FOURTH FIVE-YEAR REVIEW REPORT FOR KOPPERS COMPANY, INC SUPERFUND SITE CHARLESTON COUNTY, SOUTH CAROLINA

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Prepared for

U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

AOC	Administrative Order of Consent
ALM	Adult Lead Methodology
ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Amendment to the Record of Decision
B(a)p-TEQ	Benzo(a)pyrene Toxicity Equivalent
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CEMP	Comprehensive Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	Contaminants of Concern
DNAPL	Dense non-aqueous phase liquids
EPA	United States Environmental Protection Agency
EPC	Exposure Point Concentrations
ESC	Engineered Soil Cover
ESD	Explanation of Significant Differences
FTA	Former Treatment Area
FYR	Five-Year Review
HDPE	High-density polyethylene
IC	Institutional Control
IEUBK	Integrated Exposure Uptake Biokinetic
ISS	In-situ Stabilization/Solidification
MCL	Maximum Contaminant Level
mg/kg	Milligrams per Kilogram
NA	Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
OIA	Old Impoundment Area
O&M	Operation and Maintenance
OU	Operable Unit
PAH	Polycyclic Aromatic Hydrocarbon
POTW	Publicly Owned Treatment Works
PRP	Potentially Responsible Party
PSG	Passive Soil Gas
RAWP	Remedial Action Work Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RG	Remedial Goal
RGO	Remedial Goal Options
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
S/S	Stabilization and Solidification
TBC	To-Be-Considered
TEQ	Toxicity Equivalent Quotient
TI	Technical Impracticability
UCL	Upper Confidence Limit

LIST OF ABBREVIATIONS & ACRONYMS - Continued

UU/UE	Unlimited use and unrestricted exposure
VCP	Voluntary Cleanup Program
VOC	Volatile Organic Compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40) Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the Fourth FYR for the Koppers Company Superfund site (Site). The triggering action for this statutory review is the signature date of the previous FYR. The FYR has been prepared because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of one operable units (OU): OU1 addresses the soil remedial action and the groundwater remedial action. This FYR Report addresses the entire Site.

The South Carolina Department of Health and Environmental Control (SCDHEC) conducted the FYR and prepared this report regarding the remedy implemented at the Site in Charleston, Charleston County, South Carolina. The SCDHEC personnel conducted this review from October 2017 to June 2018. The EPA is the lead agency for developing and implementing the remedy for the cleanup at the Site. The relevant entities, Beazer East, Inc., were notified of the initiation of the five-year review. The review began on 10/10/2017.

Site Background

The Koppers Superfund Site is located in northern Charleston, South Carolina, on the west side of the peninsula formed by the Ashley and Cooper Rivers. An approximate 45 acres portion along the north portion of the Site was formerly owned by the Koppers Company (now known as Beazer East, Inc.) and used for wood treating operations. The remaining 57 acres portion of the Site, located south and adjacent to the former Koppers property, was owned by Ashepoo Phosphate/Fertilizer Works. The Site, as incorporated onto the National Priorities List (NPL), is approximately 102 acres.

The Koppers Company owned and operated a wood treating facility on an approximate 45-acre area in the north portion of the Site from 1940 until 1978. The wood treating operations consisted primarily of treating raw lumber, utility poles and cross-ties with creosote. For short periods of time, pentachlorophenol and copper chromium arsenate were also used as preservatives in the wood-treating process. After discontinuing operations at the facility in 1978, Beazer sold all of its property at the facility. Beazer reacquired a majority of the Site through property acquisitions in 1993 and 1998 and held that property until July 2003, when Ashley I LLC purchased the parcels. In addition to the parcels owned by Ashley I LLC, other parcels at the Site are currently owned by Ashley II of Charleston LLC, and Parker Real Estate LP. Ashley I, LLC and Ashley II of Charleston, LLC filed for bankruptcy in December 2015. Ashley River Investors VII (Koppers), LLC has an option to acquire the property from the lender (Magnolia/ARC Lender, LLC) that holds as collateral the portions of the Site owned by

Ashley I, LLC and Ashley II of Charleston, LLC. Portions of the Site are expected to proceed with entry into the South Carolina Brownfields/Voluntary Cleanup Program after deletion from the NPL for a redevelopment plan known as the Magnolia project.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Koppers Company, Inc. (Charleston Plants		
EPA ID: SCD980310239		
Region: 4	**State:** SC	**City/County:** Charleston/Charleston
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Craig Zeller (EPA) and Timothy Kadar (SCDHEC)		
Author affiliation: EPA and SCDHEC		
Review period: 10/03/2017 – 05/15/2018		
Date of site inspection: 02/20/2018		
Type of review: Statutory		
Review number: 4		
Triggering action date: 07/23/2013		
Due date ***(five years after triggering action date):*** 07/23/2023		

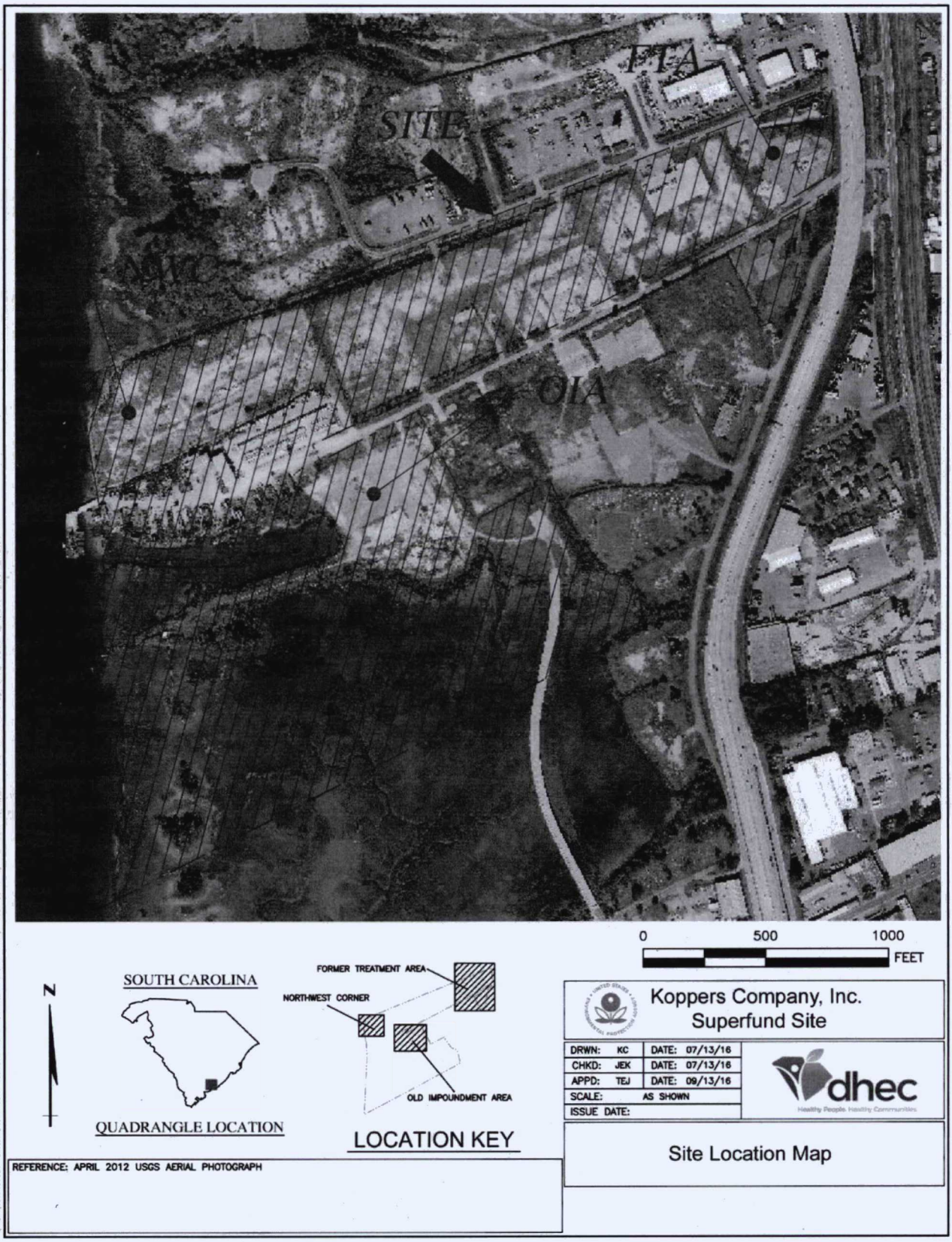

Figure 1 - Site Location

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The EPA proposed the Site for listing on the NPL in February 1992 and listed the Site on the NPL in December 1994. In January 1993, Beazer initiated a remedial investigation/feasibility study under an Administrative Order of Consent (AOC) with the EPA.

The 1998 Record of Decision (ROD) provided a detailed summary of Site risks identified during the Remedial Investigation/Feasibility Study (RI/FS)/risk assessment process. The baseline human health (Black & Veatch, 1995, 1996) and ecological (Ogden, 1996) risk assessment process provided the basis for taking action and identified contaminants and the exposure pathways required to be addressed by remedial action. Potential receptors evaluated included current/future on-site workers, current/future on-site utility workers, trespassers, future on-site residents, and future marina workers. Investigations were also conducted to evaluate potential impacts on ecological receptors. Media of concern evaluated included surface and subsurface soils, groundwater non-aqueous phase liquids (NAPL), sediment and surface water. While the 1995 Interim Action ROD addressed significant sediment and surface water exposure concerns, the 1998 ROD addressed cleanup levels for the following medias of concern: surface/subsurface soil and drainage ditch sediments; groundwater/NAPL; and sediments of the Ashley River, Barge Canal and tidal marshes.

Surface/subsurface soil and drainage ditch sediments cleanup levels were developed based on a future industrial exposure scenario for the future on-site worker, and results of the risk assessment performed in support of the RI identified Contaminants of Concern (COCs) in on-site surface/subsurface soils at concentrations greater than those deemed adequately protective of the future on-site worker.

The risk assessment concluded that potential risks were posed for ecological receptors, including the benthic community that frequent the Ashley River, so criteria were established for the long-term protection of ecological resources based on the impacts to sediments of the Ashley River, Barge Canal and tidal marshes.

As concluded in the RI, the deep water bearing zone underlying the Site was not impacted by the COCs and was therefore not included in required remedial actions. Impacted groundwater is confined to the shallow geologic unit that has little or no potential of being an underground source of drinking water; further, drinking water in this area is provided by the local municipalities. There are no potential present or future groundwater users either on the Site or off-Site. For these reasons groundwater exposures are assumed to be incomplete.

