DAMAGE ASSESSMENT AND RESTORATION PLAN
AND
ENVIRONMENTAL ASSESSMENT

WELLHEAD FAILURE AND RELEASE
DIXON BAY LOUISIANA
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1.0 Introduction [Purpose and Need]

1.1 Description of the Incident

On January 12, 1995 a wellhead on an inactive well (BLDSU #5, West Bay Field), located in Dixon Bay, approximately 10 miles South of Venice, Louisiana, suffered a failure. A leak began on a needle valve, and fluids were released under pressure, extending out 100 feet parallel to the surface of the water. The release was initially discovered at 1000 hours (local) by the crew of a fishing vessel, who reported the release to employees of Vintage Petroleum. The Coast Guard, in turn, was notified by Vintage Petroleum at approximately 1320 hours. The well was later determined to belong to Chevron USA Production Company (hereafter "Chevron"), who accepted responsibility for conducting the cleanup actions.

The well released a mixture of crude oil, natural gas, and produced water (brine that comes up to the surface along with crude oil during production) until the well bridged at approximately 1710 hours on January 13, 1995. The bridging was accomplished when sand that had built up within the well pipe stopped the flow to the surface. The total period of the release exceeded 31 hours. Chevron conducted standard response actions to try to minimize impacts of the release to the environment. However, attempts to contain the oil with boom and recover released product with skimmers were largely unsuccessful due to inclement weather. Oil slicks covered large areas of Dixon Bay (at least 25 square miles) until a series of weather fronts pushed the oil through a marsh bordering the eastern edge of Dixon Bay, and into the Gulf of Mexico via Southwest Pass. As a result of the passage of the fronts, the seas became rough and the shallow sediments in Dixon Bay were exposed to the oil. Additionally, birds were observed to be oiled, and Chevron contracted with the International Bird Rescue Research Center to rehabilitate oiled wildlife. Twenty-three oiled brown pelicans were cleaned and released. During shoreline surveys, Trustees (described in Section 1.3) observed and videotaped a small number of dead, oiled birds. Fewer than 10 total oiled dead birds were documented, and it is not clear that all of these birds died as a result of being oiled, or if some of them had been dead prior to being oiled. Mammal tracks in oiled areas and scavenged oiled bird carcasses indicate that some mammals were exposed to oil, although no carcasses were found.

State and federal natural resource Trustee representatives decided that the potential injuries resulting from the Chevron well blowout were sufficient to pursue a natural resource damage assessment (NRDA), based on observations of resources that were exposed to oil, and knowledge of impacts to these kinds of resources from previous spills. The Trustees invited Chevron to participate in a cooperative assessment of impacts to natural resources and Chevron agreed to participate in this process. The Louisiana Oil

Spill Coordinators Office (LOSCO) was selected as Lead Administrative Trustee for the NRDA.

Early in the NRDA process, Trustees focused assessment efforts on four natural resource categories that were believed to have the greatest potential to be significantly injured as a result of the release. These resource categories were: marsh, birds/wildlife, benthos, and water column. These four types of resources were selected based on observations of exposure to oil, observations of injury, and knowledge of potential effects of oil on these types of resources from previous spills. Due to the remoteness of the area, there was not believed to be significant lost recreational use as a result of the release, and Trustees did not pursue any recreational lost-use claim.

1.2 Affected Environment

Dixon Bay is a shallow bay located to the west of Southwest Pass in the Mississippi River Delta. The deltaic region of Louisiana is experiencing among the highest rate of subsidence and land loss in the United States. Dixon Bay is bordered to the east by a marsh that had been created by a freshwater diversion project, and to the west by the open waters of the Gulf of Mexico. The marsh is very complex, with a number of small cuts and islands. Vegetation is primarily composed of *Phragmites communis*, *Scirpus* sp., *Sagittaria lancifolia*, *Colocasia antiquorum*, *Typha* sp., and *Spartina alterniflora*, which is located on the bayward fringes of the marsh. In front of the marsh there are extensive intertidal and shallow subtidal mudflats, which are heavily utilized by birds as lounging and foraging areas.

The ecosystem is an extremely productive one, as might be expected since it forms a boundary zone between the marine system of the Gulf of Mexico, and the freshwater system of the Mississippi River. Important marine species inhabit the waters of Dixon Bay and its adjacent marsh including shrimp, blue crabs, and redfish. The marsh provides nursery habitat for a number of marine species, and is utilized as nesting areas by several bird species. A large variety of birds, including seabirds such as white and brown pelicans, wading birds, birds of prey, and passerines inhabit the Dixon Bay system. It serves as an important wintering grounds for thousands of waterfowl.

1.3 Natural Resource Trustees and Authorities

Trusteeship authority is designated according to Section 2706(b) of the Oil Pollution Act of 1990 (OPA), and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan. Federal Trustees are designated by the President. and State Trustees by the Governor. State Trustee responsibilities are further described under the Louisiana Oil Spill Prevention and Response Act of 1991 (OSPRA). As Trustees for living and non-

living resources in the marine environment, the National Oceanic and Atmospheric Administration (NOAA) and the State of Louisiana: LOSCO, the Louisiana Department of Wildlife and Fisheries (LDWF), the Louisiana Department of Environmental Quality (LDEQ), and the Louisiana Department of Natural Resources (LDNR) were responsible for assessing injuries to trust resources resulting from this unauthorized discharge of oil, and ensuring that the public was made whole for the losses of natural resources and services through the restoration, replacement, or acquisition of the equivalent of the injured resources.

Pursuant to Section 1002(a) of OPA, each responsible party for a facility from which oil is discharged into or upon the navigable waters or adjoining shorelines is liable for natural resource damages that result from such incident. OPA Section 1002(b)(2)(A) defines damages to natural resources as injury to, destruction of, loss of, or loss of use of, natural resources, including the reasonable costs of assessing the damage, which shall be recoverable by Federal and State Trustees.

1.4 Public Participation

OPA section 1006(c)(5) requires that public participation be allowed in the restoration planning process. This requirement has been met for the Dixon Bay NRDA through providing the public the opportunity to review and comment on the Draft Damage Assessment and Restoration Plan (DARP). The DARP provided the public with information about the nature and extent of natural resource injuries being addressed on their behalf. It was the means by which the Trustees sought public comment and advice on the methods used in assessing natural resource injuries and in effecting the restoration, rehabilitation, replacement, or acquisition of equivalent resources or resource services.

In order to comply with Section 102(2)(C) of the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) is generally required for major Federal actions that may significantly affect the quality of the human environment. In this case, the Federal action is the proposed restoration resulting from the NRDA process for the Dixon Bay release. An Environmental Assessment (EA) is the initial step in determining whether a proposed action requires an EIS. The Draft DARP is intended to integrate NEPA by including a description of the purpose and need for the action, identifying alternative actions and assessing their applicability and environmental consequences, and summarizing the current environmental setting. NOAA believes that the EA indicates that the proposed action does not require an EIS because the restoration project is not expected to have significant impacts on the quality of the human environment.

