DRAFT DAMAGE ASSESSMENT AND RESTORATION PLAN AND ENVIRONMENTAL ASSESSMENT FOR THE KOPPERS SITE, CHARLESTON, SOUTH CAROLINA

October 21, 2016

Prepared by:

National Oceanic and Atmospheric Administration

on behalf of

U.S. Department of Commerce

U.S. Fish and Wildlife Service

on behalf of the

U.S. Department of the Interior

South Carolina Department of Health and Environmental Control

and

South Carolina Department of Natural Resources

Send Comments to:

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1 INTRODUCTION

1.1 OVERVIEW

This Draft Damage Assessment and Restoration Plan and Environmental Assessment (Draft DARP/EA) outlines a proposal to restore salt marsh and benthic habitat at two sites within the Charleston Harbor estuary to compensate the public for natural resources, including ecological services, injured, lost or destroyed due to releases of hazardous substances from the National Priorities List ("NPL") Superfund site known as the *Koppers Co., Inc. (Charleston Plant) NPL Site* ("Koppers Site" or "Site") in Charleston, South Carolina. The two proposed projects include hydrologic restoration, invasive species removal, and habitat protection through a conservation easement.

This Draft DARP/EA has been developed by the following Federal and State natural resources trustees: the National Oceanic and Atmospheric Administration (NOAA) of the U. S. Department of Commerce, the United States Fish and Wildlife Service (USFWS) on behalf of the U.S. Department of the Interior (DOI), the South Carolina Department of Health and Environmental Control (SCDHEC), and the South Carolina Department of Natural Resources (SCDNR), on behalf of the South Carolina Governor's Office (collectively, "the Trustees").

1.2 PROPOSED ACTION, PURPOSE AND NEED

Proposed Action. The Trustees are proposing to carry out restoration activities at property associated with Drayton Hall, a historic plantation on the Ashley River in Charleston, South Carolina, and along Long Branch Creek, also located in Charleston.

The Drayton Hall project site is a semi-impounded brackish marsh, where tidal flow is partially restricted by a relict dike constructed after 1939. The Drayton Hall project consists of three components: 1) restoring tidal hydrology and salt marsh functions in a 70-acre partially impounded brackish marsh located across the Ashley River from the historic Drayton Hall plantation; 2) eliminating existing stands of Phragmites australiensis, an invasive non-native species that spreads rapidly, replacing native salt marsh vegetation, and 3) establishing a conservation easement to ensure long-term preservation of the restored marsh, and the immediate uplands buffer.

The Long Branch Creek project aims to restore tidal salt marsh and benthic habitat within Long Branch Creek, Charleston, South Carolina by removing three undersized, failing 48" pipes running under the West Ashley Greenway; and creating a breach that will provide natural tidal exchange above and below the causeway, and eliminate whitewater and pooling effects on the surrounding marsh. Approximately 45 acres of marsh are expected to be enhanced as a result of the Long Branch Creek project.

Purpose. The purpose of the Proposed Action is to restore salt marsh and benthic habitat at the two sites identified to compensate the public for natural resources, including ecological services, injured, lost or destroyed due to releases of hazardous substances from the Koppers Site. The Koppers Site consists of former wood treatment and fertilizer manufacturing facilities located adjacent to the Ashley River, which have released hazardous substances into wetland and river habitat in and adjacent to the river.

The purpose of this document is to, first, outline the Trustees' damage assessment and restoration planning process related to the Koppers Site, including the injuries quantified through the Natural Resource Damage Assessment (NRDA), and, second, describe restoration actions that will address those injuries.

Need. In order to achieve this purpose, the Trustees must evaluate alternative restoration measures that will adequately compensate the public for the injured resources, and services provided by those resources, associated with the Koppers Site.

1.3 AUTHORITY

This Draft DARP/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 NRDA regulations at 43 C.F.R. Part 11 (NRDA regulations) which provide guidance for this restoration planning process under CERCLA.

Under these regulations, the Trustees are responsible for recovering damages for injury to natural resources caused by a release of hazardous substances. Damages may include: 1) the cost of restoring the injured natural resources or ecological services to baseline conditions (i.e. conditions without a release); and 2) the value of recreation and ecological service losses from the time of injury until baseline is restored.

1.4 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 outlines the responsibilities of federal agencies, including 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 adverse 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.

NOAA is the lead agency for preparing the DARP/EA. In accordance with NEPA and its implementing regulations, this Draft DARP/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 will be used to make a threshold determination as to whether preparation of an EIS is required prior to selection of the final restoration actions.

1.5 Public Participation

The Trustees have prepared this Draft DARP/EA to provide the public with information on the natural resource injuries and service losses associated with the Koppers 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. Public review of the restoration plan proposed in this Draft DARP/EA is an integral and important part of the restoration planning process and is consistent with 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 restoration plan proposed in this Draft DARP/EA is being made available for review and comment by the public for a period of 30 days. The deadline for submitting written comments on the Draft DARP/EA is specified in one or more public notices issued by the Trustees to announce its availability for public review and comment. The Trustees will consider all written comments received during the public comment period prior to approving and adopting a Final Damage Assessment and Restoration Plan and Environmental Assessment (Final DARP/EA). Written comments received and the Trustees' responses to those comments, whether in the form of plan revisions or written explanations, will be summarized in the Final DARP/EA.

1.6 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 Draft DARP/EA. Information and documents, including any public comments submitted on this Draft DARP/EA as well as the Final DARP/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 South Carolina DHEC/EQC Office
1362 McMillan Avenue, Suite 300
Charleston, SC 29405
Phone: 843-953-0150
Fax: 843-953-0151
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Arrangements must be made in advance to review or to obtain copies of these records by contacting the person listed above, or the Trustee Council Lead (Howard.Schnabolk@noaa.gov). 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 materials that are copyrighted.

2 OVERVIEW AND HISTORY OF THE SITE

This section summarizes the site history, response actions that were undertaken, and the Trustees' assessment of resource injuries and compensation requirements related to the Site.

2.1 SITE BACKGROUND

The following information was excerpted from the most recent Five Year Review Report for the Koppers Site prepared by the USEPA (Zeller, 2013).

The Koppers Site is approximately 102 acres in size, and is located in "the neck" area of the city of Charleston, on the west side of the peninsula formed by the Ashley and Cooper rivers. The general site location is depicted in Figure 2.1.The current use of the area surrounding the Site to the north, south, and east consists of a mixture of industrial, commercial, and residential properties. The Site has been employed for a variety of industrial uses since the early 1900's.

From 1940 to 1978, the Koppers Company operated a wood-treatment facility on approximately 45 acres of the Site that is generally bounded on the north by Milford Street, on the south by Braswell Street, on the east by the King Street Extension, and on the west by the Ashley River. Wood-treatment activities primarily consisted of treating raw lumber, utility poles, and railroad cross-ties with creosote. Pentachlorophenol and copper chromium arsenate (CCA) were also used as wood preservatives for a period of time. The bulk of wood treatment activities were conducted in the eastern portion of the Site, near what is now Interstate 26.

Figure 2.1: Koppers Site Map

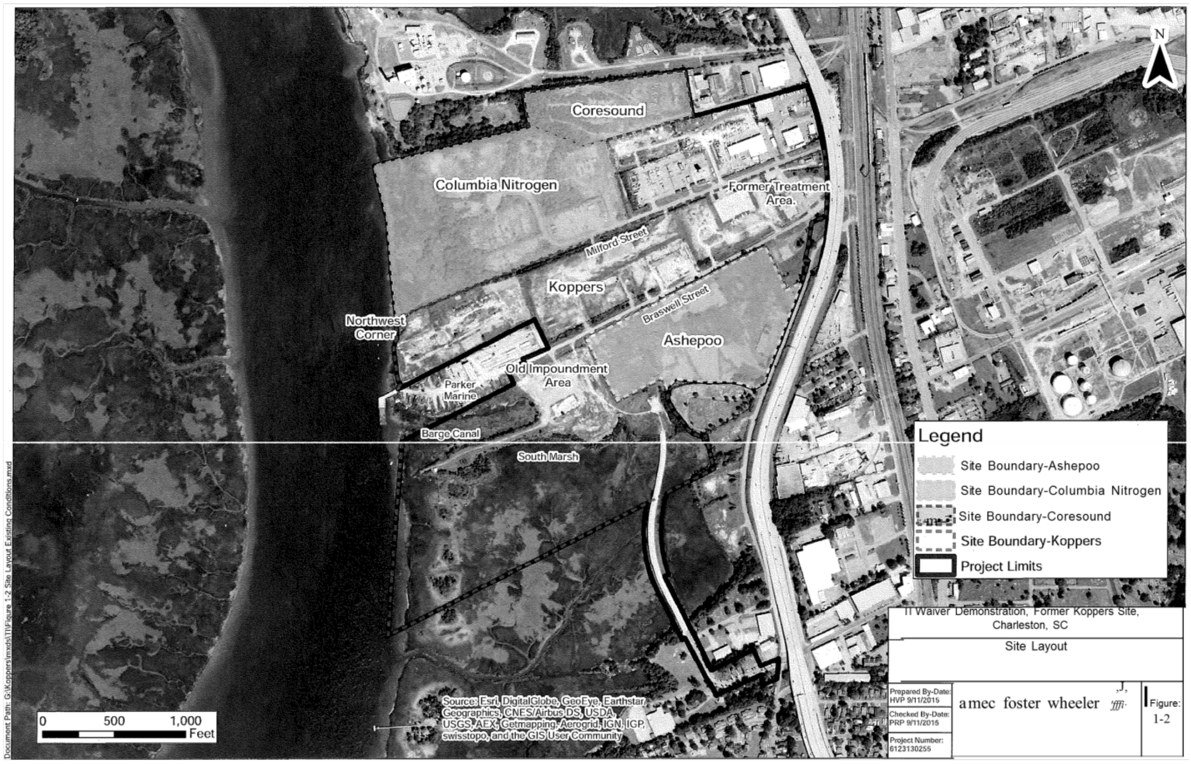

Figure provided by South Carolina Department of Health and Environmental Control

The remaining 57 acres of the Site, located south and adjacent to the former Koppers property, were never owned by Koppers. These 57 acres were part of a larger tract of land (the entire area south of Braswell Street) owned by the Ashepoo Phosphate/ Fertilizer Works. This property was used for phosphate and fertilizer production by a series of owners from the turn of the century until 1978. EPA incorporated these 57 acres into the Site boundaries to determine the environmental impact that the previous dredging operations had on the Ashley River and neighboring tidal marsh.