Wood-treatment compounds, primarily creosote-related constituents, were identified as COCs in the risk assessments completed as part of the RI. The COCs identified as indicator chemicals for soil impacts in the 1998 ROD included polycyclic aromatic hydrocarbons (PAHs), expressed as benzo(a)pyrene toxicity equivalents (BAP TEQs), arsenic, lead, pentachlorophenol, and dioxins/furans. Subsurface dense non-aqueous phase liquids (DNAPLs) are also a source of concern at the Site. DNAPLs are heavier than water, and they are only slightly soluble (immiscible) in water. Creosote-sourced contaminants may be present in either residual (immobile) or free phase (pooled/potentially mobile) DNAPL form in the subsurface. Potential identified source areas included drainage ditches, which were addressed as part of the Interim ROD action and the 1998 ROD, and three remaining primary potential source areas (Former Treatment Area, Old Impoundment Area, OIA and Northwest Corner) addressed as part of the 1998

ROD. These potential source areas contained DNAPL and creosote-related constituents in subsurface soils and groundwater, with dissolved phase creosote-related impacts in shallow groundwater. In DNAPL and shallow groundwater, COCs included creosote-related Volatile Organic Compounds (VOCs) and Semi-Volatile Compounds (SVOCs) as defined in the Remedial Action Work Plan (RAWP). Performance monitoring and operations and maintenance (O&M) reports have typically used benzene concentrations as a surrogate for total benzene, toluene, ethylbenzene, and xylene (BTEX) representations and have used naphthalene concentrations, the most mobile and abundant PAH, as a surrogate for total PAH representations in groundwater. In addition to these two indicator constituents, benzo(a)pyrene is present in select wells at concentrations above its MCL and therefore is also considered an indicator of the impact of creosote-related constituents on groundwater quality at the Site.

Due to the presence of DNAPL and groundwater concentrations of COCs that exceeded applicable Maximum Contaminant Levels (MCLs), performance standards for groundwater/NAPL were established in the 1998 ROD including the removal, treatment and containment of NAPL and the containment and restoration of aqueous contaminant plumes.

The risk assessment performed as part of the RI/FS provided the basis for the selected remedy in the 1998 ROD, in order that the selected remedy be protective of anticipated future commercial/industrial Site use. The 1998 ROD selected a Site-wide, multi-media response action to address surface/subsurface soil, sediments of drainage ditches, groundwater and NAPL, surface water, contaminant transport pathways, and sediments of the Ashley River, Barge Canal, and North/South/Northwest Tidal Marshes.

Table 1 summarizes the COCs identified in the Site's 1988 ROD.

Table 1: COCs by Media

COC	Media
Arsenic, Benzo(a)pyrene toxicity equivalent (B(a)p-TEQ), Dioxin, Lead, Pentachlorophenol	soil/sediment
NAPL[a] (naphthalene, benzene, benzo(a)pyrene)[b]	groundwater
[a]The 1998 ROD did not identify which groundwater contaminants are considered to be constituents of concern. [b] Mentioned in the 2018 ROD Amendment, but not specifically listed as COCs.	

Response Actions

The Site was proposed for inclusion on the NPL in 1992, and listed on the NPL in December 1994. In January 1993, Beazer entered into an AOC with USEPA to perform a RI and FS at the Site. This process initiated in 1993 and the Phase III RI field investigative work was completed in 1995 (ENSR, 1995a, 1995b). The FS Report (ENSR, 1996) was completed in December 1996. Parallel with RI/FS activities, an Interim Action ROD (USEPA, 1995) for interim remedial actions was completed in March 1995, and implemented between June 1996 and November 1997 to address portions of certain drainage ditches. The USEPA issued the Sitewide ROD in April 1998. USEPA issued a Unilateral Administrative Order to Beazer to implement the Sitewide ROD on January 25, 1999. The various components of the ROD remedy were implemented and constructed by Beazer between early 1999 and mid-2003. Two Explanation of Significant Differences (ESDs) were issued subsequent to the April 1998 ROD, the first in August 2001, and a second in April 2003.

To facilitate a proposed redevelopment plan, designated the Magnolia Project, a change in land use from industrial to mixed-use purposes (including residential) is planned for portions of the Site. An Amendment to the ROD (AROD) was signed on February 8, 2018 to address this proposed land reuse. The exposure assumptions used at the time of original remedy selection were reviewed and updated as part of the 2018 AROD. To allow implementation of a mixed-use redevelopment on the Site, changes to elements of the existing remedy will be implemented as defined in the 2018 AROD. The changes in remedy focus on two main components of the remedy as implemented pursuant to the 1998 ROD (the DNAPL/Groundwater remedy in the old impoundment area (OIA) and Site-wide soils in those portions of the Site that will be used for residential use under the proposed redevelopment). In addition to modifications to the remedy, a waiver of MCLs as chemical-specific or relevant and appropriate requirements (ARARs) under CERCLA § 121(d)(4) based upon a demonstration of technical impracticability for groundwater restoration was granted for two areas of the Site.

NAPL/Groundwater

Three potential source areas of subsurface NAPL and impacted groundwater have been previously identified at the Site; the FTA, the OIA, and the Northwest Corner. USEPA has adopted long-term remediation objectives for sites where NAPL is encountered in groundwater as presented in the USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9234.2-25, "Guidance for Evaluating the Technical Impracticability of Groundwater Restoration (USEPA 1993)." The groundwater/NAPL remediation objective for the FTA and OIA are consistent with this guidance. The Site's decision documents included performance standards rather than remedial action objectives (RAOs). The performance standards identified in the 1998 ROD were to remove or control NAPL discharges, and mitigate further migration of dissolved phase constituents from NAPL source areas through:

- Removal or treatment of NAPL to the maximum extent practicable.
- Containment of potentially non-restorable source areas, and
- Restoration of aqueous contaminant plumes.

The 2018 AROD specifically addresses:

- Changing the remedy for NAPL/groundwater in the OIA from active Recovery to the in-situ solidification/stabilization.
- Waiving the groundwater cleanup levels (MCLs) for benzene and benzo(a)pyrene in two separate Technical Impracticability waiver zones (TI zones).

Soils

In the 1998 ROD general remedial goals for soil are as follows:

- Reduce potential human health risks from exposure to surface and subsurface soils to levels deemed to be adequately protective as delineated in the Baseline Risk Assessment (BRA) (Black & Veatch, 1995, 1996).

The 2018 AROD specifically addresses:

- Install more extensive soil exposure cover to support a change in intended future land use from industrial to mixed use (with residential component).

- Replace certain storm water ditches with storm water conveyance piping. Replace portions of certain drainage ditches with a subterranean storm sewer system that will be consistent with the intended future land use. These measures enhance the effectiveness and permanence of the storm water remedy under the intended future land use.

No chemical-specific ARARs were identified in the ROD or AROD to specifically address soil. Remedial goals for soil were based on the BRA for future Site workers in an industrial setting. The USEPA remedial goals for the identified COCs were based on potential carcinogenic risk from 1×10^{-6} to 1×10^{-4} and hazard indices from 0.1 to 3. These objectives were achieved by a combination of general response actions consisting of capping, removal, and disposal of soils with levels of COCs greater than levels considered to be protective by USEPA, and with institutional controls.

Table 2: ROD Established Remediation Goals

Soil/Sediment			
COC	**Surface Soil/Sediment Excavation Level (milligrams per kilogram (mg/kg))**	**Subsurface Soil/Sediment Excavation Level (mg/kg)**	**Surface Soil Capping Level (mg/kg)**
Arsenic	135	1550	None
B(a)p-TEQ[1]	20	275[3]	2.0
Dioxin TEQ[2]	0.0015	0.02	None
Lead	None	None	1150
Pentachlorophenol	235	4300	None

Notes:
[1] - B(a)p-TEQ (benzo(a)pyrene toxicity equivalent) is a measure of the overall toxicity of all the carcinogenic PAHs.
[2] - Dioxin toxicity equivalent quotient (TEQ) is a measure of the overall toxicity of all the various types of dioxins.
[3] - The subsurface excavation met a cleanup standard of 55 mg/kg for B(a)p-TEQ.

The 1998 ROD did not identify which groundwater contaminants are considered to be constituents of concern. The 2018 mentioned naphthalene, benzene, benzo(a)pyrene but not specifically identify them as COCs.

Status of Implementation

The interim action work was completed in 1997. It generally involved the physical reconstruction and rehabilitation of the Milford Street and Hagood Avenue drainage systems, installation of six shallow NAPL extraction wells along Milford Street and installation of two intermediate NAPL extraction wells near the former pressure vessels. Beazer implemented the interim action under a Unilateral Administrative Order with the EPA dated May 22, 1995. The EPA and SCDHEC approved remedial design documents for the interim action in April 1996.

Beazer implemented the final remedy through a Unilateral Administrative Order (effective date of January 25, 1999) with the EPA, and pursuant to the January 1999 Remedial Design Work Plan. Design and construction efforts were separated into the following seven distinct packages:

- Site Soil and Drainage Ditch Sediments

- Barge Canal Sediments
- North Tidal Marsh Sediments
- South Tidal Marsh Sediment Excavation
- Ashley River Sediments
- NAPL/Groundwater
- In-Situ Bioremediation of Northwest & South Tidal Marsh Sediments

Initial priority was given to those remedy components that would generate F032, F034, and/or F035 listed wastes (hazardous wastes generated from wood preserving) and would require off-site disposal prior to the Land Disposal Restriction deadline of May 12, 1999. The north tidal marsh sediments and the majority of the site soils were protectively managed with these waste listings.

The various remedy components were implemented and constructed via three primary mobilization efforts: February 1999 for site soils and drainage ditch sediments, June 2001 for the Ashley River sediments, and March 2003 for the south tidal marsh sediments and NAPL/groundwater. The remainder of this section provides a brief description of the construction activities associated with the remedy components described above.

Site Soil and Drainage Ditch Sediments

In May 1998, pre-design delineation was performed to determine the volume and extent of soils exceeding the soil remediation goals. The Site was divided into remedial action zones based on historical land use, physical and chemical characteristics, and proposed remediation activities. Results from the pre-design delineation were incorporated into historical site sampling data and examined by geostatistical analyses to compute the most accurate delineation of the excavation and capping areas within the various remedial action zones. Based on the results of the geostatistical analyses, the ROD soil remedial action boundaries were defined and approved by the EPA and SCDHEC prior to field mobilization.

