor which exhibited oiled surface waters during the first six days of the oil spill include:

- all of Southeast Loch,
- all of East Loch except the northeast reach along the Aiea shoreline,
- the mouth of Middle Loch,
- the mouth of West Loch, and
- the Pearl Harbor entrance channel.

These data, collected by both the Trustees and Chevron, indicate that surface waters were contaminated by the spilled oil. This contamination interrupted services such as navigation, tourism aesthetics, fishing, boating, and swimming. Additionally, surface waters served as a pathway of contamination to shorelines, wetland habitats, fish and wildlife resources, soils, and sediments.

3.1.4 Wildlife

Mostly anecdotal accounts of macrofaunal casualties associated with the Incident exist. One endangered Hawaiian stilt was reportedly found dead as a result of the oil spill (Devine 1996), however, this mortality was not verified by any of the Trustee representatives. The USCG reported that one unidentified bird was oiled and that "some crayfish and frogs" were oiled and killed in Waiau Stream (USCG 1996j). A "couple of dead crawfish and four pufferfish" were collected from Waiau Stream during oil spill response operations (IBRRC 1996).

Chevron developed an independent summary of wildlife reportedly affected by the Incident. Two species of exotic urban birds, two species of fish (including a marine species and a euryhaline species) and one species of aquatic macroinvertebrate were listed in Chevron's report entitled "Waiau Pipeline Spill, Summary of Affected Wildlife" (Chevron 1996). This summary is shown in Table 4.

Elliott (1996) offered the following explanations for the apparent "lack of noticeably impacted native birds" in the area impacted by the oil spill:

- the spill happened at the time of year when most of the migrant bird populations were gone,
- the spill happened at night when birds were not feeding in the area, and
- the human disturbance during the spill cleanup process essentially hazed the birds from the area.

Rapid predation of bird carcasses by feral dogs, feral cats and mongooses also could have contributed to the paucity of recovered oiled birds (Demarest and Elliott 1997).

3.1.5 Marine/Estuarine Biota (Finfish, Shellfish and Invertebrates)

The type of oil discharged on May 14, 1996 has the ability to adversely affect eggs, juveniles and adults of recreationally and commercially valuable finfish and shellfish that depend on the Pearl Harbor estuary for their existence. Additionally, Pearl Harbor serves as a major source of baitfish used by the recreational and commercial skipjack tuna fisheries (=*aku*) (Naughton pers. comm., Oishi pers. comm.).

Table 4. Summary of wildlife affected by the Incident as reported by Chevron (1996).			
affected species[1]	number affected	date reported or collected	comments
mynah bird	2	5/16-17/98	found on north shore of Ford Island floating in oil/water at tide line, disposed of as oily debris
tilapia	1	5/20/98	found on Pearl Harbor Naval Shipyard shoreline, some apparent oiling on dorsal and pectoral fins
pufferfish	4	5/23/98	found at Waiau Power Plant cooling water out-take, no apparent oiling on fish
freshwater prawns	2	5/23/98	found at Waiau Power Plant freshwater pond, oiling apparent
dove (juvenile)	1	5/23/98	found at Waipio Peninsula in shallow water, no apparent oiling
[1] No scientific or Hawaiian names were provided in this report.			

The commercial baitfish fishery within Pearl Harbor is controlled by the USN by permit. The State of Hawaii closed Pearl Harbor to fishing during the spill (Oishi pers. comm.).

The discharged product has been shown in other studies to adversely affect organisms of the type found in the Pearl Harbor estuary. These impacts range from population level disruptions to individual organism effects.

3.2 INJURED NATURAL RESOURCES AND RESOURCE SERVICES

Specific discussion is provided below on the following categories of natural resources and resource services injured as a result of the Incident: intertidal habitat, water column habitat, subtidal habitat, freshwater marsh habitat and human use services.

3.2.1 Intertidal Habitat

The intertidal habitat is defined as that shoreline area which is inundated by sea water during high tide cycles and which is then exposed to the air during low tide cycles. A gently sloping sandy beach or a mudflat will have a significantly wider band of intertidal habitat and, therefore, an increased area of oil exposure opportunity than vertical seawalls or steeply sloped riprapped shorelines. The typical tidal range for Pearl Harbor is about two feet (Grovhoug pers. comm.).

Chevron and the Trustees, each applying a "Habitat Equivalency Analysis" (HEA) to evaluate injury to the intertidal habitat in Pearl Harbor, reached divergent conclusions about the estimated injury to the intertidal habitat:

- the Trustees estimated that 25 acres of intertidal habitat were affected; Chevron estimated that 11.61 acres of intertidal habitat were affected;
- the Trustees considered presence or absence of oil in evaluating each of the four defined shoreline habitat types; Chevron considered three gradations ("heavy," "moderate" or "light") in the presence of oil in each of the four shoreline habitat types;
- the Trustees assumed an initial 80 percent lost services for oiled intertidal habitat; Chevron scaled initial lost services assumptions to the three gradations of oiling: 95 percent initial lost services for "heavy" oiling, 50 percent initial lost services for "moderate" oiling and 10 percent initial lost services for "light" oiling; and
- the Trustees assumed a 10-year recovery period for all 25 acres; Chevron scaled recovery period assumptions to the three gradations of oiling: 4 years for "heavy" oiling, 2 years for "moderate" oiling and 1 year for "light" oiling.

Table 5 describes the Trustees' estimate, in linear feet, of intertidal habitat of East Loch that was likely exposed to oil as a result of the Incident. The Trustees chose to classify intertidal habitat by the four shoreline habitat categories that are predominant in the East Loch: industrial shoreline, mangrove forest, rocky shoreline and mixed sediment shoreline. The Trustees estimated that 77,965 linear feet of intertidal habitat was oiled.

Table 5. Estimated intertidal habitat, by habitat type (industrial shoreline, mangrove forest, rocky shoreline and mixed sediment), oiled in East Loch, Pearl Harbor during the Incident.

oiled intertidal habitat	intertidal habitat type				total intertidal habitat oiled
	industrial shoreline[1]	mangrove forest[2]	rocky shoreline	mixed sediment	
linear feet (feet)	48,330	7,485	15,792	6,358	77,965
area (feet^2)	114,990	374,250	315,846	254,333	1,089,419
area (acres)	3.3	8.6	7.3	5.8	25.0

[1] includes riprap, seawalls and piers
[2] predominately red mangrove (*Rhizophora mangle*)

The Trustees used a multiplier to estimate the area of habitat types impacted. The multiplier considered areas that may have been exposed to oil based on the difference between the highest high tide and the lowest low tide for the period of exposure (*e.g.*, response phase of the spill). The Trustees estimated that 1,089,419 square feet or 25 acres of intertidal habitat were impacted by the oil spill.

The Trustees estimated that initial lost services for the general intertidal habitat of East Loch was about 80 percent. Lost services include many ecological functions such as the reproduction,

survival ability and feeding efficiency of many marine, estuarine and terrestrial species known to carry out one or more of these functions in East Loch. Flora and fauna that were potentially affected by the spill in this habitat include, but are not limited to, a variety of categories such as algae, invertebrates, fish, shorebirds, waterbirds and migratory birds.

Natural communities within the affected 25-acre area were directly and indirectly exposed to oil over time. Residual oil, not retrieved during the response phase, that may have accumulated on vegetation and in sediment could have served as a pathway of exposure to these organisms. The adverse effects of oil may have been realized through absorption and ingestion of oil or oiled prey species.

The Trustees estimate that the intertidal habitat of East Loch may recover to baseline conditions within approximately ten years from the onset of the spill. This estimated recovery period is based on literature that suggests a recovery period of comparable length for intertidal habitats in general (Albers 1991, Cubit *et al.* 1987, Cubit and Connor 1993a, Cubit and Connor 1993b, Jackson *et al.* 1989, Vandermeulen 1984).

3.2.1.1 Resources at Risk

The following three general categories of living intertidal resources in Pearl Harbor were at risk of oil exposure during this Incident: birds, vegetation and intertidal invertebrates.

Birds: A list of birds known to feed, loaf, roost, shelter and in certain cases, nest within the intertidal habitat areas within Pearl Harbor is provided in Table 6. These behaviors provide spilled oil exposure opportunities in the intertidal habitats in Pearl Harbor. Table 6 also provides information about the federal and state protection status of these birds, any reported observations of these birds during oil spill response activities, and a general determination of these species' relative oil spill exposure risk. These species were likely present in the intertidal areas during the general time frame of the Incident in Pearl Harbor and the subsequent cleanup period.

Vegetation: The red mangrove, an introduced species and the dominant intertidal vegetation in East Loch, along with other types of emergent halophytes (*e.g.*, bulrush), were directly exposed to oil during the spill. Mangroves are susceptible to the toxic effects of oil (Vandermeulen 1984). Mangrove forests provide shelter and a network of channels where certain estuarine species find refuge and food during certain life stages (*e.g.*, larvae and juveniles) when they are particularly vulnerable to predation. Consequently, oiling of mangroves and/or retention of oily water could adversely affect other fauna which depend on them for habitat.

Intertidal Invertebrates: Intertidal invertebrates, including crustaceans (*e.g.*, amphipods, isopods, decapods, barnacles), mollusks and polychaete worms, are at risk to shoreline oil exposure. Such intertidal species could be killed by the smothering effect of the oil, by direct toxic effect of the oil, or by invasive shoreline cleanup measures. These invertebrates are important food items for the endangered Hawaiian stilt.

Table 6. Bird species at risk of exposure to spilled oil in the intertidal habitat areas of Pearl Harbor, Oahu, Hawaii, for a time period of six months after the incident.

bird species name			Federal status[1]	State status[2]	reported observation in vicinity of oil spill	oil spill exposure risk[3]
common name	scientific name	Hawaiian name				
WATERBIRDS: coot, Hawaiian	*Fulica americana alai*	*`alae ke`oke`o*	M, E	E	-	high
duck, Hawaiian	*Anas wyvilliana*	*koloa maoli*	M, E	E	-	high
mallard	*Anas platyrhynchos*	-	M	-	-	high
night-heron, black-crowned	*Nycticorax nycticorax hoactli*	*`auku`u*	M	-	(IBRRC 1996) (Elliott 1996)	high
SHOREBIRDS: curlew, bristle-thighed	*Numenius tahitiensis*	*kioea*	M	-	-	high
golden plover, Pacific	*Pluvialis dominica fulva*	*kōlea*	M	-	(IBRRC 1996) (Elliott 1996)	medium
plover, black-bellied	*Pluvialis squatarola*	-	M	-	-	high
sanderling	*Calidris alba*	*hunakai*	M	-	-	high
stilt, Hawaiian	*Himantopus mexicanus knudseni*	*ae`o*	M, E	E	(IBRRC 1996) (Elliott 1996)	high
tattler, wandering	*Heteroscelus incanus*	*`ūlili*	M	-	(IBRRC 1996) (Elliott 1996)	high
turnstone, ruddy	*Arenaria interpres*	*`akekeke*	M	-	(IBRRC 1996) (Elliott 1996)	high
FIELD/URBAN BIRDS: cardinal, northern	*Cardinalis cardinalis*	*`ula`ula*	M	-	(IBRRC 1996) (Elliott 1996)	low
dove, barred	*Geopelia striata*	-	-	-	(IBRRC 1996) (Elliott 1996)	low
egret, cattle	*Bubulcus ibis*	-	M	-	(IBRRC 1996) (Elliott 1996)	low
mynah, common	*Acridotheres tristis*	-	-	-	(IBRRC 1996) (Elliott 1996)	low

[1] E = listed by the USFWS as "endangered" under the Endangered Species Act (ESA).
M = listed by the USFWS as "migratory" and protected under the Migratory Bird Treaty Act.
[2] E = listed by the State of Hawaii as "endangered" under the Conservation of Aquatic Life, Wildlife, and Land Plants Act.
[3] as determined in Demarest and Elliott (1997).

3.2.1.2 Oil: Pathway and Exposure

Response personnel observed oil moving out of the freshwater marsh into East Loch before and after booms were deployed around the tributaries exiting the marsh at the HECO power plant (USCG 1996). The natural environment in East Loch was likely exposed to oil via a number of direct pathways that include water-accommodated fractions (WAFs), oil droplets, oil slicks, oiled substrate, oiled sediment particles, oiled detritus, oil in food items (e.g., in plankton guts, bioaccumulated in bivalves), and oil on food items (*e.g.*, oiled intertidal organisms) (Cubit pers. comm.).

Typically, wildlife is exposed to oil through either direct surface contact, ingestion, absorption or indirect ingestion. Direct contact with oil can foul feathers, matt hair, irritate mucous membranes, and smother animals. Oil droplets on the feathers of adult federally-listed and state-listed endangered waterbirds (*i.e.*, Hawaiian stilts, Hawaiian ducks, Hawaiian coots, or Hawaiian moorhens) may have been transmitted to chicks or eggs. Embryos in the early stage of incubation are especially vulnerable to contact with oil and small quantities ranging from 1 μl to 20 μl may be sufficient to cause death (Parnell *et al.* 1984, Hoffman 1990, Albers 1991).

Inhalation or dermal absorption of the volatile components of oil can injure airways and cause internal toxicity. Organisms can also ingest oil by preening or cleaning their body surface or through direct consumption (*e.g.*, filter feeding or swallowing oil particles). In addition, indirect exposure can occur when oil-contaminated prey is consumed. Waterbirds can be adversely affected from residual surface sheen and oil or indirectly through bioaccumlation processes whereby they ingest tainted invertebrates or vegetation during forage activities (Albers 1995b, Baca *et al.* 1985, Vandermeulen 1984). The extent to which endangered Hawaiian waterbirds were exposed to spilled oil in Pearl Harbor remains uncertain.

3.2.1.3 Evidence of Injury

Table 6 lists the bird species expected to be present in the Pearl Harbor spill zone within six months after the spill. Of these species, the Hawaiian stilt, ruddy turnstone, wandering tattler, golden plover and black-crowned night-heron were observed feeding in the mudflats (colloquially called "Shopping Cart Flats") at the mouth of Waiau Stream (Elliott 1996), an area documented to be exposed to spilled oil (Entrix 1996). Resident and migratory birds could have been negatively impacted by the spill due to direct contact with the oil or diminished food resources and foraging habitat (USFWS 1997).

Direct injury due to the oil is evidenced by a number of factors. The prop roots of many mangroves, which typically provide attachment substrate for various intertidal invertebrate fauna (*e.g.*, crustaceans, mollusks, and bryozoans), were covered with oil (SCAT observations of Divisions A, E and X, July 1996)(USCG 1996). Oiled prop roots eventually become tacky and can result in the loss of viable habitat for these species. Approximately one-quarter of an acre of mangrove forest fronting the HECO power plant at the mouth of Waiau Stream was eventually removed because it was considered a trap for oil and created a risk of exposure to wildlife resources.

Several crab carcasses, four pufferfish (*Arothron* sp.) (= *o'opu hue*), and one pigeon carcass were collected during the spill (Chevron 1996, IBRRC 1996). Oiled sand on several pocket beaches within Pearl Harbor was removed and not replaced leaving a steeper profile to the beach. Sand typically contains small mollusks and crustaceans that are often important food to probing shorebirds and benthic feeding fishes.

In accordance with the Chevron/Trustees MOA, additional field studies concerning the assessment of injury to intertidal habitat and wildlife resources were not undertaken. Instead, Chevron and the Trustees agreed to focus their efforts on restoration.

3.2.1.4 Recovery Period

It is not unreasonable to postulate that the low energy intertidal habitat within Pearl Harbor will take as long as ten years to return to baseline conditions following this spill (Vandermeulen 1984, Albers 1991, Gundlach and Hayes 1978, Cubit *et al.* 1987, Cubit and Connor 1993a, Cubit and Connor 1993b).

3.2.2 Water Column Habitat

The water column habitat comprising the open marine waters of Pearl Harbor include the water's surface and the water column proper extending from the water's surface to the harbor bottom.

3.2.2.1 Resources at Risk

The biological resources of the water column habitat consist of all species living in or on this habitat, including phytoplankton, zooplankton, fish, birds, turtles and marine mammals. These biological resources in the water column also include spores, eggs, larvae, juvenile stages and other life history stages of species whose adult stages may occur primarily in other habitats. For example, eggs and larvae from many species of subtidal and intertidal benthic invertebrates are dispersed into and develop in the water column habitat. The water column habitat of Pearl Harbor supports various commercial, recreational and subsistence finfish as shown in Table 7.

Three species of birds -- the brown booby, the black noddy and the white tern -- sit on, swim in or feed from the water column habitat of Pearl Harbor. These behaviors provide spilled oil exposure opportunities in the open water habitat in Pearl Harbor. Table 8 provides information about the federal and state protection status of these birds and a general determination of these species' relative oil spill exposure risk. These species were likely present on the open water areas during the general timeframe of the incident.

The federally-listed and state-listed threatened Pacific green sea turtle, which feeds on sea grasses and algae in Mamala Bay, has been regularly reported in Pearl Harbor (Naughton pers. comm.). At least one Pacific green sea turtle has been regularly observed in and around the sunken remains of the USS *Arizona* and is thought to be resident in that location (Adams pers. comm.). On March 21, 1998, federally-listed endangered humpback whales, specifically an adult and a calf, were observed within Pearl Harbor. This use of Pearl Harbor by humpback whales is considered an unusual event.

Table 7. Fish species in Pearl Harbor, Oahu, Hawaii, with fisheries values at risk of exposure to spilled oil from the Incident.

fish species name			water column habitat usage			fishery value	
common name	scientific name	Hawaiian name	spawning	nursery	adult forage	commercial	recreational
surgeonfishes	*Acanthuridae* spp.	*manini*	✓	✓	✓	-	✓
eagle ray	*Aetobatus narinari*	*hihimanu*	✓	✓	✓	-	✓
bonefish	*Albula vulpes*	*`o`io*	✓	✓	✓	-	✓
cardinalfishes	*Apogonidae* spp.	*upapalu*	✓	✓	✓	-	✓
soft puffer	*Arothron hispidus*	-	✓	✓	✓	-	✓
sleeper goby	*Asterropteryx semipunctatus*	-	✓	✓	✓	-	✓
parrotfish	*Calotomus spinidens*	-	✓	✓	✓	-	✓
jacks	*Carangidae* spp.	*papio*[2] *ulua*[3]	✓	✓	✓	✓	✓
blacktip shark	*Carcharhinus limbatus*	*manō*	✓	✓	✓	-	✓
butterflyfishes	*Chaetodontidae* spp.	-	✓	✓	✓	-	✓
milkfish	*Chanos chanos*	*awa*	✓	✓	✓	✓	✓
conger eel	*Conger cinreus*	*puhi uha*	✓	✓	✓	-	✓
porcupine-fishes	*Diodontidae* spp.	-	✓	✓	✓	-	✓
Hawaiian tarpon	*Elops hawaiiensis*	*awa`aua*	✓	✓	✓		✓
Hawaiian anchovy	*Encrasicholina purpurea*	*nehu*	✓	✓	✓	✓	✓
gobies	*Gobiidae* spp.	*o`opu*	✓	✓	✓	-	✓
moray eel	*Gymnothorax undulatus*	*puhi*	✓	✓	✓	-	✓
halfbeak	*Hemiramphus depauperatus*	-	✓	✓	✓	-	✓
squirrelfishes	*Holocentridae* spp.	*u`u*	✓	✓	✓	-	✓
Hawaiian flagtail	*Kuhlia sandvicensis*	*āholehole*	✓	✓	✓	-	✓
blacktail snapper[1]	*Lutjanus fulvus*	*to`au*	✓	✓	✓	-	✓

Table 7 (continued).

fish species name			water column habitat usage			fishery value	
common name	scientific name	Hawaiian name	spawning	nursery	adult forage	commercial	recreational
striped mullet	*Mugil cephalus*	*`ama`ama*[2] *anae*[3]	✓	✓	✓	✓	✓
goatfishes	*Mullidae* spp.	*weke*	✓	✓	✓	-	✓
blenny	*Omobranchus elongatus*	-	✓	✓	✓	-	✓
boxfish	*Ostracion meleagris camurum*	-	✓	✓	✓	-	✓
threadfin	*Polydactylus sexfilis*	*moi*	✓	✓	✓	-	✓
damselfishes	*Pomacentridae* spp.	*mamo*	✓	✓	✓	-	✓
lizardfish	*Saurida gracilis*	*ulae*	✓	✓	✓	-	✓
hammerhead shark	*Sphyrna lewini*	*manô kihikihi*	✓	✓	✓	-	✓
barracuda	*Sphyraena barracuda*	*kaku*	✓	✓	✓	-	✓
wrasse	*Stethojulis balteata*	*hinalea*	✓	✓	✓	-	✓
silvery tilapia[1]	*Tilapia melanotheron*	-	✓	✓	✓	-	✓
Mozambique tilapia[1]	*Tilapia mossambica*	-	✓	✓	✓	-	✓
needlefish	*Tylosurus crocodilus*	*aha`aha*	✓	✓	✓	-	✓

[1] an introduced species in Hawaii now considered naturalized.
[2] name used for juveniles.
[3] name used for adults.
(Data from Chevron 1996).