Beazer East, Inc., the Responsible Party (RP), is the successor in interest of the Koppers Company, Inc. and is thus the same corporation that operated the former wood treatment plant at the Site. After discontinuing operations at the Site in 1978, Beazer East sold all the property it owned within the Site boundaries. Beazer East reacquired a majority of the Site through property acquisitions in 1993 and 1998 and held that property until the third quarter of 2003 when Ashley I LLC purchased the parcels previously owned by Beazer East. The property transfer from Beazer East to Ashley I LLC was conveyed by a limited warranty deed that included among other items prohibitions on residential development and groundwater use (e.g. institutional controls).

At this time, the Koppers Site is largely vacant. The Parker Marine property (western end of Braswell) is used for marine manufacturing. Part of the Site is also used for parking by the neighboring City of Charleston Public Services Operations. Previously, the Site was one of three former Hazardous Waste Sites slated for a “mixed-use” redevelopment project called “Magnolia”, but that effort was suspended in 2010, when Ashley I LLC and Ashley II LLC defaulted on their loan. In 2015, plans to revive the Magnolia project were announced by a new group of investors. Plans to redevelop the Site are contingent on all cleanup goals being achieved and having the Site removed from the National Priority List (Charleston Regional Business Journal, July 27, 2015).

2.2 Summary of Response Actions

The Site was proposed to the Superfund’s National Priority List (NPL) in February 1992 and became Final on the NPL in December 1994. In January 1993, a Site-wide Remedial Investigation/ Feasibility Study (RI/FS) was initiated by Beazer East under an Administrative Order on Consent (AOC) with EPA. An Interim Action Record of Decision (ROD) was issued by EPA in March 1995. The Interim Action ROD was a source control effort designed to eliminate off-Site migration of non-aqueous phase liquid (NAPL) via surface water conveyances and shallow groundwater in close proximity to the former wood treatment area. The Final Site-wide remedy was issued by EPA in an April 1998 ROD. The Final ROD was a multi-media response action that selected remedies for surface/subsurface soils, sediments of drainage ditches, groundwater and NAPL, surface water, contaminant transport pathways, and sediments within the Ashley River, barge canal, and north/south/northwest tidal marshes. Two “Explanation of Significant Differences” (ESDs) have been added to the April 1998 ROD. An ESD was issued in August 2001 that changed the Ashley River remedy from enhanced sedimentation to placement of an engineered, subaqueous cap. In April 2003, an ESD was issued for the barge canal and northwest corner of the site. This ESD changed the barge canal remedy from placement of an engineered, subaqueous cap to natural deposition and monitored natural recovery; and changed the groundwater NAPL component for the northwest corner from active NAPL recovery with extraction wells, to immobilization using stabilization and solidification techniques.

The various remedy components were implemented and constructed via three primary mobilization efforts conducted in February 1999 for Site soils and drainage ditch sediments, June 2001 for the Ashley River sediments, and March 2003 for the south tidal marsh and NAPL groundwater. The net present worth of the remedy implemented at the Site was estimated at $20.4 Million, and generally included the following components:

- Excavation of 22,000 tons of soil with off-Site disposal in a Subtitle C landfill;
- Placement of a protective engineered soil cover over approximately 40 acres;

- Reconstruction of approximately 3,600 linear feet of surface water drainage ditches to eliminate contaminant transport pathways;
- Excavation of 1,500 tons of sediment and restoration of an estimated 1,300 linear foot reach of the tidal creek in the north marsh;
- Excavation of 2,500 tons of sediments and restoration of an estimated 2 acre area of the south tidal marsh;
- Placement of geotextile, a 2-inch sand cover, and a cement-stabilized cap over 3 acres of the Ashley River;
- Monitored Natural Recovery (MNR) for the 3.2 acre barge canal;
- In-situ bioremediation for the northwest tidal marsh, and portions of the south tidal marsh;
- Solidification/stabilization of a 17,500 square foot area in the northwest corner of the Site to immobilize residual NAPL; and
- Active groundwater and NAPL recovery via extraction wells in the former treatment area and old impoundment area.

The Final Remedial Action report was submitted in August 2003 and approved by EPA in September 2003. The Site reached construction completion status with approval of the Preliminary Close Out Report (PCOR) on September 25, 2003. Full-scale NAPL and groundwater recovery via extraction wells has been conducted in the former treatment area and old impoundment area since October 2003. Quarterly O&M reports on the performance of the recovery system have been submitted since the first quarter of 2004. As of the most recent 5-Year Review Report (2013), an estimated 14,000 gallons and 9,600 gallons of NAPL have been recovered from the former treatment area and old impoundment area, respectively. Groundwater conditions remain favorable for biodegradation of the dissolved contaminants at the site.

2.3 Assessment of Resource Injuries and Compensation Requirements

This 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)).

The evaluation of the injury and services lost can be viewed in its entirety in Section 4.

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 Site contamination. This includes any resource injuries due to the remedies undertaken. Available data indicate that groundwater, soils, sediments, and surface water in the vicinity of the Koppers Site have been contaminated with a wide variety of organic and inorganic contaminants, including polycyclic aromatic hydrocarbons (PAHs), heavy metals, pesticides, dioxins, and dibenzofurans. For the purposes of determining injury to natural resources, the Trustees decided to consider only those contaminants that could be clearly linked to operations at the former wood treatment facility. These include total PAHs and five heavy metals (arsenic, copper, chromium, lead, and zinc). These 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 will 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 injured or lost due to the release of hazardous substances to intertidal and subtidal habitats in the vicinity of the Koppers Site, 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 estimate the total potential loss of wetland acre-service 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 1.2, this assessment process is guided by the NRDA regulations under CERCLA 43 C.F.R. Part 11. For the Koppers 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.

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. The Trustees considered several factors as part of the assessment, including, but not limited to:

- specific natural resources and ecological services of concern;
- evidence indicating exposure, pathway and injury;

- type, degree, spatial, and temporal extent of injury; and
- types of restoration actions that are appropriate and feasible.

The Trustees determined an injury had occurred, and identified the nature of the injury. To undertake this effort, an understanding of the contaminants was necessary. Following the identification of the contaminants, it is possible to evaluate those resources that have been adversely affected by releases from the Site. The evaluation of the Contaminants of Concern (COCs) and their pathways to ecological receptors is described in Section 4.2.

The Trustees used the data generated during the RI/FS to determine the acreage encompassed by each of nine "Areas of Potential Ecological Concern" (APECs), where elevated levels of contaminants were found. The Trustees then used multiple lines of evidence, including contaminant concentrations, benthic community analyses, toxicity studies, and food web analyses, as well as peer-reviewed scientific literature and best professional judgment, to develop estimates of the percentage of injury in each APEC. The Trustees used the year after CERCLA was passed (1981) to begin the calculation of time-based injury duration. Therefore, injuries that may have occurred from wood treating operations from 1940 through 1980 are not considered. The Trustees also made conservative estimates (in favor of the natural resources) of the duration of the natural recovery period for each APEC, based on contaminant concentrations and the effects of planned remediation on likely duration of injury. Where sediment/soil removal was carried out, we assumed 100% injury at the time of excavation with a linear 10-year recovery period.

2.4 Restoration-based Assessment Approach

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).

2.5 Restoration Scaling Strategy

Scientific literature, knowledge of South Carolina estuaries, and a Habitat Equivalency Analysis (HEA) were used to identify appropriate restoration projects that would effectively compensate for the natural resource injury. The HEA 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. Inputs that are considered include relative habitat productivity, current level of impairment and threat level of human encroachment.

3 AFFECTED ENVIRONMENT

This section provides descriptions of the physical and biological environments in the vicinity of the Koppers 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

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.

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 (Figure 3.1). 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^{o}F to 87 ^{o}F (3.5^{o}C to 30.7^{o}C) and average 67 ^{o}F (19.4^{o}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.

Figure 3.1: Aerial View of Charleston Harbor

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 re-diversion 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.

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. The Ashley River and associated salt marsh habitat experience strong semi-diurnal tides, with tidal ranges that 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.

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.

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. 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 (bottom dwelling) resources such as copepods, polychaetes, mollusks and amphipods occupy vegetated and open water areas. 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 Charleston Harbor estuary is also considered nursery and forage habitat for the federally endangered shortnose sturgeon, *Acipenser brevirostrum.*

The spatial distribution of benthic organisms in 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.

3.3 The Social and Economic 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 76, to the City of Charleston with about 133,579 residents (U.S. Census Bureau, 2014). It is one of the fastest growing regions nationwide, with Berkley and Dorchester in the top 100 fastest growing counties in the country, and Charleston County growing by 8.8% between April 1, 2010 and July 1, 2014, according to the United States Census Bureau. The total population of the three counties combined was estimated to be 727,689 as of 2014. Administratively, their respective county councils and the combined Berkeley-Charleston-Dorchester Council of Governments (COG) serve the counties.

Although there are no major industrial dischargers in the Ashley River watershed, there are several minor industrial dischargers, as well as three major and several minor wastewater treatment facilities (SCDHEC, 2013). Other sources of pollution affecting the Ashley River and Cooper River/Charleston Harbor watersheds include nonpoint source runoff from the City of Charleston and other urban areas, industrial facilities, marina facilities, and from forested and agricultural lands. Several diked, dredged material disposal areas are located in the Charleston Harbor area, with the largest being the Clouter

Creek Disposal area on the Cooper River. 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 SCDHEC 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 are located on the western shore and include the former U.S. Navy port facilities, commercial facilities associated with the State Ports Authority, and numerous private companies. To accommodate shipping traffic, a 45-foot (13.7 m) deep navigation channel is maintained in the lower Cooper River and extends 20 miles (32 km) upstream from the mouth of the river.

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 its confluence with the Back River, the east bank of the Cooper River is dominated by several industries, while the west bank is dominated by dredged-material disposal areas. The lower Cooper River is classified as SB. Class SB waters are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption. These waters are also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora.

The Ashley River has the second largest number of industrial and commercial facilities, most of them located along the eastern shoreline. Much of the remaining upland area on both sides of the river supports residential developments. The lower portion of the Ashley River below Bacon’s Bridge is classified as SA. Like Class SB waters, Class SA waters are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption. These waters are also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora. Class SA waters have more stringent standards for dissolved oxygen and fecal coliform bacteria than Class SB waters, however.

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. Detyens Shipyard is the only industrial discharger on this river, and it is classified as a minor discharge. The upper Wando River above the Wando Terminal is classified as SFH (Shellfish Harvesting). SFH waters are tidal saltwaters suitable for shellfish harvesting and uses listed for Class SA and Class SB waters. The lower Wando River is classified as SA, with water quality 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 limited knowledge.

4 INJURY AND SERVICE LOST EVALUATION

This section describes how the Trustees assessed the injury to natural resources at the Koppers Site. This included determining a pathway for contamination, identifying contaminants of concern, and calculating the loss of resources and ecological services they provide.

A separate and distinct groundwater injury at the Koppers Site was evaluated by the South Carolina Department of Health and Environmental Control. The groundwater injury evaluation can be viewed in Section 10: Appendix.