The DARP was available for public review for 30 days, from November 21, 1995 to December 21, 1995. The Trustees received no comments about the DARP itself or about the need for an EIS during this period. However, the Department of Interior elected to

join in the settlement agreement during the period of public comment, and notified the other Trustees of their intent on November 29, 1995.

1.5 Summary of the Natural Resource Damage Claim

Trustees evaluated injury to marsh, water column, benthos, and birds/wildlife as part of the natural resource assessment. The Trustees concluded that no human intervention to speed recovery to baseline was necessary to accomplish primary restoration following completion of response actions for marsh, birds/wildlife, benthos, or water column. The possibility that actions to enhance recovery might result in additional injury was a factor Trustees considered in making the decision.

The Trustees concluded that compensation for interim lost ecological services was required for injuries to marsh, water column, and birds/wildlife. After evaluating a number of restoration alternatives for achieving compensation for lost interim ecological services from these injured natural resource categories, a freshwater diversion project in the Mississippi River delta was selected to satisfy compensatory restoration requirements for marsh impacts. This marsh creation project will replace those kinds of marsh services lost as a result of the Chevron release since the marsh that was injured had itself been created by a freshwater diversion project in the delta.

The freshwater diversion restoration alternative has the benefits of being very cost-effective, possessing a high likelihood of success and, due to the scale of the proposed alternative and the interconnections between services among the resource categories in this kind of system, achieving some measure of compensation for birds/wildlife, water column, and potential injuries to the benthos. This type of project has the advantage of requiring a limited amount of dredging compared to other potential marsh creation methods, which limits the environmental impacts associated with marsh creation. Other restoration alternatives were considered by the Trustees as part of the restoration planning process (described in Section 2) No other restoration alternatives evaluated by the Trustees provided as much net environmental benefit for as little cost as the freshwater diversion alternative.

2.0 Injury Assessment and Restoration Planning

Injury assessment techniques used for the four natural resource categories chosen by the Trustees for evaluation of potential injury are discussed individually, as are the restoration alternatives and evaluation. Selection criteria utilized in the Trustees' evaluation of restoration alternatives were based on those listed in the proposed OPA NRDA regulations. The selection criteria are given below:

1) Extent to which each alternative can return the injured natural resources to baseline (primary restoration) or make the environment and public whole for the interim lost services (compensatory restoration).

2) Extent to which each alternative will avoid additional injury to the injured resource.

3) Level of uncertainty in the success of each alternative.

4) Extent to which each alternative benefits more than one natural resource and/or service.

5) Cost effectiveness.

6) Effects of each alternative on the environment.

7) Consistency with policies and compliance with law.

The first criterion, involving returning the injured resource to baseline including ways to speed this recovery for primary restoration, and making the environment and public whole for interim lost services for compensatory restoration, is the key criterion Trustees used to evaluate each alternative. It was regarded as the single most important criterion, and the remaining ones were regarded as being of secondary importance.

2.1 Marsh

2.1.1 Injury Assessment Strategy and Findings

The marsh along the eastern edge of Dixon Bay that was oiled as a result of the Chevron well blowout was created by a freshwater diversion project (W1) off Southwest Pass. At the time of the spill, *Phragmites* and *Spartina* were the dominant plant species present. Oiled *Spartina* plants were generally oiled over 50% of their surface. whereas *Phragmites* plants were generally oiled in a small band on the stem of the plant. Relatively little oil was observed on the marsh sediments, and none was noted to have penetrated below the sediment surface. This observation was consistent with the high water levels that existed during the period of the release. In addition to the oiling of the marsh vegetation, there was oiled vegetative debris among some areas of the marsh.

Trustees determined that the key information required to assess injury to the oiled marshes was the area of oiling and degree of exposure. Trustees asked Chevron to have aerial photographs taken to provide accurate information of the marsh topography. These were digitized and used to estimate acreage of distinct marsh islands and segments. Trustee and

Chevron teams conducted field surveys, and with the use of video and field notes, reached a consensus for degree of oiling and width of oil banding in the different segments. Assumptions used in the estimation of oiling band widths were, by consensus, likely to lead to over-estimation of the acreage oiled rather than under-estimation. Final estimates for acreage of marsh oiled were not developed, as discussed below, but the initial estimates suggest that approximately 200 acres of marsh were oiled to some degree by the release.

Trustee-Chevron site visits on March 16, 1995 and June 26-28, 1995 were used by the Trustees to develop inputs for degree of injury (defined as percent lost marsh services), and recovery time for *Spartina* and *Phragmites* marsh. Together with the initial estimates of acreage oiled, these inputs were used in a Habitat Equivalency Analysis (HEA) performed independently by the Trustees to determine an estimated amount of marsh that would need to be created as compensatory restoration for the impairment of marsh function from the time of the discharge until recovery to baseline. HEA is a method in which losses in ecological services are estimated, and the amount of restoration needed to compensate the public for those losses of service is determined. Sensitivity analyses for the inputs to the HEA indicated that additional field work to develop more accurate estimates for acreage affected, percent lost marsh services, and recovery period was not cost-effective since the outcomes of the analyses run with even very conservative inputs (i.e., values leading to higher estimates of required compensation) did not significantly change the nature or scale of the preferred restoration project. Trustees and Chevron therefore determined that additional refinement of the HEA inputs would not be justified.

2.1.2 Restoration Plan

As noted in the injury assessment findings, marsh vegetation within Dixon Bay was injured as a result of exposure to oil from the release. The objectives of restoration planning for injured marsh are:

> A) Determine what actions, if any, are necessary or appropriate to enable or facilitate recovery of the injured marsh vegetation at the site of injury (Primary Restoration); and
>
> B) Determine what actions, if any, are appropriate to replace or acquire equivalent ecological services lost due to exposure of the marsh from the oil release, and to restore these services or compensate Mississippi River delta ecosystems for this loss (Compensatory Restoration).

2.1.2.1 Primary Restoration

This section considers actions which may be appropriate to restore or facilitate the recovery of injured marshes.

Alternatives Considered:

a) Natural Recovery - This alternative would not involve any direct intervention to restore the resource. While completed cleanup activities and natural processes may assist or provide for the natural recovery of this resource, no additional actions are proposed under this alternative. Natural recovery could occur unless conditions at the impact site inhibit or constrain the natural recruitment and recolonization of marsh vegetation. [The natural recovery alternative for primary restoration of this and other natural resource categories is equivalent to the "no action" alternative under NEPA].

b) Removal of residual oiled debris - Actions to remove additional oiled debris from a site would be appropriate for consideration where oily debris is inhibiting natural recovery of injured marsh.

c) On-site planting of marsh vegetation - Direct plantings of marsh vegetation may be appropriate to ensure replacement of marsh occurs or to accelerate the recovery period.