3.2.2.2 Oil: Pathway and Exposure

Gundlach (1997) determined the total geographical surface of Pearl Harbor waters that were exposed to oil from the Chevron spill. As an expert, chosen by the Trustees and agreed to by Chevron, he compiled available records of oil on the shoreline and surface waters of Pearl Harbor during the spill. This included aerial photographs, aerial videos, and shoreline oiling records. He calculated that 2,289.9 acres of surface waters in Pearl Harbor, mostly within East Loch, were exposed to oil during the first three days of the spill.

Table 8. Bird species at risk of exposure to spilled oil on the open, marine water areas of Pearl Harbor, Oahu, Hawaii, as a result of the Incident.

bird species name			Federal status[1]	State status[2]	reported observation in vicinity of oil spill	oil spill exposure risk[3]
common name	scientific name	Hawaiian name				
booby, brown	*Sula leucogaster plotus*	*`ā*	M	-	(Elliott 1996)	high
noddy, black	*Anous minutus melanogenys*	*noio, `eki`eki*	M	-	-	high
tern, white	*Gygis alba rothschildi*	*manu o kū*	M	T	-	high

[1] M = listed by the USFWS as "migratory" and protected under the Migratory Bird Treaty Act.
[2] T = listed by the State of Hawaii as "threatened" under the Conservation of Aquatic Life, Wildlife, and Land Plants Act.
[3] as determined in Demarest and Elliott (1997).

The specific gravity of the spilled oil was between 1.0097 and 1.0052, as determined from samples taken adjacent to the ruptured pipeline (Roberts 1996). The oil sank in the fresh water of Waiau Marsh and was slightly buoyant in the sea water of Pearl Harbor. This relatively dense oil is susceptible to being moved downward in the water column by the following mechanisms (NRC 1985):

- when sorbed onto sediments and other particles in the water column,
- in turbulent conditions (*e.g.*, wave mixing), and
- in zones where currents are downward moving (*e.g.*, convergence portions of Langmuir circulations and in other convergence zones where currents meet).

The last conditions are of note because oil, plankton, neuston and fish also collect in such convergence zones. Consequently, convergence zones concentrate oil and biota in the same locations, exposing water column biota to higher concentrations of oil than would be estimated from average surface area coverage.

Response personnel observed submerged globules of oil being transported under oil booms and out of Waiau Stream. At least some of this oil floated to the water surface when it reached the denser sea water of East Loch (USCG 1996j). Chevron's contractor reported that "[i]n numerous cases, particularly in the immediate vicinity of the spill, oil was observed to be 'suspended' in the water column. This effect was observed in areas of noticeable current flow and/or surface turbulence (waves)" (Entrix 1996).

Water samples were taken by Chevron (AECOS 1996), analyzed by Arthur D. Little (1996), and represented as measures of oil concentrations during the spill (Chevron 1996). However, the incident occurred on May 14, 1996 and the water samples were taken on May 28, 1996, two weeks later. The samples were taken by AECOS, Inc. at three oil-exposed locations in Waiau Bay of East Loch and one "control" location (AECOS 1996). Chevron reported low concentrations of oil in these samples. However, because of the two-week period between spill and sampling, these measurements have little meaning with regard to the concentrations that were in the water column of Pearl Harbor during the May 14-16, 1996 period when most of the oil slicks were moving through the area assessed by Gundlach's (1997) study (see above).

Examples of potential mechanisms through which water column biota can be exposed to spilled oil are the following:

- exposure to components of oil dissolved in water,
- direct contact with free oil in the water column,
- ingestion of particulate oil in the water, and
- feeding on food items contaminated with oil.

As examples of the third mechanism above, filter feeders and particulate feeders, such as zooplankton and Hawaiian anchovy, probably ingested oil particles from the water column (as described in NRC 1985). As examples of the fourth mechanism above, Hawaiian anchovy probably fed on zooplankton containing ingested oil. In addition, scavenger and predatory fish probably fed on subtidal and intertidal fauna contaminated with oil.

3.2.2.3 Evidence of Injury

Evidence of injury to water column biota consists of inferential evidence and a study based on photo documentation (Gundlach 1997). As noted above, according to the Chevron/Trustee MOA, the Trustees did not conduct detailed formal studies to determine and quantify injury. Inferential evidence of injury to water column biota is based on preliminary estimates of oil exposure and its potential adverse effects as determined from published field and laboratory studies relative to the estimated exposure to the same or similar oil.

The University of California at Santa Cruz (UCSC) laboratory studies of toxicity of the spilled Chevron oil to mysid shrimp (UCSC 1996) do not apply here because:

- the laboratory mysids were only exposed to the dissolved portion of this low-solubility oil, without exposure by direct contact with the oil or ingestion of oil particles as would have occurred in Pearl Harbor.
- the mysids were only exposed to oil for a few hours, whereas the biota of Pearl Harbor would have been exposed for much longer periods of time, especially during the first three days of the spill.
- the laboratory exposure of mysids was conducted at a water temperature of 14.3°C which is much colder than the average water temperature of 26°C in Pearl Harbor (Evans and Morris 1974). For a given concentration of oil in water, toxicity increases with temperature (for review, see Mayer and Ellersieck 1986).

- the laboratory mysids were not exposed to photo-oxidative products of the oil which include chemicals that are more soluble and more toxic than the original oil (Payne and McNabb 1983). Exposure of oil to sunlight in Pearl Harbor could have produced such compounds; and
- the laboratory mysids were only examined for acute (short-term) lethal or narcotic effects of the oil. The laboratory mysids were not examined for longer term survival or adverse effects of the oil on factors such as predator avoidance, swimming ability, feeding ability or reproductive success.

In accordance with the Chevron/Trustee MOA, additional field studies concerning the assessment of injury to fish and other water column biota were not undertaken. The spilled oil had a low acute toxicity, and therefore, adverse effects resulting from exposure to the spilled oil were not likely to have produced immediate mass mortality of most species. Consequently, lack of evidence for mass mortality is not evidence that the spill caused no adverse effects. Adverse effects of the oil, if any, were more likely to have been manifested in slow (not acute) rates of mortality or in adverse effects that were sublethal. Because the number of predatory and scavenging fish present in Pearl Harbor, edible biota that died or that were behaviorally impaired were likely to have been eaten by scavengers or predators before they could be found by personnel present during the spill (Grovhoug pers. comm.). Therefore. actual observed evidence of injury should be considered to represent a small proportion of total injury and be extrapolated accordingly.

During the spill, personnel collected four dead pufferfish (Chevron 1996, IBRRC 1996). These have been stored in a DLNR freezer and the cause of death has not been determined. In addition, one dead spiny balloonfish (*Diodon holocanthus*) (= *kokala*) was found near the spill release site (Cubit pers. comm.), and dead tilapia were found near the USN docks (Chevron 1996).

Inferred injury to water column biota includes reduced primary production, reduced secondary production and adverse effects of oil on fish reproduction and early fish development (as reviewed and described in Weis and Weis 1989). The oil may have had other adverse effects on fish, for example, by impairing avoidance of predators and reducing rates of feeding growth and long-term survival. Oil has been reported to reduce plankton populations (NRC 1985).

3.2.2.4 Recovery Period

The dimensions of the water column injury are spatial extent, severity and duration of injury. The analysis by Gundlach (1997) indicates approximately 2,300 acres of East Loch and adjoining areas were exposed to oil slicks from the Incident. Multiple pathways exist to expose zooplankton and fish to this oil. The Trustees estimate that adverse effects of oil on plankton, fish, and other water column biota would have resulted in approximately 10 percent lost services over this 2,300 acres. While a sigmoid recovery time-path may be technically appropriate, the linear time-path used by the Trustees in their HEA was considered to be a reasonable approximation over the recovery period considered.

3.2.3 Subtidal Habitat

The subtidal habitat in Pearl Harbor includes those harbor bottom areas which are perpetually submerged by water.

3.2.3.1 Resources at Risk

Subtidal habitats in Pearl Harbor include hard substrata such as submerged natural rock, riprap, cement and sheet metal piling walls and pier pilings; and soft substrata, such as sand and mud bottom.

A variety of recreationally important invertebrate species, including bivalves and crustaceans, use the subtidal, benthic habitats in Pearl Harbor. These invertebrates, both native and exotic species, occupy this subtidal habitat for spawning, nursery areas and as adult forage area. Table 9 provides a summary of those invertebrate species with fishery value that use the subtidal habitat of Pearl Harbor. Numerous other species of invertebrates (*e.g.*, gastropods, polychaetes, ascidians) are also found on the hard and soft substrata of Pearl Harbor (Coles *et al.* 1997).

Shellfish and other aquatic invertebrates generally have less efficient metabolic systems than do finfish for breaking down petroleum products. Shellfish can take in hydrocarbons directly from seawater or by ingesting oil droplets, tainted food or contaminated sediments. Crustaceans, such as crabs, are able to transform petroleum hydrocarbons to polar metabolites that may be excreted or bound to tissues. Bivalve mollusks, including clams and oysters, lack efficient enzyme systems to metabolize petroleum compounds (Chevron 1996).

3.2.3.2 Oil: Pathway and Exposure

Biota in subtidal habitats would be exposed to the heavy spilled oil through the same mechanisms as described above for the Water Column Habitat. In addition, the Oil in the Sea report (NRC 1985) lists the following as the "most important" mechanisms by which oil can reach subtidal sediments:

- sorption of oil to particles including mineral sediments, detritus and plankton;
- ingestion of oil by zooplankton and incorporation into fecal pellets;
- weathering of oil by physical and chemical processes; and
- direct mixing of oil and sediments.

Regarding sorption of oil to particles, this dense oil (specific gravity 1.0097 to 1.0052) (Roberts 1996) would readily sink if it incorporated sand or other mineral sediment. SCAT team members observed tar mats in the subtidal zone. Sorbent pad sampling near the release site adjacent to the Waiau Power Plant did not find visible amounts of oil on sediments in this location (USCG 1996, Naughton pers. comm., Chevron 1996). Shortly after the spill, however, independent sampling of surficial bottom sediments for an NPL investigation found visible free oil of undetermined origin in subtidal bottom sediments in Pearl Harbor (Grovhoug pers. comm.).

Table 9. Subtidal invertebrate species, including bivalves and crustaceans, in Pearl Harbor, Oahu, Hawaii, with fishery value at risk of exposure to spilled oil from the incident

invertebrate species name			subtidal habitat usage			fisheries value	
common name	scientific name	Hawaiian name	spawning ground	nursery ground	adult forage	com-mercial	recrea-tion
Bivalves: Japanese oyster[1]	*Crassostrea gigas*	-	✓	✓	✓	-	✓
Eastern oyster[1]	*Crassostrea virginica*	-	✓	✓	✓	-	✓
common littleneck clam[1]	*Protothaca staminea*	-	✓	✓	✓	-	✓
Crustaceans: Hawaiian crab	*Podophthalmus vigil*	-	✓	✓	✓	-	✓
white crab	*Portunus sanguinolentus*	*kuahonu*	✓	✓	✓	-	✓
mangrove crab (or Samoan crab)[1]	*Scylla serrata*	-	✓	✓	✓	-	✓
slipper lobster	*Scyllarides squammosus*	*ula papapa*	✓	✓	✓	-	✓
stone crab	*Thalamita crenata*	-	✓	✓	✓	-	✓
glass shrimp (or Hawaiian prawn)	*Macrobrachium grandimanus*	*opae*	✓	✓	✓	-	✓

[1] These species are not native to Hawaii but are now considered naturalized.
(Data provided in Chevron 1996, Oishi pers. comm.)

The most likely contamination of subtidal sediments would be adjacent to heavily oiled beaches where the oil could pick up sediment and sink into the subtidal zone (Entrix 1996). Oiled sediment and oiled debris could also be transported from these beaches into the subtidal zone (Cubit pers. comm.). Lengths of shoreline were oiled by this spill which, in turn, could have contributed oil to the adjacent subtidal habitats. However, subtidal locations adjacent to oiled shorelines were not sampled as part of the oil spill investigations during this incident. Further, pocket sand beaches along the eastern shoreline of the Waipio Peninsula continued to be oiled even after daily cleaning until at least early July 1996, approximately seven to eight weeks following the spill (Oishi pers. comm.), suggesting that all oil sources had not been located and removed. Oil from these sites could have subsequently migrated into subtidal habitats.

3.2.3.3 Evidence of Injury

In accordance with the Chevron/Trustee MOA, additional field studies concerning the assessment of injury to the subtidal habitat and associated living resources were not undertaken. Scientists from the Bernice P. Bishop Museum made some incidental observations in a few partially oiled locations as part of another study and reported that nothing seemed to be injured some weeks after the spill (Coles *et al.* 1997). However, the Bishop Museum observations, at best, would have only detected obvious injury that would have persisted from the time of the spill to the time the Museum investigators visited their sites (*e.g.*, lasting discoloration or necrosis of sessile organisms such sponges and ascidians). The Bishop Museum observations were not designed to specifically investigate effects of this spill and did not include the following:

- sites of heaviest oiling;
- biota that would have decomposed, washed away, sank, been scavenged or otherwise disappeared if killed by oil;
- systematic observations for effects of oil; and
- sublethal effects that would not have been obvious to the casual observer, such as long-term decreased survivorship or reduced reproduction.

All evidence of injury to subtidal benthic biota is inferred from preliminary estimates of oil exposure and its potential adverse effects as determined from published field and laboratory studies demonstrating adverse effects relative to the estimated exposure to same or similar oil. The UCSC studies (UCSC 1996) of toxicity of the Chevron oil do not apply here for the same reasons explained in the prior section on Water Column Habitat.

Injury to subtidal biota is inferred from exposure of the biota through probable direct contact with and ingestion of oil. Adverse effects of such exposure on subtidal biota would include decreased rates of growth, reduced long-term survivorship and decreased rates of reproduction. For example, these effects could be the consequences of oil causing reduced feeding, reduced avoidance of predators, and interference with endocrine functions.

3.2.3.4 Recovery Period

Total injury to subtidal biota is measured in terms of spatial extent, severity, and duration of injury. The Trustee estimates of total injury are based on preliminary estimates of exposure to oil and the consequent adverse effects on subtidal biota. Duration of injury is estimated from estimates of spatial extent and severity of injury in combination with life history information. Examples of factors that affect duration of injury include:

- life stages of subtidal bottom fauna and flora that were adversely affected by the spill (*e.g.*, production of eggs and larvae, survival of juveniles and adults),
- abundance of individuals surviving the spill,
- reproductive rate of surviving individuals,
- immigration of individuals from other areas, and
- life span of individuals belonging to the adversely affected species.

As an initial estimate of injury to subtidal biota, the Trustees considered that most injury probably occurred adjacent to heavily oiled beaches. Accordingly, they estimated that 5 acres of subtidal habitat suffered 30 percent lost services. While a sigmoid recovery time-path may be technically appropriate, the linear time path used by the Trustees in their HEA was considered to be a reasonable approximation over the recovery period considered.

3.2.4 Freshwater Marsh Habitat

The Trustees estimated that about two acres of freshwater marsh on the HECO power plant property near the mouth of Waiau Stream were affected by the spill. This estimate was later confirmed by the property owners and used by Chevron in their HEA (Entrix 1996, Foster pers. comm.).

The oil spill resulted in approximately 982 bbls. (41,244 gals.) of No. 6 fuel oil spilling into the stream (Chevron 1996). The petroleum product flowed downstream into the two-acre freshwater marsh on HECO power plant property. The warm oil initially floated into the marsh and permeated the emergent vegetation, predominately California grass (*Brachiaria mutica*). As the oil cooled, it sank to the bottom of the marsh creating subpools and then became incorporated into sediments (Entrix 1996).

Approximately two acres of oiled California grass was removed by Chevron as part of the response effort (Entrix 1996). Therefore, it is reasonable to assume that the volume of oil that infiltrated the marsh negatively impacted all flora and fauna found within this habitat. Sessile organisms [*e.g.*, Asiatic clams (*Corbicula fluminea*)] were smothered by the settling of the oil on the marsh sediment. Birds, fish and invertebrates that frequent the marsh were at risk of exposure with the oil in the marsh. Therefore, the Trustees believe that 100 percent of the freshwater marsh's ecological services were lost as a result of the spill.

The Trustees estimate, based on a literature review, that recovery of the freshwater marsh will take at least ten years (Albers 1995a, Baca *et al.* 1985, Gundlach and Hayes 1978, Foght and Westlake 1984) and perhaps as many as 15 to 20 years (API 1991) before the marsh is fully recovered. Biodegradation of the residual oil may be mitigated due to the penetration of the oil in the sediment and vegetation of the marsh (Foght and Westlake 1984). The nature of this low energy environment also reduced the effectiveness of weathering processes that degrade surface oil and sheen. As residual sheen and oil become mobilized, fish, invertebrates, algae and vegetation will continue to be exposed to oil and its photo-oxidized byproducts thereby posing a direct and indirect exposure threat to federally-listed and state-listed endangered waterbirds that feed opportunistically in this area of Pearl Harbor (USFWS 1997).

3.2.4.1 Resources at Risk

The following three general categories of living freshwater marsh resources in the vicinity of Waiau Stream were at risk of oil exposure during this Incident: birds, aquatic fauna and vegetation.

