FINAL

RESTORATION AND COMPENSATION DETERMINATION PLAN / ENVIRONMENTAL ASSESSMENT FOR THE MACALLOY CORPORATION SITE, CHARLESTON, SOUTH CAROLINA

July 16, 2010

Prepared by:

National Oceanic and Atmospheric Administration

South Carolina Department of Health and Environmental Control

South Carolina Department of Natural Resources

and

The United States Fish and Wildlife Service

on behalf of the

U.S. Department of the Interior

Send Comments to:

Charles J. Williams, III
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
Phone: 803-896-4162
Fax: 803-896-4292
Email: williacj@dhec.sc.gov

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

Under regulation guiding the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Federal and state natural resource agencies are designated to act as Trustees for the public (43 CFR Part 11, 1986). The Trustees are responsible for recovering damages for injury to natural resources caused by a release of hazardous substances. Damages may include the cost of restoring the resource services to baseline conditions (i.e. conditions without a release) and the value of recreation and ecological service losses from the time of injury until baseline is restored.

This Restoration and Compensation Determination Plan/ Environmental Assessment (RCDP/EA) has been developed by the National Oceanic and Atmospheric Administration (NOAA) of the U. S. Department of Commerce, the South Carolina Department of Health and Environmental Control (SCDHEC), the South Carolina Department of Natural Resources (SCDNR), and the United States Fish and Wildlife Service (USFWS) on behalf of the U.S. Department of the Interior (DOI), (collectively, "the Trustees") to address natural resources, including ecological services, injured, lost or destroyed due to releases of hazardous substances from the Macalloy Corporation Site ("Site") in Charleston, South Carolina.

1.1 AUTHORITY

This RCDP/EA was prepared jointly by the Trustees pursuant to their respective authority and responsibilities as natural resource trustees under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 *et seq.*; the Federal Water Pollution Control Act, 33 U.S.C. § 1251, *et seq*. (also known as the Clean Water Act or CWA), and other applicable federal or state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), at 40 C.F.R. §§ 300.600 through 300.615, and DOI's CERCLA natural resource damage assessment regulations at 43 C.F.R. Part 11 (NRDA regulations) which provide guidance for this restoration planning process under CERCLA.

1.2 NEPA COMPLIANCE

Actions undertaken by the Trustees to restore natural resources or services under CERCLA and other federal laws are subject to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 *et seq.*, and the regulations guiding its implementation at 40 C.F.R. Parts 1500 through 1517. NEPA and its implementing regulations outline the responsibilities of federal agencies under NEPA, including for preparing environmental documentation. In general, federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. When it is uncertain whether a contemplated action is likely to have significant impacts, federal agencies prepare an environmental assessment (EA) to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required. For a proposed restoration plan, if a FONSI determination is made, the Trustees may then issue a final restoration plan describing the selected restoration action(s).

In accordance with NEPA and its implementing regulations, this RCDP/EA summarizes the current environmental setting, describes the purpose and need for restoration actions, identifies alternative actions, assesses their applicability and potential impact on the quality of the physical, biological and cultural environment, and summarizes the opportunity the Trustees provided for public participation in the decision-making process. This information was used to make a threshold determination as to whether preparation of an EIS was required prior to selection of the final restoration actions. Based on the EA integrated into this RCDP/EA, the federal Trustees – NOAA and USFWS – have determined that the proposed restoration actions do not meet the threshold requiring an EIS, and pending consideration of public comments on this RCDP/EA, a FONSI will be issued

1.3 PUBLIC PARTICIPATION

Public review of the restoration plan proposed in this RCDP/EA is an integral and important part of the restoration planning process and is consistent with all applicable state and federal laws and regulations, including NEPA and its implementing regulations, and the guidance for restoration planning found within 43 C.F.R. Part 11.

The Trustees previously prepared and made available a draft of this RCDP/EA for a period of 30 days to provide the public the opportunity review and submit comments. The draft plan provided the public with information on the natural resources injuries and service losses associated with the Site; the restoration objectives that have guided the Trustees in developing this plan; the restoration alternatives that have been considered; the process used by the Trustees to identify preferred restoration alternatives; and the rationale for their selection.

The Trustees considered all written comments received during the public comment period prior to approving and adopting this Final Restoration Plan/Environmental Assessment (Final RCDP/EA). Written comments received and the Trustees' responses to those comments, whether in the form of plan revisions or written explanations, are summarized within this Final RCDP/EA.

1.4 ADMINISTRATIVE RECORD

The Trustees have maintained records documenting the information considered and actions taken by the Trustees during this restoration planning process, and these records collectively comprise the Trustees' administrative record (AR) supporting this RCDP/EA. Information and documents, including any public comments submitted on the Draft RCDP/EA as well as the Final RCDP/EA, are included in this AR as received or completed. These records are available for review by interested members of the public. Interested persons can access or view these records at the offices of:

Christine Sanford-Coker, Regional Director
Region 7 SCDHEC/EQC Office
1362 McMillan Avenue, Suite 300
Charleston, SC 29405
Phone: 843-953-0150
Fax: 843-953-0151
Email: sanforcc@dhec.sc.gov

Arrangements must be made in advance to review or to obtain copies of these records by contacting the person listed above. Access to and copying of these records is subject to all applicable laws and policies including, but not limited to, laws and policies relating to copying fees and the reproduction or use of any material that are copyrighted.

2 PURPOSE AND NEED FOR RESTORATION

This section generally describes the Site, summarizes the response actions which were undertaken, summarizes the Trustees' assessment of resource injuries and compensation requirements related to the Site and provides more detailed information on the physical, biological and cultural environments in the area affected by releases of hazardous substances from the Site.

2.1 OVERVIEW AND HISTORY OF THE SITE

The Macalloy Corporation Site is located at 1800 Pittsburgh Avenue in Charleston, South Carolina, approximately four miles due north of the historic downtown district (Figure 1).

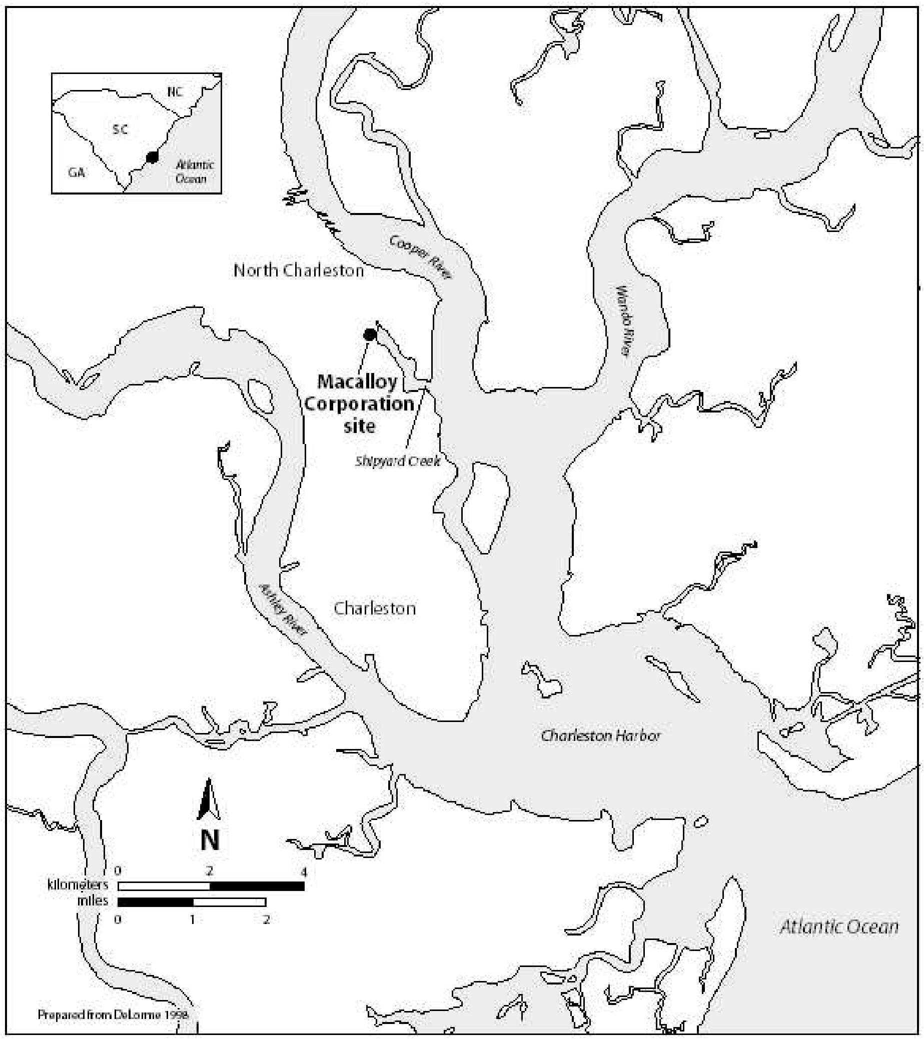

Figure 2.1. The Macalloy Corporation Site, 1800 Pittsburgh Avenue, Charleston, South Carolina

This former ferrochromium alloy manufacturing plant is located on approximately 147 acres. Pittsburgh Avenue, CSX railroad and a waste-to-energy plant operated by Foster-Wheeler, Inc. constitute the southern, western and northern site boundaries, respectively. Shipyard Creek and associated salt marsh form the eastern boundary of the Site (Figure 2).

Figure 2.2 Macalloy Site Overview, oblique aerial photograph looking NW

Shipyard Creek is a tributary to the Cooper River which empties into Charleston Harbor about two miles downstream from the Site. The Site, which ceased operations in 1998, is currently open and flat (≈10-15 feet above mean sea level). The ground surface is covered primarily with material from plant operations and is essentially devoid of vegetation except in the far northern portion and the extreme southeast corner of the site. Most of the buildings at the former plant have been demolished, although some building foundations remain. Portions of the site have been built up to current grade using slag, sludge, treated and untreated dust from air pollution control equipment and raw materials.

Ferrochromium alloy was manufactured at the site from 1941 to 1998 using electric arc furnace methods. Approximately 450 tons of chromite ore, 126 tons of coke, 45 tons of silica and 36 tons of alumina were used to produce 180 tons of finished ferrochromium per day. Waste materials generated during ferrochromium alloy production included water, airborne gases and particulate matter. Slag, ash, dust, sludge and wastewater generated on-site were stored and/or disposed of on-site in landfills and storage piles. Surface water drainage from the facility either infiltrates into the underlying soils or flows overland discharging into Shipyard Creek through two National Pollutant Discharge Elimination System (NPDES)-permitted outfalls (001 and 002). According to the SCDHEC, Macalloy failed 22 out of 23 bioassays conducted on effluent from NPDES outfalls between 1995 and 2001. On-site, solid wastes were used to fill salt marsh, a lake on-site and/or placed in an unlined surface impoundment just north of the alloy processing area (Figure 3).

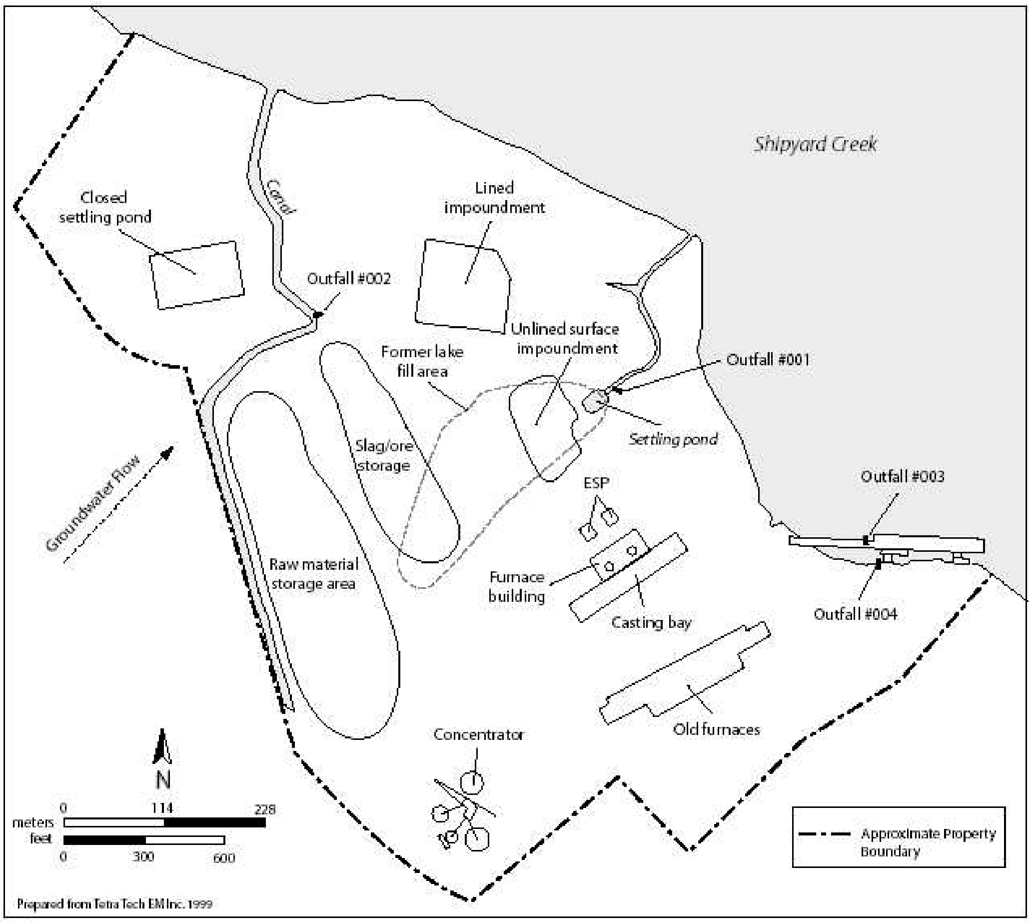

Figure 2.3 Detail of the Macalloy Corporation property.

This impoundment discharged directly to Shipyard Creek via the 001 outfall canal. The impoundment is also the source of a >20-acre hexavalent chromium groundwater plume. Groundwater in the shallow aquifer is encountered 3 to 8 feet below ground surface and flows northeast discharging to Shipyard Creek A Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) completed in 1995 found site soils and groundwater were contaminated with chromium and other inorganic compounds. Based on a storm water inspection conducted in 1997, the U.S. Environmental Protection Agency (EPA) and SCDHEC concluded that storm water discharge had occurred at site locations other than permitted outfalls. Consequently, the primary pathways for migration of contaminants to Trustee resources include permitted and non-permitted surface water runoff into Shipyard Creek as well as groundwater discharge to Shipyard Creek.

The plant at the Site was owned and operated by Pittsburgh Metallurgical Company from 1941 to 1966, Airco (British Oxygen Corporation) from 1966 to 1979, and the Macalloy Corporation from 1979 to July 1998. At various times from 1942 to the present, the Department of Defense ("DOD") has owned, operated, or otherwise used portions of the Site to produce and store ferrochromium alloy, chrome ore, and slag (waste). As such, each of the above-named entities is a potentially responsible party ("PRP") as defined in the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and the Federal Water Pollution Control Act (CWA), 33 U.S.C. § 1251 et seq. for contamination at the Site. In February 2005, the Macalloy Site was sold for $12 million to a real estate development company, "Ashley II of Charleston LLC", whose stated intent was to retain the property for container storage and various other port-related commercial and industrial uses. In March 2007, Shipyard Creek Associates LLC purchased the site from Ashley II of Charleston LLC for $33 million. The stated intent of the current owners is to create an intermodal facility to transport cargo from the Port of Charleston to various inland destinations.

2.1.1 Human Use Characteristics

The entire Site is currently zoned for industrial use only. Therefore, it is considered to be in non-residential use. The Site is a restricted-access industrial area and is expected to remain in that use indefinitely. Current owners are interested in using the property as an intermodal facility for the storage and transport of bulk shipping containers, and for various other port-related industrial activities. The surrounding properties are owned and/or operated by industrial, commercial, and municipal entities. During the CERCLA Remedial Investigation/Feasibility Study (RI/FS) process, EPA and SCDHEC established cleanup goals based on industrial land use. The Site will remain in a non-residential use for the current and foreseeable future. The Macalloy Corporation Site lies entirely within the 100-year floodplain. Shipyard Creek, like much of the rest of Charleston Harbor, is closed to the harvesting of shellfish due to elevated fecal coliform. Future plans call for the construction of an elevated highway at or near the Macalloy Corporation Site connecting a major local artery (I-26) with the former Charleston Naval Shipyard.

2.1.2 Surface Water Characteristics

Ground surface at the Macalloy Corporation Site has been extensively altered and reworked from pre-industrial natural conditions. As noted above, the ground surface is covered primarily with material from plant operations and is essentially devoid of vegetation except in the far northern portion and the extreme southeast corner of the site. In June 1998, Macalloy initiated a removal action under a consent order (No. 98-18-C) with the EPA to implement a surface water management plan to mitigate transport of contaminants to Shipyard Creek. Onsite storm water runoff now flows primarily through settling basins and diversions to two NPDES-permitted outfalls. Surface water, from some portions of the site, flows directly into Shipyard Creek.

2.1.3 Habitat Characteristics

Shipyard Creek and associated salt marsh habitat experience strong semi-diurnal tides (5-6 foot tidal excursion). Trust resources of concern include all fishery resources dependent on the area, including transient and permanent species, benthic sediments, and organisms that rely on the benthic sediments. Specific biological trust resources include spotted sea trout (*Cynoscion nebulosus*), Atlantic croaker (*Micropogonias undulates*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), summer flounder (*Paralichthys dentatus*), sheepshead (*Archosargus probatocephalus*), Eastern oyster (*Crassostrea virginica*), blue crab (*Callinectes sapidus*) grass shrimp (*Palaemonetes pugio*) and penaeid shrimp (*Penaeidae* spp.). Additionally, benthic resources such as copepods, polychaetes, mollusks and amphipods occupy vegetated and open water areas. Shipyard Creek is also considered nursery and forage habitat for the endangered Shortnose Sturgeon, *Acipenser brevirostrum*, which is protected under the Endangered Species Act (U.S. Fish & Wildlife Service 2005).

2.2 SUMMARY OF RESPONSE ACTIONS

During its final years of operation, the Macalloy plant was regulated under several Federal environmental statutes; primarily the Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act. In 1992, the SCDHEC issued an Administrative Order requiring the Macalloy Corporation to remediate contaminated groundwater. In 1996, Macalloy began the RCRA corrective action process. In 1998, NOAA sent the EPA Region 4 a letter requesting: 1) EPA perform a comprehensive sampling program under Superfund in Shipyard Creek and its associated wetlands, 2) coordinate with NOAA as provided in CERCLA to determine the nature and extent of contamination within the Shipyard Creek and associated wetlands, and 3) take the response actions necessary to protect this important estuarine habitat. That same year (1998) Macalloy implemented a surface water management system under an EPA CERCLA Consent Order (No. 98-18-C) reducing contaminant input to Shipyard Creek. Discharge of on-site storm water from the 001 Outfall to the adjacent 001 tidal creek was eliminated as part of the consent order with EPA. Also in 1998, EPA, SCDHEC and

Macalloy agreed to regulate the entire site exclusively under CERCLA. The Site was placed on EPA's National Priority List in February 2000. In March 2000, Macalloy entered into a Consent Order (No. 00-19-C) with EPA to perform a CERCLA RI/FS. The revised RCRA Facility Investigation (RFI) Work Plan formed the basis for the CERCLA RI/FS Work Plan. The RI and FS reports were finalized in March and April of 2002, respectively. Unacceptable risks to the benthic community were found during the RI driven primarily by four inorganic compounds (chromium, lead, nickel and zinc). The Record of Decision (ROD) was signed in August 2002. As part of the remedial action and because of unacceptable risks to the benthic community, sediments from the 001 outfall canal were excavated and long-term monitoring instituted in Shipyard Creek. Remedial actions were completed at the site in September 2006.