An estimated 22,000 tons of material were excavated and hauled to an on-site materials handling and staging area before being transported off-site to a Subtitle C landfill in Pinewood, South Carolina, for final disposal. This volume estimate also includes sediments excavated from the north tidal marsh (see Section 4.2.2 below). Post excavation confirmatory sampling was conducted to verify that all remedial action zones met the specified performance standards.

An estimated 3,600 linear feet of drainage ditches were reconstructed to eliminate an important contaminant transport pathway. The Braswell Street drainage system was reconstructed using large-diameter high-density polyethylene (HDPE) pipes and HDPE lined inlets and manholes. HDPE material was selected as the construction material because joints (pipe to pipe and pipe to inlet) could be welded to ensure a watertight seal. Existing drainage ditches were abandoned. Shallower swales were constructed to direct runoff to the inlets of the newly installed drainage system. The Milford Street drainage system was reconstructed along the existing drainage easement as an open ditch system consisting of a shallow lined ditch. The ditch lining consists of a welded HDPE liner that was overlain by an 8-inch-thick concrete grout mat. The Central Drainage Ditch was reconstructed in the previous drainage ditch alignment as an open ditch system consisting of a shallow, lined ditch similar to the reconstructed Milford Street drainage system.

Approximately 40 acres of the Site were covered with a protective engineered soil cover. An estimated 30 acres of the engineered soil cover were required to comply with the ROD, and Beazer voluntarily capped the remaining area to better integrate the final cap dimensions with existing land use and property boundaries. Four types of engineered soil covers were constructed; all were underlain by a geotextile barrier for visible demarcation purposes:

- Type IIA - 12-inch vegetated compacted fill
- Type IIB - 8 inches of compacted fill, followed by 4 inches of vegetated topsoil
- Type IIC - 12-inch aggregate base course
- Type IID - 3-inch aggregate base course layer overlain by a 2-inch asphalt pavement

In December 2001, a potential release of creosote-related material was observed at the outfall of the Braswell Street drainage system near the barge canal. Corrective measures were implemented from July 8 through July 23, 2002. The repair consisted of installing a cement-bentonite seepage cutoff wall across the two pipes approximately 190 feet upstream from the outfall headwall and immediately behind the headwall, injecting the gravel pipe bedding with a cement-bentonite grout mixture, and removing and solidifying the impacted sediments within the rip-rap apron downstream of the outfall. The solidified sediments were later transported to Canada for landfill disposal as a listed hazardous waste.

Barge Canal Sediments

This effort consisted of two sampling events to verify that concentrations of PAHs in sediments of the barge canal have decreased over time. A monitoring and contingency plan was adopted to ensure the revised natural deposition remedy meets the performance standards established in the 1998 ROD.

North Tidal Marsh Sediments

Beazer remediated an estimated 1,300-foot reach of the tidal creek channel, extending northwest from the intersection of Hagood Avenue and Doscher Avenue. The horizontal limits of excavation were dictated by field conditions and the material's angle of repose, but generally ranged from 20 to 30 feet in width. Best professional efforts were employed to remove visually impacted material beyond the established vertical/horizontal excavation limits, where practical.

Construction activities were initiated with dewatering and drainage control of the work area. The Hagood Avenue drainage system was temporarily diverted around the work area via a diversion ditch installed along the north side of Hagood Avenue. Ashley River tidal fluctuations were controlled by installing a tidal embankment across the marsh at the most downstream edge of the work area. The tidal embankment was fitted with an outlet structure to bypass water that accumulated in the work area. The original Hagood Avenue drainage system was restored and the tidal embankment was removed following construction.

Two access roads were constructed off Hagood Avenue to provide access to the remediation area. Access to the excavation area was accomplished using a wooden-mat working platform. The mat platform was constructed along the centerline of the tidal creek channel and the excavation proceeded in an upstream to downstream direction to minimize the possibility of recontamination. As discussed previously, implementation of north tidal marsh remedy was coordinated with the upland soils component due to the impacts of the Phase 4 Land Disposal Restrictions on off-site disposal logistics. An estimated 1,500 cubic yards of material were removed from the north tidal marsh, hauled to the on-

site material handling and staging area, and blended with upland soils before being transported off site to a Subtitle C landfill in Pinewood, South Carolina for final disposal.

Engineering controls were employed during excavation to provide short-term protectiveness and to mitigate the potential release of constituents via suspended sediments, tidal fluctuations and stormwater discharges. As an additional sediment and erosion control measure, hay bales were strategically placed to remove sediment from any bleed water or stormwater runoff prior to discharge at the downstream end. The hay bales were maintained during construction and restoration to assist in stabilizing the backfill and aid in revegetation of the area.

Once the excavations were completed to the required depth, a protective cap consisting of a non-woven geotextile and a minimum of 12 inches of sand was placed over the disturbed areas. The disturbed areas were returned to approximate pre-excavation elevations to avoid disruption of the natural dynamics of the local tidal marsh ecosystem and were revegetated and restored with native species typical to tidal marshes of the vicinity. A monitoring and contingency plan was adopted to ensure the restored areas returned to functioning and productive habitat.

South Tidal Marsh Sediment Excavation

Additional refinement sampling conducted during the project's remedial design phase increased the area of excavation to approximately 2 acres.

South tidal marsh construction activities began with mobilization in March 2003 and were finished with revegetation efforts by June 2003. The construction activities and sequencing for this component were performed in a similar fashion to that of the north marsh construction activities. A tide control embankment was installed around the periphery of the work area and a barrel/riser outlet structure was installed to bypass water that accumulated in the excavation area. Sediments from the south tidal marsh were removed by tracked excavators working on marsh mats or from the tide control embankment. Excavated material was hauled to an on-site handling and staging area for stabilization with cement kiln dust, before being hauled off site to the Lee County Subtitle D landfill in Bishopville, South Carolina, for final disposal. Approximately 2,500 tons of material, which included an estimated 600 tons of cement kiln dust, were hauled off site for disposal.

The excavated area was covered with a non-woven geotextile, backfilled with a minimum of 12 inches of sand, and graded to match pre-excavation tidal marsh elevations. The south tidal marsh was revegetated and restored with native species typical to tidal marshes of the area. A monitoring and contingency plan was adopted to ensure the restored areas returned to functioning and productive habitat.

Ashley River Sediments

Construction activities for the Ashley River component began in June/July 2001 with the demolition of the old railroad trestle and pier structures, cutting and removal of the associated timber piles, construction of access roads and construction of a revised central drainage ditch outfall. The cap construction followed the demolition activities and was completed in December 2001. The total area of the Ashley River capped was approximately 132,000 square feet, or roughly 3 acres. The subaqueous cap consisted of two types of caps, each having a minimum thickness of 12 inches:

- An approximately 2-acre sand cap was underlain by a non-woven geotextile to minimize consolidation concerns. Settlement and thickness monitors were placed in the sand cap in a regular grid at 50-foot centers to measure cap integrity over time.
- The remaining area immediately in front of the central drainage ditch outfall and the Parker Marine barge landing area received a cement-stabilized cap due to erosional concerns. This was accomplished by using a tubular mixing device and amphibious excavator to inject and mix cement-based grout into the upper 2 feet of sediments. Approximately 2,450 cubic yards of sediment were solidified to a depth of 2 feet using this technique.

A monitoring program was developed to measure the cap's effectiveness over time in mitigating potential risks to the benthic community and upper trophic level receptors.

NAPL/Groundwater

Mobilization for the northwest corner In-situ Stabilization/Solidification (ISS) remedial component was initiated in May 2003 and construction was completed by July 2003. The horizontal extent of the ISS area was approximately 17,500 square feet and the vertical extent was 1 foot into the clay confining unit, which varied in depth across the treatment area, but averaged approximately 14 feet. The ISS remedy was implemented using a slurry trenching technique due to the close proximity to the Ashley River and shallow depths to the
observed groundwater table. The treatment area was divided into 33 trenches, each being 4.5 feet wide and varying in length and depth. Each adjacent trench overlapped neighboring trenches to ensure complete treatment of the specified area.

Impacted material was excavated from each treatment trench, under bentonite slurry, and was transported to the mix containers for subsequent treatment. A total of 13,199 tons of impacted material were excavated and treated as part of this remedy. Following treatment, the solidified/stabilized material was placed back into the open excavation. At the completion of the solidification/stabilization activities, the surface of the solidified/stabilized soil was graded to promote drainage, and clean aggregate was placed.

NAPL recovery system installation activities were initiated in June 2003 and continued through August 2003. The full-scale recovery system was integrated with relevant components of the Interim Action treatment system, and full-scale recovery operations began in October 2003.

Active NAPL recovery is occurring in the FTA and old impoundment area OIA using a network of NAPL and groundwater extraction wells screened within the shallow and intermediate water bearing zones. The NAPL recovery system in the FTA consists of 11 shallow wells and four intermediate wells. In the OIA, the NAPL recovery system consists of three shallow wells and one intermediate well. This is a dual phase recovery system that extracts groundwater and NAPL through separate lines. NAPL recovery is accomplished by pumping groundwater at a controlled rate to enhance mobilization of NAPL to the extraction well sumps. The accumulation of NAPL in the storage sumps at the bottom of each extraction well is monitored on a weekly basis. When the volume of NAPL in the storage sump approaches capacity, the NAPL is extracted from the well using a surface-mounted air diaphragm pump and stored in an on-site aboveground storage tank. Recovered NAPL is periodically shipped to Giant Cement Company in Harleyville, South Carolina, for use as an energy recovery fuel in
rotary cement kilns. Recovered groundwater is discharged to the City of North Charleston publicly owned treatment works (POTW) under a Significant Industrial Wastewater Discharge Permit (permit

number 2078). The current permit is effective from January 1, 2013, until December 31, 2017. Groundwater from the 15 FTA extraction wells is pre-treated prior to discharge to the sewer to meet the POTW permit limits; the pre-treatment consists of an oil-water separator and addition of caustic to raise the pH. The water is sampled monthly for VOCs, PAHs, arsenic, and phenols. Groundwater from the four OIA extraction wells is sent directly to the POTW because no pre-treatment is required to meet the POTW permit limits.