Birds: A list of birds known to feed, forage, loaf or nest in the freshwater marsh habitat within East Loch, Pearl Harbor is provided in Table 10. These behaviors provide spilled oil exposure opportunities in the Waiau Stream freshwater marsh habitat in Pearl Harbor. Table 10

Table 10. Bird species at risk of exposure to spilled oil in the freshwater marsh habitat area of East Loch, Pearl Harbor, Oahu, Hawaii, as a result of the incident.

bird species name			Federal status[1]	State status[2]	reported observation in vicinity of oil spill	oil spill exposure risk[3]
common name	scientific name	Hawaiian name				
WATERBIRDS: coot, Hawaiian	*Fulica americana alai*	*`alae ke`oke`o*	M, E	E	-	high
duck, Hawaiian	*Anas wyvilliana*	*koloa maoli*	M, E	E	-	high
mallard	*Anas platyrhynchos*	-	M	-	-	high
moorhen, Hawaiian	*Gallinula chloropus sandvicensis*	*`alae `ula*	M, E	E	-	high
night-heron, black-crowned	*Nycticorax nycticorax hoactli*	*`auku`u*	M	-	(IBRRC 1996) (Elliott 1996)	high
pintail, northern	*Anas acuta*	*koloa māpu*	M	-	-	high
shoveler, northern	*Anas clypeata*	*koloa mohā*	M	-	-	high
SHOREBIRDS: golden plover, Pacific	*Pluvialis dominica fulva*	*kōlea*	M	-	(IBRRC 1996) (Elliott 1996)	medium
stilt, Hawaiian	*Himantopus mexicanus knudseni*	*ae`o*	M, E	E	(IBRRC 1996) (Elliott 1996)	high
tattler, wandering	*Heteroscelus incanus*	*`ūlili*	M	-	(IBRRC 1996) (Elliott 1996)	high
turnstone, ruddy	*Arenaria interpres*	*`akekeke*	M	-	(IBRRC 1996) (Elliott 1996)	high
FIELD AND URBAN BIRDS: cardinal, northern	*Cardinalis cardinalis*	*`ula`ula*	M	-	(IBRRC 1996) (Elliott 1996)	low
dove, barred	*Geopelia striata*	-	-	-	(IBRRC 1996) (Elliott 1996)	low
egret, cattle	*Bubulcus ibis*	-	M	-	(IBRRC 1996) (Elliott 1996)	low
mynah, common	*Acridotheres tristis*	-	-	-	(IBRRC 1996) (Elliott 1996)	low

[1] E = listed by the USFWS as "endangered" under the Endangered Species Act.
M = listed by the USFWS as "migratory" and protected under the Migratory Bird Treaty Act.
[2] E = a species listed by the State of Hawaii as "endangered" under the Conservation of Aquatic Life, Wildlife, and Land Plants Act.
[3] as determined in Demarest and Elliott (1997).

also provides information about the federal and state protection status of these birds and a general determination of these species' relative oil spill exposure risk. These species were likely present in the freshwater marsh during the general timeframe of the Incident and the extended period afterwards when oil still remained in the marsh.

Aquatic Fauna: The aquatic fauna of the freshwater marsh near the mouth of Waiau Stream is predominately exotic. Table 11 provides a list of common or conspicuous aquatic fauna found in freshwater marsh areas of Pearl Harbor including information about the economic use value of these species.

Table 11. Common aquatic fauna in freshwater marsh areas around Pearl Harbor, Oahu, Hawaii, including information about economic use value (Foster pers. comm.)

aquatic species name		native (N) or exotic (E)	economic use value	
common name or *Hawaiian name*	scientific name		subsistence	recreational
MOLLUSKS: Asiatic clam	*Corbicula fluminea*	E	✔	-
[no common name]	*Vivaparious chinensis*	E	-	-
CRUSTACEANS: freshwater shrimp	*Atyoida bisulcata*	N	-	-
Tahitian prawn	*Macrobrachium lar*	E	✔	✔
Malaysian giant prawn	*Macrobrachium rosenbergii*	E	✔	✔
crayfish	*Procambarus clarkii*	E	✔	✔
FISHES: North American ciclid	*Cichlasoma citinellum*	E	-	-
goby or *o opu a kupa*	*Eleotris sandwicensis*	N	-	-
mosquitofish	*Gambusia affinis*	E	-	-
goby	*Mugilgobius cavifrons*	E	-	-
tilapia	*Tilapia macrochir*	E	✔	✔
tilapia	*Tilapia melanopleura*	E	✔	✔
silvery tilapia	*Tilapia melanotheron*	E	✔	✔
Mozambique tilapia	*Tilapia mossambica*	E	✔	✔
red-bellied tilapia	*Tilapia zilli*	E	✔	✔
AMPHIBIANS: marine toad	*Buffo marinus*	E	-	-
bullfrog	*Rana catesbiana*	E	✔	✔

Vegetation: The dominant vegetation in the freshwater marsh near the mouth of Waiau Stream is California grass. Water lettuce (*Pistia stratiotes*) and parrot's-feather (*Myriophyllum brasiliense*) are common vegetation in the marsh. Water lettuce and parrot's-feather are particularly important to the federally-listed and state-listed endangered Hawaiian moorhen for forage and for shelter.

3.2.4.2 Oil: Pathway and Exposure

This section identifies the presence of oil in the marsh, its general path from the spill site through the marsh and into Pearl Harbor, and extent of exposure. Approximately two acres of freshwater marsh were impacted by oil at the time of the spill.

Response personnel observed an oil leak from the Chevron pipeline into Waiau Stream. The oil flowed through the freshwater marsh at the HECO power plant facility near the mouth of Waiau Stream and emptied into Pearl Harbor. This observation is documented in USCG SCAT reports (USCG 1996). Also, oil in the freshwater marsh was documented by TerraSystems (1997) during an overflight event and by Entrix (1996).

Typically, wildlife is exposed to oil through either direct contact or ingestion or through indirect ingestion. Direct contact with oil can foul feathers, matt hair, irritate mucous membranes, and smother animals. Smothering, due to the volume of oil in the marsh, is likely to have impacted slow moving or sessile organisms that inhabited the marsh. Inhalation or dermal absorption of the volatile components of oil can injure airways and cause internal toxicity. Organisms can also ingest oil by preening or cleaning their body surface or through direct consumption (*e.g.*, filter feeding or swallowing oil particles). In addition, indirect exposure can occur when oil contaminated prey is consumed.

Vegetation is typically impacted by direct contact that coats the plant. There is some evidence that root hairs are also negatively impacted by oil penetrating the sediment.

3.2.4.3 Evidence of Injury

Approximately two acres of California grass, including roots and emergent vegetation, were dug up manually by Chevron employees and removed (Entrix 1996). California grass continues to be impacted as a result of the initial oil recovery efforts (Foster pers. comm.). Aquatic vegetation in the marsh continues to be oiled by residual oil that is remobilized from the marsh sediments. This oiling diminishes its value as wildlife habitat.

Certain invertebrate species inhabiting the freshwater marsh could have been affected by the oil. A possible die-off of Asiatic clams, as evidenced by large numbers of empty shells littering the muddy bottom, was observed in this vicinity two months after the spill and again ten months after the spill (Oishi pers. comm.). Crayfish (*Procambarus clarkii*) were reported oiled and killed in Waiau Stream (USCG 1996j).

Residual oiling of parrot's-feather and water lettuce was observed in the freshwater marsh (Foster pers. comm.). These plant species are important shelter vegetation for the Hawaiian moorhen.

Also, the Hawaiian moorhen is known to forage for arthropods found on this vegetation (Foster pers. comm.).

Potential or probable injury likely occurred during the general time period of the spill. Some of the benthic invertebrates in the freshwater marsh, such as freshwater prawn (*Macrobrachium lar)* were likely impacted by either ingestion of oil or by smothering. The reduction of aquatic plants may impact birds *(e.g.*, Hawaiian ducks, Hawaiian moorhens, and Hawaiian coots) by reducing forage, predator protection, and nesting areas. It is likely that freshwater gobies (*Mugilgobius cavifrons*) were impacted either by ingestion of oil or smothering. It is also likely that waterbirds have been impacted by the initial and residual oil and sheen in the water column and along the waterline of the vegetation. Waterbirds are naturally attracted to open water spaces. With the loss of open water habitat in the Pearl Harbor area, it is likely that waterbirds have been attracted to the freshwater marsh, especially during periods when human activity in the marsh was low to none.

The probable die off of freshwater fish (*e.g.*, tilapia, mosquitofish) and invertebrate fauna likely resulted from ingestion of oil or smothering during the release of oil into the marsh. The normal behavior of birds within the vicinity of the marsh was likely disrupted by response crews during protracted cleanup.

In accordance with the Chevron/Trustee MOA, additional field studies concerning the assessment of injury to the freshwater marsh habitat and wildlife resources were not undertaken. However, the DOH and the USEPA are working with Chevron to further examine the risk to human health and the environment posed by the residual oil. Chevron has since contracted with Dames and Moore consultants to evaluate the ongoing risk of oil in the freshwater marsh. The final outcome of this evaluation has not yet been made available (Dames and Moore 1997).

3.2.4.4 Recovery Period

The Trustees used a recovery period of ten years in their HEA. However, based on a more thorough review of literature, the Trustees now estimate that full recovery may not be realized for 15 to 20 years in the freshwater marsh (Albers 1995a; API 1991).

3.2.5 Human Use Services

3.2.5.1 Tourism

Lost visitor use at the USS *Arizona* Memorial represents a disruption of services provided by the marine environment and thereby constitutes an injury in accordance with the OPA regulations (15 CFR Part 990.30). Lost visitor use at the Memorial includes:

- lost visits due to the closure of the Memorial immediately after the oil spill,
- lost public donations to the Memorial during the closure, and
- diminished number or quality of visits due to response actions that interfered with visitor experiences after the Memorial re-opened.

The causal link between the oil spill and this lost visitor use was established by the presence and duration of spilled oil at the Memorial and by the response actions conducted at the Visitor Center to remove the spilled oil.

The NPS closed the Memorial for four days immediately following the oil spill to assure public safety during extensive response actions at the Visitor Center. As a result of this closure, the public was denied the use and enjoyment of the Memorial contrary to the intent of Congress and the management objectives of the NPS (NPS 1983). The Memorial is one of the most popular tourist sites in Hawaii, drawing more than 1.5 million visitors a year. These visitors generally travel substantial distances (from the continental United States and from foreign countries) and likely incur substantial travel costs to see the Memorial. The NPS estimated approximated 16,200 visits were lost during the closure. Additionally, an estimated $2,843 in public donations to the Memorial were lost during the closure (Billings pers. comm.).

After the Memorial re-opened on May 18, 1996, the quality of visitor experiences was diminished by ongoing response actions at the Visitor Center. These response actions were required to remove spilled oil from the Visitor Center shoreline. To accommodate these actions, the entire back lawn of the Visitor Center was roped off, excluding the public from approximately 25 percent of the Visitor Center area that is normally open for public use, not including the parking lot. This landscaped area is oriented toward Pearl Harbor and includes the popular Remembrance Exhibit and an interpretive walk-path. A special Memorial Day observance in 1996, in which 34 new plaques at the Remembrance Exhibit were to be dedicated, had to be postponed because of these response actions. These response actions also obstructed visitors' views of the final resting place of the USS *Arizona* and the historic landscape of Pearl Harbor. Additionally, 50 percent of the parking lot that is normally open for public use was occupied as a staging area for the ongoing response actions. The NPS estimated that the quality of approximately 24,220 visits were diminished by these response actions (Billings pers. comm.).

3.2.5.2 Recreation

A portion of the public bicycle/jogging path, owned and operated by the City and County of Honolulu's Department of Public Works and which runs around the margin of East Loch was closed to the public for cleanup operations from May 14 to June 1, 1996 (see Appendix A.2).

3.2.5.3 Fisheries

A commercial baitfish fishery for Hawaiian anchovy exists in Pearl Harbor. Commercial skipjack tuna boats, under permit to the USN, are allowed to fish in certain regions of Pearl Harbor. The DOH closed Pearl Harbor to commercial and recreational fishing during an unspecified period following the May 14, 1996 release of oil into Pearl Harbor. This fishing closure was accomplished by the posting of signs at prominent shoreline access points around Pearl Harbor. An unknown number of commercial baitfish fishing opportunities in Pearl Harbor were lost following the oil spill.

3.2.5.4 Naval Operations

Injuries to Naval operations, construction projects, studies and other Navy activities are outside the scope of this Final RP/EA. The United States reserves its rights with respect to any and all such matters.

3.3 ASSESSMENT APPROACH

The goal of injury assessment under OPA is to determine the nature and extent of injuries to natural resources and services, thus providing a technical basis for evaluating the need for, type, and scale of restoration actions. The assessment process occurs in two stages: (1) injury determination, and then (2) injury quantification.

Injury determination begins with the identification and selection of potential injuries to investigate. In accordance with the OPA regulations, the Trustees considered several factors when making this determination, including but not limited to the following:

- the natural resources and services of concern;
- the evidence indicating exposure, pathway, and injury;
- the mechanism by which injury occurred;
- the type, degree, and spatial and temporal extent of injury;
- the adverse change or impairment that constitutes injury;
- available assessment procedures and their time and cost requirements;
- the potential natural recovery period; and
- the kinds of restoration actions that are feasible.

The list of potential injuries investigated for the Incident is provided in Table 12. As indicated in this Table, the Trustees evaluated possible injuries to nine categories of ecological and human use loss. These categories were selected based on input from the Preassessment Phase activities: local, state, and federal government officials; Chevron; and academic and other experts knowledgeable about the affected environment.

For each potentially injured resource category, the Trustees determined:

- whether it was likely that an injury had occurred,
- the nature of the potential injury, and
- a causal link between the potential injury and the oil spill.

Injury is defined by the OPA regulations as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service. Injury may occur directly or indirectly to a natural resource and/or service" (15 CFR 990.30). The assessment methodologies used for the Incident are described in Table 12.

Where feasible, the Trustees used simplified, cost-effective procedures and methods to document injuries to natural resources and services.

Table 12. Potentially Injured Resources and Associated NRDA Assessment Methods used for the Incident.

Potentially Injured Resources	Assessment Methods:	
	Ecological Services	*Human Use Services*
1. Air Resources	Use site investigations, *e.g.*, ambient air sampling	Use site investigations, *e.g.*, ambient air sampling.
2. Federal Lands	Compare affected area conditions with historic and reference data.	Compare affected use data with historic use data.
3. State/Local Lands	Compare affected area conditions with historic and reference data.	Compare affected use data with historic use data.
4. Surface Water	Use site investigations, relevant scientific literature, and best professional judgment of experts.	Compare affected use data with historic use data.
5. Groundwater	Compare affected aquifer conditions with historic and reference data.	Compare affected use data with historic use data.
6. Water Column	Use computer models or site investigations, primary productivity data, relevant scientific literature, and best professional judgment of experts.	--
7. Bottom Sediments	Use computer models or site investigations, relevant scientific literature, and best professional judgment of experts.	--
8. Wetlands	Use site investigations, relevant scientific literature, and best professional judgment of experts.	--
9. Wildlife	Estimate impacts to species/populations using site investigations, relevant scientific literature, and best professional judgment of experts.	
10. Marine/Estuarine Biota	Use site investigations, relevant scientific literature, and best professional judgment of experts.	--

In selecting appropriate assessment procedures, the Trustees considered:

- the range of procedures available under section 990.27(b) of the OPA regulations;
- the time and cost required to implement the procedures;
- the potential nature, degree, and spatial and temporal extent of the injury;
- the potential restoration actions considered for the injury;
- the relevance and adequacy of information generated by the procedures to meet information requirements of restoration planning; and
- the input/suggestions of Chevron.

Accordingly, depending on the injury category, the Trustees generally relied on site investigations, relevant scientific literature, literature-based calculations, and best professional judgment of experts.

Following these procedures, the Trustees determined, as described above, that injury likely occurred in the following five categories:

- freshwater marsh habitat in Waiau Stream,
- intertidal habitat in Pearl Harbor,
- subtidal habitat in Pearl Harbor,
- water column habitat in Pearl Harbor, and
- human use services related to the USS *Arizona* Memorial.

4.0 RESTORATION

4.0 RESTORATION PLANNING

4.1 RESTORATION STRATEGY

The goal of restoration under OPA is to compensate the public for injuries to natural resources and services from the May 14, 1996 Chevron pipeline oil spill. OPA requires that this goal be achieved by returning injured natural resources to their baseline condition and, if possible, by compensating for any interim losses of natural resources and services during the period of recovery to baseline.

Restoration actions under the OPA regulations are either primary or compensatory. Primary restoration is action(s) taken to return injured natural resources and services to baseline on an accelerated timeframe. The OPA regulations require that Trustees consider natural recovery under primary restoration. Trustees may select natural recovery under three conditions: (1) if feasible, (2) if cost-effective primary restoration is not available, or (3) if injured resources will recover quickly to baseline without human intervention. Alternative primary restoration activities can range from natural recovery to actions that prevent interference with natural recovery to more intensive actions expected to return injured natural resources and services to baseline faster or with greater certainty than natural recovery.

Compensatory restoration is action(s) taken to compensate for the interim losses of natural resources and/or services pending recovery. The type and scale of compensatory restoration may depend on the nature of the primary restoration action and the level and rate of recovery of the injured natural resources and/or services given the primary restoration action. When identifying the compensatory restoration components of the restoration alternatives, Trustees must first consider compensatory restoration actions that provide services of the same type and quality, and of comparable value as those lost. If compensatory actions of the same type and quality and comparable value cannot provide a reasonable range of alternatives, Trustees then consider other compensatory restoration actions that will provide services of at least comparable type and quality as those lost.

In considering restoration for injuries resulting from the Incident, the Trustees first evaluated possible primary restoration for each injury. Based on that analysis, the Trustees determined that no primary restoration, other than natural recovery for ecological injuries, was appropriate. Thus, with the exception of the natural recovery alternative, only compensatory restoration projects are presented below.

Compensatory restoration alternatives must be scaled to ensure that the size or quantity of the proposed project reflects the magnitude of the injuries from the spill. The Trustees relied on the OPA regulations to select the scaling approach for compensatory restoration actions. The Trustees selected different scaling approaches for the ecological and the lost human use projects. Those approaches will be discussed in the sections dealing with those proposed projects.

Several of the restoration alternatives included in this section are based on conceptual designs rather than detailed engineering design work or operational plans. Therefore, details of specific projects may require additional refinements or adjustments to reflect site conditions or other factors. Restoration project designs also may change to reflect public comments and further Trustee analysis. The Trustees assume that implementation of restoration will begin in 1999-

2000. Should actual implementation be substantially delayed beyond this time period, the Trustees may revise their scaling calculations.

4.2 EVALUATION CRITERIA

The OPA regulations (15 CFR 990.54) 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,
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.

In addition, the Trustees considered several other factors including:

1. Cost effectiveness,
2. Nexus to geographic location of the injuries,
3. Opportunities to collaborate with other entities involved in restoration projects, and
4. Compliance with applicable federal and state laws and policies.

NEPA applies to restoration actions taken by federal Trustees. 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.

To comply with the requirements of NEPA, the Trustees analyzed 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 most of the actions proposed in this Draft RP/EA, the appropriate context for considering potential significance of the action is local, as opposed to national or world-wide. However, the national significance of the USS *Arizona* Memorial which was affected by this spill warrants consideration of national interests as well.

With respect to evaluating the intensity of the impacts of the proposed action, the NEPA regulations (40 CFR 1508.27) suggest consideration of ten 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; and
10. Likely violations of environmental protection laws.

4.3 EVALUATION OF RESTORATION ALTERNATIVE 1: NO ACTION/NATURAL RECOVERY

NEPA requires the Trustees to consider a "no action" alternative, and the OPA regulations require consideration of the equivalent, the natural recovery option. Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services pending environmental recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources. While natural recovery would occur over varying time scales for various injured resources, the interim losses suffered would not be compensated under the no action alternative.

The principal advantages of this approach are the ease of implementation and no monetary costs because natural processes rather than humans determine the trajectory of the system. This approach, more so than any of the others, recognizes the tremendous capacity of estuaries, bays, basins and entire watersheds for self-healing and does not in any way alter existing habitats.

However, OPA clearly establishes Trustee responsibility to seek compensation for interim losses pending recovery of the natural resources. This responsibility cannot be addressed through a no action alternative. While the Trustees have determined that natural recovery is appropriate as primary restoration for injuries to the water column, subtidal habitat, intertidal habitat and the freshwater marsh, the no action alternative is rejected for compensatory restoration. Losses were, and continue to be, suffered during the period of recovery from this spill and technically feasible and cost-effective alternatives exist to compensate for these losses.

4.4 EVALUATION OF RESTORATION ALTERNATIVE 2: ECOLOGICAL RESTORATION

Lost ecological services resulting from the spill are characterized primarily as potential reductions in the ability of certain habitats to perform ecological functions such as nutrient cycling, sediment stabilization, water quality improvement, and the provision of food and refuge for various species. Those species include federal- or state-threatened and endangered species such as the endangered Hawaiian stilt, the endangered Hawaiian moorhen, the endangered Hawaiian coot, the endangered Hawaiian duck, the threatened white tern, the endangered Hawaiian owl,

endangered humpback whale, the threatened Pacific green sea turtle, the Hawaiian anchovy, as well as numerous marine finfish and invertebrate species that rely on this large estuary for their existence. The Trustees determined that these losses potentially occur in four habitat types: freshwater marsh, intertidal, subtidal, and water column.