2.3 ASSESSMENT OF RESOURCE INJURIES AND COMPENSATION REQUIREMENTS

This section begins with an overview that describes the Trustees' assessment strategy, including the approaches used to determine potential injuries to specific resources affected by hazardous substance releases from the Site. The remainder of the section describes the approach used to estimate the ecological service losses and presents the results of these assessments. The term *ecological services* means the "physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource" (43 C.F.R. §11.14(nn)).

2.3.1 Injury Determination and Quantification

The Trustees' assessment of natural resource injuries focused on identifying the injury or losses of natural resources which were likely or known to have resulted from the Site contamination, including due to the remedies undertaken. Available data indicate that Shipyard Creek, including its associated sediments, benthic and aquatic biota, is contaminated with heavy metals; especially, chromium, lead, nickel and zinc. These four inorganic compounds have been shown to cause a range of toxic responses in marine and estuarine organisms including mortality, reduced growth, and diminished reproductive capacity. These compounds are designated as "hazardous substances" under CERCLA, a designation that includes solutions and mixtures of these substances. *See* 42 U.S.C. §9701(14) (A) and 40 CFR §116.4. Heavy metals do not degrade naturally in marine and estuarine sediments and tend to persist in the environment.

Using data and other information developed as part of the remedial investigation process, as well as information on these contaminants in the existing scientific literature, the Trustees assessed impacts to natural resources.

The Trustees found that resources or resource services were lost due to the release of hazardous substances to Shipyard Creek and were injured or lost as a result of the excavation and capping undertaken as part of the remedy. The Trustees then used this information to conservatively (in favor of the natural resources) estimate the total potential loss of wetland acre-years represented by the natural resource injuries associated with the Site.

2.3.2 Injury Assessment Strategy

The goal of this assessment is to determine the nature and extent of injuries to natural resources and to quantify the resulting resource and service losses, thus providing a technical basis for evaluating the need for, type of, and scale of restoration actions. As described above in Section 1.1, this assessment process is guided by the NRDA regulations under CERCLA. 43 C.F.R. Part 11. For the Macalloy Corporation Site, the Trustees pursued an assessment approach based on information gathered during the CERCLA remedial process. This approach is advantageous because much of the data needed for the CERCLA process are useful in evaluating injuries. This approach also represents considerable time and cost savings for all, can avoid costly litigation and expedites restoration of the environment.

The injury assessment process occurs in two stages: 1) injury evaluation and 2) resource and service loss quantification. To evaluate potential injury to resources, the Trustees reviewed existing information, including remedial investigation data, ecological risk assessments, and scientific literature. Based on information from all these sources and with an understanding of the function of the terrestrial and aquatic ecosystems at and near the Site, the Trustees evaluated injury to natural resources. The Trustees considered several factors when making this evaluation, including, but not limited to:

- the specific natural resource and ecological services of concern;
- the evidence indicating exposure, pathway and injury;
- the mechanism by which injury occurred;
- the type, degree, spatial and temporal extent of injury; and
- the types of restoration actions that are appropriate and feasible.

The Trustees identified a pathway linking the injury to releases from the Site, determined whether an injury was likely to or had occurred, and identified the nature of the injury. To undertake this effort, an understanding of the important contaminants is necessary. The evaluation of the Contaminants of Concern (COCs) and their pathways to ecological receptors is described in the next two sections. Following the identification of the contaminants, it is possible to evaluate those resources that have been adversely affected by releases from the Site.

The Trustees used the data generated during the RI/FS to create a spatial representation of the locations of the contaminated areas by plotting the data (70+ sediment sample locations) on aerial photographs using software combining database and GIS packages (MS Access/ArcView 3.2). Once the concentrations of contaminants in each habitat were plotted and the amount of affected acreage was determined for each habitat type, the Trustees used the peer-reviewed scientific literature and best professional judgment to develop estimates of the percentage of injury to each habitat. The Trustees focused the injury assessment from the entire facility to specific areas within the Site and/or Shipyard Creek. The Trustees used the year CERCLA was passed (1981) to begin the calculation of time-based injury duration. The Trustees also made conservative estimations of the duration of the monitored natural recovery period for the individual areas based on contaminant concentration and effects of planned remediation on likely duration of injury. If remediation was carried out (e.g., sediment excavation in the 001 outfall canal), we assumed 100% injury at the time of excavation with a linear 10-year recovery period.

2.3.3 Preliminary Restoration Strategy

This assessment was designed for injury assessment and restoration planning to occur simultaneously, utilizing a restoration-based approach. Under a restoration-based approach, the focus of the assessment is on quantifying the injuries and/or losses in natural resources and ecological services in ways that facilitate the identification of restoration projects that will compensate the public with the same level, type and quality of resources and ecological services that were lost. This restoration-based assessment approach is consistent with the CERCLA NRDA regulations, which allow restoration planning to be included as part of the Assessment Plan Phase where available data are sufficient to support their concurrent development (43 C.F.R. §11.31).

2.3.4 Restoration Scaling Strategy

Habitat Equivalency Analysis (HEA), scientific literature and knowledge of South Carolina estuaries were used to determine how much credit could be realized from a restoration project, such as enhancing a degraded environment or preserving an existing environment. Various inputs are considered, such as the level of ecological services currently provided at the proposed location, the threat of destruction of the habitat by human encroachment and the potential for inundation. The analysis calculation shows how many discounted service acre years (DSAYs) can be credited for a given restoration project. The DSAYs are then converted to the amount of acreage that would be necessary for compensation for a specific type of injured habitat.

3 AFFECTED ENVIRONMENT

This section provides brief descriptions of the physical and biological environments in the vicinity of the Macalloy Corporation site as well as areas that may be affected by restoration actions, consistent with NEPA. The descriptions include environments affected or potentially affected by the release of hazardous substances and areas targeted for restoration activities. The physical environment includes the surface waters and sediments of Charleston Harbor as well as the Ashley, Cooper, Wando and Stono Rivers. The biological environment includes a wide variety of fish, shellfish, wetland vegetation, birds and other organisms. The descriptions below have been adapted from the Charleston Harbor Special Area Management Plan (SCDHEC/OCRM, 2000).

3.1 THE PHYSICAL ENVIRONMENT

The Charleston Harbor Watershed

The Charleston Harbor Watershed lies entirely within the South Carolina Coastal Plain and consists of sedimentary deposits of sand, gravel, clay, marl, and limestone resting on metamorphic and igneous rocks. Overlying these deposits are marine and riverine sediments and a thin veneer of sand, clay, and shell comprising Pleistocene and Recent formations. The watershed is composed of 63% uplands, 19% open water, 11% freshwater wetlands, 6.5% estuarine marsh, and less than 0.5% estuarine tidal creeks. Upland land use patterns within the watershed are 61.6% forested, 11% urban, 9.3% forested wetlands, 7.7% non-forested wetlands, 6.3% scrub/shrub/disturbed, 3.8% agricultural and grasslands, and 0.3% barren. Federal, state, county, and municipal governments own 302,122 acres (122,267 hectares) of the forested watershed lands. Farmers, corporations, and private individuals own the remaining 638,820 acres (258,527 hectares) or 68% of the total forested lands within the watershed. The forests are composed of approximately 45% loblolly, slash, and short- and long-leaf pines, and 20% oak/hickory hardwoods. Annual precipitation is 49 inches per year (124.9 cm). The wide variety of habitats present in the estuary support a diverse array of flora and fauna, including more than 80 species of plants, over 250 species of birds, 67 species of mammals, over 570 species of invertebrates and finfish, and at least 580 species of plankton.

Within the watershed is the Charleston Harbor Estuary, located in the central portion of South Carolina's coastline and formed by the confluence of the Ashley, Cooper, and Wando rivers. An estuary is a mixing zone where freshwater from the land and saltwater from the sea meet, providing habitat for salt water and freshwater organisms and those that live in between. Highly dynamic, estuaries are influenced by the salinity gradient that extends from pure seawater to freshwater upriver, and the tide that provides the energy that mixes the fresh and saltwater. The average depth of the estuary basin is 12 feet (3.7 m) at mean low water (MLW), but navigation channels have been deepened to 40 feet (12.2 m) MLW. The mean tidal range is 5.2 feet (1.6 m), and spring tides average 6.2 feet (1.9 m). Water temperatures range from 38°F to 87 °F (3.5°C to 30.7°C) and average 67 °F (19.4°C). Salinities range from 0 to 35.6 parts per thousand within the estuary. Similarly, dissolved oxygen levels range from 0 to 17.1 milligrams per liter averaging 7.3 mg/l over the entire estuary.

The Cooper River

The Cooper River watershed is extremely complex due to the initial diversion of water from the Santee River to the Cooper River as part of the Santee-Cooper Hydroelectric Project in 1941, and the subsequent rediversion of water from the Cooper River back into the Santee River in 1985. The lower component of the Cooper River basin extends 50 miles (81 km) from the Pinopolis Dam to the mouth of the Cooper River on the north side of the Charleston peninsula where it flows into Charleston Harbor. This section of the river drains almost 1400 square miles (3,625 km^2) of midlands and lowlands, including fresh and brackish wetlands. The West Branch Cooper River is 17 miles (26.5 km) long and flows from the Tail Race Canal at Moncks Corner to its junction with the East Branch. This reach is a meandering natural channel bordered by extensive tidal marshes, old rice fields, and levees in varying states of disrepair. The area contains volumes of poorly defined overbank storage and immeasurable flows because of broken levees between the channel and old rice fields. The East Branch Cooper River is 7.6 miles (12.3 km) long and flows from its headwaters in Hell Hole Bay to its junction with the West Branch, commonly referred to as the "Tee". The East Branch is a tidal slough throughout its 7.5 miles (12 km) length. The river then flows 17.7 miles (28.5 km) to its junction with the Charleston Harbor basin on the north side of the Charleston peninsula.

The Ashley River

The Ashley River flows approximately 31 miles (50 km) from its headwaters in Cypress Swamp in Berkeley County to its junction with the Intracoastal Waterway on the south side of the Charleston City Peninsula, where it empties into the lower harbor basin. The river basin drains a 216-square-mile (900 km^2) area of marsh and lowlands, spread out over Dorchester, Berkeley, and Charleston counties. Depths of the natural channel in the river range from 5.9 to 36 feet (1.8 to 11.0 m) and are influenced by tidal action throughout the river's entire length. Essentially a tidal slough, the tidal ranges of the Ashley River amplify progressively upstream. The extent of saltwater intrusion on the river varies greatly with the hydrologic condition of the basin. During extremely dry periods, with little freshwater draining from Cypress Swamp, saltwater extends throughout most of the Ashley River. During periods of heavy precipitation, saltwater can be limited to the lower part of the river below Drayton Hall. The banks of the river are dominated by *Spartina* marshes.

The Wando River

The Wando River is a tidal river that flows approximately 24 miles (38 km) from its headwaters in I'on Swamp in Charleston County to its junction with the Cooper River on the north side of the Charleston

City Peninsula. The river drains 120 square miles (310 km^2) of marsh and lowlands, and its depth ranges from 5 feet to 42 feet (1.5 to 12.8 m). The Wando is influenced by tidal action throughout its entire length, and estuarine waters extend into the creeks that form its upper limits. Like the Ashley River, the tide ranges are amplified as they progress upstream. The Wando River has the best water quality of the three rivers. Above the Wando Terminal the water quality is suitable for harvesting clams, mussels, and oysters for human consumption. Extensive *Spartina* and *Juncus* marshes dominate the banks of the River.

The Stono River

The upper Stono River watershed is located in Dorchester and Charleston Counties and consists primarily of the Stono River and its tributaries from Log Bridge Creek to Wappoo Creek (Elliott Cut). The watershed occupies 156,936 acres of the Lower Coastal Plain and Coastal Zone regions of South Carolina. There are a total of 502.9 stream miles in the Stono River watershed and 8.6 square miles of estuarine areas. The Stono River, itself, is a tidal channel that communicates with the Ashley River by way of Wappoo Creek (Elliott Creek) before flowing through the Stono Inlet into the Atlantic Ocean southwest of Charleston Harbor. The Kiawah and Folly rivers converge with the Stono River near its mouth. The only direct freshwater discharge to the Stono River is by way of overland runoff from rainfall events. Mean tidal ranges in the Stono River at Wappoo Creek are 5.2 feet during normal tides and 6.8 feet during spring tides. Shellfish harvesting is generally approved in the lower Stono River (below Wappoo Creek), but is either restricted or prohibited above this point due to high fecal coliform levels.

3.2 THE BIOLOGICAL ENVIRONMENT

The tidal currents provide a highly diverse habitat for the plants and animals common to the Charleston Harbor Estuary. Marsh vegetation is extensive in the estuary due to the gently sloping coastal plain and the tidal range. The estimated acreage of the marshes in this area exceeds 52,000 acres (21,000 ha) of which 28,500 acres (11,500 ha) consist of brackish and salt marsh, 18,500 acres (7,500 ha) consist of freshwater marsh, and approximately 5,000 acres (2,000 ha) lie within impoundments. A diverse assemblage of plant species typically found throughout the Southeast is found within the estuary with the distribution determined by salinity and the duration of inundation. The tidal marshes of the Ashley and Wando rivers reflect a strong marine influence, with salt and brackish water marshes existing throughout almost all of their length. The Cooper River marshes exhibit a wide range of vegetation, changing markedly from salt to brackish to freshwater species. The flow rate and salinity of the Cooper has been significantly altered by the diversion of the Santee into the Cooper and the 1985 diversion project.

The shallow marsh habitats of the Charleston Harbor Estuary provide seasonal year-round habitats for a diverse assemblage of adult and juvenile finfish and crustaceans. The highly productive marshes provide abundant food resources for early life history stages. The shallow-water marsh also serves as a refuge by providing a diversity of habitat and by excluding predators from the upper reaches of the estuary. These advantages result in reduced competition, lower mortality, and faster growth rates. Many of these species are either commercially or recreationally valuable. The estuary contributes approximately 20% and 8% of the state's shrimp and crab landings, respectively. Spot, Atlantic croaker, red drum, spotted seatrout, flounder, and catfish inhabit the estuary and are recreationally important. The estuary also supports numerous ecologically important species such as bay anchovy and grass shrimps, which serve as food for economically and recreationally important species. Young of several species of finfish that are spawned in the lower estuary or ocean enter the shallows of the estuary as juveniles and stay until they reach larger sizes or until lowering winter temperatures drive them seaward.

The spatial distribution of the species living in the bottom of the Charleston Harbor Estuary is similar to that of other estuaries along the mid-Atlantic, southeast and gulf coasts of the United States. Numerically dominant species include mollusks, polychaetes, oligochaetes, nematodes, and amphipods. Among the three river systems, average diversity values are lower in the Cooper River than in the Ashley and Wando rivers. The lower diversity in the Cooper River may reflect adverse effects from the greater number of industrial and port facilities in this system as compared to the other two river systems.

Studies show that many of the changes experienced within the estuary are atypical of an estuarine system whose freshwater inflow has been reduced. In a typical estuary, the mixing zone is an important nursery area for new recruits. Many species utilize the shallows of these areas independent of salinity. Many species also use the tidal stream transport to initially colonize the upper estuary. Increased flow rates displace the freshwater line seaward, compress the freshwater boundary horizontally and vertically, and prevent flood-tide displacement into the recruitment areas. Hence, a decrease in flow rate, as occurred in the diversion, should enhance the recruitment process. There are suggestions that reductions of flow rates by diversions result in a reduction in the overall size of the estuarine nursery habitat and in disruption of spawning and nursery cycles. Evidence suggests that a reduction of flow by as little as 30-40% can destroy the dynamic equilibrium of an estuary within three to seven years and may increase the impacts of pollutants by four to twelve times. In many ways the Charleston Harbor Estuary is a typical estuary in its role in recruitment and as a nursery. Yet, rather than the losses and destruction reported in other estuaries, there has been an increase in the use of this estuary by many more species as a nursery area, especially in the main channels of the rivers.

3.3 THE CULTURAL AND HUMAN ENVIRONMENT

The greater Charleston area is better known as the Trident Region and is comprised of portions of Berkeley, Charleston, and Dorchester counties. The area includes twenty-five incorporated communities ranging in size from Jamestown in Berkeley County, with a population of approximately 84, to the City of Charleston with about 104,000 residents. The total population of the three counties doubled between 1960 and 1990 and is expected to increase to 619,500 by the year 2015. Administratively, their respective county councils and the combined Berkeley-Charleston-Dorchester Council of Governments (COG) serve the counties. Charleston County is the state's most urban county with 88% of its residents living in an urban setting (as defined by the U. S. Census). Similarly, Berkeley and Dorchester counties are significantly more urban than rural, with respectively 65.1% and 67.4% of their populations classified as urban.

Tourism, the Port of Charleston, health care, and several large industrial employers heavily influence the economy. Charleston Harbor's port facilities, composed of an extensive network of modern shore side facilities, represent the largest economic resource associated with the Charleston Harbor Estuary. Most of the $10.7 billion in 1997 sales revenues attributed to South Carolina's ports came through Charleston. During the State Ports Authority's 1999 fiscal year, which ended in June, 13.3 million tons of cargo moved through the port aboard 2,457 ships and barges. The Port of Charleston is the number one container port on the southeast and gulf coasts and is second only to the combined ports of New York and New Jersey on the entire eastern seaboard. Until 1994, the U.S. Navy maintained its third largest homeport on the Cooper and Wando rivers. These facilities consisted of a naval shipyard and weapons station and served more than 70 surface vessels and submarines. Charleston International Airport provides commercial and military air service for the region and currently serves over 1.5 million passengers annually. Six private airports located throughout the region can accommodate both corporate and private aircraft. Approximately 100 motor carriers and three railroads serve the Trident Region and, along with Interstates I-26, I-95, and I-526, provide access to residential, private, government, and commercial concerns. Six colleges and universities are located within the region with a combined annual enrollment of almost 27,000 students.

Although there are no major industries located on the harbor, the basin is surrounded by urban development and receives secondarily treated effluent from two sewage treatment facilities on Plum Island and in Mount Pleasant. The number of permitted point sources of pollution in the Charleston Harbor estuary decreased from 115 in 1969 to 67 in 1996. The volume of these discharges decreased from 328 to 205 cubic feet per second (9.3 to 5.8 m^3/s) during the same time period. Other sources of pollution affecting the harbor include nonpoint source runoff from the city and other urban areas, marina facilities near the mouth of the Ashley River, and runoff and discharges from forested and agricultural lands. Several diked, dredged material disposal areas are located in the harbor area, with the largest being Drum Island. The water quality of the harbor's tidal saltwater is rated as suitable for fishing and boating, but not for swimming, and the harvesting of oysters, mussels and clams is prohibited. However, reviews of data collected by DHEC reveal that the water quality within the basin often meets higher standards for dissolved oxygen and fecal coliform than the ratings indicate.

Among the three river systems that form the Charleston Harbor Estuary, the Cooper River has the greatest number and density of industrial and port facilities. The majority is located on the western shore and includes the former U. S. Navy port facilities; commercial facilities associated with the State Ports Authority and numerous private companies. To accommodate shipping traffic, a 40 feet (12.2 m) deep navigation channel is maintained in the lower Cooper River and extends 20 miles (32 km) upstream from the mouth of the river. The eastern shore of the Cooper River is relatively undeveloped, although there are several diked dredged material disposal sites along the length of the maintained channel.

