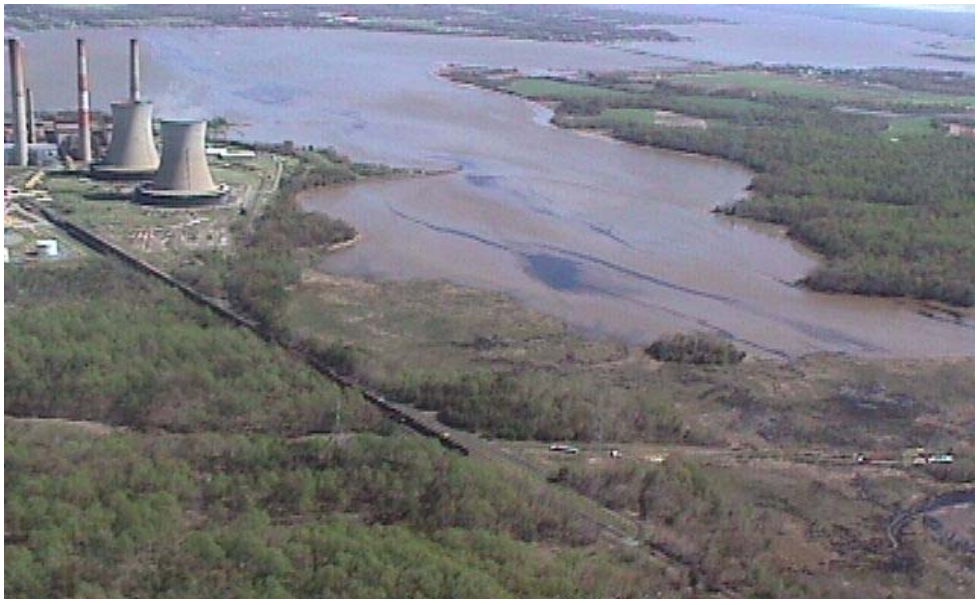
RESTORATION PLAN
AND ENVIRONMENTAL ASSESSMENT

for the April 7, 2000, Oil Spill at Chalk Point on the Patuxent River, Maryland



Draft For Public Review and Comment

May 2002

National Oceanic and Atmospheric Administration
Maryland Department of Natural Resources
Maryland Department of the Environment
U.S. Fish and Wildlife Service

This draft Restoration Plan was prepared by the natural resource Trustee agencies: the National Oceanic and Atmospheric Administration, the U.S. Fish and Wildlife Service, and the Maryland Departments of Natural Resources and Environment. These agencies have conducted a natural resource damage assessment (NRDA) for the April 7, 2000, pipeline rupture that spilled an estimated 126,000 gallons of oil at Pepco's Chalk Point Generating Facility in Aquasco, Maryland. The goal of NRDA is to restore the public's natural resources injured by the oil spill.

The Trustees have prepared this draft Plan to inform the public and solicit written comments on the proposed restoration projects to address the injuries from the spill. **Written comments should be submitted by July 8, 2002** to the contact person listed below.

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EXECUTIVE SUMMARY

On April 7, 2000, a ruptured pipeline spilled roughly 126,000 gallons of oil at the Potomac Electric Power Company Chalk Point generating facility in Aquasco, Maryland. Under the federal Oil Pollution Act, four government agencies—the National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, Maryland Department of Natural Resources, and Maryland Department of Environment—are responsible for restoring natural resources injured by the spill. These agencies act as Trustees on the public's behalf to conduct a natural resource damage assessment to determine the nature and extent of injuries to resources and the restoration actions needed to reverse these losses.

Draft Plan to restore the resources

The Trustees have written this draft Restoration Plan describing the injuries and proposed restoration alternatives. This plan was developed cooperatively among the Trustees, Pepco and ST Services (respectively, the owner and operator of the pipeline). The Trustees are seeking written comments from the public on the proposed restoration alternatives.

What was injured?

Studies conducted by the Trustees and other experts identified the following injuries to natural resources and recreational services from the spill:

- Wetlands – 76 acres lightly, moderately, or heavily oiled
- Beaches – 10 acres of shoreline lightly, moderately or heavily oiled
- Ruddy ducks – 553 estimated dead
- Other birds – 143 estimated dead
- Diamondback terrapins –122 estimated dead and a 10% reduction in hatchlings for year 2000
- Muskrats – 376 estimated dead
- Fish and shellfish – estimated total biomass loss of 2,464 kg (5,432 lbs)
- Benthic communities – estimated total biomass loss of 2,256 kg (4,974 lbs)
- Recreational services – an estimated 125,000 trips on the river affected by the spill

How were restoration alternatives evaluated and selected?

The Trustees considered numerous restoration alternatives to compensate the public for spill-related injuries. Each proposed project was evaluated using the following criteria:

- Restore the same species at the same location of the injury, when possible
- Ensure a high likelihood of success
- Prevent future and avoid additional injury from implementing the restoration project
- Benefit more than one natural resource and/or service
- Benefit or neutral effect on public health and safety
- Provide a cost-effective approach

After evaluating the proposals, the Trustees identified the following preferred restoration projects.

Creating tidal marsh and enhancing shoreline beach
Create five to six acres of intertidal marsh wetland adjacent to Washington Creek, a tributary of the Patuxent River, located south of Chalk Point. This wetland would be similar to those impacted by the spill and provide habitat for juvenile fish, shellfish, birds, and mammals; improve water quality by filtering sediments and other pollutants from the water column; and provide storm surge and flood protection. This project also includes creating roughly one acre of beach habitat to benefit diamondback terrapins and other organisms.

Acquiring and restoring ruddy duck nesting habitat
Restore ruddy duck nesting habitat and acquire perpetual protective easements in areas of the Prairie Pothole Region of the Midwest. Ruddy ducks breed in wetlands located in the Midwest and southern Canada and migrate to the Chesapeake Bay to spend the winter. Restoration and protection of their nesting habitats would enhance ruddy duck populations in the Bay.

Creating an oyster reef sanctuary
Create four to five acres of oyster reef sanctuary in the Patuxent River to address injuries to fish, shellfish, birds (excluding ruddy ducks), and benthic communities. Oyster reefs enhance benthic communities, increase aquatic food for fish and birds, and improve water quality by filtering out sediments and pollutants from the water column.

Improving recreational opportunities
The Trustees propose the following alternatives to address the estimated 125,000 river trips that were affected by the spill:

- Create two canoe/kayak paddle-in campsites on the Patuxent River, one north of Golden Beach and one at Milltown Landing
- Establish a disabled-accessible kayak/canoe launch at Greenwell State Park
- Improve recreational opportunities at Maxwell Hall Natural Resource Management Area
- Improve the Forest Landing boat ramp
- Rebuild the King's Landing boardwalk and provide canoes for a river education program
- Build a fishing pier at Cedar Haven Park

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CHAPTER 1.0 INTRODUCTION

This draft Restoration Plan and Environmental Assessment (Restoration Plan/ EA) was prepared by state and federal natural resource trustees responsible for restoring natural resources[1] and resource services[2] injured by the April 7, 2000 oil spill at the Potomac Electric Power Company (Pepco) Chalk Point Generating facility. The purpose of restoration, as outlined in this draft Plan, is to make the environment and the public whole for injuries resulting from the spill by implementing restoration actions that return injured natural resources and services to baseline (or prespill) conditions and compensate for interim losses.

The natural resource trustees for this oil spill include four federal and state agencies: the National Oceanic and Atmospheric Administration (NOAA), the primary federal Trustee for coastal and marine resources; the U.S. Fish and Wildlife Service (USFWS), the primary federal Trustee for migratory birds, some fish, many endangered species, and lands managed by the agency; and the Maryland Departments of the Environment (MDE) and Natural Resources (MDNR), which share responsibilities for natural resources and their supporting ecosystems belonging to, managed by, controlled by, or appertaining to the state of Maryland.

At the time of the spill, the pipeline was owned by Pepco and operated by Support Terminal (ST) Services. Under the federal Oil Pollution Act of 1990 (OPA), these Responsible Parties (RPs) are liable for the costs of conducting a natural resource damage assessment, as well as the costs of implementing the Trustees' preferred restoration actions identified in the final Restoration Plan/ EA.

The Trustees, in cooperation with the RPs, have prepared this draft Plan to inform the public about the natural resource damage assessment and restoration planning efforts that were conducted following the April 7, 2000 spill. The Trustees seek comments on the

[1] Natural resources are defined under the Oil Pollution Act as "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government.

[2] Services (or natural resources services) means the functions performed by a natural resource for the benefit of another natural resource and/or the public.

proposed restoration alternatives presented in this draft Restoration Plan/ EA. The Trustees will consider written comments received during the public comment period before finalizing the document and presenting the selected restoration alternatives to the RPs for funding or implementation.

1.1 Overview of the Incident

On April 7, 2000, at approximately 6 pm eastern daylight time, a leak was detected in a 12-inch underground pipeline that supplies oil to the Pepco Chalk Point Generating facility in Aquasco, Maryland. The U.S. Environmental Protection Agency (EPA) reported that between 126,000 and 139,000 gallons of fuel oil spilled from the ruptured pipeline into Swanson Creek, a small tributary of the Patuxent River (U.S. EPA Clean-up Order, May 1, 2000) (Figure 1). The spilled oil was a mix of Number 6 fuel, the oil normally transported by the pipeline to generate electricity, and Number 2 fuel, much lighter oil that was being used to flush the pipeline as part of a cleaning process.

Pepco, EPA, and MDE began containment and clean-up following the April 7 spill. Initial response actions were focused in Swanson Creek, and included deployment of protective booms to limit the spread of oil and the use of vacuum trucks and tanks to collect the discharged oil. On the night of April 8, severe weather conditions caused oil to breach and/or crest over the booms that had been deployed (U.S. EPA Clean-up Order, May 1, 2000), spreading oil into the Patuxent River, approximately 17 linear miles downstream. About 40 miles of environmentally sensitive downstream creeks and shorelines along the Patuxent River were oiled.

State and federal natural resource Trustee agencies also responded to the spill and observed potential indicators of injury from the effects of the release. Marshes were observed to have been exposed to black oil or sheen, birds were observed to have been oiled, and survey teams collected dead birds, fish, muskrats and other animals. As a result of public health concerns associated with the possible consumption of contaminated shellfish by the public, MDE implemented an emergency health advisory for fishing and the temporary closure of harvesting for oysters and clams in the Patuxent River north of the Thomas Johnson Bridge. A Precautionary Beach Advisory urging residents not to use beaches and shorelines impacted by the spill was also issued by MDE.

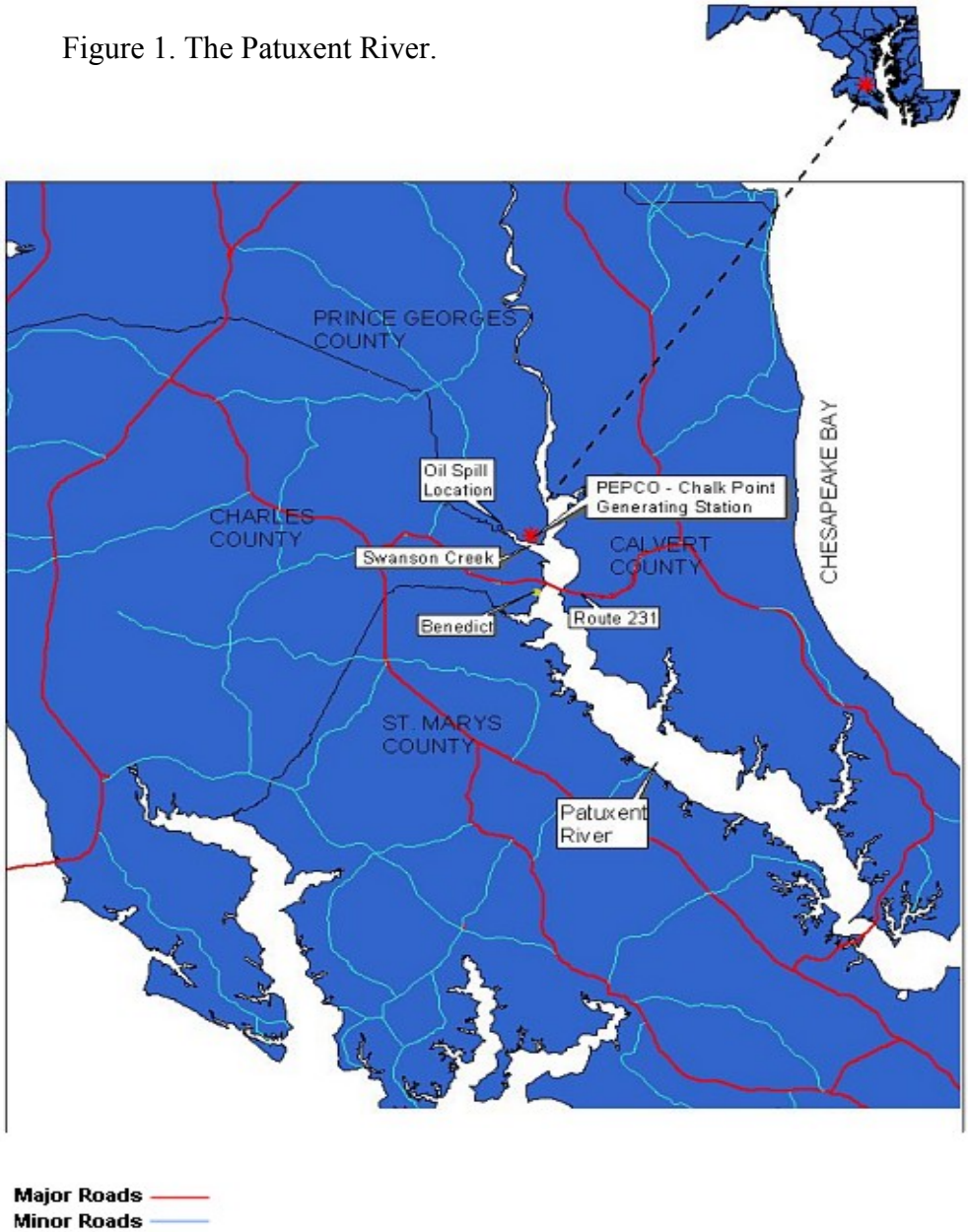
Based on information and data collected immediately following the spill, the Trustees initiated a damage assessment pursuant to section 1006 of the Oil Pollution Act (OPA) to determine the nature and extent of injuries to natural resources and services. Pepco and ST Services were active and cooperative participants in these efforts.

1.2 Summary of Natural Resource Injuries

The Trustees conducted more than 25 separate studies from April 7, 2000 through September 21, 2001 to assess the nature and extent of natural resource injuries and lost services resulting from this spill. Principal investigators included state and federal

scientists, consultants with damage assessment experience, and local experts, including those from the University of Maryland's Chesapeake Biological Laboratory and the Academy of Natural Sciences Estuarine Research Center. The findings and injury estimates derived from these studies are presented in Chapter 4 of this draft Plan. Based on this work, the Trustees believe that the spill caused injuries to natural resources in Swanson Creek and the Patuxent River, including wetlands, fish and shellfish, benthic communities, birds, and diamondback terrapins. The spill also affected recreational use. Table 1.1 summarizes the Trustees' injury assessment findings.

Figure 1. The Patuxent River.



Throughout the injury assessment and restoration planning process, the Trustees have used available information, expert scientific judgment, focused studies, and literature on

the fate and effects of oil spills to arrive at the best estimate of the injuries caused by the spill. There is, however, some uncertainty inherent in the assessment of impacts from oil spills. While collecting more information may increase the precision of the estimate of the impacts, the Trustees believe that the type and scale of restoration actions would not substantially change as a result of more research. The Trustees have sought to balance the desire for more information with the reality that further research would delay the implementation of the restoration projects, at the expense of the local environment, the citizens of Maryland, and others who use and enjoy the area's natural resources. As part of the planned restoration efforts, the Trustees intend to conduct a significant monitoring effort, both to evaluate the effectiveness of the restoration projects, and to ensure that the natural resources affected by the spill are recovering.

1.3 Summary of Preferred Restoration Alternatives

The Trustees' mandate under the federal Oil Pollution Act of 1990 (OPA) (33 U.S.C. 2706(b)) is to make the environment and the public whole for injuries to natural resources and natural resource services resulting from the discharge of oil. This requirement must be achieved through the restoration, rehabilitation, replacement or acquisition of equivalent natural resources and/or services. Thus, for a project to be considered, there must be a connection between natural resource injuries and proposed restoration actions.

Restoration actions under OPA are termed primary or compensatory. Primary restoration is any action taken to accelerate the return of injured natural resources and services to their baseline condition. Trustees may elect to rely on natural recovery rather than primary restoration actions where feasible or cost-effective primary restoration actions are not available, or where the injured resources will recover relatively quickly without human intervention.

Compensatory restoration is any action taken to compensate for interim losses of natural resources and services pending recovery. The scale of the required compensatory restoration will depend on the extent and severity of the initial resource injury and how quickly each resource and associated service returns to baseline. Primary restoration actions that speed resource recovery will reduce the requirement for compensatory restoration.

Based on observations made during the injury assessment studies and the best professional judgment of the scientific experts retained for those studies, the Trustees determined that active primary restoration would not significantly speed the recovery to baseline levels.[3] Therefore the natural recovery alternative was chosen for primary restoration.

The Trustees and their scientific advisors considered approximately 40 restoration ideas and alternatives with the potential to provide compensatory restoration. These were evaluated based on selection criteria developed by the Trustees consistent with the legal

[3] As part of the clean up and response efforts, EPA replanted areas within the immediate vicinity of the pipeline break. These actions could be considered primary restoration.

guidelines provided under OPA (15 C.F.R. 990.54(a)). Chapter 5 of this draft Plan presents OPA-based selection criteria developed by the Trustees for this spill, as well as a description and evaluation of a range of alternatives considered by the Trustees. Based on the Trustees' evaluation, a total of nine projects are being proposed as preferred restoration alternatives. These are presented for each category of injury in Table 1.1.

Table 1.1. Summary of Injuries and Restoration Alternatives. Injury estimates are described in Chapter 4 of this draft Plan; restoration alternatives are presented in Chapter 5.

Injury Category	Injury Estimate	Primary Restoration	Preferred Compensatory Restoration Alternatives
Wetlands and Shorelines	76 acres of brackish marsh habitat (40.5 acres lightly oiled, 12.0 acres moderately oiled, 23.4 acres heavily oiled)	Natural Recovery	Tidal marsh and beach creation - Washington Creek (5.66 acres)
	10 acres oiled shoreline (0.5 acre heavy, 6.4 acres moderate, 3.2 acres light)		
	376 muskrats		
Diamondback Terrapins	122 estimated dead and 10 percent loss of hatchlings in the 2000 cohort Total injury estimate is 5,245 lost discounted terrapin years	Natural Recovery	
Fish and Shellfish	2,464 kg lost biomass	Natural Recovery	Create and seed an oyster reef sanctuary (2.84 acres)
Benthic Communities	2,256 kg lost biomass	Natural Recovery	
Birds	696 birds estimated dead (553 of which were ruddy ducks)	Natural Recovery	(1) Restore ruddy duck nesting habitat (2) Create and seed an oyster reef sanctuary (1.85 acres)
Lost Recreational Use	12,704 lost trips 112,359 trips with diminished value. Estimated dollar value loss $453,500	Natural Recovery	(1) Canoe/ kayak paddle-in campsites (2) ADA-Accessible kayak/ canoe launch (3) Maxwell Hall NRMA recreational improvements (4) Forest Landing boat ramp (5) King's Landing boardwalk and river education project (6) Cedar Haven fishing pier

CHAPTER 2.0 PURPOSE AND NEED FOR RESTORATION

This draft Restoration Plan/ EA was prepared by the natural resource trustees to evaluate a range of alternatives for restoring natural resource injuries and lost services resulting from the April 7, 2000 oil spill at Chalk Point. The Trustees are making this draft Plan available to the public to solicit their comments on the proposed restoration actions. This draft Plan also serves as a draft Environmental Assessment (EA) as defined under the National Environmental Policy Act (NEPA) (42 U.S.C. 4371 et seq.).

2.1 Authorities and Legal Requirements

The four federal and state agencies that prepared this draft Plan -- NOAA, USFWS, MDE, and MDNR -- are designated pursuant to the Oil Pollution Act of 1990 (OPA) (33 U.S.C. 2706(b)) and the National Oil and Hazardous Substances Pollution Contingency Plan (40 C.F.R. 300.600 et seq.) as Trustees for natural resources injured by the Chalk Point oil spill. As a designated Trustee, each agency is authorized to act on behalf of the public to protect and restore natural resources that have been threatened by releases of oil.

2.1.1 Overview of the Oil Pollution Act

OPA provides the statutory authority for natural resource trustees to carry out the necessary studies and implement restoration projects, with reimbursement by the RPs, to assess and recover damages and to plan and implement actions to restore natural resources and resource services injured or lost as a result of a discharge of oil. The law defines injury as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service". Restoration, under OPA, means "restoring, rehabilitating, replacing or acquiring the equivalent of injured natural resources and services" and includes both primary restoration (returning injured natural resources and services to pre-spill (or baseline) conditions, and compensatory restoration (returning the interim losses of natural resources and services that occurred from the date of the incident until full recovery).

A natural resource damage assessment, as described under section 1006 of OPA (33 U.S.C. Section 2706) and its implementing regulations (15 C.F.R. 990), consist of three phases: (1) Preassessment; (2) Restoration Planning; and (3) Restoration Implementation. The Trustees may initiate a damage assessment provided that an incident has occurred; the incident is not from a public vessel or an onshore facility subject to the Trans-Alaska Pipeline Authority Act; the incident is not permitted under federal, state or local law; and Trustee natural resources may have been injured as a result of the incident.

Based on information collected during the Preassessment, the Trustees make an initial determination as to whether natural resources or services have been injured or are likely to be injured by the release. Through coordination with response agencies (e.g., the EPA for the Chalk Point incident), the Trustees next determine whether the oil spill response actions will eliminate the injury or the threat of injury to natural resources. If injuries are expected to continue and feasible restoration alternatives exist to address such injuries, the Trustees may proceed with the restoration planning phase. Restoration planning also may be necessary if injuries are not expected to continue but are suspected to have resulted in interim losses requiring compensatory restoration.

The purpose of the Restoration Planning phase is to evaluate the potential injuries to natural resources and services, and to use that information to determine the need for, and scale of, associated restoration actions. Natural resources are defined as "land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any state or local government or Indian tribe, or any foreign government". Services (or natural resources services) means the functions performed by a natural resource for the benefit of another natural resource and/or the public. This phase provides the link between injury and restoration and has two basic components -- injury assessment and restoration selection. The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services, thus providing a factual basis for evaluating the need for, type of, and scale of restoration actions. As the injury assessment is being completed, the Trustees develop a plan for restoring the injured natural resources and services. The Trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a draft Restoration Plan/ EA presenting the alternative(s) to the public, solicit public comment on the draft Restoration Plan/ EA, and consider those comments before issuing a final Restoration Plan/ EA.

During the Restoration Implementation phase, the final Restoration Plan/ EA is presented to the RPs to implement or to fund the Trustees' cost of implementing the Plan, thus providing an opportunity for settlement of damage claims without litigation. Should the RPs decline to settle a claim, OPA authorizes Trustees to bring a civil action against RPs for damages, or to seek reimbursement from the Oil Spill Liability Trust Fund equal to the value of the damages. Components of damages are specified in sections 1002(b) and 1001(5) of OPA and include the cost of conducting damage assessments.

2.1.1.1 Coordination among the Trustees

Throughout the damage assessment and restoration planning process the four federal and state Trustee agencies worked together to meet their respective natural resource trustee responsibilities under OPA, and other applicable federal law and state statutory and common law. A June 2000 Memorandum of Agreement (MOA) signed by all of the Trustees provided a framework for coordination by establishing a Trustee Council that has been responsible for all natural resource damage assessment activities, including restoration planning and implementation. The Trustee Council met on a regular basis. And while the Trustees requested that NOAA's Damage Assessment and Restoration Program assume the role of the Federal Lead Administrative Trustee and the overall natural resource damage assessment coordinator, all decisions were made by a consensus of Trustee Council representatives.

2.1.1.2 Coordination with the Responsible Parties

The OPA regulations require the Trustees to invite the RPs to participate in the damage assessment process. Accordingly, the Trustees delivered a formal invitation to Pepco and ST Services on June 22, 2000. The RPs accepted the Trustees' invitation, and a Trustee-RP MOA was signed by the Trustees and RPs in September 2000.

The Trustee–RP MOA provided the framework for cooperative damage assessment pursuant to section 1006 of OPA. Under this MOA, the Trustees and RPs formed a Natural Resource Damage Assessment Council that included the four Trustees and two RPs. The Council met regularly to review and discuss the progress of the injury assessment and restoration planning efforts. Under the Trustee–RP MOA, designated technical representatives of Pepco and ST Services participated in Technical Work Groups established by the Trustees to assist with the design of studies and interpretation of data. Information collected by all parties was shared, as were the results of those analyses that were undertaken independently by the Trustees and RPs. While the coordination between the Trustees and RPs reduced duplication of studies, increased the cost-effectiveness of the assessment process, and increased sharing of information and experts, the final authority to make determinations regarding injury and restoration rested solely with the Trustees.

The Trustees have also presented Pepco and ST Services with this draft Restoration Plan/ EA. This action is consistent with OPA regulations, and is intended to provide the opportunity for settlement of damage claims without litigation.

2.1.1.3 Coordination with the Public

Throughout the injury assessment and restoration planning process, the Trustees have provided the public with information on the status of injury assessment and restoration planning efforts (Appendix 1). The Trustees published a *Notice of Intent to Conduct Restoration Planning* in the Federal Register (Vol. 65, No. 28, pgs. 70698-70699 November 22, 2000), stating that based on preassessment findings, they were proceeding with restoration planning under OPA and opening an Administrative Record to facilitate

public involvement in the restoration planning process. The Trustees also worked extensively with Pepco to disseminate information to the public and conducted a number of outreach activities, including numerous public meetings with the U.S. Environmental Protection Agency and Pepco and four newsletters (called the *Swanson Creek Bulletin*) that were mailed to about 30,000 residents.

The Trustees also worked closely with the Oil Spill Citizens Advisory Committee established by Governor Parris Glendening. Trustee representatives attended all of the Committee's scheduled meetings, responded to their suggestions, concerns and needs for information, and formally solicited their recommendations for potential experts to peer review injury assessment studies and restoration ideas that they considered appropriate. The Trustees also co-hosted a technical workshop with the Committee to present injury assessment methodologies to members of the local scientific community. In addition to the Governor's Committee, the Trustees also coordinated their efforts with the Patuxent River Commission, a state watershed commission charged with coordinating state, local and federal efforts to restore and protect the Patuxent River.

The Trustees also placed information about the spill on their internet sites and made the Administrative Record for the damage assessment available for public review at the Pepco offices in St. Mary's and Calvert counties, the Maryland Department of Natural Resources, and the NOAA web site (www.darp.noaa.gov/neregion/chalkpt.htm). Through all of the above-mentioned efforts, the public was able to obtain reports and fact sheets for injury assessment studies and was provided with an agency contact to obtain more information.

Public review of this draft Restoration Plan/ EA is also considered an integral component of the restoration planning process. Through the process of public review, the Trustees are seeking public comment on: (1) the approaches used to define and estimate natural resource injuries, and (2) the projects being proposed to restore injured natural resources or replace services provided by those resources.

While preparing the final Restoration Plan/ EA, the Trustees will review and consider comments received during the public comment period. An additional opportunity for public review will be provided in the event that the Trustees decide to make significant changes to the draft Plan based on the initial public comments.

2.1.1.4 Administrative Record

The Trustees have compiled an Administrative Record which contains documents considered by the Trustees as they have planned and implemented the NRDA and addressed restoration and compensation issues and decisions. The Administrative Record is available for public review at the following locations:

Lighthouse Point Center	Information Resource Center
30383 Three Notch Road	MD Dept. of Natural Resources
Charlotte Hall, MD	580 Taylor Avenue, B-3
(301) 290-0946	Annapolis, MD 21401
1-800-685-1266	(410) 260-8830
fax (301) 290-0943	fax (410) 260-8951
Mon. - Fri. 9 am to 5 pm	Mon. - Fri. 8 am to 4 pm

In addition, documents in the Administrative Record can also be viewed at the following website: www.darp.noaa.gov/neregion/chalkpt.htm. A copy of the Administrative Record index is provided in Appendix 2 of this draft Restoration Plan/ EA.