4.4.1 Scaling Approach

The OPA regulations require the Trustees to consider compensatory restoration actions that provide services of the same type and quality, and of comparable value as those injured. When services of the same type and quality, and of comparable value can be provided, the OPA regulations prescribe the "service-to-service" scaling approach to determine the appropriate scale of compensatory restoration.

The Trustees determined that "services of the same type and quality, and of comparable value" as the lost ecological services could be provided through appropriate habitat enhancement projects. Therefore, consistent with the criterion described in Section 4.2 above, the Trustees followed the "service-to-service" approach to scale compensatory restoration projects that address lost ecological services. To implement this approach, the Trustees decided to use the HEA methodology. HEA is commonly applied in NRDA cases to scale compensatory restoration projects that address lost ecological services. It is described in the preamble to the OPA regulations as a potential approach to scaling such projects.

In HEA, compensatory restoration projects are scaled so that the quantity of replacement services provided equals the quantity of lost services. These services are quantified in physical units of measure such as "acre years." There is no need to value replacement services in monetary terms if they are comparable to the lost services. Therefore, to satisfy the compensation criterion, Trustees must evaluate whether compensatory restoration projects can provide services that are comparable to the lost services. For this spill, the Trustees have determined that compensatory restoration projects that enhance habitat can provide services that are comparable to the lost ecological services.

For this spill, the Trustees considered the area affected by the oil, estimates of initial lost ecological services, and recovery periods for each impacted habitat type as inputs into the HEA. To calculate these inputs, the Trustees relied on available data, applicable literature, experience and best professional judgment. Precise scaling calculations often are not possible due to incomplete knowledge of relevant physical and biological processes. Out of necessity, the calculations utilize some simplifying assumptions while seeking to estimate fairly the magnitude of restoration required to compensate for injuries resulting from this spill.

The Trustees considered other approaches for providing more specific information for the HEA such as field or laboratory studies. The Trustees decided, however, that such work would be expensive to undertake and would not provide results in a timely fashion. Further, it was uncertain whether the studies would provide information that would significantly improve the accuracy of the scaling results. Because both the Trustees and Chevron preferred to focus on rapid implementation of restoration, they agreed to a more expedited process, recognizing that both sides would have to accept a degree of uncertainty in the scaling calculations.

4.4.2 Preferred Alternative: Pouhala Marsh Enhancement

4.4.2.1 Project Description

Pouhala Marsh, located in Pearl Harbor's West Loch (Figure 2, Photo 2), is a remnant fish pond and coastal marsh. The 70-acre marsh is the largest remaining wetland habitat in Pearl Harbor. The USFWS identified Pouhala Marsh as a wetland of critical concern for protection and habitat enhancement (USFWS 1995, USFWS 1998a). The marsh serves as habitat for native endangered waterbirds and several species of migratory shorebirds (Ducks Unlimited 1997).

Development, water pollution, and invasion of introduced flora have degraded the wetland over the past few decades. Of the 70 acres, 8 have been filled, 38 are degraded and overgrown, and the remaining 24 acres have been degraded through siltation and waste disposal. The local residential community uses the area as an illegal dumping site, and cats and dogs disturb waterbird nesting sites (Ducks Unlimited 1997).

Ducks Unlimited, Inc., the State of Hawaii, the USFWS, and the City and County of Honolulu have joined forces in the hope of restoring Pouhala Marsh. In September of 1998, the State of Hawaii issued a Finding of No Significant Impact (FONSI) for this project. To restore the wetland functions of Pouhala Marsh, the project has established the following goals:

- enhance existing wetland basins so that they function under naturally occurring hydrologic conditions by clearing 20 acres of vegetation, sculpting basins and removing obstructions (levees);
- clean the marsh of all human debris and trash;
- fence the 70-acre marsh to exclude humans, vehicles and large mammalian predators;
- restore eight acres of marsh through the removal of 66,000 cubic yards of fill material;
- exclude fish from entering the managed 8-acre wetland through fish screens; and
- create a hydrologic link for Kapakahi Stream to the 8-acre managed wetland.

The Trustees propose to fund a portion of the above project, specifically restoration of the eight acres of degraded and partially filled marsh and establish an endowment for the maintenance of Pouhala Marsh. The USFWS will ensure compliance with NEPA prior to implementation of this project.

4.4.2.2 Restoration Objective

The overall goal of the Pouhala Marsh Project is to restore the area to its historic seasonal and semi-permanent marsh functions. This overall objective also meets the goals of the Trustees to replace lost services related to injuries to the freshwater Waiau Marsh. Additionally, the project will compensate for lost services provided by the injured intertidal and shallow subtidal areas which were oiled. Those injured habitats provide forage (*e.g.*, small invertebrates, polychaetes) for the same types of shorebirds that will utilize the enhanced Pouhala Marsh.

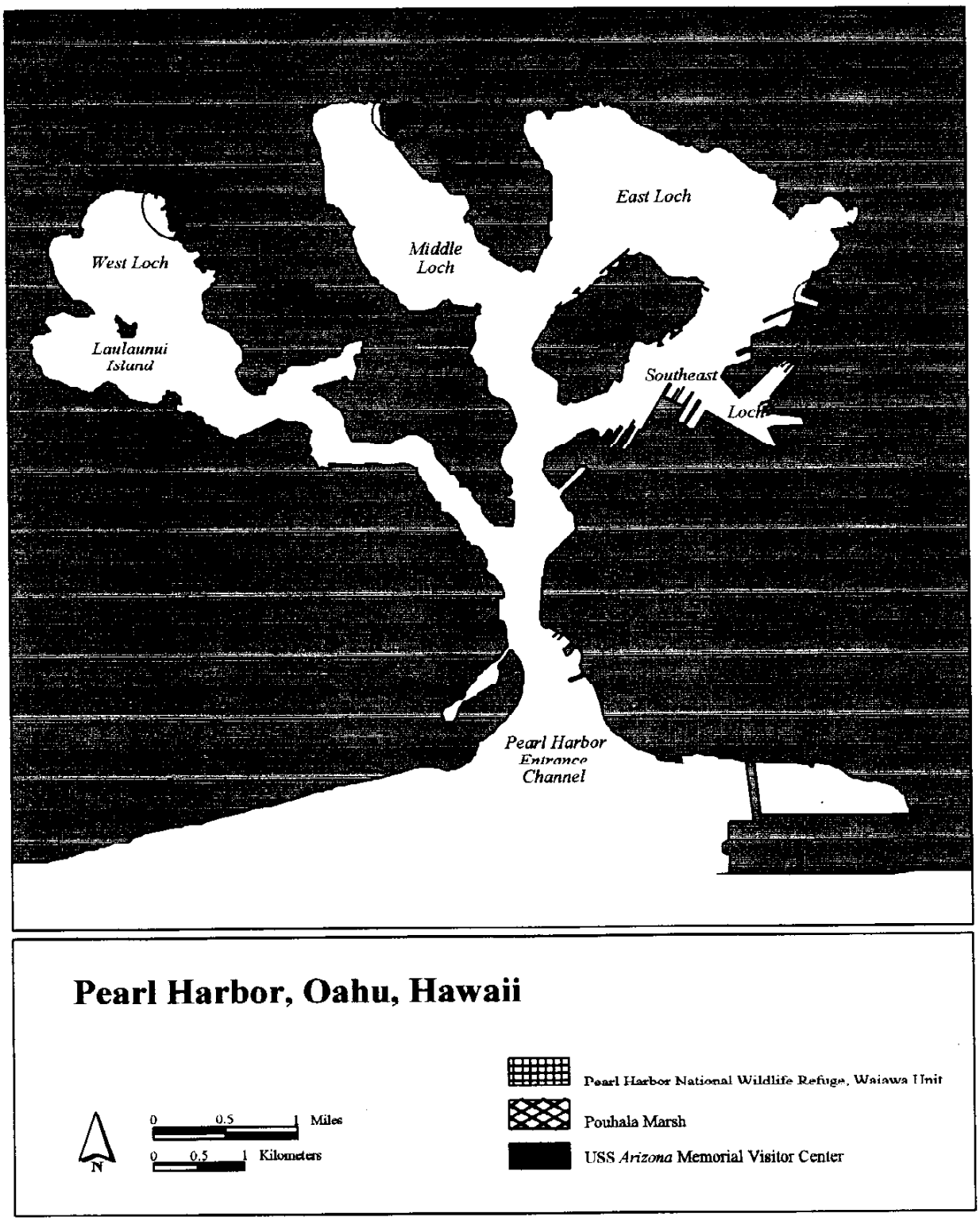

Figure 2. Pearl Harbor, Oahu, Hawaii, showing the locations of proposed natural resource restoration projects at the Waiawa Unit of the Pearl Harbor National Wildlife Refuge, Pouhala Marsh and the USS *Arizona* Memorial Visitor Center.

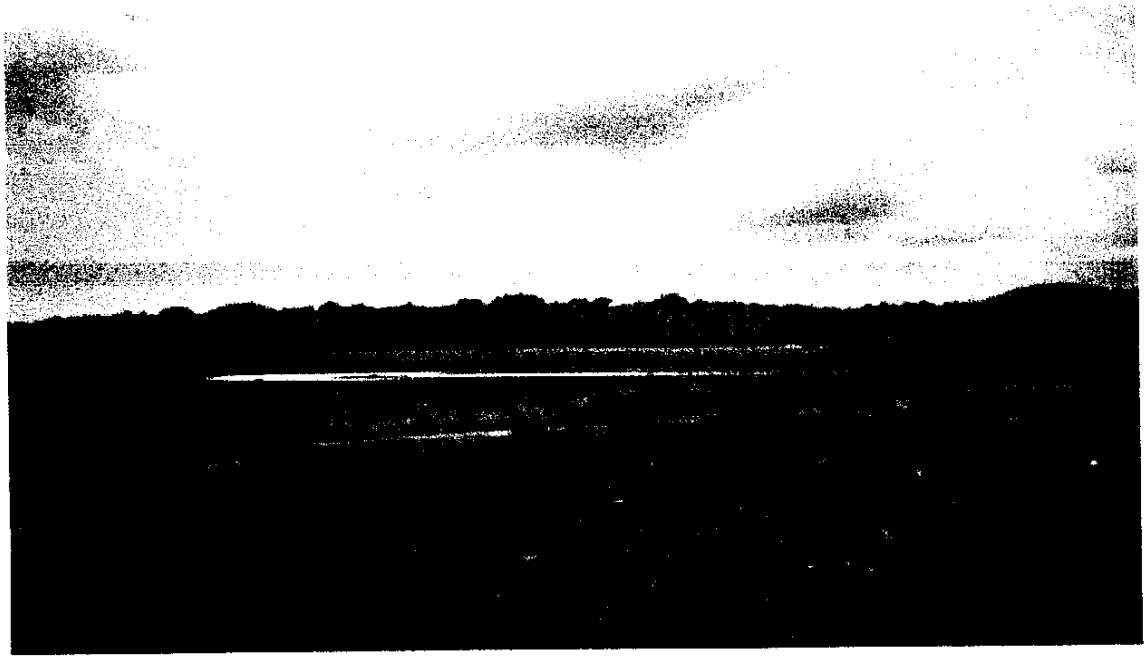

Photo 2. Pouhala Marsh, on the shoreline of West Loch, Pearl Harbor, Oahu, Hawaii (see Section 4.4.2)(Photo courtesy of G. Siani, NOAA)

Photo 3. Pearl Harbor National Wildlife Refuge, Waiawa Unit, on the shoreline of Middle Loch, Pearl Harbor, Oahu, Hawaii (see Section 4.4.3)(Photo courtesy of G. Siani, NOAA)

4.4.2.3 Probability of Success

The probability of restoring wetland functions to the degraded Pouhala Marsh is great. There have been many projects which have successfully created or restored wetland areas. Establishment of construction criteria will enhance the likelihood of success. See discussion below. Fencing the property will deter human degradation of the area once it is enhanced and will prevent larger mammals from entering the area and disturbing nesting sites. The endowment to which theTrustees propose to contribute will provide for maintenance such as control of invasive flora. Additionally, the project sponsors have secured funding to complete most of the components of the project.

4.4.2.4 Performance Criteria and Monitoring

An overview of the technical specifications for the project is included in the Environmental Assessment and Enhancement Plan for Pouhala Marsh, Oahu, Hawaii (Plan) prepared by Ducks Unlimited (Ducks Unlimited 1997). Those specifications cover the work involving construction of fencing, levees and water control structures to improve wetland habitat conditions. For vegetation removal, the plan identifies species which will be removed (*e.g.*, pickleweed) and the area of removal. Periodic predator monitoring and removal is a long-term management need and will be undertaken by the State of Hawaii Department of Land and Natural Resources' Division of Forestry and Wildlife. Long-term monitoring and removal of invasive plant species also are necessary and should be provided, in part, through the endowment.

4.4.2.5 Environmental and Socio-Economic Impacts

Potential impacts from the project are identified in the Plan are briefly summarized here:

Hydrology: The project will use existing hydrology to manage the site. Hydrologic processes will be re-established in the eight-acre restored wetland. The hydrologic connection between Kapakahi Stream and Pouhala Marsh will be re-established as well.

Water Quality: There is no evidence of polluted waters in the project area. Thus, reconnecting the Kapakahi Stream with the marsh should have no negative impacts. Planned excavations will be conducted so as not to impact water quality.

Soils: The fill material proposed to be removed, after sampling and analysis, has been characterized as non-hazardous, homogeneous silty clay.

Vegetative Impacts: There are no endangered, threatened or candidate plant species in the wetlands. Restoration activities will not affect native ecosystems (*i.e.*, patches of Kaluha Sedge lands)(USFWS 1998b).

Wildlife Impacts: The site is home to three endangered bird species: Hawaiian stilt, Hawaiian moorhen and Hawaiian duck (USFWS 1998a). The Hawaiian moorhen inhabits Kaluha Sedge lands which will not be impacted by the restoration. Fill material removal will be undertaken when the marsh is mostly dry to minimize disturbance to stilts. Field crews will work under the direction of a biologist. The biologist will monitor endangered bird activity and disturbance and will make

recommendations to the site manager to stop work if required to minimize impacts to waterbirds. No endangered, threatened or sensitive species of arthropods or fish have been observed on site.

Archaeology: Pouhala Marsh was used historically as a series of fish ponds. One fish pond wall is suspected to be in the area where fill will be removed. An archaeologist will monitor the excavation there and attempt to locate the wall and direct field equipment to avoid the wall.

4.4.2.6 Evaluation

Based on the Plan and the USFWS' initial environmental review of the marsh, the Trustees find that the benefits of the project far outweigh any negative impacts. The project will provide ecological services of the same type lost as a result of the spill. Restoration actions at Pouhala Marsh will be covered by existing Section 404 Clean Water Act permits held by Ducks Unlimited for construction activities in wetlands. Likewise, the Trustees find this alternative to be consistent with the provisions of EO 11988 covering construction or enhancement of structures within the floodplain.

4.4.3 Preferred Alternative: Waiawa Unit Mangrove Removal Project

4.4.3.1 Project Description

The Pearl Harbor National Wildlife Refuge serves as habitat for four species of federal and state endangered endemic waterbirds and 25 other species of federally protected migratory birds including shorebirds and waterbirds (see sections 2.2 and 2.4). The Refuge is composed of two, geographically separate units, one of which is the Waiawa Unit (Figure 2, Photo 3). The western boundary of the Waiawa Unit is vegetated with a dense stand of red mangroves which have invaded the shallow waters along the shoreline.

Red mangrove is an exotic plant species in Hawaii. Red mangroves in Hawaii are considered undesirable because they encroach on coastal shorelines and nearshore waters, displace native fauna and flora and cause drainage and aesthetic problems (Allen, in press). These introduced red mangroves displace and alter habitat essential to a number of native estuarine species such as juvenile and adult Hawaiian anchovies (Naughton pers. comm.). By encroaching into the shallow mudflats near the shoreline, the mangroves displace foraging habitat for various species of waterbirds and shorebirds.

The major component of this project is the removal of red mangroves along the shoreline to create a more open water environment adjacent to the Refuge. Adult red mangroves will be cut below the water line to prevent them from re-emerging. The root systems will not be removed thereby minimizing disturbance of sediments. The cut red mangroves will be removed from the shoreline area. It is estimated that approximately four acres of red mangrove will be removed from the western boundary of the Waiawa Unit.

In addition to the mangrove removal, several smaller, associated projects are necessary to achieve the objective of the proposal. These include:

- construction of a fence to provide security and predator exclusion along the western boundary of the Refuge,
- purchase and deployment of a floating barrier to prevent red mangrove seedlings (propagules) from settling and recolonizing the area, and
- revegetation of the shoreline with native vegetation (*e.g.*, *naupaka* shrubs) following the red mangrove removal project.

This project also presents the opportunity for interested parties to monitor both the effect of removal of red mangroves and the success of revegetation efforts.

4.4.3.2 Restoration Objectives

Removal of mangroves will create open intertidal and shallow subtidal mudflat habitat for estuarine species and foraging waterbirds. The project will compensate for lost services provided by the injured water column, intertidal and shallow subtidal areas which were oiled as a result of this spill.

4.4.3.3 Probability of Success

Removal of adult red mangroves is a labor intensive undertaking requiring that the mangroves be cut below the water line, and the cut mangroves removed from the shoreline area. However, it is not technologically difficult and has been done in other locations on Oahu (*e.g.*, Marine Corps Station Hawaii in Kaneohe). Red mangroves recolonize when propagules float into an area and anchor themselves to a substrate. Small, recently settled, propagules pull out easily. Removal becomes more difficult as the red mangroves grow larger. Based on observations made during a red mangrove removal project in the area of the HECO Waiau Power Plant, pulling out the new propagules once or twice a year is the cheapest, simplest way to maintain the open shoreline (Oishi pers. comm.). The USFWS will provide assistance in maintaining the open water area. Use of a floating barrier or boom offshore from the restored shoreline will also prevent propagules from reaching the shoreline and settling in the area.

4.4.3.4 Performance Criteria and Monitoring

Adult red mangroves will be cut below the water line to prevent the mangroves from growing again. Annual or semi-annual maintenance is necessary to ensure that mangrove propagules do not settle in the cleared area. The shoreline will be planted with native flora such as *naupaka* shrubs which will not intrude into the open water area.

4.4.3.5 Environmental and Socio-Economic Impacts

The initial removal of the red mangroves may temporarily disturb the shoreline and sediments. Disturbance of the sediments will be minimized because the root structure of the mangroves will not be removed. Instead, the roots will degrade slowly. Samples of sediments in adjacent areas are being analyzed for contaminants. The Trustees will evaluate the analyses when available, or as it further considers this project. Revegetation of the shoreline will stabilize the area and prevent soil erosion into the water. Removal of the adult red mangroves also will disturb any birds using the mangroves for nesting or roosting. Such impacts can be lessened or avoided by doing the

removal outside of the nesting season. Nevertheless, the requirements of the ESA will be complied with if threatened or endangered birds will be impacted. Removal of adult red mangroves would impact some invertebrates such as bryozoans, tunicates and sponges that attach to hard substrates and to the prop roots themselves. Other species would be displaced as well such as the mangrove (or Samoan) crab, an introduced but recreationally important species. Removal of the adult red mangroves will alter the hydrologic conditions by the shoreline by allowing for greater water circulation. The periodic propagule removal will temporarily and minimally disturb the sediments. No socio-economic impacts are expected from this project.

