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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).

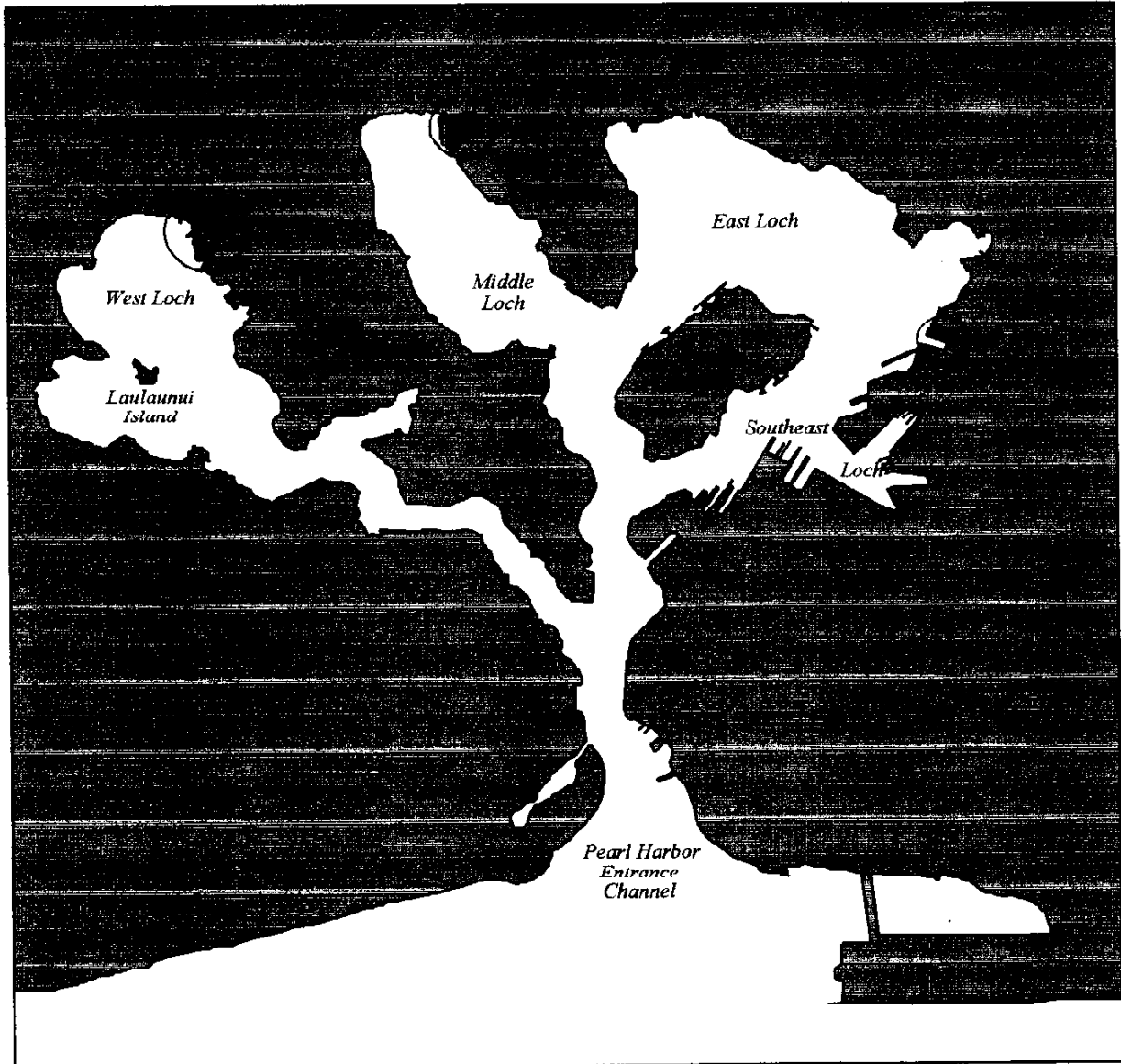
Ducks Unlimited, Inc., the State of Hawaii, the USFWS, and the City and County of Honolulu have joined forces in the hope of restoring Pouhala Marsh. In September of 1998, the State of Hawaii issued a Finding of No Significant Impact (FONSI) for this project. To restore the wetland functions of Pouhala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



Pearl Harbor, Oahu, Hawaii



0 0.5 1 Miles

0 0.5 1 Kilometers



Pearl Harbor National Wildlife Refuge, Waiawa Unit



Pouhala Marsh



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 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 the Trustees 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 and 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 Waiiau 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

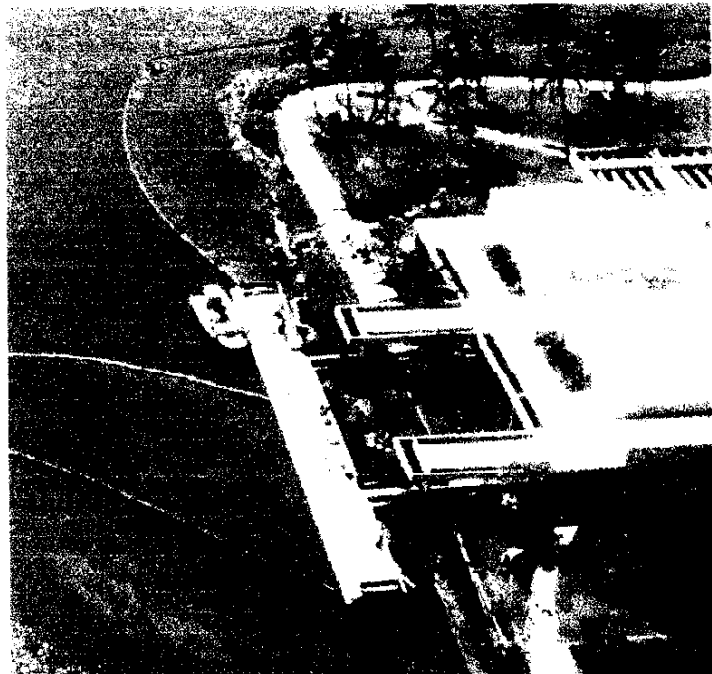
The shoreline protects the property on which the Visitor Center is located. The harbor-facing shoreline has exhibits used by visitors to interpret the historical scene of the December 7, 1941 attack. Due to the eroding condition of the shoreline, exacerbated by the response activities, a shoreline protection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