Evaluation of Alternatives and Environmental Consequences:

The natural recovery alternative meets several of the criteria (listed in Section 2.0 of DARP) used by the Trustees to evaluate restoration alternatives (see Table 1 for summary of evaluation for each criterion). Evidence and expert opinion indicates that natural recovery of marsh vegetation is occurring at oiled sites and full recovery to baseline is expected without human intervention. No negative impacts to the marsh or to the surrounding environment are expected under this alternative. It is cost-effective, and is consistent with policy and law. It will not benefit other natural resources, however, the Trustees do not regard this as a key criteria in determining appropriate methods to satisfy primary restoration needs.

Removal of oiled debris fails to meet several criteria. Although it could act to speed recovery to baseline, and may provide benefits to other resources by reducing the probability that birds and wildlife would be exposed to oil, it has the disadvantage of running a high risk of causing further injury to the marsh through the disturbance that would be caused by movement of boats and personnel to collect and remove the oiled debris. Due to the possibility of causing additional injury, the likelihood of success of this alternative in enhancing recovery is uncertain. It is estimated that the cost of this alternative would be relatively high compared to the likely benefits due to the remoteness of the area and the need to use airboats to work in the marsh, thereby failing the cost-effectiveness criterion. Existing policies for remediating oil spills tend to discourage active

cleanup activities within marshes requiring personnel to move among marsh vegetation.

Direct planting of marsh vegetation in bare areas may speed recovery of the marsh, however this alternative, like the removal of oiled debris alternative, requires access into the marsh to conduct the activity. The soft marsh sediments would be difficult to work in, and it is possible that the resultant impacts from the planting effort could outweigh any benefits gained by planting. Planting would require lots of activity in the marsh that could cause additional injury, would be expensive, and might not result in a net increase in the recovery rate.

Preferred Alternative:

The Trustees propose the natural recovery alternative for primary restoration of injured marsh vegetation since Trustee observations indicate that recovery is occurring at a satisfactory rate. To attempt to accelerate the recovery process through direct intervention would not be cost- effective, and the potential for causing additional harm due to the logistics of a directed restoration effort (including dredging channels to provide access for equipment), is very high. Although oily debris could slow recovery of the marsh, Trustees observed that by June 1995 very little oiled debris remained, and what did remain was stained rather than having "loose" oil on it, suggesting that any negative effect that may have existed was slight and short-lived. Bare areas that existed in the oiled marsh were generally similar in size and number to bare areas in the unoiled reference marsh used in the field study, and Trustees were unable to clearly link bare areas in the oiled marsh to the Chevron release.

2.1.2.2 Compensatory Restoration

Trustee representatives' observations during field visits indicate that ecological services provided by the injured marsh have been lost due to exposure to oil from the incident. This section considers alternatives for replacing or acquiring the equivalent of those lost services consistent with the addition of marsh proposed as the basis for compensating for these losses. Restoration actions to compensate for this interim loss of ecological services can be provided through creation of the same or ecologically equivalent habitat at a site near the injured marsh communities.

Alternatives Considered:

a) No compensation for interim losses to marsh - This alternative would be appropriate where there were no significant interim losses incurred as a result of the oil spill, or where actions to assess compensation for those losses are not cost-effective. [The no compensation alternative for marsh and other natural resource category compensatory restoration is equivalent to the "no action" alternative under NEPA].

b) Marsh creation onsite using dredge and fill technology - This alternative would involve dredging an offshore area, and deposition of spoil in the affected area to create new marsh. Marsh development may occur through natural recruitment or direct plantings on the spoil islands.

c) Silt fence placement to encourage development of marsh - This alternative would involve the placement of silt fencing at strategic locations to accelerate siltation rates, allowing for a more rapid development of marsh.

d) Barrier creation in front of existing marsh - This alternative would involve the construction of a barrier "island" from dredge spoil material in front of a section of the WI marsh to prevent erosion losses due to storms and to encourage siltation between the existing marsh and the barrier. The spoil barrier would require transplanted vegetation to maintain its integrity and purpose.

e) Creating marsh habitat using freshwater diversion - This alternative would expand the size of, or improve conditions in, an existing marsh community, or create a new area of marsh at a suitable site. Methodology for these alternatives would involve dredging a crevasse through levees in a pass at one or more suitable sites.

Evaluation of Alternatives and Environmental Consequences:

The no compensation alternative fails to meet important criteria (Table 1). Since ecological service losses did occur, the environment and the public would not be made whole without appropriate compensatory restoration as OPA and OSPRA require. These factors alone preclude the need for further consideration of this alternative given the presence of cost-effective methods to achieve compensation.

Creation of marsh through dredge and fill technology meets several criteria. The public could be made whole through the creation of an appropriate amount of marsh although the type of marsh usually created using this method is somewhat different from the marsh that was oiled. Marsh creation would provide benefits to other resources such as benthos through export of detritus to the benthic food web, and to the water column through provision of nursery habitat for water column species and their prey items. This method has the potential for impacting the surrounding environment in several ways. Dredging in an offshore area would directly impact the subtidal area dredged, would affect water quality and injure filter-feeding organism by increased turbidity outside the immediate dredging area, and would catastrophically destroy the subtidal area where the spoil was placed. This type of project is relatively expensive, and the created marsh may be relatively short-lived since, without a continued supply of sediment to maintain the marsh, it would gradually disappear due to subsidence. National and State policy recognize the importance of wetlands, so this type of project is consistent with these policies.

Creation of marsh through the placement of silt fences meets several of the selection criteria. It would make the public whole by creation of the same type of marsh that was affected by the Chevron release. Marsh creation would provide benefit to other resources, as discussed above, with little or no additional injury to the oiled marsh or other environmental impact. Silt fence placement would be inexpensive and have a high probability of success in accelerating marsh development, but would need regular maintenance. It may be difficult to predict its performance in creating marsh, and thus be difficult to scale the needed restoration. Silt fencing may only accelerate the natural development of marsh, which may have eventually formed as a result of natural processes in the absence of silt fences, and could therefore produce only a small net benefit to the public.

Construction of a barrier offshore in front of the W1 marsh to protect existing marsh from erosion and encourage new marsh creation could serve to make the public whole for interim lost ecological services, although the likelihood of success of this alternative is lower than other forms of marsh creation. It would also require substantial dredging of offshore areas to provide spoil and allow access of the barge, with the associated impacts already discussed. The cost associated with this project would be prohibitively high.