4.4.3.6 Evaluation

Mudflat habitat is one of several critical shoreline types within the Pearl Harbor estuary system. These mudflats have been degraded by the invasion of non-native red mangroves. These mangroves are monopolizing the previously open shallow shoreline around Pearl Harbor which had served as important habitat for juvenile fish. After considering injuries to the water column from the spill and available restoration opportunities, the Trustees are proposing the Waiawa Unit of the Pearl Harbor National Wildlife Refuge as the site for compensatory restoration to address water column injuries.

Although there will be some negative impacts to natural resources as a result of the removal of adult mangroves, the Trustees have determined that the project's overall environmental impacts are positive. The creation of shallow open water habitat will benefit intertidal and shallow subtidal species (*e.g.*, small invertebrates, polychaetes); species feeding on organisms in those habitats such as the Hawaiian stilt, shorebirds and wading birds; and water column species such as juvenile Hawaiian anchovy and shallow water finfish species. The spill injured all of these habitats. The project will also improve water flows.

Since there are no construction activities involving the replacement or enhancement of structures within the floodplain, the Trustees find that EO 11988 does not apply.

4.4.4 Non-Preferred Alternatives

The Trustees considered the following compensatory restoration projects to replace ecological service losses resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed above.

- Implement educational programs to reduce nonpoint source pollutants in Pearl Harbor: A series of television commercials on cause and effects, coupled with a brochure, would raise public awareness of the problem.

- Shoreline protection and intertidal and subtidal enhancement: Boulder revetment and armorstone structures would be used to increase interstitial space thereby creating shallow marine habitat (shelter and attachment surface area). Potential locations for this project would be the shoreline adjacent to the Visitor Center and the existing riprap that was oiled on the north shoreline of Ford Island.

- Mangrove removal at Pouhala Marsh: Removing approximately 28 acres of mangrove to create shallow, open water area and revegetating the cleared shoreline with native plants.

- Replanting reed/marsh grasses along shoreline adjacent to "Shopping Cart Flats" mudflats: Marsh grasses would serve as intertidal habitat for juvenile finfish and shellfish species.

- Funding of an endowment to clean up Pearl Harbor shoreline: The shoreline receives many human discards such as styrofoam cups, plastic bags, and domestic and industrial wastes. Shoreline cleanup would preserve more natural ecological conditions, create preferred conditions for the natural evolution of marine communities, and reduce the likelihood of adverse environmental impacts to wildlife.

- Create hard substratum in shallow water habitat: Concrete slabs from construction demolition would be used to create a shallow water habitat, preferably near a freshwater source such as a stream so that nutrients would stimulate zooplankton production, thereby enhancing prey species standing crops (such as the Hawaiian anchovy). Slabs are preferred over a cobble or boulder pavement so as to reduce the availability of crevices for predatory fish that would feed on juvenile Hawaiian anchovy. The habitat would have to be constructed at a depth greater than one foot at low tide to prevent mangrove propagules from lodging into the crevices between the slabs.

- Develop artificial reef(s): Artificial reef development would increase the amount of shelter for fishes and invertebrates that are important to recreational and commercial fisheries.

- Create more "distribution channels" in existing mangroves surrounding the marsh for streams emptying into West Loch adjacent to Pouhala Marsh.

- Restore native marine species such as black-lipped pearl oyster through aquaculture: A stock enhancement program for species that could benefit from enhanced recruitment.

- Coral transplantation.

- Develop a red mangrove management plan for Pearl Harbor: This proposed plan would cover the history of introduction of the species, life history, environmental impact, geographic scope of the problem, advantages/disadvantages of control, review of control/removal methods and relevant case histories, hydrogeologic considerations, recommended treatment methods, costs, permitting requirements, land ownership issues, maintenance requirements and strategies, and priority listing of sites for removal/control. The plan also would analyze the feasibility and benefits of controlling and/or removing the introduced species. The plan would be coupled with a pilot project. The information generated could provide the basis for a regional restoration plan.

- Waiawa Unit habitat enhancement: Remove 4.4 acres of overgrown pickleweed from the Lower Pond, maintain Lower Pond, and rebuild sluice gate.

4.5 EVALUATION OF RESTORATION ALTERNATIVE 3: LOST HUMAN USE RESTORATION

Lost visitor services at the USS *Arizona* Memorial are characterized primarily as lost visits due to the closure of the Memorial immediately after the spill, and secondarily as diminished visits due to continuing response actions that interfered with visitor experiences after the Memorial reopened. That is, during the closure, would-be visitors were denied the entire experience of visiting the Memorial due to the spill and associated response actions. After the Memorial reopened, visitors were unable to enjoy the full experience which they would have had but for the spill.

4.5.1 Scaling Approach

The Trustees determined that "services of the same type and quality, and of comparable value" as the lost visits could be provided only by accommodating additional visitors at the Memorial. To maintain the same type, quality, and comparable value of an entire visitor experience this could be replaced only by an entire visitor experience. However, the ability of the Memorial to accommodate additional visitors is severely limited by the capacity of the existing facilities. Typically, visitors assemble in one of two theaters at the Visitor Center to view a documentary film and then board a shuttle boat to visit the Memorial. The fixed capacities of these facilities limit the number of visitors that can experience the Memorial to approximately 4,500 per day. The Memorial regularly turns visitors away because of this limitation. Moreover, the Trustees believe that accommodating more visitors at the Memorial would rapidly diminish the experience of quiet reflection and meditation that is appropriate for the site where 1,177 American servicemen died in the Japanese attack on Pearl Harbor (Billings pers. comm.).

Therefore, the Trustees decided that the best approach to replacing lost visitor services at the Memorial is to implement compensatory restoration projects that enhance the experience of visitors rather than increase the number of visitors. While such projects may not replace an entire visitor experience, they would nonetheless provide enhanced value to the public in compensation for the lost visitor services.

The fact that the replacement services provided by compensatory restoration projects do not exactly correspond with the lost services (*i.e.*, the projects considered would enhance the experience of visitors rather than increase the number of visitors) determines, in part, how compensatory restoration is to be scaled. The OPA regulations specify that when the lost and replacement services are not of comparable value, compensatory restoration will be scaled by valuing the lost and replacement services. In general, this approach requires Trustees to measure the value of lost services and then determine the scale of compensatory restoration actions that provide replacement services of equal value. Hence, in order to ensure that the public is neither over-compensated nor under-compensated, the value of replacement services must be measured in addition to the value of lost services to establish an equivalency between the two.

The Trustees selected the benefits transfer methodology to value lost visitor use. This methodology combines value estimates from existing economic studies with site-specific injury information to estimate the value of lost services. It is described in the preamble to the OPA regulations as a potential approach to scaling compensatory restoration actions. The Trustees determined that the benefits transfer methodology was appropriate based on the consideration of a number of factors, including the ability to implement the approach within a reasonable time frame and at a reasonable cost. The increased cost of other methodologies that require more intensive data collection and analysis was considered to be unreasonable relative to the expected increase in the quantity or quality of relevant information.

The preamble to the OPA regulations recommends that Trustees use the same methodology to value lost services as replacement services to avoid introducing a bias into the scaling calculations. Accordingly, the Trustees sought to apply the benefits transfer methodology to value replacement services provided by compensatory restoration. However, there are no known economic studies that value the benefits of the type of compensatory restoration projects that could be implemented at the Memorial. After considering other possible methodologies for valuing the replacement services, the Trustees concluded that such methodologies could not be performed within a reasonable time frame or at a reasonable cost.

The OPA regulations provide that if, in the judgment of the Trustees, valuation of the lost services is practicable, but valuation of the replacement services cannot be performed within a reasonable time frame or at a reasonable cost, the Trustees may estimate the value of the lost services and then select the scale of compensatory restoration that has a cost equivalent to the lost value. Following this provision, the Trustees considered a set of compensatory restoration projects with a total cost equal to the value of lost visitor services, as estimated using the benefits transfer methodology.

4.5.2 Preferred Alternative: Shoreline Protection System

4.5.2.1 Project Description

This project would replace the existing, inadequate shoreline protection system with a new permanent riprap system. The existing shoreline is composed of broken concrete pilings and other rubble with *naupaka* shrub landscaping. This project requires removal of the sandbags installed as a temporary erosion control measure after the oil spill cleanup and the design and construction of a riprap system that would provide a permanent shoreline protection system to prevent erosion. The project area encompasses the shoreline from the Visitor Center dock to the ferry landing adjacent to the Visitor Center, approximately 600 feet (Figure 2, Photo 4). Most of the work would be accomplished from the water side of the shoreline.

4.5.2.2 Restoration Objectives

The shoreline protection system will enhance visitor services by protecting the shoreline in front of the Visitor Center, particularly the areas which were inaccessible during the oil spill cleanup operations and which are the most vulnerable to erosion. The protection system is critical to the continued existence of the center.

4.5.2.3 Probability of Success

The shoreline protection system is technically feasible and presents no unique engineering problems.

4.5.2.4 Performance Criteria and Monitoring

The design for this proposed project will provide for a permanent shoreline protection system. Construction logistics will be designed to minimize impacts to visitors. This alternative will require an Environmental Assessment and a U.S. Army Corps of Engineers permit. The NPS and USN must approve the design plans. NPS oversight of the entire project is required. According to the Use Agreement between the NPS and the USN, review of the entire project by the Navy is required. The NPS concluded its environmental review of this project on August 3, 1999, with a Finding of No Significant Impact (Reynolds 1999).

4.5.2.5 Environmental and Socio-Economic Impacts

Removal of the sandbags may disturb temporarily the shoreline and cause some erosion of the soil into the adjacent water. Some existing vegetation on the shoreline will be removed to enable the construction. That vegetation will be replaced. Any species using the existing vegetation or sandbags as habitat will be displaced. Placement of the new shoreline protection system may disturb the sediments next to the shoreline and any organisms living in those sediments. Such disturbances will be short-lived. There will be a temporary impact to visitors at the Memorial while construction is ongoing which may result in diminished value of the visit. This is most likely to occur when the construction work is being done in the area of the interpretive exhibits located on part of the shoreline. However, efforts will be made to minimize such impacts. Other potential impacts will be assessed during the review of the U.S. Army Corps of Engineers Clean Water Act Section 404 permit for this project and during the Environmental Assessment process.

4.5.2.6 Evaluation

The shoreline protects the property on which the Visitor Center is located. The harbor-facing shoreline has exhibits used by visitors to interpret the historical scene of the December 7, 1941 attack. Due to the eroding condition of the shoreline, exacerbated by the response activities, a shoreline protection system is essential to protect the Visitor Center and for visitors' use and enjoyment of the Memorial.

The Trustees are proposing this project because it would enhance visitor services and because of its nexus to the losses suffered by the public as a result of the spill. Recognizing the national and international significance of the USS *Arizona* Memorial and the necessity of protecting the existing facilities, the Trustees find that the benefits of this alternative far outweigh the temporary impacts to natural resources or visitors. The Trustees also have determined that the alternative is consistent with the provisions of EO 11988 for the construction within flood plains.

Photo 4. Shoreline of USS *Arizona* Memorial Visitor Center at the mouth of Halawa Stream on East Loch, Pearl Harbor, Oahu, Hawaii, showing oiled shoreline and areas exposed following vegetation removal during the response phase to the Incident (see Section 4.5.2)(Photo courtesy of NPS, Honolulu, HI).

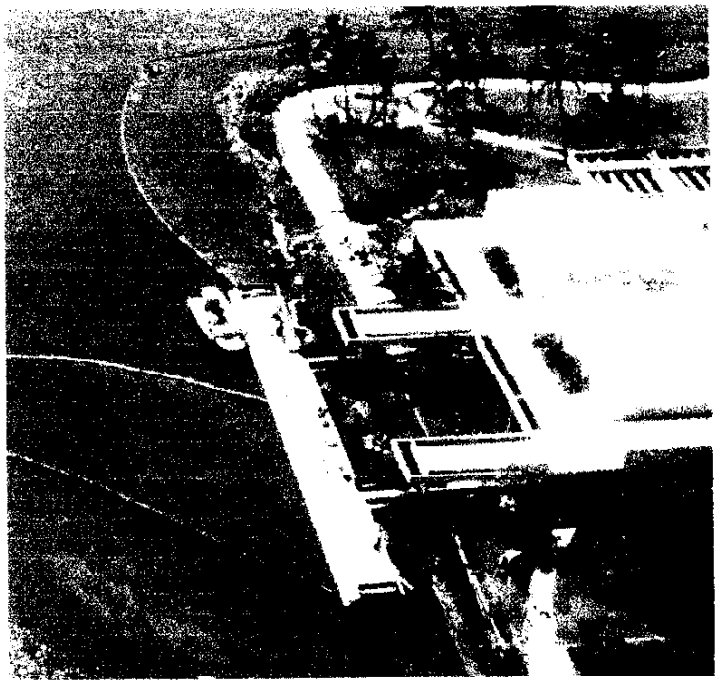

Photo 5. Oblique aerial view of USS *Arizona* Memorial Visitor Center, on the shoreline of East Loch, Pearl Harbor, Oahu, Hawaii, showing the Visitor Center boat dock during the response phase to the Incident (see Section 4.5.3) (Photo courtesy of NPS, Honolulu, HI)

4.5.3 Preferred Alternative: Visitor Center Boat Dock

4.5.3.1 Project Description

This project supplements an ongoing project for the design, removal and replacement construction of the shoreside dock at the Visitor Center. The existing fixed dock is located on Halawa Stream. It is a rectangular concrete pier 15 feet wide by 180 feet long, offset about ten feet from the edge of the existing shoreline. The existing dock needs to be replaced because it is deteriorating along the concrete pile cap, beams and skirt (Photo 5).

4.5.3.2 Restoration Objectives

The Visitor Center boat dock will enhance visitor services by ensuring future and safe transport of visitors to the Memorial via USN boats.

4.5.3.3 Probability of Success

Construction of the Visitor Center boat dock is technically feasible and presents no unique engineering problems. NPS has completed the contracting for this project and construction will commence in the Spring of 1999.

4.5.3.4 Performance Criteria and Monitoring

Technical specifications will be contained in the design plans. Logistics require that the design incorporate a phased dock replacement to avoid interruption of boat service to the Memorial for visitors. The replacement dock will be designed to accommodate two "white" boats at the same time. The permanent replacement dock and the temporary dock must be handicap accessible. The NPS and USN have approved the design plans. NPS oversight of the entire project is required.

4.5.3.5 Environmental and Socio-Economic Impacts

The construction will affect temporarily the surface water, sediments and submerged resources of Pearl Harbor. There should be few, if any, impacts on visitors to the Memorial. The construction area is located away from the more heavily visited parts of the Visitors Center. Most visitors will only be in the area where the dock is being replaced as they embark and debark the USN boats. Potential impacts were assessed in the NEPA review process. The NPS has issued a FONSI based on its review of the Environmental Assessment for this construction. A U.S. Army Corps of Engineers Clean Water Act Section 404 permit has been approved.

4.5.3.6 Evaluation

The visit to the Memorial straddling the sunken remains of the USS *Arizona* is the most valued activity by visitors to this NPS unit and is the focal point of the ranger-led tour. To reach the Memorial, visitors are transported on USN boats. Naval Base, Pearl Harbor has informed the NPS that the existing dock is deteriorating at a rapid rate and must be replaced in order to ensure the continued safety of the visitors using it.

The Trustees selected this project as one of their preferred projects because it would enhance visitor services and because of its nexus to the losses suffered by the public as a result of the spill. Recognizing the national and international significance of the USS *Arizona* Memorial and the necessity of access to the Memorial, the Trustees find that the benefits of this alternative far outweigh the temporary impacts to natural resources. The Trustees have determined that the expected impacts to natural resources are acceptable and find this project to be consistent with the provisions of EO 11988 for the construction within floodplains.

4.5.4 Non-Preferred Alternatives

The Trustees considered, but did not select, the following compensatory alternatives:

- Projector Lamphouses. This project involves supplementing a project to upgrade the lamphouses on the projectors in the Visitor Center theaters. There are four projectors in the projection room, and all four lamphouses would be upgraded to increase light for the film. Luminosity is below industry standards for all projectors. Upgrading the lamphouses on the projects will enhance visitor services by upgrading the quality of the Memorial's documentary film, in which most of the footage was recorded more than 50 years ago.

- Restroom/Dive Locker: This project involves the design and construction of a restroom/dive locker building between the boat dock and front lobby of the Visitor Center to replace the existing inadequate facilities located under the Visitor Center. The design would require integration of the new building with the existing structures. Because the Visitor Center is located on a landfill, the design would require soil type and compaction tests. The size of the restroom would be determined by the projected future visitation level. The number of fixtures required would meet current code requirements. The new building would include space for dive equipment storage, shower facilities and restrooms for the dive team.

- Bus Parking Lot: This project involves the design, grading and paving of the bus parking lot in front of the Visitor Center complex. Total square footage of the lot is 49,600 square feet. The area consists of dirt, base coarse, and concrete slab portions. The concrete covers 27, 600 square feet. The project would require configuration of the space for the maximum number of buses, tour vans and taxis. Grading and drainage of the area would be required. The project would require soil compaction tests and removal of the concrete slab in the area. The area would be paved and striped with swinging gates installed at entrances. A shade structure would be designed and constructed along the entrance side to provide weather protection for visitors.

- Lanai Skylights: This project involves the design and construction of skylights over the shoreside lanai at the Visitor Center complex. The entire back lanai structure is approximately 100 feet by 40 feet, with an open wood trellis structure between concrete beams. The design would require a light-w8 system of clear skylights with a roof drainage system that would be above the wooden slats in the lanai structure. The designed structure should have a low visual impact to the building. Skylights would cover the wooden slats and provide a weather protected area for visitors.

Logistics for construction would involve closing half of the lanai at one time to maintain accessibility for visitors to the back lawn area.

- Purchasing of Copyrights for Park Movie: The documentary film shown daily in the park theater to visitors was professionally produced by non-government sources. These sources, producers, directors, cinematographers and narrators, retained copyrights for their work. In order for the NPS to sell this film to park visitors, it must purchase these copyrights.

5.0 COORDINATION

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 of Pearl Harbor are OPA and NEPA. OPA and its regulations provide the basic framework for natural resource damage assessment and restoration. NEPA 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. As well, it will be necessary to take Navy interests into consideration. The potentially relevant laws, regulations and policies are set forth below.

In addition to laws and regulations, the Trustees must consider relevant environment or economic programs or plans that are ongoing or planned in or near the affected environment. For example, as previously noted, the restoration projects may be occurring, in part, in an area designated as a federal Superfund site. A number of documents have been and will be produced as a part of that Superfund process. As well, the Trustees propose to work with the sponsors of the ongoing Pouhala Marsh Project. The Trustees must ensure that their proposed restoration activities neither impede nor duplicate such programs or plans. By coordinating restoration with other relevant programs and plans, the Trustees can enhance the overall effort to improve the environment of Pearl Harbor.

In initiating the Final RP/EA, the Trustees elected to combine the Restoration Plan required under OPA with the environmental review processes required under NEPA. This is expected to enable the Trustees to implement restoration more rapidly than had these processes been undertaken sequentially.

5.2 KEY STATUTES, REGULATIONS AND POLICIES

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

OPA establishes a liability regime for oil spills 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 USC 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.

This rule provides 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.

- Park System Resource Protection Act, 16 USC 19jj

Public Law 101-337, the Park System Resource Protection Act (16 USC19jj), requires the Secretary of the Interior to assess and monitor injuries to NPS resources. The Act specifically allows the Secretary of the Interior to recover response costs and damages from the Responsible Party causing the destruction, loss of, or injury to park system resources. This Act provides that any monies recovered by the NPS may be used to reimburse the costs of response and damage assessment and to restore, replace or acquire the equivalent of the injured resources.

- 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 USC 4321, *et seq.* 40 CFR 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, 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. NEPA requires that an Environmental Assessment (EA) be prepared in order to determine whether the proposed restoration actions will have a significant effect on the quality of the human environment.