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 intertidal and subtidal habitats of the Ashley River, as well as the discharge of "free product" (i.e., non-aqueous phase liquid, or NAPL) and contaminated ground water to these habitats.

Industrial operations and 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 Remedial Investigation and subsequent studies conducted by the Trustees indicated that soils, sediments and water were contaminated with Site-related constituents.

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 (COCs). 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 polycyclic aromatic hydrocarbons (PAHs) and heavy metals, especially arsenic, chromium, copper, lead, 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 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are ubiquitous in the environment, and can originate from natural processes, such as forest fires and volcanic eruptions, as well as from human activities. PAHs can enter aquatic environments from oil spills, as well as a variety of industrial activities. Sediments heavily contaminated with industrial PAH wastes have been shown to cause elevated PAH body burdens and increased frequency of liver neoplasia in fishes (Eisler, 1987). PAHs are released from wood treated with creosote (a chemical compound used as a preservative) and are known to cause cancer, reproductive anomalies, and immune dysfunction; to impair growth and development; and to cause other impairments in fish exposed to sufficiently high concentrations over periods of time (NMFS, 2010).

The Koppers Company performed wood-treating operations at the Site from 1942 until 1977. The primary wood-treating operations on the property consisted of treating raw lumber and utility poles with creosote, a distillate of coal tar and a complex mixture of PAHs. The Site is contaminated with PAHs consistent with those found in creosote. The Trustees have determined that creosote contamination at the Site is the main driver of toxicity. While other Parties were potentially responsible for PAH contamination, only the Koppers source is responsible for disposing creosote. Thus, the Koppers PAH contribution is the main toxicity driver contamination at the Site. The Trustees have restricted their damage assessment to Koppers-only (i.e. Beazer East) constituents, and have determined that Beazer East is the party primarily responsible for the Site injury.

4.2.2 Metals

In addition to creosote, both pentachlorophenol (Penta) and copper chromium arsenate (CCA) were used as wood preservatives on the Koppers Site. CCA is made from the oxides of chromium, copper and arsenic. Coal, the raw material for the manufacture of creosote, contains trace levels of various toxic metals including chromium, copper, lead, and zinc. In addition, the petroleum used as a carrier for Penta can also display a significant concentration of toxic metals. Metals, unlike the organic constituents of wood preserving waste, are not readily degraded or detoxified, and may pose a long-term environmental hazard.

4.2.2.1 Arsenic

Arsenic (As) occurs naturally in rocks and soil, water, air, and plants and animals. It can be further released into the environment through natural activities such as volcanic action, erosion of rocks and forest fires, or through human actions. Approximately 90 percent of industrial arsenic in the U.S. is currently used as a wood preservative, but arsenic is also used in paints, dyes, metals, drugs, soaps and semi-conductors. High arsenic levels can also come from certain fertilizers and animal feeding operations. Industry practices such as copper smelting, mining and coal burning also contribute to arsenic in our environment.

Arsenic can occur in many inorganic and organic species, with a wide variety of chemical and toxicological properties. In general, inorganic arsenicals are more toxic than organic arsenicals, and trivalent forms are more toxic than pentavalent forms. Arsenic is bioconcentrated by organisms, but not biomagnified in the food chain. Early life stages are generally most sensitive. Large interspecies differences in sensitivity have been reported, even among those closely related taxonomically. Arsenic in salt water has been demonstrated to cause reduced survival, growth, sexual reproduction, and metabolic activity in various species of plants and animals. In birds and mammals, arsenic toxicosis can cause a variety of physiological and behavioral abnormalities, as well as death.

4.2.2.2 Chromium

Trivalent chromium, Cr (III), and hexavalent chromium, 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.

4.2.2.3 Copper

Copper (Cu) can be released into the environment from both natural processes and human activities. Examples of natural sources are wind-blown dust, decaying vegetation, and forest fires. A few examples of human activities that contribute to copper release are mining, metal production, wood preserving, and phosphate fertilizer production.

Copper leaches from treated wood products in a dissolved state. Once in the aquatic system, it can rapidly bind to organic and inorganic materials in suspension. The adsorbed material may then settle and become incorporated into the sediments. Although copper may stay bound in sediments, it may also be resuspended, dissolved in interstitial water or reenter the water column depending upon biotic, physical, and chemical conditions at the site. This copper may be taken up by organisms that inhabit or ingest benthic sediments. Additionally, the copper could be taken up by some species of plants or algae and reintroduced to the ecosystem via consumption or decomposition of these plants. For many species, the greatest probability of adverse effects is from long-term accumulation of copper in sediments. Copper leached into sediments near CCA-treated wood in aquatic environments have been found to accumulate in benthic and epibenthic organisms. Other animals can acquire elevated levels of copper indirectly through trophic transfer, and may exhibit toxic effects at the cellular level (DNA damage), tissue level (pathology), organism level (reduced growth, altered behavior and mortality) and community level (reduced abundance, reduced species richness, and reduced diversity) (NMFS, 2010).

4.2.2.4 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.

4.2.2.5 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

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 Remedial Investigation (RI), literature values, and a HEA to estimate natural resource injuries. An important element of the RCIE for the Koppers Site was the decision by the Trustees to focus exclusively on injury to the benthic community. The rationale behind this decision was two-fold. One, injury and subsequent restoration scaling to the benthic community could be conducted in a protective yet 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. Biological resources that may have been injured, but which are not included in this damage assessment, are listed in 4.3.2.

4.3.1 Aquatic Ecological Services at the Site and the Benthic Community

Aquatic habitats associated with the Koppers Site provide multiple ecological services. These services are defined here as the benefits that flow from one habitat, natural resource, or species to another. The relative health and function of a given habitat affects the ecological services flowing to another. At the Koppers Site, many ecological services are provided—or are directly affected—by the benthic community (the focus of the injury assessment). 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).

This benthic community provides a number of ecological services to the broader estuary, of which only a subset are explicitly described here. The benthic community at the Koppers Site 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 Ashley River system near the Koppers 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).

In short, 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 provided at the Koppers Site, therefore, would likely have adverse effects on other biological communities and ecological service flows in broader the Ashley River system.

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, birds, amphibians, reptiles, and semi-terrestrial mammals) 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 Koppers Site area provide habitat for many organisms. Ecological services provided by these physical habitats include refuge 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.

4.3.2 Ecological Services Not Evaluated in this Injury Analysis

The previous sections established that the benthic community provides, as well as significantly affects, many ecological services in the Ashley River. Consequently, the injury analysis focuses on adverse effects to the benthic community, resulting from the release of the identified COCs. 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 migratory birds, mammals and reptiles
5) Services provided by the upland portion of the Site
6) Ecological services lost as a result of exposure to chemicals other than total PAHs and the five selected metals (e.g., dioxins/furans, pentachlorophenol).

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

4.3.3 Using Sediment Benchmarks to Evaluate Benthic Injury

Sediment benchmarks are chemical concentrations demonstrated by the scientific community to be associated with adverse impacts (e.g., toxicity) to aquatic biota (Burton 1992, EPA 1992, Ingersoll et al. 1997). The set of benchmarks that the Trustees chose to evaluate adverse impacts to the benthic community at the Koppers Site was that developed by Long et al. (1995, 1998). This set of benchmarks includes an Effects Range-Low (ER-L) value and an Effects Range-Median (ER-M) value for each of contaminant analyzed. ER-Ls and ER-Ms were developed by regressing large datasets of synoptic sediment chemistry and biological effects information. The datasets focused largely on the results of sediment bioassays examining acute toxicity to benthic organisms (primarily amphipods). The ER-L and ER-M correspond to the 10th and 50th percentile of effects concentrations, respectively. ER-Ms represent elevated concentrations above which biological effects are highly probable (Long and MacDonald 1998). The Trustees used these benchmarks to calculate ER-M quotients for total PAHs and five individual metals in each of the nine APECs. In accordance with ecological risk assessment guidance from EPA Region 4, the Trustees also used the results of Site-specific sediment toxicity testing to reduce uncertainty and help estimate service loss. These bioassays were conducted as part of EPA's RI at the Koppers Site.

4.3.4 Estimating Percent Loss of Benthic Services

Past (pre-remedial) and residual (post-remedial) injury levels were estimated for each APEC. Within each APEC, areas that were actively remediated were considered separately from areas that were not actively remediated (i.e., those areas where “monitored natural recovery” was the selected remedy). Percent service level losses within each of the nine APECs were estimated based on multiple lines of evidence. These lines of evidence included ER-M quotients (as described above) and comparisons to individual ecological benchmark values; toxicity testing; benthic community analyses; and a food web analysis to determine if benthic organisms were providing contaminated food to upper trophic level receptors.

Table 4.1: Benthic Services Lost Before and After Remediation

APEC Site	Service Level Loss Pre-Remediation	Lines of Evidence	Service Level Loss Post-Remediation*
South Marsh (Excavated)	80%	- PAHs exceed NOAA Effect-Range - Median Benchmark (E-RM) - Metals mean ERM-Q > 1 - Demonstrated toxicity to amphipods, grass shrimp - Benthic community data mixed - Benthos providing contaminated food to higher trophic levels - Free creosote product observed repeatedly seeping out of North Marsh capped area	100%
South Marsh (Non-Excavated)	50%	- PAHs exceed E-RM Benchmark - Metals mean ERM-Q >1 - Demonstrated toxicity to amphipods, grass shrimp - Potential reduction in benthic community (abundance and diversity) - Benthos providing contaminated food to higher trophic levels - Relatively small change in sediment chemistry over 8 years	50%
North Marsh (Sand-Capped)	80%	- PAHs exceed E-RM Benchmark - Metals mean ERM-Q > 1 - Demonstrated toxicity to amphipods, grass shrimp - Benthic community data mixed - Benthos providing contaminated food to higher trophic levels - Free creosote product observed repeatedly seeping out of North Marsh capped area	100%
North Marsh (Uncapped)	40%	- Metals E-RM Quotient (ERM-Q) > 1 - Benthos providing contaminated food to higher trophic levels - Demonstrated grass shrimp toxicity	40%
Northwest Marsh	20%	- PAHs and metals both exceed NOAA Effect-Range Low Benchmark (E-RL) - Demonstrated toxicity to amphipods (benthos) - Benthos providing contaminated food to higher trophic levels	20%
Ashley River (Capped)	70%	- Assume faster recovery in sand cap area than in non-capped areas	100%
Ashley River (Uncapped)	70%	- PAHs exceed E-RM Benchmark - Metals exceed E-RL Benchmark - Demonstrated toxicity to mysids, polychaetes (benthos) - Mixed benthic community results; Benthos providing contaminated food to higher trophic levels	70%
Barge Canal	70%	- PAHs exceed E-RM Benchmark - Metals exceed E-RL Benchmark - Benthic community data indicate low species density, and few species - Benthos providing contaminated food to higher trophic levels - Recent data indicate PAH levels all still greater than E-RL Benchmark - Log recovery curve allows for faster rate of initial recovery as canal fills in.	70%

* APECs where remediation occurred (excavation or capping) had residual benthic services lost at 100% because of the remediation activity (excavation or capping). However, these sites were estimated to return to baseline levels more rapidly than non-remediated sites.