2.1.2 NEPA Compliance

Restoration of natural resources under OPA must comply with NEPA (42 U.S.C. 4371 et seq.) and its implementing regulations (40 C.F.R. 1500 et seq.). In compliance with NEPA, this draft Restoration Plan also serves as an Environmental Assessment (EA). As such, it includes a summary of the current environmental setting, describes the purpose and need for action, and identifies alternative actions and their potential environmental consequences.

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

CHAPTER 3.0 AFFECTED ENVIRONMENT

This chapter presents a brief description of the physical, biological, and cultural environment affected by the Chalk Point oil spill, as required by NEPA (40 U.S.C. Section 4321, et. seq.). The physical environment includes approximately 40 miles of surface water, sediments, and shoreline along the main stem of the Patuxent River and associated tidal tributaries, marshes, and shoreline habitats including (but not limited to) the mainstem of the Patuxent River, Swanson Creek, Indian Creek, Trent Hall Creek, Washington Creek, Cremona Creek and Caney Creek. The biological environment includes a wide variety of birds, fish, mammals, shellfish, and other organisms. The federally-recognized threatened bald eagle and Puritan tiger beetle reside in the Patuxent River region. The diamondback terrapin, Maryland's official state reptile, is also of special interest to state and federal wildlife managers and is found within the spill area.

3.1 Physical Environment

The 963-square-mile Patuxent watershed, located entirely in Maryland, drains into the western shore of the Chesapeake Bay and is the next major tidal arm of the Bay upstream from the Potomac River. There are 6,773 acres of coastal wetlands within the Patuxent River watershed, accounting for 2.6 percent of the total area of coastal wetlands in the State and consisting mainly of fresh and brackish marsh wetlands (McCormick and Somes, 1982). The portion of the Patuxent River watershed affected by the Chalk Point oil spill (the Lower Patuxent) stretches through Prince George's, Charles, St. Mary's, and Calvert counties. Coastal wetlands and associated estuaries are vital to the maintenance of commercial and sport fisheries and shellfisheries. At least 60 percent of the species important to these activities in Maryland are dependent on the estuarine environments during at least part of their lives (Metzgar, 1973). Wetlands are also transition zones from uplands to deepwater aquatic systems. This niche in the landscape allows wetlands to provide valuable functions, such as those of organic exporters or inorganic nutrient sinks (Mitsch and Gosselink, 1986).

The 113-mile Patuxent River, shown in Figure 1, is a major tributary to the Chesapeake Bay and meanders through seven counties in the state of Maryland. Major tributaries contributing to the Patuxent River include the Western Branch, Little and Middle

Patuxent Rivers, in addition to two large water supply reservoirs that supply water to the Washington, D.C., metropolitan area. The Lower Patuxent River watershed consists of moderately saline water. Low salinity conditions exist in the Middle Patuxent, while the Upper Patuxent consists of tidal fresh water.

The Chalk Point spill released fuel oil into Swanson Creek (Figure 1), a tidal tributary of the Patuxent River approximately 23 miles from the mouth of the river at the Chesapeake Bay. The main stem of the Patuxent River, associated shoreline habitats, and other tributaries were impacted as far south as Broomes Island, approximately 15 miles from the site of the spill. The shoreline and riparian area is comprised of brackish marshes, which are the predominant estuarine wetland type in Maryland, and palustrine wetlands, represented by fresh water marshes and swamps (Tiner and Burke, 1995).

Table 3.1 provides additional information about the types of wetlands found in the Patuxent River watershed. Within the fresh marsh category, the most common types of wetlands are smartweed/rice cutgrass, composed almost entirely of one or several species of smartweeds or tearthumbs, and cattails, composed purely of the common cattail (McCormick and Somes, 1982). The fresh marsh wetlands are generally farther north of the mouth of the Patuxent River or along tributaries that drain into the Patuxent. Within the brackish high marsh category, the most common types of wetlands are cattails and salt marsh hay. The marshes, shrub swamps, swamp forests, and submerged vegetation of coastal wetlands are the principal sources of food for the animals that inhabit the waters of the Chesapeake Bay estuary, coastal bays, and the nearshore ocean (McCormick and Somes, 1982). These habitats provide many other benefits to society through fish and wildlife habitats, water quality maintenance (pollution filter, sediment removal, oxygen production, nutrient recycling), aquatic productivity, and socio-economic values such as flood control, wave damage protection, shoreline erosion, water supply, and groundwater recharge (Tiner and Burke, 1995)

Table 3.1. Wetlands in the Patuxent River Watershed (from McCormick and Somes (1982)).

Category	Acres of Wetland	Percentage
Shrub Swamp	461	6.8
Wooded Swamp	20	0.3
Fresh Marsh	2,605	38.5
Brackish High Marsh	2,866	42.3
Brackish Low Marsh	449	6.6
Saline High Marsh	0	0
Saline Low Marsh	0	0
Open Water	177	2.6
Mudflat/Sandbar/Beach	23	0.3
Submerged Aquatics	51	0.8
Untyped Wetlands	121	1.8
Total	**6,773**	**100**

The physical environment of the Patuxent River watershed is impacted by human development. Human activities that can affect wetlands include livestock grazing, timber harvesting, and drainage for agriculture and filling for industrial or residential development. In addition, there are many natural threats to the wetlands ecosystem such as subsidence (including the natural rise of sea level), droughts, hurricanes, tornados and biotic effects (Tiner and Burke, 1995).

3.2 Biological Environment

The waters of the Patuxent River and its tributaries serve as important spawning or nursery sites for many finfish and shellfish species such as spot, croaker, striped bass, menhaden, herring, and shad, as well as clams, oysters, and blue crabs. Freshwater spawning marine species, such as striped bass and American shad, and many marine spawners, including bluefish and menhaden, depend on wetlands for nursery, feeding, and cover areas. Metzger (1973) recognized irregularly flooded salt marsh as a highly valued habitat for fishery resources based on usage by 21 species including prized commercial and sport fish such as bluefish, striped bass, and white perch. Major tributaries of the Chesapeake Bay, including the Patuxent, account for approximately 90 percent of the striped bass spawned on the East Coast (Berggren and Lieberman, 1997).

Benthic invertebrates, including oysters, clams, and crabs, are among the most important components of estuarine ecosystems and may represent the largest standing stock of organic carbon in estuaries (Frithsen, 1989). Blue crab is the most abundant and valuable shellfish catch in Maryland, with a five-year average (1996 – 2000) harvest of 31.8 million pounds and an annual dockside value of $33.2 million (Chesapeake Bay Commission, 2001). Blue crabs commonly use marshes, wetlands and submerged aquatic vegetation in the Patuxent River as nursery grounds, and they seek refuge in these areas when molting.

Wetlands provide year-round habitats for a host of resident and migratory bird species and are particularly important breeding grounds, overwintering areas, and feeding grounds for migratory waterfowl and numerous other birds. The Chesapeake Bay and its associated wetlands have been the winter home of approximately one-third of all the waterfowl using the Atlantic Flyway (Tiner and Burke, 1995). The abundance of crustaceans, mollusks, and other invertebrates in the smooth cordgrass zone of the tidal marsh provides food for herons, egrets, boat-tailed grackles, laughing gulls, seaside sparrows, and other birds (McCormick and Somes, 1982). During the autumn and spring periods of migration, waterfowl, including black and ruddy ducks and green-winged and blue-winged teal are abundant on the brackish marshes along the bays in the upper Chesapeake region of Maryland (McCormick and Somes, 1982). Fresh water tidal marshes are common feeding grounds for red-winged blackbirds, bobolinks, rails, teals and other ducks (Stewart, 1949; Meanly, 1975). In addition to the large numbers of waterfowl that inhabit the Patuxent River watershed, ospreys and great blue herons commonly nest in the impacted region near Swanson Creek. Other wildlife that inhabit

Maryland's wetlands include mammals (e.g., muskrats), reptiles (e.g., turtles, lizards, and snakes) and amphibians (e.g., toads, frogs, and salamanders) (Tiner and Burke, 1995).

3.2.1 Species of Special Concern

The Patuxent River watershed ecosystem provides particularly valuable habitat for the bald eagle, a bird included on the federal list of threatened species. The section of Swanson Creek and Patuxent River impacted by the spill is used by several pairs of nesting bald eagles (McGowan, 2000). In total, six nests were identified within the spill zone, three of which were active during the spill. The nesting period of the bald eagle is generally from February 15 to August 1.

A second federally-recognized threatened species, the Puritan tiger beetle, is also present near the Patuxent River. Although this species is a member of the ecosystem affected by the Chalk Point oil spill, available information indicates that they were located outside of areas directly impacted by the spill.

Diamondback terrapins are also found along the Patuxent River. Although not currently on the state or federal list of threatened species, terrapins are of special concern to the state. Terrapins are long-lived animals (>40 years) with maturity at 4 to 7 years for males and 8 to 13 years for females. They mate in April and May depending on water temperatures. Their nesting season is roughly between early June and the end of July when eggs are laid above the high tide line on many of the narrow, isolated sandy beaches found along the fringes of Patuxent River salt marshes (Roosenburg, 1996). Roosenburg (1994) reported nesting densities ranging from 240 to 1125 nests per hectare in the Lower Patuxent River.

No plants listed under the Endangered Species Act were known to be impacted by the spill.

3.3 Cultural Environment

The Patuxent River has been a vital resource for the region for thousands of years. Native Americans lived in the area as early as 7,500 B.C. Early European settlements and plantations were established along the Patuxent River in the early 1600s (e.g., Jug Bay Wetlands Sanctuary). Several locations along the Patuxent were significant sites in the War of 1812.

In addition to valuable cultural resources, the Patuxent River watershed supports a considerable amount of recreational activity, including fishing, swimming, boating, and picnicking. Recreational anglers took 3,722,018 fishing trips and caught 17,175,687 fish within the state in 2000 (NMFS, 2000). National Marine Fisheries Service data indicate that $63 million of fish were landed commercially in Maryland in 1999 (NMFS, 1999). While available data are not sufficient to determine the contribution of economic activity in the impact area to these statewide totals, the contributions are significant and depend on a healthy ecosystem in the Patuxent River region.

CHAPTER 4.0 INJURY DETERMINATION

This chapter describes the Trustees' efforts to quantify the nature, extent and severity of injuries to natural resources and recreational uses resulting from the April 7, 2000 oil spill at Pepco's Chalk Point facility. It begins with an overview of the data collected immediately following the spill as part of the "preassessment", followed by a description of the Trustees' damage assessment strategy. The remainder of this chapter presents summaries of the injury assessment methods and results.

4.1 Overview of Preassessment Activities and Findings

The Trustees for the Chalk Point oil spill initiated preassessment activities on April 8, 2000, immediately following notification of the spill. Preassessment activities, as defined by OPA, focused on collecting ephemeral data essential to determine whether: (1) injuries have resulted, or are likely to result, from the incident; (2) response actions have adequately addressed, or are expected to address, the injuries resulting from the incident; and (3) feasible restoration actions exist to address the potential injuries. The following summarizes key preassessment activities and findings:

Shoreline Oiling Surveys: On-the-ground and aerial surveys from about four miles upstream of Swanson Creek to the Thomas Johnson Bridge at Solomons, MD were conducted to document the location, amount, and extent of oiling in Swanson Creek and along the Patuxent River and its tributaries. These surveys indicated that about 96 acres of beach shoreline, manmade shoreline and marsh habitat were exposed to oil (Entrix, 2002a).

Oiled Wildlife Surveys: Survey teams walked the shoreline from April 9 through April 16, 2000, recording the extent and degree of oiled wildlife, collecting dead wildlife and capturing oiled birds (if possible) for rehabilitation. An aerial survey on April 12, 2000 provided information on bird populations in the area of the Patuxent River from Eagle Harbor to the mouth of the Patuxent River. A separate survey was also conducted to evaluate impacts of the oil spill on muskrats in Swanson Creek. A total of 831 dead animals were collected, including 67 birds, 90 mammals, 25 reptiles, 539 fish, and 84 invertebrates (McGowan, 2000).

Sediment Blotting: On April 29 and 30, 2000, a survey was conducted in the Patuxent River and its tributaries to determine if oil was settling on the river bottom. A weighted sorbent pad was pushed to the bottom sediment, retrieved, and visually inspected for the presence of oil. Sixty-four locations in Swanson Creek, Indian Creek, Trent Hall Creek, and the Golden Beach area were sampled at depths to 15 feet. Some oil was detected in the intertidal shoreline habitat (Entrix, 2002b).

Oil Properties and Fate: The properties of the spilled oil (a combination of Number 6 and Number 2 oils) were analyzed and determined to have the following physical properties: specific gravity of 0.94 g/cc at 60°F; API Gravity of 18.4 at 60°F; and kinematic viscosity of 287.53 centistokes at 60°F. To predict the amount of oil that evaporated into the air and/or dispersed into the water column, NOAA modeled the fate and effects of the spilled oil. Model results indicate that 31 percent of the spilled oil evaporated into the air and 8 percent dispersed into the water column within the first 5 days of the spill (Entrix, 2002b).

Shellfish, Crab, and Fish Tissue Surveys: The MDE implemented an emergency closure for harvesting oysters and clams in the Patuxent River north of the Thomas Johnson Bridge based on public health concerns associated with the consumption of potentially contaminated shellfish. Shellfish, crab, and fish tissue samples were subsequently collected from the Patuxent River and analyzed for concentrations of polycyclic aromatic hydrocarbons (PAHs). The shellfish survey, conducted in cooperation with a local waterman, included 25 locations from north of Broomes Island to Ramsey Creek, approximately 13 miles. The crab survey was conducted by commercial watermen at 10 locations between Broomes Island and Eagle Harbor. Pepco and MDE collected a variety of fish species by trawl following the spill. Analyses of the tissue data indicated that levels of petroleum substances in shellfish, crabs, and fish did not pose a human health risk (Entrix, 2002b).

Abiotic Surveys: Surface water and sediment samples were collected to characterize the extent and magnitude of PAHs in the spill area on April 8, 2000 from six locations in Swanson Creek. On April 10, 2000, seven locations in Swanson Creek and six sites near the mouth of Swanson Creek in the Patuxent River were sampled. From April 12 to 14, 2000, surface water samples were collected at 26 stations and sediment samples were collected at 33 stations located from about 4 miles upstream of Chalk Point to Broomes Island. Total PAH concentrations in water samples ranged to 767.82 ug/l (Entrix, 2002b).

Based on information collected during the preassessment efforts summarized above, the Trustees identified the following six categories of injury: (1) wetlands and beach shoreline, (2) fish and shellfish, (3) benthic communities, (4) birds, (5) diamondback terrapins and (6) recreational use. The Trustees determined that a number of potential restoration actions exist to compensate for the losses and proceeded with injury assessments.

4.2 Injury Assessment Strategy

The goal of injury assessment is to determine the nature, extent and severity of injuries to natural resources, thus providing the technical basis for evaluating and scaling restoration actions. The OPA defines injury as "an observable or measurable adverse change in a natural resource or impairment of a natural resource service." Diminution in the quantity and/or quality of recreational use of natural resources also constitutes an injury as defined by OPA regulations.

For each of the six injury categories, the Trustees selected appropriate assessment procedures based on the: (1) range of procedures available under section 990.27(b) of OPA regulations; (2) time and cost necessary to implement the procedures; (3) potential nature, degree, and spatial and temporal extent of the injury; (4) potential restoration actions for the injury; (5) relevance and adequacy of information generated by the procedures to meet information requirements of planning appropriate restoration actions; and (6) input from local, state, and government officials, the RPs, and academic and other experts knowledgeable about the affected environment.

Each injury assessment focused on determining both the magnitude of the injury (i.e., number of animals killed or area of habitat lost) and the time to full recovery. This was accomplished for some resources, such as terrapins, by multiplying the number of lost animals by the recovery period to generate a number denominated in units such as terrapin-years. For wetland and beach shoreline habitats, injuries were quantified as acre-years, where an acre-year is the flow of benefits that one acre provides over the period of one year. Injury assessments also considered "production foregone," measured as either the growth in organism biomass or number of offspring that would have been produced in the absence of the spill. For recreational use, losses were calculated as the number of trips not taken to the spill zone and diminished value of trips that were taken, expressed in dollars. Injury estimates in future years were discounted at three percent per year (NOAA, 1999), summed, and added to the injury in the year of the spill yielding an estimate of total injury. All of these methods produce an estimate of direct plus interim (from the time of injury until full recovery) loss of resources resulting from the oil.

Injury assessment studies were conducted by federal and state scientists, consultants with damage assessment experience, and local experts, including those from the Academy of Natural Sciences and the Chesapeake Biological Laboratory. A full description of the injury assessment methods and results is presented in resource specific injury reports prepared by the principal investigators. In each instance, the Trustees retained an outside expert to peer review key reports and, where appropriate, the Trustees modified each report to address peer review comments prior to approval. Final injury reports and peer review comments were then placed into the Administrative Record, where they are available for public review (see section 2.1.1.4). Section 4.3 of this draft Plan presents a summary of each injury assessment, including methods and findings.

4.3 Injury Assessment Methods and Results

The following sections describe the results of the Trustees' injury assessments for the Chalk Point oil spill. Descriptions of injuries are organized into the following six categories: wetlands and beach shoreline, fish and shellfish, benthic communities, birds, diamondback terrapins, and recreational use.

4.3.1 Wetlands and Beach Shoreline Injury Assessment

Field surveys and observations made during preassessment efforts indicate that about 76 acres of wetlands were oiled. Of this total, 40.5 acres were lightly oiled, 12.0 acres were moderately oiled, and 23.4 acres were heavily oiled (Entrix, 2002a) (Table 4.1).

The Trustees and RPs conducted a field study to determine the nature, extent and severity of marsh injuries. In July 2000, September 2000, and July 2001, data on degree of oiling, vegetative metrics (e.g., stem height, stem density, etc.), sediment chemistry, and abundance and composition of infauna were collected at 61 one square meter quadrats established in oiled and unoiled marshes. A comparison of field data from oiled and unoiled areas was then used as a relative indicator to estimate the degree of injury and time for full recovery.

To account for the different aspects of wetlands and the effects of oil on the different physical components, injury was estimated for wetland vegetation and wetland soils separately. Above-ground vegetation represents a broad range of ecological functions (or services) related to primary production, habitat structure, recreational and aesthetic value, food chain support, and fish and shellfish production. Assessment of soil function is also important to understanding potential effects of the oil on soil development, long-term plant response and biogeochemical cycling.

Table 4.1 shows the final estimated area and associated vegetative and soil injuries for wetlands based on habitat type and degree of oiling. A complete description of the injury assessment can be found in Michel et al. (2002). A brief description of the wetland injuries is presented below:

(1) Lightly oiled wetlands: Approximately 40.5 acres of marsh were lightly oiled, defined as areas with less than 10 percent oil distribution and 0.01 cm oil thickness. All lightly oiled wetlands were combined into one category, without distinction among vegetation types, because injuries were expected to be minimal. Marsh vegetation and marsh soils in this category were estimated to have suffered an initial 10 percent loss, with full recovery by October 2000 (six months following the spill and following the first growing season). The estimated interim loss of wetlands in this category is provided in Table 4.1.

(2) Moderately oiled wetlands: Moderately oiled marshes included areas outside of Swanson Creek with more than 10 percent oil distribution and 0.01 cm oil thickness. All moderately oiled wetland habitat types were combined into one injury category because few differences were noted between the different plant species, and they often formed

mixed stands. A total of 12.02 acres of marsh were exposed to moderate oiling. Field observations and data collected at these areas showed the following:

- At about 25 percent of the sites visited in July and September 2000, oil droplets were released from soils when disturbed. By July 2001, slight sheening was observed after soil disturbance at just two sites;

- One of the sites, located in an area that received intensive clean-up, showed significant vegetative mortality (i.e., reduced stem count and percent cover) in 2000 and 2001; and

- Total petroleum hydrocarbon (TPH) concentrations in soils from two sites in 2000 were 3,270 and 4,230 parts per million (ppm); concentrations of polynuclear aromatic hydrocarbons (PAH) in soils from these sites were 90 and 330 ppm, and the oil was characterized as weathered to significantly weathered.

Based on the field data, as highlighted above, the vegetation and soils in this wetland category were estimated to have suffered a 50 percent initial loss of function, with recovery in one year for vegetation and three years for soils. Table 4.1 provides the estimated interim loss of marsh in this category.

(3) Heavily oiled wetlands: This category included all areas within Swanson Creek with more than 10 percent oil distribution and 0.01 cm oil thickness. Heavily oiled wetlands were divided into shoreline and interior areas for each of the predominant vegetation types (*Typha sp., S. alterniflora,* and *S. cynosuroides)* because of significant differences in degree of oiling and expected natural rates of oil weathering for these two settings.

(3a) Heavily oiled *Typha sp.*: A total of 0.16 acre of shoreline and 2.3 acres *Typha sp.* of interior wetlands were heavily oiled. Observations and data from these areas can be summarized as follows:

- Vegetative cover, stem density, and stem height data were highly variable, but generally comparable with controls in July 2000 and 2001;

- At all sites, oil droplets were released from the soils when disturbed underwater in 2000. By 2001, only sheens were released after disturbance;

- Soil chemistry data for 0 - 5 cm depths in 2000 showed widely different degrees of soil contamination, with one site having 40 times more TPH (37,000 ppm) than the other (840 ppm). Data from 2001 showed only slight decreases. PAH levels in surface soils in 2001 were 9 and 1,500 ppm and moderately weathered, indicating highly variable but very high and toxic levels; and

- Concentrations of TPH for interior sites in July 2000 were typically lower than those on the shoreline, and ranged from background to 7,600 ppm. Only one PAH analysis was available, from 2000, with a result of 540 ppm and slight weathering.

Based on field data described above and observations at other spills, the Trustees estimated that heavily oiled *Typha sp.* vegetation in shoreline and interior areas suffered an initial 100 percent loss of function, with full recovery within 1 year. Interior soils were estimated to have suffered an initial 50 percent loss, with recovery to 80 percent in 5 years and 100 percent in 10 years. For shoreline soils, an initial 75 percent loss was estimated, with a return to 60 percent in three years, and 100 percent in ten years. Table 4.1 provides the estimated interim loss of marsh in this category.

(3b) Heavily oiled *S. alterniflora*: A total of 1.52 acres of shoreline and 3.80 acres *S. alterniflora* interior wetlands were heavily oiled. Observations and data from these areas can be summarized as follows:

- Shortly after the spill, shoreline vegetation cover and stem densities were reduced compared to reference sites. Although values were still lower than reference sites in 2001, percent cover and stem density had increased by about a factor of two;

- Oil penetrated into the substrate, along stem cavities and roots. Oil droplets were released from the sediments when disturbed underwater in July 2000. By July 2001, only sheens were released upon disturbance;

- TPH levels in interior soils in 2000 were highly variable, ranging from background to over 15,000 ppm, with evidence of penetration at depths greater than 10 cm. By 2001, TPH levels had decreased (maximum 1,850 ppm), and all saturated hydrocarbons were characterized as significantly weathered. PAH levels in interior soils in 2000 ranged from 2 - 210 ppm; levels in 2001 were 1 - 54 ppm and characterized as moderately weathered; and

- Benthic community data collected in July 2000 from interior sites showed a reduction in both overall species numbers and numbers of oil-sensitive species (amphipods and isopods) compared to reference sites, but species numbers were similar to reference sites by September 2000.

The Trustees estimated from the field data summarized above that the heavily oiled *S. alterniflora* vegetation in both shoreline and interior habitats suffered an initial 100 percent loss of function, with a recovery to 50 percent in 1 year and 100 percent in five years. Soils were estimated to have suffered an initial 75 percent loss. Along the shoreline, recovery of soils is expected at 80 percent within three years and 100 percent within five years. As interior soils experience higher initial oil levels and are subject to lower natural removal rates, recovery is estimated at 75 percent within five years and 100 percent within 10 years. Table 4.1 provides the estimated interim loss of marsh in this category.

(3c) Heavily oiled *S. cynosuroides*: A total of 1.66 acres of shoreline and 7.60 acres of interior *S. cynosuroides* marsh were heavily oiled. Oiling exposure and impacts in these areas can be summarized as follows:

- Impacts to interior vegetation varied widely. Some areas were completely devoid of vegetation while others had reduced stem densities or appeared normal. By 2001, two interior sites showed good recovery (similar to reference sites) while a third showed very little re-growth. Shoreline vegetation showed good recovery by 2001;

- Oil penetrated deep into root clumps, along stem cavities, roots, and burrows (20+ cm in some cores). In July 2000, black oil droplets were released from disturbed sediments at all quadrats. Soil cores at the interior sites had oil-filled pores in 2000 and 2001. Surface oil samples collected in both 2000 and 2001 contained over 40,000 ppm TPH. There was evidence of alkane weathering in the surface soils between 2000 and 2001, but little to no weathering of the PAHs; and

- Benthic communities showed partial recovery by September 2000, but poor recruitment of oil-sensitive species by July 2001.

The heavily oiled *S. cynosuroides* vegetation in both shoreline and interior habitats were estimated to have suffered an initial 100 percent loss of function, with a recovery to 50 percent in 1 year and 100 percent in 10 years. Shoreline and interior soil functions were estimated to have suffered losses of 75 percent initially, with shoreline habitats returning to 60 percent in three years and 100 percent in 10 years. Soil functions for interior habitats were estimated at 50 percent in five years and 100 percent in 20 years. Table 4.1 provides the estimated interim loss of these marshes.

(4) <u>"W1A" Wetlands</u>: Approximately 6.4 acres of wetlands in the immediate vicinity of the pipeline break (the area referred to as W1A) were the most heavily oiled and subject to the most aggressive clean-up activities (flooding, flushing, trenching, construction of boardwalks, nutrient augmentation, replanting, etc.). Oiling exposure and impacts in these areas can be summarized as follows:

- Initial oiling consisted of thick pools that formed and persisted on the marsh surface for several weeks until cleaned up. There was chronic re-oiling at least until July 2001, as residual oil was re-mobilized;

- Oil penetrated deeply into the root clumps, along stem cavities, roots, burrows, etc. In September 2000, one site contained 77,800 ppm TPH and 7,140 ppm PAH in the top 5 cm, with 6,300 ppm TPH and 420 ppm PAH at the interval 18-20 cm. At this same site in 2001, the surface oiling decreased by about half, but the subsurface oiling increased by about a factor of two, with no evidence of further weathering;

- Ditched areas, although backfilled with clean sand, contained 1,300 and 3,900 ppm TPH in 2000, indicating a substantial amount of re-oiling; and

- Vegetation in the replanted areas showed large reductions in cover and stem density.

Based on field observations, the W1A area was divided into "less-impacted areas" and "more-impacted areas." The "more-impacted" areas include those that were ditched to facilitate oil clean up and subsequently replanted, as well as areas of extensive physical disturbance during pipeline repair activities. The remainder of W1A, where the vegetation showed significant recovery, was considered "less-impacted." Vegetation in both areas was estimated to have suffered an initial 100 percent loss. At one year, vegetative recovery at less-impacted areas was 50 percent and at more impacted areas 20 percent. Both were estimated to recover fully in 10 years. For soil-related services at both "less-" and "more-impacted" areas, initial loss was estimated to be 100 percent, with full recovery in 20 years. Table 4.1 provides a summary of the estimated interim losses of marsh in this category.

(5) Restricted Access Areas: This category included 4.11 areas of unoiled wetlands that were nearly surrounded by oiled wetlands, thereby restricting access to wildlife during the time that oil persisted in adjacent areas. It was estimated that there was an initial 100 percent loss of vegetation in these areas, with full recovery within one year. There were no estimated reductions in soil function for this injury category. Table 4.1 provides a summary of the estimated interim losses of marsh in this category.

Table 4.1. Summary of Wetland Injury by Habitat Type and Degree of Oiling.