A performance monitoring program for the groundwater/NAPL recovery and ISS remedies was developed using a network of existing and new monitoring wells across the Site. A monitoring plan was adopted to ensure the long-term permanence and effectiveness of the NAPL recovery systems, the solidification/stabilization remedy, and monitored natural attenuation mechanisms to meet the required performance standards. O&M reports have been submitted to the EPA and SCDHEC since this recovery system began full scale operation.

In-Situ Bioremediation of Northwest and South Tidal Marsh Sediments

After completion of additional characterization work in the south tidal marsh to refine the excavation boundaries, a 12-month pilot test for in-situ bioremediation of sediments in portions of the northwest and south tidal marshes was conducted from April 2000 to April 2001. The pilot study focused on the following three topics:

- Monitoring acute toxicity.
- Monitoring microbial community activity and constituent concentration of sediments in response to nutrient enhancement.
- Monitoring marsh biology (e.g., plants and macroinvertebrates) in response to nutrient enhancement.

The pilot study included fertilization with nitrogen and phosphorus over the entire south marsh study area and the addition of oxygen releasing compounds to three smaller subplots. The goal of these treatments was to enhance phytoremediation and to stimulate the catabolic activities of the indigenous microflora with known abilities to biodegrade organic constituents such as PAHs. The accelerated biological activities were intended to reduce constituent concentrations to acceptable levels as measured by a reduction in acute toxicity. The pilot study indicated that in-situ bioremediation did not produce an appreciable reduction in contaminant concentrations or a reduction in acute toxicity. As a result, full-scale implementation was not pursued. No further remedial action is planned for the marsh.

IC Summary Table

Table 3: Summary of Planned and/or Implemented Institutional Controls (ICs)

Media, Engineered Controls and Areas that Do not Support UU/UE Based on Current Conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or Planned)
Groundwater	Yes	No	4640000012 4660000029	Restrict use of groundwater as a drinking water source.	July 2003 deed prohibits residential development and groundwater use at this parcel and other parcels purchased by Ashley I LLC.
Groundwater	Yes	No	4660000017 4660000032 4660000033 4660000037 4660000044	Restrict use of groundwater as a drinking water source.	None. No ICs are in place at parcels owned by parties other than Ashley I LLC.
Soil	Yes	No	4640000012 4660000019 4660000028 4660000029 4660000030 4660000031 4660000035 4640000049	Prohibit land uses not compatible with remedy.	July 2003 deed prohibits residential development and groundwater use at parcels purchased by Ashley I LLC.
Soil	Yes	No	4660000032 4660000033 4660000034 4660000037 4660000043 4660000047	Prohibit land uses not compatible with remedy.	None. No ICs are in place at parcels owned by parties other than Ashley I LLC.

The majority of the Site is owned collectively by Ashley I, LLC and Ashley II of Charleston, LLC. These entities filed for bankruptcy in December 2015. Ashley River Investors VII (Koppers), LLC has an option to acquire the property from the lender (Magnolia/ARC Lender, LLC) that holds as collateral the portions of the Site owned by Ashley I, LLC and Ashley II of Charleston, LLC. ICs are in place for the parcels owned by Ashley I LLC. Ashley II LLC is in the process of placing ICs, as specified in the 2018 AROD, on the parcels they own. Parcel 4660000043, owned by Parker Real Estate and operated by Parker Marine, requires a Deed Notice to protect against the use of groundwater and to prohibit land uses not compatible with the remedy (See Figure 2).

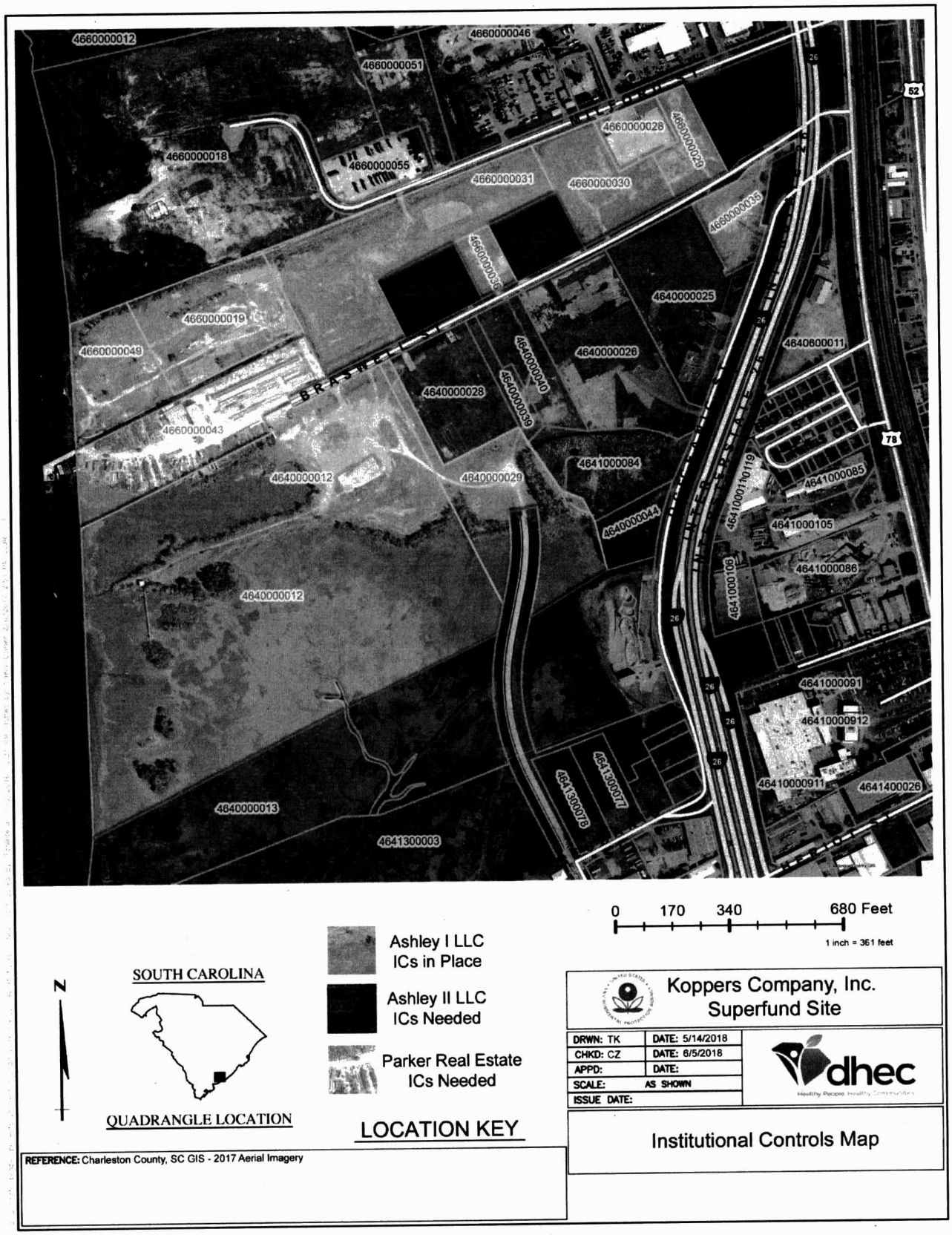

Figure 2 - Site Institutional Control Base Map

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last five-year review as well as the recommendations from the last five-year review and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2013 FYR

OU #	Protectiveness Determination	Protectiveness Statement
OU1	Protectiveness Deferred	A protectiveness determination of the Site's remedy cannot be made at this time until further information is obtained. Further information will be obtained by conducting air sampling to assess more precisely the potential for vapor intrusion. It is expected that these actions will take approximately one year to complete, at which time a protectiveness determination will be made. For the remedy to be protective in the long term, the EPA will issue a decision document to select land and groundwater use restrictions where needed, and implement the selected restrictions.

Table 5: Status of Recommendations from 2013 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1	Some of the Site's parcels do not have land use restrictions in place.	Issue decision document to select land use restrictions where needed. Implement selected restrictions.	Ongoing	ICs will be updated and documented when site is redeveloped	
OU1	Some of the on-site and off-site parcels above the NAPL/groundwater plume do not have groundwater use restrictions in place.	Issue decision document to select land use restrictions where needed. Implement selected restrictions.	Ongoing	ICs will be updated and documented when site is redeveloped.	
OU1	The arsenic MCL has become more stringent since the 1998 ROD.	Determine whether the NAPL/groundwater system should be modified to address arsenic.	Considered but not implemented	Plumes in FTA and OIA are defined by creosote constituents. Existing systems have effective capture zones. Effluent water meets POTW standards.	September 2018
OU1	Vapor intrusion may pose an unacceptable risk for the existing buildings in use at the Charleston Public Service area, and for potential future uses of on-site areas.	Conduct air sampling to further assess the potential for vapor intrusion at existing buildings. Require additional vapor intrusion assessment or mitigation prior to future construction.	Considered but not Implemented	Indoor air sampling in an active maintenance garage with multiple potential sources was not considered practical. The garage doors are open and facility is well ventilated during operating hours. The February 2018 ROD Amendment requires appropriate engineering controls during future	September 2018

				maintenance building development.	
OU1	Additional investigation is needed to delineate the northern extent of NAPL at the OIA.	Conduct additional investigation at the OIA to delineate the northern extent of NAPL. Determine if the existing recovery system for the intermediate water-bearing zone at the OIA is adequate.	Completed	Additional data requested for NAPL delineation at the OIA has been completed and the results submitted to EPA in the Remedial Action Work Plan	May 2015

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a newspaper posting in the Wednesday, December 27, 2017 edition of *The Post & Courier newspaper*, stating that there was a five-year review and inviting the public to submit any comments to the U.S. EPA. The results of the review and the report will be made available at the Site information repository located at the Charleston County Public Library at 68 Calhoun Street, Charleston, South Carolina.

The FYR process included interviews with regulatory agencies involved in Site activities or aware of the Site. The purpose was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. All the interviews were conducted in person, via telephone, or completed by email after the Site inspection. The interviews are summarized below. Appendix D provides the complete interviews.

Craig Zeller is the EPA Region 4 Remedial Project Manager (RPM) for the Site. His overall impression of the Site is positive. The AROD addresses remedial and regulatory issues preventing the Sitefrom being redeveloped. The remedy has been well operated, monitored and maintained. The 2018 AROD addresses remedial and regulatory issues and will allow the Site to be redeveloped within the next 5 year review cycle. Under the 2018 AROD, the majority of the Site is close to achieving Remedial Goals and those portions of the Site should be deleted within the next several years.