4.3.5 Habitat Equivalency Analysis (HEA)

Habitat Equivalency Analysis, or HEA, (NOAA, 2000) is an accounting tool used to determine the amount of compensatory restoration required to replace the lost services that would have been provided by the injured habitat. The restoration project should be sufficient to provide enough ecological service gains to offset the total service losses resulting from the injury.

Ecological services are quantified by the relative function (in %) of a given habitat over a given time period. For example, one acre of a fully functional benthic habitat provides one benthic "service-acre-year." An injured acre of benthic habitat that provides only 50% of the baseline services provides ½ of a "service-acre-year," and so on. Baseline is defined as the relative services that would have been provided had the contamination not occurred, inclusive of any and all other stressors on the system such as development, offsite pollution, diminished water quality, etc. All service levels are established relative to baseline.

Since services occur across time, a discount factor is applied to make all values comparable into equivalent terms. A 3% discount rate has been adopted throughout NRDA and is applied here as well. The resulting time-adjusted measure of ecological services is now as "discounted-service-acre-year" (DSAY).

4.3.5.1 HEA for the Koppers Site

Inputs to the HEA for the Koppers Site were based on multiple lines of evidence 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 scaling tool,2) injury began in 1981, 3) full recovery of the injured resources occurs some years into the future, depending on extent of contamination and other factors, and 4) restoration will begin in 2017. 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 will be completed in 2017 served as the basis for calculating compensatory credits in the HEA, and for subsequent discussions with the Responsible Party, which resulted in an agreement in principle on a restoration project and partial cash settlement.

[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 Trustees determined the number of affected acres of habitat in each APEC. In doing so, the Trustees sought to balance the cost and complexity of the injury assessment with the need for more precision in determining the degree of injury. Building on estimates of services lost summarized in Table 4.1, the trustees calculated the DSAYs lost due to the injury that the public would need to be compensated for (Table 4.2). In the second part of the 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 (Table 4.3). For purposes of assessing the Koppers Site, the HEA was used to estimate the size of tidal salt marsh restoration or other estuarine habitat necessary to make the public whole. Since one restoration type is being applied to injuries across multiple habitats types, the injuries are scaled to equivalent relative value. Results of the HEA performed by the Trustees indicate that proposed restoration alternatives adequately offset the approximately 525 DSAYs lost from injury (Table 4.4). Details on these restoration alternatives can be seen in Section 5.

Table 4.2: HEA Analysis Summary of Injuries at the Koppers Site.

Area of Concern	Size (acres)	Years Until Recovery (yr return to baseline)	DSAYs Lost Due to Injury	Scaling	Tidal Salt Marsh DSAY equivalents
Barge Canal	3.2	10 2015	82.13	5	16.43
Northwest Marsh	1.8	10 2015	13.20	1	13.20
Ashley River (uncapped)	0.69	10 2015	17.71	5	3.54
Ashley River (cement cap)	0.2	No recovery	10.46	5	2.09
Ashley River (sand cap)	2.02	5 2010	50.35	5	10.07
North Marsh (uncapped)	7.32	15 2020	112.70	1	112.70
North Marsh (capped)	1.02	10 years to 90% 10% loss perpetuity 2015	32.94	1	32.94

South Marsh (non-excavated)	13.72	30 2035	295.21	1	295.21
South Marsh (excavated)	1.28	10 2015	38.09	1	38.09
Total DSAYs required to offset injury					524.26

HEA assumes 5:1 ratio for services provided by marsh:subtidal sediments (applies to barge canal and Ashley River).

Table 4.3: HEA Assumptions for Compensatory Restoration Projects

Input parameter	Drayton Hall	Long Branch Creek	Oyster Creation
Year project initiated	2017	2017	2017
Years to maximum recovery	10	10	3
Maturity curve functional form	Linear	Linear	Linear
Pre-project Service Provision	50%	60	0
Maximum Service Provision	85%	85%	100%
Relative productivity of restored natural habitat	100%	100%	360% *
Time horizon for service production of restored habitat	50 yrs	50	50

* Estimated productivity: 1 acre of intertidal oyster habitat is equivalent to 3.6 acres of salt marsh (Peterson et al., 2007)

Table 4.4: HEA Summary for Compensatory Restoration Alternatives

Restoration Alternative	DSAYs Gained (per acre of restoration)	Habitat Productivity (1 acre marsh: 3.6 acre intertidal oyster reef)	Project Acreage	Conservation Easement (CE)?	Total DSAYs of Injury Offset	Total Percent Offset (by Restoration Alternative
					Alternative 1	
1: Drayton Hall*	4.99	100	70	YES	350	97% + CE Benefit
1: Long Branch Creek	3.57	100	45	NO	161	
					Alternative 2	
2: Drayton Hall	4.99	100	70	YES	350	94% + CE Benefit
2: Oyster Reef	16.28	360	2.4	NO	141	

Drayton Hall Project includes a conservation easement that will protect the restoration project and buffering upland in perpetuity. While not included in the HEA, it provides additional restoration value.

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 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 Draft DARP/EA only addresses the need for compensatory restoration action.

In accordance with NRDA regulations, the Trustees and Beazer East identified and evaluated a reasonable range of project alternatives that could be used to restore or enhance estuarine marsh habitat in the Charleston Harbor area. The projects identified came from a broad survey of the Charleston Harbor area conducted by consultants for Beazer East and the Trustees. The Trustees reviewed available information on these projects and consulted with individuals knowledgeable 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. All project alternatives, including the Trustees' preferred alternative, are discussed in Section 5.0 of this DARP/EA.

5.2 RESTORATION SELECTION CRITERIA

In accordance with the NRDA regulations, and satisfying NEPA screening for reasonable alternatives, 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. 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 under NRDA. Additionally, the Trustees considered the total cost of the project and the availability of matching funds, if any (which would be over and above the restoration requirement). 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 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 Koppers DARP 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 Draft DARP, the opportunity for a restoration project to provide ecological benefits while also enhancing 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. 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.

5.3 First Tier Screening of Restoration Alternatives

The Trustees developed a list of more than 50 potential restoration opportunities in the Charleston Harbor area. The consultants for Beazer East identified several other potential restoration projects specifically intended to compensate for ecological injuries at the Koppers Site. The Trustees, working cooperatively with Beazer East, narrowed the list of projects using 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 applying the above first-tier screening factors, the Trustees and Beazer East identified the following alternatives as potential restoration projects for the Site:

- Daniel Island Marsh Restoration –Create Restore salt marsh by removing dredge spoils in order to reestablish elevations that would allow for tidal inundation.
- Filbin Creek Flap Gate Removal – Enhance salt marsh by removing flap gates in order to restore tidal hydrology.

- Nelson Creek Rice Dike Removal or Breaching - Removal or breaching of a relict dike in order to restore tidal hydrology and enhance 13 acres of salt marsh habitat.
- Pine Bark Road Rice Dike Removal or Breaching– Restore six acres of salt marsh habitat by breaching or removing a relict dike to restore tidal hydrology.
- Popperdam Creek Rice Dike Removal or Breaching (Air Force Base Property) –Removal or breaching of a relict dike in order to restore tidal hydrology and enhance 22 acres of salt marsh habitat.
- Drayton Hall Rice Dike Removal or Breaching– Restore 70 acres of salt marsh habitat by breaching relict dike to restore tidal hydrology.
- Long Branch Creek Greenway Culvert Replacement –Enhance 45 acres of salt marsh on 155 acres of degraded marsh by replacing undersized culverts with a pedestrian bridge.
- Charleston Area-Oyster Reef Creation/Restoration - 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 a second tier qualitative screening (Table 5.1), several of the alternatives described in the previous section were dropped from further consideration. (Subjective screening summarized in Table 5.1 is based on a scale of zero to +3). Projects were removed from consideration due to circumstances such as land ownership concerns, impacts to neighboring land parcels, logistical difficulties, and excessive cost.

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
Daniel Island Marsh Creation	No	+++	+++	Yes	No
Filbin Creek Flap Gate Removal	No	+++	++	Yes	No
Nelson Creek Rice Dike Removal or Breaching	No	+++	++	Yes	No
Pine Bark Road Rice Dike Removal or Breaching	No	+++	+	Yes	No
Popperdam Creek (Air Force Base) Rice Dike Removal or Breaching	N/A (project secured by Air Force separately)	+++	++	Yes	No
Drayton Hall Rice Dike Removal or Breaching	Yes	+++	+++	Yes	Yes
Long Branch Creek Greenway Culvert Replacement	Yes	+++	+++	Yes	Yes
Charleston-Area Oyster Reef Creation/Restoration	Yes	+++	+++	Yes	Yes
No action	Yes	0	0	0	Yes

Scale of zero to +3.

5.5 Scaling the Preferred Restoration Project

The Trustees considered the "Drayton Hall Rice Dike Removal or Breaching" ("Drayton Hall"), "Charleston-Area Oyster Reef Creation/Restoration" ("Oyster Reef") and "Long Branch Creek Greenway Culvert Replacement" ("Long Branch Creek"), as well as the "No action" alternative in developing the remainder of this Draft DARP/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 Draft DARP/EA.

5.5.1 Habitat Equivalency Analysis Credit Model

The preferred restoration project should provide sufficient habitat creation and/or enhancement to compensate the public for the losses outlined in Section 4.0 (and summarized in Table 4.2). Using scientific literature and knowledge of South Carolina estuaries, the Trustees evaluated the last four restoration alternatives identified in Table 5.1 in order to determine the amount of credit (i.e., the number of DSAYs) that would be generated by each of these four alternatives (Table 5.2).

Table 5.2: Habitat Equivalency Analysis Summary of Restoration Credits to Offset Injury

Restoration Alternative	Restoration Project	Project Acreage (acres)	Conservation Easement (CE)?	Discount Service Acre Years (DSAYs)	Percent of Injury Offset (Injury = 524.26 DSAYs)
1		115		511	97% + CE Benefit
	Drayton Hall Rice Dike Breaching	70	YES	350	
	Long Branch Creek Culvert Replacement	45	NO	161	
2		72.4		491	94% + CE Benefit
	Drayton Hall Rice Dike Breaching	70	YES	350	
	Oyster Reef Creation	2.4	NO	141	
3				0	0%
	No Action	0	NO	0	

Due to the size of the injury, and the estimated credits for each project above, the Trustees have developed restoration alternatives that combine the Drayton Hall project with either the Long Branch Creek or the Oyster Reef Creation options (See Section 6).