In 1954, Bushy Park Industrial Area was established along the east bank of the Back River and the west bank of the Cooper River. To provide freshwater to the industrial complex, the Back River was dammed near its confluence with the Cooper River and the 11-km Durham Canal was constructed as a freshwater supply from the upper Cooper River. Downstream of Flag Creek, industries dominate the eastern bank of the river and the west bank serves as a dredged-material disposal area. There are 22 industrial and municipal permitted point dischargers into the Cooper River with a combined flow of 127 ft^3/s (3.6 m^3/s). The water quality rating of the lower basin is rated as suitable for fishing and crabbing, but not for swimming or the harvesting of clams, oysters or mussels. Water quality often meets higher standards than the rating for oxygen and fecal coliform.

The Ashley River has the second largest number of industrial and commercial facilities, most of them located along the eastern shoreline. There are seven permitted municipal dischargers in the basin with a combined discharge of about 53 million gallons per day. Much of the remaining upland area on both sides of the river supports residential developments. Water quality in the Ashley River is suitable for fishing and boating, but not for the harvest of clams or for swimming.

The Wando River presently has the least upland development compared to the other two river systems, except in its lower reaches. In that area on the eastern shore, the State Ports Authority maintains the Wando Terminal facility. There are also several residential communities present and/or being developed on this shoreline. Large dredged material disposal areas are located on Daniel Island, which forms the western shoreline of the Wando River. The only major industrial facility on this river is the Detyens Shipyard across from Cainhoy. Water quality above the Wando Terminal is suitable for harvesting clams, mussels, and oysters for human consumption. Water quality in the lower Wando River is similar to that of the Ashley River.

The Charleston Harbor area also contains some of the most significant historic and archeological sites in the United States. Cultural resources include historic buildings, structures and sites, unique commercial and residential areas, unique natural and scenic resources, archeological sites, and educational, religious, and entertainment areas or institutions. In some areas preservation programs are effective in maintaining these resources. In other areas these resources are being lost or neglected primarily because of our limited knowledge. There is a continuing need for surveys to identify the cultural resources, their locations and significance. This knowledge must be made available to local officials and interest groups to gain greater support of preservation programs and other cultural activities.

4 INJURY AND SERVICE LOSS EVALUATION

4.1 PATHWAYS OF CONTAMINATION TO TRUST RESOURCES

A *pathway* is defined as the route or medium (for example, water or soil) through which hazardous substances are transported from the source of contamination to the natural resource of concern (43 C.F.R. § 11.14). The Trustees concluded that the transport pathways to habitats of concern were surface water/soil transport from the site to Shipyard Creek as well as likely discharge of shallow ground water to Shipyard Creek.

Waste disposal practices at the Site resulted in the presence of contamination in areas utilized by wildlife and other ecological receptors of interest. Results of the RI and laboratory analyses indicated that soils, sediments water and biota were contaminated with site-related constituents.

On-site surface water impoundments served as an attractive nuisance to terrestrial and migratory avian receptors.

4.2 CONTAMINANTS OF CONCERN (COCS)

One of the early steps of the damage assessment was to identify which chemicals should be included on the list of contaminants of concern. The Trustees participated in this evaluation during the remedial investigation process by determining which contaminants released from the Site could pose a risk to ecological receptors.

The Trustees determined that the contaminants threatening trust natural resources were inorganic compounds; especially chromium, lead, nickel and zinc. These hazardous substances were found in the surface soils, surface waters, sediments, groundwater, and adjacent wetlands at or near the Site.

4.2.1 Chromium

Trivalent Cr, Cr (III), and hexavalent Cr, Cr (VI), are the two principal forms of Cr in the environment. The fate of Cr in aquatic systems varies depending on the form of the metal that is released and the environmental conditions in the receiving water system. Generally, Cr (III) forms associations with sediment, while Cr (VI) remains in the water column. Both forms of Cr are toxic to aquatic organisms, with Cr (VI) being the more toxic of the two. Dissolved Cr is highly toxic to aquatic plants and invertebrates, with short- and long-term exposures causing adverse effects on survival, growth, and reproduction. Fish are generally less sensitive to the effects of Cr than are invertebrates. Exposure to elevated levels of sediment-associated Cr causes acute and chronic toxicity to sediment-dwelling organisms. Dietary exposure to Cr can also adversely affect survival, growth, and reproduction in avian and mammalian wildlife species.

4.2.2 Lead

Although lead (Pb) may be released into the environment from natural sources, most of the Pb that occurs in aquatic systems has been released due to human activities. Depending on the form of Pb that is discharged, Pb can remain dissolved in the water column or become associated with sediments upon release to aquatic systems.

Lead has been shown to be neither essential nor beneficial to living organisms. While dissolved Pb generally is not acutely toxic to aquatic organisms, longer-term exposure to relatively low levels of this substance can adversely affect the survival, growth, and reproduction of fish, invertebrates, and, to a lesser extent, aquatic plants. Exposure to elevated levels of sediment-associated Pb causes acute and chronic toxicity to sediment-dwelling organisms. In birds and mammals, dietary exposure to elevated levels of Pb can cause damage to the nervous system and major organs, reduced growth, impaired reproduction, and death.

4.2.3 Nickel

Nickel (Ni) is released into the environment from natural sources and human activities, with the burning of fossil fuels and the processing of Ni-bearing ores being the most important sources. Unlike many other metals, Ni is considered to be highly mobile in aquatic ecosystems, repeatedly cycling between the water column, bottom sediments, and biological tissues.

Exposure to dissolved Ni is known to adversely affect the survival, growth, and reproduction of amphibians, fish, invertebrates, and aquatic plants. In birds and mammals, dietary exposure to elevated levels of Ni can result in reduced growth and survival.

4.2.4 Zinc

Zinc (Zn) is released into the environment as a result of various human activities, including electroplating, smelting and ore processing, mining, municipal wastewater treatment, combustion of fossil fuels and solid wastes, and disposal of Zn-containing materials. In aquatic systems, Zn can be found in several forms, including the toxic ionic form, dissolved forms (i.e., salts), and various inorganic and organic complexes. While Zn can form associations with particulate matter and be deposited on bottom sediments, sediment-associated Zn can also be remobilized in response to changes in physical-chemical conditions in the water body.

The acute toxicity of dissolved Zn is strongly dependent on water hardness; however, chronic toxicity is not. Long-term exposure to dissolved Zn has been shown to adversely affect the survival, growth, and reproduction of fish, invertebrates, and aquatic plants. Exposure to sediment-bound Zn may cause reduced survival and behavioral alterations in sediment-dwelling organisms. In birds and mammals, dietary exposure to elevated levels of Zn can cause impaired survival, growth, and health.

4.3 Injury Assessment & Findings

Assessment of the present condition of the injured resources and evaluation of the reduction in ecological services from the injured resource provided the measure of injuries to natural resources and loss of services as a result of releases of hazardous substances from the Macalloy Corporation Site. This quantification includes accounting for the time required for the injured resources to recover through natural or enhanced means to their pre-release condition.

The Trustees chose a Reasonably Conservative Injury Evaluation (RCIE) approach to assess injuries to benthic and terrestrial organisms resulting from releases from the Site. The RCIE approach uses data from the CERCLA RI, literature values, and a HEA to estimate natural resource injuries. An important element of the RCIE for the Macalloy Corporation Site was the decision by the Trustees to focus exclusively on injury to the benthic community. The rationale behind this decision was twofold. One, injury and subsequent restoration scaling to the benthic community could be conducted in a protective yet timely and cost-effective manner. Two, restoration for benthic injury would provide additional ecological service flows to other resources (e.g., fish, birds, and wildlife) potentially injured at the site.

4.3.1 Aquatic Ecological Services at the Site

Aquatic habitats associated with the Macalloy site can provide multiple ecological services. Major categories of services are briefly described below.

Primary Production – Primary production is the fixation of abiotic carbon by plants using solar energy. At this Site, aquatic plants include emergent and submerged wetland vegetation (e.g., *Spartina*), attached flora (e.g., benthic algae) as well as photosynthetic microflora (e.g., diatoms).

Organic Detritus Production – Organic detritus is produced by the incomplete decomposition of organic matter derived from dead plants, dead animals and animal feces. Organic detritus, along with dissolved organic matter, are very important sources of energy and nutrients in the estuarine food web.

Secondary Production – Secondary production is the biomass growth of heterotrophic microbes and animals (largely benthic fauna) that are supported by organic detritus and primary productivity.

Tertiary Production - Tertiary production is the biomass growth of upper trophic level animals (e.g., flounder, red drum) that are supported by lower trophic level production.

Nutrient Cycling - While primary, secondary and tertiary production (see above) generally represents *carbon flow* through successive trophic levels, *nutrients cycle* among marsh compartments (sediment, water, and biota). In estuarine environments, abiotic nutrient cycling is largely controlled by the reduction/oxidation (redox) state of sediments as well as sediment/water interactions. Redox, in turn, is controlled by sediment organic matter, biota activity (e.g., bioturbation) and diurnal/semi-diurnal cycles (e.g., tides, photoperiod). Nutrients taken up by plants and animals are essential to vital processes such as growth and reproduction. Microorganisms decompose and mineralize nutrients via aerobic and anaerobic processes. Important nutrients include nitrogen, phosphorus, iron, manganese, sulfur, magnesium, and silicon.

Physical Habitat - Salt marshes in the Macalloy site area represent physical habitat for many organisms. Ecological services provided by these physical habitats include refugia from predation, shelter from high-energy storm events, forage areas as well as protected nursery areas for the growth and development of larval/juvenile life stages. A three-dimensional, time-variant landscape is created in the salt marsh by the combined presence of sediment, tidal water, oyster shells and stands of vegetation. Sediments, in particular, provide essential habitat for numerous salt marsh organisms. Many spend their entire lives entirely within or closely associated with the sediment substrate. Primary producers in the marsh (emergent plants like *Spartina*, macroalgae and benthic diatoms) require sediments to physically grow and reproduce. The shells of live and dead oysters provide substrate for large populations of non-reef building encrusting organisms such as bryozoans, sponges, barnacles, mussels, anemones, worms, slipper shells and algae. Some species of fish (e.g., gobies, blennies, oyster toad) reproduce only in the open shells of recently deceased oysters. These small resident fish, in turn, represent secondary production and provide forage for larger predators such as flounder, red drum and striped bass.

Many of the ecological services described above are provided by or are directly affected by the benthic community. The benthic community is composed of populations of organisms living in or closely associated with bottom sediments. The community is dominated by microbes; meiofaunal and macrofaunal invertebrates, such as annelid worms (e.g., polychaetes and oligochaetes), crustaceans (e.g., shrimp and crabs), and mollusks (e.g., oysters and clams); and certain finfishes. These animals live within the sediment (infaunal invertebrates), on the surface of sediments or hard substrata (epifaunal invertebrates), or near the sediment-water interface (demersal fishes and crustaceans).

The benthic community is the primary element and controlling influence over carbon flow and nutrient cycling in estuaries. Benthic animals represent essentially all the standing stock for secondary production. Because they ingest sediment and organic detritus containing refractory carbon and nutrients, benthic organisms are the essential link in the passage of carbon and nutrients to higher trophic levels (e.g., finfish). In this role, the benthic community supports almost all trophic levels in the Shipyard Creek/Cooper River system near the Macalloy site. Larger members of the benthic community (head-down worm feeders, burrowing mollusks, foraging fish, crabs, and shrimp) infuse oxygen downward to highly reducing (hypoxic/anoxic) sediments while moving nutrient-rich deep sediments up towards the surface. This bioturbating activity also alters the redox zone and affects nutrient cycling (Lee and Swartz 1980, McCall and Tevesz 1982, Krantzberg 1985, Matisoff 1995).

To summarize, the benthic community provides and/or directly affects essential ecological services related to carbon flow, nutrient cycling and standing stock. Loss or reduction of these services, therefore, would likely have adverse effects on other biological communities and ecological service flows in the Shipyard Creek/Cooper River system.

4.3.2 Ecological Services Evaluated/Not Evaluated in this Injury Analysis

The previous sections argue that the benthic community provides, as well as significantly affects many ecological services in Shipyard Creek. Consequently, this injury analysis will focus on adverse effects resulting from the release of hazardous substances (inorganic compounds) at the Macalloy site to the benthic community. Services not evaluated in this analysis include the following.

1) Primary productivity by emergent vegetation (e.g., *Spartina*) and benthic flora

2) Primary and secondary productivity by water column organisms

3) Tertiary productivity by higher trophic level resources (e.g., predatory fish)

4) Trustee resources such as wading birds, mammals and reptiles.

5) Services provided by the upland portion of the Site

6) Ecological services lost as a result of chemicals other than four selected inorganic compounds

To the extent that these services are not evaluated, this sediment injury analysis may not be protective of Trustee resources. This uncertainty is balanced by some of the protective assumptions and approaches taken in the following injury analysis and subsequent compensatory scaling using HEA.

4.3.3 Sediment Benchmarks

Sediment benchmarks are chemical concentrations demonstrated by the scientific community to be associated with adverse impacts (e.g., toxicity) to aquatic biota (Burton 1992, USEPA 1992, Ingersoll et al. 1997). Two sets of benchmarks (discussed below) appear frequently in the scientific literature as well as many project reports for hazardous waste sites including Macalloy (e.g., sediment quality triad investigations, Chapman et al. 1997, EnSafe 2002). These benchmarks are briefly described below.

4.3.3.1 FLDEP TELs and PELs

The Florida Department of Environmental Protection (FLDEP) has developed two sediment benchmarks called the Threshold Effect Level (TEL) and Probable Effect Level (PEL) (MacDonald, 1994). As the terms suggest, a TEL is a chemical concentration below which adverse effects are rare. Concentrations above the PEL are consistently associated with adverse impacts. Between the TEL and PEL, adverse impacts range from possible to probable. At the Macalloy site, EPA and the RPs used FLDEP TELs and PELs to judge sediment quality (EnSafe 2002). Moreover, EPA Region 4 scientists routinely use FLDEP TELs and PELs to help evaluate ecological risks associated with contaminated sediments at Superfund sites. Consequently, for this sediment injury analysis, TELs and PELs will be used to evaluate adverse impacts to the benthic community.

4.3.3.2 NOAA ER-Ls and ER-Ms

NOAA has also developed two sediment benchmarks, analogous to the FLDEP TELs/PELs, which are called Effects Range-Low (ER-L) and Effects Range-Median (ER-M) (Long et al. 1995, 1998). Like the FLDEP benchmarks, ER-Ls and ER-Ms were developed by regressing large datasets of synoptic chemistry and biological effects information. The domains of data for TELs/PELs and ER-Ls/ER-Ms overlap and focus largely on acute toxicity (lethality) sediment bioassays with benthic organisms (primarily amphipods). The ER-L and ER-M correspond to the 10th and 50th percentile of effects concentrations, respectively. Both PELs and ER-Ms represent elevated concentrations above which biological effects are highly probable (Long and MacDonald 1998). A major difference between the

FLDEP and NOAA benchmarks is the latter exclude “no effects” data while the former include “no effects” data. As a result, FLDEP TEL/PEL values are slightly lower than their corresponding NOAA ER-L/ER-M values. Ecological risk assessment guidance from EPA Region 4 recommends site-specific sediment toxicity bioassays be conducted to reduce the uncertainty associated with these two sets of national sediment benchmarks. This site-specific data was collected at the Macalloy site during EPA's RI and is used to reduce uncertainty and help estimate service loss.

4.3.3.3 EPA “Protective Levels”

As required by their guidance (USEPA 1997), EPA Region 4 scientists developed ecologically "protective levels" for the Macalloy site and reported their findings in the ROD (see Appendix A, EPA 2002). Site-specific "protective levels" were developed from exposure-response information generated in the chronic sublethal grass shrimp sediment bioassays conducted during the RI. The grass shrimp bioassay was used because it demonstrated good exposure-response relationships for Site Contaminants of Potential Concern (COPCs) (EnRisk Management Solutions 2000; EnSafe 2002) and because previous field investigations demonstrated populations of grass shrimp in Shipyard Creek were significantly reduced (Holland et al. 1996; Fulton et al. 2000). To develop "protective levels", EPA scientists generated a series of scatter plots for each COPC and bioassay test endpoint combination. Biological response (e.g., diminished reproduction) was plotted on the y-axis and sediment chemistry concentration on the x-axis. Biological responses in the grass shrimp test included mortality, ovary production, embryo production, embryo hatch and DNA strand damage. COPCs included Cd, Cr, hexavalent Cr, Cu, Pb, Mn, Hg, Ni, Se, Va and Zn. EPA calculated R-squares for each exposure-response plot indicating the degree to which the relationship followed a linear model. While not causal, these scatter plots aid in differential diagnosis; i.e., the systematic elimination of COPCs leaving the more probable candidate toxicity drivers.

EPA developed a high and a low "protective level" for 6 of the 11 inorganics (Cr, Cu, Pb, Mn, Ni, and Zn), noting that 5 chemicals (Cd, hexavalent Cr, Hg, Se, Va) lacked any discernable exposure-response relationships in the scatter plots. EPA scientists concluded, *"The evidence identifying those contaminants most likely to be responsible for the adverse effects shown in the grass shrimp toxicity test is strongest for chromium, nickel, and zinc. Lead is the next likely toxicity driver, followed by manganese…The evidence identifying copper as a driver of toxicity is the weakest of all the COPCs"*. The Trustees agree with EPA's conclusions, and decided for this injury analysis to focus exclusively on chromium, nickel, lead and zinc. It is important to note, however, that even within the EPA’s nominal "protective levels", statistically significant adverse effects were still observed on grass shrimp survival, ovary production, embryo production, embryo hatch and DNA damage. EPA's "protective levels" are above sediment concentrations observed at the two site-specific reference locations (Rathall and Foster creeks) and generally fall between the "probable" effects benchmarks (ER-M and PEL) and the "possible" effects benchmarks (ER-L and TEL). Consequently, these data from the Macalloy site reflect a very consistent exposure-response gradient in sediment concentrations from "probable" effects (ER-Ms and PELs), to site-specific "protective levels", to "possible" effects (ER-Ls and TELs), to levels at the two site-specific reference locations. This gradient of national sediment benchmarks and site-specific information is consistent with classic dose-response curves suggesting these inorganic compounds are causing the observed toxicity in grass shrimp. Consequently, this combination of site-specific toxicity information and national toxicity-based sediment benchmarks will be the primary basis for estimating loss of benthic services at the Macalloy site.

4.3.4 Estimating Percent Loss of Benthic Services

4.3.4.1 Calculating Mean Sediment Quotients (MSQs) for Cr, Pb, Ni, Zn

It is common practice in the field of contaminated sediment assessment, to express mixtures of chemicals found in sediments as the mean of ratios. To calculate this mean, each chemical concentration is divided by a common sediment benchmark and an average of these ratios (or quotients) is calculated. A hypothetical example is shown below.

[Chemical A] / common benchmark	=	Quotient for Chemical A
[Chemical B] / common benchmark	=	Quotient for Chemical B
[Chemical C] / common benchmark	=	Quotient for Chemical C
[Chemical D] / common benchmark	=	<u>Quotient for Chemical D</u>
		Mean of Chemicals A+B+C+D

Mean ER-M quotients are perhaps the most frequently used form for evaluating contaminated sediments (Long et al. 1995; 1998). The mean ER-M quotient represents 25 chemicals; 9 inorganic compounds, 13 individual polycyclic aromatic hydrocarbons, p,p'-DDE, total DDTs and total PCBs. The concentration of each chemical is divided by the common sediment benchmark, ER-M (see sediment benchmark sections above) and a mean for the 25 individual chemicals is calculated.