Creation of a marsh by a freshwater diversion would make the public whole through the creation of the same kind of marsh that was impacted by the release. It is inexpensive, and has a high likelihood of success, as evidenced by the remarkable performance of similar projects in the Mississippi River Delta. It would not impact the oiled marsh, and would cause less overall environmental impact than the other active alternatives with the exception of the silt fence alternative. A small amount of shrub/scrub levee habitat would be destroyed, but these impacts would be dwarfed by the beneficial creation of marsh for nursery habitat, detritus production, and other services. The diversion would help re-create the processes that created the delta originally, by allowing sediment-rich water to flow out into shallow subtidal areas, gradually transforming them to mudflats and finally to marsh. The flats would continue to spread out as more marsh forms. This alternative would provide greater benefits to other resources than other alternatives, especially by the formation of great expanses of shallow subtidal and intertidal flats that serve as rich foraging areas for fish, crabs, and birds.

Preferred Alternative:

The Trustees propose creating or enhancing an existing marsh by creating a freshwater diversion. This alternative is an accepted and preferred method for creation of marshlands in the Mississippi River delta, often creating upwards of 200 acres of emergent marsh and associated mudflat habitat per project. The habitat created would be very similar to the injured habitat in terms of vegetative composition, species supported, and overall ecological function since the injured area was initially created by a freshwater diversion

project. The project would be more cost-effective than any of the other identified alternatives, have a stronger likelihood of success, and will most closely replace those marsh services lost as a result of the discharge, as well as provide benefits to other injured natural resources. Freshwater diversion projects have become instrumental in countering the high rate of subsidence and land loss in the delta by providing the needed sediments for land accretion and marsh creation.

Trustee HEA calculations based on a freshwater diversion project suggest that as little as five acres of marsh would need to be created as direct compensation for lost marsh services. It is likely that a freshwater diversion project would create additional acreage as well as extensive intertidal and shallow subtidal mudflats, thus also providing compensation for other injury categories which benefit from the existence of marsh and mudflat habitats. In the opinion of the Trustees, this alternative will be most effective in replacing those services lost, will provide the most overall benefits to the delta ecosystem, and is the most inexpensive method.

2.2 Water Column

2.2.1 Injury Assessment Strategy and Findings

The waters of Dixon Bay, Southwest Pass, and a portion of the open Gulf of Mexico were exposed to oil discharged as a result of the Chevron wellhead failure. On January 13, 1995, at 1315 hours, a Trustee representative on an overflight estimated that approximately 25 square miles of water around the wellhead was covered with slicks or sheens. This estimate was made using the Loran on the aircraft and flying around the area with visible oil on the surface. The severe weather that occurred during the period in which large amounts of oil were present is believed to have increased the dispersion of oil into the water column above that which would have been expected in calm weather conditions.

The Trustees considered the use of models to try to estimate potential impacts to species present in the water column of affected areas of Dixon Bay. This approach was ultimately rejected for two reasons. First, it would be difficult to determine the volume of oil discharged as a result of this incident. Different agency estimates of oil discharged vary by two orders of magnitude. The Trustees considered hiring a outside expert to develop an independent estimate of the volume released, but the costs that would have been incurred in this approach were not deemed reasonable given the expected level of injury. Secondly, existing models do not accurately reflect the current topography and habitats in the immediate vicinity of the release. Trustees considered modifying an existing model to reflect conditions existing at the time of the spill, but the expense required to make these modifications was not judged to be reasonable.

The Trustees believe that some degree of injury did occur to organisms in the water column of Dixon Bay. In support of this belief, the current version of the Type A model, using real wind and tide data with the minimum volume estimated for the release predicts that oil concentrations in Dixon Bay were at toxic levels for some water column organisms. [The Type A model was developed by the Department of the Interior to meet the requirement for a simplified assessment method in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). It predicts the physical fate of the spilled substance, the biological effects, restoration costs, and damages (in dollars) for the spill.] Although this model run supports the belief that injury to the water column did occur, Trustees could not use this model to quantify that injury for reasons discussed above.

2.2.2 Restoration Plan

Restoration planning for injuries to the water column have the following objectives:

A) Determine what actions, if any, are necessary or appropriate to facilitate the recruitment or recovery of the resident water column species, and

B) Determine what actions, if any, would appropriately replace or represent an acquisition by the nearshore waters of the Mississippi River delta system of ecological services equivalent to those lost as a result of the exposure of water column resources to oil from the Dixon Bay spill.

2.2.2.1 Primary Restoration

This section considers actions which may be appropriate to restore or facilitate the recovery of the injured water column.

Alternatives Considered:

a) Natural recovery - This alternative would not involve any direct intervention to restore injured water column resources. Because completed cleanup activities and natural processes may assist or provide for the natural recovery of these resources, no additional actions are proposed under this alternative. Natural recovery occurs when natural biological, physical, and chemical processes in the coastal ecosystem sufficiently degrade, dilute, and remove oil in the water column to allow ecological services to recover without human intervention.

b) Population enhancement - This alternative could include actions such as fertilization, artificial spawning, or hatchery rearing and release of selected species in the impact area. Intervention of this type may be appropriate where injuries to the water column are not

transitory in nature or important resident species will not naturally recruit back into the impact area within a reasonable period of time even though oil concentrations have dropped below levels which are toxic or trigger avoidance behaviors.

Evaluation of Alternatives and Environmental Consequences:

The natural recovery option satisfies several relevant criteria (Table 2). Rapid recovery to baseline is expected since current scientific knowledge and expert opinion hold that resident water column communities are likely to have recruited back into oil-exposed areas of Dixon Bay once oil concentrations fell below levels which were toxic or resulted in avoidance behavior in resident species.

Population enhancement actions are not needed to speed return to baseline because recovery to baseline is expected to be occurring at a satisfactory rate. Hatchery and other population enhancement actions are relatively costly, and are known to have some potentially detrimental consequences. These include introducing disease and creating water quality problems in waterbodies receiving discharges from hatchery operation, which can lead to algal blooms and low oxygen conditions. Artificially-raised individuals may differ genetically from resident populations, and the likelihood of successful survival and reproduction in the ambient environment is uncertain. If the Dixon Bay spill coincided with a major spawning event of a species such that loss of eggs or larvae in the vicinity of the release would have significant affects at the population level, then population enhancement actions could be justified. However, since that was not the case in the Dixon Bay release, the cost of population enhancement actions is not justified, especially given the risk of causing more harm than benefit. Under these circumstances, injuries to the water column from the Dixon Bay spill are appropriately viewed as having transient effects and insufficient to require costly population enhancement actions. As noted above, the natural recovery alternative is effective where an oil-exposed water column is able to remediate itself effectively and where its normal biological profile is able to return naturally.