Joel Padgett works in the Bureau of Land and Waste Management Federal Remediation Program at SCDHEC. Mr. Padgett feels the remedy is working towards reaching remedial goals (RGs).

Data Review

In accordance with the Comprehensive Environmental Monitoring Plan (CEMP) established to meet the goals of the 1998 ROD the following monitoring requirements have been completed for each remedy at the Site over the past 5 years:

- Site Soil and Drainage Ditch Sediments: Annual monitoring of the Engineered Soil Cover (ESC) and the ditch lining system;
- Barge Canal: No further sediment monitoring and sampling activities are required;
- North Tidal Marsh: No further monitoring of the North Tidal Marsh is required;
- South Tidal Marsh: No further monitoring of the South Tidal Marsh is required;

- Ashley River: Annual monitoring of the subaqueous cap thickness;
- Northwest Corner: Semi-annual NAPL thickness monitoring and annual chemical monitoring near the solidification/stabilization (S/S) area;
- NAPL Recovery System: Monthly and semi-annual monitoring of the performance of the NAPL recovery system in the OIA and FTA; and,
- Groundwater Natural Attenuation: Monitoring of the effectiveness of the natural attenuation (NA) remedy in the OIA and FTA. As of the September 4, 2007 submittal, the frequency of this monitoring is semi-annual and annual.

Site Soil and Drainage Ditch Sediments

The Soil and Drainage Ditch remedy has been successfully implemented and continues to meet the ROD performance standards set forth in the CEMP. Maintenance of the Braswell Street Drainage Ditch, Central Drainage Ditch, and the Milford Street Drainage Ditch were completed in the First Quarter 2013 and the Fourth Quarter 2013. Trees and larger vegetation were cleared from along the Milford and Braswell Streets and other areas of the property during the Third Quarter 2015. The Central and the Milford Street Drainage Ditches were cleared during the Fourth Quarter 2015 of vegetative growth that had established after the growing season.

Ashley River Sediments

The Ashley River remedy has been successfully implemented and continues to meet the ROD performance standards set forth in the CEMP. No maintenance activities were performed during the span of this FYR.

Northwest Corner and NAPL Recovery System

Groundwater monitoring activities are being conducted at the Site in accordance with the CEMP and the operations/monitoring modifications described in Beazer's September 4, 2007 Plan. Dioxins, pentachlorophenol, styrene, antimony, arsenic, cadmium, chromium, copper and lead, are no longer being monitored in the Site's groundwater. The Site's groundwater continues to have contamination at levels above the MCLs. Due to the magnitude of the groundwater contamination, it may not be possible to achieve the MCL cleanup level in NAPL plume areas.

Groundwater monitoring being implemented at the Site includes an extensive list of representative constituents in accordance with EPA protocols. The groundwater monitoring program being implemented at the Site has been deemed appropriate for the Site conditions and approved by the EPA.

The 2018 AROD specifically addresses the following allowable adjustments from the 1998 ROD:

- Changing the remedy for NAPL/groundwater in the Old Impoundment Area (OIA) from active Recovery to the ISS of potentially mobile NAPL and contiguous areas of residual NAPL.
- Waiving the groundwater cleanup levels (based on Safe Drinking Water Act Maximum Contaminant Levels or MCLs) for benzene and benzo(a)pyrene that were identified in the 1998 ROD. Two separate Technical Impracticability waiver zones (TI zones) define the spatial extent over which a groundwater ARAR waiver applies.

The lateral extent of NAPL generally exhibits a decreasing trend at the FTA and the OIA. The gauging events for this FYR period indicate that the extent has essentially stabilized or is reducing. These analyses and observations are consistent with the inferred capture zones for each area and both the shallow and intermediate water bearing zones. These results indicate that the cumulative effect of the extraction well network's cones of depressions and the naturally occurring horizontal groundwater gradients are sufficient to capture NAPL and prevent further NAPL migration at the FTA and OIA.

The lateral extent of NAPL at the FTA and the OIA has been stable over the past five years. The NAPL recovery system has removed approximately 21,788 gallons and 14,001 gallons of NAPL from the FTA and OIA, respectively, from system startup in October 2003 through the end of 2017 (Tables 1 & 2). The most recent annual O&M report, for 2017, states that the NAPL capture zones are sufficient. The 2017 annual O&M report stated that the shallow recovery wells at the OIA had annual NAPL recovery efficiencies (defined as gallons of NAPL collected per gallon of groundwater extracted) greater than 3 percent. The FTA recovery wells and the deeper recovery well at the OIA had efficiencies below 1 percent. An efficient NAPL recovery system operates in the 1 to 3 percent range. NAPL recovery efficiencies less than 0.1 percent are considered inefficient. The 2013-2017 annual O&M reports found that all the wells had annual NAPL recovery efficiencies below 1 percent. However, most of the wells had recovery efficiencies greater than 0.1 percent.

As recommended in the Third FYR for the Site, additional investigation was needed to delineate the northern extent of NAPL at the OIA and to determine if the existing recovery system for the IWBZ at the OIA is adequate. The additional data requested for NAPL delineation at the OIA has been completed and the results submitted to EPA in the May 2015 Remedial Action Work Plan.

Conditions in the groundwater continue to be favorable for biodegradation of the dissolved contaminants at the Site. The trend analysis presented in the 2017 annual O&M report found that benzene and naphthalene concentrations are decreasing or stable at all 15 locations evaluated in the shallow water bearing zone. In the intermediate water bearing zone, concentrations are decreasing or stable at 12 locations and increasing at three locations. The three locations with increasing trends are spread across the Site, with two locations at the FTA and one at the OIA.

Recovered groundwater is discharged to the City of North Charleston POTW under a Significant Industrial Wastewater Discharge Permit (permit number 2078).

Table 7 - NAPL Recovery System Operations Summary - FTA

Period	SWBZ Wells	IWBZ Wells	Total
Startup	204	158	**362.2**
Q1/2004	113	149	**261.5**
Q2/2004	282	321	**603.1**
Q3/2004	133	181	**313.75**
Q4/2004	305	286	**590.5**
Q1/2005	239	230	**469.4**
Q2/2005	208	341	**548.5**
Q3/2005	192	274	**465.5**
Q4/2005	141	62	**202.5**
Q1/2006	0	0	**0**
Q2/2006	34	272	**306.1**
Q3/2006	184	412	**595.7**
Q4/2006	154	412	**566.1**
Q1/2007	226	366	**592**
Q2/2007	96	292	**388**
Q3/2007	135	360	**495**
Q4/2007	285	460	**745**
Q1/2008	272	489	**761**
Q2/2008	135	367	**501.5**
Q3/2008	184	370	**554**
Q4/2008	231	407	**638**
Q1/2009	146	390	**536**
Q2/2009	160	227	**387**
Q3/2009	82	201	**283**
Q4/2009	133	293	**426**
Q1/2010	147	314	**461**
Q2/2010	102	189	**291**
Q3/2010	98	236	**334**
Q4/2010	74	204	**278**
Q1/2011	85	234	**319**
Q2/2011	78	199	**277**
Q3/2011	117	161	**278**
Q4/2011	22	212	**234**
Q1/2012	65	189	**254**
Q2/2012	66	140	**206**
Q3/2012	133	203	**336.5**
Q4/2012	99	160	**258.5**
Q1/2013	0	222	**222**
Q2/2013	69	306	**375**
Q3/2013	75	307	**382**
Q4/2013	87	289	**376**
Q1/2014	67	362	**428.5**
Q2/2014	80	268	**348**
Q3/2014	22	217	**239**
Q4/2014	84	287	**370.5**
Q1/2015	41	365	**406**
Q2/2015	80	287	**367**
Q3/2015	21	285	**306**
Q4/2015	69	330	**399**
Q1/2016	83	328	**411**
Q2/2016	40	221	**261**
Q3/2016	42	199	**241**
Q4/2016	60	267	**327**
Q1/2017	20	219	**239**
Q2/2017	38	258	**296**
Q3/2017	82	352	**434**
Q4/2017	41	202	**243**
All Dates	**6459**	**15329**	**21788**

Table 8 - NAPL Recovery System Operations Summary - OIA

Period	SWBZ Wells	IWBZ Wells	Total
Startup	177.5	176	353.5
Q1/2004	103	258	361
Q2/2004	206.5	185	391.5
Q3/2004	68.5	128.5	197
Q4/2004	240.5	225.5	466
Q1/2005	209	257	466
Q2/2005	193.5	238	431.5
Q3/2005	394	309	703
Q4/2005	162	92	254
Q1/2006	0	0	0
Q2/2006	46	110	156
Q3/2006	451	283	734
Q4/2006	260	259	519
Q1/2007	134	83	217
Q2/2007	221	35	256
Q3/2007	105	60	165
Q4/2007	198	56	254
Q1/2008	163	107	270
Q2/2008	198	138	336
Q3/2008	288	222	510
Q4/2008	117	245	362
Q1/2009	81	199	280
Q2/2009	97	126	223
Q3/2009	171	121	292
Q4/2009	210	89	299
Q1/2010	50	121	171
Q2/2010	118	82	200
Q3/2010	188	85	273
Q4/2010	0	86	86
Q1/2011	63	134	197
Q2/2011	85	153	238
Q3/2011	60	116	176
Q4/2011	68	91	159
Q1/2012	0	69	69
Q2/2012	76	92	168
Q3/2012	99	86	185
Q4/2012	30	62	92
Q1/2013	20	121	141
Q2/2013	95	103	198
Q3/2013	120	170	290
Q4/2013	85	140	225
Q1/2014	107	116	223
Q2/2014	52	136	188
Q3/2014	108	88	196
Q4/2014	100	100	200
Q1/2015	94	98	192
Q2/2015	86	64	150
Q3/2015	40	88	128
Q4/2015	84	75	159
Q1/2016	71	93	164
Q2/2016	71	49	120
Q3/2016	70	48	118
Q4/2016	42	76	118
Q1/2017	43	98	141
Q2/2017	88	109	197
Q3/2017	119	114	233
Q4/2017	51	59	110
All Dates	**6877**	**7124**	**14001**

Site Inspection

The site inspection took place on February 20, 2018. In attendance were the EPA RPM Craig Zeller, and Joel Padgett, Karen Seaber, and Timothy Kadar from SCDHEC. Its purpose was to assess the protectiveness of the remedy. For a full list of site inspection activities, see the Site Inspection Checklist in Appendix D.