5.6 Geographic Proximity of Projects

The projects selected for more detailed analysis are located in or near the Charleston Harbor estuary. The Drayton Hall site is located approximately 10 miles upriver from the Koppers Site. The Long Branch Creek site is approximately 8 miles to the south of Charleston Harbor, and less than 10 miles from the Koppers Site. The oyster reef restoration action would occur within the Charleston Harbor estuary as well, though the exact reef creation site has not been chosen.

6 EVALUATION OF RESTORATION ALTERNATIVES

6.1 RESTORATION ALTERNATIVE 1: DRAYTON HALL AND LONG BRANCH CREEK MARSH RESTORATION PROJECTS

Drayton Hall

The Drayton Hall project consists of three components: 1) restoring tidal hydrology and salt marsh functions in a partially impounded brackish marsh located across the Ashley River from the historic Drayton Hall plantation, 2) eliminating existing stands of *Phragmites australiensis,* an invasive non-native species that spreads rapidly, replacing native salt marsh vegetation; and 3) establishing a conservation easement to ensure long-term preservation of the restored marsh, and the immediate uplands buffer. Hydrologic restoration and invasive species removal are restoration actions that improve the health and function of benthic and marsh habitat and the ecological services they provide.

The Drayton Hall site is a semi-impounded brackish marsh, where tidal flow is partially restricted by a relict dike constructed after 1939. The site is located on the north side of the Ashley River, across from the historic Drayton Hall plantation (Figure 6.1). The project property and surrounding uplands are owned by the National Trust for Historic Preservation. The site is approximately 70 acres, with a mixture of marsh grasses including *Spartina spp., Juncus roemerianus,* and the invasive *Phragmites australiensis.*

Figure 6.1: Drayton Hall Project Site Map

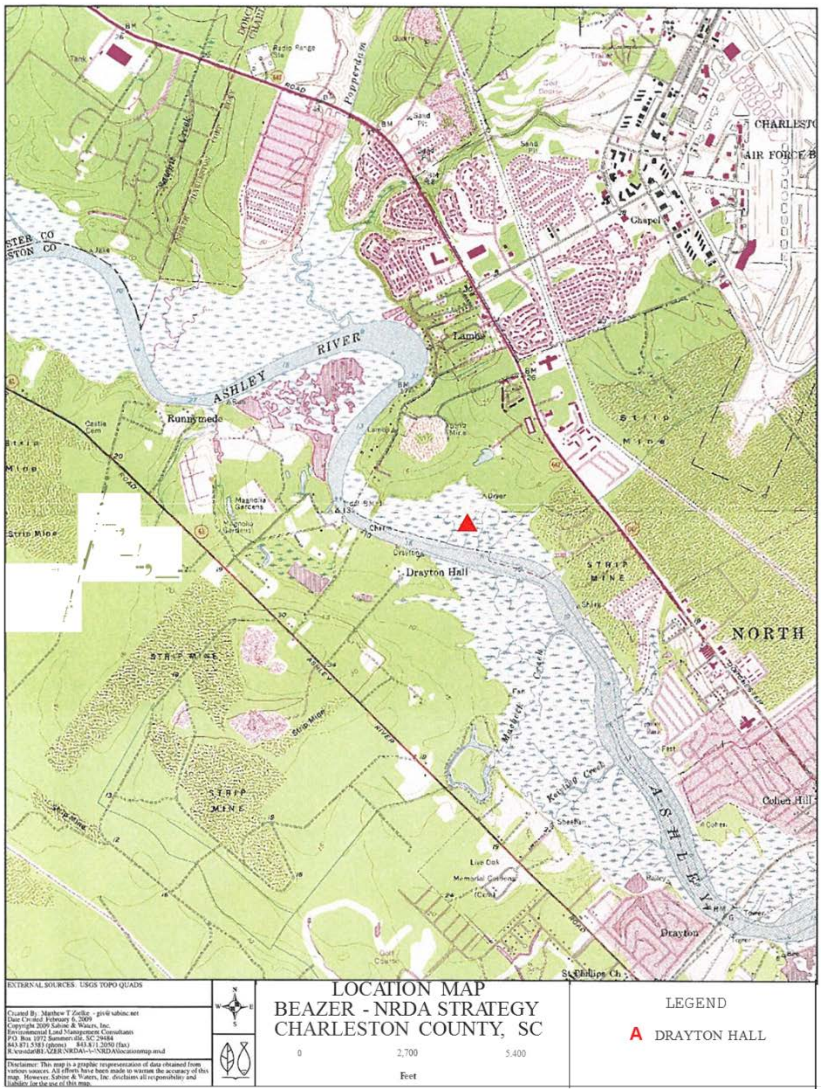

Figure provided by Beazer East

Restoring tidal flow will be achieved by breaching the existing dike at several locations associated with historical tidal creeks, and reconnecting the upper and lower reaches of these remnant tidal creeks. The current dike is broken on both the western and eastern ends. A total of five new breaches will be created in the dike using a track hoe (Figure 6.2).

Figure 6.2: Breach Locations at Drayton Hall Project Site.

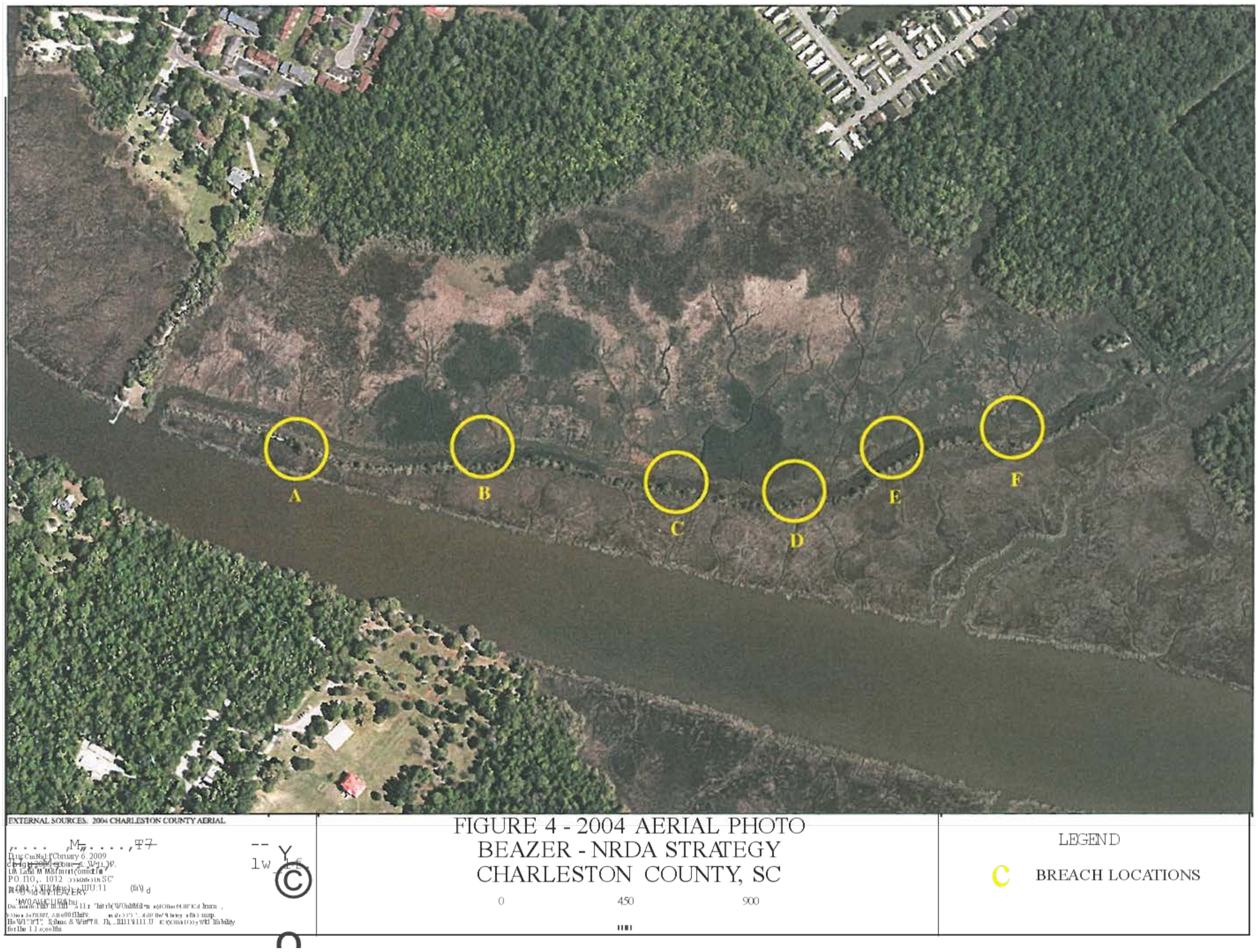

Figure provided by Beazer East

Each of the five breaches will be dug out 15-20 feet wide and will be graded down to an elevation slightly above the surrounding marsh. All spoil will be placed on the dike. Coconut mat will be staked over the fresh spoil piles to minimize erosion back into the marsh. The track hoe will be brought in and conduct activities by barge (river and canal) which will reduce damage to the marsh. Any damage that is sustained will be minimized by leveling marsh to the original grade and, if necessary, replanting with *Spartina alterniflora.*

Pedestrian surveys of the impaired marsh revealed several stands of *Phragmites*. *Phragmites* is an exotic and invasive species that spreads rapidly and replaces the natural vegetation. An appropriate herbicide labeled for aquatic use will be used to eradicate the invasive species, per best practices approved by the Trustees.

Long Branch Creek

The project consists of enhancing and restoring approximately 45 acres of tidal salt marsh and fishery habitat within Long Branch Creek, Charleston, South Carolina (Figure 6.3). Work includes removing three undersized, failing 48" pipes running under the West Ashley Greenway (Greenway) and creating a breach that will provide tidal exchange above and below the causeway. Like the Drayton Hall project, restoring natural hydrology to the salt marsh system will improve the overall health and function of benthic and marsh habitat.

Figure 6.3 Satellite View of the Long Branch Creek Project Site

Image provided by City of Charleston (Google Earth)

The Greenway is a 9-mile trail parallel to US Highway 17 that serves as the collector spine for the majority of the bicycle / pedestrian trail system in the West Ashley area of Charleston. At the location where the Greenway crosses Long Branch Creek, 3 pipes serve as the only hydrological connection for the creek upstream of the Greenway, which is severely impaired. The undersized pipes restrict tidal flow leading to water backup and whitewater effects, increased sedimentation, and increased erosion along the causeway and creek banks. Over 75% of the causeway has eroded, which is now at risk of failure; and the marsh immediately adjacent to the causeway is highly impaired by the unnatural flow of water.