Degree of Oiling/ Habitat Type	Total Area (Acres)	Vegetation Injury (Acre years)	Soil Injury (Acre years)
Lightly oiled	40.50	1.01	1.01
Moderately oiled	12.02	3.01	8.87
Heavily oiled *Typha* sp. shoreline	0.16	0.08	0.46
Typha sp. interior	2.30	1.15	4.79
S. alterniflora shoreline	1.52	2.58	2.40
S. alterniflora interior	3.80	6.45	11.05
S. cynosuroides shoreline	1.66	4.62	4.81
S. cynosuroides interior	7.60	21.14	44.14
W1A: less impacted	3.21	8.94	18.99
W1A: more impacted	3.21	13.33	23.01
Total Oiled Area	**75.94**	--	--
Restricted Access (unoiled)	4.11	2.05	0.00
Total Injury Area	**80.05**	**64.35**	**119.53**

Summing the categories of wetland injuries provides a total injury estimate of approximately 64 acre-years for vegetation-related services and 120 acre-years for soil-

related services (Table 4.1)[4]. Assuming that the contributions of vegetation and soils to overall wetland functions are equal, the total injury is 91.94 wetland acre-years.[5]

The loss of marsh habitat, as quantified in acre-years, will be used to scale restoration actions that produce sufficient compensation for the losses. An assumption inherent in this injury assessment is that the quantification of wetland injury takes into account the entire flow of marsh services, including habitat for wildlife. To validate that the scale of marsh restoration would compensate for associated wildlife injuries, the Trustees assessed injuries to muskrats and the marsh acreage needed to compensate for these losses. Based on the 70 dead muskrats that were collected following the spill, a total of 376 muskrats were estimated to have been killed (Michel et al., 2002; Appendix D). The scaling calculations presented in chapter 5 indicate that the area of marsh needed to compensate for the wetlands injury will also compensate for the muskrat injuries.

(6) Beach Shorelines: Approximately 10.11 acres of beach shoreline were oiled by the Chalk Point spill. Of this total, about 0.5 acre was heavily oiled, 6.4 acres were moderately oiled, and 3.2 acres were lightly oiled.

Most beach shorelines recovered within a relatively short time after the spill. Approximately 70 percent of the oiled beach acreage met the Phase 1 clean-up criteria established by EPA[6] within several months of the spill. Ninety-six percent of the remaining oiled beach shoreline acreage met Phase 1 criteria within approximately one year (or less). Estimates of the initial loss were 25 percent for lightly oiled shorelines, 75 percent for moderately oiled shorelines, and 100 percent for heavily oiled shorelines. Full recovery in all areas was estimated at 6 - 30 months from the date of the spill. Estimated interim loss of shorelines is 4.7 acre years. A complete description of the assessment of beach shoreline injuries is provided in Appendix E of Michel et al. (2002).

4.3.2 Fish and Shellfish Injury Assessment

The Chalk Point oil spill occurred during the spring spawning period of many fish that inhabit the Patuxent River. Preassessment data indicate that fish and shellfish resources were exposed to oil and died as a result of the Chalk Point oil spill. Water samples collected during the spill indicated that petroleum products were present in the water column in Swanson Creek at levels that may be toxic to aquatic organisms. In addition, laboratory tests conducted by the Academy of Natural Sciences indicated that water collected from Swanson Creek a few days after the spill occurred, was acutely toxic to striped bass larvae (Breitburg and Riedel, 2001). Field surveys recovered more than 500 dead fish and 80 dead invertebrates, many of these with visible signs of oiling (McGowan, 2000).

The full nature and extent of injuries to fish and shellfish was estimated through model analysis using SIMAP (Spill Impact Model Analysis Package) (French McCay and

[4] An acre-year is the flow of benefits that one acre provides over the period of one year.
[5] (64.35 acre-years vegetation x 0.50) + (119.53 acre-years soils x 0.50) = 91.94 wetland acre-years.
[6] EPA Response Action Plan, July 2000

Jennings, 2002). This model system is based on the Natural Resource Damage Assessment Model for Coastal and Marine Environments (Version 2.4, April 1996), which is included in the Code of Federal Regulations (43 C.F.R. Part II) for performing natural resource damage assessments for spills under the Comprehensive Environmental Response, Compensation and Liability Act (42 U.S.C. 9601 et seq.).

SIMAP includes two submodels. The physical fates submodel estimates the distribution of the spilled oil (as mass and concentrations) on the water surface, on shorelines, in the water column and in the sediments. The model is three-dimensional, using a latitude-longitude grid to map environmental data. Algorithms based on published research account for spreading, evaporation, transport, dispersion, emulsification, entrainment, dissolution, volatilization, partitioning, sedimentation and degradation (weathering) of the oil. Site- and incident-specific data used in the model include hourly wind speed and direction taken from Thomas Pt., MD (NOAA station TPLM2) and hydrographic data obtained from the NOAA National Geophysical Data Center. The results and outputs of the physical fates submodel, including the predicted oil trajectory and dissolved PAH concentrations, were validated by comparison with shoreline survey observations, aerial overflight maps made during the response and measured concentrations of TPH and PAH in samples taken during the week following the spill.

The second component of SIMAP is the biological fates submodel. This submodel assumes exposure to fish and shellfish through contact with dissolved aromatic compounds in water and sediments, as predicted by the physical fates model. It uses habitat-specific data, estimates of fish and shellfish biomass, and documented species-specific sensitivities to oil to estimate mortality of adults, as well as their eggs and larvae. Mortality is calculated for present and future years, using estimated abundance and mortality rates that would occur in the absence of the spill.

Fish and shellfish biomass (kg/ km^2) estimates used as input parameters for the biological effects model were based on surveys conducted by the MDE immediately following the spill and the historic literature, as well as the best professional judgment of fisheries experts within MDNR, MDE, NOAA, and the USFWS (Entrix, 2002c). Despite the inherent uncertainties associated with developing species-specific biomass estimates for use in the model, the Trustees believe that the estimates are reasonable, and that more precise estimates would require extensive monitoring in future years that would delay implementation of restoration, and substantially increase assessment costs.

Fish and shellfish losses estimated by SIMAP for all age classes are summarized in Table 4.2. Assuming the model input data and average species sensitivity to PAHs, the best estimate of total injury to fish and invertebrates is 2,464 kg. This total injury includes: (1) the biomass equivalent of the direct kill, equal to 1,485 kg and (2) future growth of the killed animals, had there not been a spill, totaling 979 kg (the production foregone) (French McCay and Jennings, 2002).

Table 4.2. Model estimates of fish and invertebrate losses totaled for all age classes, assuming average species LC50 = 75 ug/L.

Species	Kill (kg)	Production Forgone (kg)	Total Injury (kg)
Bay anchovy	0.01	0.0	0.01
Blueback herring	0.02	0.1	0.12
Atlantic menhaden	120	50	170
Atlantic silverside	1.39	0.21	1.6
Striped killifish	0.30	0.05	0.35
Mummichog	4.4	0.7	5.1
Spottail shiner	0.02	0.00	0.02
Inland silverside	0.01	0.00	0.01
Less common finfish	1.7	0.3	2.0
Striped bass	60	81	141
White perch	252	343	595
Atlantic croaker	329	317	645
American eel	17	20	38
Hogchoker	84	70	154
Brown bullhead	1.7	0.7	2.4
Blue crab	579	44	623
Horseshoe crabs	32	51	83
Oysters, dry weight	2.1	0.8	2.9
Total	**1,485**	**979**	**2,464**

4.3.3 Benthic Communities Injury Assessment

Preassessment activities provided evidence that the spilled oil contaminated intertidal and subtidal sediments, as well as created potentially toxic conditions in the water column. To evaluate the injury to benthic macroinvertebrates due to exposure to oil contaminated sediments or water, the Trustees undertook several studies to determine the extent and duration of injuries to benthic communities. The first was conducted by the Academy of Natural Sciences Estuarine Research Center to measure the abundance of infaunal invertebrates from intertidal and subtidal areas located in Hunting Creek (control site), Trent Hall Creek (moderately oiled site), and Swanson Creek (heavily oiled site) (Osman, 2001). The second benthic injury assessment study, conducted by Versar Inc., compared macrofauna and sediment characteristics in Swanson Creek to the mainstem of the Patuxent River and to Hunting Creek (control site) (Llanso and Volstad, 2001). The methods and analyses were consistent with the long-term benthic monitoring program in the Chesapeake Bay.

The nature and extent of injuries to subtidal benthic resources was quantified by Peterson (2002), based on data and findings presented in Osman (2001) and Llanso and Volstad (2001). Specifically, the evidence for and against spill impacts to the soft-bottom macroinvertebrates was assembled and organized by geographic area and time frame. The results of statistical analyses, along with data on average densities, were then used to

identify those species or higher taxonomic groups that demonstrated responses, positive or negative, to the spill and the geographic extent and temporal duration of the responses. The biomass contrasts for each of those affected species or taxa were then used to estimate the magnitude of the lost production per unit area (m^{-2}). The area of each impact was then calculated based on the shoreline oiling data, with the product of these latter two factors computed to estimate the total biomass change induced by the oil spill at that sampling date for each affected taxon.

The review and data analyses by Peterson (2002) found strong evidence that the spill caused injury to subtidal benthic communities in Swanson Creek. These findings included: (1) reduced biomass of bivalves (mostly *Macoma balthica* and *Rangia cuneata)* in upper Swanson Creek in June and September 2000, (2) reduced biomass of amphipods (*Leptocheirus plumulosus*) in upper and lower Swanson Creek in June 2000 and upper Swanson Creek in September 2000, and (3) increased biomass of polychaetes. The data did not indicate any compelling evidence of benthic injury in the mainstem Patuxent (Peterson, 2002).

Table 4.3 summarizes the estimate of benthic injury, presented in units of Ash-Free Dry Weight (AFDW). The reduction of bivalve biomass in upper Swanson Creek was estimated to be 1.14 g m^{-2} in June 2000 and 2.73 g m^{-2} in September 2000. Because growth naturally slows dramatically as water cools in the fall and *M. balthica* is largely an annual species with strong year classes living little more than a year (Holland et al., 1987), the difference in biomass at the end of the warm season in September represents a reasonable estimate of total production lost from the oil spill during 2000. Thus, bivalve injury was calculated by multiplying the loss of 2.73 g m^{-2} by the area affected (about 708,000 m^2 for upper Swanson Creek) to yield the total bivalve biomass production lost in 2000 of 1,932.8 kg (Table 4.3).

The total biomass production lost by the amphipod *L. plumulosus* required two separate calculations, one for June when injury extended from upper Swanson Creek through lower Swanson Creek, and a second for September, when only upper Swanson Creek remained impacted. This species produces multiple broods per year and reproduction is continuous from May to November, with peaks of reproduction and population growth in spring and fall (Spencer and McGee, 2001). Hence, an estimation of injury that sums the biomass differences documented in June and September represented the best estimate of *Leptocheirus sp.* biomass production lost. In June, the lost amphipod production was 0.1067 g m^{-2} in upper Swanson Creek and 0.1024 g m^{-2} in lower Swanson Creek. Lower Swanson Creek has an area of about 1,320,000 m^2. Consequently, the total biomass production lost from the spring population peak is the sum of the products of loss per unit area and total area for each of the two segments of the creek, or 75.5 kg for upper Swanson Creek and 135.2 kg for lower Swanson Creek (Table 4.3). The September injury, presumably to the second population peak, only appeared in upper Swanson Creek and amounted to 42.6 kg of biomass production lost. Thus, the total *Leptocheirus* amphipod production lost from the oil spill in 2000 was 253.3 kg (Table 4.3).

The most likely injury to persist beyond September 2000, when field studies ended, would be to *Leptocheirus*, due to its sensitivity to contaminants and from the multi year duration of impacts to amphipods reported in other spills. Therefore, the loss of *Leptocheirus* was extended to June 2002. Assuming a similar loss of biomass for this period as occurred in 2000 (75.0 kg for June 2001, 42.6 kg for September 2001, and 75.5 kg for June 2002), an additional loss of 193.6 kg was estimated (Table 4.3).

The enhancement of polychaete production was considered as partial mitigation for the loss of bivalve and amphipod production. Like the injured bivalves *M. balthica* and *R. cuneata* and the injured amphipod *L. plumulosus*, polychaetes also serve a role as prey for higher trophic level consumers in the system. The biomass enhancement of polychaetes was greatest in June 2000. Totaled over the affected area of upper Swanson Creek, the oil spill resulted in 247.1 kg of increased polychaete production (Table 4.3).

Table 4.3. Estimation of subtidal benthos injury in units of biomass (ash free dry weight) production lost for Chalk Point oil spill of April 2000.

Injured or Affected Resource	Date	Biomass Difference (Impact-Control)	Affected Area	Total Biomass Change over Affected Area	Biomass Production Lost [1] in 2000
Bivalve mollusks (mostly *M. balthica* also *R. cuneata*)	Sept 2000	-2.73 g m^{-2} Upper Swanson	708,000 m^2	-1,932.8 kg	-1,932.8 kg
Polychaetes (mostly spionids, also capitellids)	June 2000	+0.349 g m^{-2}	708,000 m^2	+247.1 kg	+247.1 kg
Crustacean amphipod *(L. plumulosus)*	June 2000	-0.1067 g m^{-2} Upper Swanson	708,000 m^2	-75.5 kg	-253.3 kg
		-0.1024 g m^{-2} Lower Swanson	1,320,000 m^2	-135.2 kg	
	Sept 2000	-0.0602 g m^{-2} Upper Swanson	708,000 m^2	-42.6 kg	
	June 2001	-0.1067 g m^{-2} Upper Swanson	708,000 m^2	-75.5 kg	-193.6 kg
	Sept 2001	-0.0602 g m^{-2} Upper Swanson	708,000 m^2	-42.6 kg	
	June 2002	-0.1067 g m^{-2} Upper Swanson	708,000 m^2	-75.5 kg	

[1] = negative number means a loss in production

While the increase in polychaete production totaled 247.1 kg, a full credit for the enhanced production is not warranted. Because of their greater longevity and greater capacity to filter water, the bivalves probably serve a more important biogeochemical function in protecting water quality than polychaetes, implying that the biomass credit for enhanced polychaete production should not be credited against polychaete production on a one-for-one basis. Similarly, substantially more of the amphipods that were lost could be expected to have been be preyed upon by higher trophic levels than the enhanced polychaetes because (1) amphipods and other small crustaceans are highly preferred fish

foods and (2) the opportunistic polychaetes typically suffer from food limitation, die, and decompose in the sediments (Marsh and Tenore, 1990). Given the above, the Trustees assumed a credit equaling 50 percent of increased production of polychaetes for scaling.

The net loss of production by benthic invertebrates from the Chalk Point oil spill thus involves summing the losses to each taxon by year and then applying partial credit for the enhancement of opportunistic polychaetes. In 2000, lost bivalve production was 1,932.8 kg, and lost *L. plumulosus* production was 253.3 kg (Table 4.3). The additional losses of *L. plumulosus* production are projected to be another 75.5 kg in June 2001, 42.6 kg in September 2001 and 75.5 kg in 2002, totaling an additional 193.6 kg. Thus the total injury to amphipods, not discounted by year of occurrence, was estimated to be 446.9 kg. Giving a 50 percent credit for enhancement of production by opportunistic polychaetes reduces overall injury by 123.6 kg. Consequently, the undiscounted sum of all injuries and credits to the benthos is 2,256.1 kg of AFDW. The complete benthic injury assessment is presented in Peterson (2002).

4.3.4 Bird Injury Assessment

The preassessment survey data indicate that a wide variety of birds were oiled by the Chalk Point oil spill and many died as a result of this exposure. Table 4.4 provides the list of the 61 oiled dead birds that were either collected dead by field survey teams, clean-up crews, or died during rehabilitation efforts.

Table 4.4. Observed number of dead birds by species.

Species	Number of Dead Birds Collected	Number of Birds Dying in Rehabilitation	Total Dead Birds (observed)
Ruddy Duck	35	4	39
Double-crested Cormorant	3	1	4
American Coot	1	1	2
Mallard	1	1	2
Great Blue Heron	2	0	2
Osprey	2	0	2
Virginia Rail	0	1	1
Herring Gull	1	0	1
Kingfisher	1	0	1
Loon	1	0	1
Ring-billed Gull	1	0	1
Savannah Sparrow	0	1	1
Unidentified Tern	2	0	2
Unidentified Warbler	0	1	1
Unidentified Bird	1	0	1
Total	**51**	**10**	**61**

The Trustees and RPs conducted four separate studies to determine the full nature and extent of injuries to birds resulting from the spill. The first study was conducted to

estimate the number of birds that died and the lost future production of offspring as a result of the oil spill. The remaining three studies assessed the impact of the spill on the reproductive success of ospreys, great blue herons, and bald eagles.

Bird Mortality: The Trustees and RPs conducted a "risk-based" assessment to estimate the total mortality of birds. Data collected following the spill (total dead collected, population size, number rehabilitated, etc.) and life history information from the scientific literature were used to estimate the population at risk, the percent of the population oiled, and the total mortality. Tables 4.5, 4.6, 4.7 and 4.8 provide a summary of the injury assessment approach and findings.

Table 4.5 presents the results of the effort to estimate the number of dead birds that were not recovered by field survey. Estimates of population size were based on field surveys conducted by the USFWS. A total of 412 birds were estimated to have died, but were not recovered (Michel, 2001a).

Table 4.5. Calculations to estimate the number of dead birds that were not recovered.

Species	Population Size[1]	Estimated and/ or Observed Number Oiled[2]	Number Collected (live and dead)	Estimated Number Not Collected[3]	Estimated Mortality Rate in the Field	Estimated Number Dying in the Field
Ruddy Duck	851	426 (est. 50% of number in field)	59	367	0.85	312
Double-crested Cormorant	200	50 (est. 25% of number in field)	4	46	0.85	39
American Coot	40	40 (observed)	4	36	0.85	31
Mallard	29	53 (est. 50% of number in field + all 38 recovered)	38	15	0.5	8
Green-winged Teal	50	12 (est. 25% of number in field)	0	12	0.85	11
Greater Scaup	41	10 (est. 25% of number in field)	0	10	0.85	9
Osprey	15	6 (observed)	6	0	-	0
Great Blue Heron	7	7 (observed)	2	5	0.23	1
Canada Goose	13	12 (observed)	7	5	0.23	1
Virginia Rail	0	1 (observed)	1	0	-	0
Total			121	496		412

[1] Based on field surveys conducted by the USFWS following the spill.
[2] About half of the observed ruddy ducks in the spill zone were observed to be oiled. Other bird species were expected to have a lower probability of exposure to oil either because of their behavior or because they were observed in areas that were not heavily oiled. Consequently, the Trustees assumed that 25% of the observed scaup, teal and cormorants were oiled and used the actual observed number oiled for the remaining species.
[3] Number observed to be oiled minus number collected (live and dead).

Table 4.6 presents estimates of the number of birds that died following rehabilitation efforts, but were not recovered by field survey teams. Estimates of the mortality rate are based on studies by Anderson et al. (2000) on the survival, condition, and behavior of oiled and rehabilitated American coots, and Anderson et al. (1996) on the survival of oiled and rehabilitated brown pelicans. Of the 89 oiled birds that were rehabilitated and released alive, the Trustees estimated that 22 died shortly thereafter.

Table 4.6. Estimated number of birds dying after rehabilitation.

Species	Number Oiled Released Alive	Mortality Rate After Release	Estimated Number Dying After Release
Ruddy Duck	20	0.50	10
Canada Goose	7	0.23	2
American Coot	2	0.50	1
Mallard	36	0.25	9
Osprey	4	0.23	1 (was collected)
Other Birds	20		
Total	**89**		**22**

After reviewing the estimated number of dead birds, as well as the available data on fledging rates, survival rates, and population abundances, the Trustees and RPs concluded that ruddy ducks were the only bird species where the injury was large enough to affect future production. The Trustees and RPs therefore calculated the loss of future production for ruddy ducks based on the number observed oiled and/or dead, life history information available in the scientific literature (Johnsgard and Carbonell, 1996; Bellrose, 1978), and expert scientific judgment. Using the simplifying assumptions that none of the oiled ruddies nested after being oiled and that natural recovery occurred within one year, an estimated 384 fledged young were lost as a result of the spill. Adjusting for natural mortality between fledgling and adults (50 percent, based on Johnsgard and Carbonell, 1996), the Trustees estimate that the 384 fledged young would have yielded 192 adult ruddy ducks that were lost as a result of the spill.

Table 4.7 summarizes the bird mortality estimates, including birds observed dead, estimated number dying in the field, and estimated number dying after release from rehabilitation. A total of 687 adult birds were estimated to have died. A complete description of the methods and findings is presented in Michel (2001a).

Table 4.7. Summary of the estimates and total mortality of adult birds.

Species	Observed Dead	Estimated Number Dying After Release from Rehabilitation	Estimated Number Dying in the Field	Production Foregone	Total Dead
Ruddy Duck	39	10	312	192	553
Double-crested Cormorant	4	0	39		43
American Coot	2	1	31		34
Mallard	2	9	8		19
Green-winged Teal	0	0	11		11
Greater Scaup	0	0	9		9
Great Blue Heron	2	0	1		3
Osprey	2	0	0		2
Canada Goose	0	2	1		3
Virginia Rail	1	0	0		1
Other Birds	9	0			9
Total	**61**	**22**	**412**	**192**	**687**

Nesting Bird Studies: The Trustees and RPs conducted field surveys between April and August 2000 to determine the degree and extent to which the oil spill affected the reproductive success of ospreys, great blue herons, and bald eagles. For each of these three species, monitoring included the evaluation of hatching percentage, number of young, number of successful nests, and fledging success.

Osprey: Over one hundred osprey nests in the Patuxent River were monitored; forty-four were located within the middle section of the river thought to be impacted by the spill and twenty-eight were upstream of the spill. The mean of 1.50 young fledged per active nest in the middle section was similar to the twenty-five year average of 1.51 for the river. In addition, there were no significant differences in survival rates of nestlings from the middle and upper sections of the river in 2000 or in the number of young produced in 2000 and previous years. However, there was evidence of localized impacts to individual nests, with an estimated 17 osprey young lost due to the oil spill and associated clean-up activities. Assuming a survival rate of 55 percent from fledgling to adults (Henny and Wight, 1969; Spitzer, 1980), the 17 osprey young would have resulted in the loss of nine adults. A complete description of the methods and finding is available in Cardano et al. (2001).

Great blue herons: Twelve heron nests in Swanson Creek and seventeen in Black Swamp Creek, located roughly four miles upstream, were monitored from mid-May through mid-June 2000. Results indicate no detectable effects of the oil spill on the reproductive success of the Swanson Creek herons. There were no significant differences in the mean number of birds fledged or survival rates of nestlings between the sites. There was some uncertainty with the results due to the delay in initiating monitoring,

which began almost a month after the spill occurred. Consequently, a follow-up nesting bird survey was conducted in spring 2001 at both colonies. Results indicate the number of breeding birds at both colonies was similar to, or greater than, the number in 2000. A complete description of the methods and findings is available in McGowan et al. (2001).

Bald eagles: Two active bald eagle nests were located within Swanson Creek and a third active nest was identified near Cremona Creek. Two of the three nests each initially contained two nestlings (one in Swanson Creek and the other in Cremona Creek). In mid-April, the Swanson Creek nest was destroyed by high winds, resulting in the death of both nestlings. The two nestlings successfully fledged from the Cremona Creek nest. Results of this study indicate that the spill did not affect bald eagles. A complete description of the methods and findings is available in Wearmouth and McGowan (2001).

Based on the results of the mortality and hatching success studies, the total number of birds estimated to have died as a result of the Chalk Point oil spill is calculated as follows: 687 adult birds + (0.55 x 17 osprey young) = 696 birds lost. Of this total, 553 were ruddy ducks.

4.3.5 Diamondback Terrapin Injury Assessment

Seven dead diamondback terrapins were collected during wildlife and shoreline surveys conducted immediately following the spill and four were subsequently reported dead by waterfront landowners in the spill zone. An additional 8 oiled, live terrapins were also captured in the spill zone. Seven of them were rehabilitated and returned to the wild, while the eighth died in captivity. Therefore, the number of known dead diamondback terrapins associated with the spill is 12.

The Trustees and RPs conducted two studies to determine the total mortality of terrapins resulting from the Chalk Point oil spill. The first was a nesting success study designed to assess the impact of the spill on the year 2000 hatchling cohort (Wood and Hales, 2001). The second study estimated the total terrapin injury, including total acute mortality and next generation production foregone (Michel et al., 2001b; Byrd et al., 2002b).

Nesting Success Study: The nesting success study compared the hatching success of terrapins at oiled and unoiled nesting beaches. At each of the nine selected nesting beaches, two 50-square meter exclosures were constructed to enable detection of any terrapin hatchlings. Monitoring occurred over a nine-week period beginning on September 10, 2000. Selected exclosures were then excavated to identify the location of nests from which hatchlings had emerged prior to September 10th, as well as to look for nests or hatchlings overwintering underground.

Results of the hatching success study suggest that the oil spill may have contributed to a reduction in nest size and may have increased the mortality of the year 2000 hatchling cohort. Based on statistical comparisons of hatching and hatchlings between variously oiled and unoiled sites, and comparison of egg and nest information from the excavation

of terrapin nests at heavily oiled and unoiled enclosures, the following conclusions were reached:

(1) The density of nests on oiled and unoiled beaches did not differ;

(2) Hatching of terrapins in the fall did not differ between oiled and unoiled nesting beaches;

(3) Fall hatchlings recovered from oiled and unoiled sites were comparable in size and weight;

(4) Nest size at oiled and unoiled sites did not differ. However, observed nesting size at both oiled and unoiled beaches were significantly lower than those reported for the 1987-1991 period; and

(5) There was a significantly higher frequency of dead embryos and a lower frequency of presumed spring-emergers at oiled sites compared to unoiled sites. The cause of death of those embryos is not known and may not necessarily be attributed to the oil.

A complete description of the methods and findings from the terrapin nesting study are presented in Wood and Hales (2001).

Total Mortality Study: The Trustees and RPs used a "population-at-risk" approach to estimate total acute mortality to adult and juvenile terrapins. The population at risk from exposure to the oil was based on the mean population estimate of 2,293 adults and juveniles (86.2 terrapins/ km) from Roosenburg (1990). The total length of shoreline between Chalk Point and Spring Cove is estimated to be 54.5 km, including oiled and unoiled shoreline (only the oiled portion is used to estimate mortality, however). Thus, the total population of terrapins between Chalk Point and Spring Cove is estimated to be 4,698 (54.5 km x 86.2 terrapins/km).

The shoreline was then partitioned into three oiled exposure zones. Total acute mortality was estimated based on best professional judgment concerning the mortality risks posed by the differential degrees of oiling and the length of oiled shoreline and population estimates, as follows:

- Chalk Point to Teague Point: This zone had the highest degree of oil exposure. The mortality rate for terrapins was estimated to be 10 percent in this zone because of the degree and persistence of oiling. The total shoreline length of this zone is 14.0 km and the oiled portion was 11.3 km long. Mortality is estimated (11.3 km x 86.2 animals/km x 10 percent mortality) to be 97 animals (range of 73 to 123).

- Teague Point to Long Point: This zone had relatively moderate amounts of oil exposure, with most of the oil confined to a narrow band along the outer fringes of marsh. The amount/ duration of oiling was much reduced, compared to the Chalk Point/ Teague Point area. The mortality rate for terrapins is estimated to be two percent in this

zone. The total shoreline length for this zone is 13.9 km and the oiled portion was 8.2 km long. Mortality was estimated (8.2 km x 86.2 animals/km x 2 percent mortality) to be 14 animals (range of 11 to 18).

- Long Point to Spring Cove: This zone had relatively light amounts of oil stranded on the shoreline and little sheening. The mortality rate for terrapins was estimated to be 0.5 percent in this zone. The total shoreline length for this zone is 26.6 km and the oiled portion was 24.7 km. Mortality was estimated (24.7 km x 86.2 animals/km x 0.5 percent mortality) to be 11 animals (range of 8 to 14).