The Trustees have adapted the Mean ER-M quotient approach for the four inorganic chemicals of interest at the Macalloy site. Working from the hypothetical example above, the Trustees calculated Mean Sediment Quotients (MSQs) for the site-specific Macalloy data (sediment data in Shipyard Creek, reference locations, EPA "protective levels") as follows:

[Chromium] / ER-M for Cr	=	Quotient for Chromium
[Lead] / ER-M for Pb	=	Quotient for Lead
[Nickel] / ER-M for Ni	=	Quotient for Nickel
[Zinc] / ER-M for Zn	=	Quotient for Zinc
		MSQ for Cr+Pb+Ni+Zn

In addition, we calculated MSQs for the 4 national sediment benchmarks (ER-L, ER-M, TEL, and PEL) to provide a comparable and common basis for evaluating the site-specific sediment data. An example for calculating MSQ for one of the national sediment benchmarks (TEL) is shown below.

Chromium TEL / ER-M for Cr	=	Quotient for Chromium
Lead TEL / ER-M for Pb	=	Quotient for Lead
Nickel TEL / ER-M for Ni	=	Quotient for Nickel
Zinc TEL / ER-M for Zn	=	Quotient for Zinc
		TEL MSQ

The MSQ calculated for the ER-M sediment benchmark is a special case because the mean of the quotient is always 1.0 (see calculation below). Thus, the ER-M MSQ can be viewed as a point of reference for judging all other MSQs.

Chromium ER-M / Cr ER-M	=	1.0
Lead ER-M / Pb ER-M	=	1.0
Nickel ER-M / Ni ER-M	=	1.0
Zinc ER-M / Zn ER-M	=	1.0
		ER-M MSQ = 1.0

MSQs based on the other three national sediment benchmarks cited above will always be less than 1.0, because these alternative benchmarks are all lower than the comparable ER-M value. MSQs based on site-specific data may be higher or lower than 1.0, depending on the extent to which concentrations of the four metals are higher or lower than their respective ER-M values.

4.3.4.2 Percent Loss of Services at ER-M and PEL MSQs

By definition, an ER-M is the 50th percentile of adverse effects when regressing large datasets of synoptic chemistry and biological effects information (Long et al. 1995). Most of the effects represented by the ER-M are acute lethality to benthic organisms in sediment bioassays. Therefore, for the Macalloy injury assessment, the Trustees will associate a 50% loss of benthic services for the ER-M MSQ calculated for Cr, Pb, Ni, and Zn.

FLDEP PELs are consistently slightly lower than ER-Ms for reasons discussed earlier. Therefore, the loss of service should be <50% (ER-Ms) but >10% (ER-Ls and TELs). For the Macalloy injury assessment, the Trustees will associate a 40% loss of benthic services for the PEL MSQ calculated for Cr, Pb, Ni, and Zn.

4.3.4.3 Percent Loss of Services at ER-L and TEL MSQs

Long and MacDonald (1998) demonstrated that for some sediments, even when no ER-Ls and TELs are exceeded, approximately 10% of the sediments will be "highly toxic". Similar frequencies of effects have been reported for presumably safe concentrations in the aquatic toxicity literature. Crane and Newman (1990) demonstrated that the routinely used statistic, No Observed Effect Concentration (NOEC), is not truly protective. They report that, in chronic fish exposure studies, adverse effects are observed 10% to 34% of the time at concentrations equal to the NOEC. Therefore, for the Macalloy injury assessment, the Trustees will associate a 10% loss of benthic services for the ER-L and TEL MSQs calculated for Cr, Pb, Ni, and Zn.

4.3.4.4 Percent Loss of Services at the Site-Specific Reference Locations

At the Foster Creek location, the only test endpoint with significant adverse effects was the proportion of females grass shrimp producing embryos (40% versus 72% in the control treatment). At the Rathall Creek location, sediment chemistry was slightly, but consistently greater than Foster Creek. In addition, significantly greater grass shrimp mortality was observed at the Rathall Creek reference (20%) relative to the control treatment (8%). Shrimp mortality in Foster Creek sediment (12%) was not significantly different from controls. Therefore, because some adverse effects on grass shrimp were observed at both locations, the percent loss of benthic services should be >0% but <10% (see ER-Ls and TELs above). For the Macalloy injury assessment, the Trustees will associate a 2% and 5% loss of benthic services for MSQs calculated for Cr, Pb, Ni, and Zn at the Foster Creek and Rathall Creek reference locations, respectively.

4.3.4.5 Percent Loss of Services for the EPA "Protective Levels"

As discussed earlier, significant adverse effects on grass shrimp survival, ovary production, embryo production, embryo hatching and DNA damage were observed at sediment concentrations corresponding to EPA's "protective levels". That observation, coupled with the fact that EPA "protective levels" generally fall between "possible" (ER-L, TEL) and "probable" (ER-M, PEL) benchmarks, suggest that the estimated loss of benthic services for EPA's high and low "protective levels" should fall between 10% and 50% (range of estimated service loss for sediment benchmarks). For the Macalloy injury assessment, the Trustees will associate a 30% and 25% loss of benthic services for MSQs calculated for Cr, Pb, Ni, and Zn for EPA's high and low "protective levels", respectively.

4.3.4.6 Percent Loss of Services versus Mean Sediment Quotients (MSQs)

To summarize the above discussion, the percent loss of benthic services associated with each of the MSQs calculated above, are as follows.

Mean Sediment Quotient (MSQ)	Estimated % Loss of Benthic Services
ER-M MSQ	50%
PEL MSQ	40%
EPA High "Protective Level" MSQ	30%
EPA Low "Protective Level" MSQ	25%
ER-L MSQ	10%
TEL MSQ	10%
Rathall Creek Reference MSQ	5%
Foster Creek Reference MSQ	2%

The relationship between estimated percent service loss and MSQs is linear (R-squared = 0.95) for the linear equation y = 55x – 1.8 where y = percent loss of benthic services and x = MSQ for Cr, Ni, Pb, and Zn. This equation will be used to estimate percent loss of benthic services for the Macalloy sediment data from Shipyard Creek during the HEA (see below).

4.3.5 Habitat Equivalency Analysis (HEA)

4.3.5.1 Background

Habitat Equivalency Analysis, or HEA, (NOAA, 2000) is a calculation tool used to determine the amount of compensation (in the form of acreage) needed to replace an injured habitat. The scale, or size, of a restoration project should be such that it provides enough ecological service gains to offset the total of the losses.

Losses are quantified as lost resource habitat area and ecological services. Restoration projects are scaled to provide comparable habitat resources and ecological services (equivalency) between the lost and restored habitat resources and ecological services.

In general, the HEA is a technique that balances “debits” (injured habitat or other resource service losses) that have occurred as a result of releases of hazardous substances against compensatory “credits” (habitat restoration projects) and uses a discount factor to account for the difference in time that the restoration services are delivered. Because the losses occur in different time periods, the relevant losses are not directly comparable. To make the losses that occur in different time periods comparable, a discount factor is applied to the losses to determine “discounted service-acre-years” or DSAYs.

4.3.5.2 HEA for the Macalloy Corporation Site

Inputs to the HEA for the Macalloy Corporation Site were based on sediment chemistry analytical results and conservative assumptions[1]. A number of generic, conservative assumptions were associated with all of the areas that were assessed: 1) the HEA is an appropriate analytical tool, 2) the annual discount rate is 3%, 3) the base year (the year from which a discount is applied) is the year 2005, 4) the onset of injury was calculated beginning in 1981, 5) full recovery of the injured resources occurs some years into the future, depending on extent of contamination, and 6) restoration would be initiated in the year 2006. Because historical sediment data are generally lacking, injury levels were assumed to be constant from 1981 until the time of the RI or presumptive remedial action, as appropriate. (It should be noted that, although the restoration has not yet been initiated, the assumption that it would be initiated in 2006 served as the basis for the HEA, and for subsequent discussions with the Responsible Party, which resulted in a cash settlement of this case in 2006.)

---

[1] *The term” conservative assumption” indicates that the value of the parameter in question would tend to favor the natural resource and the public’s interests in injured natural resources when used in the analysis. The assumed value therefore leads to an upper-end estimate of how much injury occurred or how much restoration is required. Often these assumptions are used in initial analyses to guide the Trustees in determining the appropriate level of effort to apply in obtaining more refined estimates. Sometimes, as is the case for most of the assumptions used in this injury assessment, the cost of developing refined estimates for parameters would exceed the potential reduction in the cost of restoration. In these instances, the use of conservative assumptions in the final analysis, rather than developing more precise point estimates, results in an overall cost savings to the potentially responsible parties (PRPs) while still protecting the public’s interest in obtaining sufficient restoration for the injuries.*

Through preliminary habitat mapping, the Trustees determined the number of affected acres of habitat at each of the injury levels. After mapping sediment contamination stations according to MSQs, the overall site was divided into three general levels of injury based on an evaluation of sediment contaminant levels: Upper Shipyard Creek, Lower Shipyard Creek, and the 001 Creek. While there is some variability within these categories, the Trustees sought to balance the cost and complexity of the injury assessment with the need for more precision in delineating these categories. The three areas of Shipyard Creek, the categories of injury, the levels of services losses, and recovery times are described below and summarized in Table 4.1.

1. *Upper Shipyard Creek*, north of the 001 outfall canal, is approximately 16 acres of habitat (5 acres subtidal soft-sediment plus 11 acres intertidal salt marsh). Sediments in this area of Shipyard Creek generally have higher MSQs relative to the Lower Shipyard Creek. The average service loss calculated for Upper Shipyard Creek was 19% based on the average MSQ over the 16-acre area. Recovery is assumed to occur linearly over a 20-year period.

2. *Lower Shipyard Creek* is a larger area south of the 001 outfall canal. Sediments generally have lower MSQs and thus lower service loss (7%) based on the average MSQ over 50.7 acres. Since this area is less contaminated than the other site areas, recovery will likely occur more rapidly and is assumed to occur linearly over a 10-year timeframe.

3. *001 Outfall Canal Removal Area* is a small (≈ 0.5 acre) tidal creek that has been proposed by EPA to undergo sediment excavation/backfill/vegetation as part of the site remedial action. Sediments here are generally the most contaminated within the Shipyard Creek estuary. Service loss for this area was calculated to be 70% based on the average MSQ over the area. The area was excavated in 2004 and, at that point, was considered to have 100% loss of services with a 10-year linear recovery period.

Table 4.1. HEA Input Parameters and Results

Shipyard Creek (SYC) Areas	Size (acres)	Average % Loss of service	Time to recovery	Discounted service acre-years lost
Upper SYC	16	19	20	83.5
Lower SYC	50.7	7	10	124.9
001 Creek	0.5	70 -100	10	18.8
Total				227.2

In the second part of HEA, compensatory habitat restoration provides “credit” inputs that are used to project the amount of services generated over time by a restoration activity such as salt marsh creation. Credit inputs may include parameters such as the number of years to maturity, how long a project is expected to last, and rate of natural recovery. For purposes of assessing the Macalloy Site, the HEA was used to estimate the size of tidal salt marsh restoration necessary to make the public whole. Results of the HEA performed by the Trustees indicate the equivalent of approximately 12.7 acres of created salt marsh habitat, or another marsh restoration project type that generates the equivalent 227.2 DSAYs, would be needed to compensate for losses incurred from 1981 until full recovery of the area. The Trustees agreed that, for this case, an oyster reef restoration or creation project of approximately 4-6 acres would provide a comparable number of DSAYs.

4.4 GROUNDWATER INJURY ASSESSMENT & FINDINGS

4.4.1 Scope:

This section evaluates the injuries to groundwater caused by the release of hazardous substances at this Site. The Site-specific information and variables necessary to evaluate and develop the surrogate value for groundwater damages were obtained from the South Carolina Department of Health and Environmental Control’s (SCDHEC’s) Macalloy Corporation Site - Charleston NPL Site File.

4.4.2 Introduction:

SCDHEC has reviewed the Site file and has determined that groundwater injuries exist as a result of discharge from the Macalloy Site. This report provides a discussion of the methodology used to evaluate/conduct the injury assessment of the area of impacted groundwater.

4.4.3 Background/Site Description:

The groundwater contamination plume was delineated during the Remedial Investigation at the Site. The remedy description for the groundwater was outlined in the ROD issued by EPA in September of 2002 (USEPA 2002). The remedy includes the in-situ injection of a chemical reductant to permanently reduce hexavalent chromium to trivalent chromium through a series of individual injection points across the Site.

4.4.4 Purpose and Natural Resource Values:

The purpose of the groundwater claim is to redress injuries to groundwater, and the ecological services groundwater provides, as a result of hazardous discharges at the Macalloy Site. The State of South Carolina considers groundwater to be one of the State’s natural resources, acknowledging that “clean” water is important economically and ecologically to the well-being of the State, and that the quality of the groundwater influences surface water quality, water supply quality, and the health of aquatic ecosystems. Thus, not only is groundwater important as a potable drinking water source, but also as an integral part of the ecosystem of this State.

Despite the absence of current direct human consumption of the State's groundwater, groundwater is considered a valuable natural resource to the citizens of South Carolina. Groundwater acts as a source of water (base flow) to support wetlands, helps prevent saltwater intrusion, and is important to the management of other ecological habitats. The State considers groundwater potentially to be a critical source of water for direct human consumption in the future. Especially with the increasing frequency of drought and growth of the human population, the demand for potable water is increasing rapidly.

While the groundwater resources cannot be restored in kind, a natural resource value still must be determined in order to seek an appropriate restoration project or compensation for injuries to this valuable resource. SCDHEC has developed a surrogate valuation methodology (consistent with New Jersey's Office of Natural Resource Restoration Methodology) to determine the scale of compensatory restoration or monetary compensation necessary to redress the injury to the State's groundwater resources resulting from discharges at contaminated sites. The goal is to use the surrogate value both to assess the value of the resource that has been injured and to identify the scope of an appropriate restoration project or compensation.

4.4.5 Groundwater Natural Resource Injury Valuation:

The following facts were considered during the groundwater injury valuation:

- This evaluation is for groundwater injury only. Damages to other natural resources are evaluated separately in this RCDP/EA.

- This natural resource injury assessment includes only the groundwater injury arising from the plume(s) of groundwater contamination originating at the Site.

- The time period selected for the past damages is from 1998 (i.e., when the remedial investigation for the Site was initiated) and not from the time period when the contamination could have been released to the environment (i.e., from early 1940 Site operation period).

- The area utilized for the calculations was based on information submitted by Macalloy's contractor and approved by SCDHEC.

Although the time period for the non-aqueous phase liquid (NAPL) contaminated groundwater to be restored is unknown, the time period selected for the groundwater damage calculation is capped at 30 years. SCDHEC generally agreed to the current configuration of the groundwater remedial system, but believes that uncertainty exists regarding the actual amount of time needed to attain groundwater standards. This uncertainty is due to constraints placed on the treatment area by the physical features of the site.

The following is a description of the formula used to determine a surrogate groundwater injury value and an explanation of the variable for the calculation. It should be recognized that the surrogate groundwater injury is likely valued low due to the above stated assumptions.

Surrogate Groundwater Injury Value = contaminant plume area * annual recharge rate * conversion factor * duration of the injury * water rate

Where,

Contaminant plume area = total square feet of the contaminated groundwater plume determined during the remedial investigation. For this Site, the approximate area of contaminated groundwater was calculated using the GIS/Arc View software that used the groundwater plume maps provided in the 100% Remedial Design Report.

Annual Recharge Rate = annual groundwater recharge rate for the specific regional area. The annual recharge used in the calculation was 1.67 feet/year (20 inches/year). The Superfund Hydrogeology Section in the Bureau of Land and Waste Management provided this information.

Conversion Factor = conversion of cubic feet of water to gallons (7.48 gal/cu. ft). (Engineer In-Training Reference Manual)

Duration of Injury = number of years that the contamination will be present in the groundwater above the groundwater quality standards (starting from the time the contamination was investigated until the groundwater quality standards have been met). The ten (10) year period represents the time from Remedial Investigation to Remedial Action. The thirty (30) year period is the estimated period of time the selected remedy will meet the groundwater quality standards.

Water Rate = price of water obtained from the Public utilities (current value in $/1000 gallons). The water rate used is $1.66/100 cu. feet, which was obtained from Charleston CPW in May 2003.

For calculating the existing volume of contaminated groundwater, the calculated groundwater plume area was multiplied by the depth of groundwater. The depth of existing contaminated groundwater was approximated from the depths at which the existing extraction wells are screened. This information may change once as-build construction completion reports become available.

4.4.6 Conclusions and Recommendations:

Based on the formula provided and calculation presented in the attached spreadsheet, the total surrogate value of the groundwater injuries for this Site is $516,659.71. This dollar value does not account for time and effort spent to develop this assessment.

The Trustees have agreed that, for this case only, the preferred restoration alternative (oyster reef creation) will serve to adequately compensate the public for ecological injuries resulting from the discharge of contaminated groundwater to surface water in the vicinity of the Macalloy Site. This determination is justified by the known capacity of oysters to filter large volumes of water, thus contributing to improved surface water quality. The dollar amount of the monetary settlement for injuries to natural resources at the Macalloy Site also necessitated the selection of a single project that would compensate the public for all categories of injury, including groundwater contamination.

Table 4.2 Summary of SCDHEC Ground Water Claim

Sr. #	Description	Dollar Value
1	Surrogate Value for Contaminated Groundwater from 1998-2002 (Time Period from RI to RA)	58,138.58
2	Surrogate Value for Existing Contaminated Groundwater	22,481.80
3	Surrogate Value for Contaminated Groundwater for Time Period to Remediate GW to MCLs	436,039.34
4	Total Groundwater Surrogate Value	516,659.71

5 RESTORATION PLANNING PROCESS

5.1 RESTORATION OBJECTIVE

The overall objective of the restoration planning process is to identify restoration alternatives that are appropriate to restore, rehabilitate, replace or acquire natural resources and their services equivalent to natural resources injured or lost as a result of releases of hazardous substances. The restoration planning process may involve two components: primary restoration and compensatory restoration. Primary restoration actions are actions designed to assist or accelerate the return of resources and services to their pre-injury or baseline levels. In contrast, compensatory restoration actions are actions taken to compensate for interim losses of natural resources and services, pending return of the resources and their services to baseline levels.

In this instance, remedial actions undertaken at the Site (e.g., wastes treatment and consolidation, capping of the terrestrial areas, and sediment excavation) are expected to protect natural resources in the vicinity of the Site from further or future harm and presumably allow natural resources to return to pre-injury or baseline conditions within a reasonable period of time. Under these circumstances, it was unnecessary for the Trustees to consider or plan for primary restoration actions. Accordingly, this RCDP/EA only addresses the need for compensatory restoration action.

In accordance with NRDA regulations, the Trustees identified and evaluated a reasonable range of project alternatives that could be used to create and enhance estuarine marsh habitat in the Charleston Harbor area. The projects identified came from a broad survey of the Charleston Harbor area conducted by the Trustees (Ridolfi Inc. 2003), a GIS-based survey conducted by Macalloy (BDY 2004), and oyster reef restoration/creation projects suggested by the South Carolina Department of Natural Resources' (SCDNR's) Shellfish Management Section. The Trustees reviewed available information on these projects and consulted with individuals with knowledge of specific projects or of the benefits and feasibility of the alternatives, based on project design. In identifying and evaluating these alternatives, the Trustees also sought to ensure the restoration action selected would be capable of providing multiple benefits or services thus providing the greatest overall benefit to the public. The restoration project alternatives were considered carefully by the Trustees based on the criteria outlined below. Each project alternative, the results of that evaluation and the restoration action(s) that the Trustees have selected on the basis of that evaluation are identified in Section 5.0 of this RCDP/EA.