Preferred Alternative:

The Trustees propose the natural recovery alternative as an appropriate strategy for resource recovery to baseline conditions. Indeed, it is the consensus of the Trustees that natural recovery has already taken place for the water column injuries and any direct restoration actions at this time would be ineffective and are unnecessary.

2.2.2.2 Compensatory Restoration Alternatives:

Ecological services provided by the marine water column in and adjacent to Dixon Bay were lost, to some degree, as a result of exposure to oil from the Chevron wellhead blowout in Dixon Bay. This section considers restoration actions which may appropriately serve as compensation for such losses.

Alternatives Considered:

a) No compensation for interim losses to the water column - This alternative would be appropriate where there were no significant interim losses incurred as a result of the oil spill or where action to assess compensation for this resource injury is not determined to be cost-effective.

b) Wetlands creation or improvement project - Under this alternative, compensation would be provided as part of a wetlands creation or improvement project which would increase available habitat for water column resources. The project would expand critical nursery areas for larval and juvenile marine species within the water column community.

c) Population enhancement - This alternative could include actions such as fertilization, artificial spawning, or hatchery rearing and release of selected species in the impact area.

Evaluation of Alternatives and Environmental Consequences:

The no compensation alternative for interim lost services for the water column is not acceptable since this alternative would not make the environment or public whole for the injury (Table 2). Although no assessment technique was deemed to be accurate and cost-effective under the circumstances of the Dixon Bay release, inexpensive alternatives exist to compensate the public for water column injuries at the level expected from this release.

Wetland creation will provide benefits to the water column through improvement in water quality and provision of nursery habitat for water column organisms. For example, LDWF data has clearly demonstrated a link between the amount of marsh nursery habitat and shrimp production. Thus, the Trustees feel that this approach, which can be very cost-effective using a freshwater diversion selected as the compensatory restoration alternative for marsh injuries, will serve to make the public whole. Marsh creation through freshwater diversion will benefit other resources, will cause little or no additional injury, and the environmental benefits far-exceed the potential environmental consequences, as was discussed earlier.

The population enhancement option was previously discussed. It has serious potential drawbacks, including the risk of environmental impacts, high cost, and uncertain likelihood of success. Only a few select species could be the target of enhancement under this

alternative for practical reasons, unlike the marsh creation alternative which would benefit a large suite of species.

Preferred Alternative:

The Trustees propose that compensation as part of a wetlands creation project from a freshwater diversion would be an acceptable choice to compensate for interim loss of biota and ecological services which define the water column injury. By combining compensation for water column injury with a wetland creation, a cost-effective and technologically feasible plan of action can be carried out.

2.3 Benthos

2.3.1 Injury Assessment Strategy and Findings

During cleanup operations for the Chevron wellhead blowout release, observers noted sheens being stirred up from the shallow sediments of Dixon Bay by response vessels. Based on these observations, Trustees determined that the potential for injury to benthic communities existed and would need to be investigated. A consensus was reached between the Trustees and Chevron on a workplan for benthic studies. A total of 17 stations were established, with two of the stations located outside Dixon Bay. A total of six replicate samples were collected from each of the stations for analysis of benthic community structure and abundance. All sampling was conducted during the first week in February 1995 (2/1-6/95). Sorting and identification of benthic samples was performed by a contractor mutually agreed upon by Chevron and the Trustees. In order to prevent unnecessary assessment costs, the Trustees asked that the samples be processed in phases. Sediment chemistry samples were also collected at each station, and analysis of these samples was performed by a laboratory mutually agreeable to Trustees and Chevron.

The results of the first phase analysis (13 stations, four replicates per station analyzed) indicated that no catastrophic impacts to the benthic community of Dixon Bay had occurred due to the Chevron release or, if significant injury had occurred, it was not detectable less than one month after the release. Given the level of variability that typically exists in benthic communities, and the results of the first phase analysis, Trustees and Chevron concluded that it would not be cost-effective to conduct additional phases of benthic analysis. Trustees concluded that any injury to benthic communities as a result of the release were minor and unlikely to be detected without a very large and costly study. The sediment chemistry data did not indicate petroleum hydrocarbon levels in excess of that expected in a producing oil field or at levels which would be expected to cause injury to benthic organisms.

2.3.2 Restoration Planning

Restoration planning for potentially injured bottom sediments has the following objectives:

A) Determine what actions, if any, are necessary to facilitate the removal of residual oil contamination and recovery of sediment biota, and

B) Determine what actions, if any, would appropriately replace or represent an acquisition by the Mississippi River delta ecosystem of ecological services equivalent to those lost as a result of the exposure of bottom sediments to oil from the discharge.

2.3.2.1 Primary Restoration

Direct restoration of bottom sediments would involve actions to restore or facilitate recovery of the oil-impacted sediments. This would require locating remaining areas of contaminated bottom sediments, evaluating the residual sediment contamination for toxicity and receptivity for restoration, and feasible technology for locating these sediment areas and conducting on-site restoration.

Alternatives Considered:

a) Natural recovery - This alternative would not involve any direct intervention to restore the resource. While completed cleanup activities and natural processes may assist or provide for the natural recovery of this resource, no additional actions are proposed under this alternative.

b) Remove and/or replace contaminated sediments - Intervention of this nature may be appropriate where field assessments indicate the presence of residual oil in or on bottom sediments that will inhibit or retard the natural recovery process without human intervention. The implementation of this alternative requires access to technology which allows areas of contaminated sediments or residual oiling to be effectively identified and remediated.

Evaluation of Alternatives and Environmental Consequences:

The natural recovery option meets key criteria since the benthic assessment study failed to discern significant reductions from baseline as a result of the Chevron release less than one month after the incident (Table 3). The Trustees concluded that if injury did occur, it was relatively minor and short-lived. Natural processes such as dissolution into the water column and biodegradation could have rapidly acted to remove above-background

concentrations of petroleum hydrocarbons. Any actions under these circumstances would not be cost-effective or worth the risk of causing additional harm to the environment.

Removal of submerged oil or contaminated sediments is not an acceptable alternative since evidence suggests that recovery to baseline has occurred. The high cost associated with this alternative, as well as the low likelihood of success, are unjustified given the lack of evidence that deviation from baseline resulted from the release.

Preferred Alternative:

The Trustees propose the natural recovery alternative for direct sediment restoration. Based on the data gathered to assess potential injury to sediments and benthic communities as a result of the release which indicated that any injury that did occur was minor and transient, no actions are required. No discrete areas of high petroleum hydrocarbon levels were found. The rapid natural recovery that assessment studies suggest occurred and the lack of any technically feasible, cost-effective alternative for direct intervention to aid resource recovery make the natural recovery alternative the best option.

2.3.2.2 Compensatory Restoration

The exposure of bottom sediments to oil from the discharge is potentially injurious to sediment biota and can result in a loss of ecological services of these sediments until natural recovery restores the sediments to pre-spill conditions. This section considers restoration actions which may appropriately compensate for the interim loss of sediment services.