Participants accessed the Site via Milford Street. The EPA RPM Craig Zeller and SCDHEC Project Manager Joel Padgett provided a brief history of the Site, an update on the progress of groundwater remediation, the redevelopment project, and 2018 AROD status. The NAPL recovery system is located in the northwest corner of the Site. The facility is enclosed within a concrete knee wall and chain link fence with locked gate. The knee wall, chain link fence, and gate were found to be in good condition. The wells were properly secured and in good condition. Participants performed a drive-through survey of the Site stopping at multiple locations to inspect wells, Site conditions, etc. Conditions remain similar to those that existed five years ago.

The Traffic and Transportation Department of North Charleston operates a vehicle maintenance/garage facility at 1950 Milford Street, Charleston, SC. The garage is approximately 12,000 square feet in size with a large, overhead door located at the southern end of the building. During the site inspection, the door was in the open position. Based on previous site visits by the EPA RPM, DHEC personnel, and Google Earth, Street View photos, the standard operating procedure for the facility is to leave the door open during operating hours.

DHEC staff visited the designated site repository, the Charleston County Public Library, located at 68 Calhoun Street, Charleston, South Carolina. The repository file contained the necessary administrative records. The Library requests that documentation be made available in a secure electronic format, preferably a website containing all relevant information. The Library can then provide access via the publicly available computers on site and the appropriate website link.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

A review of remedial design and remedial action reports, monitoring reports, decision documents and the results of the site inspection indicate that the engineered components of the soil cover, in-situ solidification/stabilization, sediment excavation/marsh revegetation, and NAPL/groundwater recovery portions of the remedy are functioning as intended by the 1998 ROD, 2001 ESD, and 2003 ESD. The Site's soil and drainage ditch sediments were excavated and capped as specified in the ROD. Tidal marsh sediments were excavated as specified in the ROD. The barge canal sediments were covered by natural deposition as called for in the 2003 ESD. A subaqueous cap was placed over the Ashley River sediments as called for in the 2001 ESD. The northwest corner NAPL was immobilized using in-situ stabilization and solidification as called for in the 2003 ESD. The NAPL/groundwater recovery systems in the FTA and OIA continue to remove NAPL from the subsurface.

The ROD's cleanup goal for groundwater is to achieve the MCLs specified by the Safe Drinking Water Act. However, because it may not be technically possible to achieve the MCLs, the ROD established

performance standards for groundwater. The NAPL/groundwater remedy is meeting these performance standards.

Institutional controls restricting land and groundwater use have been implemented for some, but not all, of the Site's parcels. Land and groundwater use restrictions are needed, given that the Site was cleaned to industrial levels and groundwater contamination exists. The July 2003 limited warranty deed transferring some of the Site's parcels from Beazer East Inc. to Ashley I LLC contains restrictive covenants prohibiting residential use and use of groundwater, for all current and future users of those parcels. The 2003 deed applies only to the parcels owned by Ashley I (see Figure 2). Other parts of the Site, owned by Ashley II of Charleston LLC and Parker Real Estate LP as well as the municipal property north of Milford Street, are not subject to the restrictive covenants in the 2003 deed.

In December 2015, Ashley I, LLC and Ashley II of Charleston, LLC filed for bankruptcy. As of the writing of this FYR, the Ashley River Investors VII (Koppers), LLC has an option to acquire the property from the lender (Magnolia/ARC Lender, LLC) that holds, as collateral, the portions of the Site owned by Ashley I, LLC and Ashley II of Charleston, LLC.

The 2018 AROD was written to facilitate the Site's rapid redevelopment through the partial deletion of the Site from the NPL. A significant portion of the Site, except the 3.94 acre Former Treatment Area, will be eligible for deletion from the NPL when the remedy modifications are implemented in accordance with the AROD. The portion of the Site to be delisted will be referred to herein as the "NPL Deletion Property." Simultaneous with deletion of the NPL Deletion Property from the NPL, the NPL Deletion Property will enroll in the South Carolina Brownfields/Voluntary Cleanup Program (VCP) for the purposes of the brownfields redevelopment and liability protection.

As the AROD was signed on February 8, 2018, there has not been sufficient time to assess the function of the remedy as specified in the AROD.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the remedy selection still valid?

Question B Summary:

The exposure assumptions used at the time of ROD and AROD remedies selection are still valid. Soil at the Koppers Site was previously remediated to achieve remediation goals protective of industrial workers. The Hagood Avenue drainage ditch was cleaned to residential levels. Groundwater remains impacted by free product and dissolved phase constituents. Groundwater is addressed through monitored natural attenuation. A product removal remedy has been active for several years and land use restrictions are in place to exclude the use of groundwater at the Site. These restrictions will remain in place for the foreseeable future. In addition, ISS technology will be applied in one or more areas to stabilize and bind residual product in place. Direct use groundwater exposure pathways are incomplete. Previous impacts to surface water and sediment were addressed through sediment removal from the drainage ditches, sediment capping and natural sedimentation.

The 1998 ROD calculated cleanup goals for soil/sediment contaminants based on a site-specific risk that assumed future industrial land use.

The 1998 ROD calculated cleanup goals for soil/sediment contaminants based on a site-specific risk assessment that assumed future industrial land use. This FYR compared the contaminants' current toxicity values with their previous toxicity values that were used to calculate the cleanup goals. This comparison is presented in Appendix E. Except for lead, all of the contaminants have at least one toxicity value that has changed to indicate increased toxicity. As shown in Table 3 below, a comparison to current, generic screening levels indicates that each contaminant's surface soil cleanup level is still within the EPA's acceptable cancer risk range (10^{-4} to 10^{-6}). Summing the cancer risks from the five contaminants yields a cumulative cancer risk of 1.83×10^{-5} which is within the acceptable risk range. Therefore, the surface soil cleanup levels in the ROD are valid based on the risk associated with exposure to soil or sediment containing a level of contamination equal to the cleanup levels.

The Site's subsurface cleanup levels are still protective. The feasibility study found that the residual risk from subsurface soil would be less than the residual risk from surface soil. The subsurface excavation met a cleanup standard of 55 milligram per kilogram (mg/kg) for B(a)p-TEQ, which is more stringent than the 275 mg/kg subsurface cleanup level selected in the ROD.

The EPA calculated the Site's soil lead cleanup goal (1,150 mg/kg) using the EPA's 1996 adult lead methodology, based on protectiveness for a future pregnant on-site worker. This is higher than the EPA Regional Screening Levels (RSLs) for industrial soils of 800 mg/kg. The 1998 ROD used a value of 1.9 for the geometric standard deviation, and a value of 2.2 ng/dL for the baseline blood lead concentration. These parameter values are still appropriate (*Frequent Questions from Risk Assessors on the Integrated Exposure Uptake Biokinetic (IEUBK) Model and Frequent Questions from Risk Assessors on the Adult Lead Methodology (ALM)*, 2013). Using the current method of calculating adult lead, the cleanup goal is still protective.

Table 2 - Review of Surface Soil Cleanup Levels

Contaminant[a]	**Residential Soil RSL[b]** (mg/kg)	**Industrial Soil RSL[b]** (mg/kg)	**1998 ROD Surface Soil Cleanup Level** (mg/kg)	**Risk Associated with 1998 ROD Surface Soil Cleanup Level[c]**
Arsenic	6.8E-01	3.0E+00	1.35E+02	2.2E-08
Benzo(a)pyrene	1.1E-01	2.1E+00	2.0E+00	1.0E-06
Dioxin, mixture	4.8E-06	2.2E-02	1.5E-03	1.5E-05
Pentachlorophenol	1.0E+00	4.0E+00	2.5E+00	1.6E-06
Lead	4.0E+02	8.0E+02	1.15E+03	7.0E-07

a) This table presents the cancer risk for each of the contaminants.

b) The EPA's Regional Screening Levels (RSLs) are generic values; they are not based on site-specific conditions. Based on May 2018 RSLs Table.

c) The cancer risks were calculated using the following equation, based on the fact that RSLs are derived on 1 x 10-6 risk: Cancer risk = (cleanup goal ÷ cancer-based RSL) × 10-6.

The AROD risk evaluation completed in the RAWP evaluated post-ROD soil conditions at the NPL Deletion Property in consideration of future redevelopment, including future residential use. The RAWP evaluation focused on residual concentrations of arsenic, BAP TEQs, lead, and pentachlorophenol. These four constituents are the primary risk drivers for soil at the site and are the focus of the remedial design for the AROD.

The AROD residential remedial goals were calculated based on a risk range of 1 x 10^{-6} to 1 x 10^{-4} and were compared to the exposure point concentrations (EPCs) for the COCs. Included in the risk range are values for a target risk of 5 x 10^{-5}, which was the accepted target risk used in the 1998 ROD. The resulting upper confidence limit (UCLs) for arsenic (10 mg/kg) and for BAP TEQ (7.4 mg/kg) are greater than risk-based Remedial Goal Options (RGOs) based on target risks of 1 x 10^{-6} and 1 x 10^{-5}; however, both lead and pentachlorophenol were less than the RGOs. The EPC for arsenic was compared to background concentrations from the 1995 RI investigations. The calculated UCL for arsenic using 47 data points is approximately equivalent to background. The BAP TEQ UCL is equivalent to a target risk of 6.4 x 10^{-5}, indicating potentially unacceptable risk for future residents without future exposure controls.

The Third FYR stated that "*all areas that had dioxin levels above the current screening level (*0.6 µg/kg for industrial soils*) have been excavated and/or capped. One location (SB-18) that is outside the areas that were excavated and/or capped had a dioxin toxicity equivalent quotient using current toxicity equivalency factors of 0.7 µg/kg.*" This concentration does exceed the residential soil screening value of 4.9E-6 mg/kg (USEPA, 2015). The AROD proposed modifications and enhancements to the in-place soil remedy will be more protective of future residential receptors. These enhancements include the placement of 1 or more feet of clean fill during site re-grading in support of site redevelopment, including the area of SB-18. Placement of 1-foot or greater of clean fill soils will prevent direct exposure to potentially impacted surface soils under the residential soil scenario and the soil exposure pathway will be incomplete.

Based on detected concentrations in site groundwater of naphthalene and benzene, groundwater could potentially generate subsurface emissions that might be associated with vapor intrusion into future site buildings. Appropriate engineering controls (i.e., vapor barriers and other best management practices) are called for in the AROD to address potential vapor intrusion during design of future development. Alternatively, the owner may further evaluate subsurface vapor through a soil vapor investigation prior to construction at the site. The results of this investigation would be used to evaluate remediation and mitigation alternatives for the site. Based on the remedy modifications of the AROD, the vapor intrusion pathway will be incomplete for any future developments located within the NPL Deletion Property.