5.2 RESTORATION SELECTION CRITERIA

In accordance with the NRDA regulations, the following criteria were used to evaluate restoration project alternatives and identify the project(s) selected for implementation under this plan:

The extent to which each alternative is expected to meet the Trustees' restoration goals and objectives: The primary goal of any compensatory restoration project is to provide the same quantity and quality of resources and services as those lost. In this plan, that goal is met through the stated restoration objective: to provide for the creation of sufficient habitat acreage in the Charleston Harbor area to compensate for the natural resource injuries and service losses attributed to hazardous substance releases at the Macalloy Corporation Site. The Trustees considered the potential relative productivity of restored habitat and whether the habitat is being created or enhanced. Future management of the restoration site is also a consideration because management issues can influence the extent to which a restoration action meets its objective.

The cost to carry out the alternative: The benefits of a project relative to its cost are a major factor in evaluating restoration alternatives. Additionally, the Trustees considered the total cost of the project and the availability of matching funds if any. Factors that can affect and increase the costs of implementing the restoration alternatives may include project timing, access to the restoration site (for example with heavy equipment), acquisition of state or federal permits, acquisition of the land needed to complete a project, and the potential liability from project construction. Although a monitoring program does increase the cost of an alternative, the inclusion of an adequate monitoring component is necessary to insure that the public is made whole and that project success criteria are met.

The likelihood of success of each project alternative: The Trustees consider technical factors that represent risk to successful project construction, successful project function or long-term viability of the restored habitat. For example, high rates of subsidence at a project site are considered a risk to long-term existence of constructed habitats. Alternatives that are susceptible to future degradation or loss through contaminant releases or erosion are considered less viable. The Trustees also consider whether difficulties in project implementation are likely and whether long-term maintenance of project features is likely to be necessary and feasible. Sustainability of a given restoration action is a measure of the vulnerability of a given restoration action to natural or human-induced stresses following implementation and the need for future maintenance actions to achieve restoration objectives.

The extent to which each alternative will avoid collateral injury to natural resources as a result of implementing the alternative: Restoration actions should not result in additional significant losses of natural resources and should minimize the potential to affect surrounding resources during implementation. Projects with less potential to adversely impact surrounding resources are generally viewed more favorably. Compatibility of the project with the surrounding land use and potential conflicts with any endangered species are also considered.

The extent to which each alternative benefits more than one natural resource or service: This criterion addresses the interrelationships among natural resources, and between natural resources and the services they provide. Projects that provide benefits to more than one resource and/or yield more beneficial services overall, are viewed more favorably. This is especially important for the Macalloy RCDP/EA because we limited our injury assessment only to the benthic community with the assumption that restoration for benthic injury would provide service flows for additional resources. Although recreational benefits are not an explicit objective in this RCDP/EA, the opportunity for a restoration project to enhance recreational use of an area was considered favorably.

The effect of each alternative on public health and safety: Projects that would negatively affect public health or safety are not appropriate.

The U.S. Department of the Interior's NRDA regulations gives the Trustees discretion to prioritize these criteria and to use additional criteria as appropriate. In developing this RCDP/EA, the first criterion listed (i.e., "*The extent to which each alternative is expected to meet the Trustees' restoration goals and objectives"*) has been a primary consideration, because it is key to ensuring the restoration action will compensate the public for injuries to resources attributed to Site releases, consistent with the assessment of compensation requirements for the Site. The evaluation of projects according to the criteria involves a balancing of interests in order to determine the best way to meet the restoration objective. The Trustees have approached restoration planning with the view that the injured natural resources/lost services are part of an integrated ecological system and that the Charleston Harbor area represents the relevant geographical area for site restoration actions. Areas outside of this are considered less geographically relevant as restoration alternatives. This helps to ensure the benefits of restoration actions are related, or have an appropriate nexus, to the natural resource injuries and losses at the Site. The Trustees also recognized the importance of public participation in the restoration planning process, as well as the acceptance of the projects by the community. Alternatives were considered more favorably if complementary with other community development plans/goals.

NEPA and the NRDA regulations required the Trustees to evaluate the "No Action" alternative, which for compensatory restoration equates to "No Compensation." Under this alternative, the Trustees would take no action to compensate for interim losses associated with the evaluated natural resources.

This Section identifies the restoration project alternative(s) selected for use to restore the natural resource services that were injured or lost due to the Macalloy Corporation Site based on the Trustees' evaluation of the restoration alternatives in light of the restoration objective of this plan, the selection criteria listed in Section 4.2 and, consistent with the RCDP/EA's role as a Environmental Assessment under NEPA, information relating to the restoration setting and factors such as the potential environmental, social, and economic consequences of each project. Information supporting the Trustees' project selection is provided throughout the remainder of this section as well as in Section 6.0.

5.3 FIRST TIER SCREENING OF RESTORATION ALTERNATIVES

In 2003, the Trustees developed a list of more than 50 non-project specific potential restoration opportunities in the Charleston Harbor area (Ridolfi Inc. 2003). Macalloy (BDY 2004) identified an additional 22 potential areas of possible restoration for the Macalloy Corporation Site. The Trustees, working cooperatively with Macalloy, narrowed the list by considering the following screening factors:

- Preference for restoration projects that could be implemented in the short term.
- Preference for restoration projects with a strong nexus to the injured resources.
- Preference for restoration projects with a high degree of habitat enhancement.
- Preference for restoration projects that limit disruption to existing resources.

As a result of the above screening factors, the Trustees and Macalloy identified the following restoration alternatives as potential restoration projects for the Site:

- Long Branch Creek Diagonal Berm - Salt marsh enhancement/creation by installing water conduit structure in an existing berm that was built at a "diagonal" axis to the creek.
- Long Branch Creek Tide gate and Berm Removal - Salt marsh enhancement by removing a tide gate structure and associated berms that were used to prevent saltwater from inundating and disrupting historic rice field production.
- Long Branch Creek Highway 17 Box Culverts Upgrade - Salt marsh enhancement by upgrading existing box culverts where Long Branch Creek flows under State Highway 17.
- Long Branch Creek Greenway Culvert Replacement – Salt marsh enhancement by replacing currently undersized culverts with a pedestrian bridge and/or properly sized culverts.
- Noisette Creek Golf Course – Salt marsh creation by scraping down portions of a 9-hole golf course that's no longer used.
- Noisette Creek Concrete Perimeter Road Removal – Salt marsh enhancement/creation by removing an existing concrete causeway, regrading and replanting *Spartina*.
- Macalloy On-site Salt marsh Creation – Reclaim salt marsh from historic filled area in the northern quarter of the Macalloy Corporation Site by scraping down, regrading and planting *Spartina*.
- Charleston Area-Oyster Reef Creation/Restoration - To create or restore oyster reefs in and around the Charleston Harbor area by planting shell to provide a suitable substrate on which oyster larvae could settle and grow.
- No Action.

5.4 SECOND TIER SCREENING OF RESTORATION ALTERNATIVES

As result of the second tier qualitative screening (Table 5.1), several were dropped from consideration. (Subjective screening summarized in Table 5.1 is based on a scale of zero to plus-3). The Long Branch Creek Highway 17 Box Culverts Upgrade was dropped because it was judged not feasible to do within a reasonable period of time. While the existing culverts are slightly undersized (they are not visible at high tide), they still provide adequate tidal exchange. Highway 17 is a major transportation artery and thus disrupting traffic flow patterns for any period of time would be a major political and public relations challenge. In addition, project planning with South Carolina Department of Transportation would likely result in excessive project delay.

The Long Branch Creek Greenway Culvert Replacement project, located approximately 1300 feet downstream from Highway 17, was dropped because increasing the tidal prism at this point in the creek would put undue pressure on the already undersized box culverts at Highway 17.

The Noisette Creek Golf Course was dropped because another responsible party has expressed interest in conducting this project as compensation for an oil spill in the Charleston Harbor. The responsible party is currently developing a restoration proposal and, for the purposes of this RCDP/EA, the Trustees consider the Golf Course project no longer available for potential compensation for the Macalloy Corporation site.

The Noisette Creek Concrete Perimeter Road Removal project, located on the former Charleston Naval Shipyards, is less than the needed 12-13 acres of marsh creation. This site is also the subject of ongoing environmental investigations for soil and sediment contamination, which could delay implementation of the project, or even eliminate it as a viable option depending on the results of the investigation. Therefore, detailed analysis of this alternative was not undertaken at this time.

The on-site restoration project at the Macalloy facility was dropped at the request of Macalloy representatives.

Table 5.1 Summary of Trustees' Second Tier Screening of Restoration Alternatives

Restoration Alternative	Implementable in short-term	Strong nexus between injured & restored habitats	Amount of habitat function enhancement	Avoids injury to existing resources	Retain for detailed analysis
Long Branch Creek Diagonal Berm	Yes*	+++	+++	Yes	Yes
Long Branch Creek Tidegate and Berm Removal	Yes*	+++	+++	Yes	Yes
Long Branch Creek Highway 17 Box Culverts Upgrade	No	+++	+	Yes	No
Long Branch Creek Greenway Culvert Replacement	No	+++	+	Yes	No
Noisette Creek Golf Course	No	+++	++	Yes	No
Noisette Creek Concrete Perimeter Road Removal	No	+++	++	Yes	No
Macalloy On-site Saltmarsh Creation	No	+++	+++	Yes	No
Oyster Reef Creation	Yes	+++	+++	Yes	Yes
No action	Yes	0	0	0	Yes

* Implementation in the short-term subsequently determined NOT to be feasible

5.5 SCALING THE PREFERRED RESTORATION PROJECT

The Trustees considered the first two "Long Branch Creek" restoration alternatives, the "Oyster Reef Creation" alternative, and the "No action" alternative in developing the remainder of this RCDP/EA. In compliance with CERCLA NRDA regulations and NEPA, the selection of the restoration alternative will be finalized following public review and comment on this RCDP/EA. Important assumptions in this analysis are that the projects are technically feasible, and will be implementable in the short-term.

5.5.1 Habitat Equivalency Analysis Credit Model

The preferred restoration project must provide sufficient habitat creation and/or enhancement to compensate the public for the losses outlined in Section 3.0. Using scientific literature and knowledge of South Carolina estuaries, the Trustees evaluated the first two Long Branch Creek restoration alternatives identified in Table 5.1, as well as a hypothetical intertidal oyster reef creation project, in order to determine the amount of credit that would be generated by each of these three alternatives.

The numbers of "Discounted Service Acre Years" (DSAYS) generated by these three projects are reported in Table 5.2 (below).

Table 5.2 DSAY Credit That Would Be Produced by Each of Three Restoration Projects.

	Acreage	Anticipated DSAYs Generated by Project
Long Branch Creek Diagonal Berm	23	129
Long Branch Creek Tide gate and Berm Removal	25	140
Oyster Reef Creation Project	4	228

5.6

5.7 GEOGRAPHIC PROXIMITY OF PROJECTS

Both of the Long Branch Creek restoration alternatives that were selected for more detailed analysis are located within the general Charleston Harbor area, approximately 7 miles southwest of the Macalloy Corporation Site. With respect to the oyster reef creation alternative, SCDNR's Shellfish Management Section has identified several areas in the Charleston Harbor estuary as being suitable for this purpose. Charleston Harbor's watershed includes the Ashley River, Cooper River, Wando River and their tributaries, including Shipyard Creek (where the Macalloy Site is located), as well as Charleston Harbor itself. A large part of the watershed is classified as "prohibited" or "restricted" to shellfish gathering, thus assuring that any constructed oyster reefs would be undisturbed by commercial or recreational harvesting.

6 RESTORATION ALTERNATIVES COMPARISON

6.1 RESTORATION ALTERNATIVE 1: OYSTER REEF CREATION/ RESTORATION PROJECT (PREFERRED ALTERNATIVE)

The Trustees' preferred alternative is to create additional oyster reef habitat in the Charleston Harbor estuary. This would involve the construction of one or more intertidal oyster reefs, encompassing a minimum of four acres (total). It is anticipated that this project would eventually provide ecological services equivalent to those of a natural oyster reef of equivalent size. The precise location(s) for this alternative has not been selected; however, several potential sites within the Charleston Harbor estuary, primarily in the Wando River, have already been identified. Environmental conditions in these areas appear to be suitable for the successful establishment of oyster reefs. Under this alternative, the South Carolina Department of Natural Resources would place and maintain a foundation of purchased or recycled oyster shell cultch, on which oyster spat could settle and grow into mature oysters. These oysters would serve as the "keystone" species in the development of a functional oyster reef community. Details concerning the construction and monitoring of the proposed reef(s) are included as Appendix 1 to this document.

6.1.1 Ecological and Socio-Economic Impacts of Alternative 1

Eastern oysters, *Crassostrea virginica*, create complex habitats utilized by numerous finfish, invertebrates, wading birds, and mammals. Oysters improve water clarity and quality as they filter large quantities of water and transfer nutrients from the water column to the benthos. Intertidal populations of oysters form natural breakwaters that protect shorelines and fringing marshes from erosion. Declines in oyster populations are associated with adverse effects on other species, reduced water quality, and ecosystem alterations.

The South Atlantic Fisheries Management Council (SAFMC) has designated oyster reefs as essential fish habitat (EFH). Federally managed species that utilize this type of habitat during various life stages include red drum and penaeid shrimp. Other species of commercial, recreational and ecological importance include Atlantic croaker, spot, Atlantic menhaden, blue crab, killifish and striped mullet. In turn, these fish provide prey for Spanish and king mackerel, cobia, and others managed by the SAFMC, and for migratory species such as sharks and billfishes managed by NOAA. In South

Carolina, oyster reefs generate biodiversity and are identified as critical habitats of concern in both the State Conservation Plan and SCDNR's Comprehensive Wildlife Conservation Strategy.

Practically all of South Carolina's oyster resource is intertidal, consisting of three-dimensional multi-generational clusters of vertically growing oysters. The total surface area created by intertidal oyster reefs is approximately fifty times that of a non-oyster intertidal mud bottom (Bahr and Lanier 1981). The primary limiting factor for oyster propagation in South Carolina is cultch, as most larvae die for lack of locating a suitable surface to attach. Because of the demise of the oyster canning and raw shuck industries during the latter part of the 20th century, considerably less shell cultch planting has occurred over the last twenty years, contributing to a net loss of oyster reef habitat. In addition, oyster reefs in proximity to urbanized and industrialized areas have been subject to long-term fecal coliform pollution and habitat destruction. Although some viable oyster habitat remains within Charleston Harbor, boat wakes and environmental perturbations, such as port expansion, residential and industrial development, and changes in salinity due to massive river diversions in 1941 and 1985 have diminished many productive oyster grounds (Bradley, Kjerfve and Morris 1990). Therefore, oyster reef restoration and creation projects have become increasingly important to the continued existence of this critical habitat.

Implementation of the preferred project, oyster reef creation, would involve the temporary use of equipment or activities that would increase noise and the level of human activity in the project area for a short period of time. No other negative socio-economic effects would be expected as a result of this project.

6.1.2 Evaluation of Alternative 1

The preferred alternative provides an opportunity for cost-effective estuarine habitat enhancement through the planting of cultch to support oyster reef development. The SCDNR has a demonstrated record of successfully implementing oyster reef restoration and creation projects in coastal South Carolina. This restoration alternative would be expected to improve water quality and increase habitat complexity and species diversity in the vicinity of the proposed project. It is anticipated that the constructed oyster reefs would be largely self-sustaining, require minimal intervention following construction to achieve functional success, and would provide an uninterrupted flow of services into the future. The nature of the project and the setting for construction would present no human health or safety issues beyond those met by standard procedures for safe construction.

6.2 Restoration Alternative 2: Long Branch Creek Diagonal Berm (Non-Selected Alternative)

The project site is located on Long Branch Creek, a tidally influenced tributary to the Stono River in Charleston County, South Carolina. Long Branch Creek is approximately 1.5 miles long and generally flows south from the Glenn McConnell Expressway at West Ashley Park to the Stono River. Historical aerials indicate Long Branch Creek has a history of extensive channelization and berm/dike construction largely for agricultural purposes (rice farming).

This restoration project would return tidal exchange to a degraded 23-acre wetland located at the headwaters of Long Branch Creek between the Glenn McConnell Expressway and a berm that runs diagonal to the long axis of the creek (hence the term "diagonal berm"). The project would be carried out by installing a water conduit structure(s) (e.g., culverts) in the existing diagonal berm. The construction efforts would be designed to increase marsh habitat functions and increase habitat diversity at the site. The goals of the project would be to: 1) restore tidal exchange between the 23-acre wetland and Long Branch Creek; 2) increase the areal extent of high salinity salt marsh habitat where it probably existed prior to hydrological modification; and 3) increase utilization by estuarine organisms and wading birds by increasing habitat quality.

6.2.1 Ecological and Socio-Economic Impacts of Restoration Alternative 2

Restoring hydraulic connection to Long Branch Creek would enhance the entire 23-acre wetland system at this location for aquatic estuarine organisms and wading birds. This modification would improve sheet flow across the site and increase the rate of tidal exchange. This project would also increase the tidal volume capacity in the Long Branch Creek system, thereby decreasing the chance of unplanned inundations of residential areas further downstream during spring tide and storm events.

This restoration alternative would be expected to increase habitat diversity, increase and enhance utilization of the area by estuarine organisms, and re-establish salinity and tidal regimes necessary for the growth of emergent saltmarsh plant communities. Increasing the habitat value of this area would be expected to enhance the carrying capacity and biological productivity of the system. These ecological effects would indirectly benefit the public by contributing to opportunities for enjoying recreational activities such as bird watching and fishing.

Implementation of the project would involve the temporary use of equipment or activities that would increase noise and the level of human activity in the project area for a short period of time. The project could affect storm water management in the upper reaches of Long Branch Creek. This possibility would have to be investigated as part of a baseline hydrological study of the Long Branch Creek System. No other negative socio-economic effects would be expected as a result of this project.

6.2.2 Evaluation of Restoration Alternative 2

The project area is within the general Charleston Harbor area and provides an opportunity for estuarine marsh restoration though the reestablishment of tidal exchange needed to support marsh vegetation. It is anticipated that the restored marshes would be self-sustaining, requiring limited or no active intervention following construction to achieve functional success. The nature of the project and the setting for construction would present no human health or safety issues beyond those met by standard procedures for safe construction.

Although the Natural Resource Trustees considered Alternative 2 to be an excellent restoration project, this alternative was ultimately dropped because of likely complications, delays, and additional costs that would be incurred by having to relocate utility lines that are buried within the berm. The Trustees also foresaw potential permitting problems associated with exposing an area designated as "jurisdictional freshwater wetlands" to increased tidal flow and salinity intrusion. It was also discovered that these wetlands were already proposed to be protected in their current condition as part of a master plan for an adjacent residential development. Therefore, Alternative 2 was not selected as the preferred alternative.