Generally, when it is uncertain whether an action will have a significant effect, federal agencies will begin the NEPA planning process by preparing an 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, an environmental impact statement (EIS) or a FONSI will be issued.

The Trustees have integrated this Restoration Plan with the NEPA process to comply, in part, with those requirements. This integrated process allows the Trustees to meet the public involvement requirements of OPA and NEPA concurrently. The Final RP/EA was intended to accomplish partial NEPA compliance by:

- summarizing the current environmental setting,
- describing the purpose and need for restoration action,
- identifying alternative actions,
- assessing the preferred actions' environmental consequences, and
- summarizing opportunities for public participation in the decision process.

Project-specific NEPA documents will need to be prepared for those proposed restoration projects not already analyzed in an EA or EIS. As noted in Section 4.0, the Pouhala Marsh project and the Visitor Center Boat Dock project have undergone or are undergoing environmental review by their respective federal agencies.

- 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 decisionmaking 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.

- Clean Water Act (CWA) (Federal Water Pollution Control Act), 33 USC 1251, *et seq.*

The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the disposal of dredged or fill material into navigable waters. The U.S. Army Corps of Engineers (Corps) administers the program. In general, restoration projects which move significant amounts of material into or out of waters or wetlands -- for example, hydrologic restoration of marshes -- require Section 404 permits.

Some of the preferred NRDA restoration projects in the Final RP/EA will require such permits. For one preferred project, enhancement of Pouhala Marsh, Ducks Unlimited already has secured the permit.

Under Section 401 of the CWA, restoration projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. The Hawaii Department of Health implements the Section 401 certification program. Generally, restoration projects with minor wetlands impacts (*i.e.*, a project covered by a Corps general permit) do not require Section 401 certification, while projects with potentially large or cumulative impacts must undergo a certification review.

- Coastal Zone Management Act (CZMA), 16 USC 1451, *et seq.*, 15 CFR 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 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 comply with the CZMA, the Trustees intend to 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.

- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601, *et seq.*

CERCLA provides the basic legal framework for cleanup and restoration of the nation's hazardous substances sites. Generally, parties responsible for contamination of sites and the current owners or operators of contaminated sites are liable for the cost of clean up and restoration. CERCLA establishes a hazard ranking system for assessing the nation's contaminated sites with the most contaminated sites being placed on the NPL. The Pearl Harbor Naval Complex is listed on the NPL.

To the extent that restoration projects are proposed for areas containing hazardous substances, the Trustees will avoid exacerbating any potential risk posed by such substances and will undertake no actions which might constitute "arrangement for disposal of hazardous substances." Fill in the eight-acre parcel at Pouhala Marsh that the Trustees propose to restore has been sampled and analyzed. Based on that sampling and analysis, the fill has been characterized as non-hazardous. At this time, the Trustees are not aware of any other potential hazardous substance problem associated with the areas where the proposed restoration projects will occur.

The Waiawa Unit of the Pearl Harbor National Wildlife Refuge is immediately adjacent to the Pearl City Landfill on the shoreline of the Pearl City Peninsula and is an Operable Unit of the Pearl Harbor Naval Complex NPL site. Solid and liquid hazardous wastes were disposed in this landfill. Before removing any red mangroves from the shoreline of the Waiawa Unit, the USFWS will coordinate with the appropriate individuals to determine whether these hazardous wastes could potentially be mobilized by their proposed actions.

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

The ESA directs all federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authorities to further these purposes. Under the Act, the National Marine Fisheries Service (NMFS) 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 Trustees have determined that the two preferred ecological projects -- enhancement of Pouhala Marsh and red mangrove removal at the Waiawa Unit -- will benefit some endangered species such as Hawaiian stilts, Hawaiian ducks and Hawaiian moorhens. It is possible that the red mangrove removal project could disturb endangered species. Prior to implementation of that project, the Trustees will conduct Section 7 consultations.

- Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1801 *et seq*.

The Magnuson-Stevens Fishery Conservation and Management Act as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) established a program to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

The Trustees believe that the proposed restoration projects will have no adverse effect on EFH and will promote the protection of fish resources and EFH. Prior to implementation of any restoration projects that may potentially create a potential adverse impact to EFH, the Trustees will consult with the National Marine Fisheries Service.

- 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 endangered or threatened. The statute directs the DLNR to determine what conservation measures are necessary to ensure the continued ability of species to sustain themselves. The Trustees will work with the appropriate state officials concerning the potential disturbance of endangered species related to the mangrove removal project. *See* discussion above.

- Fish and Wildlife Coordination Act (FWCA), 16 USC 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 NRDA restoration actions under this RP/EA, the fact that the three consulting agencies for the FWCA (*i.e.*, USFWS, NMFS and DLNR) are represented by the Trustees means that FWCA compliance will be inherent in the Trustee decisionmaking process.

- Rivers and Harbors Act, 33 USC 401, *et seq*.

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

- Executive Order (EO) 12898 - Environmental Justice

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

- Executive Order (EO) 11988 – Construction in Flood Plains

This 1977 Executive Order directs federal agencies to avoid to the extent possible the long- and short- term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of development in flood plains wherever there is a practicable alternative. Each agency is responsible for evaluating the potential effects of any action it may take in a floodplain.

Before taking an action, the federal agency must determine whether the proposed action will occur in a floodplain. For major federal actions significantly affecting the quality of the human environment, the evaluation will be included in the agency's NEPA compliance document(s). The agency must consider alternatives to avoid adverse effects and incompatible development in flood plains. If the only practicable alternative requires siting in a floodplain, the agency must: (1) design or modify the action to minimize potential harm, and (2) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the floodplain.

The Trustees considered this Executive Order with regard to their proposed actions. Two projects – the shoreline protection system and replacement of the Visitor Center boat dock – were investigated and the Trustees determined that they were not located in a floodplain.

- Defensive Sea Area 33 USC 475; Executive Order (EO) 8143

EO 8143 (May 26, 1939) established the "defensive sea area" which encompasses Pearl Harbor itself and the area immediately outside the entrance channel to the harbor. The Executive Order prohibits any person, other than persons on public vessels of the United States, or any vessels other than public vessels of the United States from entering or navigating within the defensive sea area without authorization of the Secretary of the Navy. Entry control over Pearl Harbor has been

delegated to the Commander, Navy Region Hawaii. Under 33 USC 475, the Secretary of the Navy is directed to adopt rules and regulations governing the navigation, movement and anchorage of vessels in the waters of Pearl Harbor and the entrance channel to the harbor.

5.3 OTHER POTENTIALLY APPLICABLE LAWS AND REGULATIONS

This section lists other laws that potentially affect NRDA restoration activities. The statutes or their implementing regulations may require permits from federal or state permitting authorities.

Archaeological Resources Protection Act. 16 USC 470. *et seq.*
Clean Air Act, 42 USC 7401, *et seq.*
Marine Mammal Protection Act, 16 USC 1361, *et seq.*
Migratory Bird Treaty Act. 16 USC 703. *et seq.*
National Historic Preservation Act, 16 USC 470, *et seq.*
National Park Act of August 19, 1916 (Organic Act), 16 USC 1, *et seq.*
USS *Arizona* Memorial Enabling Legislation (PL 87-201)

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8.0 BUDGET

8.0 BUDGET SUMMARY

The Trustees and Chevron reached a settlement in principle in 1998. The Federal District Court in Honolulu approved the settlement September 9, 1999.

Under the terms of the settlement, Chevron will:

- Design and construct riprap repair to the USS *Arizona* Memorial Visitor Center shoreline in a project valued at $1,000,000.00.
- Pay $550,000.00 to address lost visitor services at the USS *Arizona* Memorial. Three percent of this amount (*i.e.*, $16,500.00) will be paid to the U.S. Department of Justice Working Capital Fund pursuant to Section 108 of the Department of Justice Appropriations Act of 1994, Public Law No. 103-121. The remainder (*i.e.*, $533,500.00) will partially reimburse the NPS for the design, removal and replacement of the shoreside dock at the Visitor Center, a preferred alternative to address the lost visitor services.
- Pay $1,000,000.00 to implement the preferred projects to address the biological injuries: mangrove removal and associated projects at the Waiawa Unit of the Pearl Harbor National Wildlife Refuge and enhancement and maintenance endowment of Pouhala Marsh.

Final costs and allocation of available funds for restoration projects will depend on finalization and approval of associated design documents.

APPENDICES

APPENDICES

A.1 PUBLIC COMMENTS AND TRUSTEES' RESPONSES TO PUBLIC COMMENTS

A.1.1 Public Comments

Author: <mcbrown@iquest.net > at ~internet
Date: 5/13/99 3:22 PM
Priority: Normal
TO: Chip Demarest at ~IOSPEP
Subject: USS Arizona
---------- Message Contents ----------

Aloha.

My name is David Brown.

I'm from Indianapolis, Indiana.

I recently was able to visit the USS Arizona memorial.

My wife and I wondered about the oil in the harbor and around the memorial. Was it really bubbling up from a ship that was sunk nearly 60 years ago?

I looked on the web and found the OEPC report on the Draft Restoration Plan and Environmental Assessment for the May 14, 1996, Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii.

I was wondering if the oil was a result of that spill and if so, I am happy to see that a restoration plan was in place.

If not, and the oil really is coming from the USS Arizona, why has there never been an effort to get that cleaned up as well?

Any information that you can provide us would be greatly appreciated.

Mahalo,

David (Mc) Brown
mcbrown@iquest.net
http://www.iquest.net/~mcbrown

Public Comment Mail-in Form

This form offers a convenient way for you to provide comments regarding the Draft Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill. Write your comments and either place this form in the comment box or mail to the below address by May 21, 1999. The comment period will close on June 1, 1999.

To: Regional Environmental Officer, Office of Environmental Policy and Compliance, Department of the Interior, 600 Harrison Street, Suite 515, San Francisco, CA 94107-1376

Subject: Draft Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill

I'm in support of the restoration Plan and EA

Signed: Dawn Stovall **Date:** 5/17/99

Name and address (please print):

66-570 Kamehameha Hwy

Haleiwa HI 96712

Public Comment Mail-in Form

MAY 21 1999

This form offers a convenient way for you to provide comments regarding the Draft Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill. Write your comments and either place this form in the comment box or mail to the below address by May 21, 1999. The comment period will close on June 1, 1999.

To: Regional Environmental Officer, Office of Environmental Policy and Compliance, Department of the Interior, 600 Harrison Street, Suite 515, San Francisco, CA 94107-1376

Subject: Draft Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill

Mahalo for your directives on behalf of Pearl Harbor. Please read the attached statement.

Aloha!

Signed: Joseph J. Cherniskey **Date:** May 19, 1999

Name and address (please print):

JOSEPH J. CHERNISKEY, UH. LEEWARD COMMUNITY COLLEGE, PEARL HARBOR 21, 96-045 ALA IKE STR. PEARL CITY, HI 96782

UNIVERSITY OF HAWAI'I

LEEWARD COMMUNITY COLLEGE

PEARL HARBOR 21 SERVICE LEADERSHIP PROGRAM

PUBLIC COMMENT

TO: Regional Environmental Officer
Office of Environmental Policy and Compliance

FROM: Assistant Professor Joe Chernisky
Pearl Harbor 21 Program Coordinator

RE: Comments on 4.4.4. and 4.5.5. Non-Preferred Alternatives

Aloha! I would like to commend Chevron and the Trustees for the progress being made in the Draft Restoration Plan. However, I request that the Trustees consider adding the following proposed action: Pearl Harbor's 'People Do' Campaign. This project is consistent with Chevron's own corporate environmental ethic and international 'People Do' campaign (Policy 530, Chevron Board of Directors, 1992). The project's description and objectives are as follows:

- To create a broader representation of community participation (non-profits, schools, military personnel, veteran groups, Chevron employee volunteers) in meeting the evaluation criteria;
- To encourage community stewardship of diverse environmental and educational projects along the Pearl Harbor shoreline (fishpond restoration, clean-ups, mangrove control, Waiau stream projects, water and soil testing, bike path projects);
- To sustain a number of smaller scale environmental and human use benchmarks over a ten year period. These benchmarks are in addition to the proposed three large scale projects. Data and findings from these additional sites would give a broader perspective of the environmental progress of Pearl Harbor.

The Pearl Harbor 'People Do' campaign would utilize Chevron's expertise. Chevron has numerous international and national success stories in Environmental Programs, Land Conservation and Habitat Preservation, Wildlife Protection and Environment Education. Chevron would be expected to contribute monetary resources ($50,000/year awards); human resources (experts, employee volunteers, education program); and technical resources (equipment, supplies, development of a comprehensive environment plan for Pearl). This private-public partnering of Chevron and our diverse communities balances over a sustained period the ecological and human use restoration needs identified in the Draft Restoration Plan. If Chevron's conservation track record is any indication, then I am confident that the Trustees will identify this project's overall environmental and human impacts as positively benefiting Pearl Harbor, its communities and Chevron-Hawai'i. Mahalo.

The Moon Whose Nine THE PEARL OF GREAT PRICE

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Chevron

People Do.

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Chevron
Hawaii Refinery
91-480 Malakole Street
Kapolei, HI 96707

Tom J. Simons
Resource Superintendent
(808) 682-2213

6/1/99

VIA FACSIMILE (415) 744-4121
AND MAIL

Regional Environmental Officer
Office of Environmental Policy and Compliance
U.S. Department of the Interior
600 Harrison Street, Suite 515
San Francisco, California 94107-1376

Re: Draft Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii

Dear Sir or Madam:

Chevron Products Company appreciates the opportunity to comment on the captioned Draft Restoration Plan and Environmental Assessment (Draft RP/EA). Chevron supports the compensatory restoration projects proposed by the Trustees in the Draft RP/EA. Chevron agrees that the preferred projects will enhance wetlands and wetland services, open vegetated shoreline areas and improve visitor services at the USS Arizona Memorial.

Thank you for your consideration of our views in the restoration planning process.

Very truly yours

Tom Simons
Resource Superintendent

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

Chevron Oil Spill
JA/G

Scott W.H. Seu, P.E.
Manager
Environmental Department

June 1, 1999

RECEIVED
JUN - 3 1999
BY:

Ms. Patricia Port
Regional Environmental Officer
Office of Environmental Policy and Compliance
Department of the Interior
600 Harrison Street, Suite 515
San Francisco, CA 94107-1376

Dear Ms. Port:

Re: **Comments on Draft Restoration Plan and Environmental Assessment of May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii**

Our primary comment concerns the restoration plan for the Waiau Stream and wetland areas nearby our Waiau Power Plant. It is our understanding that the NRDA trustees have determined that the Chevron oil remaining in the Waiau Stream and wetland areas will be allowed to biodegrade in place for the next 20 years. If this restoration approach is followed, we would like to bring to your attention that the oil from the Chevron release may be disturbed, as HECO conducts various operations in the area such as for vegetation and flood control management. In this event, we expect that Chevron will take appropriate action to deal with the disturbed Chevron oil. Although we have had preliminary discussions with Chevron about treatment of the oil left in the Waiau area, we have not reached any resolution of this issue. We hope to do so in the near future.

Our secondary comment regarding the draft restoration plan/EA is with regard to clarifying in the report that the oil release was not due to HECO operations at the Waiau Power Plant. In particular, we note the following areas for clarification:

- Page 1, Section 1.2, first paragraph, second sentence. Please state that the product transfer that resulted in the Chevron oil spill was not a transfer to the Waiau Power Plant.

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- Page 21, Section 3.1.3, last bullet in middle of page, last two words. Prior to "oil spill," insert "Chevron" such that it reads: "location of the Chevron oil spill." This is due to mention of the HECO power plant, which was not the source of the oil spill.

- Page 37, Section 3.2.3.2, last paragraph, third sentence. This sentence might mistakenly be read that the HECO power plant was the source of the release. We request it be changed to read: "Sorbent pad sampling near the release site adjacent to the Waiau Power Plant...."

- Page 40, Section 3.2.4, first paragraph, first sentence, and second paragraph first sentence. Please refer to the spill as the "Chevron oil spill" to clarify that the source of the spill was not the HECO power plant.

- Page 16, Section 2.5.2, second paragraph, last sentence. Please clarify that the bicycle/jogging path does not pass through HECO's Waiau Power Plant. Rather, the Navy Right-of-Way is federal land and bisects HECO's property.

We thank you for this opportunity to comment.

Sincerely,

A.1.2 Trustees' Responses to Public Comments

The Trustees' responses to the five written public comments appear below (in chronological order of receipt).

- To the email from David Brown, Indianapolis, Indiana, dated May 13, 1999 (1 page), the Trustees respond:

  The oil that you recently observed from the USS *Arizona* Memorial was not a result of the May 14, 1996, Chevron pipeline oil spill but more likely oil leaking slowly out of the USS *Arizona*. When the USS *Arizona* was attacked on December 7, 1941, she had approximately 1.5 million gallons of oil onboard. In the attack, the ship exploded from bombs and burned for three and a half days. At least two of the onboard oil bunkers were penetrated in the explosion and the fuel was released into Pearl Harbor in 1941 and/or burned off by the fire. The ship has continued to leak very small amounts of oil since 1941. No one knows how much oil is still on board the ship.

  In 1998, the NPS began an oil monitoring program. Measurements of the amount of oil released from the ship are taken on a quarterly basis. The current baseline is that approximately 20 to 50 gallons per year are released by the ship. The oil is released very slowly and volatilizes in contact with air usually in a matter of a few minutes depending on weather and tide conditions.

  The NPS has developed a partnership with two University of Nebraska researchers to assess the stability of the metal on the USS *Arizona* and to determine rates of corrosion. Also, the NPS monitors the ship on a monthly basis for overall condition. The NPS is currently exploring today's technology to determine potential alternatives for managing the ship's remaining oil.

  The Navy and the NPS have developed a Contingency Plan for Pearl Harbor to be activated in the case of a large oil spill from the USS *Arizona*. The Contingency Plan anticipates the protection of the resources of the Harbor while containing the oil in the area of the USS *Arizona* Memorial. Mock oil spills have been conducted to test the planning actions and have been considered successful.

- To the "Public Comment Mail-In Form" from Donna Stovall, Haleiwa, Hawaii, dated May 17, 1999 (1 page), the Trustees respond:

  The Trustees acknowledge this commenter's support of the Draft RP/EA.

- To the "Public Comment Mail-In Form" and letter plus attachment from Joseph J. Chernisky, Assistant Professor, University of Hawaii, Leeward Community College, Pearl City, Hawaii, dated May 19, 1999 (3 pages), the Trustees respond:

  This commenter suggested adding a "People Do" Campaign to Section 4.4.4 Non-Preferred Alternatives and to Section 4.5.5 Non-Preferred Alternatives. The Trustees have determined to proceed with the proposed preferred alternative projects so there would be no practical consequence to adding the suggested "People Do" Campaign as a non-preferred project.

Moreover, the information provided as to the "People Do" Campaign is not specific as to how resources that were injured would be restored. From the information submitted by this commenter, it appears that the preferred alternative projects are consistent with the objectives of the "People Do" Campaign. In fact, Chevron has endorsed the preferred alternative projects. Given the commitment of the participating State and federal agencies to these preferred alternative projects, they have the highest probability for successful implementation.

- To the letter from Tom Simons, Resource Superintendent, Chevron Hawaiian Refinery, Kapolei, Hawaii, dated June 1, 1999 (1 page), the Trustees respond:

  The Trustees acknowledge this commenter's support, on behalf of Chevron Products Company, for the compensatory restoration projects proposed in the Draft RP/EA.