The project will create a 10-15-foot breach in the Greenway, remove the pipes, and construct a 50-foot footbridge or install a box culvert. The breach will allow a natural tidal exchange above and below the causeway. Eliminating the pooling and whitewater effects will reduce shoreline erosion and sedimentation, and improve both benthic and fisheries habitat. Additionally, public access to the upper reaches of Long Branch Creek will be improved. A longer-term goal for the project is to catalyze additional efforts to remove other impediments from Long Branch Creek, and improve the overall health of the 155 acre salt marsh system.

6.1.1 Evaluation of Alternative 1

This alternative provides an opportunity for cost-effective estuarine habitat enhancement through hydrologic restoration. Both the Drayton Hall and Long Branch Creek projects restore degraded salt marsh habitat by improving tidal hydrology. Anticipated benefits from these actions include improving the quality of benthic and fishery pelagic habitat provided by salt marsh. Detritus derived from the decomposition of *Spartina* and other plant species forms the basis of the tidal marsh food web. This material is consumed by organisms such as plankton, clams, crabs, snails, and some fish, which are, in turn, a source of food for higher trophic level organisms in the estuarine food web, including federally protected migratory birds. In addition to being a source of food, tidal marshes provide nursery grounds and protection from predators for a wide range of aquatic organisms. Tidal marshes enhance the water quality of adjacent open waterbodies by acting as filters, absorbing nutrients and pollutants from upland areas, while at the same time protecting those upland areas from erosion due to storms and sea level rise.

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 South Atlantic Fisheries Management Council (SAFMC), and for migratory species such as sharks and billfishes managed by NOAA. The Atlantic Coastal Fish Habitat Partnership (ACFHP) identifies estuarine marsh as priority habitat in its Conservation Strategic Plan.

It is expected that the restored marshes will be largely self-sustaining, require minimal intervention following construction to achieve functional success, and would provide an uninterrupted flow of services into the future. Additionally, the conservation easement will ensure protection for the restored marsh, as well as preserving the buffering upland.

6.2 Restoration Alternative 2: Drayton Hall Site and Oyster Reef Creation

Drayton Hall
See Section 5.1

Oyster Reef Creation
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 oyster project would create additional oyster reef habitat in the Charleston Harbor estuary. This would involve constructing one or more intertidal oyster reefs, encompassing approximately 2.4 acres (total). It is anticipated that this project would eventually provide ecological services equivalent to those of a natural oyster reef of equivalent size. Under this alternative, the SCDNR 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.

The precise location(s) for this alternative has not been selected; however, several potential sites within the Charleston Harbor estuary have been identified. Final site selection will include identifying intertidal bottom firm enough to sustain oyster propagation, and measuring the proposed cultch footprint with a Global Positioning System (GPS). Data from the GPS is transferred into the SCDNR's Geographic Information System (GIS) and maps are produced on digital imagery acquired by SCDNR's remote sensing oyster mapping project. Once the GIS calculates the footprint, the intertidal shoreline area will be staked with 1" diameter PVC poles before planting shells at high tide. Oyster shells will be 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.

6.2.1 Evaluation of Restoration Alternative 2

This alternative provides an opportunity for cost-effective estuarine habitat enhancement by combining salt marsh restoration with oyster reef creation. In addition to the benefits expected from the Drayton Hall project—including, but not limited to, benthic and pelagic habitat improvement—the oyster reef creation project 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 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, for migratory species such as sharks and billfishes managed by NOAA, and for federally protected migratory birds. 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.

6.3 Restoration Alternative 3: No Action

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 Koppers 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 resource 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.

6.3.1 Evaluation of No Action Alternative

Under the No Action alternative, no restoration, rehabilitation, replacement, or acquisition actions would occur. If the No Action alternative is selected, there would be no restoration or replacement of the lost resources and their services and the public would not be made whole for past injuries from releases from the Site. The No Action Alternative would not meet the Restoration Criteria.

- Relationship to Injured Resources and Services - The No Action alternative would not provide for restoration, replacement, enhancement or acquisition of resources.

- Consistency with the Restoration Goals – The No Action alternative would not provide for restoration of injured biological resources.

Compliance with Laws – While consideration of the No Action alternative is required by NEPA, this alternative would not meet the requirements and goals of CERCLA and the NRDA process under

CERCLA to provide for restoration that compensates the public for the injury and loss of the natural resources and services caused by releases of hazardous substances from the Site.

The No Action alternative is considered in this Draft DARP/EA as required by NEPA. The Trustees found that the No Action alternative would not meet the purpose and need for restoration under this Draft DARP/EA nor the responsibilities of the Trustees under CERCLA, including as defined by NRDA processes under CERCLA.

6.4 PREFERRED ALTERNATIVE

While both alternatives meet the criteria outlined in Sections 4.2 – 4.4, Alternative 1 is the preferred alternative because it will most effectively compensate the public for natural resource injuries related to the Site. The preferred alternative is more closely linked to the injured benthic habitat and services, and better able to restore and enhance like-habitat, and provide the same quantity and quality of resources lost; and also provides the added benefit of long-term preservation through the conservation easement. Additionally, the Long Branch Creek project creates opportunities for further restoration actions along the Long Branch Creek system.

7 NEPA ENVIRONMENTAL CONSEQUENCES ANALYSIS

This section describes the Trustees' NEPA analysis of the environmental consequences arising from the proposed actions. For the proposed actions identified in this Draft DARP, the appropriate context for considering potential significance of the actions is local as opposed to national or worldwide.

7.1 SCOPE OF THE NEPA ANALYSIS

This Draft Environmental Assessment (Draft EA) describes the major potential impacts of the proposed action of carrying out restoration activities at Drayton Hall and Long Branch Creek in Charleston, South Carolina. The Draft EA analyzes the potential direct, indirect, and cumulative ecological, social, and economic impacts associated with two alternatives.

In considering the Proposed Action, NOAA National Marine Fisheries Service (NMFS) is responsible for complying with a number of Federal regulations, including NEPA. As such, the purpose of the Draft EA is to provide an environmental analysis to analyze the potential effects of NMFS' Proposed Action to inform its decision-making process and to encourage and facilitate public involvement in the environmental review process.

Under NEPA, a draft EA is prepared to determine if any significant environmental impacts are likely to be caused by a proposed action. If the draft EA does not identify significant impacts, a Finding of No Significant Impacts (FONSI) is prepared to document the decision maker's determination and to approve the proposed action. If at any time during preparation of the draft EA it appears that significant impacts would result from the proposed action, the agency would halt development of the draft EA and begin preparation of an Environmental Impact Statement (EIS) to more thoroughly evaluate the potential impacts and potential ways to reduce or mitigate those impacts.

The following definitions were generally used to characterize the nature of the various impacts evaluated with this EA.

Short-term or long-term impacts. These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period. Long-term impacts are those that are more likely to be persistent and chronic.

Direct or indirect impacts. A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.

Minor, moderate, or major impacts. These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in Council of Environmental Quality (CEQ) regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.

Adverse or beneficial impacts. An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

Cumulative impacts. CEQ regulations implementing NEPA define cumulative impacts as the "impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

7.2 Preferred Alternative: Drayton Hall and Long Branch Creek Projects

See Section 5.1 for project description.

7.2.1 Impact of Preferred Alternative and No Action Alternative

The Trustees evaluated the potential for restoration actions associated with all proposed alternatives to impact the following: the physical environment (air and noise pollution, water quality, geological and energy resources, and contaminants), the biological environment (benthos, finfish, vegetation, wildlife, and endangered species), socioeconomic environment (environmental justice, recreation, commercial fishing, traffic, and cultural resources), and the potential for cumulative impacts.

7.2.1.1 Physical Environment

Air Quality: There would be minor, short-term, direct, adverse impacts because of construction activities. Exhaust emissions from heavy equipment would occur during the construction phase, but the amounts would be small and temporary. Adverse impacts would be short-term because air quality would return to present levels immediately after construction.

No Action: Air quality conditions would remain as they are, and there would be no adverse impacts to air quality from construction activities.

Water Quality: There would be minor, short-term, direct, adverse impacts because of earth moving activities associated with breaching the relict dike and the Greenway; and removing the culverts, increasing turbidity and sedimentation in the immediate construction area and nearby water bodies. Increased suspended sediments can affect benthic filter feeders and young fish by damaging gills and feeding tissues. However, best management practices (containment berms, erosion control, etc.) will be employed to minimize the extent, duration, and intensity of water quality impacts. Post-construction, water quality should stabilize, and there should be moderate-to-major, beneficial, long-term impacts to water quality because of improved benthic habitat.

No Action: Under this alternative, there may be long-term indirect, adverse impacts to water quality because impaired benthic and salt marsh habitat would continue to degrade and may result in reduced habitat function which includes acting as a filter for surface and groundwater inputs. Additionally the long-term beneficial impacts to water quality anticipated from the compensatory actions would not occur.

Noise: Minor, short-term, direct, adverse impacts would occur because of earth-moving equipment. During the construction phase, wildlife in the immediate vicinity of the site may be temporarily disturbed. Community residents and/or recreational users may adjust their activities (e.g., boating and biking) due to noise as well. Adverse impacts would be short-term because noise levels would return to present conditions immediately after construction.

No Action: Noise conditions would remain as they are, and there would be no adverse impacts from construction activities.

Geology: Breaching the dike at several points will impact the geology by adjusting the hydrology and providing more tidal influx into the currently impaired marsh land. Likewise, the shift in hydrology at Long Branch Creek may alter the geology immediately surrounding the causeway. These would be moderate, long-term beneficial impacts because these shifts in the landscape strengthen the habitat being restored. While construction activities at both sites will have direct, short-term impacts to geology, any adverse impacts would be greatly offset by the long-term beneficial impacts of the improved hydrologic system.

No Action: There would be minor long-term, indirect adverse impacts to the geology under this alternative because of continued erosion, sedimentation, and reduced hydrologic connectivity.

Energy: There would be no impacts because the project sites are not associated with energy production, transport, or infrastructure.

No Action: Under this alternative, there would be no impacts because energy production, transport, or infrastructure would remain as is.

Contaminants: There would be no impacts to human health and safety because construction will not occur at the Superfund site or any other contaminated are; therefore, contaminated sediments are not being disturbed.

No Action: Under this alternative, there would be no change in any current contaminant level or current public health threat.

7.2.1.2 Biological Environment

Benthos: There would be minor, direct, short-term, adverse impacts because construction activities may disrupt substrate and increase sedimentation, affecting benthic organisms temporarily. However, best management practices (containment berms, erosion control, etc.) should be employed to minimize the extent, duration, and intensity. Post-construction, sedimentation is to be reduced at Long Branch Creek, and there would be moderate-to-major, long-term, beneficial impacts to benthos at both sites because of the restored habitat.