6.3 Restoration Alternative 3: Long Branch Creek Tide gate and berm removal (Non-Selected Alternative)

The project site is located on Long Branch Creek, a tidally influenced tributary to the Stono River in Charleston County, South Carolina. Long Branch Creek is approximately 1.5 miles long and generally flows south from the Glenn McConnell Expressway at West Ashley Park to the Stono River. Historical aerial photographs indicate Long Branch Creek has a history of extensive channelization and berm/dike construction probably for agricultural purposes (rice farming).

This restoration project would increase tidal exchange to a 25-acre wetland located immediately downstream from the diagonal berm restoration project described above. The project would be carried out by removing an existing tide gate and associated berm. The construction efforts would be designed to increase marsh habitat functions and increase habitat diversity at the site. The goals of the project would be to: 1) increase tidal prism for the 25-acre salt marsh; 2) increase the areal extent of high salinity salt marsh habitat where it probably existed prior to hydrological modification; 3) increase utilization by estuarine organisms and wading birds by increasing habitat quality.

6.3.1 Ecological and Socio-Economic Impacts of Restoration Alternative 3

Increasing tidal exchange to this portion of Long Branch Creek would enhance the entire 25-acre wetland system for aquatic estuarine organisms, birds and terrestrial animals. This modification would improve sheet flow across the site and increase the rate of tidal exchange. This project would also increase the tidal volume capacity in the Long Branch Creek system, thereby decreasing the chance of unplanned inundations of existing and planned residential areas during spring tide and storm events.

This restoration would be expected to increase habitat diversity; increase and enhance utilization of the area by estuarine organisms; reduce eutrophic conditions; and enhance salinity and tidal regimes necessary for the growth of emergent salt marsh plant communities. Increasing the habitat value of this area would be expected to enhance the carrying capacity and biological productivity of the system. These ecological effects would indirectly benefit the public by contributing to opportunities for enjoying recreational activities such as bird watching and fishing.

Implementation of the project would involve the temporary use of equipment or activities that would increase noise and the level of human activity in the project area for a short period of time. The project could affect storm water management in the upper reaches of Long Branch Creek. This possibility would have to be investigated as part of a baseline hydrological study of the Long Branch Creek System. No other negative socio-economic effects would be expected due to this project.

6.3.2 Evaluation of Restoration Alternative 3

The project area is within the Charleston Harbor area and would provide an opportunity for estuarine marsh restoration though enhanced tidal exchange needed to support salt marsh vegetation. It is anticipated that the restored and enhanced marshes would be self-sustaining, requiring limited or no active intervention following construction to achieve functional success. The nature of the project and the setting for construction would present no human health or safety issues beyond those met by standard procedures for safe construction.

Although the Natural Resource Trustees considered Alternative 3 to be a potentially excellent restoration project, this alternative was ultimately dropped because the developers of the adjacent residential development were unwilling to modify their already approved plan to incorporate this berm into a system of walking trails for the residents of this development. The Trustees believe that breaching the berm in one or more places and bridging these gaps, and/or installing larger culverts to enhance tidal exchange, would still be compatible with the use of this berm as part of a walking trail; however, until ownership of the berm is transferred to another entity, such as a homeowners association, the project has been determined not to be feasible. Therefore, Alternative 3 was not selected as the preferred alternative.

6.4 Restoration Alternative 4: No Action (Non-Selected Alternative)

Under this alternative, the Trustees would take no action to create, restore, or enhance estuarine marsh services to compensate for the resource losses attributed to the Macalloy Corporation Site. The Trustees determined that natural resources or ecological resource services were lost due to injuries caused by releases of hazardous substances from the Site. While the remedial activities addressed the actions needed to allow injured resources to recover, the remedial activities did not compensate the public for ecological resources service losses. Such compensation serves to make the public whole for the full harm done to natural resources injured by the release of hazardous substances from the Site.

Under CERCLA, the Trustees sought compensation for these interim losses on behalf of the public through actions that restore, replace, or provide services equivalent to those lost. Under the "no action" alternative, restoration actions needed to make the environment and the public whole for its losses would not occur. This is inconsistent with the goals of natural resource damage provisions under CERCLA, and the compensation objective of this restoration plan. Thus, the Trustees have determined that the "no action" alternative (*i.e.*, no compensatory restoration) must be rejected.

7 NEPA, ENDANGERED SPECIES ACT, & ESSENTIAL FISH HABITAT: ANALYSIS AND PRELIMINARY FINDING OF NO SIGNIFICANT IMPACT

Pursuant to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4371, *et seq.*, and the implementing regulations at 40 C.F.R. Parts 1500 - 1517 (the NEPA regulations), federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. NEPA defines the human environment comprehensively to include the "natural and physical environment and the relationship of people with that environment." 40 C.F.R. § 1508.14. All reasonably foreseeable direct and indirect effects of implementing a project, including beneficial effects, must be evaluated. 40 C.F.R. § 1508.8. Federal agencies may conduct an environmental assessment (EA) to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required.

Section 1508.27 of the NEPA regulations describes the minimum criteria that federal agencies should consider in evaluating the potential significance of proposed actions. The regulations explain that significance embodies considerations of both context and intensity. In the case of site-specific actions such as those proposed in this RCDP/EA, the appropriate context for considering significance of action is local, as opposed to national or worldwide.

With respect to intensity of the impacts of the proposed restoration action, the NEPA regulations suggest consideration of ten factors:

- likely impacts of the proposed project,
- likely effects of the project on public health and safety,
- unique characteristics of the geographic area in which the project is to be implemented,
- controversial aspects of the project or its likely effects,
- degree to which possible effects of implementing the project are highly uncertain or involve unknown risks,
- precedential effect of the project on future actions that may significantly affect the human environment,
- possible significance of cumulative impacts from implementing this and other similar projects,

- effects of the project on National Historic Places, or likely impacts to significant cultural, scientific or historic resources,
- degree to which the project may adversely affect endangered or threatened species or their critical habitat, and
- likely violations of environmental protection laws.

40 C.F.R. § 1508.27. These factors, along with the federal Trustees' preliminary conclusions concerning the likely significance of impacts of the proposed restoration action, are discussed in detail below.

7.1 LIKELY IMPACTS OF THE PREFERRED ALTERNATIVE (OYSTER REEF CREATION/ RESTORATION)

7.1.1 Nature of Likely Impacts

The proposed restoration action for injuries to natural resources at the Macalloy Corporation Site consists of oyster reef creation. Oyster reef creation would generally benefit estuarine resources within coastal South Carolina. The proposed project would provide increased nursery, foraging, and cover habitat for estuarine species that depend on oyster reefs for at least a portion of their life history. The filtering action of oysters that are expected to settle and grow on the planted oyster cultch would improve water quality by removing excess nutrients and particulate matter that can contribute to high turbidity and low dissolved oxygen.

7.1.2 Effects on public health and safety

The Trustees do not expect oyster reef creation to have any appreciable adverse impacts on public health and safety. The created oyster reefs would not present any unique physical hazards to humans (i.e., none other than the same minor cuts or abrasions that might be expected from encountering similar substrate on a natural oyster reef). The oyster reef creation project would be purposely located in areas that are closed to shellfish harvesting for human consumption, thereby limiting the likelihood of human contact with the planted cultch. No pollution or toxic discharges would be associated with the planting of oyster shell for this project.

7.1.3 Unique characteristics of the geographic area

The proposed oyster reef creation project would be conducted in unvegetated, intertidal mud and sand flats that have little or no hard substrate. These types of habitats, while important in their own right, are more common in the Charleston Harbor estuary than intertidal oyster reefs, which have diminished considerably over the past several years. Therefore, no unique or rare habitat would be destroyed as a result of the proposed restoration activities.

7.1.4 Controversial aspects of the project or its effects

The Trustees do not expect any controversy to arise in connection with the proposed projects. Current governmental policy generally supports the restoration and enhancement of oyster reef habitat in coastal areas. The Trustees anticipate that the citizens of South Carolina would support this oyster reef creation project, as well.

7.1.5 Uncertain effects or unknown risks

The primary uncertainties associated with implementing the proposed restoration actions are 1) the availability and cost of shell at the time of project implementation, and 2) the successful recruitment of oyster spat to the shell. The proposed budget takes into consideration the likely increase in costs by the time the project is implemented. Careful site selection and shell planting should maximize the likelihood of successful spat recruitment subsequent reef development.

7.1.6 Precedential effects of implementing the project

The SCDNR has extensive experience in implementing oyster reef restoration and creation projects in South Carolina. The proposed restoration actions, therefore, set no precedents for future actions of a type that would significantly affect the quality of the human environment.

7.1.7 Possible, significant cumulative impacts

Project effects will be cumulative in the sense that the creation of oyster reef habitat will provide increased beneficial resource service flows into the future. The Trustees, however, know of no impacts to the environment to which the proposed restoration actions would contribute that, cumulatively, would constitute a significant adverse impact on the quality of the human environment. Further, the actions proposed in this RCDP/EA are intended to restore habitat services to offset the natural resource loss of comparable habitat services attributable to the Macalloy Corporation Site. The restoration of these services is designed to make the public whole, i.e. to compensate for injuries to natural resources.

7.1.8 Effects on National Historic Sites or nationally significant cultural, scientific or historic resources

The site(s) chosen for oyster reef restoration will be purposely selected to avoid National Historic Sites, as well as nationally significant cultural, scientific and historic resources. Therefore, the Trustees believe the proposed restoration actions will not affect any of these sites or resources.

7.1.9 Effects on endangered or threatened species

The Trustees know of no direct or indirect impacts of the proposed restoration actions on threatened or endangered species, or their designated critical habitats. The general locale where the restoration actions would be sited is not critical habitat for any listed species.

7.1.10 Violation of environmental protection laws

The proposed restoration actions do not require nor do the Trustees anticipate any violation of federal, state or local laws, designed to protect the environment incident to or as a consequence of the implementation of either of the proposed actions. The restoration actions proposed can be implemented in compliance with all applicable environmental laws.

7.2 Preliminary Conclusion And Finding of No Significant Impact on the Quality of the Human Environment

Under 40 C.F.R. §§ 1501.5 and 1501.6 for the purposes of this NEPA analysis, NOAA is the lead agency and USFWS is a cooperating agency. Based on the analysis in this Section and the other information and analyses included throughout the RCDP/EA as part of the environmental review process for the proposed restoration actions, the federal Trustees conclude that the oyster reef creation project, if implemented, will not result in any significant adverse impacts on the quality of the human environment. The proposed restoration projects would provide habitat that would be beneficial to the biological environment found within the proposed project areas. The proposed restoration projects will not impact the cultural or human environment except for providing increased oyster reef habitat for certain recreationally and commercially important finfish and other aquatic organisms. Pending the public review and comment process, significant impacts are not expected from the Proposed Restoration Alternative; thus, no environmental impact statement (EIS) is expected to be required for the oyster reef creation project outlined herein.

Pending the public review and comment process, a Finding of No Significant Impact (FONSI) based upon this EA, would fulfill and conclude all requirements for compliance with NEPA by the federal Trustees.

7.3 Endangered and Threatened Species

The Endangered Species Act (ESA) of 1973 instructs federal agencies to carry out programs for the conservation of endangered and threatened species and their critical habitats and to conserve the ecosystems upon which these species depend. Numerous endangered and threatened species are seasonal or occasional visitors to the Charleston Harbor area coastal ecosystem.

Endangered and threatened species known to occur in the Charleston Harbor estuary are listed in Table 7.1 (USFWS 2005, Sandifer et al. 1980). Many of these species, including the wood stork (*Mycteria americana*), piping plover (*Charadrius melodus*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempi*), and loggerhead sea turtle (*Caretta caretta*) have been documented in or are believed to utilize the Charleston Harbor estuary. Most species would be present in the estuary incident to migration through the area. The estuary's habitats provide general support for any threatened and endangered species migrating through or utilizing these communities. Because the proposed project will provide beneficial habitat, no adverse impacts are expected on any listed endangered or threatened species found within the project area. Designated Critical Habitat for the piping plover within Charleston County is located outside the area of the proposed restoration project.

The ESA directs all federal agencies to conserve endangered and threatened species and their habitats to the extent their authority allows. Protection of wildlife and preservation of habitat are central objectives in this effort. Under the ESA, the Department of Commerce (through NOAA) and the Department of the Interior (through USFWS) publish lists of endangered and threatened species. Section 7 of the Act requires federal agencies to consult with these agencies to minimize the effects of federal actions on these listed species. The restoration actions described in this RCDP/EA are not expected to adversely impact any threatened or endangered species or critical habitats. The actions would create or enhance habitats beneficial to supporting ecosystems for any such species.

Table 7.1 Federal and State Endangered or Threatened Species in the Charleston Harbor Area

Common Name	Scientific Name	Status
Mammals		
West Indian manatee	*Trichechus manatus*	FE, SE
Birds		
Bachman's warbler	*Vermivora bachmanii*	FE, ST
Kirtland's warbler	*Dendroica kirtlandii*	FE, ST
Piping plover	*Charadruis melodus*	FT, Critical Habitat
Red-cockaded woodpecker	*Picoides borealis*	FE, ST
Bald eagle	*Haliaeetus leucocephalus*	ST
Wood stork	*Mycteria americana*	FE, SE
Reptiles and Amphibians		
Green sea turtle	*Chelonia mydas*	FT
Leatherback turtle	*Dermochelys coriacea*	FE, SE
Loggerhead sea turtle	*Caretta caretta*	FT, ST

Common Name	Scientific Name	Status
Kemp's ridley turtle	*Lepidochelys kempii*	FE, SE
Flatwoods salamander	*Ambystoma cingulatur*	FR
Fish		
Shortnose sturgeon	*Acipenser brevirostrum*	FE, SE
Plants		
Sea-beach amaranth	*Amaranthus pumilus*	FT
Canby's dropwort	*Oxypolis canbyi*	FE
Pondberry	*Lindera melissifolia*	FE
Chaff-seed	*Schwalbea americana*	FE

7.4 ESSENTIAL FISH HABITAT

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265) in 1996 that established procedures for identifying Essential Fish Habitat (EFH) and required interagency coordination to further the conservation of federally managed fisheries. Rules published by the NOAA Fisheries (50 C.F.R. §§ 600.805 - 600.930) specify that any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity which could adversely affect EFH is subject to the consultation provisions of the above-mentioned act and identifies consultation requirements. This section was prepared to meet these requirements.

The Southeast Atlantic Fishery Management Council has identified the proposed project area as Essential Fish Habitat (EFH) for shrimp (Penaeid sp.), red drum (*Sciaenops ocellatus*), and the snapper grouper complex.

7.4.1 Effect on Essential Fish Habitat

Completion of these projects represents a significant overall gain in the ecology of the Charleston Harbor estuary. These projects will increase and enhance essential fish habitats, which will likely increase fisheries populations within the project area.

7.4.2 The Federal Agency View Regarding the Effects of the Action on EFH

It is the opinion of the federal trustees that the project as proposed will not have a significant adverse effect upon EFH. The overall effects of the restoration projects will benefit managed species and will provide an overall increase in oyster reef habitat.

7.4.3 Conclusion of Effects on EFH

These projects will enhance and create essential fish habitats, and likely increase fish populations within the project area. Therefore, no mitigation is necessary.

The Trustees have initially determined that the proposed restoration actions will have no adverse effect on any EFH designated or pending designation under the Act.

8 COMPLIANCE WITH OTHER KEY FEDERAL STATUTES, REGULATIONS AND POLICIES

8.1 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. The Army Corps of Engineers (USACE) administers the program. In general, restoration projects, which move significant amounts of material into or out of waters or wetlands require 404 permits. A CWA 404 permit will be obtained, if required, in order to implement any restoration action selected in this RCDP/EA.

8.2 RIVERS AND HARBORS ACT, 33 U.S.C. § 401 *ET SEQ.*

The Rivers and Harbors Act regulate development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the Corps with authority to regulate discharges of fill and other materials into such waters. Restoration actions that must comply with the substantive requirements of Section 404 must also comply with the substantive requirements of Section 10. Although not anticipated for the preferred restoration project, any such permit would be obtained, as required, in order to implement any restoration action selected in this RCDP/EA.

8.3 COASTAL ZONE MANAGEMENT ACT (CZMA), 16 U.S.C. § 1451 *ET SEQ.*, 15 C.F.R. PART 923

The goal of the CZMA is to encourage states to preserve, protect, develop, and, where possible, restore and enhance the nation's coastal resources. Under Section 1456 of the CZMA, restoration actions undertaken or authorized by federal agencies within a state's coastal zone are required to comply, to the maximum extent practicable, with the enforceable policies of a state's federally approved Coastal Zone Management Program. NOAA and the USFWS found the restoration actions identified in this RCDP/EA to be consistent with the South Carolina Zone Management Program, and a determination of consistency will be submitted to the appropriate state agencies for review in parallel to the release of the RCDP/EA.

8.4 FISH AND WILDLIFE CONSERVATION ACT, 16 U.S.C. § 2901 *ET SEQ.*

The restoration actions described herein will encourage the conservation of non-game fish and wildlife.

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

The FWCA requires that federal agencies consult with USFWS, NOAA Fisheries, and state wildlife agencies regarding 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 utilizing these aquatic environments. Coordination is taking place by and between NOAA Fisheries, the USFWS and SCDNR, the appropriate state wildlife agency. This coordination is also incorporated into compliance processes used to address the requirements of other applicable statutes, such as Section 404 of the CWA. The restoration actions described herein will have a positive effect on fish and wildlife resources.

8.6 Marine Mammal Protection Act, 16 U.S.C. § 1361 *et seq.*

The Marine Mammal Protection Act provides for the long-term management of 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 restoration actions described in this RCDP/EA will not result in any adverse effect to marine mammals.

8.7 Migratory Bird Conservation Act, 16 U.S.C. § 715 *et seq.*

The proposed restoration action will have no adverse effect on migratory birds that are likely to benefit from the establishment of new oyster reef habitat.

8.8 National Historic Preservation Act, 16 U.S.C. § 470 *et seq.*

The Trustees will purposely select the oyster reef creation site(s) to avoid any known cultural or historic resources within or in the vicinity of the Charleston Harbor estuary.

8.9 Information Quality Guidelines issued pursuant to Public Law 106-554

Information disseminated by federal agencies to the public after October 1, 2002, is subject to information quality guidelines developed by each agency pursuant to Section 515 of Public Law 106-554 that are intended to ensure and maximize the quality of such information (i.e., the objectivity, utility and integrity of such information). The RCDP/EA, upon release as a draft document, was identified as an information product covered by information quality guidelines established by NOAA and DOI for this purpose. The information contained herein complies with applicable guidelines.

8.10 Executive Order 12898 (59 Fed. Reg. 7629) - Environmental Justice

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 is probably no low income or ethnic minority communities that would be adversely affected by the preferred restoration project identified herein.

8.11 Executive Order Number 11514 (35 Fed. Reg. 4247) - Protection and Enhancement of Environmental Quality

An Environmental Assessment is integrated within this RCDP/EA. Environmental analyses and coordination have taken place as required by NEPA.

8.12 Executive Order Number 11990 (42 Fed. Reg. 26,961) - Protection of Wetlands

The selected restoration actions will not result in adverse effects on wetlands or the services they provide, but rather will provide for the enhancement and protection of wetlands and wetland services.

8.13 Executive Order Number 12962 (60 Fed. Reg. 30,769) - Recreational Fisheries

The selected restoration actions will not result in adverse effects on recreational fisheries but will help ensure the enhancement and protection of such fisheries.

9 LITERATURE CITED

Bahr, L.M. and W.P. Lanier. 1981. The ecology of intertidal oyster reefs of the South Atlantic Coast: a community profile. U. S. Fish Wildl. Serv. Program FWS/OBS/81/15, 105pp.