Total adult and juvenile acute mortality, using the population-at-risk approach, is estimated to be 122 individuals. This results in a loss of 616 discounted terrapin-years. An additional 3,793 discounted terrapin-years were lost due to production foregone in the next generation.

The Trustees and RPs also estimated a 10 percent reduction in the number of hatchlings produced in 2000 in the spill zone based on the findings of lower nest size (compared to the 1987 - 1991 period) and higher frequency of dead embryos at oiled sites (compared to unoiled sites) (Wood and Hales (2001). The 10 percent increase in mortality of hatchlings in 2000 results in an additional 836 discounted terrapin years that were lost due to the spill. Thus, the total estimated injury is 5,245 lost discounted terrapin years[7]. A complete description of the methods and findings from the terrapin mortality study is presented in Michel et al. (2001b) and Byrd et al. (2002b).

4.3.6 Lost Recreational Use Injury Assessment

The Trustees determined that the Chalk Point oil spill caused a reduction in the number of trips taken to the Patuxent River for swimming, boating, fishing and general shoreline use. The number of lost trips was estimated based on historical records available from Golden Beach, a residential community located in the spill impact zone. Golden Beach maintains records for their five private sites offering recreational opportunities similar to those available throughout the spill impact zone. Recreational use at the sites in 1999, adjusted for differences in weather, was used as an estimate for baseline recreational use in 2000 that would have occurred but for the spill. The difference between observed use at the Golden Beach sites following the spill in 2000 and the weather-adjusted 2000 baseline represents an estimate of lost trips at Golden Beach.

To extrapolate from Golden Beach to the entire spill impact zone, additional data was collected. First, an informal on-site survey was conducted along the shoreline of the Patuxent to determine the extent of the spill impact zone. Based on responses to the surveys, it was determined that the spill affected recreational use from the town of Eagle Harbor, upstream and north of the spill, to Greenwell State Park in the south. Second, helicopter overflights were conducted to perform counts of recreational activity

[7] 616 lost discounted terrapin years from acute mortality + 3,793 lost discounted terrapin years from production foregone + 836 lost discounted terrapin years from year 2000 hatchlings = 5,245 total lost discounted terrapin years

throughout the spill impact zone. Five overflights were conducted, four on weekends and one during the week. By comparing recreational use at Golden Beach to the level of use observed during the overflights, estimates of lost trips at Golden Beach were extrapolated to the entire spill impact zone. Since the Golden Beach sites made up about 2.5 percent of the total recreational trips in the spill zone and since this proportion was relatively consistent across the five overflights, it was assumed that recreational use patterns in the entire spill zone mimic the patterns of visitors at Golden Beach. This assumption implies that changes in recreational use due both to differences in weather and to the effects of the oil spill are the same for Golden Beach and the rest of the spill zone. The total estimate of lost trips due to the spill was 12,704 from the time of the incident in April through the end of the summer recreation season in September. It was determined that no recreational-use losses occurred after September 2000.

Total lost trips were multiplied by a value per trip of $27, which was obtained from the relevant economics literature. The value of a trip to a particular recreational site represents the amount a visitor would be willing to pay for access to the site beyond any expenses actually incurred. Numerous studies have been undertaken over the past 30 years to determine the economic value of recreation. For example, Walsh et al. (1992), Freeman (1993), and McConnell and Strand (1994) report figures for recreational fishing ranging from $10 to over $100 per trip. The figure of $27 represents an average composite value derived from empirical studies that examined fishing, boating, swimming and shoreline use at a variety of recreational sites in the United States.

In addition to recreational trips forgone by area residents, the Trustees determined that losses also occurred when trips taken under degraded conditions following the spill provided less value than they otherwise would have. Using the data from Golden Beach and the helicopter overflights, it was estimated that 112,359 trips were taken to the spill impact zone in the months from April to September 2000. The Trustees determined that the value of trips taken immediately after the spill was diminished by 20 percent. This loss was based on similar calculations presented in the *American Trader* oil spill damage assessment (Hanemann, 1997), which also used the 20 percent figure. Furthermore, responses to the Patuxent River on-site surveys indicated that some people perceived a significant, but moderate loss, in the value of trips taken. The loss per actual trip was estimated to decline gradually throughout the summer as the presence of the oil grew less severe through clean-up efforts and natural processes. The diminished value per trip began at $5.40 in April and declined to less than a dollar per trip by the end of September.

The two categories of loss were added together to calculate total losses. The estimate of 12,704 lost trips was multiplied by $27 to arrive at $343,010 for the total value of lost trips. There were an estimated 112,359 actual trips taken throughout the season. The number of actual trips on any given day was multiplied by the diminished value per trip as determined for that day. The total value of diminished trips was calculated to be $110,489. Estimated total losses to recreational use following the spill were $453,500. The complete analysis is presented in Byrd et al. (2001).

4.4 Summary of Injuries

A summary of the injury assessment results, as described in the preceding sections, is provided in Table 4.8.

Table 4.8. Summary of injury estimates for the Chalk Point oil spill.

Injury Category	Injury Estimate
Wetlands and Beach Shorelines	76 acres of brackish marsh habitat (40.5 acres lightly oiled, 12.0 acres moderately oiled, 23.4 acres heavily oiled) 91.94 lost acre years
	10 acres oiled beach shoreline (0.5 acre heavy, 6.4 acres moderate, 3.2 acres light) 4.7 lost acre years
	376 muskrats
Fish and Shellfish	2,464 kg lost biomass
Benthic Communities	2,256 kg lost biomass
Birds	696 dead adult birds (553 of which were ruddy ducks)
Diamondback Terrapins	122 dead terrapins 10 percent loss of hatchlings in the 2000 cohort 5,245 lost terrapin years
Lost Recreational Use	12,704 lost trips 112,359 diminished trips Estimated dollar value $453,500

CHAPTER 5.0 RESTORATION ALTERNATIVES

The goal of restoration under OPA is to restore natural resources injured by oil spills to the condition in which they would have been if the incident had not occurred. OPA requires that this goal be achieved by restoring natural resources and by compensating for interim losses of those resources and their services that occur during the period of recovery.

Restoration actions are defined as primary or compensatory. Primary restoration expedites the return of injured resources to their baseline condition; compensatory restoration addresses interim losses of natural resources from the time of injury until recovery. Natural recovery, in which no human intervention is taken to restore the injured resources, is considered a primary restoration alternative, and is appropriate where feasible or cost-effective primary restoration actions are not available or where the injured resources will recover relatively quickly without human intervention. The scale of the compensatory restoration projects depends on the nature, extent, severity and duration of the resource injury. Primary restoration actions that speed resource recovery will reduce the scale of compensatory restoration.

5.1 Restoration Strategy

The Trustees' injury assessment studies indicate that the natural resources impacted by this spill either have recovered or, where injuries persist, will best recover to baseline conditions naturally over time. Therefore, the restoration alternatives presented in this draft Plan are for compensatory restoration. The only primary restoration considered by the Trustees was replanting the heavily oiled wetlands in the immediate vicinity of the pipeline break. EPA initiated this action as part of its clean up and response efforts, thereby eliminating the need for the Trustees to consider this action further.

The Trustees considered over 40 different restoration ideas and alternatives potentially capable of providing compensatory restoration for injuries resulting from the Chalk Point oil spill. These were provided to the Trustees by members of the Governor's Citizen Advisory Committee, Patuxent River Commission, RPs, and appropriate federal, state, and local officials. Projects considered by the Trustees are listed in Appendices 2 and 3.

All of the restoration ideas and alternatives submitted to the Trustees were evaluated based on the criteria presented in section 5.2. Preferred alternatives were then scaled to ensure that their size appropriately compensates for the injuries resulting from the spill. For injuries to ecological resources, the Trustees employed a resource-to-resource scaling methodology, where restoration actions provide natural resources and/or services of the same type and quantity as those lost. In contrast, projects to compensate for lost recreational use were scaled to a total dollar amount estimated as the value lost by recreational anglers who were either unable to fish because of the spill and/or experienced a reduction in trip quality.

The preferred restoration alternatives included in this chapter are based on preliminary designs rather than detailed engineering plans. The final selected projects may require additional refinements or adjustments to suit site conditions or other factors. Restoration project designs also may change to reflect public comments and further Trustee analysis.

Cost estimates presented for each preferred alternative are the Trustees' best current estimates, and assume that project implementation will begin prior to January 2004. If project implementation is delayed beyond this date, the Trustees may increase costs estimates to account for inflation.

For each of the preferred ecological restoration projects, implementation costs were included based on the assumption that the Trustees would implement the project themselves. Project costs may be different if one or more projects are implemented by the RPs. Oversight costs will be used by the Trustees to review data reports and reports assessing the progress and results of restoration projects, participate in Trustee meetings and conference calls and otherwise ensure that restoration objectives are met.

In contrast to the preferred ecological restoration projects, the Trustees anticipate that the preferred alternatives for restoring recreational losses will be implemented by state or local government officials. Costs incurred by state and local officials to implement recreational use restoration projects have been accounted for within each of the major cost components of these projects, and, therefore, are not presented separately.

Along with the cost elements associated with each preferred restoration alternative, the Trustees added a contingency factor of 25 percent to account for the uncertainties inherent in these preliminary estimates. This 25 percent contingency is intended to cover: (1) the risk that the costs of the projects will turn out to be higher than expected and/or (2) the risk that the projects will not result in the expected magnitude of benefits and may need augmentation.

5.2 Evaluation Criteria

The OPA regulations require Trustees to consider a reasonable range of restoration alternatives and to identify preferred alternatives based on the following criteria:

- The extent to which the alternative returns the injured natural resources to baseline conditions and/or compensates for interim losses;

- The likelihood of success of each alternative;
- The cost to carry out the alternative;
- The extent to which each alternative will prevent future injury as a result of the incident, and avoid collateral injury as a result of implementing the alternative;
- The extent to which each alternative benefits more than one natural resource and/or service; and
- The effect of each alternative on public health and safety.

For this spill, the Trustees used all of the criteria listed above, and considered the first two criteria to be the most important (NOAA, 2002). Where practical and beneficial, restoration alternatives were selected that restore the species killed by the oil spill (in-kind) at the same geographic location of the injury (in-place). In some cases, direct restoration of species killed by the spill was not possible or practical, so enhancement of alternative species that provide similar services was proposed. In other cases, addressing several injured species with a single restoration project provided increased benefits and cost-effectiveness.

Information supporting the Trustees' selection of restoration alternatives is provided throughout the remainder of this chapter. In compliance with OPA and NEPA, the selection of restoration alternatives will be finalized following public review and comment on this draft Restoration Plan/ EA.

5.3 Evaluation of Restoration Alternatives

5.3.1 No-Action Alternative

NEPA requires that Trustees evaluate the "no-action" alternative, which is also an option that can be selected under OPA. Under this alternative, the Trustees would not act to restore injured natural resources or compensate for losses from injury to recovery, and so would rely only on natural recovery. While the Trustees have determined that natural recovery is appropriate as a primary restoration decision, the “no-action” alternative is rejected for compensatory restoration because significant losses were suffered during the time period from injury to recovery, and technically feasible and cost-effective alternatives exist to compensate for these losses.

The Trustees’ responsibility to seek compensation for interim losses pending environmental recovery is clearly set forth in OPA, and cannot be addressed through a no-action alternative. Failure to undertake compensatory restoration projects would result in significant uncompensated interim losses of natural resources. Accordingly, the Trustees reject the no-action alternative for compensatory restoration.

5.3.2 Restoration of Wetlands

The Trustees conducted an extensive search for opportunities to restore, create or enhance wetlands as compensation for the approximately 92 acre-years of wetland loss (see section 4.3.1) estimated to have resulted from the spill. The search for projects included soliciting potential sites from local resource agencies and interest groups including the Chesapeake Bay Foundation, Alliance for the Chesapeake Bay, EPA, Army Corps of Engineers, Patuxent River Tributary Team, county Park and Recreation Departments (Calvert, St. Mary's, Charles, and Prince George's), a local chapter of the Audubon Society, Maryland State Highway Commission, Citizens Advisory Committee, Oyster Recovery Partnership, Chesapeake Biological Laboratory, and the Patuxent River Commission. Natural resource surveys and maps of the area were searched as well, focusing on shoreline erosion, wetlands, oyster bars, and SAV occurrence and history. Aerial photographs of the area were scoured looking for restoration opportunities. Finally, real estate specialists prepared lists of shoreline properties with elevations that made them potentially attractive restoration sites. Representatives of each Trustee agency and RP then conducted reconnaissance surveys along the Patuxent River. During these trips, all potential sites identified through the above mentioned efforts were inspected and evaluated for their restoration potential.

A full description of the site selection activities and sites that were initially identified and investigated is provided in Appendix 3. Of the sixteen sites that were reviewed, three are presented under this section as potential restoration alternatives for restoring the loss of wetlands (as described in section 4.3.1): (1) tidal marsh creation at Washington Creek; (2) integrated wetlands/ oyster restoration at Battle Creek; and (3) control of the invasive plant species, *Phragmites*. The preferred alternative is creation of tidal marsh at the mouth of Washington Creek. This project has multiple ecological benefits, and also serves as the preferred restoration alternative to compensate for injuries to diamondback terrapins and beach shorelines (see section 5.3.6).

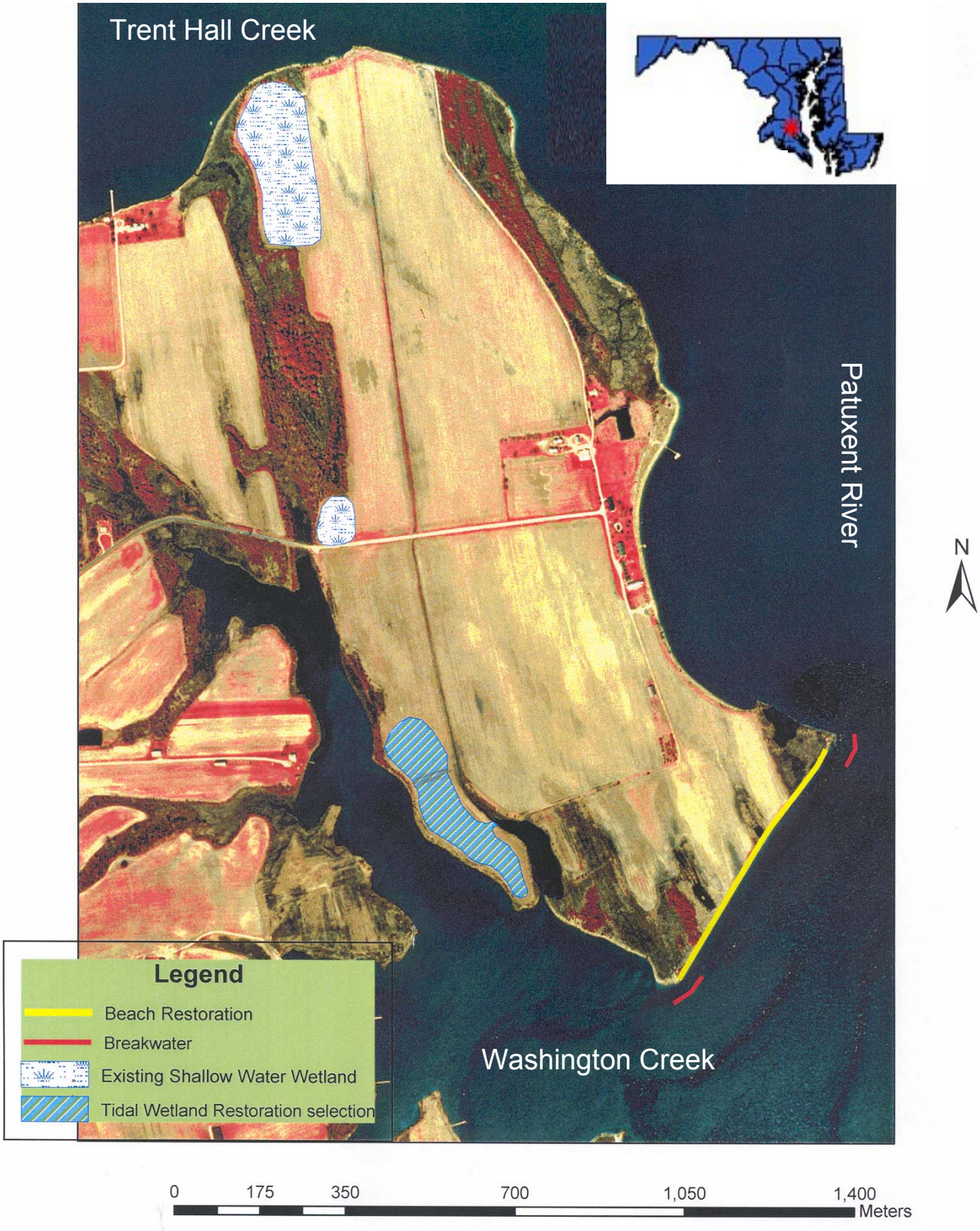
5.3.2.1 Alternative 1 (Preferred) Tidal Marsh Creation, Washington Creek, St. Mary's County, MD

Project Description

The preferred compensatory restoration alternative for marsh injuries is the creation of about 5.7 acres of brackish intertidal marsh on farmland adjacent to Washington Creek, a tributary on the western shore of the Patuxent River located in St. Mary's county just south of Chalk Point (Figure 2). The property is currently in private ownership and actively farmed.

This project would create a functioning intertidal marsh similar to the type of marsh injured by the spill. The site would be excavated to an intertidal elevation suitable for growth of wetland plants, channels would be constructed to carry water into and out of the marsh, and the excavated area would be planted with appropriate species (e.g., *S. alterniflora* and *S. cynosuroides*) installed on 1.5-foot centers and fertilized with

Figure 2. Location of the proposed restoration project: Tidal marsh creation and shoreline beach enhancement at Washington Creek.



time-release fertilizer at the time of planting. *Phragmites sp*., a non-native invasive plant species, will be actively removed from the project site during the first five years.

The material to be excavated from the project site is a sandy loam soil that will be used to restore an eroding shoreline and enhance nesting habitat for diamondback terrapins (see section 5.3.6.1). The cost of using the sand for this additional project is considerably less than the cost of disposing of the material offsite.

Restoration Objectives

The primary objective of this restoration project is to provide wetland habitat sufficient to compensate for lost wetland services, including wildlife species such as muskrats. An important additional benefit is the ability to use the excavated sand to stabilize an eroding beach. This cost-effective option for disposal would prevent further erosion and increase the quality of nesting habitat for diamondback terrapins.

Scaling Approach

The Habitat Equivalency Analysis (HEA) method was used to determine the size of the marsh restoration to compensate for the losses resulting from the spill. HEA is a resource-to-resource scaling method to determine compensation for lost services based on the quantification of incident-related natural resources injuries. HEA considers several project-specific factors in scaling restoration, including elapsed time from the onset of injury to restoration implementation, relative productivity to restored habitats (that is, the proportional equivalence of ecological services provided by the compensatory restoration project relative to the baseline productivity of the injured habitat), the time required for restored habitats to reach full function, and project lifespan.

To determine the appropriate estimates for the HEA input parameters identified above, the Trustees relied on resource agency staff experience with creating wetlands in this region, input from a wetlands restoration specialist (Ed Garbish, pers. comm., 2001)[8], data from other damage assessment cases, information in the scientific literature (including the recent National Research Council publication on Compensating for Wetland Losses Under the Clean Water Act (NRC, 2001)), and a synthesis of studies on created wetlands by Strange et al. (2001). Using this information, the Trustees assumed that the marsh would be completed in 2003, with a project life span of 50 years. Services provided (as a percent of a fully functioning marsh) were determined to be 50 percent in 5 years; 75 percent in 10 years; and 80 percent in 20 years and beyond[9]. Based on these inputs and assuming a three percent discount rate, each restored acre provides a credit of 16.23 acre-years. Therefore, an area of 5.66 acres at the preferred restoration site will compensate for the 92 acre-year wetland injury determined in section 4.3.1.

[8] Ed Garbisch. Environmental Concern, Inc., St. Michaels, MD.

[9] That is, the created wetland will never be 100 percent equivalent to an otherwise comparable natural wetland. Based on this assumption, a larger area of restoration is required.

The Trustees assessed injuries to muskrats and the marsh acreage needed to compensate for these losses to validate that the scale of marsh restoration would compensate for associated wildlife injuries. A total of 376 muskrats were estimated to have been lost. Using HEA, the Trustees estimated that it will take 5.48 acres of new marsh to restore the muskrat losses (Michel et al., 2002; Appendix D). Because this area is less than that needed for restoration of injury to wetlands (i.e., 5.66 acres), this wetland restoration project is expected to fully compensate for injury to muskrats.

Probability of Success

Creating new wetlands is a feasible and proven technique with established methodologies and documented results. Local, state, and federal agencies have successfully implemented similar projects in this region of the Chesapeake Bay. Thus, the Trustees believe that this project has a high likelihood of success.

While final details of the project remain to be fully developed, the Trustees will carefully monitor plant handling and installation to ensure that appropriate guidelines are being followed. All plant material will be inspected to ensure that it is healthy and vigorous, and will be protected during mobilization from drying and physical damage. Container grown plants will be treated with a slow-release fertilizer at the time of planting. Replanting will occur if a significant number of plants die.

The project is located on privately owned land, and the landowner is committed to the project. The landowner has ensured full cooperation.

Performance Criteria and Monitoring

Project performance will be assessed by comparing quantitative monitoring results to pre-determined performance standards that define the minimum physical or structural conditions deemed to represent normal and acceptable growth and development (e.g., percent plant survival and cover at 60 days, one year, five years, etc.). The monitoring program for this project will use these standards to determine whether the project goals and objectives have been achieved, and whether corrective actions are required to meet the goals and objectives. Details concerning the performance criteria and monitoring will be developed prior to implementation of the project.

In the event that performance standards are not achieved or monitoring suggests unsatisfactory progress, corrective actions will be implemented. Possible corrective actions include regrading the area to proper elevations and replanting appropriate vegetation. These corrective actions would be funded by the contingency component of the project costs (Table 5.1).

Approximate Project Costs

Project costs are summarized in Table 5.1. The major cost item is project construction ($361,200), which includes excavation of the site and plantings. Project implementation and oversight costs ($117,600) assume that the Trustees will implement the project.

While these costs would be lower if the RPs implement the project, funding for Trustee oversight would still be required. Monitoring costs are estimated at $88,800. A 25 percent contingency ($151,000) has been added to cover (1) the risk that the costs of the project will turn out to be higher than expected and (2) the risk that the project will not result in the expected magnitude of benefits and need augmentation. As shown, total project costs are estimated at $754,600.

Table 5.1. Summary of Project Costs: Tidal Marsh Creation, Washington Creek.

Cost Element	Cost
Engineering	$36,000
Construction	$361,200
Monitoring	$88,800
Project Implementation and Oversight	$117,600
Contingency (25%)	$151,000
Total	**$754,600**

Environmental and Socio-Economic Impacts

Marshes are widely recognized as providing numerous ecological functions, including habitat for juvenile fish and shellfish, exporting detritus (energy source for the aquatic food web) into the estuary, and increasing water quality by filtering sediments and other pollutants from the water column. Marshes also provide many additional benefits such as storm surge protection, habitat for birds and mammals, and enhanced recreational use of the area by increasing the numbers of important aquatic species.

Creating a marsh at the mouth of Washington Creek is not expected to have any significant adverse environmental or economic impacts. Any impacts to existing habitats from project construction are expected to be temporary.

Constructing this wetland would remove land from agricultural production. This property is currently leased to a local farmer by the landowner, and no problems are anticipated by withdrawing this land from production. This portion is a small fraction of the land remaining available for production.

Evaluation

This project meets all of the restoration criteria discussed in section 5.2, including the Trustees' priority for in-kind (wetlands loss restored by wetlands creation) and in-place (same geographic vicinity) restoration. The selected site is also preferred because the excavated material can be used for a nearby beach replenishment project. This has a number of benefits including: (1) reduced impacts to the environment from the operation of heavy equipment, (2) significantly reduced costs associated with moving the excavated

material, and (3) provides additional ecological benefits in the form of shoreline and terrapin nest habitat enhancement. In particular, the opportunity to combine the beach creation/terrapin nesting project with the marsh creation project makes this site cost-effective for both projects.

The Trustees do not anticipate any adverse impacts. Other than the inherent risk to workers, there is no significant risk to human health and safety.

Based on the above evaluation, the Trustees have determined that this project is the preferred compensatory restoration action for marsh injury.

5.3.2.2 Alternative 2 (Non Preferred): Integrated Wetland Restoration at Battle Creek, Calvert County, MD

Project Description

This project would stabilize approximately 1100 feet of eroding bank along Battle Creek by creating fringe marsh and protecting the shoreline with a combination of breakwaters, an artificial reef, riprap and sills. Clean sand would be deposited behind the breakwaters and planted with marsh vegetation to create approximately 1 acre of new marsh. The offshore reef would be seeded with oysters, which would protect the fringe marsh by attenuating wave energy from the river and provide habitat for benthic and aquatic organisms. Construction of the project is estimated to cost between $260,000 and $343,000.

The property is privately owned and the landowner is interested in stabilizing the eroding shoreline. With the landowner's input, Calvert County designed a project in 1999 that was intended to stabilize soil erosion. While the project was not built because funds were not available, its design has been the starting point for this proposal.

Evaluation

If properly engineered, this project is expected to have a high likelihood of success. Because of the depth characteristics at the site, there is an opportunity to combine marsh with a nearby offshore oyster reef, a configuration that was common in the river in the past. If this offshore oyster reef functions as a seed source, it would benefit the oyster fishery.

This project has the potential to compensate for injuries to wetlands, benthos, fish and shellfish, and is located within the spill zone. The scale of the benefit from this restoration project, however, would be considerably less than what is required to compensate for the losses resulting from the Chalk Point oil spill (e.g., 5.66 acres of wetlands). If the Trustees were to implement this project, additional restoration of these resources would be required to fully compensate for the losses.

This project is not selected as the preferred alternative because the Trustees believe that the Washington Creek Tidal Marsh Creation Project is a more cost-effective alternative for restoring wetlands injured by the Chalk Point oil spill.

5.3.2.3 Alternative 3 (Non Preferred): *Phragmites sp.* Control

Project Description

Phragmites australis has expanded in marshes along the northern and middle Atlantic coasts at a rate and pattern that is perceived as invasive (Chambers et al., 1999). This project would fund efforts to remove and control this plant species, thereby restoring native wetland plant communities. *Phragmites* is typically controlled on a site by a combination of herbicide applications and controlled burns.

Evaluation

The scientific literature presents conflicting accounts on the impact of *Phragmites* on wetlands. For estuarine fish, Weinstein and Balletto (1999) and Chambers et al. (1999) argued that potential negative impacts of *Phragmites* on nekton could result from the build up of sediment levels and choking of channels, with a reduction of tidal exchange and foraging pathways. In a later study, organic and inorganic material was found to buildup at a three-times greater rate in *Phragmites* monocultures compared to *Spartina* monocultures due to a greater rate of production and slower rate of decay (Windham, 2001). *Phragmites* also appears to have a negative effect on the use of marshes by birds. A lower number of bird species has been reported in stands where *Phragmites* was growing as a monoculture, when compared to other saltmarsh habitats in Connecticut (Benoit and Askins, 1999).

While *Phragmites* appears to affect the use of wetlands by fish and birds, macroinvertebrate abundance does not appear to be reduced in *Phragmites.* Fell et al. (1998) found that the four most common macroinvertebrate species in Connecticut brackish marshes were as abundant, and often more abundant, in *Phragmites* monocultures than in adjacent stands of mixed salt marsh plants (either *Juncus/Spartina* mix or *Typha/Scirpus* mix). Further, they found that the numerically dominant fish species, *Fundulus heteroclitus,* was feeding as effectively on the macroinvertebrate prey within *Phragmites* as on the other marsh types. Thus, *Phragmites* is an effective foraging source and there appears to be a direct trophic link between *Phragmites* and the adjacent estuary that is at least of the same magnitude as for the other, mixed marsh types.