No Action: Under this alternative, there would be minor, long-term adverse impacts to benthic organisms as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

Finfish: There would be minor, direct short-term, adverse impacts because construction activities would temporarily strain fish habitat and populations in the immediate project area. Indirect adverse impacts may relate to feeding, gas exchange, spawning, and other natural behaviors. However, moderate, long-term, beneficial impacts would be expected due to the enhancement of salt marsh habitat through compensatory actions.

No Action: Under this alternative, there would be minor, long-term adverse impacts to finfish as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

Vegetation: There would be minor, short-term, adverse impacts to some vegetation because of construction activities and altered hydrology. Some species that would be impacted include *Spartina* spp., and *Juncus*. Best practices will be employed during construction to minimize damage injury to the marsh vegetation. Replanting will also be undertaken, as appropriate. Additionally, the Drayton Hall project will provide a moderate-to-major long-term, beneficial impact to native plant populations by removing the invasive *Phragmites* stands. There will also be indirect long-term beneficial impacts to native marsh vegetation because of the improved hydrology, and overall enhancement of salt marsh habitat.

No Action: Under this alternative, there would be long-term adverse impacts to native marsh vegetation because the invasive *Phragmites* stands would likely expand, and further degrade the marsh.

Wildlife: There would be minor, short-term, adverse impacts because noise and construction activities may temporarily disrupt wildlife. There would be long-term, indirect, beneficial impacts to wildlife through the enhancement of salt marsh habitat.

No Action: Under this alternative, there would be minor, long-term adverse impacts to wildlife as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

7.2.1.3 Socioeconomic Environment

Environmental Justice: This alternative does not have the potential to negatively or disproportionately affect minority or low-income populations in the area, including economically, socially, or in terms of conditions affecting their health. There would be long-term, indirect, beneficial impacts because proposed activities are expected to restore an environment that is of equal benefit to all area residents.

No Action: Under this alternative, there would be no long-term beneficial impacts to the public from improved habitat. Additionally, the lack of meaningful recovery would have indirect, adverse impacts on the economic and social well-being of all residents.

Recreation: There would be minor, short-term, direct adverse impacts because construction activities may temporarily impact recreational use of the Greenway and areas of the Ashley River (Drayton Hall project site). Impacted activities include walking, biking, and water uses such as boating and fishing. There would be long-term, indirect beneficial impacts to recreation because restored habitat may enhance recreational activities through improved water quality, wildlife viewing, and recreational fishing.

No Action: Under this alternative, there would be no adverse impacts from construction activities. However, there would be long-term, direct, adverse impacts at the Long Branch Creek site because erosion at the Greenway caused by impaired hydrology would continue, and likely lead to reduced or denied public access at that section of the Greenway.

Commercial fishing: There would be minor, short-term direct, adverse impacts because construction activities could deter commercial fishing (e.g., commercial crab pot, shrimp seine, bait trap fisheries) in the vicinity of the Drayton Hall site. However, there are anticipated long-term, beneficial indirect impacts to commercial fisheries from the improved habitat for these species of interest.

No Action: Under this alternative, commercial fisheries would continue uninterrupted. However, there could be long-term, indirect adverse impacts to commercial fishing if populations of species of interest declined due to lack of quality habitat.

Traffic: There would be no impacts to traffic at the Drayton Hall site because the proposed alternative does not include roads and, therefore, motorists would not be affected. There would be minor short-term adverse impacts at the Long Branch Creek site because access to the Greenway at the construction site would be limited for a finite period of time.

No Action: Under this alternative, there would be no impacts because transportation infrastructure would not be modified or disrupted.

Cultural Resources: There would be minor beneficial indirect impacts to nationally significant cultural, scientific, or historic resources because the proposed restoration actions will maintain or enhance "viewsheds" for Drayton Hall and Long Branch Creek. The Drayton Hall site is owned by the National Trust for Historic Preservation, and is within the "viewshed" of Drayton Hall Plantation, a National Trust Historic Site located on the opposite side of the Ashley River. The National Trust is supportive of the proposed project, provided the view from Drayton Hall remains essentially unchanged. The Trustees and Beazer East will continue to closely coordinate all restoration activities with the National Trust and their local representatives, to avoid any adverse impact to Drayton Hall or its viewshed. Aside from the proposed breaches in the dike that currently restricts tidal exchange between the semi-impounded wetland and the Ashley River, the view from Drayton Hall will remain undisturbed. Any vegetation on the dike that is removed or injured as a result of construction activities, will be promptly replaced with native plant species of comparable size, so that the post-construction view from Drayton Hall is not discernibly different from the pre-construction view. Additionally, the Long Branch Creek's anticipated improvement to the health of salt marsh will improve the landscape and viewshed along the creek's stretch of the Greenway.

No Action: Under this alternative, there would be no impacts because cultural, scientific, and historic resources would remain as they currently stand.

7.2.2 Cumulative Impacts of Preferred Alternative

The preferred alternative (including both Drayton Hall and Long Branch Creek restoration actions) is expected to result in cumulative, long-term, beneficial impacts by increasing the area and ecological function of salt marsh habitat, including increased habitat stability. Approximately 130 acres of marsh will be directly impacted by restoration, and the overall ecological function of the larger salt marsh system at both sites will be benefitted by the restored hydrologic function and removal of invasive species. Additionally, it is anticipated that the Long Branch Creek restoration project will catalyze additional restoration actions by the City of Charleston along the creek, extending the restoration footprint into further stretches of the salt marsh system.

The project actions would not result in any change to the economic activity in the area, and the restoration would contribute to the overall ecological health of the area. There is the direct potential to improve water quality through reduced sedimentation. The creation and enhancement of wildlife habitat supplements existing habitat in the region. A net cumulative beneficial impact may result from the synergy with future restoration activities. Further, the proposed actions are intended to compensate the public, i.e., make the public and the environment whole, for resources injuries caused by releases of hazardous substances into the watershed.

7.2.3 Cumulative Impacts of No Action Alternative

The No Action alternative is expected to result in cumulative negative impacts and would not provide the conditions necessary for recovery of the injured resources. With No Action, natural resources and their services would not return to baseline, and interim service losses would not be compensated.

7.3 NON-PREFERRED ALTERNATIVE: DRAYTON HALL AND OYSTER REEF CREATION

See Section 5.2 for project description.

7.3.1 Impact of Non-Preferred Alternative and No Action Alternative

7.3.1.1 Physical Environment

Air Quality: There would be minor, short-term, direct, adverse impacts because of proposed construction activities. Exhaust emissions from heavy equipment would occur during the construction phase, but the amounts would be small and temporary. There would be no long-term adverse impacts to air quality because air quality would return to present levels immediately after construction.

No Action: Air quality conditions would remain as they are, and there would be no adverse impacts to air quality from construction activities.

Water Quality: There would be minor, short-term, direct, adverse impacts because of earth moving activities associated with breaching the relict dike, increasing turbidity and sedimentation in the immediate construction area and nearby water bodies. Indirect impacts from increased suspended sediments can affect benthic filter feeders and young fish by damaging gills and feeding tissues. However, best management practices (containment berms, erosion control, etc.) should be employed to minimize the extent, duration, and intensity of water quality impacts. Post-construction, water quality should stabilize, and there would be moderate-to-major, long-term, beneficial impacts to water quality because of the increased and improved benthic habitat.

No Action: Under this alternative, there may be long-term indirect, adverse impacts to water quality because impaired benthic and salt marsh habitat would continue to degrade and may result in reduced habitat function which includes acting as a filter for surface and groundwater inputs. Additionally the long-term beneficial impacts to water quality anticipated from the compensatory actions would not occur.

Noise: Minor, short-term, direct, adverse impacts would occur because of earth-moving equipment and the vessel used to transport shell to the oyster reef creation site. The noise associated with these actions may temporarily disturb wildlife and community residents in the immediate vicinity of the sites. However, the noise from would not exceed the daily or average noise-range for the Charleston waterways, and there would be no long-term adverse impacts because noise would return to regular levels once construction ceased.

No Action: Noise conditions would remain as they are, and there would be no adverse impacts from construction activities.

Geology: The proposed action would create or enhance oyster reefs in the Charleston Harbor estuary, and this would change the immediate bathymetry, as well as alter hydrology (with regard to Drayton Hall). These are long-term beneficial impacts because the alterations allow new or strengthened habitat to persist.

No Action: Under this alternative, there would be minor, long-term indirect adverse impacts to geology because of restricted hydrologic connectivity. Geologic alterations would not occur from building reefs, and, therefore, the long term beneficial impacts anticipated from the compensatory actions would not be realized.

Energy: There would be no impacts because the project sites are not associated with energy production, transport, or infrastructure.

No Action: Under this alternative, energy production, transport, or infrastructure would remain as is.

Contaminants: There would be no impacts to human health and safety because construction will not occur at the Superfund site or any other contaminated site; therefore, contaminated sediments are not being disturbed.

No Action: Under this alternative, there would be no change in any current contaminant level or current public health threat.

7.3.1.2 Biological Environment

Benthos: There would be minor, short-term, direct adverse impacts because construction activities may disrupt substrate and increase sedimentation, affecting benthic organisms temporarily. However, best management practices (containment berms, erosion control, etc.) should be employed to minimize the extent, duration, and intensity. Both restoration actions would provide moderate-to-major, long-term, beneficial impacts to benthos because of the newly established or restored benthic habitat.

No Action: Under this alternative, there would be minor, long-term adverse impacts to benthic organisms as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

Finfish: There would be minor, short-term, adverse impacts because construction activities may temporarily strain fish habitat and populations in the immediate project area. Indirect adverse impacts may relate to feeding, gas exchange, spawning, and other natural behaviors. However, moderate, long-term, beneficial impacts would be expected due to the enhancement of salt marsh and oyster habitat through compensatory actions.

No Action: Under this alternative, there would be minor, long-term indirect adverse impacts to finfish organisms as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

Vegetation: There would be minor, short-term, adverse impacts to some vegetation because of construction activities and altered hydrology. Species that would be impacted include *Spartina* spp., and *Juncus*. Best practices will be employed during construction to minimize damage to the marsh vegetation. Replanting will also be expected, as appropriate. Additionally, the Drayton Hall project will provide a beneficial impact to native plant populations by removing the invasive *Phragmites* stands. Improved hydrologic connectivity will strengthen native marsh vegetation over time.

No Action: Under this alternative, there would be long-term direct, adverse impacts to native marsh vegetation because the invasive *Phragmites* stands would like expand, and further degrade the marsh.

Wildlife: There would be minor, short-term, adverse impacts because noise and activities associated with construction may temporarily disrupt wildlife. There would be long-term, indirect, beneficial impacts to wildlife through the enhancement of coastal habitat, including oyster reef habitat.

No Action: Under this alternative, there would be minor, long-term adverse impacts to wildlife as the salt marsh habitat continued to degrade from impaired hydrology and increased invasive species coverage.