BDY. 2004. Ashley-Cooper River Basin Salt Marsh Restoration Site Selection. Prepared by Breedlove, Dennis, Young & Associates for Macalloy Corporation, September 30, 2004.

Bradley, P.M., B.Kjerfve and J.T. Morris. 1990. Rediversion salinity change in the Cooper River, South Carolina: ecological implications. Estuaries. 13(4) 3763-379.

Burton, G. Allen. 1992. Sediment Toxicity Assessment. Lewis Publishers, Inc., Chelsea, MI.

Chapman, P.M., M. Cano, A.T. Fritz, C. Gaudet, C.A. Menzie, M. Sprenger, W.A. Stubblefield. 1997. Workgroup summary report on contaminated site cleanup decisions. In: Ecological Risk Assessments of Contaminated Sediments. Ed., C.G., Ingersoll, T. Dillon, G.R. Biddinger. SETAC Press, Pensacola, FL.

Crane, Mark and M. C. Newman. 2000. What Level Of Effect Is A No Observed Effect? Environ. Toxicol. and Chem. 19(2):516–519

EnRisk Management Solutions. 2000. Preliminary Ecological Risk Evaluation for the Macalloy Corporation Site, Charleston, South Carolina. Report prepared by EnRisk Management Solutions, Mt. Pleasant, SC for U.S. Environmental Protection Agency Region 4, July 2000.

EnSafe Inc. 2002. Final Phase II Remedial Investigation Report, Prepared for Macalloy Corporation by EnSafe Inc., Memphis, TN and BDY BreedLove, Dennis, Young & Associates, (TN) Inc., Franklin, TN, January 28, 2002.

Fulton, M., P. Key, K. Chung, S. Lund, E. Wirth, G. Scott, T. Chandler, P. Maier, R. Van Dolah, J. Jones, D. Conners, R. Lee and T. Snell. 2000. An Evaluation of Sediments from Contaminated Estuarine Sites (Koppers, Diesel and Shipyard Creeks) Using laboratory Toxicity Testing and Field Ecotoxicological Assessment Methodologies. Submitted to US Environmental Protection Agency, NHEE Laboratory, Gulf Breeze, FL.

Holland, A.F., G.H.M. Riekerk, S.B. Lerberg, L.E. Zimmerman, D.M. Sanger, T.D. Mathews, G.I. Scott, M.H. Fulton, B.C. Thompson, J.W. Daugomah, J.C. DeVane, K.M. Beck, A.R. Diaz. 1996. The Tidal Creek Project Interim Report. Submitted to J. Heyward Robinson, Project Director, Charleston Harbor Project.

Ingersoll, C.G., T. Dillon, G.R. Biddinger. 1997. Ecological Risk Assessments of Contaminated Sediments. SETAC Press, Pensacola, FL.

Krantzberg, G. (1985). "The influence of bioturbation on physical, chemical and biological parameters in aquatic environments: A review," *Environ. Pollut. (Ser. A)* 39, 99-122.

Lee, H., II, and Swartz, R. (1980). "Biological processes affecting the distribution of pollutants in marine sediments. I. Biodeposition and bioturbation," *Contamination and sediment*s. R. A. Baker, ed., Vol. 2, Ann Arbor Science, Ann Arbor, MI.

Long, E.R., D.D. MacDonald, S.L. Smith, F.D. Calder. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environmental Management. Vol. 19, No. 1, pp. 81-97.

Long, E.R., L.J. Field and D.D. MacDonald. 1998. Predicting toxicity in marine sediments with numerical sediment quality guidelines. Environ. Toxicol. and Chem. 17:714-727.

Long, E.R. and D.D. MacDonald. 1998. Recommended uses of empirically derived, sediment quality guidelines for marine and estuarine ecosystems. Human and Ecol. Risk Assem. 4:1019-1039.

MacDonald, D.D. 1994. Approach to the assessment of sediment quality in Florida Coastal Waters. Report to FL Department of Environmental Protection, November, 1994.

Matisoff, G. (1995). "Effects of bioturbation on solute and particle transport in sediments." *Metal contaminated aquatic sediment*s. H. E. Allen, ed., Ann Arbor Press, Chelsea, MI, 201-272.

McCall, P. L., and Tevesz, M. J. S. (1982). "The effects of benthos on physical properties of freshwater sediments." *Animal-sediment relations: The biogenic alteration of sediment*s. P. L. McCall and M. J. S. Tevesz, ed., Plenum Press, New York, 105-176.

NOAA. 2000. Habitat Equivalency Analysis: An Overview, Damage Assessment and Restoration Program, National Oceanic and Atmospheric Administration, Department of Commerce, 23 pp. http://www.darp.noaa.gov/pdf/heaoverv.pdf

Ridolifi Inc. 2003. Habitat Restoration Opportunities In The Charleston Harbor, SC, Area. Prepared by Ridolifi Inc. for NOAA, November 2003.

Sandifer, P.A., J.V. Miglarese, D.R. Calder, J.J. Manzi and L.A. Barclay. 1980. Ecological characterization of the sea island coastal region of South Carolina and Georgia. Volume III: Biological Features of the Characterization area. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-79/42, December 1980.

South Carolina Department of Health and Environmental Control/Office Coastal Resource Management (SCDHEC/ OCRM). 2000. Charleston Area Special Area Management Plan. NOAA Award # NA86OZ0203. http://www.scdhec.net/environment/ocrm/pubs/docs/SAMP/CHP/CHP.pdf

U.S. Environmental Protection Agency (USEPA). 2002. Final Record of Decision, Macalloy Corporation. Charleston, South Carolina, Prepared by USEPA, Region 4, Atlanta, Georgia, August 2002.

U.S. Environmental Protection Agency (USEPA). 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. EPA 540-R-97-006, Office of Solid Wastes and Emergency Response, Washington, D.C., July 1997.

U.S. Environmental Protection Agency (USEPA). 1992. Sediment Classification Methods Compendium. EPA 823-R-92-006.

U.S. Fish & Wildlife Service. 2005. Threatened and Endangered Species Homepage [http://ecos.fws.gov/tess_public/TESSSpeciesReport].

10 APPENDICES

10.1 STATEMENT OF WORK (SOW) FOR INTERTIDAL OYSTER RESTORATION PROPOSAL FOR THE MACALLOY RESTORATION PROJECT

STATEMENT OF WORK (SOW)
FOR

INTERTIDAL OYSTER RESTORATION PROPOSAL
FOR THE MACALLOY RESTORATION PROJECT

CHARLESTON HARBOR, SC

9 October, 2008

1.0 Introduction and Overview

This document provides the Statement of Work (SOW) developed by the South Carolina Department of Natural Resources (SCDNR) to establish living intertidal oyster (*Crassostrea virginica*) habitat as mitigation for deleterious substances released from the Macalloy Corporation Site in Charleston Harbor, SC. Large scale intertidal oyster restoration is proposed for shoreline areas selected by SCDNR in estuarine waters of the Charleston Harbor watershed. Restored shellfish grounds, closed to public harvesting, are designed to provide habitat for other species and renew public trust resources.

Funding for this restoration initiative is provided by an agreement entered into by the SC Office of the Governor (SCOG), the SC Department of Health and Environmental Control (SCDHEC), the SC Department of Natural Resources (SCDNR), the National Oceanic and Atmospheric Administration (NOAA) and the United States Fish and Wildlife Service (USFWS) on behalf of the United States Department of the Interior (USDOI) collectively, “the Trustees.” The Trustees have been provided the authority to make the public whole for ecological and groundwater losses suffered as a result of contaminant releases at the Macalloy Corporation site and provide funds necessary to construct and monitor habitat that will increase ecological services.

2.0 Background

Eastern oysters, *Crassostrea virginica*, once valued primarily as a renewable resource are now recognized more widely as ecosystem engineers (Luckenbach et al. 1999, Gutiérrez et al. 2003, ASMFC 2007) that create complex habitats utilized by numerous finfish, invertebrates, wading birds and mammals (Lehnert and Allen 2002, Peterson et al. 2003). Oysters improve water clarity and quality as they filter large quantities of water and transfer nutrients, particularly nitrogen from the water column to the benthos (Dame 1999, Dame et al. 2001, Porter et al. 2004). Declines in oyster populations are associated with adverse effects to other species, reduced water quality and ecosystem shifts (Luckenbach et al. 1999, Dame et al. 2002). In the southeastern United States, in contrast to much of its range, *C. virginica* occurs primarily in shallow water and more typically in the intertidal zone (Bahr and Lanier 1981, Burrell 1986). Unlike subtidal oysters, intertidal populations form natural breakwaters that protect shorelines and fringing marshes (Meyer et al. 1997, Piazza et al. 2005).

The South Atlantic Fishery Management Council (SAFMC) has designated estuarine marshes, oyster reefs, associated estuarine water columns, intertidal flats and submerged aquatic vegetation (SAV) as essential fish habitat (EFH). Federally managed species that depend on one or more of these designated habitats include red drum and penaeid shrimp. These marine animals and countless others utilize their interrelationships with reef and other habitats for survival during various life stages. Other species of commercial, recreational and ecological concern include Atlantic croaker, spot, Atlantic menhaden, blue crab, killifish and striped mullet. In turn, these fish provide prey for Spanish and king mackerel, cobia, and others managed by the SAFMC and for migratory species such as sharks and billfishes managed by NOAA (ASMFC 2007). In South Carolina, oyster reefs generate biodiversity and are identified as critical habitats of concern in both the State Conservation Plan and DNR's Comprehensive Wildlife Conservation Strategy.

Intertidal oyster reef restoration and enhancement has occurred in SC for over 100 years as commercial fishermen returned shucked oyster shells from canneries and raw shuck houses during the summer months to create new beds for harvesting in fall, winter and spring. SC's last oyster cannery closed in 1986 and the industry has since transformed into shell stock harvests for local oyster roasts. Because of the demise of the canning and raw shuck industries, considerably less shell cultch planting has occurred over the last twenty years. Practically all of SC's oyster resource is intertidal—three dimensional multi-generational clusters of vertically growing oysters. Total surface area created by intertidal oyster reefs is approximately fifty times that of a non-oyster intertidal mud bottom (Bahr and Lanier 1981).

Charleston Harbor's watershed includes the Ashley River, Cooper River, Wando River and smaller creeks as well as Charleston Harbor itself (Figure 1). A large part of the watershed is classified "prohibited" or "restricted" to shellfish gathering, thus assuring that constructed reefs will be undisturbed by commercial and recreational harvesting. The watershed is urbanized and some of the industrialized areas have been subject to long-term fecal coliform pollution and habitat destruction. Although some viable oyster habitat remains within Charleston Harbor, boat wakes and environmental perturbations, such as port expansion, residential and industrial development and changes in salinity due to massive river diversions in 1941 and 1985 have diminished many productive oyster grounds (Bradley, Kjerfve and Morris 1990).

3.0. Restoration Objectives

This shellfish restoration initiative will consist of a number of large scale plantings of quarantined Gulf Coast oyster shells (and possibly whelk (*Busycon spp)* and fossil oyster shells) placed on selected intertidal bottom areas 3”- 4” in thickness over a three year period (see Section 6.0 for details on acreage of areas to be restored). Shells will serve as cultch or substrate to attract free swimming larvae that will settle on the shells and grow from spat into juvenile oysters. Successfully restored reefs should continue growing vertically into three dimensional intertidal oyster habitat. Frequent monitoring and adaptive management strategies are expected to enhance reef propagation.

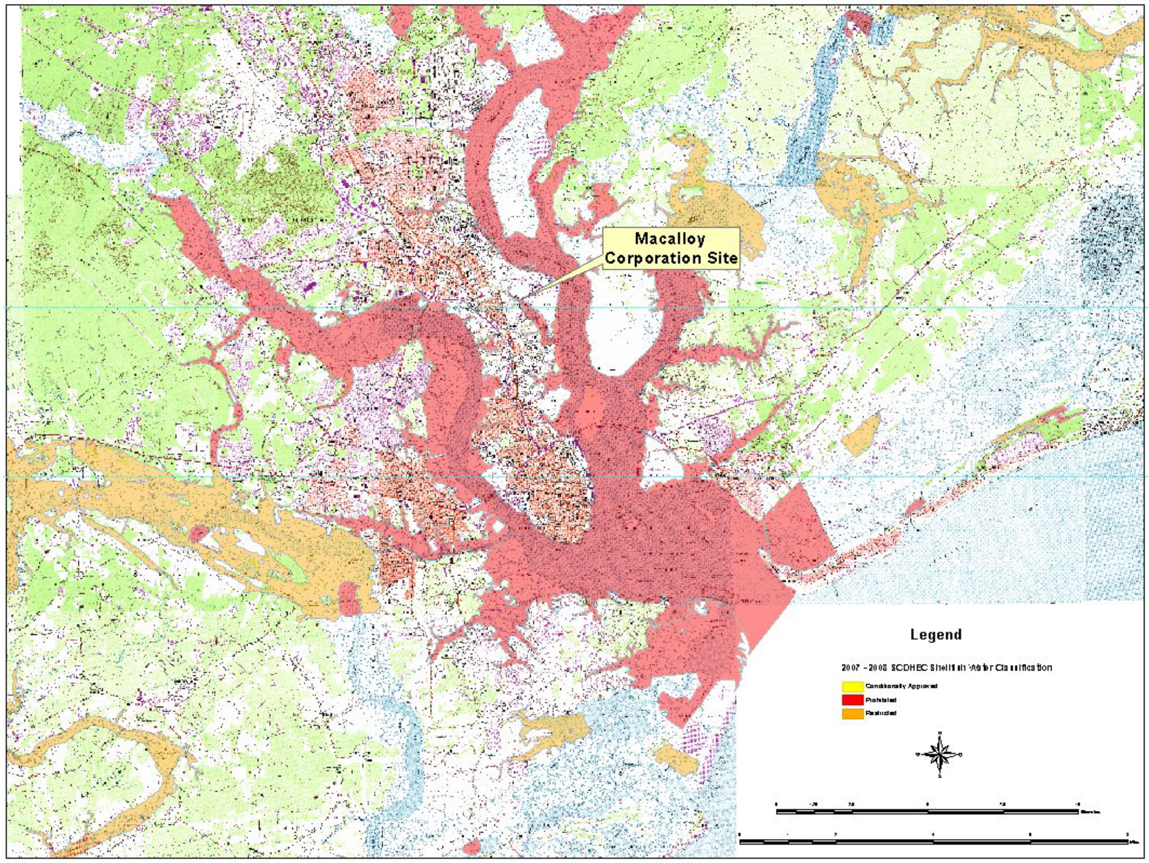

Figure1. Charleston Harbor's watershed consists of shellfish waters classified prohibited and restricted by SCDHEC. Restoration sites will be located within these closed harvesting areas.

The state's extensive intertidal oyster resource, unlike mid-Atlantic regions such as the Chesapeake Bay, generates ubiquitous oyster larvae in estuarine waters throughout most of the year with greatest quantities occurring from spring through fall. Ideally, planting operations should be scheduled to begin in May to capture this optimum oyster spatfall. The primary limiting factor for oyster propagation in SC is cultch as most larvae die for lack of locating a suitable surface to attach. Freshets or extreme environmental conditions, however, may periodically diminish successful spatfalls in certain areas.

3.1 Site Selection and Planting

Site selection consists of identifying intertidal bottom firm enough to sustain oyster propagation and measuring the proposed cultch footprint with a Trimble® XP Pro GPS. Data from the GPS is transferred into the DNR's Geographic Information System (GIS) and maps are produced on quarter meter resolution multi-spectral digital imagery acquired by DNR's remote sensing oyster mapping project. The GIS calculates the footprint's area and the intertidal shoreline area is staked with 1" diameter PVC poles before planting shells at high tide. Approximately 700-1,000 U.S. bushels of oyster shells are floated off a barge during a tidal planting cycle within the designated area by high pressure water cannon. Raking or dispersal of shells is sometimes required after planting to obtain desired coverage and thickness (Figures 2 and 3).

Figures 2. and 3. Quarantined Gulf Coast oyster shells are floated off a contractor's barge (left) onto a previously designated restoration area using high pressure water cannon at high tide. Results of intertidal planting after PVC poles have been removed are shown (right).

4.0 Project Monitoring

Critical to the success of shellfish habitat restoration and enhancement is the monitoring process—an integral component of each restored habitat's architecture. Beginning with site selection, monitoring incorporates larval recruitment, oyster growth and footprint measurements (before and during grow out) to increase the potential for success. Adaptive management may consist of planting more shells at specific growth intervals or conducting *in situ* cultivation throughout the maturation process.

4.1. *Site evaluation* - Monitoring begins by evaluating a number of potential restoration sites, assessing sediment type and shoreline characteristics (composition, slope, intertidal elevation and area, shell matrix depth and bottom firmness). Historical cartographic data from 1890-91 and 1980s SC oyster surveys will be used to identify shell matrices of earlier populations. Hydrographic data and locations of adjacent oyster habitat are incorporated into the DNR's GIS. Boat wake perturbations and shoreline susceptibility to siltation from non-point source runoff is evaluated at each location. The prospective restoration site must be accessible to planting barges during high tide. Finally, the site is digitally archived at designated GPS points. Based on this information, optimum planting thickness (which may be greater or less than 3"– 4") is calculated for the site's footprint and each restoration location is prioritized.

4.2 *Footprint demarcation* – Immediately before cultch planting the intertidal perimeter is outlined at low tide with 1" diameter PVC poles approximately 100' apart to facilitate shell placement when grounds are underwater during planting. Loaded barges with 700 – 1,000 U.S. bushels of quarantined shells move over the planting area during high tide and a water cannon is used to float the shells overboard (Figure 2). Oyster shell cultch is quarantined for a minimum of three months to reduce the risk of importing shellfish diseases as well as exotic flora and fauna. Several barge loads may be required per restoration site. Following construction, a footprint of the actual planted area is recorded by walking the shell perimeter with a GPS unit and transferring into the DNR's GIS (Figure 3). Digital photographs, tagged by GPS point and other metadata, are obtained throughout the footprint. The restoration footprint is revisited at semiannual intervals and recommendations for maintenance planting (i.e. adding more cultch material) are mapped by walking small perimeters of GPS footprints within the interior of the original restoration site. An evaluation of the site is made regarding its long-term grow out potential during these visits.

Figure 4. A Trimble® XP Pro GPS is used to determine the perimeter boundaries of each prospective restoration site prior to and following planting. This example of a two year old restored habitat in Two Sisters Creek, ACE Basin, SC was assessed to determine the area of vertical growth. Polygons are uploaded into ArcView and illustrated on GIS maps.

4.3 *Monitor oyster growth and recruitment* – Plastic shell trays filled with oyster shells (or identical cultch) are deployed in early spring to evaluate spat recruitment and oyster growth. Trays are retrieved nine months to one year later and oysters are counted and measured. Data is compared with other recruitment sites statewide and historical long-term trends. Tray recruitment is further compared to spat recruitment in large-scale restoration plantings to determine whether the site is larval-limited or whether other factors are affecting recruitment success.

4.4 *Document post-planting shoreline changes* – Accretion or erosion of adjacent *Spartina* is measured by benchmarked PVC stakes at the edge of the marsh (adapted from Anderson and Yianopoulos 2003, Hodges et al. 2006). Sediment accretion on and behind the reef is documented with digital photography and benchmark stakes. Digital photography documentation is collected by tagging photos to original sites established in 4.1.