Alternatives Considered:

a) No compensation for interim losses to bottom sediments - This alternative would be appropriate where there were no measurable or significant interim losses incurred as a result of the oil spill, or where actions to assess compensation for sediment injuries are not cost-effective.

b) Remediate off-site contaminated sediments - This alternative would involve remediation of existing contamination in an off-site location to benefit depauperate benthic communities at that contaminated site.

c) Marsh creation - This alternative would involve a marsh creation project at a site in the Mississippi River delta, which would benefit the benthic community by providing detritus to enhance the benthic food web.

Evaluation of Alternatives and Environmental Consequences:

The no compensatory restoration alternative meets the key criteria of making the public whole, since no significant interim reduction in benthic services were detected by the assessment studies. Given these circumstances, no active restoration alternative would be considered cost-effective or appropriate under OPA.

Remediation of a contaminated off-site area is a viable alternative where demonstrable lost-services for benthos is found. In this case, such demonstrable losses were not found, and therefore the cost and the likely environmental impacts associated with access for, and the conduct of, dredging is not justified.

Marsh creation to benefit the benthic community in the nearshore Mississippi River Delta is a cost-effective and practical alternative. Such action would be of direct and long-term benefit to the ecological function and productivity of coastal sediments. However, it cannot be justified given the lack of evidence that compensatory restoration is needed for benthos to make the public whole.

Preferred Alternative:

The no compensation alternative is acceptable since assessment studies did not demonstrate that significant interim losses occurred as a result of the Chevron release (Table 3). Given that the field studies utilized in evaluating potential benthic injury were felt to be adequate to detect significant benthic injury if it had occurred, the lack of observable injury precludes the Trustees from seeking compensatory restoration. The Trustees recognize that the preferred alternative chosen to compensate for interim lost services by marsh oiled by the discharge, a freshwater diversion project to create new marsh, will provide benefits to the coastal benthic ecosystem. This factor provides reassurance to the Trustees that even if interim losses did occur but were not demonstrated by the Trustees' assessment actions, the public will be made whole as a result of the marsh compensatory restoration alternative chosen.

2.4 Birds/Wildlife

2.4.1 Injury Assessment Strategy and Findings

As described in the incident summary, a number of oiled birds were observed by Trustees. These were documented in videotapes, photographs, and field notes. Bird species observed to be oiled but not captured for rehabilitation or found dead include white pelicans, great blue herons, snow geese, and marsh hens. On January 25, 1995, the Trustees did a shoreline survey for dead birds and wildlife along a sandspit near the southern end of the area that was exposed to heavy oiling. A total of seven oiled bird

carcasses were observed (one cormorant, one herring gull, two ring-necked ducks, two other ducks that were not identifiable, and one owl) over a distance of approximately 0.25 miles. The birds were found among oiled vegetative debris left by the storms that had passed through. No other sections of the impacted shoreline were suitable for surveys by Trustees because of the thick marsh vegetation and soft sediments. No mammals were found dead or observed to be oiled, although Trustees believe that mammals were exposed to oil as evidenced by tracks observed leading into oiled marsh and vegetative debris, and scavenged oiled bird carcasses. As late as March 17, 1995 Trustees observed that there was "loose" oil in the oiled marsh that could have continued to serve as a mechanism for oiling birds and wildlife. Small droplets of emulsified oil and oil that could be wiped off vegetation were noted at two locations, although the majority of the affected area did not appear to have "loose" oil in March.

A total of 24 oiled birds were taken for rehabilitation, of which 23 were brown pelicans. All of these pelicans were rehabilitated and released, although Trustees cannot assume that additional injury to these birds did not occur since previous studies indicate that many "rehabilitated" birds do not survive long after release or have reduced reproductive success. The fate of the released birds from this spill is unknown. Two other brown pelicans were brought to the bird cleaning station that may have been injured prior to the discharge- one bird had a broken wing, and the other had apparently been shot. The other oiled bird brought for rehabilitation was a clapper rail that died shortly after capture.

The inclement weather conditions that existed during the early stages of the incident, and the difficulty in locating areas suitable for surveys for dead birds and wildlife, prevented the Trustees from accurately estimating bird and wildlife injuries as a result of the release. It is possible that many birds may have died as a result of the release, and either sank, were carried out to sea, or lost among marsh vegetation or debris. Even under the best of circumstances, only a small fraction of the number of birds thought to be killed as a result of an oil spill are usually found. In this case, the harsh weather conditions and nature of the habitats in the vicinity of the release would be expected to further reduce the recovery rate of dead birds and wildlife. The Trustees considered the use of models to try to predict bird injuries resulting from the release, however it was felt that no reliable and cost-effective method was available. An additional complication is that some of the dead birds may have died prior to the well blowout and been oiled afterwards.

2.4.2 Restoration Planning

As noted above, birds and wildlife in the vicinity of the Chevron wellhead blowout were injured as a result of this discharge. The objectives of restoration planning for birds and wildlife is to:

A) Determine what actions, if any, are necessary to provide for replacement of birds and wildlife estimated to have been exposed to the spill; and

B) Determine appropriate compensation for interim lost ecological services which were provided by the birds until full recovery.

2.4.2.1 Primary Restoration

This section considers actions which may be appropriate to restore or facilitate the recovery of the injured birds and wildlife.

Alternatives Considered:

a) Natural recovery - This alternative would not involve any direct intervention to restore the resource, and presupposes that natural recovery has, or will, restore the resources to pre-spill conditions.

b) Capture and rehabilitate additional oiled birds - This alternative would involve trying to capture additional oiled birds, cleaning them, and releasing survivors back into the wild.

c) Increase available habitat - This alternative would increase the probability of reproductive success and survival by increasing nesting, lounging, and feeding areas. Actions would include creating habitat in an area appropriate to these bird and wildlife activities.

d) Conduct captive breeding to enhance recruitment - This alternative would take eggs from unaffected populations, and hatch and rear birds for eventual release in affected areas.

Evaluation of Alternatives and Environmental Consequences:

The natural recovery alternative appears to meet several criteria (Table 4). While evidence indicates that direct injury to the bird population did occur and suggests that other wildlife may potentially have been injured, it is unclear that human intervention would have a positive effect on the recovery rate of resident bird and mammal populations. The natural recovery alternative makes the assumption that recovery will occur naturally and that there is no significant benefit from active human intervention to directly restore this resource. Such an assumption is consistent with expert opinion which indicates natural recovery of the impacted bird populations has or will occur without intervention.