Finally, while there are documented cases where *Phragmites* has reduced plant diversity (Odum et al., 1984), there is little quantitative evidence for a consistent loss of productivity and ecosystem function with a change in marsh-plant species composition. Productivity, energy transfer and use of habitats by faunal components do not appear to be related to species composition of marshes *per se*, but to structural conditions of the marshes such as tidal exchange and access pathways for fauna. For example, Meyer et al. (2001) found no significant or consistent difference in abundance or biomass of any fish

species or of all fish species combined when they compared structurally and hydrologically similar stands of *Phragmites* and *Spartina*. Marshes in each case were relatively open with small sinuous channels between hummocks. In comparison, distinct increases in species diversity and abundance were found when the channel fringe area and tidal exchange were increased by restoration work within a monoculture of *S. alterniflora* (Able and Hagen, 2000).

The literature summarized above presents conflicting data on potential net gains in productivity generated by removal of *Phragmites*. This makes it difficult, if not impossible, for the Trustees to scale the ecological restoration benefits that would be generated by removal of *Phragmites* to the wetland injuries. In addition, the Trustees determined that most of the large stands of *Phragmites* exist outside of the spill zone (i.e., upriver). For these reasons, this alternative was not considered further.

5.3.3 Restoration of Fish and Shellfish Resources

The total loss of fish and shellfish biomass resulting from the Chalk Point spill was estimated to be 2,464 kg (section 4.3.2) (French McCay and Jennings, 2002). The Trustees considered four compensatory restoration alternatives for these losses: (1) creating and seeding an oyster reef sanctuary, (2) seeding private oyster leases, (3) hatchery production of American shad, and (4) restoration of oysters and submerged aquatic vegetation via the Sandy Point Integrated Ecosystem Restoration Project. As described below, the Trustees propose creating and seeding an oyster reef sanctuary as the preferred option for restoring the lost fish and shellfish biomass. This cost-effective restoration option would be located within the Patuxent River and help satisfy federal, state, and local restoration goals for the Chesapeake Bay.

5.3.3.1 Alternative 1 (Preferred): Creating and Seeding an Oyster Reef Sanctuary

Project Description

The preferred compensatory restoration alternative for fish and shellfish losses (2,464 kg of biomass) is creating and seeding about 1.7 acres of oyster reef sanctuary in the Patuxent. The MDNR would review potential sites in this region based on other oyster enhancement efforts that are scheduled or have already been done in the area; data on spat set, salinity, and disease; and on underwater surveys of potential sites to evaluate their condition. MDNR would then seek consensus among both local county oyster committees and environmental interests, and then recommend the specific location(s) for Trustee approval.

Once a sanctuary site is selected, it would be resurfaced with six inches of clean oyster shell (or alternate bar building material, if deemed suitable) and seeded at a density of 500 oysters per square meter (approximately 2 million oysters per acre). After five years, the bed(s) would be surveyed again and reseeded (at the same seeding density of 500

oysters per square meter). Throughout the 10-year duration of the project, the oyster bed(s) would be monitored for survival, disease incidence, and extent of habitat created.

Restoration Objectives

Creating and seeding a new oyster reef would directly enhance benthic habitat, with increased biomass generated by the seeded oysters and biota associated with the reef. This enhanced production, once scaled to account for the ecological transfer efficiencies between different trophic levels (i.e., fish, shellfish, and benthos), would compensate for lost fish and shellfish biomass.

Scaling Approach

Restoring oyster reef habitat in the Patuxent River is expected to produce increased populations in four groups of organisms; oysters, mud crabs, grass shrimp and small crustaceans (amphipods, tanaids and isopods) (French McCay et al., 2002). Scaling calculations estimate the increased quantity of these invertebrates as prey biomass made available to the food web. The reef size is then adjusted to produce enough prey to restore lost fish and shellfish biomass, given assumptions about transfer efficiencies between different trophic levels of the food web.

Using data from local researchers and species life history information from the scientific literature (Kneib, 1987; Zimmerman et al., 1989; Llanso and Volstad, 2001; Peterson, 2001), reef-related increase in the production of oysters, mud crabs, grass shrimp and small crustaceans was estimated to be approximately 365.9 grams (ash free dry weight) per square meter of restored reef (French McCay et al., 2002). This estimate reflects the net increase in productivity associated with oyster reefs compared to shell bottom for the mesohaline conditions that exist in the vicinity of the spill based on the proposed seeding density and a lifespan of five years for each seeding. The five-year lifespan is a conservative estimate used to ensure minimum benefits are achieved. Actual oyster survival may produce benefits at or above calculated expectations.

The next step was to determine the area required to restore the 2,464 kg of lost fish and shellfish biomass resulting from the spill. For these calculations, injured and restored oyster biomass was assumed to be equivalent (from a biomass perspective). For fish, the ecological efficiency of prey to fish consumers was estimated to be about 20 percent (Slobodkin, 1960, 1962; Ryther, 1969; Odum, 1971; Steele, 1974; Petersen and Curtis, 1980; Cohen et al., 1982; Jones, 1984; Sissenwine et al., 1984; Borgman et al., 1984; Mills et al., 1984; Cohen and Grosslein, 1987). The implication of this assumption is that five kilograms of benthic production from the reef are required for every one kilogram of biomass injury to fish or invertebrate predators of these resources.

Based on the trophic level scaling calculations described above, 1.73 acres of oyster reef are required to compensate for the fish and shellfish biomass loss. More details of this scaling approach, including assumptions and ecological efficiency parameters, are presented in French McCay et al. (2002).

Probability of Success

Oyster populations in the Patuxent River, and the Chesapeake Bay in general, have decreased dramatically over the past several years. Reasons for the declines include mortality from disease, sedimentation, low dissolved oxygen, extended exposure to freshwater, predation, and harvest.

The proposed sanctuary would be located in the optimal zone for oyster restoration in the Patuxent, as determined by data on spat set, salinity, and disease. Oyster bed enhancement combined with seed planting has been done in the Chesapeake Bay area in general, and in this area in particular since 1980, and is generally practiced as the most effective method to date for supplementing oyster populations.

To compensate for the uncertainty of oyster survival, careful monitoring will assess mortality rates so that adjustments to the Restoration Plan can be made, if needed. Two seedings are planned for the same area five years apart to maintain the oyster population for a longer period than a single seeding, thus increasing the likelihood the oyster bed may persist after the restoration is complete. Monitoring will measure oyster survival, incidence of disease, and area of benthic habitat created quarterly for the first and second years following seeding. Sampling in subsequent years will be done in spring and fall until success criteria for the area of habitat created and its persistence have been met.

Performance Criteria and Monitoring

Performance criteria will be based on the generally accepted view that if the oyster reef is present, the benthic populations that were used to scale this restoration project will occupy it. Monitoring will be done by direct sampling for the expected ten year duration of the project to determine oyster survival, incidence of disease, and area of benthic habitat created. Over time, the oyster population is expected to gradually decrease because of the environmental factors mentioned earlier. Monitoring will allow adjustments to be made to the Restoration Plan if the oyster population in this oyster bed decreases more rapidly than expected. This can be done by moving up the second seeding and using contingency funds for additional seeding, if mortality is greater than expected during the first few years of the restoration.

Approximate Project Costs

Table 5.2 provides a summary of the costs for creating and seeding approximately 1.7 acres of oyster reef sanctuary. An historical survey of the selected restoration site is required to ensure that historical resources, such as shipwrecks, will not be damaged by restoration activities. Site surveys will include bathymetry and video imaging of the oyster bed to determine the size and boundaries of the reef, as well as substrate types present. The material placed on the reef surface may be natural oyster shell or an alternative material if shell is not available. Costs for applying material to the reef include permitting, barge loading, transportation, and placement. Costs for storage of the

reef material have also been included, so that the material can be purchased and reserved before application. Oyster spat costs for the first seeding are estimated as $150/million larvae with 9.38 million larvae required. Additional costs include staff time to produce the spat, and shell and bag material for setting the spat. The second seeding, five years later, is expected to require the same number of spat as the first seeding, and all related costs have been calculated to account for an expected increase of three percent per year. Monitoring will cost $35,200 for 20 sampling events over the 10-year monitoring period. Project implementation and oversight costs ($25,600) assume that the Trustees will implement the project. While these costs would be lower if the RPs implement the project, funding for Trustee oversight would still be required. The 25 percent contingency is included to cover: (1) the risk that the costs of the project will turn out to be higher than expected, and (2) the risk that the project will not result in the expected magnitude of benefits and need augmentation. As shown, total costs are estimated at $261,000.

Table 5.2. Summary of Project Costs: Creating and Seeding an Oyster Reef Sanctuary (1.73 acres).

Cost Element	Cost
Historical Survey	$5,600
Site Survey	$8,000
Reef Resurfacing (6" layer)	$59,000
Seed (first seeding)	$34,900
Seed (second seeding, costs increase 3% per yr)	$40,500
Project Implementation and Oversight	$25,600
Monitoring (ten years)	$35,200
Contingency (25%)	$52,200
Total	**$261,000**

Environmental and Socio-Economic Impacts

In addition to enhancing benthic and fish biomass, the created oyster reef could improve water quality. Oysters are known to reduce suspended particulate matter and consume phytoplankton that contribute to anoxia in bottom waters, thereby improving water clarity and light penetration critical for aquatic life.

Oysters are a harvestable resource and economically important in the area. While oyster harvesting will not be allowed in the sanctuary, these areas could provide broodstock populations. There are numerous commercial and recreational fisheries and supporting industries that could benefit from such enhanced production of naturally produced oysters and the reef structure.

Creating a new sanctuary would eliminate some of the currently available area for oyster harvesting. This decrease will be small, however, because the area withdrawn is small compared to the area remaining available. In addition, the oyster bar chosen for restoration is expected to improve in productivity after resurfacing with fresh shell.

Evaluation

This project is consistent with the Trustees evaluation criteria, representing a cost-effective alternative for restoring lost fish and shellfish biomass within the immediate spill zone. Oyster enhancement is also consistent with state and federal policies seeking to restore Chesapeake Bay oyster populations. The Chesapeake 2000 Bay Agreement signed by both state and federal agencies establishes the goal of increasing native oysters in the Bay and its tributaries 10-fold by the year 2010. Additionally, both the 1993 and 2000 Maryland Oyster Roundtable Action Plans emphasize the need to restore Maryland's oyster resource. In particular, the Plan designates the Patuxent River as one of six Oyster Recovery Areas.

An important component of this project is that the created oyster reef will be designated as a sanctuary where harvesting is prohibited. According to many experts (CRC, 1999), permanent sanctuaries have many significant ecological advantages. They will allow for the development and protection of larger oysters that have a higher fecundity. Thus, a small number of very large oysters can produce many more eggs than a large number of small oysters. In addition, large oysters have demonstrated greater ability to survive disease, a characteristic that is, at least in part, inherited by their offspring. Reef sanctuaries are also critical for habitat and ecological value, allowing reef structure and function to fully develop (CRC, 1999).

The Trustees believe that the environmental benefits associated with creating and seeding an oyster reef sanctuary will be achieved with minimal negative impacts on the environment. Other than the inherent risk to workers, there is no significant risk to human health and safety.

The project will employ established methods and techniques currently in use by state and private organizations. Existing seed production capabilities are available to support this project.

For the reasons identified above, the Trustees selected this project as the preferred alternative for restoring fish and shellfish injuries.

5.3.3.2 Alternative 2 (Non Preferred): Cooperative Oyster Restoration

Project Description

This project would prepare and seed four private oyster leases in the upper Patuxent River. Twenty acres of seed would be planted for three consecutive years. Following a three year growing period, sub-adult oysters would be moved from the private beds to public fishing grounds and private leaseholders.

Evaluation

This project has the potential to provide similar ecological benefits to those described under the Trustees' preferred alternative for restoring fish and shellfish injuries (as described under section 5.3.3.1). The significant difference is that by allowing the harvesting of the oysters, the restoration potential per unit area of created reef, as compared to a sanctuary, is considerably lower.

Under the OPA regulations, the construction of seed ground for commercial harvesting would not be appropriate as compensation for public losses. Further, the reduced restoration potential resulting from the harvesting of the oysters requires a greater area of reef be created to generate the same benefit as a sanctuary, making this a much less cost-effective restoration alternative. Therefore, the Trustees did not consider this project further.

5.3.3.3 Alternative 3 (Non Preferred): Hatchery Production of American Shad

Project Description

This project would increase hatchery production of American shad (*Alosa sapidissima*) and release shad into the river to restore a depleted population. Rearing would be conducted at state or private hatchery facilities (e.g., Chalk Point) using established rearing practices.

Shad is the proposed species for hatchery production and release because: (1) it has been an historically important forage fish in the Chesapeake Bay with recreational and commercial importance, and (2) shad populations, including those in the Patuxent River, are at extremely low levels, with a fishing moratorium in effect since 1980. In addition, there are established methodologies for successful rearing of shad. Hatchery production was initiated in the Patuxent River in the mid-1990s and continues today.

Evaluation

Hatchery production and release of American shad in the Patuxent River could improve the shad stocks and compensate for the fish and shellfish injury due to the oil spill. Although shad were not killed by the spill, scaling of hatchery production could be readily accomplished to restore the fish biomass lost based on growth and survival literature values. Post-release growth and survival is believed to be comparable to wild stocks (CBP, 2000).

Although this project could provide positive environmental benefits and is not expected to have any adverse environmental or economic impacts, the Trustees determined that restoration in the form of oyster creation and seeding (Alternative 1, section 5.3.3.1) is more consistent with federal, state, and local restoration goals established for the Patuxent River and Chesapeake Bay. Shad restoration is also ongoing under a federal aid program, so additional effort is unnecessary at this time. Therefore, increased hatchery of

American shad was not selected as the preferred alternative to compensate for fish and shellfish losses.

5.3.3.4 Alternative 4 (Non Preferred): Sandy Point Integrated Ecosystem Restoration Project

Project Description

This project focuses on 63 acres of degraded aquatic habitat at the mouth of the Patuxent River. It calls for planting about five acres of submerged aquatic vegetation (SAV), and constructing about three acres of oyster bars just offshore of the SAV plantings to reduce wave energy directed at the SAV plantings.

The proposed site has been the subject of research and pilot scale restoration efforts since 1995. While these previous efforts to restore SAV at this site were not successful, the project sponsors believe that information developed from the pilot efforts increases the likelihood that this restoration proposal will succeed. More specifically, it is proposed that the integration of oysters and SAV restoration will lead to a successful restoration project.

This is a three-year project, with a total cost of $670,000.

Evaluation

This project would restore some of the types of resources injured by the oil spill. Specifically, as described in section 5.3.3.1, the proposed three acres of oyster reef would enhance benthic biomass that could be scaled to injuries to fish, shellfish, and benthic communities. There is also a rational relationship between the potential benefits of SAV (in terms of improved water quality and biomass production) and injuries to birds, benthos, fish and water quality.

Both the oyster and SAV components of this project are consistent with regional restoration goals established for the upper Chesapeake Bay. The integration of these two components also represents an innovative restoration approach that attempts to create a configuration that was historically present in the Patuxent River.

The Trustees did not select this project as a preferred alternative because of the uncertainty over the success of the SAV component. Previous pilot efforts to restore SAV at this location have not been successful. The lessons learned from the pilot efforts will undoubtedly increase the chance that this project will be successful. However, with the failure of previous efforts and little, if any, literature available documenting the success of this type of project, the Trustees are not able to quantify the restoration benefits that will result from the SAV planting. Without an ability to quantify the restoration benefits that would accrue from the SAV component of this project, the increased costs associated with these plantings make this restoration alternative less cost-effective than the preferred restoration alternative (section 5.3.3.1; creating and seeding an oyster reef sanctuary).

While this project was not selected as the preferred alternative, the Trustees recognize the restoration potential of the proposed oyster reef. As part of the site review and selection process described under section 5.3.3.1, the Trustees would work with interested individuals or groups to review this site as a potential location for a new sanctuary that could be created with a portion of the oysters that would be planted under this draft Restoration Plan/ EA (see sections 5.3.3.1, 5.3.4.1, and 5.3.5.2).

5.3.4 Restoration of Benthic Communities

The total benthic biomass loss resulting from the Chalk Point oil spill was 2,256.1 kg, comprised of 1,932.8 kg of bivalve mollusks (mostly *Macoma balthica*, also *Rangia cuneata*), 446.9 kg of amphipods (primarily *Leptocheirus plumulosus*) and offset by a spill-related increase of 123.6 kg in opportunistic polychaetes[10] (section 4.3.3) (Peterson, 2002). The Trustees considered two alternatives to compensate for the losses: (1) creating and seeding an oyster reef sanctuary and (2) wetlands enhancement. The Trustees selected creating and seeding an additional area of oyster reef sanctuary as the preferred alternative.

5.3.4.1 Alternative 1 (Preferred): Creating and Seeding an Oyster Reef Sanctuary

Project Description

The preferred compensatory restoration alternative for benthic losses is creating and seeding approximately 1 acre of oyster reef sanctuary in the Patuxent. The process and methods for establishing the sanctuary would be identical to those described under section 5.3.3.1 (preferred alternative for fish and shellfish injuries). In fact, if selected as final restoration projects, it is likely that the two projects would be combined into one effort.

Restoration Objectives

The objectives of this project would be to restore lost benthic biomass through the enhancement of equivalent benthic biomass associated with the created oyster reef sanctuary.

Scaling Approach

The total benthic injury of 2,256.1 kg included losses of (1) bivalves in Year 2000 (1932.8 kg) and (2) amphipods in Year 2000 (253.3 kg), Year 2001 (118.1 kg), and Year 2002 (75.5 kg), with a credit of polychaetes in Year 2000 (123.6 kg) (section 4.3.3: Peterson,

[10] As discussed in section 4.3.1 and Peterson (2002) only 50 percent (123.6 kg) of the 247.2 kg total increase in polychaete production caused by the spill is "credited". This is because of the likelihood that a substantial fraction of this production of opportunists suffered food limitation, died, and decomposed. A well established pattern of succession in marine sediments is early explosion of opportunists, especially polychaetes, followed by starvation (Marsh and Tenore, 1990).

2002). The first step in the scaling analysis was to express the amphipod injury that occurred in Years 2001 and 2002 in Year 2000 units. Using a standard discount rate of three percent, the total discounted amphipod injury (expressed as Year 2000 equivalents) is 439.1 kg. Combining this number with the 1932.8 kg of bivalve injury and 123.6 kg credit for increased polychaete production results in a discounted net loss of 2,248.3 kg for benthic injuries that was used as the basis for the calculations performed in the restoration scaling analysis.

The scaling approach for this project is described under section 5.3.3. In summary, the increased production associated with reef creation and seeding was estimated as 365.9 grams per square meter (French McCay, 2002). To determine the area required to restore 2,248.3 kg of lost benthic biomass, the simplifying assumption was made that restored biomass is equivalent to the injured biomass, and is therefore scaled on a one to one basis (i.e., one kilogram of benthic production is required for every kilogram of benthic biomass lost). These scaling calculations indicate that 1.11 acres of oyster reef (with seedings in year one and year five) are needed to compensate for the benthic losses. A complete description of the scaling analyses is provided in French McCay et al. (2002).

Probability of Success

Based on the information presented in section 5.3.3.1, the Trustees believe that this project has a high likelihood of success.

Performance Criteria and Monitoring

See section 5.3.3.1.

Approximate Project Costs

Table 5.3 provides a summary of the costs of creating and seeding 1.11 acres of oyster reef sanctuary. Survey, resurfacing, seeding and monitoring costs are explained under section 5.3.3.1. Project implementation and oversight costs assume that the Trustees will implement the project. While these costs would be lower if the RPs implement the project, funding for Trustee oversight would still be required. The 25 percent contingency is intended to cover the risk that: (1) the costs of the project will turn out to be higher than expected, and (2) the risk that the project will not result in the expected magnitude of benefits and need augmentation. As shown, total costs are estimated at $169,200.

Table 5.3. Summary of Project Costs: Creating and Seeding and Oyster Reef Sanctuary (1.11 acres).	
Cost Element	**Cost**
Site Survey	$5,200
Historical Survey	$3,600
Reef Resurfacing (6" layer)	$38,300
Seed (first seeding)	$22,600
Seed (second seeding, costs increase 3% per yr)	$26,300
Project Implementation and Oversight	$16,600
Monitoring (ten years)	$22,800
Contingency (25%)	$33,800
Total	**$169,200**

Environmental and Socio-Economic Impacts

See section 5.3.3.1.

Evaluation

This alternative is consistent with the Trustees' evaluation criteria. It is cost-effective, and restores the same type of injury (i.e., benthic biomass) and in the same geographical area of the spill. Creation and seeding of an oyster reef sanctuary is also consistent with state, federal, and local restoration goals established for the Chesapeake Bay. For these reasons, this project was selected as the preferred alternative for restoring benthic injuries.

5.3.4.2 Alternative 2 (Non Preferred): Wetlands Enhancement

Project Description

This project would restore lost benthic biomass by creating or enhancing wetlands. The most likely scenario under this alternative would be to increase the area of the Tidal Marsh creation at the mouth of Washington Creek (see section 5.3.2.1)

Evaluation

As discussed under section 5.3.2.1, marshes are widely recognized as providing numerous ecological functions, including benthic invertebrate species that inhabit marshes. Marsh creation also can be cost-effectively implemented, and is consistent with state and federal policies concerning wetlands and essential fish habitat.

The Trustees determined that, for the benthic injury, restoration in the form of oyster reef creation and seeding (alternative 1, listed above) is more consistent with regional restoration goals and objectives for the Chesapeake Bay. Therefore, wetland restoration was not selected as the preferred alternative to compensate for benthic losses.

5.3.5 Restoration of Birds

The total number birds estimated to have been lost as a result of the Chalk Point oil spill is 696, the majority of which (553) were ruddy ducks (see section 4.3.2) (Michel, 2001a). The Trustees considered several alternatives to restore these losses. Two preferred alternatives were selected. The first, restoration of ruddy duck nesting habitat, was the only alternative identified that would provide direct restoration of this species. The second preferred restoration alternative would restore the relatively small injury to "other birds" through additional oyster reef creation and seeding.

5.3.5.1 Alternative 1 (Preferred): Restoration of Ruddy Duck Nesting Habitat

Project Description

Ruddy ducks are a migratory species that breed in wetlands located in the Prairie Pothole Region (PPR) of the Midwest, including portions of Iowa, Minnesota, North Dakota, South Dakota, Montana and southern Canada. Their principle migration corridor to the Atlantic coast extends from North Dakota across Minnesota, and southeast Michigan to the Chesapeake Bay where they overwinter. By February (until mid April), ruddies begin their migration from the Bay back to their nesting grounds in the PPR (Bellrose, 1978).

The preferred compensatory restoration alternative for ruddy ducks is the acquisition of perpetual protective easements on land necessary to support additional ruddy duck breeding. Selected sites would have wetlands where the adjacent upland areas have been converted to farmland, thereby making the associated wetland unsuitable for ruddy duck nesting. Once easements are acquired, farmland will be restored back to perennial grass cover, resulting in a net increase in ruddy duck nesting habitat. The increased nesting habitat will produce additional ruddy ducks. The portion of the additional ruddy ducks produced in this new habitat that would return to the Chesapeake Bay (70 percent) would then compensate for those lost as a result of the Chalk Point oil spill.

The USFWS has established programs in the PPR that protect and restore valuable nesting habitat for birds species like ruddy ducks. The USFWS would recommend potential sites to the Trustees for final approval, and then coordinate project implementation with the Trustees, including acquisition of easements, restoration, project oversight and monitoring.

Restoration Objectives

The objective of this alternative is to restore ruddy duck losses resulting from the spill. This objective would be accomplished by restoring nesting habitat and purchasing

perpetual easements to protect the areas from farming or development. Acquiring protective easements and restoring enough land to increase the appropriate number of new nest sites can enhance future production of ruddy ducks sufficiently to compensate for the losses caused by the Chalk Point oil spill.

Scaling Approach

As described in section 4.3.2, the Trustees estimated that 361 ruddy ducks were directly killed by the spill, with an additional production foregone loss of 384 fledglings. The fledgling loss was then adjusted to account for natural mortality between the time of fledging and recruitment to the fall population (50 percent survival rate; Johnsgard and Carbonell (1996)) and added to the adult injury to arrive at an estimated 553 ruddy ducks that need to be replaced as compensation for the losses resulting from the spill (Michel, 2001a).

The 553 ruddy duck loss was then adjusted to account for the differences in timing between injury and restoration. The Trustees assumed project benefits will begin to accrue in 2005. Consistent with standard practice in natural resource damage analyses, the restoration objective was compensated by three percent for every year that restoration is delayed. This results in a "time-adjusted" restoration goal of 641 ruddy ducks.

The area of habitat needed to compensate for the 641 lost ruddy ducks was then calculated. First, productivity at restored and protected breeding sites was estimated to be 1.5 birds per nest per year (Johnsgard and Carbonell, 1996). This productivity was converted into productivity per unit area of 0.038 birds per hectare (ha) per year using an estimated nesting density of ruddy ducks in the PPR of 40 ha per nest.[11]

Project lifespan was assumed to be 100 years, with future years' production discounted at three percent per year. Restoration credit would begin in 2005, to account for time to acquire easements and complete restoration activities. Taking the present value over 100 years gives the total habitat productivity per hectare over the life of the project, or 1.22 birds per ha. This productivity estimate was then reduced by 30 percent to account for the proportion of ruddy ducks produced by this project that would be expected to overwinter in areas outside the Chesapeake Bay area. These calculations result in a required project area of 750 ha.[12]

[11] This density estimate is based on an analysis of 12 years of ruddy duck data from the PPR collected by the USFWS Habitat and Population Evaluation Team, Bismarck, ND (Reynolds 2002b). This estimate represents the density of nests in the overall landscape (i.e., multiple wetlands and associated supporting grasslands) that will be most supportive of ruddy duck productivity. It incorporates a number of factors related to ruddy duck nesting density, including the presence of other semi-permanent and seasonal wetlands in the surrounding landscape, areas of surrounding grassland, temporal variability (driven largely by hydrologic conditions), and territoriality of nesting ruddy ducks.

[12] 750 ha = 641 ruddies / (1.22 ruddies per ha * 0.7 Chesapeake wintering ruddies).

Probability of Success

The USFWS has established programs in the PPR that have a strong record of conserving critical breeding and/or migratory habitat for migratory birds. The Trustees would coordinate this project through these established programs to ensure success.

The Trustees would also seek to acquire easements and conduct habitat restoration in areas that would serve as high quality ruddy duck breeding habitat. Such habitat is likely to become available in the scale needed for this project, given past acquisition and restoration experience in the PPR.

Overall, the Trustees believe that the probability of success for this project is high.

Performance Criteria and Monitoring

Successful implementation of the restoration project will be measured by two criteria: (1) occupation and use of restored habitat by ruddy ducks and (2) productivity of nesting pairs in the restored habitats. The USFWS Habitat and Population Evaluation Team Office in Bismarck, ND will monitor the restored sites to ensure that the project is meeting established biological objectives and that the landowner is complying with the terms of the easement, as required under National Wildlife Refuge System easement acquisition policy. Field surveys will be used to monitor breeding populations and productivity, while aerial surveillance will be used to monitor habitat conditions and easement compliance. Specific monitoring tasks may include twice yearly aerial surveillance monitoring for habitat disturbance; monitoring of habitat use by breeding pairs and productivity of nests; and analysis of remote sensing imagery to account for environmental variation and effects on ruddy duck populations.

Approximate Project Costs

Table 5.4 summarizes project costs. The cost to place the required farmland areas containing wetlands into perpetual conservation easement is estimated at $185,000. Reality costs associated with acquiring the easements are estimated at $18,500. Costs for restoring grassland, which requires tilling and seeding, is estimated at $100 per ha, for a total of approximately $146,000. The ten year monitoring costs total $40,200. Project implementation by the USFWS and oversight costs expected to be incurred by the Trustees total $82,200. A 25 percent contingency is included to cover the risk that (1) the costs of the project will turn out to be higher than expected and (2) the project will not result in the expected magnitude of benefits and may need augmentation. As shown, estimated project costs total $589,900.