The MCLs from the 1995 RI Report were compared to the current MCLs (See Table E-1 in Appendix E). The 1995 RI report was used as a reference because the 1998 ROD and 2018 AROD does not list the MCLs. The MCLs for the Site's groundwater contaminants have not changed, except for arsenic and nickel. The arsenic MCL has become more stringent since the 1998 ROD. Arsenic is no longer a constituent of concern that is monitored. The AROD provides for ICs prohibiting the use of groundwater within the NPL Deletion Property. The nickel MCL was withdrawn in 1995. The toxicity equivalence factors for carcinogenic PAHs have not changed since the Site's cleanup levels were selected. Although the Site's ecological risk assessment was completed before the EPA finalized its ecological risk assessment guidance document, the assessment is still adequate, given that it included a baseline ecological risk assessment with whole sediment toxicity tests, in addition to a screening level assessment.

The RAOs used at the time of remedy selection are still valid.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the FYR:
None

Issues and Recommendations Identified in the FYR:

OU(s): OU1	**Issue Category: Institutional Controls**			
	Issue: Institutional controls prohibiting the use of groundwater has not been implemented on the following parcels legally identified as: 4660000017, 4660000032, 4660000033, 4660000037, and 4660000044.			
	Recommendation: Implement institutional controls required by the AROD.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	8/1/2022

OU(s): OU1	**Issue Category: Institutional Controls**			
	Issue: Institutional controls prohibiting land uses not compatible with the remedy have not been implemented on the following parcels legally identified as: 4660000032, 4660000033, 4660000034, 4660000037, 4660000043, and 4660000047.			
	Recommendation: Implement institutional controls required by the AROD.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	8/1/2022

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement	
Operable Unit:	*Protectiveness Determination:*
OU1	Short-term Protective
Protectiveness Statement:	
The remedy at OU1 protects human health and the environment because contaminated soils and sediments have been excavated, treated, and/or stabilized/solidified. It may not be technically feasible to achieve ROD established cleanup goals for groundwater. Institutional controls restricting land and groundwater use have been implemented for most, but not all, of the Site's parcels. For the remedy to be protective in the long term, institutional controls restricting land and groundwater use are required by the 2018 AROD on the affected property.	

Sitewide Protectiveness Statement	
Protectiveness Determination:	~~*Planned Addendum Completion Date:*~~
Short-term Protective	
Protectiveness Statement:	
The remedy at the Site protects human health and the environment because contaminated soils and sediments have been excavated, treated, and/or stabilized/solidified. The groundwater treatment system continues to capture NAPL, decrease the lateral extent of the NAPL plumes, and prevent further NAPL migration. It may not be technically feasible to achieve ROD established cleanup goals for groundwater. Institutional controls restricting land and groundwater use have been implemented for most, but not all, of the Site's parcels. For the remedy to be protective in the long term, institutional controls restricting land and groundwater use are required by the 2018 AROD on the affected property.	

VIII. NEXT REVIEW

The next FYR for the Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Amec Foster Wheeler Environment & Infrastructure, Inc. *Remedial Action Work Plan for Former Koppers Superfund Site Charleston, SC.* February 2015

Beazer East, Inc. *Remedial Investigation Report: Former Koppers Site.* January 1995.

Beazer East, Inc. *Feasibility Study Report: Former Koppers Site.* December 1996.

Beazer East, Inc. *Final Remedial Action Report: Final Remedial Action. Charleston Plant Site. Prepared by URS.* August 2003.

Beazer East, Inc. *2013 Annual Operations and Monitoring Report, Former Koppers Company, Inc. Superfund Site. Charleston, South Carolina. Prepared by Field & Technical Services, LLC.* March 17, 2014.

Beazer East, Inc. *2014 Annual Operations and Monitoring Report, Former Koppers Company, Inc. Superfund Site, Charleston, South Carolina. Prepared by Field and Technical Services, LLC.* March 30, 2015.

Beazer East, Inc. *2015 Annual Operations and Monitoring Report, Former Koppers Company, Inc. Superfund Site, Charleston, South Carolina. Prepared by Field and Technical Services, LLC.* March 31, 2016.

Beazer East, Inc. *2016 Annual Operations and Monitoring Report, Former Koppers Company. Inc. Superfund Site, Charleston, South Carolina. Prepared by Field and Technical Services, LLC.* March 31, 2017.

Beazer East, Inc. *2017 Annual Operations and Monitoring Report, Former Koppers Company. Inc. Superfund Site, Charleston, South Carolina. Prepared by Field and Technical Services, LLC.* March 30, 2018.

Environmental Resources Management. *Koppers Vapor Intrusion Screening Assessment.* February 20, 2008.

Environmental Resources Management. *Passive Soil Gas Survey Report: Magnolia Development Site. Prepared for Ashley II of Charleston, LLC.* February 10, 2010.

EPA Region 4. *Final Baseline Risk Assessment for Koppers Company, Inc. (Charleston Plant).* Prepared by Black & Veatch Waste Science, Inc. January 18, 1995.

EPA Region 4. *Interim Action Record of Decision for the Koppers Co., Inc. (Charleston Plant) NPL Site.* March 1995.

EPA Region 4. *Record of Decision Declaration for Koppers Co., Inc. (Charleston Plant) NPL Site.* April 29, 1998.

EPA Region 4. *Explanation of Significant Difference to the Final Record of Decision: Koppers Co., Inc. (Charleston Plant) NPL Site.* August 8, 2001.

EPA Region 4. *Explanation of Significant Difference to the Final Record of Decision: Koppers Co. Inc. (Charleston Plant) NPL Site.* April 24, 2003.

EPA Region 4. *Third Five Year Review for the Koppers Co., Inc (Charleston Plant) NPL Site, Charleston, Charleston County, South Carolina.* June 2013.

EPA Region 4. *DRAFT – Record of Decision (ROD) Amendment Former Koppers Company Superfund Site, Charleston, Charleston County, South Carolina.* May 2018.

APPENDIX B – CURRENT SITE STATUS

Environmental Indicators
- *Current human exposures at the Site are under control.* - *Insufficient data to determine groundwater migration control status.*

Are Necessary Institutional Controls in Place?
☐ All ☒ Some ☐ None *The Site needs further evaluation to determine which properties may require institutional controls.*

Has EPA Designated the Site as Sitewide Ready for Anticipated Use?
☐ Yes ☒ No

Has the Site Been Put into Reuse?
☐ Yes ☒ No

APPENDIX C – PRESS NOTICE

Public Notice

Koppers Company, Inc.
Charleston County, South Carolina

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a Five-Year Review of the former Koppers Company, Inc. site located in Charleston, South Carolina. This is a federal Superfund site with ongoing cleanup activities. The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff will conduct interviews with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. **You are encouraged to participate in the review by contacting us with your comments or questions through February 1, 2018.**

The Five-Year Review process is expected to be complete in summer 2018, at which time a report will be written on our findings. Any comments received about the site will be summarized in the report. The report will be available on EPA's website and at the Charleston County Public Library at 68 Calhoun Street, Charleston, South Carolina. For more information about the Koppers Company, Inc. site, please visit:

https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0403350

For comments, questions, or to participate in an interview, please contact:

Technical Comments: Craig Zeller, EPA Project Manager, at (404) 562-8827, or by e-mail at zeller.craig@epa.gov

Community Involvement: Donna Moye, DHEC Community Liaison, at (803) 898-1382, or by e-mail at moyedd@dhec.sc.gov.

Please share this with others you know who might be interested.

C22-1649157-1

APPENDIX D – SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Koppers Company, Inc.	**Date of Inspection:** 2/20/2018
Location and Region: Charleston, Charleston County, South Carolina/Region 4	**EPA ID:** SCD980310239
Agency, Office or Company Leading the Five-Year Review: USEPA Region 4	**Weather/Temperature:** Sunny, clear, 80s

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☐ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☒ Other: Excavation and off-site disposal
- ☒ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Craig Zeller (Name) | EPA RPM (Title) | 5/9/2018 (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone : By Email
   Problems, suggestions ☐ Report attached: Yes

2. **O&M Staff** _____ (Name) | _____ (Title) | _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone :
   Problems/suggestions ☐ Report attached:

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency SCDHEC
   Contact Joel Padgett (Name) | DHEC PM (Title) | 5/9/2018 (Date) | _____ (Phone No.)
   Problems/suggestions ☐ Report attached: Yes

   Agency _____
   Contact _____ (Name) | _____ (Title) | _____ (Date) | _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ (Name) | _____ (Title) | _____ (Date) | _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____ (Name) | _____ (Title) | _____ (Date) | _____ (Phone No.)
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☐ As-built drawings	☐ Readily available	☐ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: EPA and SCDHEC retain O&M documents off site.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A

☐ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A

Remarks: SCDHEC and synTerra retains safety documents off site.

3. **O&M and OSHA Training Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: EPA and SCDHEC retain training records off site.

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☐ Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
☒ Waste disposal, POTW	☐ Readily available	☐ Up to date	☐ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

7. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air	☐ Readily available	☐ Up to date	☒ N/A
☐ Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A

Remarks: _____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☐ PRP in-house ☒ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☒ Funding mechanism/agreement in place ☒ Unavailable

Original O&M cost estimate: $1.6 million total net present worth over 30-year period (1996 dollargs) ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached
From: _____ Date	To: _____ Date	_____ Total cost	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☒ Gates secured ☐ N/A

Remarks: Groundwater treatment area containing storage building, NAPL storage tank, and groundwater treatment trailer is fenced with a locked gate. Gate was locked and fencing in good repair during site visit. Rest of site is unfenced.

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks: There are no warning signs posted at the Site.

C. Institutional Controls (ICs)

1. **Implementation and Enforcement***

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒ N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A

Violations have been reported ☐ Yes ☒ No ☐ N/A

Other problems or suggestions: ☐ Report attached

*ICs have not yet been implemented at the Site.

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: ICs have been implemented only on parcels owned by Ashley I LLC. ICs not implemented on parcels owned by other entities.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☐ No vandalism evident

Remarks: Signs of trespassing were noted throughout the Site.

2. **Land Use Changes On Site** ☐ N/A

Remarks: No changes since the last FYR.