7.3.1.3 Socioeconomic Environment

Environmental Justice: This alternative does not have the potential to negatively or disproportionately affect minority or low-income populations in the area, including economically, socially, or in terms of conditions affecting their health. There would be long-term, indirect, beneficial impacts because proposed activities are expected to restore an environment that is of equal benefit to all area residents.

No Action: Under this alternative, there would be no long-term beneficial impacts to the public from improved habitat. Additionally, the lack of meaningful recovery would have indirect, adverse impacts on the economic and social well-being of all residents.

Recreation: There would be minor, short-term, adverse impacts because construction activities may temporarily impact recreational use of the rivers (at the project sites). Impacted activities include boating and fishing. There would be long-term, indirect beneficial impacts to recreation because restored habitat may enhance recreational activities through improved water quality, wildlife viewing, and recreational fishing.

No Action: Under this alternative, there would be no adverse impacts from construction activities.

Commercial fishing: There would be minor, short-term, adverse impacts because *c*onstruction activities could deter commercial fishing (e.g., commercial crab pot, shrimp seine, bait trap fisheries) in the vicinity of the project sites. However, there are anticipated long-term, beneficial indirect impacts to commercial fisheries from the improved habitat for these species of interest.

No Action: Under this alternative, commercial fisheries would continue uninterrupted. However, there could be long-term, indirect adverse impacts to commercial fishing if populations of species of interest declined due to lack of quality habitat.

Traffic: There would be no impacts to traffic because the proposed alternative does not include roads or other transportation infrastructure.

No Action: Under this alternative, there would be no impacts because infrastructure would not be modified or disrupted.

Cultural Resources: There would be minor beneficial impacts to national significant cultural, scientific, or historic resources because the proposed action will enhance the "viewshed" for Drayton Hall. The Drayton Hall site is owned by the National Trust for Historic Preservation, and is within the viewshed of Drayton Hall Plantation, a National Trust Historic Site located on the opposite side of the Ashley River.

The National Trust is supportive of the proposed project, provided the view from Drayton Hall remains essentially unchanged. The Trustees and Beazer East will continue to closely coordinate all restoration activities with the National Trust and their local representatives, to avoid any adverse impact to Drayton Hall or its viewshed. Aside from the proposed breaches in the dike that currently restricts tidal exchange between the semi-impounded wetland and the Ashley River, the view from Drayton Hall will remain undisturbed. Any vegetation on the dike that is removed or injured as a result of construction activities, will be promptly replaced with native plant species of comparable size, so that the post-construction view from Drayton Hall is not discernibly different from the pre-construction view. Additionally, there would be no impacts to cultural resources at the oyster reef creation site because the site chosen will be purposely selected to avoid National Historic Sites, as well as nationally significant cultural, scientific, and historic resources.

No Action: Under this alternative, cultural, scientific, and historic resources would remain as they currently stand.

7.3.2 Cumulative Impacts of Non-Preferred Restoration Alternative

The preferred alternative (including both Drayton Hall and oyster reef actions) is expected to result in cumulative, positive impacts by increasing the area and ecological function of salt marsh and oyster habitat, including increased habitat acreage and stability. Approximately 70 acres of marsh and will be directly affected by restoration, and an additional 3 acres of oyster reef could be created.

The project actions would not result in any change to the economic activity in the area, and the restoration would contribute to the overall ecological health of the area. There is the direct potential to improve water quality through the establishment of filter feeding benthos. The creation and enhancement of wildlife habitat supplements existing habitat in the region. A net cumulative beneficial impact may result from the synergy with past restoration activities. Further, the proposed actions are intended to compensate the public, i.e., make the public and the environment whole, for resources injuries caused by releases of hazardous substances into the watershed.

7.3.3 Cumulative Impacts of No Action Alternative

The No Action alternative is expected to result in cumulative negative impacts and would not provide the conditions necessary for recovery of the injured resources. With No Action, natural resources and their services would not return to baseline, and interim service losses would not be accounted for.

8 COMPLIANCE WITH OTHER KEY FEDERAL STATUTES, REGULATIONS AND POLICIES

8.1 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT, 16 U.S.C. § 1801 *ET SEQ.*

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.

The South Atlantic Fishery Management Council identified the proposed project area as EFH for shrimp (Penaeid sp.), red drum (*Sciaenops ocellatus*), and the snapper grouper complex. In accordance with regulations, the Trustees requested consultation from NOAA's National Marine Fisheries Service (NMFS) on the proposed restoration alternatives. Upon review of the Draft DARP/EA, NMFS has no objection to the proposed projects and offers no EFH additional conservation recommendations to reduce the impacts to EFH and fishery species.

8.2 ENDANGERED SPECIES ACT OF 1973, 16 U.S.C. § 1531 *ET SEQ.*

The Endangered Species Act of 1973 (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.

Endangered and threatened species known to occur in and around the Charleston Harbor estuary are listed in Table 8.1 (USFWS 2015, Sandifer et al. 1980). The estuary's habitats provide general support for any threatened and endangered species migrating through or utilizing these communities. The general locale where the restoration actions would be sited is not critical habitat for any listed species, and they are not expected to be present during construction. The trustees do not believe the proposed restoration projects will adversely impact listed species, and will likely improve species habitat designated under the ESA; however, this will be considered during the ESA consultation that will be conducted prior to the release of the Final DARP/EA.

Table 8.1: Federal 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
Piping plover	*Charadruis melodus*	FT, CH
Red-cockaded woodpecker	*Picoides borealis*	FE, ST
Red knot	*Calidris canutus rufa*	FT
Wood stork	*Mycteria americana*	FT, SE
Reptiles and Amphibians		
Green sea turtle	*Chelonia mydas*	FT
Leatherback sea turtle	*Dermochelys coriacea*	FE, SE
Loggerhead sea turtle	*Caretta caretta*	FT, ST, CH
Kemp’s Ridley sea turtle	*Lepidochelys kempii*	FE, SE
Frosted flatwoods salamander	*Ambystoma cingulatum*	FT, CH
Fish		
Atlantic sturgeon	*Acipenser oxyrinchus*	FE
Shortnose sturgeon	*Acipenser brevirostrum*	FE, SE
Plants		
Seabeach amaranth	*Amaranthus pumilus*	FT
Canby's dropwort	*Oxypolis canbyi*	FE
Pondberry	*Lindera melissifolia*	FE
American chaffseed	*Schwalbea americana*	FE

FE – Federal Endangered; FT – Federal Threatened; SE – State Endangered; ST – State Threatened; CH – Critical Habitat

8.3 CLEAN WATER ACT, 33 U.S.C. § 1251 *ET SEQ.*

The Clean Water Act (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 that move material into or out of waters or wetlands of the United States require 404 permits. A CWA 404 permit will be obtained, if required, in order to implement any restoration action selected in this Draft DARP/EA.

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

The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the 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 Draft DARP/EA.

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

The goal of the Coastal Zone Management Act (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 Draft DARP/EA to be consistent with the South Carolina Coastal Zone Management Program, and a determination of consistency will be submitted to the appropriate state agencies for review, concurrent with the release of the Draft DARP/EA.

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

The Fish and Wildlife Conservation Act of 1980 provides for the consideration of impacts on wetlands, protected habitats and fisheries. The restoration actions described herein will enhance estuarine habitat, which will benefit both game and non-game fish and wildlife.

8.7 FISH AND WILDLIFE COORDINATION ACT, 16 U.S.C. § 661 *ET SEQ.*

The Fish and Wildlife Coordination Act (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.

8.8 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 Draft DARP/EA will have no effect on marine mammals.

8.9 MIGRATORY BIRD CONSERVATION ACT, 16 U.S.C. § 715 *ET SEQ.*

The proposed restoration actions will have no adverse effect on migratory birds. In fact, several species of migratory birds are likely to benefit from the enhancement of salt marsh habitat.

8.10 NATIONAL HISTORIC PRESERVATION ACT, 16 U.S.C. § 470 *ET SEQ.*

The proposed restoration actions will have no adverse effect on any known cultural or historic resources within, or in the vicinity of, the Charleston Harbor estuary. A National Historic Preservation Act consultation will be completed prior to the release of the Final DARP/EA.

8.11 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).

8.12 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 are no low income or ethnic minority communities that would be adversely affected by any of the proposed restoration alternatives.

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

A Draft Environmental Assessment is integrated within this Draft DARP. Environmental analyses and coordination have taken place as required by NEPA.

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

The proposed 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.

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

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

8.16 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 the proposed actions. The proposed restoration actions can be implemented in compliance with all applicable environmental laws.

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10 APPENDIX: GROUNDWATER INJURY ASSESSMENT & FINDINGS

10.1.1 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) Koppers Site - Charleston NPL Site File.

10.1.2 Introduction:

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

10.1.3 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 April of 1998 (USEPA 1998), and the ESD issued by EPA in August of 2003. The remedy includes full scale recovery of impacted ground water and creosote underlying the former treatment area and old impoundment areas of the Site. Remedial activities were initiated in October 2003. Performance reports indicate that greater than 30,000 gallons of creosote have been recovered from the shallow and intermediate water bearing zones underlying these two areas since full scale recovery was initiated. A comprehensive environmental monitoring program is being conducted to ensure the cleanup approach remains adequately protective of human health and the environment.

10.1.4 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 Koppers 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. According to SC statutes all groundwater in SC is considered Class GB, which would be considered as potential drinking water. 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.

10.1.5 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 Draft DARP/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 1993 (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 the 1940-1978 Site operation period).
- The area utilized for the calculations was based on information submitted by Koppers' 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 x annual recharge rate x duration of the injury x 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. This total area is 393,750 square feet.

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 Federal Remediation Section in the SCDHEC Bureau of Land and Waste Management provided this information.

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. The water rate used is $1.66/100 cu. feet, which was obtained from Charleston CPW in December 2015.

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 (35 feet) was approximated from the depths at which the existing extraction wells are screened.

10.1.6 Conclusions:

Based on the formula presented above the total surrogate value of the groundwater injuries for this Site was determined to be $665,390.26 (see Table 10.1). This dollar value does not account for time and effort SCDHEC spent to develop this assessment. Pursuant to an agreement in principal signed by both Beazer East and SCDHEC, Beazer East agreed to pay SCDHEC the negotiated sum of $390,000.00 for the groundwater injury, as well as all past costs related to the groundwater claim, including past costs incurred subsequent to that agreement.

Table 10.1 Summary of the Groundwater Claim for the Koppers Site.

Description	Dollar Value
Contaminated groundwater from 1993-2003 (time period from RI to RA)	$109,155.38
Existing contaminated groundwater	$228,768.75
Contaminated groundwater for time to remediate groundwater to MCLs	$327,466.13
Total groundwater surrogate value	$665,390.26