Table 5.4. Summary of Project Costs: Restoration of Ruddy Duck Nesting Habitat.	
Cost Element	**Cost**
Easement Acquisition	$185,000
Reality Cost (fees, title searches, etc.)	$18,500
Restoration	$146,000
Monitoring	$40,200
Project Implementation and Oversight	$82,200
Contingency (25 percent)	$118,000
Total	**$589,900**

Environmental and Socio-Economic Impacts

This project is not expected to have any significant adverse environmental or economic impacts. While nesting habitat protection will restrict development on lands with easements, the program is voluntary and the landowners will be compensated at fair market value. The relatively small amount of agricultural land converted to grassland by this project is unlikely to have a measurable effect on the market for land in the region.

Evaluation

This project is consistent with the Trustees' evaluation criteria established for this spill. In particular, it is the only proposed project that will directly restore the injured species, thereby meeting the priority for in-kind restoration, where possible.

Federal and local biologists and information from the literature strongly suggest that that the availability of breeding habitat constrains ruddy duck populations. The restoration and purchase of conservation easements for appropriate parcels will increase available ruddy duck breeding habitat and result in net gains to the population. The proportion of the enhanced population that returns to the Chesapeake Bay will directly compensate for the losses resulting form the Chalk Point oil spill.

This project effectively makes use of existing programs to restore and protect breeding habitat in the PPR previously used by ruddy ducks killed by the Chalk Point oil spill, and has a high likelihood of successfully restoring ruddy ducks in numbers equivalent to those lost due to the spill. The costs associated with this project are reasonable, and no adverse environmental or economic consequences are expected.

After considering all of the available restoration options, the Trustees determined that the only way to provide a direct benefit to the ruddy ducks with a high degree of success was to restore and preserve their nesting habitat. Therefore, it was decided that the ruddy ducks lost as a result of the spill would be replaced through the restoration of grassland in

the PPR and the purchase of conservation easements on the restored nesting habitat. This project was selected as the preferred restoration alternative for ruddy ducks.

5.3.5.2 Alternative 2 (Preferred): Creating and Seeding an Oyster Reef Sanctuary

Project Description

In addition to the ruddy ducks, 134 other birds were lost as a result of the Chalk Point oil spill. These losses represent a relatively small number of over 14 different species, ranging from Virginia rail to double-crested cormorants (section 4.3.2) (Michel, 2001a). The preferred compensatory restoration project for these losses is creating and seeding about 1.9 acres of oyster reef sanctuary.

The process and methods for establishing the sanctuary would be identical to those described under section 5.3.3.1 (preferred restoration alternative for restoring fish and shellfish injuries) and section 5.3.4.1 (preferred restoration alternative for restoring benthic injuries). In fact, if selected as final restoration projects, it is likely that the three projects would be combined into one effort.

Restoration Objective

The objective of this project would be to restore non ruddy duck bird injuries by creating and seeding an oyster reef sanctuary. The resulting increase of benthic biomass associated with the reef would serve as a food source that, once adjusted to account for trophic levels and ecological transfer efficiencies, would enhance bird biomass.

Scaling Approach

Losses of birds, other than ruddy ducks, were scaled on a biomass basis, to oyster reef production. By multiplying the number of lost birds by the estimated weight per bird (by species from Sibley (2000)), the total bird biomass was calculated to be 169 kg (French McCay et al. (2002). The increased production associated with reef creation and seeding (365.9 grams per square meter (French McCay et al., 2002) (section 5.3.3.1)) was then used to determine the area required to restore lost bird biomass. A "transfer ratio" of 2 percent was used for those bird species that feed directly on the enhanced benthic invertebrates (i.e., 50 kg of prey biomass needed for one kg of biomass injury). For bird species that feed on fish (where the fish feed on the enhanced benthic invertebrates), a transfer ratio of 0.4 percent was used (i.e., 250 kg of prey biomass needed for one kg of biomass injury) (McNeill and Lawton, 1970; Steele, 1974; Whittaker, 1975; Grodzinski and Wunder, 1975). Based on these assumptions and scaling calculations, 1.85 acres of oyster reef (with seedings in year one and year five) are needed to compensate for the losses of other birds (French McCay et al., 2002).

Probability of Success

Based on the information presented in section 5.3.3.1, the Trustees believe that this project has a high likelihood of success.

Performance Criteria and Monitoring

See section 5.3.3.1.

Approximate Project Costs

Table 5.5 provides a summary of the estimated costs of creating and seeding 1.85 acres of oyster reef sanctuary. Survey, resurfacing, seeding and monitoring costs are explained under section 5.3.3.1. Project implementation and oversight costs assume that the Trustees will implement the project. While these costs would be lower if the RPs implement the project, funding for Trustee oversight would still be required. A 25 percent contingency is included to cover the risk that: (1) the costs of the project will turn out to be higher than expected, and (2) the project will not result in the expected magnitude of benefits and need augmentation. As shown, estimated project costs total $275,000.

Table 5.5. Summary of Project Costs: Creating and Seeding an Oyster Reef Sanctuary (1.85 acres).

Cost Element	Cost
Site Survey	$8,400
Historical Survey	$5,800
Reef Resurfacing (6" layer)	$62,100
Seed (first seeding)	$36,800
Seed (second seeding, costs increase 3% per yr)	$42,600
Project Implementation and Oversight	$27,000
Monitoring (ten years)	$37,200
Contingency (25%)	$55,100
Total	**$275,000**

Environmental and Socio-Economic Impacts

See section 5.3.3.1.

Evaluation

This project is consistent with the Trustees' evaluation criteria, providing cost-effective restoration of non ruddy duck bird losses within the spill zone. In addition, the oyster reefs provide direct and indirect benefits to waterfowl by providing food and improving water quality. The oyster reef itself provides habitat for other benthic invertebrates,

which are an important food source to fish and birds. Increased oyster production in the Patuxent River would also improve the water quality by filtering out the sediments and pollutants and improve the aquatic habitat, which in turn would increase reproduction and survival of fish and other aquatic food sources, potentially attracting and supporting an increased number of waterfowl. Creation and seeding an oyster reef sanctuary is also consistent with state, federal, and local restoration goals established for the upper Chesapeake Bay.

This project would restore lost bird biomass by producing an equivalent amount of bird biomass through increased feeding opportunities associated with the benthic production of oyster reefs. While the size of the reef has been scaled to ensure that the lost bird biomass equals the restored bird biomass, the restored bird biomass may not be the same species as those injured. To the extent that the composition of bird species injured and restored through increased bird biomass differs, this alternative would not be consistent with the Trustees' priority for in kind restoration. However, direct restoration of each of the 14-plus species, given the relatively small number of each that were lost, would be impractical. Thus, combining these injuries and restoring them with a biomass-to-biomass approach is a cost-effective, practical restoration option.

For these reasons, the Trustees selected this as the preferred alternative for restoring the non ruddy duck bird losses.

5.3.5.3 Alternative 3 (Non Preferred): Submerged Aquatic Vegetation (SAV) Restoration

Project Description

SAV provides habitat critical to aquatic life in the Bay. Over the past several decades, the amount of SAV in the Bay and its tributaries has declined dramatically. Several causes, including increased sediment loading, chemical runoff, and grazing by mute swans and Canada geese, have been cited. Restoration of these grasses would improve the water quality of the Bay and increase the numbers of fish and benthic organisms, providing improved habitat and additional food for birds, including those species impacted by the spill. This project would compensate for the non ruddy duck bird losses resulting from the spill by restoring SAV in the Patuxent River and its tributaries. Conducting such a project would require planting a variety of species of grasses. Some species are currently being grown through the "Grasses in Classes" Program, a successful state program where students grow the plants in school.

Evaluation

After talking to state and federal SAV restoration experts, it was discovered that the section of the Patuxent River where the spill occurred is near the turbidity maximum, an area of high sediment deposition due to the mixing of fresh and salt water. High levels of suspended solids have been shown to inhibit the growth and survival of SAV in Chesapeake Bay. Although historical records show that SAV once grew in this area, it

no longer is found in this section of the River, and recent attempts to plant it have failed. Hence, the project was viewed as having a low probability of success. Today, SAV only grows in the upper reaches near Jug Bay and farther downstream near the mouth of the Patuxent River (areas outside the spill zone). Planting SAV in these areas was considered. But after further inquiries, it was determined that to improve the chances of success, extensive efforts to control invasive bird species, such as mute swans and Canada geese would have to be made. These methods included fencing the area and employing methods to deter the birds from using the area which are either costly or labor intensive, and still the probability of success is limited.

5.3.6 Restoration of Diamondback Terrapins

The total terrapin injury, as presented in Byrd et al. (2002b) and summarized in section 4.3.5 is estimated to be 5,245 discounted terrapin years. This represents the sum of the direct terrapin years lost (122 adults and juveniles), production foregone, and loss from increased hatching mortality (10 percent of the year 2000 cohort). The Trustees considered three alternatives to restore these losses: (1) shoreline beach enhancement at Washington Creek, (2) shoreline beach enhancement at Cremona Farm, and (3) protection of terrapin nests from natural predation. The project at Washington Creek was determined to be the preferred alternative based on the likelihood of success and cost-effectiveness attributable to its close proximity and link to the preferred restoration alternative for wetlands.

5.3.6.1 Alternative 1 (Preferred): Shoreline Beach Enhancement, Washington Creek, St. Mary's County., MD

Project Description

This project is linked to the preferred alternative for restoring wetlands losses. It uses sand excavated to create the wetland at that site (see section 5.3.2.1; Figure 2) to stabilize a nearby eroding beach, providing enhanced nesting opportunities for terrapins. This project also serves as the preferred restoration project for the relatively small injury to beach shorelines.

The projects are located on farmland adjacent to Washington Creek, a tributary of the Patuxent located just south of Chalk Point. The property is currently in private ownership and actively farmed. At this site, there is currently a narrow width of sandy beach marginally suitable for terrapin nesting. As the beach has eroded over time, the bank has been undercut, resulting in a "wall" between the beach and an area of vegetation. As the erosion process continually has undercut the bank, the same width of sandy beach has "marched inward" over time. Rebuilding the shoreline to provide a gradual slope from water to "high beach" areas should make it easier for terrapins to find nest sites and should increase the area available for nesting.

Two breakwaters that would extend approximately two feet above mean high water would be constructed offshore to stabilize the shoreline. The excavated sand removed from the preferred marsh creation project would be used to rebuild the eroding beach

behind the breakwaters. The area between the existing upland and the newly created beach will be planted to provide a windbreak that will keep the sand from migrating inland. Prior to project implementation, a detailed planting plan will be developed that meets state requirements and the objective of maximizing terrapin nesting habitat.

If determined to be necessary, a combination of nest relocation and/or hatchling "head starting" will be undertaken to help ensure that the enhanced high beach terrapin nesting habitat will produce an increase in terrapin hatchlings. These efforts would be aimed at imprinting hatchlings on the new beach with the expectation that the new females will return as adults to lay their eggs.

Restoration Objectives

This project would restore diamondback terrapins and beach shoreline injuries resulting from the Chalk Point oil spill by stabilizing an eroding shoreline and creating additional beach area, and enhancing the quality of existing terrapin nesting habitat.

Scaling Approach

This restoration project has the potential to: (1) enhance the quality of existing terrapin nesting habitat, and (2) increase the amount of high beach nesting habitat. A complete description of the scaling methods for this alternative is provided in Byrd et al. (2002a). As a first step, the restoration potential associated with the enhanced habitat was estimated by assuming that the current nesting density is at the low end of the reported range, and, following project implementation, will be at the average nesting density. Using values reported by Roosenburg (1994), the increase in nesting density resulting from this project is calculated at 443 nests per ha[13]. Literature values for the number of eggs per nest (13) and nest survivorship (20 percent) were then used to estimate the number of hatchlings produced per hectare per year ($(443 * 13 * 0.2) = 1151.8$). Modeling presented in Byrd et al. (2002b) for the injury assessment, determined that each hatchling generates 2.095 discounted terrapin years. Thus, the discounted terrapin years produced per hectare per year is: $(1150.5 * 2.095) = 2410.3$. For scaling to terrapin injuries, the project was assumed to have a 25 year project lifespan, with 20 percent services provided at the end of 2003, increasing linearly to 100 percent at the end of 2007. Using these assumptions, the total discounted terrapin years produced per hectare is 34,233.4, requiring 0.15 hectares (0.37 acres) of enhanced beach to compensate for the terrapin losses. Preliminary project engineering indicates that about 0.38 ha (0.94 acres) of terrapin nesting habitat will be improved by this project. Thus, the increased terrapin productivity resulting from the enhancement of existing nesting areas was determined to be more than sufficient to offset the terrapin injury.

In addition to the high beach terrapin nesting area, approximately 0.31 ha (0.77 acres) of lower, intertidal beach will be created between the breakwaters and the existing shoreline. This area was scaled to the beach shoreline injury (4.7 beach acre years) quantified in

[13] 683 nests/ ha (average reported nesting density) – 240 nests/ ha (low end of reported nesting density) = 443 nest/ ha (as reported by Roosenburg (1994)

Michel et al. (2002) (see section 4.3.1). Applying the same assumptions that were used in the terrapin scaling (25 year lifespan of restored beach, 20 percent services provided at the end of 2003, increasing linearly to 100 percent at the end of 2007), one acre of restored beach will provide 13.8 acre years. Therefore, to compensate for the 4.7 acre year loss, 0.34 acres (0.13 ha) of beach is needed. The area of restored beach is therefore more than sufficient to compensate for the losses to beach shorelines.

Probability of Success

The Trustees believe that the beach augmentation portion of the project has a high probability of success, based on preliminary engineering surveys. The project is designed to create a stable beach by engineering offshore structures that will anchor beach transport, maintaining beach structure in a high-energy system. This portion of the project is patterned after a similar project at Jefferson Patterson State Park, located just downstream of this proposed project.

Conservative assumptions built into the modeling include: (1) the beach immediately returns to its current baseline condition after 25 years; (2) the improved habitat will provide an "average" nest density; and (3) there is no credit given for offspring using other nesting areas (the credit is limited only to the production on this specific parcel and the specific areas currently being used on this site by terrapins).

Performance Criteria and Monitoring

Performance criteria will be established to assess beach stabilization/ enhancement and terrapin nesting. These criteria will be monitored over the course of this project to ensure that enhanced nesting occurs at the densities expected. If nest densities fall below expectations, corrective actions will be taken with the contingency funds identified in Table 5.6.

Environmental and Socio-Economic Impacts

Beach augmentation will ensure that the shoreline is stable and create terrapin nesting habitat. It will also provide rare backbeach habitat for other organisms and plants.

Construction of the offshore breakwaters would alter the bottom characteristics of the offshore bottom. Breakwaters most likely would be located on soft, silty, featureless bottom, and displace the existing flora and fauna that depend on that type of habitat and replace them with ones that rely upon a hard surface. The environmental benefits of constructing the breakwaters include perching sites for birds, attachment sites for aquatic macroinvertebrates (like oysters), and a source of cover and food for fish and crabs.

Evaluation

This project is consistent with the Trustees' evaluation criteria, providing for both in-kind and on-site restoration. The opportunity to combine the beach creation/terrapin nesting

project with the marsh creation project makes this site cost-effective for both projects and provides more acres of shoreline enhancement and terrapin nest habitat than would be possible at other locations. Disposal of the excavated sand along the eroding beach costs less than hauling and disposing the material offsite, and provides additional ecological benefits by reducing erosion and enhancing nesting habitat for diamondback terrapins. This project would also provide collateral benefits to water quality by stabilizing an eroding shoreline.

Finally, several experts[14] in terrapin ecology have suggested to the Trustees that loss of suitable terrapin nesting habitat resulting from shoreline development is a significant problem for this species.

For these reasons, this project was selected as the preferred restoration alternative for terrapins and beach shorelines.

Approximate Project Costs

A summary of project costs is provided in Table 5.6. The major items are construction of the offshore breakwaters necessary to stabilize the shoreline ($52,100) and planting to stabilize the beach ($20,000). Project implementation and oversight costs ($49,700) assume that the Trustees will implement the project. While these costs would be lower if the RPs implement the project, funding for Trustee oversight would still be required. Monitoring costs are estimated at $35,000. A 25 percent contingency is included to cover the risk that: (1) the costs of the project will turn out to be higher than expected, and (2) the project will not result in the expected magnitude of benefits and may need augmentation. As shown, estimated project costs total $207,300.

Table 5.6. Summary of Project Costs: Shoreline Beach Enhancement (Washington Creek).

Cost Element	Cost
Engineering	$9,000
Construction of Offshore Breakwaters	$52,100
Plants	$20,000
Project Implementation and Oversight	$49,700
Monitoring	$35,000
Contingency (25%)	$41,500
Total	**$207,300**

[14] Dr. Willem Roosenburg, Ohio University; Dr. Whit Gibbons, University of Georgia; and Dr. Roger Wood, The Wetlands Institute.

5.3.6.2 Alternative 2 (Non Preferred): Shoreline Beach Enhancement at Cremona Farm, St. Mary's County, MD

Project Description

This project would stabilize shoreline located between the mouth of Persimmon Creek and the pier in front of Cremona Farm, located on the western shore of the Patuxent River just south of Chalk Point. Five to seven offshore, U-shaped rock structures would be built approximately 30 – 70 feet offshore at an elevation above the highest high water level. The area shoreward of the structures would be backfilled with sand to create high beach for terrapin nesting habitat.

The project is estimated to cost between $350,000 and $500,000.

Evaluation

The design of this project is based on the successful shoreline stabilization and habitat creation initiative at Jefferson Patterson Park in St. Leonard, MD. The proposed project at Cremona Farm, if designed properly, would stabilize approximately 400 meters of shoreline and create about 300 feet of high beach that could be suitable terrapin nesting habitat. Careful engineering would be necessary to produce a design that would not only create the new habitat desired, but also would not cause problems elsewhere by redirecting currents or wave energy.

The design and objective of this project are similar to the preferred alternative. Both would stabilize shoreline, enhance and/or create terrapin nesting habitat, and provide benefits to benthic organisms like barnacles. One significant difference is the cost. The preferred alternative is considerably more cost-effective given its close proximity to the wetlands restoration project that will provide the sand that will be backfilled behind the offshore breakers. For this reason, this project was not selected as a preferred alternative.

5.3.6.3 Alternative 3 (Non Preferred): Protection of Terrapin Nests from Natural Predation

Project Description

One of the factors affecting survival of terrapins in the Patuxent River is predation of young, with only 1-3 percent of the eggs laid expected to survive to hatchlings (Roosenburg, 1990). Most of this predation occurs in the first 24 hours after the eggs are laid. This restoration alternative focuses on compensating for the terrapin injury by protecting nests from predation thereby increasing hatchling survival.

Potential locations for this project include beaches in the general spill area such as Caney Creek, Sheridan Point, Jack Bay, and Prison Point. Studies done in the past two years have confirmed that these are reliable nesting beaches. Suitable nesting beaches would be monitored daily during the nesting season, beginning in early June. After eggs are deposited on sandy substrates, nests would be marked with stakes, and cage exclosures

would be placed over the nest. The exclosures would be left in place until the eggs hatch, about 60-80 days later. After hatching, exclosures would be removed.

The probability of success of this project is high. There are several known nesting beaches within the spill area, and the methods proposed for the restoration -- immediate fencing of nests -- has been successfully implemented on the Patuxent River (Roosenburg, 1992). Recent studies conducted by the Trustees provide additional information on the nesting beaches and increases the likelihood of success of this project.

Overall, this restoration project would provide an effective and practical way to replace the terrapins that were injured due to the spill. No adverse environmental or economic impacts are expected. However, while the project appears consistent with the Trustees' evaluation criteria, the Trustees believe that the preferred alternative described under section 5.3.6.1 has the potential to provide substantially more benefits to terrapins and the environment.

5.3.7 Restoration of Lost Recreational Use

Trustee analysis indicates that the Chalk Point oil spill had a direct adverse impact on recreational use of the Patuxent River. The Trustees determined that recreational losses occurred from the outset of the spill in April 2000, through September 2000, when recreational activity appeared to return to normal. An estimated 125,000 trips to the river were affected by the spill, amounting to $453,500 in lost value (see section 4.3.6) (Byrd et al., 2001).

The Trustees identified numerous potential projects to compensate for recreational losses. These preliminary restoration proposals are included in Appendix 4. The Trustees solicited restoration options from government officials, including park and planning officials from each of the affected counties. Input was also solicited from state officials and the public through a Citizens Advisory Committee appointed by Governor Parris Glendening.

The proposed projects were evaluated based on their expected impacts to Patuxent River recreation, their appeal to the local community, their ability to address losses over the breadth of the spill impact zone, and other factors. Six projects were selected as preferred by Trustees: construction of a fishing pier, a boardwalk, a canoe/kayak launch, and paddle-in campsites, improvements to an existing boat ramp, and creation of a park for recreational use.

The Trustees scaled the lost-use restoration projects using a "value-to-cost" approach. Relying on this approach, the Trustees have selected projects such that the total value of recreational losses ($453,500) is equal to the total cost of implementing the projects. The Trustees did not use a "service-to-service" scaling approach whereby restoration actions are chosen to precisely offset lost recreational services. This is due to uncertainty regarding the increase in recreational trips the preferred restoration projects could be expected to provide. The Trustees also elected not to undertake a monetary valuation of

restoration actions, which would have permitted a "value-to-value" scaling approach, whereby the value of restoration equals the value of lost recreational services. The Trustees believe that the high cost of implementing the value-to-value approach is not warranted in this case. This is due to uncertainty regarding the increase in recreational trips the preferred restoration projects could be expected to provide. The Trustees also elected not to pursue a "value-to-value" scaling approach, whereby the value of restoration equals the value of lost recreational services. This is due to the high cost of undertaking a monetary valuation of restoration actions. Based on OPA regulations, the "value-to-cost" scaling approach may be used where Trustees have determined that the first two approaches are not appropriate.

5.3.7.1 Alternative 1 (Preferred): Canoe/Kayak Paddle-In Campsites

Project Description

The Trustees have identified two sites where overnight canoe/kayak campsites would be established. Both sites are on state-owned land and would be managed by the Forest and Park Service of the MDNR. One site is on the west shore of the Patuxent River just north of Golden Beach, and the other is at Milltown Landing, also on the west shore of the Patuxent about five miles north of Eagle Harbor. Each site would include a picnic table, a fire ring for campfires, a sanitation facility and a space suitable for tents. The sites would be identifiable by a marker and directions to the sites would be available upon registering for an overnight stay with the state Forest and Park Service.

Restoration Objective

The objective of the project is to provide additional boating opportunities in the vicinity of the spill to compensate for boating losses incurred during the period of the spill. Extended overnight trips on established canoe/kayak trails is a popular recreational activity throughout the Chesapeake. Existing paddle-in sites on the Patuxent are a considerable distance apart, and the new sites would enable extended trips in areas that are currently difficult to access. One of the sites is located within the spill impact zone and the other is located just north of the impact zone.

Probability of Success

Paddle trails have been established throughout Chesapeake Bay and the state Forest and Park Service successfully maintains other paddle-in sites on the Potomac River and elsewhere. The state already owns the sites under consideration, which are accessible for maintenance using existing roads. Available sites on the Patuxent are limited, and based on the requests park officials have received, demand for more sites appears to be substantial.

Performance Criteria and Monitoring

The performance criterion for this project is construction of the necessary facilities at the paddle-in sites by the Maryland Department of Natural Resources. Contingent upon an agreement by state officials to maintain the sites, no further monitoring of the project is anticipated.

Approximate Project Costs

Approximate project costs for the two campsites are provided in Table 5.7. The total cost is expected to be about $16,750. A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.7. Summary of Project Costs: Paddle-In Campsites.

Cost Element	Cost
Picnic Table, Fire Ring and Other Materials	$3,670
On-Site Installation (Labor)	$2,840
Access Road Improvements	$6,000
Permitting	$890
Contingency (25%)	$3,350
Total	**$16,750**

Environmental and Socio-Economic Impacts

No significant adverse environmental, social or economic impacts are expected.

Evaluation

The Trustees believe these two projects represent a low-cost way to enhance water-based recreation without adverse impacts. Recreational boating use throughout the spill impact zone would be enhanced, since overnight paddle-in campsites are used for extended canoe and kayak trips up and down the shore. Paddle-in campsites are part of a larger plan to expand paddle trails in the Patuxent and throughout Chesapeake Bay. State tourism officials indicate that considerable demand exists for additional overnight sites.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.2 Alternative 2 (Preferred): ADA-Accessible Kayak/Canoe Launch

Project Description

Located at Greenwell State Park in St. Mary's County, this project would consist of a launch for canoes, kayaks and other small boats. While this project is intended to improve access for all patrons, it would be specially designed and equipped to assist physically disabled patrons under the guidelines of the Americans with Disabilities Act (ADA). The launch would include a floating pier equipped with overhead grips for support, and it would be accessible by a short access road from a nearby parking lot. The facility would be constructed and managed by DNR officials at the park.

Restoration Objective

The objective of the project would be to provide additional boating opportunities to compensate for activities that were displaced or diminished during the period of the spill. Canoeing and kayaking are popular activities throughout the spill impact zone. ADA accessible recreation is a focus of Greenwell State Park, which is included in the area affected by the spill. Users of this facility would be among those whose boating activities were impacted by the spill.

Probability of Success

Greenwell State Park attracts considerable shoreline recreational use. Although there is currently no designated boat-access site, patrons use the park informally for launching and landing canoes and kayaks. The creation of a facility for canoe and kayak access, with emphasis on access for the disabled, would enhance boating use and complement the other recreational amenities available at the park.

Performance Criteria and Monitoring

The performance criterion for this project is construction of the canoe and kayak launch as agreed upon by the Trustees and state DNR officials. Contingent upon an agreement by DNR officials to maintain the facility, no further monitoring of the project is anticipated.

Approximate Project Costs

Approximate project costs are provided in Table 5.8. The ADA accessible launch combined with improvements to the access road will cost about $95,485. A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.8. Summary of Project Costs: ADA-Accessible Kayak/ Canoe Launch.	
Cost Element	**Cost**
Engineering and Design	$5,000
Dock and Walkway	$17,300
Kayak Launch Purchase/Installation	$31,218
Road Improvements/Parking	$22,870
Contingency (25%)	$19,097
Total	**$95,485**

Environmental and Socio-Economic Impacts

No significant adverse environmental, social or economic impacts are expected.

Evaluation

The Trustees believe this project represents a low-impact way to restore recreational use of the Patuxent River in the immediate vicinity of the spill impact zone. It would not involve destruction of desirable habitat, since the current shoreline where the launch would be created is stone riprap. Furthermore, boaters currently use the site and access the water by traversing a small marsh, which has been damaged by the foot traffic. Installation of the canoe and kayak launch would draw boaters away from the marsh and allow it to recover. ADA accessible amenities are an important feature of Greenwell State Park and this project would be compatible with the park's other recreational programs.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.3 Alternative 3 (Preferred): Maxwell Hall NRMA Recreational Improvements

Project Description

This project consists of opening to the public for recreational use a 670-acre parcel of land adjacent to the Patuxent River. The land is currently a Natural Resource Management Area (NRMA) jointly owned by the Maryland DNR and Charles County, and is managed by the Charles County Division of Parks. The land is located at the mouth of Swanson Creek just south of the Chalk Point facility in an area heavily impacted by the spill. The recreational improvements would include foot trails, benches, a boardwalk across a tidal marsh area, and interpretive signs. The area would be accessible from Teagues Pt. Road and a 15-car parking area would be created near the entrance. The improvements would be constructed and managed by the Charles County Division of Parks.

Restoration Objective

Trustees believe the project would provide recreational opportunities of the kind lost during the spill, including fishing and shoreline activities such as picnicking, wildlife viewing, and hiking.

Probability of Success

Given the lack of public access to the Patuxent River in Charles County and the scenic nature of the Maxwell Hall property, the Trustees believe it is likely that this project will provide highly desirable and appropriate opportunities for increased shoreline use.

Performance Criteria and Monitoring

The performance criterion for this project is construction of the necessary facilities and recreational amenities by Charles County Park and Recreation authorities. Contingent upon an agreement by county officials to maintain the site, no further monitoring of the project is anticipated.

Approximate Project Costs

Estimated costs total $97,986 (Table 5.9). Major components include cost of constructing a boardwalk ($45,000) and trail construction ($13,500). A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.9. Summary of Project Costs: Maxwell Hall NRMA Recreational Improvements.