Attempting to capture and rehabilitate additional birds was an option shortly after the release, but the likelihood of success was low, the cost would have been high, and there was an unacceptable risk of causing additional injury to the birds through the stress of capture. All oiled birds that could be caught without causing undue stress were captured for rehabilitation

during the response actions. The efforts made were substantial. Additional efforts were likely to be unsuccessful.

Enhancing habitat availability to increase reproductive success and survival is partially addressed by habitat creation under other natural resource categories. For the purpose of returning birds and wildlife to baseline it may not be cost-effective to create habitat since recovery is expected to occur satisfactorily under a natural recovery option.

The captive breeding alternative would be very expensive, and, given the environmental drawbacks associated with disturbing nesting areas to remove eggs, would only be appropriate where natural recovery would not be expected to occur or to take an extended period to return to baseline. The likelihood of success is questionable since the birds raised would need to be reintroduced into the wild where their survival would be uncertain.

Preferred Alternative:

The Trustees propose the natural recovery alternative since the cleanup of oil and subsequent weathering and natural processes have removed the toxic fractions endangering bird and mammal populations. With this removal, it is believed that these populations will recover unassisted.

2.4.2.2 Compensatory Restoration Alternatives

This section considers alternatives to provide compensation for the interim losses to bird populations.

Alternatives Considered:

a) No compensation for the injuries to birds and wildlife - This alternative would be appropriate where bird and mammal injuries caused by the spill were not measurable, were not significant or where the cost to assess compensation for the injuries is not cost-effective.

b) Provide grant funds to support existing bird rehabilitation organizations - Bird rehabilitation organizations that are actively involved during oil spills would directly benefit from funding to prepare for ongoing and future rehabilitation efforts.

c) Conduct captive breeding to enhance recruitment - This alternative would take eggs from unaffected populations, and hatch and rear birds for eventual release in affected areas.

d) Habitat creation - This alternative would benefit bird and wildlife populations by providing habitat for nesting, lounging, and feeding.

Evaluation of Alternatives:

The no compensation alternative is not acceptable because it fails to meet the key first criterion that the public be made whole for natural resource injuries (Table 4). Since a viable alternative exists to achieve compensatory restoration that meets the selection criteria, the no compensation alternative is not appropriate.

Funding bird/wildlife rehabilitation organizations would be appropriate under some circumstances, however it does not satisfy the first criterion of making the public whole as directly as other alternatives. It would benefit birds and wildlife in the Mississippi River Delta, where the release occurred, only in the event of a future release injuring birds. OPA requires that lost services be restored or replaced as directly as practical, and other alternatives are better suited to this. Additionally, there is no clear method for scaling the appropriate level of funding.

The captive breeding alternative has already been discussed (Section 2.4.2.1), and the same evaluation is appropriate here. The high cost, the low likelihood of success, and the risk of doing more injury than is compensated for makes this alternative unappealing for the Dixon Bay release.

Habitat creation has already been discussed under other natural resource categories. A freshwater diversion project would create additional nesting, lounging, and foraging areas for birds and wildlife at a low cost. A habitat creation project has a much greater potential for ultimately having a positive effect on resident and migratory bird populations than the other alternatives. It could therefore serve as a low-cost method for achieving sufficient benefit to bird and wildlife populations in order to make the public whole for interim lost-services from the release.

Preferred Alternative:

The Trustees propose that the habitat creation alternative be selected, and that compensation for injuries to Mississippi River bird and mammal populations be provided by a freshwater diversion marsh creation project. This proposal is consistent with natural resource objectives for the impacted area and will directly benefit bird and mammal population recovery for the long-term.

2.5 Restoration Planning Summary

The Trustees' evaluation of the four natural resource categories considered to have the greatest potential for significant injury as a result of the Chevron Dixon Bay wellhead failure and release that began on January 12, 1995 resulted in the conclusion that restoration for natural resource injuries is required for three of the natural resource

categories.

2.5.1 Primary Restoration

No human intervention to return injured resources to baseline is required for marsh, benthos, birds/wildlife, or water column resources. Actions to speed recovery were deemed unnecessary due to the relatively rapid natural recovery that followed the cleanup actions, unjustifiable due to high costs or uncertain success, and potentially counter-productive given the possibility of causing additional injury and thus actually delaying recovery to baseline conditions. The Trustees therefore concluded that the preferred alternative to accomplish the goal of primary restoration for injuries resulting from the Dixon Bay release is the natural recovery alternative.

2.5.3 Compensatory Restoration

Compensatory restoration is required for interim lost ecological services due to injuries to marsh, birds/wildlife, and water column resulting from Dixon Bay well blowout. Using the HEA approach, the Trustees have determined that approximately five acres of marsh created by a freshwater diversion project would provide adequate compensatory restoration for injuries to marsh. This restoration method would most closely replace those services lost by the type of marsh oiled by the release in an extremely cost-effective manner. Trustees could not identify cost-effective methods to quantify injuries to birds/wildlife and water column. Habitat creation was determined by the Trustees as the preferred alternative for compensatory restoration for these injury categories. A freshwater diversion project in the Mississippi River delta system would be expected, based on extensive experience with these types of projects, to create one to two orders of magnitude more marsh than is required to compensate for direct marsh lost services. Additionally, extensive intertidal and shallow subtidal mudflats would be created, supporting a variety of plant and animal species that would provide food resources for birds and wildlife. The marsh and flats would provide nursery habitat and forage areas for water column organisms. The Trustees feel therefore that the freshwater diversion project proposed as compensation for the marsh injuries will additionally satisfy compensatory restoration requirements for water column and bird/wildlife lost services. No other restoration alternatives provided as much net benefit for all injured natural resources requiring compensatory restoration in as cost-effective a manner as this alternative.

The results of assessment studies evaluating potential injury to benthic communities failed to demonstrate any significant injuries to benthic communities from the Chevron release. The sheening that was observed being stirred off the sediments during the response activities clearly suggested that the subtidal sediments had been exposed to oil from the release, but sediment chemistry data and macrobenthic community analysis did not support the existence of significant injury as a result of the exposure in this case. Therefore the

Trustees feel that no compensatory restoration is required for the benthos. The Trustees note, however, that a freshwater diversion project would provide benefit to the benthic community through the export of detritus to the benthos. This provides reassurance to the Trustees that even if slight injuries to the benthic communities had occurred, those injuries would be offset by the benefits provided by the freshwater diversion project.

3.0 Proposed Compensatory Restoration Project

3.1 Site Selection

Relatively early during the assessment process, the Trustees identified a freshwater diversion project as a cost-effective method for restoration in this area of Louisiana. The HEA analysis used for scaling required compensation for marsh injury was based on a freshwater diversion as the restoration method. Although many potential sites for a diversion project are available in the Mississippi River delta system, one of the key criteria for selection of a site is that the created marsh should provide full ecological service for the life of the marsh. The State Pass a Loutre Wildlife Refuge was considered as the location of a diversion, but the refuge managers did not have a suitable site at the present time. The Federal Delta National Wildlife Refuge was considered next, and Delta refuge managers identified a suitable site for a diversion. The proposed location is approximately 10 miles from the marsh oiled by the release, and will thus provide services to the Mississippi River delta in the general vicinity of the release.