- To the letter from Scott W.H. Seu, P.E., Manager, Environmental Department, Hawaiian Electric Company, Inc., Honolulu, Hawaii, dated June 1, 1999 (2 pages), the Trustees respond:

  This commenter provided (self-identified) "primary" and "secondary" comments on the Draft RP/EA. The "primary comment" was "to bring to your attention that the oil from the Chevron release [remaining in Waiau Stream and the freshwater marsh] may be disturbed, as HECO conducts various operations in the area such as for vegetation and flood control management." During the restoration planning phase, the trustees were aware of HECO's vegetation and flood control management operations in the freshwater marsh. In part because of these anticipated future disturbances of the freshwater marsh habitat for maintenance operations by HECO, the Trustees proposed natural recovery as primary restoration for the freshwater marsh area and factored this decision into determining interim lost ecological services and in scaling compensatory restoration actions elsewhere around Pearl Harbor. The proposed preferred alternative restoration projects are intended to fully compensate the public for interim lost services resulting form leaving the residual oil in place and relying on natural recovery.

  The Trustees understand that HECO and Chevron continue to discuss possible methods to avoid the re-release of Chevron oil by HECO maintenance operations and encourage those efforts. However, the Trustees believe that it is important to begin restoration of the resources at the other locations rather than to await the outcome of these discussions.

  This commenter provided five "secondary comments" (listed as bullet items) which the Trustees address individually below. In response to the first bullet, the Trustees added the following sentence at the end of paragraph two in Section 1.2, as suggested: "The oil product transfer that resulted in the oil spill was not a transfer to the Waiau Power Plant (Seu 1999)."

  In response to the second bullet, the Trustees believe that the source of the oil spill is explicitly and sufficiently explained and described in Section 1.2 as being a Chevron Products Company pipeline and not the HECO power plant.

  In response to the third bullet, the Trustees amended the third sentence in paragraph two in Section 3.2.3.2, as suggested, as follows: "Sorbent pad sampling near the release site adjacent to the Waiau Power Plant did not find visible amounts of oil on sediments in this location (USCG 1996, Naughton pers. comm., Chevron 1996)."

In response to the fourth bullet, the Trustees believe that the responsible party and source of this oil spill is explicitly and sufficiently identified in Section 1.2 as being a Chevron Products Company pipeline and not the HECO power plant. The last sentence in paragraph seven in Section 1.2 states: "Chevron is the responsible party for this Incident and has acknowledged its liability (Chevron 1996, Pai 1996)."

In response to the fifth and last bullet, the Trustees amended the end of paragraph two in Section 2.5.2, as suggested, as follows: "This bicycle/jogging path is heavily used by joggers, walkers, skaters, and bicyclists. This path bisects HECO property at the Waiau Power Plant along a Navy right-of-way and passes within several feet of the location of the pipeline breach next to Waiau Stream."

A.2 PUBLIC MEETING

A.2.1 Attendee's Sign-In Forms

PUBLIC MEETING
DRAFT RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR CHEVRON OIL SPILL
MAY 17, 1999

NAME	ADDRESS	ORGANIZATION	PHONE
Gary Gill	Kinau Hale	DOH State of HI	586-4424
Tony Wiest	433 Ala Moana Blvd Honolulu HI 96819	USCG Marine Safety Office	522-8280
Joe Chernisky	UH-LCC	UH-LCC	455-0625
Faith Caplan	Damest Moore → 615 Piikoi St. H/H 96814	Damest Moore	593-1197
Keith Kawaoka	911 Ala Moana Blvd/Hon 96814	DOH HEER	586-4249
Linda Jameson	1170 Auahi	KHON	591426-1
Dave Carlin	KGMB-9		973-9889

PUBLIC MEETING
DRAFT RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR CHEVRON OIL SPILL
MAY 17, 1999

NAME	ADDRESS	ORGANIZATION	PHONE
DAVID LEGNARD	P.O. BOX 3526 SEATTLE WA 98115 98111	TESORO	547-3688
GAIL SIANI	7600 SAND POINT WAY NE	NOAA, GENERAL COUNSEL	206-526-4566

PUBLIC MEETING
DRAFT RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR CHEVRON OIL SPILL
MAY 17, 1999

NAME	ADDRESS	ORGANIZATION	PHONE
Lisa Munger	PO Box 3196 Hnl 96801	Goodsill Anderson	547-5600
ROBIN BOND	7289 Ninini PL	C&C PARKS	395-4242
KAREN EVANS	P.O. Box 17308 Honolulu, HI 96817	Ducks Unlimited.	848-4173
Susan Li	PO Box 2750 Hon. HI 96840	Hawaiian Electric	543-4791
James Abbott	591 K Kolu	"	262 3385
Jeff Juliano	733 Bishop St. #2400	ROP	544-8603
Charles O'Neil	"	"	"
Brad Dougherty	"	"	"
FAIRON PAVOLINI	91-480 MALAKOLE ST. KAPOLEI, HI 96707	CHEVRON	682-2376
Donna Stovall	66-590 Kam Hwy Haleiwa, HI 96712	USFWS	637-6330
CHRIS JANSEN	P.O. Box 3379 Honolulu 96842	TESORO	5473242
Bruce Schlieman	770 Kapiolani Blvd Suite 405 Honolulu 96813	HEG	543-4474
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PUBLIC MEETING
DRAFT RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR CHEVRON OIL SPILL
MAY 17, 1999

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DRAFT RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT SPEAKER SIGN-IN FORM

If you wish to speak tonight, please PRINT your name and, if applicable, the affiliation or agency you represent and turn this form in. Speakers will be called in the order that forms are received.

Karla Evans

Name of Speaker

Ducks Unlimited, Inc.

Affiliation/Agency

The speaker, Karen Evans of Ducks Unlimited, briefed the Trustees on the participation of her organization in the Pouhala Marsh restoration project. Ducks Unlimited, Inc., the State of Hawaii, the U.S. Fish and Wildlife Service, and the City and County of Honolulu have been working toward restoring the marsh for several years. The speaker encouraged the Trustees to proceed with the restoration of the eight acres of degraded marsh and welcomed their participation in the maintenance of the marsh.

A.3 ACRONYMS

bbls	barrels (42 gallons/barrel)
°C	Centigrade
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Chevron	Chevron Products Company
CWA	Clean Water Act
DLNR	Department of Land and Natural Resources, State of Hawaii
DOD	U.S. Department of Defense
DOH	Department of Health, State of Hawaii
DOI	U.S. Department of the Interior
Draft RP/EA	Draft Restoration Plan and Environmental Assessment
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FPN	Federal Project Number
GIS	Geographic Information System
HEA	Habitat Equivalency Analysis
HECO	Hawaiian Electric Company
HST	Hawaiian Standard Time
LAT	Lead Administrative Trustee
m, m^2	meters, square meters
m/sec	meters per second
MOA	Memorandum of Agreement
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NMFS	National Marine Fisheries Service
nm	nanometers
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NPS	National Park Service
NRDA	Natural Resource Damage Assessment
OEPC	Office of Environmental Policy and Compliance (DOI)
OPA	Oil Pollution Act of 1990
ppb	parts per billion
ppT	parts per thousand
psi	pounds per square inch

PVC	polyvinyl chloride
Refuge	Pearl Harbor National Wildlife Refuge
RIMPAC	Rim of the Pacific
RP/EA	Restoration Plan and Environmental Assessment
SCAT	Shoreline Cleanup Assessment Team
SHPO	State Historic Preservation Office
SUP	Special Use Permit
TPH	total petroleum hydrocarbons
UCSC	University of California at Santa Cruz
USC	United States Code
USCG	U.S. Coast Guard
USDOD	U.S. Department of Defense
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Department of the Navy
Visitor Center	USS *Arizona* Memorial Visitor Center
WAFs	water-accommodated fractions
μg	micrograms
μl	microliters

A.4 CHRONOLOGY OF OIL SPILL RESPONSE ACTIONS

The following chronology of oil spill response actions was excerpted from U.S. Coast Guard Pollution Reports (called "polreps") prepared by the Marine Safety Office in Honolulu. Information contained in these polreps augments other information developed demonstrating the spatial and temporal extent of the spilled oil in Waiau Stream and Pearl Harbor. Reference citations are provided at the end of the chronology.

May 14:
- release of No. 6 fuel oil from pipeline discovered;
- major pockets of black oil observed from Waiau Bank south to Ford Island extending east to Hotel Piers and mouth of Aiea Bay;
- Notice of Federal Interest issued to Chevron;
- Letter of Designation delivered to Chevron (USCG 1996a).

May 15:
- 700 bbls. of oily water recovered;
- skimming operations commenced by *Hawaii Responder*, *Clean Islands* and Navy skimmers;
- 7 vacuum trucks operating in vicinity of Power Plant;
- *Arizona* and *Utah* Memorials boomed off;
- deflection booms deployed in vicinity of Bishop Point and in South Channel;
- HECO Power Plant intakes boomed off;
- Aiea Bay sensitive area and Halawa Stream boomed off;
- water intakes for National Wildlife Refuge secured (USCG 1996b).

May 16:
- Chevron accepts responsibility and continues to conduct cleanup operations,
- *Arizona* Memorial remains closed;
- cleanup assets being applied include: *Hawaii Responder*, *Clean Islands*, CGC *Mallow*, 9 vacuum trucks and approximately 240 response personnel,
- oil leaked through boom at Waimalu Stream;
- source of new oil into Harbor appears to be oil on bottom of Waiau pond;
- cleanup efforts heavily focused on Halawa Stream and *Arizona* Memorial Visitor Center (USCG 1996c);
- approximately 6,000 bbls. oil/water mixture recovered to date (USCG 1996d).

May 17:
- *Arizona* Memorial remains closed;
- shoreline cleanup operations continue from discharge site at Waiau Stream to Pearl Harbor Dry Dock area;
- cleanup activities continue at *Arizona* Memorial Visitor Center using 7 skiffs, 1 vacuum truck and 25 personnel;
- cleanup activities at spill source at Waiau Stream continue with 7 vacuum trucks and 30 personnel;
- cleanup of oiled piers at Pearl Harbor Naval Shipyard continues with skimmers, 2 vacuum trucks, 8 boats and 70 Navy personnel;
- cleanup of Ford Island shoreline continues with 3 boats, 1 marco barge and 25 personnel;
- decontamination of Navy vessels begins;
- no free-floating oil reported during overflight however sheening from oiled piers continues (USCG 1996e);
- small pockets of oil reported around mangroves and on beach areas on Waipio Peninsula shoreline (USCG 1996f).

May 18:
- *Arizona* Memorial re-opens (USCG 1996g).

May 19:
- cleanup operations at *Arizona* Memorial continue using pressure washers, sorbents, 4 skiffs and 50 personnel;
- cleanup operations of oiled piers at Pearl Harbor Naval Station continues using 1 skimmer, 2 vacuum trucks, 11 boats and 76 personnel;
- cleanup of Ford Island shoreline continues using 2 work boats, 3 skiffs, 1 crane truck and 70 personnel;
- buried oil and asphalt pavement discovered on Waipio Peninsula shoreline (USCG 1996g).

May 20:
- cleanup operations at *Arizona* Memorial Visitor Center continue using pressure washers, sorbents, 7 skiffs without motors and 50 personnel;
- Unified Command stands down (USCG 1996h).
- Kona (southerly) winds mobilized previously trapped oil from under Navy Piers;
- some re-oiling of *Arizona* Memorial Visitor Center;
- CGC *Mallow* recovered 337 bbls. of oily water (USCG 1996j).

May 21:
- cleanup operations at spill source at Waiau Stream continues using sorbents, 6 vacuum trucks, 3 tank trucks, 80-ton crane, marco barge, 1 whaler, 1 skiff, 1 pontoon boat, 4 pressure washers and 55 personnel;
- cleanup operations at *Arizona* Memorial Visitor Center continue using pressure washers, sorbents, 7 skiffs without motors and 53 personnel;
- cleanup operations on Ford Island shoreline continue using sorbents, 1 boom truck, 1 dump truck, 1 rolloff truck, 1 whaler, 4 boats and 95 personnel;
- cleanup operations on Waipio Peninsula shoreline continues using sorbents, 1 boat and 33 personnel (USCG 1996i).

May 23:
- divers located submerged oil within labyrinth of supply/discharge tunnels under Waiau Power Plant (USCG 1996j).

May 26:
- submerged oil recovery operations continue at Power Plant (USCG 1996j).

May 28:
- shoreline cleanup continues;
- 17,000 gallons of oil recovered from Waiau Stream since 14 May;
- Chevron accepted designation of source and started advertising in Tuesday, Thursday and Sunday editions of the *Honolulu Advertiser* (USCG 1996j).

June 4:
- minor shoreline cleanup continues at Ford Island, Waipio Peninsula and new Navy Piers on Pearl City Peninsula;
- passive cleanup of specific areas may continue for some weeks;
- discussions continue between Navy, contractors and Chevron regarding damages, liability and delay/disruption of three Navy construction sites;
- some crayfish and frogs oiled and killed in Waiau Stream;
- one bird reported to be oiled;
- active cleanup complete at *Arizona* Memorial Visitor Center however some continued sheening with ebb tides;
- crews continue to clean/high-pressure wash piling/faces of Bravo, Hotel, Kilo and Yankee Piers at Pearl Harbor Naval Station;
- Waipio Peninsula shoreline continues to be lightly re-oiled during some tide cycles;
- oiling on rock/gravel foundation of new Ford Island Bridge impacting this Navy construction project;

- ongoing cleanup operations to wash an 18-inch to 24-inch oily band from 1,200 pilings under the Hotel Pier renovation because pilings must be completely oil-free prior to application of new concrete epoxy;
- Ongoing cleanup of oil stains on pier and oil trapped in riprap at New Pier (Victor Dock) on Pearl City Peninsula (USCG 1996j).

June 5:
- preliminary surveys indicate oil is migrating from Waiau Marsh and represents possible source of recontamination of Power Plant intakes (USCG 1996k).

June 7:
- high pressure washing of impacted piers at Naval Station suspended (USCG 1996k).

June 10:
- additional subsurface oil discovered in freshwater marshland adjacent to pipeline rupture;
- minor shoreline cleanup continues at Ford Island, Waipio Peninsula and new Navy Piers on Pearl City Peninsula;
- four transects (10 - 25 feet) cut into Waiau Marsh encountered heavy oil in two locations;
- some sheening with ebb tides at *Arizona* Memorial Visitor Center;
- pom-poms and snares in place to work passively with tide along north shoreline of Ford Island;
- Waipio Peninsula shoreline continues to be lightly re-oiled during some tide cycles;
- cleanup on-going of stains on pier and oil trapped in riprap at New Pier (Victor Dock) on Pearl City Peninsula (USCG 1996k).

June 17:
- minor shoreline cleanup continues at Ford Island, Waipio Peninsula and new Navy piers on Pearl City Peninsula;
- unknown amount of subsurface oil remains in marsh adjacent to Waiau Stream;
- some sheening with ebb tides at *Arizona* Memorial Visitor Center;
- tidal action continues mobilizing some sheen on Ford Island
- Waipio Peninsula shoreline continues to be lightly re-oiled during some tide cycles (USCG 1996l).

July 16:
- intend to keep several containment, collection and recovery sites in place until subsurface oil is removed from marsh adjacent to Waiau Stream (USCG 1996m).

July 22:
- passive cleanup at Ford Island continues (USCG 1996m).

Sept. 21:
- Chevron and HECO negotiating written agreement on final actions in marshland adjacent to pipeline rupture (USCG 1996n).

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A.5 HABITAT EQUIVALENCY ANALYSES[1]

A.5.1 Conceptual Background

The fundamental concept behind HEA is that compensation for injured natural resources can be provided by restoration projects that provide comparable natural resource services (*i.e.*, through compensatory restoration). The criterion that rationalizes this concept is that Responsible Parties must pay for (or implement) compensatory restoration projects that are sufficient to provide replacement services which are equal in value to the lost services. Compensation is determined in three steps under this criterion. First, the value of the lost services is assessed. Second, appropriate compensatory restoration projects are selected. The purpose of this step is to identify projects that are capable of providing comparable replacement services to the relevant population. The final step is to scale the selected projects so that they will provide replacement services which are equal in value to the lost services. This last step potentially involves estimating the value of the replacement services provided by projects of different size and scope.

Obviously, this process relies heavily on economic valuation. Both the natural resource injury and the restoration project intended to compensate for that loss must be valued to ensure that the public is fully compensated. Hence, in relatively small injury cases, Trustees may be unable to assess natural resource damages in this manner within the constraint of reasonable cost. However, HEA, as a specific application of this criterion, requires little, if any, explicit economic valuation.

In HEA, compensatory restoration projects are scaled so that the quantity of replacement services they provide equals the quantity of lost services.[2] These services are quantified in physical units of measure such as "acre years."[3] There is no need to value replacement services in monetary terms if they are comparable to the lost services.[4] Therefore, to satisfy the compensation criterion, Trustees must determine whether compensatory restoration projects can provide services that are comparable to the lost services.

The ability to avoid economic valuation makes HEA a very appealing assessment tool, especially for small injury cases. However, the following cautions qualify the valid application of the methodology:

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[1] This material has been summarized for this RP/EA by Bruce Peacock, National Park Service, Washington, D.C.

[2] Services provided in the future are discounted at an appropriate rate of discount to reflect time preference considerations.

[3] An acre year refers to all the natural resource services provided by one acre of habitat for one year. This measure of natural resource services is specific to habitat since different habitats provide different services.

[4] This condition is satisfied if 1) the unit economic values of the replacement services are comparable to those of the lost services, 2) these unit economic values are invariant with respect to the scale of compensatory restoration projects, and 3) these unit economic values are invariant with respect to time (except for adjustments for inflation and time preference).

- Before the scale of compensatory restoration can be determined, Trustees must select primary restoration projects that return the injured natural resources to their baseline conditions, or determine that such restoration projects are infeasible or otherwise inappropriate. This is because the total quantity of lost services depends, in part, on how fast injured natural resources are returned to their baseline conditions.
- The replacement services provided by compensatory restoration projects must be comparable to the lost services. HEA cannot account for significant differences in economic values that occur between different types of services.
- In general, HEA should be used in situations involving primarily the loss of ecological services with relatively little or no loss of direct human use. HEA cannot account for the reductions in marginal values that occur as people become satiated with increasingly larger compensatory restoration projects or as congestion increases.

Assuming that these cautions are heeded, HEA implicitly balances the lost economic values forgone by the public through time with additional economic values provided in the future. These values must be adjusted for differences in time to comport with observed differences in the public's perception of value through time. This adjustment process, known as discounting, permits one to examine values occurring at different times on a comparable basis. The discount rate used in this process is a key input to HEA and should be chosen carefully.

A.5.2 Implementation

The first step in HEA is to quantitatively characterize lost ecological services such as nutrient cycling, water quality improvement, and the provision of food and refuge for wildlife. At each point in time, lost services are characterized as a proportional reduction below baseline, where baseline characterizes the natural resource conditions absent the injury. Objective biological indices, such as Habitat Suitability Indices, or best professional judgment can be used to determine proportional reductions below baseline. These proportional reductions are then applied to the affected habitat area and aggregated over time to obtain the total quantity of lost services (*e.g.*, acre years). The total discounted quantity of lost services can be viewed as the "debit" created by the natural resource injury.

The second step in HEA is to quantitatively characterize the replacement services provided by the selected compensatory restoration project. At each point in time, replacement services are characterized as a proportional equivalent of baseline called relative productivity. Relative productivity reflects the net ecological services provided by the compensatory restoration project relative to the baseline productivity of the injured habitat. The total present value of relative productivity expressed as a proportion can be interpreted as the total number of discounted acre years of ecological services provided by each acre of restoration.

The third step in HEA is to solve for the project size that will equate the total discounted quantity of replacement services to the total discounted quantity of lost services. This project size is calculated by dividing the total present value of lost services in acre years by the total present value of relative productivity expressed as a proportion. This calculation assures that the compensatory restoration project will provide a "credit" just equal to the total discounted quantity of lost services.