3. **Land Use Changes Off Site** ☐ N/A

Remarks: None.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: _____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident

Arial extent: _____ Depth: _____

Remarks: _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident

	Lengths: _____	Widths: _____	Depths: _____
	Remarks: _____		
3.	**Erosion**	☐ Location shown on site map	☒ Erosion not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
4.	**Holes**	☐ Location shown on site map	☒ Holes not evident
	Arial extent: _____		Depth: _____
	Remarks: _____		
5.	**Vegetative Cover**	☒ Grass	☐ Cover properly established
	☐ No signs of stress	☐ Trees/shrubs (indicate size and locations on a diagram)	
	Remarks:		
6.	**Alternative Cover** (e.g., armored rock, concrete)		☐ N/A
	Remarks: Parts of the engineered soil cover were designed to be vegetated. Grass growth is sporadic.		
7.	**Bulges**	☐ Location shown on site map	☒ Bulges not evident
	Arial extent: _____		Height: _____
	Remarks: _____		
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident	
	☐ Wet areas	☐ Location shown on site map	Arial extent: _____
	☐ Ponding	☐ Location shown on site map	Arial extent: _____
	☐ Seeps	☐ Location shown on site map	Arial extent: _____
	☐ Soft subgrade	☐ Location shown on site map	Arial extent: _____
	Remarks: _____		
9.	**Slope Instability**	☐ Slides	☐ Location shown on site map
	☒ No evidence of slope instability		
	Arial extent: _____		
	Remarks: _____		
B. Benches		☐ Applicable	☒ N/A
	(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)		
1.	**Flows Bypass Bench**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
2.	**Bench Breached**	☐ Location shown on site map	☐ N/A or okay
	Remarks: _____		
3.	**Bench Overtopped**	☐ Location shown on site map	☐ N/A or okay

Remarks: _____

C. Letdown Channels ☐ Applicable ☒ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ No evidence of settlement
   Arial extent: _____ Depth: _____
   Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
   Material type:_____ Arial extent: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
   Arial extent: _____ Depth: _____
   Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
   Arial extent: _____ Depth: _____
   Remarks: _____

5. **Obstructions** Type: _____ ☐ No obstructions
   ☐ Location shown on site map Arial extent: _____
   Size: _____
   Remarks: _____

6. **Excessive Vegetative Growth** Type: _____
   ☐ No evidence of excessive growth
   ☐ Vegetation in channels does not obstruct flow
   ☐ Location shown on site map Arial extent: _____
   Remarks: _____

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Gas Monitoring Probes**
   ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
   ☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A
   Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☐ Erosion not evident

Remarks: _____

3. **Outlet Works** ☐ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☐ Functioning ☐ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
   Horizontal displacement: _____ Vertical displacement: _____
   Rotational displacement: _____
   Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
   Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident
   Area extent: _____ Depth: _____
   Remarks:

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
   ☒ Vegetation does not impede flow
   Area extent: _____ Type: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Area extent: _____ Depth: _____
   Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A
   Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Area extent: _____ Depth: _____
   Remarks: _____

2. **Performance Monitoring** Type of monitoring:
   ☐ Performance not monitored
   Frequency: ☐ Evidence of breaching
   Head differential: _____
   Remarks: _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**
   ☒ Good condition ☒ All required wells properly operating ☐ Needs maintenance ☐ N/A
   Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☒ Oil/water separation ☐ Bioremediation*

☐ Air stripping ☐ Carbon adsorbers ☐ In-situ chemical oxidation*

☐ Filters: _____ ☒ Monitored natural attenuation*

☒ Additive (e.g., chelation agent, flocculent): Caustic to raise pH

☐ Others: _____

☒ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of groundwater treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks:

2. **Electrical Enclosures and Panels** (properly rated and functional)

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☒ N/A ☐ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair

☒ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☒ Properly secured/locked ☒ Functioning ☐ Routinely sampled ☒ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks:

D. Monitoring Data*

1. **Monitoring Data**

☒ Is routinely submitted on time ☐ Is of acceptable quality

2. **Monitoring Data Suggests:**

☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

E. Monitored Natural Attenuation*

1. **Monitoring Wells** (natural attenuation remedy)

☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☒ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

The remedy was designed to eliminate unacceptable human and ecological exposure to soil and sediment contamination, manage some marsh areas using bioremediation, remove or treat NAPL, and contain NAPL and aqueous contaminant plumes. In general, the remedy is effective and functioning as designed. However, the bioremediation was not successful. Additional land and groundwater use restrictions are needed, given that the Site was cleaned to industrial levels and groundwater contamination exists.

B. Adequacy of O&M

	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M procedures for the soils, sediments, and groundwater components of the remedy are adequate at this time.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Site Inspection Participants:

Craig Zeller, EPA RPM
Joel Padgett, SCDHEC PM
Karen Seaber, SCDHEC
Timothy Kadar, SCDHEC

APPENDIX E – DETAILED ARARs REVIEW

Appendix G includes a review of relevant, site-related documents including the RODs, AROD, ESDs, remedial action reports and recent monitoring data.

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

- Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location or other circumstance found at a CERCLA site.
- Relevant and appropriate requirements are those standards that, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are more stringent than federal requirements may be applicable or relevant and appropriate.

- To-Be-Considered (TBC) criteria are non-promulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary remedial action. For example, TBCs may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish an acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Examples of chemical specific ARARs include maximum contaminant levels (MCLs) under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act.

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats and historic places.

Remedial actions are required to comply with the chemical-specific ARARs identified in the ROD. In performing the five-year review for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

Groundwater ARARs

According to the 1998 ROD, the cleanup goal for groundwater is restoration to the ARAR-based cleanup levels, which are the MCLs specified by the Safe Drinking Water Act. However, since it may be technically impracticable to achieve the MCLs, the EPA established the following performance standards:

- Removal or treatment of NAPL to the maximum extent practicable.
- Containment of potentially non-restorable NAPL source areas.
- Containment and restoration of aqueous contaminant plumes.

The MCLs from the 1995 Remedial Investigation (RI) Report were compared to the current MCLs (Table H-1). The 1995 RI report was used as a reference because the 1998 ROD does not list the MCLs. None of the MCLs have changed, except for arsenic and nickel. The arsenic MCL has become more stringent since the 1998 ROD. The nickel MCL was withdrawn in 1995.

The 1998 ROD stated that "All groundwater recovered via this remedy component shall be treated to meet the ARARs of the selected discharge option... The water treatment system shall be properly operated and maintained to meet the discharge requirements imposed by the North Charleston POTW." The current permit, which is effective from January I, 2013, until December 31, 2017, imposes various contaminant limits.

Table E-1 - ARAR Review for Groundwater

Contaminant	1995 RI ARAR (µg/L)[a]	Current 2017 ARAR (µg/L)[b]	ARAR Change
Organics			
Benzene	5	5	No Change
Benzo(a)Pyrene	0.2	0.2	No Change
Chlordane	2	2	No Change
1,2-Dichlorobenzene	600	600	No Change
Dioxins	0.00003	0.00003	No Change
Endrin	2	2	No Change
Ethylbenzene	700	700	No Change
Heptachlor	0.4	0.4	No Change
Heptachlor epoxide	0.2	0.2	No Change
Lindane (gamma-BHC)	0.2	0.2	No Change
Methoxychlor	40	40	No Change
Methylene chloride	5	5	No Change
Pentachlorophenol	1	1	No Change
Styrene	100	100	No Change
Toluene	1,000	1,000	No Change
Xylenes	10,000	10,000	No Change
Inorganics			
Antimony	6	6	No Change
Arsenic	50	10	More Stringent
Barium	2,000	2,000	No Change
Beryllium	4	4	No Change
Cadmium	5	5	No Change
Chromium	100	100	No Change
Copper	1,300	1,300	No Change
Cyanide	200	200	No Change
Lead	15	15	No Change
Mercury	2	2	No Change
Nickel	100	MCL Dropped	Less Stringent
Selenium	50	50	No Change
Thallium	2	2	No Change

Notes:
a) Source: 2008 AROD; listed values are MCLs.
b) Listed values are MCLs from https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants, accessed 05/21/2018.
µg/L = micrograms per liter

Soil/Sediment ARARs

The 1998 ROD did not specify chemical-specific ARARs for soil. The ROD specified soil/sediment ARARs that were relevant to the disposal of excavated materials; those ARARs are not relevant to the Site's continued protectiveness. The USEPA remedial goals for the identified COCs were based on

potential carcinogenic risk from 1 x 10^{-6} to 1 x 10^{-4} and hazard indices from 0.1 to 3. These objectives were achieved by a combination of general response actions consisting of capping, removal, and disposal of soils with levels of COCs greater than levels considered to be protective by USEPA, and with institutional controls. See Section 5; Question B of this FYR for a discussion of the Site's soil cleanup goals.

APPENDIX F – DETAILED RISK REVIEW

Table H-1: Review of Groundwater Remedial Goals

COC	Groundwater Remedial Goal (µg/L)	Tapwater RSL[a]		Risk[b]	HQ[c]
		10^{-6} Risk	HQ = 1		
Arsenic	50[d]	0.052	6	**1.9E-04[e]**	**8.30[e]**
Benzene	5	0.46	80	1.1E-05	0.06
Benzo(a)Pyrene	0.2	0.025	6	8.0E-06	0.03
Dioxins	0.00003	0.000013	None	2.3E-06	None
Pentachlorophenol	1	0.041	100	2.4E-05	0.01
Lead	15	15	None	5.0E-06	None

Notes:

a) Current EPA MCLs, dated May 2018, are available at http://www2.epa.gov/risk/risk-based-screening-table-generic-tables (accessed 5/21/2018).

b) The cancer risks were calculated using the following equation, based on the fact that RSLs are derived based on 1 x 10^{-6} risk: Cancer risk = (cleanup goal ÷ cancer-based RSL) × 10^{-6}.

c) The noncancer HQ was calculated using the following equation: HQ = (cleanup goal ÷ noncancer RSL).

d) MCL as stated in the 1995 RI. Current MCL is 10 µg/L which yields a HQ of 1.67 exceeding a HQ of 1.

e) The EPA is currently conducting health assessments on arsenic as part of the Six-Year Review of the national primary drinking water standards to determine if MCLs require revision. In the interim, the current MCLs remain valid, as indicated at https://www.epa.gov/dwsixyearreview/six-year-review-2-drinking-water-standards.

Bold = risk exceeds EPA's risk management range of 10^{-6} to 10^{-4} or HQ exceeds 1.

µg/L = micrograms per liter