Cost Element	Cost
Trail Construction	$13,500
Boardwalk	$45,000
Parking, Benches, Interpretive Signs	$19,889
Contingency (25%)	$19,597
Total	**$97,986**

Environmental and Socio-Economic Impacts

No significant environmental, social or economic impacts are expected. Ecological impacts will be minimized. For example, the parking lot would be constructed using a pervious surface to minimize the visual and ecological impacts. The planned boardwalk would be constructed high enough above the surface of the water to minimize the impact of shading on aquatic vegetation

Evaluation

The site's proximity to the spill zone in an area of limited shoreline access makes this a desirable restoration project. Ground zero of the spill is visible from this site and interpretive signs will be used to educate visitors about local natural resources and the spill.

The project would encourage low-impact recreational activities of the kind lost during the spill. The improved maintenance and oversight of existing trails and shoreline areas may reduce the potential for ecological or personal harm resulting from unauthorized use. Ecological impacts of the recreational improvements to the site will be minimized.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.4 Alternative 4 (Preferred): Forest Landing Boat Ramp

Project Description

The existing boat ramp at the end of Forest Landing Road in Hollywood, MD, would be lengthened to ensure the safe launching of longer boats. This site provides access to the Patuxent River via Cuckold Creek in an area just outside the southern border of the spill zone. The boat ramp is currently too short for many boat trailers, with the ledge at the end of the ramp creating a hazard when trailers are lowered too far into the water. The pier beside the boat ramp is in need of replacement, and would be rebuilt in conjunction with extension of the boat ramp. Additional features, such as a floating pier alongside the fixed pier, would improve ADA accessibility. The facility improvements would be constructed and managed by the St. Mary's County Department of Parks and Recreation.

Restoration Objective

The extension of the boat ramp at Forest Landing would expand boat access to the Patuxent River by enabling longer boats to use the ramp and providing safer conditions for all boaters. Reconstruction of the pier will extend the life of the facility, thereby permitting additional recreational use in future years. The Trustees believe that the project would help facilitate recreational boating opportunities of the type lost during the spill.

Probability of Success

The Trustees believe there is a high probability that this project will provide increased opportunities for Patuxent River boating by enhancing the utility and safety of the boat ramp facility.

Performance Criteria and Monitoring

The performance criterion for this project is completion of the boat ramp extension and reconstruction of the pier. Contingent upon an agreement by county officials to maintain the site, no further monitoring of the project is anticipated.

Approximate Project Costs

A breakout of the approximate cost is provided in Table 5.10. The total estimated cost of the project is $106,281. A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.10. Summary of Project Costs: Forest Landing Boat Ramp Extension.

Cost Element	Cost
Permitting, Design and Engineering	$9,000
Demolition and Removal of Existing Ramp and Pier	$37,000
Construction of New Ramp	$12,000
Construction of New Pier and Dock	$27,025
Contingency (25%)	$21,256
Total	**$106,281**

Environmental and Socio-Economic Impacts

No significant adverse environmental, social or economic impacts are expected.

Evaluation

The Trustees believe the project will improve boating access on the Patuxent River by enhancing the utility and safety of the existing site. Although located outside the spill zone, the Forest Landing boat ramp is open to all and serves residents throughout St. Mary's County. There is limited boating access along the west shore of the Patuxent in much of the spill zone, so the Forest Landing location is important for those wishing to access the spill zone from the south.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.5 Alternative 5 (Preferred): King's Landing Boardwalk and River Education Project

Project Description

Located at King's Landing Park in Calvert County, MD, this project involves replacing a deteriorated boardwalk and establishing a river education project. King's Landing Park

is located on the eastern shore of the Patuxent, just north of the spill impact zone. The boardwalk is about 160 feet long by six feet wide, and extends from a footpath in a wooded area, across a marsh, to the open water of Cocktown Creek. A 10-by-20 foot platform at the end of the boardwalk would also be replaced, and canoe access would be enhanced using steps that lead into the water. In addition, restoration funds would be used to purchase several canoes and canoe accessories that would be used for guided tours by school groups and the general public as part of a river education program. Park authorities would be responsible for the construction of the boardwalk and future maintenance of the boardwalk and canoes.

Restoration Objective

The boardwalk needs to be replaced. By creating a safer facility and by extending the life of the facility, shoreline and water access will be enhanced. The canoes and river education program will enhance use of the site and will restore lost boating activity.

Probability of Success

The Trustees do not believe there are any obstacles to the success of this project.

Performance Criteria and Monitoring

The performance criterion for this project is completion of the boardwalk. Contingent upon an agreement by county officials to maintain the site, no further monitoring of the project is anticipated.

Approximate Project Costs

Table 5.11 provides estimated project costs totaling $44,340. A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.11. Summary of Project Costs: King's Landing Boardwalk and Education Program.

Cost Element	Cost
Boardwalk Materials and Labor	$28,500
River Education Program	$6,972
Contingency (25%)	$8,868
Total	**$44,340**

Environmental and Socio-Economic Impacts

No significant adverse environmental, social or economic impacts are expected.

Evaluation

The Trustees believe the Cocktown Creek boardwalk and river education program would be an important amenity at King's Landing Park. The boardwalk is currently used for canoe and kayak access to Cocktown Creek and to the Patuxent River, especially when high winds or waves make access difficult on the main channel of the Patuxent. The boardwalk and canoes would also be used for educational study of the marsh, for guided river tours, wildlife viewing and other activities. Though the facility is north of the spill impact zone, it is open and accessible to residents throughout Calvert County and the Patuxent River area. It can be expected to attract visitors from the local area where recreational activities were adversely affected by the spill.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.6 Alternative 6 (Preferred): Cedar Haven Fishing Pier

Project Description

A pier would be constructed at an existing public recreation site in Cedar Haven, Maryland. It is located in Prince George's County, on the western shore of the Patuxent just north of the spill impact zone. The site currently includes vehicle access and parking, with picnic tables and shore access for fishing and crabbing. The base of the T-shaped fishing pier would be approximately 8 feet wide and 50 feet long and lead to the top of the "T" that would be about 10 feet wide and 70 feet long. The Maryland National Capital Park and Planning Commission (MNCPPC) would construct and manage the pier. All parks operated by the MNCPPC are open to the public for a one-time five-dollar annual fee.

Restoration Objective

The pier will improve fishing access by expanding the area available for shoreline fishing and crabbing. Users of the fishing pier would be drawn from among area residents whose use of the river was adversely affected by the spill.

Probability of Success

The newly expanded Cedar Haven recreation site has ample parking to accommodate additional fishing access. The site currently receives considerable use by anglers, and historically has been a popular crabbing site. The Trustees believe that the probability of success of the project is high.

Performance Criteria and Monitoring

The performance criterion for this project is completion of the fishing pier according to specifications agreed upon by the Trustees and county officials. Contingent upon an

agreement by county officials to maintain the site, no further monitoring of the project is anticipated.

Approximate Project Costs

A breakout of the approximate cost is provided in Table 5.12. The total estimated cost of the project is $92,656. A 25 percent contingency has been included to account for uncertainties associated with the project that result in higher than expected project costs.

Table 5.12. Summary of Project Costs: Cedar Haven Fishing Pier.

Cost Element	Cost
Permits, Design and Engineering Fees	$15,000
Materials and Labor	$59,125
Contingency (25%)	$18,531
Total	**$92,656**

Environmental and Socio-Economic Impacts

No significant adverse environmental, social or economic impacts are expected.

Evaluation

A pier at this location would provide fishing access to many area residents. The pier would not allow anglers to reach deeper water than is accessible from shore, since the entire area of the river near the Cedar Haven site is only a few feet deep. However, the site is popular with anglers and crabbers despite the shallow depth, and the area available to anglers would be expanded considerably by the addition of the pier. ADA access would also be improved. Cedar Haven is close to the site of the spill and there are currently few if any piers on the west shore of the Patuxent with significant size and parking. A similar pier on the east shore of the Patuxent at King's Landing receives considerable use. The addition of a fishing pier at Cedar Haven would increase use without causing significant ecological impacts.

For the reasons stated above, this project has been selected as a preferred alternative for the restoration of recreational losses.

5.3.7.7 Alternative 7 (Non-Preferred): Playground Equipment at Greenwell State Park

The Trustees reviewed a proposal to fund playground equipment in a day-use area at Greenwell State Park. A swing set and other equipment would be added to an existing shelter with picnic tables near an open field. Although the project would enhance recreational use at a location within the spill impact zone, unlike the kayak launch

proposed for a nearby site in the park, it would not enhance water-based recreation in any direct way. For this reason, the Trustees do not view this project as a preferred restoration alternative.

5.3.7.8 Alternative 8 (Non-Preferred): Upgrade Public Boat Ramp at Cape St. Mary's Marina

The Trustees reviewed a proposal to fund repairs to the boat ramp at Cape St. Mary's Marina in Mechanicsville, Maryland. The marina is located on an inlet next to Cat Creek, on the west shore of the Patuxent. The county currently owns an easement for public use of the boat ramp, but county officials have not supported access to the ramp because it is in need of repair. County officials proposed the use of restoration funds to widen the ramp and repair large cracks in the ramp. The project would improve access for boats in an area with few nearby boat launch sites. However, there are uncertainties about the future status of both ownership of the property and the county's easement for use of the ramp. For these reasons, this project is not a preferred alternative.

5.3.7.9 Alternative 9 (Non-Preferred): Paddle-Trail Guidebook at Jefferson Patterson State Park

The Trustees considered a proposal to fund the creation of a guidebook for a canoe and kayak paddle-trail under development on St. Leonard's Creek in Calvert County, Maryland. Officials at Jefferson Patterson State Park plan to implement and maintain the trail, and the guidebook would inform those using the trail about historical and geological sites along the water. While the paddle trail will increase water-based recreation near the spill impact zone, the creation of the guidebook would not be essential to the project and would not directly generate additional recreational use. Furthermore, local planning officials expressed strong support for other projects in the county, such as the King's Landing project described under section 5.3.7.5.

5.3.7.10 Alternative 10 (Non-Preferred): Boardwalk and Foot Trail at Jefferson Patterson State Park

The Trustees considered a proposal to create a boardwalk and foot trail along part of the west shore of the Patuxent River in Jefferson Patterson State Park. The boardwalk would be about 600 feet long and would provide views of the marsh and wooded areas along the Patuxent River. While the trail would enhance shoreline uses such as walking and wildlife viewing, a considerable array of similar recreational opportunities are already available at the same location and throughout the area. The expense of the project and the potential disruption of shoreline vegetation and wildlife weighed against the project in the Trustees' selection process. Also, the Trustees believe that the boardwalk and trail would not directly enhance water-based recreation as effectively as the preferred projects described above.

5.4 Summary of Preferred Restoration Alternatives

Table 5.13 summarizes the preferred restoration alternatives and restoration costs for the Chalk Point oil spill. As indicated below, the Trustee selected three projects to restore ecological injuries and six projects to restore lost recreational use. Costs to implement these projects total $2,710,498.

Table 5.13. Summary of Preferred Restoration Alternatives for the Chalk Point Oil Spill.

Injury Category	Preferred Restoration Project	Cost
Wetlands and Muskrats	Tidal Marsh Creation (5.66 acres) and Shoreline Beach Enhancement, Washington Creek	$754,600
Diamondback Terrapins and Beach Shorelines		$207,300
Ruddy Ducks	Acquisition and Restoration of Ruddy Duck Nesting Habitat	$589,900
Birds (excluding ruddy ducks)	Creating and Seeding an Oyster Reef Sanctuary (4.69 acres)	$705,200
Benthic Communities		
Fish and Shellfish		
Lost Recreational Use	Canoe/Kayak Paddle-In Campsites	$16,750
	ADA-Accessible Kayak/Canoe Launch	$95,485
	Maxwell Hall NRMA Recreational Improvements	$97,986
	Forest Landing Boat Ramp	$106,281
	King's Landing Boardwalk and River Education Project	$44,340
	Cedar Haven Fishing Pier	$92,656
	Subtotal (Lost Recreational Use Projects)	$453,498
	Total (All Restoration Projects)	**$2,710,498**

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7.0 LIST OF FIGURES

Figure 1. The Patuxent River.

Figure 2. Location of the proposed restoration project: Tidal marsh creation and shoreline beach enhancement at Washington Creek.

8.0 APPENDICES

8.1 Appendix 1. Outreach activities involving the Natural Resource Trustees.

APRIL 2000

- Three community meetings are held in Benedict, Charles County.
- Two community meetings are held in Mechanicsville, St. Mary's County.
- Community meeting is held in Baden, Prince George's County.
- Community meeting is held in Prince Frederick, Calvert County.
- Community meeting is held in Broomes Island, Calvert County.
- Community meeting is held at Calvert County Fairgrounds.

MAY 2000

- *Swanson Creek Marsh Response and Restoration Community Guide* distributed to over 26,000 residents.
- Community meeting is held in Benedict, Charles County.
- Community meeting is held in Mechanicsville, St. Mary's County.
- Community meeting is held in Avenue, St. Mary's County.

JUNE 2000

- Trustees participate in "Taste of the Patuxent" and community meeting held in Benedict, Charles County.

JULY 2000

- The *Swanson Creek Bulletin* is distributed to over 26,000 local residents.
- Community meeting is held in Mechanicsville, St. Mary's County.
- Governor establishes the Patuxent River Oil Spill Citizens Advisory Committee.

SEPTEMBER 2000

- The *Swanson Creek Bulletin* is distributed to over 26,000 local residents.
- Community meeting is held at Calvert County Fairgrounds.
- First meeting of Governor's Patuxent River Oil Spill Citizens Advisory Committee.

OCTOBER 2000

- Trustees testify before Maryland Senate Economic and Environmental Affairs.

NOVEMBER 2000

- Second meeting of Governor's Patuxent River Oil Spill Citizens Advisory Committee.

DECEMBER 2000

- Third meeting of Governor's Patuxent River Oil Spill Citizens Advisory Committee
- Trustees hold workshop for local scientific community about NRDA activities
- Trustees published a *Notice of Intent to Conduct Restoration Planning* in the *Federal Register*

JANUARY 2001

- The *Swanson Creek Bulletin* is distributed to over 26,000 local residents.
- Community meeting is held in Benedict, Charles County.

- Trustees testify before MD House Committee on Environmental Matters

APRIL 2001
- Trustees ask Governor's Patuxent River Oil Spill Citizens Advisory Committee to review lost use study and suggest ideas for potential restoration projects.

JULY 2001
- Community meeting is held in Mechanicsville, St. Mary's County.

AUGUST 2001
- Community meeting is held in Prince Frederick
- Governor's Patuxent River Citizens Advisory Committee meets to and reviews Trustee work on injuries to birds.

NOVEMBER 2001
- Governor's Patuxent River Citizens Advisory Committee meets to review and discuss potential restoration alternatives.

MARCH 2002
- Governor's Patuxent River Citizens Advisory Committee meets and reviews and discuss elements of the draft potential restoration alternatives Trustee work on injuries to birds.

Misc. Activities

- NOAA establishes a Chalk Point website and periodically updates site as with final study plans and reports
- Pepco establishes three outreach centers immediately following the spill; Trustee information is made available at each center
- Pepco publishes community guide detailing cleanup and NRDA efforts
  Pepco publishes 3-4 newsletters mailed to 30,000 citizens; Trustees provide periodic updates for each issue

List of Fact Sheets

- April 2000 - Chalk Point/Swanson Creek Oil Spill
- May 2000 - A public claim versus a private claim: What are the differences?
- September 2000 - Status Report on the Chalk Point/Swanson Creek Oil Spill NRDA Assessing the Injuries
- November 2000 Study Summary - Wetland Injury Assessment
- December 2000 Study Summary - Nesting Birds (eagles, ospreys, great blue herons)
- December 2000 Study Summary - Bivalve Tissue Surveys
- December 2000 Study Summary - Fish Tissue Surveys
- December 2000 Study Summary - Fish Community
- December 2000 Study Summary - Benthic Invertebrate Community
- December 2000 Study Summary - Wetland Injury Assessment
- December 2000 Study Summary - Shoreline Clean-up Assessment Team
- December 2000 Study Summary - Wildlife Mortality Assessment (furbearers and waterfowl)
- May 2001 Study Summary - Injuries to Recreational Use

- January 2002 Study Summary – Nesting Bird Studies (Eagles, Ospreys, and Great Blue Herons)
- January 2002 Study Summary – Waterfowl Mortality Summary

8.2 **Appendix 2.** File structure and index of the Administrative Record developed by the Trustees for the Chalk Point oil spill.

1 Administrative Record Index Structure
1.1 Internal Record Structure
1.2 Summary of Administrative Record Contents

2 Law and Regulations
2.1 Applicable Law and Regulations
1 Oil Pollution Act of 1990 (OPA, 1990). 1/23/1990.
Document ID 2045
2.2 Notice to Responsible Parties
1 Sharon Shutler, to Kenneth A. Rubin, Duane A. Siler, 6/22/00, Letter on Invitation to Participate in the Natural Resource Damages Assessment for the Chalk Point Oil Spill
Document ID 1953
2.3 Public Legal Notices
1 Notice of Intent to Conduct Restoration Planning. NOAA. (9/1/2000). 8
Document ID 1964
2 Notice of availability of a Draft Restoration Plan and Environmental Assessment for the oil spill at Pepco's Chalk Point generating facility, Request for comments
Document ID 2044

3 Trustee Council
3.1 Agreements
3.1.1 Memorandum of Understanding Among Trustees
1 Memorandum of Agreement Amongst National Oceanic & Atmospheric Admin., Dept. of the Interior, MD Dept. of Natural Resources, MD Dept. of Environment
Document ID 1951
3.1.2 Memorandum of Understanding Between Trustees and the Responsible Party
1 Memorandum of Agreement Between The Trustees and The Responsible Parties Governing Cooperative Natural Resource Damage Assessment and Restoration Planning Activities for the Chalk Point Oil Spill, MD. (9/1/00), 17
Document ID 1967

4 Response Phase

5 Emergency Restoration

6 Injury Assessment
6.1 Preassessment
1 U.S. Fish and Wildlife Service Response During the Chalk Point Oil Spill (Mortality Report) plus 2 Attachments. Chesapeake Bay Field Office, (Fish and Wildlife Service)(10/5/00), 17
Document ID 1963
2 Summary of NRDA-related surveys initiated during the emergency phase of the Swanson Creek oil spill. Entrix, Inc. (2/1/2002). 278
Document ID 2043
6.2 Marshes
1 Final Wetland Vegetative Injury Assessment Plan Swanson Creek Oil Spill. Natural Resource Trustees, Potomac Electric Power Company, (10/4/00), 15
Document ID 1952
2 Swanson Creek oil spill natural resource damage assessment: Extent of oiling report [with color maps]. FINAL. Marsh Assessment Subgroup. (1/23/2002): 89 + [color maps]

Document ID 2047

3 Injury to Wetlands Resulting from the Chalk Point Oil Spill [with Carl Hershner peer review, 16 February 2002, and Trustees' responses to comments by C. Hershner, 19 February 2002]. Jacqueline Michel, Kevin Smith, Mitch Keiler, Al Rizzo, Rick Ayella, James Hoff. (Wetlands Assessment Team). (3/8/2002). 67+[4 and 3]
Document ID 2035

6.3 Aquatic Resources (Benthic, Fish, and Shellfish Resources)

1 Patuxent River Oil Spill Proposal to Assess Oil Spill Impacts on Benthic Invertebrates. Versar, Inc., MD. Dept. of Nat. Res. (6/15/00), 8
Document ID 1968

3 Statement of Work: Patuxent River Damage Assessment of the Chalk Point Oil Spill on Shallow Water and Intertidal Benthos. The Academy of Natural Science, (10/1/00), 4
Document ID 1962

4 Patuxent River oil spill: assessment of impacts on benthos. Final Report. Roberto J. Llanso, Jon Volstad (Versar, Inc.). (11/1/2001). 181
Document ID 2042

5 Estimation of the fisheries standing stock in the Patuxent River in April 2000 [with George Abbe peer review]. Aquatic Resources Subgroup. (3/1/2002): 108
Document ID 2046

6 Quantification of injury to benthic resources from the Chalk Point oil spill on the Patuxent River [with A. Fred Holland peer review, March 2002, and response to Holland comments, March 2002]. Charles H. Peterson (University of North Carolina at Chapel Hill). (3/5/2002). 17+[6 and 8]
Document ID 2041

7 Chalk Point oil spill of April 7, 2000 in Patuxent River, MD: modeling of the fates and acute biological effects of the spilled oil on the water column. FINAL REPORT. Deborah French McCay, Jill Jennings (Applied Science Associates). (4/1/2002): 131
Document ID 2048

8 Final Report: A survey of the shallow water and intertidal benthic invertebrates at three sites in the vicinity of the Chalk Point Steam Electric Station. Richard W. Osman (Curator, Benthic Ecology, The Academy of Natural Sciences, Estuarine Research Center). (11/26/2001). 36
Document ID 2040

6.4 Birds and Wildlife

1 Wildlife Injury Assessment Plan for the Chalk Point Oil Spill. Natural Resource Trustee Agencies and Pepco Representatives, (10/5/00), 7
Document ID 1965

2 Draft Study Plan Patuxent River Diamondback Terrapin Project. Roger Wood, (The Wetlands Institute and Richard Stockton College of New Jersey)(10/1/00), 3
Document ID 1954

3 Reproductive Success of Bald Eagles (Haliaeetus Leucocephalus) Nesting in the Vicinity of the Chalk Point Oil Spill Final Report. Ann Wearmouth, Peter McGowan, Wildlife Injury Workgroup for the Natural Resource Trustee Council, (4/11/2001), 5
Document ID 1986

4 Estimate of Total Acute Mortality to Birds Resulting from the Chalk Point Oil Spill, Swanson Creek, Maryland, April 7, 2000. Wildlife Injury Workgroup for the Natural Resource Trustee Council, (5/7/2001), 15
Document ID 1985

5 Reproductive Success of Great Blue Herons (Ardia Herodias) Nesting in Swanson Creek, Maryland During the Chalk Point Oil Spill Final Report. Wildlife Injury Workgroup for the Natural Resource Trustee Council, (5/16/2001), 13
Document ID 1987

6 Reproductive Success of Osprey (Pandion haliaetus) Nesting in the Vicinity of the Chalk Point Oil Spill: Final Report [with Charles Henny peer review, 1 October 2002]. (United States Fish and Wildlife Service)(11/1/2001): 30+[2]

Document ID 2034

7 Acute mortality of diamondback terrapins from the Chalk Point oil spill [with J. Whitfield Gibbons peer review, 11 Nov. 2002]. Jacqueline Michel, Richard Greer, Mark Hoffman, Peter McGowan, Roger Wood. (Wildlife Injury Workgroup). (11/9/2001). 4+[2]
Document ID 2036

8 Comparison of northern diamondback terrapin (Malaclemys terrapin terrapin) hatching success among variably oiled nesting sites along the Patuxent River following the Chalk Point oil spill of April 7, 2000 [w/ J. Whitfield Gibbons peer review, 7 Sept 2001]. Roger C. Wood, L. Stanton Hales, Jr. (12/7/2001). 33+[6]
Document ID 2037

9 Estimate of total injury to diamondback terrapins from the Chalk Point oil spill [with J. Whitfield Gibbons peer review, 11 Nov. 2001]. Heath Byrd, Eric English, Richard Greer, Heidi Hinkeldey, Wayne Kicklighter, Norman Meade, Jacqueline Michel, Ted Tomasi, Roger Wood (Wildlife Injury Workgroup). (2/25/2002). 16+[2]
Document ID 2038

10 Scaling the Washington Creek restoration project to the Chalk Point oil spill diamondback terrapin injury. Heath Byrd, Eric English, Norman Meade, Ted Tomasi. (Byrd and Tomasi: ENTRIX, Inc.; English and Meade: NOAA). (3/12/2002).
Document ID 2039

6.5 Lost Human Use

1 Dr. Kenneth E. McConnell, to Norman Meade, 2/28/01, Letter on Peer Reviews: Chalk Point Lost Recreational Use Valuation Report
Document ID 1971

2 Study Summary - Injuries to Recreational Use: Chalk Point Oil Spill Natural Resource Damage Assessment. Heath Byrd, Eric English, Doug Lipton, NormanMeade, Ted Tomasi, (5/30/01), 2
Document ID 1973

3 Chalk Point Oil Spill: Lost Recreational Use Valuation Report. Heath Byrd, Eric English, Doug Lipton, Norman Meade, Ted Tomasi (3/1/01), 66
Document ID 1970

4 Quantification of Lost Human Use: Proposed Work Plan and Budget Chalk Point Oil Spill. Heath Byrd, Eric English, Doug Lipton, Norman Meade, Ted Tomasi (6/30/00), 3
Document ID 1969

7 Restoration Planning

1 Factors to Evaluate Proposed Restoration Projects under the Oil Pollution Act Patuxent River
Oil Spill. Sharon Shutler, ENTRIX, Inc., (2/5/01), 6
Document ID 1966

2 Restoration scaling of benthic, aquatic and bird injuries to oyster reef and marsh restoration projects. Deborah French McCay, Pete Peterson, Michael Donlan. (4/16/2002): 45
Document ID 2049

8.2 Appendix 3. Site selection for wetland restoration activities associated with the Chalk Point oil spill (Prepared by Kevin Smith, MDNR)

Background

The magnitude and extent of oiling to marsh habitat was assessed by a team of wetland specialists over the 2000 and 2001 growing seasons. Impacts to wetland vegetation, soils and the benthic community were assessed, analyzed and quantified. The results of this analysis are documented in Michel et al., (2002).

Injury Assessment

Vegetation - Since different community types (e.g.; *Typha sp.*, *Spartina cynosuroides*, *Spartina alterniflora*, *Iva frutesens*) were impacted at varying degrees, a number of permanent monitoring stations were established to measure the recovery of the different vegetative communities within the different oiling categories (light, moderate and heavy). Monitoring stations were also established for unoiled sites within the same vegetative communities.

Soils - Chemical analyses conducted on sample cores were collected in permanently established monitoring stations (the same stations as the vegetative monitoring stations). Cores were analyzed for total petroleum hydrocarbon (TPH) and total polynuclear aromatic hydrocarbon (PAH) concentrations for each sample.

Benthic Community - Sample cores were also collected at permanent monitoring stations (the same stations as the vegetative monitoring stations) at the heavily oiled sites and reference areas. Species were collected and identified to species or tax as appropriate and counted.

By analyzing the data collected above and calculating the area or extent of each injury, recovery curves were developed for each wetland vegetation type. Recovery curves were developed for both vegetation and soils for each wetland vegetation type. The recovery curves describe both the magnitude of service loss and the time to recovery for each category of wetland.

Calculation of Restoration Needs

Based on the recovery curves established, the Trustees calculated the area of wetlands restoration replacement to compensate for the lost services due to the oil spill. The final calculation for tidal wetland replacement is 5.66 acres. (Note: This also includes the replacement for injuries to muskrats.)

Based on all of the information collected throughout the monitoring period, the requirements of the Oil Pollution Act (OPA) and based on the extensive field work accomplished by members of the Wetlands Assessment Team, it was known that the preferred restoration site would primarily focus on areas where:

> *Intertidal wetlands, similar to the vegetative types injured, could be restored, created or enhanced.*

In addition, preferred restoration sites would be those that:

- *Were located within the area of impact;*
- *Replaced the extent and type of wetlands that were injured;*
- *Could be implemented effectively and at a reasonable cost; and*
- *Had a reasonable assurance of success*

Restoration Site Search

The search for potential restoration sites included the following methods:

- Aerial Photo Interpretation;
- On-the-Ground Site Investigations;
- Recommendations from individuals and organizations; and
- Local Knowledge of Potential Restoration Sites.

As a result of the information collected above, a number of possible restoration sites were identified and investigated. After this initial investigation, three potential restoration projects were deemed to meet the requirements as good candidates for restoration. Those sites are marked with an asterisk below. The following is a list of all the sites recommended and investigated. Also included is a brief explanation of why each site was or was not chosen. (A map showing all of the potential sites is attached)

1. **Maxwell Hall/Teague Point** - This site was investigated as an area where the soils in the existing farm fields could be cut down in order to establish a tidal connection. This practice was referred to as "scrape-down". This site was dropped from consideration when it was determined that this was not practical.