3.2 Project Design

Trustees identified a project that had been previously permitted under US Army Corps of Engineers (COE) general permit NOD-25, but was not yet funded. The project was judged to be suitable for creating the type and quantity of marsh required to satisfy compensatory restoration requirements. The proposed project involves excavating a maximum of a 80' X 1000' X 6' crevasse off Main Pass in the Delta Refuge. This will allow sediment-laden water to flow out into a shallow open water area, causing the sediments to drop out creating flats and emergent areas where marsh will naturally develop. Similar projects in the vicinity have created as much as 100 acres or more of marsh, along with extensive flats.

3.3 Permitting Considerations

The NOD-25 general permit was originally issued by the COE to Delta National Wildlife Refuge on January 26, 1983. The COE issued an EA and Finding of No Significant Impact (FONSI) on January 7, 1983. The COE concluded that the benefits of this type of project exceeded the impacts, and that there were no reasonable alternatives which would accomplish the same purposes. It was determined to be consistent with the LDNR Coast

Zone Management Program and was granted a Water Quality Certification by LDEQ. The general permit has since been renewed and is valid until December 31, 1997.

The specific project was approved by the COE under NOD-25 on August 8, 1995. In a July 24, 1995 letter to the COE supporting the permit application, the National Marine Fisheries Service of NOAA cited the successful creation of marsh resulting from freshwater diversions. The Consistency Section of the Coastal Management Division of LDNR described this particular project as worthwhile in a consistency determination on October 17, 1995.

3.4 Monitoring Requirements

Environmental monitoring is required to assess the success of restoration projects. For the proposed project, monitoring methods that have already proven successful in evaluating past freshwater diversions will be utilized. Delta refuge personnel conduct routine monitoring of freshwater diversion projects performed on their refuge. These include elevation transects, vegetation surveys, and waterfowl surveys. Trustees believe that this monitoring will be sufficient to provide the Trustees with the necessary information to judge the success of the restoration. The project will be considered successful when five acres of vegetated habitat are created by the diversion project. If the crevasse does not remain open long enough to create five acres, then the Trustees and Chevron will either decide to reopen the crevasse, relocate the project, or choose another mechanism to satisfy any remaining compensatory need.

3.5 Proposed Project Implementation

Chevron has proposed implementing the project themselves, with Trustee oversight. Chevron has successfully completed previous freshwater diversion projects in the Delta National Wildlife Refuge, demonstrating a strong capability to conduct this type of work. Allowing Chevron to implement the project would be more cost-effective than if the Trustees performed the construction, and the project would likely be completed more expeditiously. The Trustees believe that allowing Chevron to undertake the proposed restoration project is an appropriate culmination of a successful cooperative damage assessment. This project would be used exclusively as compensatory restoration for the January 12, 1995 release, and would not serve as compensatory restoration that might be required for other discharges or mitigation for permitted oil and gas activities. Successful implementation of the restoration project and reimbursement of all Trustee assessment and projected oversight costs will relieve Chevron of all liability associated with injuries to natural resources resulting from the January 12, 1995 discharge into Dixon Bay from the BLDSU #5 well.

TABLE 1. Summary of evaluation of restoration alternatives for Marsh. F=fully meets criteria; P=partially meets criteria or uncertain; N=does not meet criteria; X=criteria not applicable.

Primary Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NATURAL RECOVERY	F	F	F	X	F	P	F
REMOVAL OF OILED DEBRIS	P	N	N	P	N	P	P
ON-SITE PLANTING OF MARSH VEGETATION	F	N	P	P	N	P	P

Compensatory Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NO COMPENSATION	N	X	N	N	X	N	N
MARSH CREATION BY DREDGE AND FILL TECHNOLOGY	F	P	P	F	N	P	F
SILT FENCE PLACEMENT TO ACCELERATE MARSH DEVELOPMENT	P	F	P	F	F	F	F
BARRIER CREATION IN FRONT OF EXISTING MARSH	F	P	P	F	N	P	P
MARSH CREATION BY A FRESHWATER DIVERSION	F	F	F	F	F	F	F

TABLE 2. Summary of evaluation of restoration alternatives for Water Column. F=fully meets criteria; P=partially meets criteria or uncertain; N=does not meet criteria; X=criteria not applicable.

Primary Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NATURAL RECOVERY	F	F	F	X	F	P	F
POPULATION ENHANCEMENT	P	P	N	P	N	P	P

Compensatory Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NO COMPENSATION	N	X	N	X	X	X	N
WETLANDS CREATION OR IMPROVEMENT	F	F	F	F	F	F	F
POPULATION ENHANCEMENT	P	P	N	P	N	P	P

TABLE 3. Summary of evaluation of restoration alternatives for Benthos. F=fully meets criteria; P=partially meets criteria or uncertain; N=does not meet criteria; X=criteria not applicable.

Primary Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NATURAL RECOVERY	F	F	F	X	F	F	F
REMOVAL OF CONTAMINATED SEDIMENTS	P	N	N	N	N	N	N

Compensatory Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NO COMPENSATION	F	X	F	X	P	X	F
REMEDIATE OFF-SITE CONTAMINATED SEDIMENTS	N	P	P	F	N	P	N
MARSH CREATION	N	P	P	F	N	P	N

TABLE 4. Summary of evaluation of restoration alternatives for Birds/Wildlife. F=fully meets criteria; P=partially meets criteria or uncertain; N=does not meet criteria; X=criteria not applicable.

Primary Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NATURAL RECOVERY	F	F	P	X	F	P	F
CAPTURE AND REHABILITATE ADDITIONAL OILED BIRDS	P	N	N	X	N	X	P
INCREASE AVAILABLE HABITAT THROUGH MARSH CREATION	F	F	P	F	P	F	P
CONDUCT CAPTIVE BREEDING TO ENHANCE RECRUITMENT	P	X	N	N	N	P	P

Compensatory Restoration Alternative Evaluation

RESTORATION ALTERNATIVE	SELECTION CRITERIA						
	ONE	TWO	THREE	FOUR	FIVE	SIX	SEVEN
NO COMPENSATION	N	X	N	X	X	X	N
PROVIDE GRANT FUNDS TO SUPPORT BIRD REHABILITATION GROUPS	P	F	P	N	P	P	P
CONDUCT CAPTIVE BREEDING TO ENHANCE RECRUITMENT	P	X	N	N	N	P	P
INCREASE AVAILABLE HABITAT THROUGH MARSH CREATION	F	F	P	F	F	F	F