4.5 *Determine the extent of oyster population development* – Samples are collected from the restored reef and density and size of individual oysters are measured. "Strata" (characteristic oyster density) within the footprint is described and the approximate number of bushels of live oysters per area is calculated based on natural reef strata coefficients. Site success is evaluated by the percentage of original footprint remaining (or expanding) along the shoreline, vertical oyster populations, strata types, abundance, size and distribution of oysters and shoreline stabilization after a three year grow out period.

4.6 *Cultivating the habitat for additional restoration* – After the second year of grow out, each restoration site will be evaluated to determine the restored area's capacity to allow removal of high density seed oysters and establish additional habitat in the immediate area. Transplanting seed oysters will be contracted and monitored as necessary following site selection protocols similar to those described above.

4.7. *Restoration Success Criteria* – For the purposes of meeting the compensatory requirements of the Natural Resource Damage Assessment (NRDA) process, the intertidal oyster restoration project will use the following success criteria:

(1) Acreage of vertical oysters will be ≥ 70% of the original planted footprint at the end of three years.

(2) Density, mean and maximum size of oysters on restored reefs will be within 1 SD of natural populations after three years.

(3) Population parameters of the restored reef will meet or exceed "F^1" strata characteristics (approximately 1,926 bushels of live oysters per acre) based on DNR's state-wide intertidal resource assessment of natural populations conducted in the 1980s.

(4) Size distributions after three years will include at least 30% recruits (<25mm) to insure continuing reef propagation.

Other variables, including documentation of shoreline stabilization or erosion and sedimentation will be measured and reported for informational purposes only. These criteria are based on assessments of large-scale plantings over the last seven years and represent realistic goals for oyster habitat restoration. Natural oyster reefs have been developing for decades and restored reefs cannot be expected to resemble wild stock reefs within a six-year period. However, achievement of the above benchmarks should assure that self-sustaining populations have been established.

5.0 Laws, Regulations and Permits

SCDNR maintains a positive working relationship with the state's coastal zone agency (SCDHEC-OCRM) and the US Army Corps of Engineers. DNR is currently working with USACE, Charleston District on a hard clam restoration project in the Atlantic Intracoastal Waterway (AIWW). In addition, some DNR restoration and enhancement work is exempt from SCDHEC-OCRM permitting requirements as stated in OCRM regulation 30-5(A)(2): "Hunting, erecting duckblinds, fishing, shellfishing and trapping when and where otherwise permitted by law: the conservation, replenishment and research activities of State Agencies and educational institutions; or boating or other recreational recreation provided that such activities cause no material harm to flora, fauna, physical, or aesthetic resources of the area."

USACE Nationwide Wetland Permit 27 covers construction of shellfish habitat restoration activities including shellfish seeding over unvegetated bottoms conducted to restore shellfish populations. Based on professional working relationships and agreements with state and federal permitting agencies, DNR does not foresee problems obtaining permits or permission for the proposed restoration initiatives.

6.0 Intertidal Oyster Habitat Construction Logistics

Oyster habitat construction will occur over a three year period in Charleston Harbor (Figure 1) deploying 48,045 U.S. bushels of shells and creating 1.75 acres the first year, 1.5 acres the second and 1.25 acres the third year at several locations. At the end of three years a minimum of 4.0 acres is expected to be constructed taking into consideration attrition of approximately 0.5 acres. Maintenance planting conducted during years two through six will consist of an additional 5,338 bushels to insure footprint integrity. Approximately 53 tractor trailer loads of quarantined Gulf Coast oyster shells or other alternative cultch will be shipped to an embarkation point near Charleston Harbor and loaded onto a barge. DNR will supervise contractual planting operations during the three-year period and perform maintenance with its push boat and barge during years two through six. Gulf Coast oyster shell cultch delivered from NC ranged from $1.83 to $2.11 per bushel in September, 2007.

6.1 *Oyster cultch caveats* - Availability of Gulf Coast oyster shells and whelk shells for restoration is becoming increasingly scarce as most east coast states prefer to use natural cultch to restore shellfish habitat. Additionally, oyster shells are purchased as decoration in construction projects, fill for drainage and used to build pervious driveways. Competition for dwindling shell supplies may impact this project if shells must be purchased from Gulf Coast stockpiles costing between $2.46 and $3.37 per bushel delivered. Higher shell costs could reduce the size of the restoration areas by a commensurate percentage.

DNR is currently examining the feasibility of several alternative cultch materials in small deployments, one of which is fossilized shell available in Florida that, although heavier and slightly more expensive, has performed well in certain high energy environments. Based on economics, aesthetics and other issues, fossilized shell may be used for habitat restoration in this restoration initiative.

Project construction and associated monitoring is expected to be conducted over a period of three years, with subsequent monitoring and shellfish cultivation (seed planting, thinning clusters) continuing for an additional three years. Restoration sites should remain closed to shellfish harvesting for twenty years or more, however some sites may require cultivation for continued propagation and be utilized as a seed source to construct additional shellfish habitat.

7.0 Deliverables

Restoration sites will be monitored immediately following planting and seasonally for the first year following habitat construction. Annual reports will be submitted to the Trustees within 60 days after the anniversary date of the year's last footprint deployment. If the success criteria are achieved at the end of three years, monitoring will be discontinued. If the success criteria are not achieved at the end of three years, appropriate corrective action (i.e. maintenance planting) will be taken, and annual monitoring will be continued, following consultation with and concurrence by the Trustees until the success criteria are met or until a maximum of five years of post-construction monitoring has been completed, whichever comes first.

8.0 References

Anderson, W.D. and G.M. Yianopoulos. 2003. Final Report to NOAA-RC, Intertidal oyster and clam bed restoration in the ACE Basin, South Carolina using recycled oyster shell, hatchery raised clam seed, and other cultch material, Project Period, July 2000 – September 2002, 18pp.

ASMFC, 2007. The Importance of habitat created by shellfish and shell beds along the Atlantic Coast of the U.S., prepared by L.D. Coen, and R. Grizzle, with contributions by J. Lowery and K.T. Paynter, Jr., 108pp.

Bahr, L.M. and W.P. Lanier. 1981. The ecology of intertidal oyster reefs of the South Atlantic Coast: a community profile. U. S. Fish Wildl. Serv. Program FWS/OBS/ -81/15, 105pp.

Bradley, P.M., B.Kjerfve and J.T. Morris. 1990. Rediversion salinity change in the Cooper River, South Carolina: ecological implications. Estuaries. 13(4) 3763-379.

Burrell, V.G. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (South Atlantic)--American oyster. U.S. Fish Wildl. Serv. Biological Report 82 (11.57), U.S. Army Corps of Engineers TR EL-82-4, 17 pp.

Dame, R. F. 1999. Oyster reefs as components in estuarine nutrient cycling: Incidental or controlling? Pages 267–280 in M.W. Luckenbach, R. Mann, and J. A. Wesson (Eds), Oyster reef habitat restoration: a synopsis and synthesis of approaches. Virginia Institute of Marine Science, Gloucester Point.

Dame, R., D. Bushek and T. Prins. 2001. Benthic suspension feeders as determinants of ecosystem structure and function in shallow coastal waters. Pp. 11-37 in K. Reise (Ed), Ecological Comparisons of Sedimentary Shores. Ecological Studies, Vol. 151, Springer-Verlag Berlin Heidelberg, Germany, 384 pp.

Dame R., D Bushek, D. Allen, A. Lewitus, D. Edwards, E. Koepfler and L. Gregory. 2002. Ecosystem response to bivalve density reduction: management implications. Aquatic Ecology, 36 (1): 51–65. Springer Netherlands.

Gutiérrez, J.L., C.G. Jones, D.L. Strayer and O.O. Iribarne, 2003. Mollusks as ecosystem engineers: the role of shell production in aquatic habitats. Oikos 101:79-90.

Hodges, M. N. H. Hadley, L. Coen, S. Roth, L. Goodwin and M. Bolton-Warberg. 2006. Shoreline stabilization and changes in sediment composition associated with small-scale oyster reefs in South Carolina. 2006 International Conference on Shellfish Restoration, Charleston, SC.

Lehnert, R.L. and D.M. Allen, 2002. Nekton use of subtidal oyster shell habitats in a southeastern U.S. estuary. Estuaries 25:1015-1024.

Luckenbach, M.W., R. Mann and J.A. Wesson (eds.) 1999. Oyster reef habitat restoration. A Synopsis and synthesis of approaches. Virginia Institute of Marine Science Press. Virginia Institute of Marine Science Press, Gloucester Point, VA, 358 pp.

Meyer, D.L., E.C. Townsend and G.W. Thayer. 1997. Stabilization and erosion control value of oyster cultch for intertidal marsh. Restoration Ecology 5:93-99.

Peterson, C. H., J. H. Grabowski and S. P. Powers. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. Marine Ecology Progress Series 264:249-264.

Piazza, B. P., P.D. Banks and M. K. LaPeyre. 2005. The potential for created oyster shell reefs as a sustainable shoreline protection strategy in Louisiana. Restoration Ecology 13: 499-506.

Porter E.T., J.C. Cornwell, L.P. Sanford, and R.I.E. Newell, 2004. Effect of oysters *Crassostrea virginica* and bottom shear velocity on benthic-pelagic coupling and estuarine water quality. Mar. Ecol. Prog. Ser. 271:61-75.

10.2 RESPONSE TO COMMENTS

The following is the Natural Resource Trustees' response to comments received during the public comment period for the Macalloy Site Draft RCDP/EA:

Comment[1]: *"I am writing this letter to express the community concerns about the Draft RCDP/EA that was prepared for the Macalloy Corporation Site in Charleston, SC. Shipyard Creek and its associated salt marsh are located on the eastern portion of the Macalloy Site which operated a ferrochromium alloy manufacturing plant that entered into an agreement with the Environmental Protection Agency (EPA) to be put on the National Priority Listing (NPL) for environmental hazard cleanup due to the release of hexavalent chromium, Lead, Nickel and Zinc into Shipyard Creek which is a tributary to Cooper River which feeds into Charleston Harbor. All of these heavy metals are known to cause major health concerns to both humans and the environment.*

Shipyard Creek is a popular recreational area for many of the residents who regularly visit the creek to fish and crab. South Carolina Department of Health and Environmental Control (SC DHEC) closed Shipyard Creek to all harvesting activities due to its contamination levels in the soil, benthic organisms and aquatic organisms. Today, community members still visit this creek to recreationally fish and crab. To my understanding, Shipyard Creek has not been evaluated since EPA done [sic] its risk assessment of the creek in 1995.

In the Draft RCDP/EA, it mentions that no specific site has been selected for restoration but it mentions Wando River as a possible site. Wando River is located outside of the impacted area. The Restoration Sites should be in the area that was impacted by the pollution and that area is Shipyard Creek, mouth of Shipyard Creek where it meets Cooper River and Cooper River below the mouth of Shipyard Creek. We feel that these areas suffered from the activities from the Macalloy Site and any restorations [sic] that is funded from this mitigation should happen in the before mentioned area to restore this area to pre-contaminated conditions.

In closing, we look forward to every effort to restore Shipyard Creek to its pre-contaminated condition because this creek has been identified as a valuable nursery and foraging habitats [sic] for the endangered Shortnose Sturgeon and many of the important recreational and commercial [sic] important species."

---

1 Submitted by Mr. Omar Muhammad, a community representative and resident of North Charleston.

Response: The Natural Resource Trustees appreciate the opportunity to respond to these comments. First of all, it appears that the commenter is not fully informed about the remedial (clean-up) actions that have already been completed in and around the Macalloy Site (including Shipyard Creek). The commenter states *"To my understanding, Shipyard Creek has not been evaluated since EPA done* [sic] *its risk assessment of the creek in 1995."* This is not factually correct. Since 1995, numerous studies documenting the nature and extent of contamination at the Macalloy Site, including Shipyard Creek, have been conducted. As a result of those remedial investigations, and as specified in the Record of Decision (ROD) for this Site, several actions have been taken to remediate (clean-up) contamination in and around Shipyard Creek. The Record of Decision (ROD) for the Macalloy Site was issued in August 2002. In general, the ROD specified the following clean-up components: ex-situ mechanical mixing of soil impacted by hexavalent chromium to prevent leaching to underlying groundwater; injection of chemical reductant to treat groundwater impacted by hexavalent chromium; excavation of sediments in, and restoration of, the former 001 tidal creek (which discharges directly into Shipyard Creek); and implementation of a comprehensive storm water management system to reduce concentrations of inorganics discharging to Shipyard Creek. Remedial construction activities at the Macalloy Site were completed in September 2006. A detailed account of all remedial actions completed at the Macalloy Site, including Shipyard Creek, can be found on the USEPA website (http://www.epa.gov/region4/waste/npl/nplsc/macalosc.htm).

The Natural Resource Trustees understand the commenter's request on behalf of his community that restoration be implemented in or near Shipyard Creek, where the ecological injury resulting from operations at the Macalloy Site occurred. In responding to this comment, it is important to distinguish between "primary restoration", which includes actions taken to clean up a contaminated site and restore it to baseline conditions, and "compensatory restoration", which is undertaken to compensate the public for interim losses or injuries to natural resources as a result of site-related contamination. All of the remedial actions described above are components of "primary restoration", and all of these remedial actions were conducted in and adjacent to Shipyard Creek and the Macalloy Site. Therefore, the commenter and the local community should be reassured that a substantial effort *"to restore Shipyard Creek to its pre-contaminated condition"* has already been undertaken and completed.

The focus of the Draft RCDP/EA is on "compensatory restoration" for past (pre-remedial) and residual (post-remedial) injuries to natural resources in the vicinity of the Macalloy Site. The Trustees generally agree with the commenter that locating restoration projects as close to the site of injury as possible is a desirable goal; however, there are a number of factors that must be considered in order to maximize the likelihood of success. The potential for success of an oyster reef creation project is a function of several variables, including substrate, currents, wave action, boat wakes, and the slope of the shoreline. In addition, there must be a reasonable expectation that the restoration project will survive, essentially undisturbed by human activity, for several years to come (in this case, 20 years or more).

The Trustees will evaluate the potential of Shipyard Creek and its environs to support a successful oyster reef creation project; however, if a suitable site in the Shipyard Creek area cannot be identified, other viable locations in the Charleston Harbor watershed will be considered. The Wando River site mentioned by the commenter was suggested as a potential oyster reef creation site by SCDNR Shellfish Management staff, because conditions there suggest a high likelihood of success. In addition, the Wando River site is located in the same 8-digit hydrologic unit watershed as Shipyard Creek (03050201), and like Shipyard Creek, the Wando River is a tidal tributary of the Charleston Harbor estuary. From an ecological perspective, the Trustees consider all such tidal tributaries to Charleston Harbor, as well as Charleston Harbor itself, to be sufficiently close to the Macalloy Site to merit consideration as potential restoration sites. Nevertheless, the Trustees understand the commenter's concern and will make every effort to choose suitable restoration sites that are as close to the Shipyard Creek area as possible.

Finally, the commenter also observed that Shipyard Creek is a popular recreational area for many of the residents who regularly visit the creek to fish and crab. The Trustees acknowledge that this is true; however, the residents should also be aware that all of Charleston Harbor, including Shipyard Creek, is closed to shellfish harvesting for human consumption. Therefore, while an oyster restoration project in the Shipyard Creek area could potentially compensate for injuries to ecological resources, it would not provide recreational shellfishing opportunities for the nearby communities.

10.4 NATURAL RESOURCE TRUSTEE SIGNATURES

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE SIGNED THIS FINAL RCDP/EA ON THE DATE APPEARING NEXT TO THEIR SIGNATURES:

FOR the South Carolina Office of the Governor:

[signature] 3 SEP 2010

Scott D. English — Date

Chief of Staff

FOR the South Carolina Department of Health and Environmental Control:

C. Earl Hunter [signature] 8-31-10

C. Earl Hunter — Date

Commissioner

FOR the South Carolina Department of Natural Resources:

John E. Frampton — Date

Director

10.4 Natural Resource Trustee Signatures

IN WITNESS WHEREOF, THE PARTIES HERETO HAVE SIGNED THIS FINAL RCDP/EA ON THE DATE APPEARING NEXT TO THEIR SIGNATURES:

FOR the South Carolina Office of the Governor:

____________________________ ____________

Scott D. English Date
Chief of Staff

FOR the South Carolina Department of Health and Environmental Control:

____________________________ ____________

C. Earl Hunter Date
Commissioner

FOR the South Carolina Department of Natural Resources:

[signature] 8-2-10

John E. Frampton Date
Director

IN WITNESS WHEREOF, the parties hereto have signed this Final RCDP/EA on the date appearing next to their signatures:

FOR the U.S. Fish and Wildlife Service:

______________________________ ____________

Cynthia K. Dohner — Date

Regional Director, Southeast Region

FOR the National Oceanic and Atmospheric Administration:

______________________________ 8-23-10

Howard Schnabolk — Date

Restoration Specialist

FINDING OF NO SIGNIFICANT IMPACT

Project Description: The Department of the Interior represented by the U. S. Fish and Wildlife Service (Service), along with the National Oceanic and Atmospheric Administration (NOAA); the South Carolina Department of Health and Environmental Control (SCDHEC); and the South Carolina Department of Natural Resources (SCDNR), propose to restore natural resources, including ecological services, injured, lost or destroyed due to releases of hazardous substances from the Macalloy Corporation Site ("Site") in Charleston, South Carolina.

The proposed restoration action is oyster reef creation in Charleston Harbor. Oyster reef creation will generally benefit estuarine resources within coastal South Carolina. The proposed project will provide increased nursery, foraging, and cover habitat for estuarine species that depend on oyster reefs for at least a portion of their life history. The filtering action of oysters that are expected to settle and grow on the planted oyster cultch will improve water quality by removing excess nutrients and particulate matter that can contribute to high turbidity and low dissolved oxygen.

The proposed restoration action is more thoroughly described in the Macalloy Restoration and Compensation Determination Plan/Environmental Assessment (RCDP/EA) to which this Finding of No Significant Impact (FONSI) is an Appendix.

Coordination: The Service and NOAA have coordinated this project with other Federal and State Resource Agencies and the interested public as described on page 2 of the RCDP/EA.

Alternatives: The Service and the cooperating agencies have analyzed several alternatives, as described in chapter 5 (Restoration Planning Process) and in Chapter 6 (Restoration Alternatives Comparison) of the RCDP/EA.

The preferred alternative was selected over other alternatives for the following reasons. This alternative provides an opportunity for cost-effective habitat enhancement by planting of cultch to support oyster reef development. The SCDNR has a successful record of implementing similar projects throughout coastal South Carolina. This restoration alternative is expected to improve water quality, increase habitat complexity, and species diversity. The constructed oyster reefs will be self-sustaining, and will present minimal human health, safety, or environmental effects. Chapter 6 describes the evaluation of the various alternatives in detail.

Determination: I have determined that this action does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, the action does not require the preparation of a detailed statement under Section 102 (2) (c) of the National Environmental Policy Act of 1969 (42 U.S.C. § 4321 *et seq.*). My determination was made considering the following factors discussed in the RCDP/EA to which this document is an Appendix:

a. The project will not adversely impact any threatened or endangered species potentially occurring in the project area.

b. No apparent unacceptable adverse cumulative or secondary impacts will result from project implementation.

c. Any cultural resource issues will be addressed prior to implementing any of the proposed actions.

d. All issues relating to the project's potential impact on wetlands and waters of the U.S. issues will be addressed prior to project construction.

e. The proposed project raises no environmental justice concerns, 59 C.F.R. Reg 7629.

"for" Cynthia K. Dohner
Regional Director, Southeast Region
U.S. Fish and Wildlife Service
Authorized Official