2. **Benedict Parcel** - This site was offered for sale to the Trustees. The site was investigated to ascertain whether or not there was any opportunity to enhance or restore wetlands within the parcel. The existing wetlands were deemed to be of good value and there was little opportunity for restoration or enhancement.

3. **Patuxent River NRMA** - This site was intensively investigated for possible tidal wetland restoration, creation or enhancement. While some potential opportunities existed, it was determined that the amount of earthwork involved would be prohibitive. This site was also intensively investigated for nontidal wetland restoration. Based on this investigation, a number of potential sites were identified. However, since tidal wetland restoration was our primary objective, this site was dismissed.

4. **Indian Creek Bulkhead** - The Wetlands Assessment Team (WAT) examined the possibility of removing an existing bulkhead on private property. While it was felt that the removal of an existing bulkhead was a worthy project, the site was situated in an existing residential area which limited its functional capabilities.

5. **Trent Hall*** - A number of different opportunities for tidal, nontidal and shoreline restoration and creation were investigated at this site. After our initial investigation, it was determined that the creation of approximately 5.7 acres of tidal wetlands could be created in an existing farm field adjacent to Washington Creek by removing a few feet of soil and tying into the adjacent tidal elevations. In addition, the excavated soil (a sandy loam) could be used to replenish approximately 2,000 feet of southeast facing shoreline. This would provide a cost-effective method to dispose of the excavated material, mitigate for impacts to diamondback terrapins and provide needed shore erosion control in an area that is being actively eroded. This site has been determined to be the "Preferred" site for restoration.

6. **Washington Creek** - This was a potential "scrape-down" site. However, the elevations were too high to make this site practical.

7. **Cremona*** - This potential project involved the installation of u-shaped breakwaters/sills offshore and the emplacement of sand between the breakwaters and an existing reveted shoreline. This site was designed primarily to mitigate for injuries related to diamondback terrapins. This site is still being considered as a potential restoration site.

8. **Marsh Point** - This was a potential "scrape-down" site adjacent to the Patuxent River. This is an existing high beach/dune type area. It was determined that the existing habitat value at this site was too high and therefore, did not warrant further consideration.

9. **Cat Creek** - This was also a potential "scrape-down" site adjacent to the Patuxent River. This is an existing high beach/dune type area. It was determined that the existing habitat value at this site was too high and therefore, did not warrant further consideration.

10. **Parker's Wharf** - This was a shoreline area that was extensively rip-raped with bricks, cinder blocks and other assorted rubble items. This site was considered as a potential site for the establishment of fringe wetlands. In order to establish fringe wetlands at the site, the existing rubble would have to be removed and some type of protection (breakwater, sill, etc.) would need to be installed. This site was dismissed from further consideration since the site is currently protected (to a limited degree) by the existing rubble and the cost to remove the rubble and install breakwaters or sills would be prohibitively expensive. In addition, the acreage of wetlands that would be established would be relatively small (approximately 1 acre).

11. **Ben Creek** - This is an existing eroding shoreline along the eastern shore of the Patuxent River. In order to establish fringe marsh at the existing shoreline would have to be cut back significantly and some type of wave protection would need to be installed. Based on the amount of wetland acreage gained (less than 1 acre), it was determined that the cost to implement this project would be prohibitively expensive.

12. **Battle Creek South*** - This site had good opportunity to integrate oyster reef and fringe marsh habitat. This site consists of an existing eroding shoreline with a rather steep nearshore bottom. We examined this site as an area where we could establish an offshore

oyster reef (constructed of limestone or similar material). This oyster reef would act as wave attenuation for a fringe marsh area along the shoreline. This project is still under consideration as a potential restoration site.

13. **Battle Creek North** - this site was evaluated as a potential "scrape-down" site. However, due to the high elevation of the existing farm fields, it was determined that the cost of lowering the elevation to that of the adjacent tide would not be cost-effective.

14. **Sandy Lake** - This is an existing ponded area connected by a narrow inlet to the Patuxent River. While opportunities to stabilize eroding slopes and enlarge the tidal connection to the River are good and would increase tidal flushing in the ponds. It was determined that the amount of wetland acreage to be gained would not be significant to warrant further investigation.

15. **Buzzard Island** - This site consists of a number of islands across the River from Indian Creek and was offered for sale. Since the preservation of existing areas does not provide compensation for injuries, this opportunity was dismissed.

16. **Hallowing Point** - This is the site of an existing trailer park which is situated in the 100-year floodplain of the Patuxent River. Calvert County along with the State of Maryland is negotiating with the property owner to purchase this property, remove the trailers and return the area to open space. While this is a good opportunity for restoration, the timing of the purchase and removal of the trailers was sketchy and seemed to be a few years down the road. For that reason this site was not considered any further.

8.4 Appendix 4. List of restoration ideas and alternatives considered by the Trustees. These were provided to the Trustees by members of the Governor's Citizens Advisory Committee, Patuxent River Commission, RPs, and appropriate federal state, and local officials. Cost estimates and other information were preliminary and are presented here as originally proposed. A discussion of specific sites identified and evaluated to restore wetland losses is provided in Appendix 3.

	Project Name	Project Description	Location by County	Compensation Category	Preliminary Evaluation
1	Greenwell State Park	Install playground equipment ($35,000) Contact: Pete Smith, MDNR	St. Mary's	Lost use: Shoreline recreation	Evaluate in draft Restoration Plan
2	Paddle-in campsites	Establish paddle-in primitive campsites on state NRMA properties at Indian Creek, Hall Creek, and Milltown Landing. Maintenance of the sites would be funded by state authorities. ($18,000) Contact: Donnie Hammett, MDNR	Charles, Prince George's, Calvert	Lost use: Boating, shoreline recreation	Meets restoration criteria; evaluate in the draft Restoration Plan.
3	Maxwell Hall NRMA	Open to access 670 acres of land by Teague Point at the mouth of Swanson Creek, across from the Chalk Point facility. Land was purchased with MDNR and county funds and is managed by Charles Co. Dep. of Parks and Recreation. Public access is currently not supported because of lack of funds. Could involve creation of parking area, boardwalk and foot trails to reach water's edge, equestrian park, and creation of paddle-in campsites. Contact: Tom Rowland, Charles County Dept. of Parks & Rec. Project submitted by: George B. Wilmot, PRC, CAC	Charles	Lost use: Shoreline recreation	Meets restoration criteria; evaluate in the draft Restoration Plan.
4	St. Mary's marina boat ramp	Upgrade and repair the boat ramp at St. Mary's Marina. The county funded dredging and construction of bulkhead to maintain the channel into the private Marina. In exchange, it received a 25-year lease for public access to the boat ramp. Before the Recreation and Parks Department takes over operation of the boat ramp, repairs are needed. ($50,000 - $100,000) Contact: Billy Ball, St. Mary's County Dept. of Rec. and Parks	St. Mary's	Lost use: Boating	Legal issues associated with the property owner's agreement to maintain the facility for public access prohibit further consideration. Evaluate in draft Restoration Plan

5	Forest Landing boat ramp	Extend (and possibly repair) boat ramp on Forest Landing (south of Greenwell SP). The county-owned facility currently has parking and a ramp at the end of Forest Landing road, near Hollywood (Leonardtown). The ramp is too short for many boat trailers. ($50,000) Contact: Billy Ball, St. Mary's County Dept. of Rec. and Parks	St. Mary's	Lost use: Boating	Evaluate in the draft Restoration Plan.
6	King's Landing boardwalk and foot trail	Reconstruct a boardwalk and foot trail to access Cocktown Creek. Funding is also desired for the purchase of canoes. This is a state-owned, county-operated park at the site of a former YMCA camp, with a swimming pool, fishing pier, and canoe access, among other facilities. ($50,000 - $60,000) Contact: Sherrod Sturrock, Calvert Co. Open Space Committee	Calvert	Lost use: Shoreline Recreation	Meets restoration criteria; evaluate in the draft Restoration Plan.
7	Jefferson Patterson State Park boardwalk and foot trail	Construction of a boardwalk and foot trail along the base of a bluff by the shore. The area has a series of sheltered beaches accessible by small boats. ($50,000) Contact: Mike Smolek, Jefferson Patterson State Park	Calvert	Lost use: Shoreline Recreation	Evaluate in the draft Restoration Plan.
8	Jefferson Patterson State Park paddle trail	Development of a paddle trail from Jefferson Patterson State Park up to the headwaters of St. Leonard Creek, with interpretive guidebook (conservation efforts and historical events, including War of 1812 sites) and signage at launch site. ($30,000 for guidebook or $100,000 total). Contact: Mike Smolek, Jefferson Patterson State Park	Calvert	Lost use: Shoreline Recreation	Evaluate in the draft Restoration Plan.
9	Cedar Haven fishing pier	Construction of fishing pier at a currently undeveloped access point in the community of Cedar Haven, just north of Eagle Harbor on the western shoreline of the Patuxent. The site currently has a dirt access road and open grass and shoreline, and is used for limited fishing. The fishing pier is one of several improvements envisioned by the county, including picnic benches and designated parking. ($60,000 - $80,000) Contact: Chuck Montrie, Capital Parks and Planning Commission	Prince Georges	Lost use: Fishing	Meets restoration criteria; evaluate in draft Restoration Plan

10	Integrated ecological restoration (oyster reef/ SAV/ wetlands restoration)	Rebuild/restore historical oyster reef and adjacent wetland and/or SAV bed. Oyster bed to be a sanctuary and seed source for nearby private and public oyster beds. Site chosen to be low energy and proximal to injury site. Contacts: Kevin Smith, MDNR; John Collins, NOAA; and Al Rizzo, USFWS	Site to be determined	benthic, water column, muskrats	Appropriate sites were not identified within the spill zone
11	The Sandy Point Integrated Ecosystem Restoration Project	Plant 5 acres of SAV; construct 3 acres of oyster bars; part of ongoing restoration, research and education work at this site; 3-year budget=$670,000 Contacts: Dennis King, CBL; Eileen M. Seltzer-Hamilton, CBL; Ken Tenore, CBL, CAC	Calvert	benthic and water column resources, birds and waterfowl, lost use	Include and evaluate in the draft Restoration Plan
12	Enhance elbow bar oyster reef	Elbow Bar Reef off Chalk Point: survey, rebuild, monitor for disease, stock with oyster spat from Chalk Point nursery. Contact: Kim Coble, Chesapeake Bay Foundation, CAC	Prince George's (?)	oysters, benthic invertebrates	Oyster reef enhancement meets restoration criteria; evaluate in draft Restoration Plan.
13	A Cooperative Approach for Oyster Restoration in the Patuxent River	Use 4 private oyster leases as seed beds; oysters are set at State and U. of MD hatcheries; 15-acre seed beds are prepared, then 5 acres planted at each site with hatchery-produced spat for 3 consecutive years; then sub-adults are moved to private beds (40%), public beds (30%), and sanctuary and broodstock programs (30%); oyster disease research accompanies the program; 6-year budget=$2,192,806 Contact: William Pfeiffer, Chesapeake Appreciation, Inc.	Calvert	benthic and water column resources	Evaluate in draft Restoration Plan.
14	Wetlands restoration/ Phragmites control	Apply herbicide in the Fall, then burn the killed Phragmites; repeat as needed; multi-year likely. Contact: Jack Leighty, Patuxent River Commission, CAC	site(s) to be determined	Wetlands/ muskrats	Evaluate in draft Restoration Plan.

15	Finding new sites for planting riparian buffers	Individuals and organizations want to volunteer to plant riparian buffers. This project would fund publishing a list of riparian buffer planting sites that volunteers can work on. Contact: Larry Cartano, Patuxent River Commission	Patuxent River Watershed: Montgomery, Howard, Anne Arundel, Prince George's, Calvert, Charles, St. Mary's	All Ecological	Already being done by many agencies. Anne Sloan (MDNR) will follow up with contact person.
16	Stormwater treatments	Use current technology to remove (126,000 gallons of) hydrocarbons from existing stormwater sources. Contact: Kim Coble, Chesapeake Bay Foundation, CAC	Patuxent River Watershed: Montgomery, Howard, Anne Arundel, Prince George's, Calvert, Charles, St. Mary's	water quality	Specific locations where this technology would be used could not be identified.
17	Watershed education outreach	Develop comprehensive plan to involve local schools in restoration projects; ensure inclusion of oil spill science in curriculum Contact: Dr. Lee J. Summerville, Patuxent River Commission	local schools	All Ecological	Existing programs include: Chesapeake Bay watershed educational outreach program; EPA oil spill program (learning center: curriculum guides, interactive site, links); Chesapeake Bay Foundation programs in partnership with the National Geographic; Watershed Radio (broadcasts environmental radio lessons, offers classroom programs and public outreach programs; Mongomery County Public Schools event-based science module for oil spills and coastal oceanography; Save Our Seabirds (online spill response training, education site); OSAGE (Oil Spill Awareness through Geoscience Education - curriculum guides and resource materails), Marine Oil Spill Prevention Education (Oil Spill Education Specialist sponsored by Washington Sea Grant Program).

18	Citizen outreach	Create grant source to fund citizen organization projects: pollution reduction, habitat restoration, outreach. Priority for Patuxent watershed groups. Contact: Kim Coble, Chesapeake Bay Foundation, CAC	Patuxent River Watershed: Montgomery, Howard, Anne Arundel, Prince George's, Calvert, Charles, St. Mary's	all	Specific benefits of a grants program could not be scaled directly to losses resulting from the spill (necessary to determine the appropriate size of the grant program).
19	General habitat creation/ acquisition	Restore or acquire habitat (shoreline buffers, beaches, wetlands) within the Patuxent watershed equivalent in size to that impacted or destroyed. Contact: Kim Coble, Chesapeake Bay Foundation, CAC	Patuxent River Watershed: Montgomery, Howard, Anne Arundel, Prince George's, Calvert, Charles, St. Mary's	wetlands, muskrats, terrapins	Specific sites were not proposed; potential sites for this type of project evaluated separately. This proposal is consistent with Maxwell Hall NRMA evaluated in the draft Restoration Plan.
20	Swanson Creek land acquisition	The Bunting-Summers property is a 68 acre undeveloped parcel that straddles Prince Georges County and Charles County, covering a long, narrow strip of shore and floodplain. It is in private ownership and is currently used for duck and goose hunting (Total cost is about $200,000; the Charles Co. portion would be about $70,000) Contact: Chuck Montrie, Maryland National Capital Parks and Planning Commission Project submitted by: Raymond B. Palfrey, Jr., PRC	Prince George's/ Charles	Lost Use/ ecological	It is not clear that this property is subject to development. May not provide significant lost use or ecological benefits unless the area is suitable and scheduled for development.
21	Trent Hall land acquisition	Assist in the purchase of conservation easement on 650-acre tract on southern shore of Trent Hall Creek. The parcel is under consideration by the Maryland Rural Legacy program. (Partial contribution to total cost of $1.5 million)	St. Mary's	Uncertain	This project will proceed under Rural Legacy Program.
22	Benedict Bridge land acquisition	Purchase 20 acres on the north side of Benedict Bridge, marshy shore with a pier.	Charles	Uncertain	It is not clear that this property is subject to development.

23	Buzzard Island land acquisition	Purchase 12 acres on point of land including Buzzard Island, with a road out to it, on the eastern shore of the Patuxent across from Golden Beach.	Calvert	Uncertain	It is not clear that this property is subject to development.
24	PG county land acquisition	A number of parcels are available from north of Eagle Harbor up to Rt. 50. Contact: Chuck Montrie, Maryland National Capitol Parks and Planning Commission	Prince George's	Uncertain	It is not clear that this property is subject to development.
25	Piney Point Lighthouse	Create environmental exhibits. Contact: Michael Humphries	St. Mary's	Uncertain	Outside of the spill area; potential benefits difficult to scale to the injuries.
26	Oyster rafts	Oyster rafts are large floating anchored rafts with many long "ribbons" hanging from the underside that are colonized by oysters. These rafts have been used in Tampa Bay for many years as an approach to help improve water clarity. This restoration option may become attractive as a pilot project if more traditional oyster restoration options cannot be implemented. Contact: Jesse Webber (Entrix)	to be determined	water quality, bivalves	Oyster reef restoration considered to be appropriate restoration option. Oyster rafts, however, are not the preferred method of regional interests.
27	Hatchery production	Both MDNR and Mirant have active hatchery facilities for producing fish. Contact: Jesse Webber (Entrix)	to be determined	fish, lost use	Consistent with restoration criteria; evaluate in draft Restoration Plan.
28	Terrapin nest protection	Replace the terrapins that were killed by the spill by increasing the hatching success of the eggs laid. Contact: Jesse Webber (Entrix)	to be determined	terrapins	Consistent with restoration criteria; evaluate in draft Restoration Plan.
29	Habitat protection/ conservation easements	Support protection of important waterfowl habitat (e.g., wetlands and associated upland habitats) to enhance natural production and/or provide protection for migratory birds through existing Federal or State programs (e.g., Maryland's Conservation Reserve Enhancement Program) or through non-profit (e.g., Ducks Unlimited or Nature Conservancy). Contact: Jesse Webber (Entrix)	to be determined	waterfowl	The Trustees will try to incorporate this into other restoration projects, where appropriate.

30	Mute swan control	Designate Restoration areas as "Swan Free" Zones - areas for researching and documenting the success or failure of various methods of control (e.g., fencing, pyrotechnics, addling eggs, oiling eggs, removal, etc.) Also investigate the time and cost associated with each method. Outreach and education areas. Contact: Ediee Thompson (MDNR)	to be determined	Native bird and SAV enhancement	The Trustees will try to incorporate this into other restoration projects, where appropriate.
31	Mute swan outreach	Develop Waterfowl Education Package. Fact sheets, on-line information, etc., on why mute swans need to be controlled, methods of control, and success stories. Press coverage, discussions and demonstrations in restoration/enhancement areas, refuges, parks, etc. Develop instructional materials and modules for teachers, etc. Trail signs. Contact: Edie Thompson (MDNR) Chris Swarth (Jug Bay Wetland Sanctuary)	to be determined	Native bird and SAV enhancement	The Trustees will try to incorporate this into other restoration projects, where appropriate.
32	Canada Goose control	1) See #30. 2) Geese Peace - group that uses trained dogs to keep geese away from an area. (Won't work for swans or in wetlands w/ dogs in the water.) Cost: area with 50 geese = $20,000. Usually buy the dogs. Contact: Edi Thompson (MDNR).	to be determined	Native bird and plant sps. enhancement	The Trustees will try to incorporate this into other restoration projects, where appropriate.
33	Wild rice restoration	Research project looking at the wild rice/resident geese connection. Involves fencing off wild rice to keep Canada geese from cropping rice. Propagation of rice requires collecting seed and replanting annually, installing and maintaining fencing, and hazing. Also need to control Canada goose population. Wild rice restoration is experimental. Contact: Mike Haramis (USGS, PWRC)	Jug Bay	Native bird and plant sps. enhancement	Suitable areas located outside of the spill zone; likelihood of success uncertain.

34	SAV restoration	1) Jug Bay Wetlands Sanctuary working with MDNR - reintroducing native SAV in beaver area above project. They are also doing some restoration and research. Problem: Carp (Asian and Common) destroying SAV in Jug Bay. Need to control. Contact: Chris Swarth; 2) SAV restoration in the Patuxent River - Area near the spill is near the turbidity maximum, therefore, SAV won't grow there. Grows farther down the river and in Jug Bay. Would be willing to do some planting; utilizes the Grasses and Classes Program. Contact: Mike Naler (MDNR). 3) Any wetland restoration will require fencing which will need to be maintained over several years. Also pipes will need to be installed in wetland to deter geese and swans from using the area. Contact: Peter Bergstrom (USFWS, CBFO)	Anne Arundel (Jug Bay Wetlands Sanctuary) and PG (Patuxent River Park)	water quality, waterfowl	Outside of spill zone.
35	Identification guide	Identification guide to reduce accidental kills of ruddy ducks Contact: Sam Droege, (USGS, PWRC)	to be determined	ruddy ducks	A guide already exists.
36	Gillnet license buyout	Purchase permit authorizing gill netting and/ or cancel permits following buy out. Benefits: eliminates gill nets and fishing. Allows for increased survival and food source. Contact: Doug Forsell, (USFWS-CBFO)	Patuxent River	Waterfowl - Ruddy ducks	Requires a change of state legislation.
37	Ruddy Duck nesting habitat	Enhance/purchase nesting areas in the Prairie Pothole Region. Contact: Doug Forsell, (USFWS-CBFO).	site to be determined	Ruddy ducks	Evaluate in draft Restoration Plan.

8.5 Appendix 5. Compliance with key statutes, regulations, and policies.

Oil Pollution Act of 1990 (OPA), 33 U.S.C. 2701, et seq., 15 C.F.R. Part 990
OPA establishes a liability regime for oil spills that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. OPA provides a framework for conducting sound natural resource damage assessments that achieve restoration. The process emphasizes both public involvement and participation by the RPs. The Trustees have conducted this assessment in accordance with OPA regulations.

National Environmental Policy Act (NEPA), 42 U.S.C. 4321, et seq., 40 C.F.R. Parts 1500-1508
An Environmental Assessment (EA) was prepared for the restoration projects as part of the Restoration Plan and Environmental Assessment (RP/EA). This EA evaluates the effects of implementing the restoration projects considered in the plan. A Finding of No Significant Impact (FONSI) is anticipated after completion of the public review process and approval of the final RP/EA.

Clean Water Act (CWA), 33 U.S.C. 1251, et seq.
The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the beneficial uses of dredged or fill material in navigable waters. The Army Corps of Engineers administers the program. In general, restoration projects, which move significant amounts of material into or out of waters or wetlands—for example, hydrologic restoration or creation of tidal marshes—require 404 permits. Under section 401 of the CWA, restoration projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. The application process to obtain these permits has been initiated and issuance of the required permits is expected at the completion of the process.

Rivers and Harbors Act, 33 U.S.C. §§ 401, et seq.
The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the COE with authority to regulate discharges of fill and other materials into such waters. Restoration actions that comply with the substantive requirements of Section 404 of the CWA will also comply with the substantive requirements of Section 10 of the Rivers and Harbors Act.

Coastal Zone Management Act (CZMA), 16 U.S.C. 1451, ET SEQ., 15 C.F.R. 923
The goal of the CZMA is to preserve, protect, develop and, where possible, restore and enhance the nation's coastal resources. The federal government provides grants to states with federally approved coastal management programs. Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. No federal license or permit may be granted without giving the state the opportunity to concur that the project is consistent with the state's coastal policies. The regulations outline the consistency procedures that will be followed by the Trustees. The Trustees believe that the restoration

projects selected for implementation will be consistent with the Maryland CZMA program, and have begun the process of seeking concurrence by the state.

Endangered Species Act (ESA), 16 U.S.C. 1531, et. seq., 50 C.F.R. Parts 17, 222, 224
The ESA directs all federal agencies to conserve endangered and threatened species and their habitats to the extent their authority allows. Under the Act, the Department of Commerce through NOAA and the Department of the Interior through the United Stated Fish and Wildlife Service (USFWS) publish lists of endangered and threatened species. Section 7 of the Act requires that federal agencies consult with these departments to minimize the effects of federal actions on endangered and threatened species. This process has begun through consultation with NOAA's National Marine Fisheries Service (NMFS) and the USFWS. Restoration projects proposed in this RP/ EA are not expected to adversely impact any species listed under the ESA.

Fish and Wildlife Conservation Act, 16 U.S.C. 2901, et seq.
The proposed restoration projects will either encourage the conservation of non-game fish and wildlife, or have no adverse effect.

Fish and Wildlife Coordination Act (FWCA), 16 U.S.C. 661, et seq.
The FWCA requires that federal agencies consult with the U.S. Fish and Wildlife Services, the National Marine Fisheries Service, and state wildlife agencies for activities that affect, control, or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other federal permit, license, or review requirements. The proposed restoration projects will have either a positive effect on fish and wildlife resources or no effect. Coordination is in progress between NOAA National Marine Fisheries Service and the U.S. Fish and Wildlife Service.

Magnuson-Stevens Fishery Conservation and Management Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson-Stevens Act), 16 U.S.C. 1801 et seq.
The Magnuson-Stevens Act provides for the conservation and management of the Nation's fishery resources within the Exclusive Economic Zone (from the seaward boundary of every state to 200 miles from that baseline). The management goal is to achieve and maintain the optimum yield from U.S. marine fisheries. The Act also established a program to promote the protection of Essential Fish Habitat (EFH) in the review of projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, Federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized funded, or undertaken by such agency that may adversely affect any EFH.

The proposed restoration projects, under OPA, are being undertaken to make the environment and the public whole for injuries to natural resources and natural resource services by returning injured natural resources and natural resource services to their pre-spill, or baseline condition and compensating for interim losses of natural resources. While the overall goal is to restore and

enhance the injured habitat, some restoration activities may convert one habitat to another and must be considered as a potential adverse impact to EFH and analyzed appropriately.
The areas in which the river bottom or wetland is being modified by enhancing oyster reef habitat, placing offshore breakwaters to protect an eroding beach, rebuilding and extending boat ramps and boardwalks, or building a fishing pier, are being evaluated to determine whether they affect EFH for species managed by the Atlantic Regional Fishery Management Council. The Trustees expect that the proposed actions will not represent an adverse effect on any of the species in question.

Marine Mammal Protection Act, 16 U.S.C. 1361 et seq.
The Marine Mammal Protection Act provides for long-term management and research programs for marine mammals. It places a moratorium on the taking and importing of marine mammals and marine mammal products, with limited exceptions. The Department of Commerce is responsible for whales, porpoise, seals, and sea lions. The Department of the Interior is responsible for all other marine mammals. The selected restoration project will not have an adverse effect on marine mammals.

Migratory Bird Conservation Act, 126 U.S.C. 715 et seq.
The selected restoration projects will have no adverse affect on migratory birds. Migratory birds are expected to benefit from creation of new marsh habitat and protection of nesting habitat for ruddy ducks.

Archeological Resources Protection Act, 16 U.S.C. 470 et seq.
The wetland restoration site has been surveyed to determine its value as an archaeological resource, and the oyster restoration site will be selected to avoid any submerged archaeological resources. The lost use restoration projects will be evaluated for their potential as archaeological resources and are not expected to require protection under the Act. Survey results from the wetland project have been submitted to the Maryland Division of Historical and Cultural Programs for review. The Trustees expect concurrence by the Maryland Division that the site does not represent an archaeological site requiring protection under the Act.

Executive Order 11990 (42 FR 26,961) - Protection of Wetlands
On May 24, 1977, President Carter issued Executive Order 11990, Protection of Wetlands. This Executive Order requires each federal agency to take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: acquiring, managing, and disposing of federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. The Trustees have concluded that the selected restoration projects will meet the goals of this executive order.

Executive Order 12898 (59 Fed. Reg. 7,629) – Environmental Justice
On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. This Executive Order requires each federal agency to identify and address, as appropriate,

disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low-income populations. EPA and the Council on Environmental Quality (CEQ) have emphasized the importance of incorporating environmental justice review in the analyses conducted by federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations. The Trustees have concluded that there are no low-income or ethnic minority communities that would be adversely affected by the selected restoration project.

Executive Order Number 11514 (35 FR 4,247) - Protection and Enhancement of Environmental Quality

An Environmental Assessment (EA) has been prepared as part of the RP/ EA and environmental coordination is taking place as required by NEPA.

Executive Order Number 12962 (60 FR 30,769) – Recreational Fisheries

The selected restoration projects will help ensure the protection of recreational fisheries and the services they provide. These projects will have no adverse effects on recreational fisheries.

Executive Order Number 13112 (64 FR 6,183) – Invasive Species

The proposed ecological restoration projects will not cause or promote the introduction or spread of invasive species. Annual surveys for invasive species (specifically *Phragmites*) and actions to control them should they be present in the created tidal marsh, have been budgeted into costs for this project. The proposed lost use projects will also not cause or promote the introduction or spread of invasive species.

9.0 Preparers

The following Trustee participated in the development of this RP/EA:

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10.0 Finding of No Significant Impact

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

_____ _____

Date