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A.7 TRUSTEE ADOPTION OF RESTORATION PLAN

ADOPTION RESOLUTION

The undersigned, as authorized officials of their respective federal and State natural resource trustee agencies, hereby approve and adopt the "*Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii*" and select the restoration projects described as Preferred Alternatives contained therein.

Department of the Interior

By: _____
Name: John J. Reynolds, Authorized Official
Title: Regional Director, Pacific West Region, National Park Service

Date: 10/27/99, 1999

Concur:

_____
Anne Badgley
Regional Director, Region 1
Fish and Wildlife Service

Approved as to Form:

_____
Charles McKinley
Assistant Field Solicitor
Office of the Solicitor

ADOPTION RESOLUTION

The undersigned, as authorized officials of their respective federal and State natural resource trustee agencies, hereby approve and adopt the "*Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii*" and select the restoration projects described as Preferred Alternatives contained therein.

Department of the Interior

By: _____
Name: John J. Reynolds, Authorized Official
Title: Regional Director, Pacific West Region, National Park Service

Date: _____, 1999

Concur: _____
Anne Badgley
Regional Director, Region 1
Fish and Wildlife Service

Approved as to Form: _____
Charles McKinley
Assistant Field Solicitor
Office of the Solicitor

ADOPTION RESOLUTION

This certifies that the Damage Assessment and Restoration Program Managers, on behalf of the National Oceanic and Atmospheric Administration, approved the "*Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii*" and agreed to the select of the restoration projects described as Preferred Alternatives contained therein. Approval by the Program Managers is pursuant to the Damage Assessment and Restoration Program Board of Directors' delegation decision of July 17, 1996.

By: Katherine A. Pease

Name: Katherine A. Pease

Title: Senior Counselor for Natural Resources
DARP Manager

Date: 22 November 1999

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
517 RUSSELL AVENUE
PEARL HARBOR, HAWAII 96860-5020

IN REPLY REFER TO:

ADOPTION RESOLUTION

The undersigned, as authorized officials of their respective federal and State natural resource trustee agencies, hereby approve and adopt the *"Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii"* and select the restoration projects described as Preferred Alternatives contained therein.

Department of Defense
For the Secretary of the Navy

By: _____
Name: RADM John W. Townes III, USN
Title: Commander, Navy Region Hawaii

Date: 11/24, 1999

State of Hawaii
Department of Land and Natural Resources

By: _____
Name: Timothy E. Johns
Title: Chairman of the Board of
Land and Natural Resources

Date: October 29, 1999

State of Hawaii
Department of Health

By:

Name: Gary Gill

Title: Deputy Director, Department of Health

Date: November 2, 1999

A.8 FINDING OF NO SIGNIFICANT IMPACT

United States Department of the Interior
OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
600 Harrison Street, Suite 515
San Francisco, California 94107-1376

Finding of No Significant Impact

Restoration Plan/Environmental Assessment
for the
May 14, 1996 Chevron Pipeline Oil Spill
into
Waiau Stream and Pearl Harbor, Oahu, Hawaii

The Department of the Interior, Office of Environmental Policy and Compliance, is the lead federal agency for National Environmental Policy Act (NEPA) compliance for the Restoration Plan for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii. The cooperating agencies include the U.S. Fish and Wildlife Service, the National Park Service, the National Oceanic and Atmospheric Administration, the Department of the Navy (through the Commander, Navy Region Hawaii) and the State of Hawaii (through the Department of Health and the Department of Land and Natural Resources).

The Environmental Assessment for this project evaluated ten alternatives, including the "no action" alternative. The public has been afforded two opportunities to review and provide input on the alternatives, including the preferred alternatives. A Public Meeting was held in Honolulu, Hawaii, on May 17, 1999 to present the Draft Restoration Plan/Environmental Assessment to the public. Additionally, the Draft Restoration Plan/Environmental Assessment was made available to the public, for a 51-day open comment period from April 12, 1999 through June 1, 1999, in both hardcopy form and posting on government web pages.

DETERMINATION:

Based upon an environmental review and evaluation of the Environmental Assessment for the Restoration Plan for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii, I have determined that the proposed action does not constitute a major federal action significantly

affecting the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969, as amended. Accordingly, an Environmental Impact Statement is not required for this project.

Patricia Sanderson Port
Regional Environmental Officer
Office of Environmental Policy and Compliance
Department of the Interior

11/10/99
Date

Concurrence:

RADM John W. Townes III, USN
Commander, Navy Region Hawaii
Department of the Navy

11/24/99
Date

FINDING OF NO SIGNIFICANT IMPACT
RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT
FOR THE
MAY 14, 1996 CHEVRON PIPELINE OIL SPILL
INTO WAIAU STREAM AND PEARL HARBOR

The National Oceanic and Atmospheric Administration (NOAA) is a cooperating federal agency for National Environmental Policy Act (NEPA) compliance for the Restoration Plan and Environmental Assessment (RP/EA) for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor. The lead federal agency for NEPA compliance for the RP/EA is the U.S. Department of the Interior (DOI). Other cooperating agencies include the Pearl Harbor Natural Resource Trustees (Trustees) -- the National Park Service (DOI); the U.S. Fish and Wildlife Service (DOI); the Hawaii Department of Health; the Hawaii Department of Land and Natural Resources; and the U.S. Department of Defense, U.S. Department of the Navy, Commander, Naval Base Pearl Harbor, Hawaii. These parties participated in the damage assessment and restoration planning activities resulting from the injuries to natural resources and resource services as a result of the oil spill.

The Trustees evaluated several types of restoration alternatives: the no action/natural recovery alternative, ecological restoration alternatives, and lost human use restoration alternatives. Within those alternatives, several restoration projects were evaluated to determine what projects would best meet the goals and objectives of the Trustees. The Trustees concluded that their preferred restoration alternatives would be a mix of both the ecological and lost human use alternatives. The particular projects are briefly described as: restoration of an eight-acre area of the Pouhala Marsh; removal of red mangroves along the shoreline of the Waiawa Unit, Pearl Harbor National Wildlife Refuge; protection of the shoreline of the USS *Arizona* Memorial Visitor Center; and assisting in the replacement of the shoreside dock area at the USS *Arizona* Memorial Visitor Center. The draft RP/EA was presented to the public, and all public comments were supportive of the Plan and the proposed projects.

DETERMINATION:

Based upon an environmental review and evaluation of the Final Restoration Plan and Environmental Assessment for the May 14, 1996 Chevron Pipeline Oil Spill into Waiau Stream and Pearl Harbor, Oahu, Hawaii, I have determined that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969, as amended. Accordingly, an environmental impact statement is not required for this project.

for

Penelope D. Dalton
Assistant Administrator for Fisheries
National Marine Fisheries Service
National Oceanic and Atmospheric Administration

11/10/95
Date

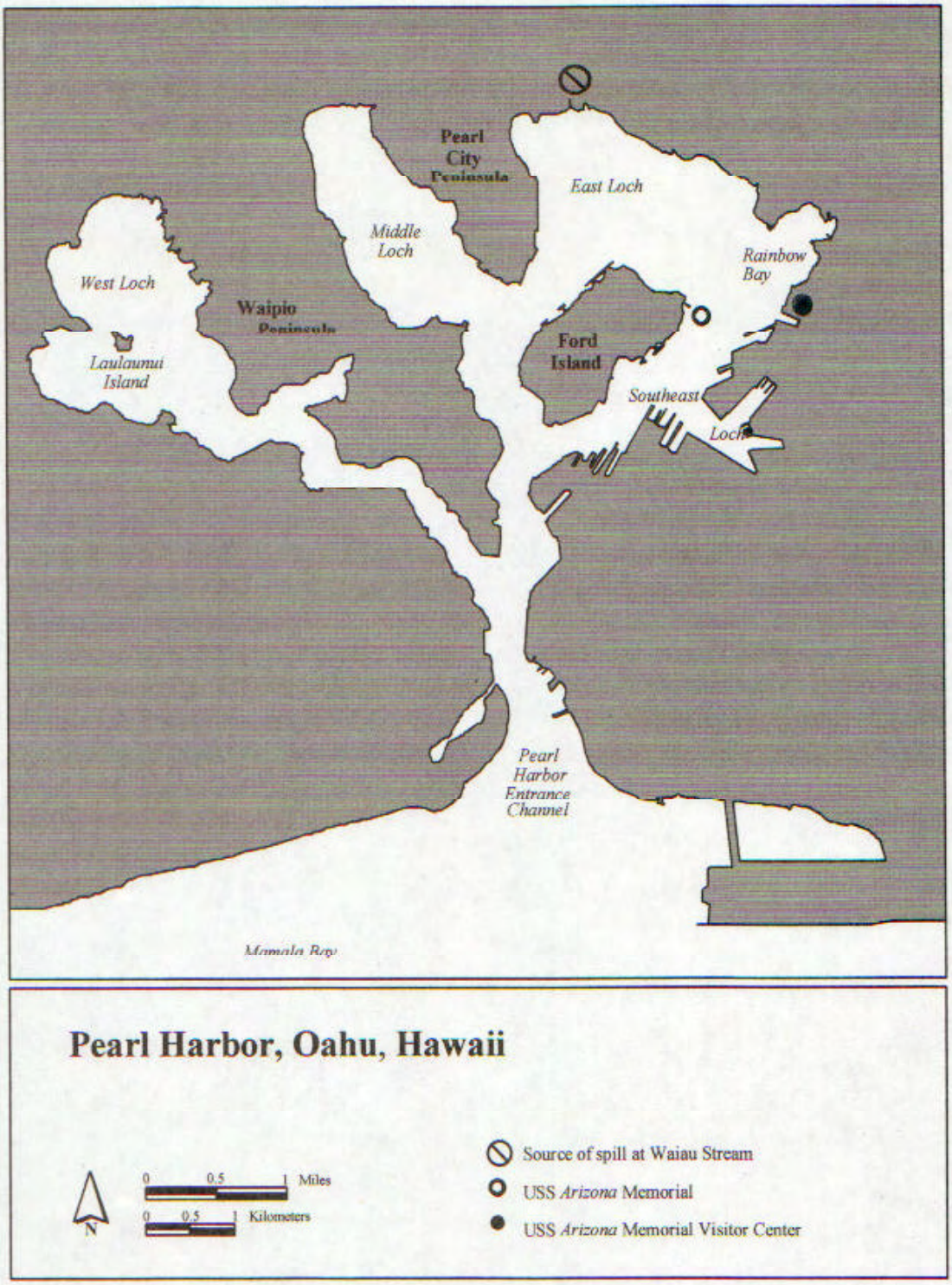

Figure 1. Pearl Harbor, Oahu, Hawaii, showing major land forms and harbor features including the locations of the May 14, 1996 Chevron pipeline oil spill, the USS *Arizona* Memorial and the USS *Arizona* Memorial Visitor Center.

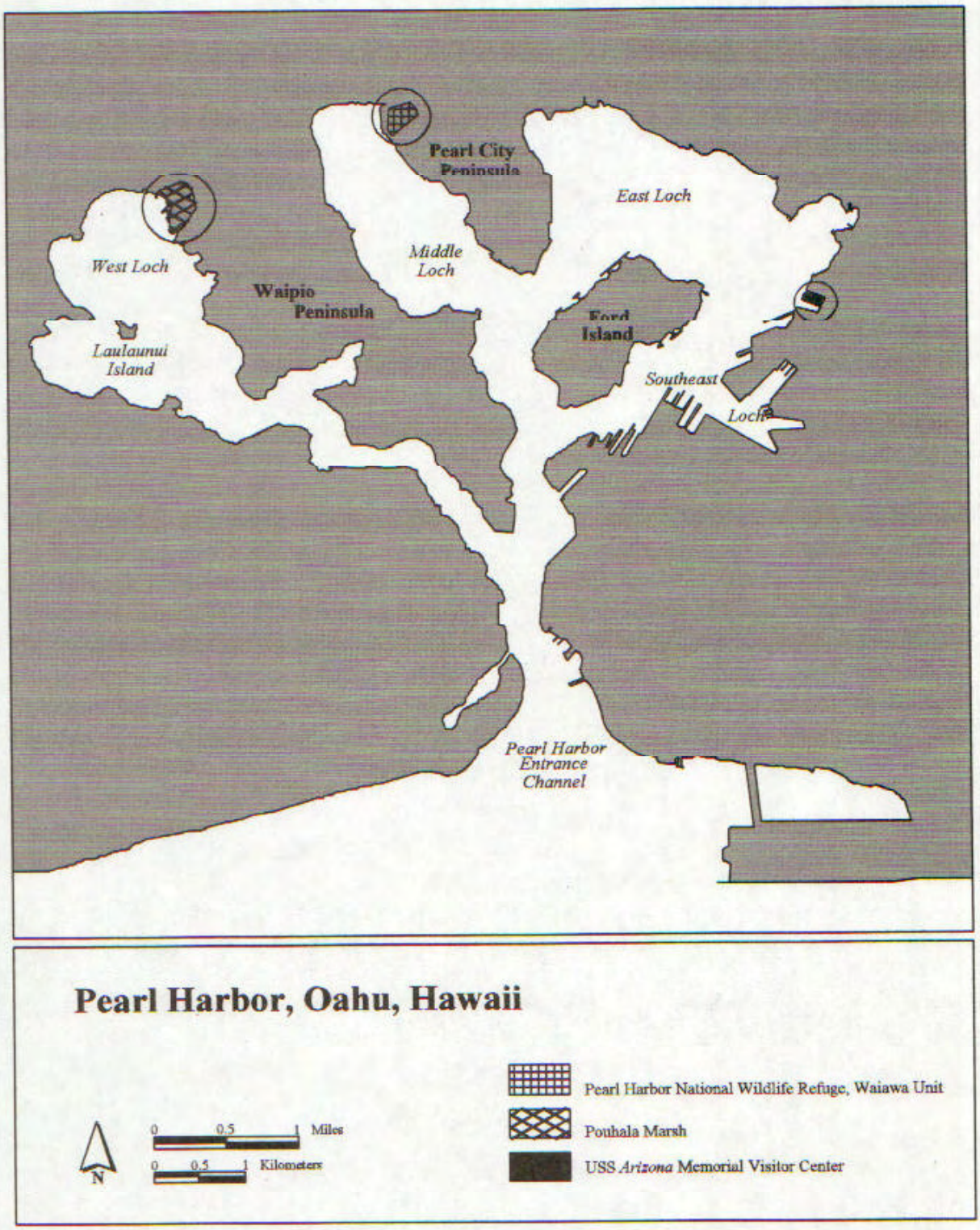

Figure 2. Pearl Harbor, Oahu, Hawaii, showing the locations of proposed natural resource restoration projects at the Waiawa Unit of the Pearl Harbor National Wildlife Refuge, Pouhala Marsh and the USS *Arizona* Memorial Visitor Center

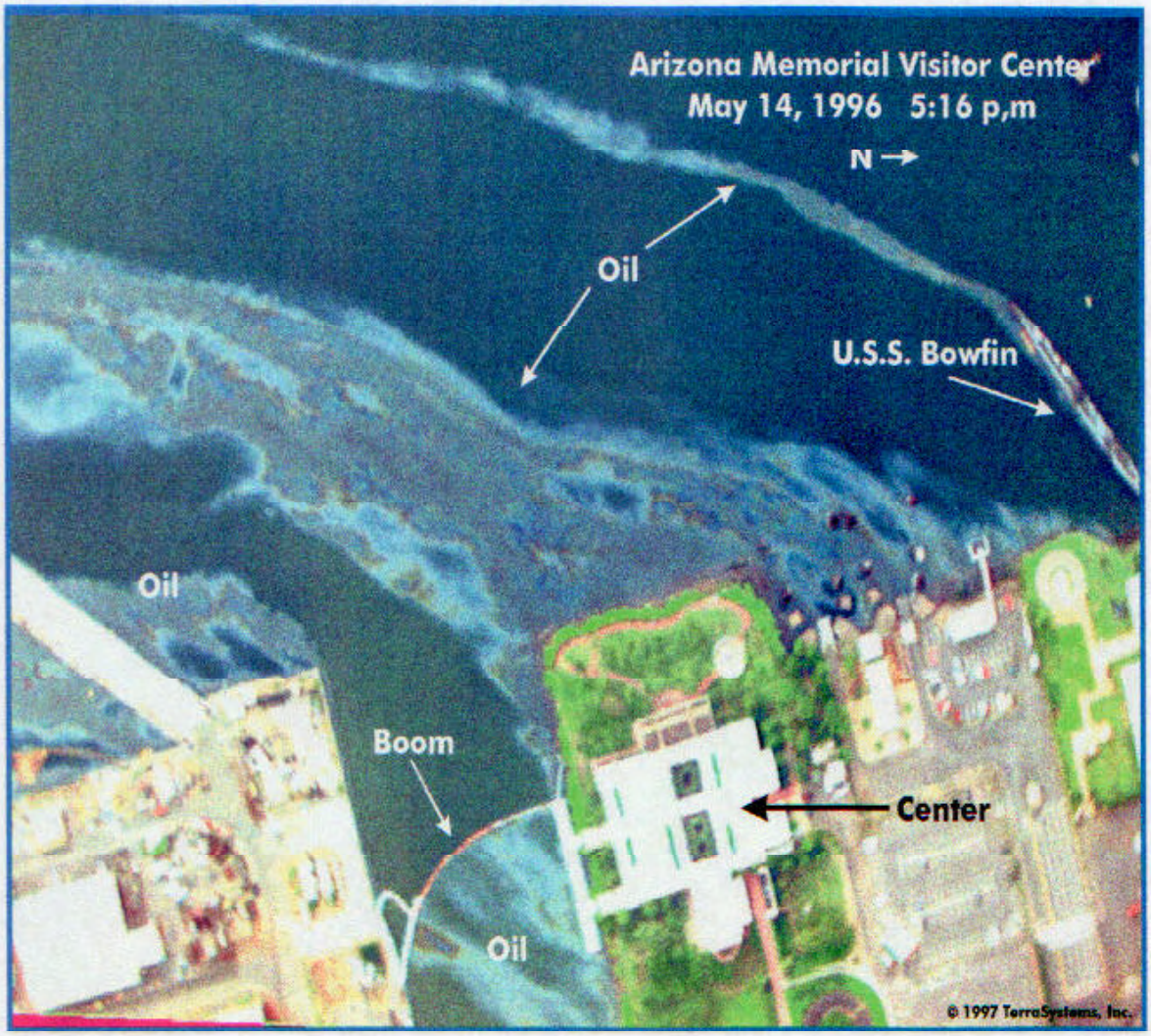

Photo 1. Aerial view of USS *Arizona* Memorial Visitor Center, on the shoreline of East Loch, Pearl Harbor, Oahu, Hawaii on May 14, 1996, 5:16 pm, showing oil on the surface water and shoreline of Pearl Harbor and in the mouth of Halawa Stream (see Section 3.1.3)(Photo courtesy of TerraSystems, Inc.).

Photo 2. Pouhala Marsh, on the shoreline of West Loch, Pearl Harbor, Oahu, Hawaii (see Section 4.4.2)(Photo courtesy of G. Siani, NOAA)

Photo 3. Pearl Harbor National Wildlife Refuge, Waiawa Unit, on the shoreline of Middle Loch, Pearl Harbor, Oahu, Hawaii (see Section 4.4.3)(Photo courtesy of G. Siani, NOAA)

Photo 4. Shoreline of USS *Arizona* Memorial Visitor Center at the mouth of Halawa Stream on East Loch, Pearl Harbor, Oahu, Hawaii, showing oiled shoreline and areas exposed following vegetation removal during the response phase to the Incident (see Section 4.5.2)(Photo courtesy of NPS, Honolulu, HI).

Photo 5. Oblique aerial view of USS *Arizona* Memorial Visitor Center, on the shoreline of East Loch, Pearl Harbor, Oahu, Hawaii, showing the Visitor Center boat dock during the response phase to the Incident (see Section 4.5.3) (Photo courtesy of NPS, Honolulu, HI)